

INSTRUCTION MANUALS

The instruction and service manual for this base radio are not published at this time. However, draft copy of the manual is available and has been included as part of the filing package in the form of an electronic pdf document.

Upon request, published and/or printed manuals will be sent to the commission and/or telecommunication certification body (TCB) as soon as they become available. All of the descriptions and schematics included this filing package are up to date.

APPLICANT: MOTOROLA INC.

EQUIPMENT TYPE: ABZ89FC5794

TUNE-UP PROCEDURE

There is no field tune-up procedure. All adjustments are software controlled and are pre-set at the factory. Certain station operating parameters can be changed via man-machine interface (MMI) commands, within predetermined limits. Examples include transmit / receiver operating frequencies and power level.



MOTOROLA

Network Solutions Sector



ENHANCED BASE TRANSCEIVER SYSTEM (EBTS)

VOLUME 2 OF 3
BASE RADIOS



FCC INTERFERENCE WARNING

The FCC requires that manuals pertaining to Class A computing devices must contain warnings about possible interference with local residential radio and TV reception. This warning reads as follows:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

INDUSTRY OF CANADA NOTICE OF COMPLIANCE

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.
Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

COMMERCIAL WARRANTY (STANDARD)

Motorola radio communications products (the "Product") is warranted to be free from defects in material and workmanship for a period of ONE (1) YEAR (except for crystals and channel elements which are warranted for a period of ten (10) years) from the date of shipment. Parts including crystals and channel elements, will be replaced free of charge for the full warranty period but the labor to replace defective parts will only be provided for One Hundred-Twenty (120) days from the date of shipment. Thereafter purchaser must pay for the labor involved in repairing the Product or replacing the parts at the prevailing rates together with any transportation charges to or from the place where warranty service is provided. This express warranty is extended by Motorola, 1301 E. Algonquin Road, Schaumburg, Illinois 60196 to the original end use purchaser only, and only to those purchasing for purpose of leasing or solely for commercial, industrial, or governmental use.

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Motorola cannot be responsible in any way for any ancillary equipment not furnished by Motorola which is attached to or used in connection with the Product, or for operation of the Product with any ancillary equipment, and all such equipment is expressly excluded from this warranty. Because each system which may use Product is unique, Motorola disclaims liability for range, coverage, or operation of the system as a whole under this warranty.

This warranty does not cover:

- a) Defects or damage resulting from use of the Product in other than its normal and customary manner.
- b) Defects or damage from misuse, accident, water or neglect
- c) Defects or damage from improper testing, operation, maintenance installation, alteration, modification, or adjusting.
- d) Breakage or damage to antennas unless caused directly by defects in material workmanship.
- e) A Product subjected to unauthorized Product modifications, disassemblies or repairs (including without limitation, the addition to the Product of non-Motorola supplied equipment) which adversely affect performance of the Product or interfere with Motorola's normal warranty inspection and testing of the Product to verify any warranty claim.
- f) Product which has had the serial number removed or made illegible.
- g) A Product which, due to illegal to unauthorized alteration of the software/firmware in the Product, does not function in accordance with Motorola's published specifications or the FCC type acceptance labeling in effect for the Product at the time the Product was initially distributed from Motorola.

This warranty sets forth the full extent of Motorola's responsibilities regarding the Product. Repair, replacement or refund of the purchase price, at Motorola's option is the exclusive remedy. IN NO EVENT SHALL MOTOROLA BE LIABLE FOR DAMAGES IN EXCESS OF THE PURCHASE PRICE OF THE PRODUCT, FOR ANY LOSS OF USE, LOSS OF TIME, INCONVENIENCE, COMMERCIAL LOSS, LOST PROFITS OR SAVINGS OR OTHER INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGE ARISING OUT OF THE USE OR INABILITY TO USE SUCH PRODUCT, TO THE FULL EXTENT SUCH MAY BE DISCLAIMED BY LAW.

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This warranty extends only to individual products: batteries are excluded, but carry their own separate limited warranty.

In order to obtain performance of this warranty, purchaser must contact its Motorola salesperson or Motorola at the address first above shown, attention Quality Assurance Department.

This warranty applies only within the fifty (50) United States and the District of Columbia.

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Foreword

About This Manual

Volume 2 of the Enhanced Base Transceiver System (EBTS) manual, *Base Radios*, provides the experienced service technician with an overview of the EBTS operation and functions, and contains information regarding the 800 MHz, 900 MHz, or 1500 MHz base radios.

The EBTS System has three major components:

- ☐ integrated Site Controller (iSC)
- ☐ Base Radios (BRs)
- ☐ RF Distribution System (RFDS)

Installation and testing is described in Volume 1, *System Installation and Testing*, and RFDS are described in Volume 3, *RF Distribution Systems (RFDS)*. Detailed information about the iSC is contained in the *iSC Supplement Manual*, 68P81098E05.

The information in this manual is current as of the printing date. If changes to this manual occur after the printing date, they will be documented and issued as Schaumburg Manual Revisions (SMRs).

Target Audience

The target audience of this document includes field service technicians responsible for installing, maintaining, and troubleshooting the EBTS.

In keeping with Motorola's field replaceable unit (FRU) philosophy, this manual provides sufficient functional information to the FRU level. Please refer to the appropriate section of this manual for removal and replacement instructions.

Foreword**Maintenance Philosophy**

The EBTS has been designed using a Field Replaceable Unit (FRU) maintenance concept. To minimize system down time, faulty FRUs may be quickly and easily replaced with replacement FRUs. This helps to restore normal system operation quickly.

Due to the high percentage of surface mount components and multi-layer circuit boards, field repair is discouraged. Faulty or suspect FRUs should be returned to the Motorola Customer Support Center for further troubleshooting and repair.

Each FRU has a bar code label attached to its front panel. This label identifies a sequential serial number for the FRU. Log this number whenever contacting the Motorola Customer Support Center. For complete information on ordering replacement FRUs, or instructions on how to return faulty FRUs for repair, contact:

Nippon Motorola LTD.
Tokyo Service Center
044-366-8860

OR

Motorola Customer Support Center
1311 East Algonquin Road
Schaumburg, Illinois 60196
(800) 448-3245 or (847) 576-7300

Technical Support Service

Motorola provides technical support services for installation, optimization, and maintenance of its fixed network equipment. Before calling the Motorola Customer Support Center, please note the following information:

- ☐ Where the system is located.
- ☐ The date the system was put into service.
- ☐ A brief description of problem.
- ☐ Any other unusual circumstances.

General Safety Information

The United States Department of Labor, through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), has established an electromagnetic energy safety standard which applies to the use of this equipment.

Proper use of this radio will result in exposure below the OSHA limit, however, this applies only within the United States of America. Obey all electromagnetic energy safety standards that have been established by your local governing body.

The following precautions are always recommended:

- ☐ DO NOT operate the transmitter of a mobile radio when someone outside the vehicle is within two feet (0.6 meter) of the antenna.
- ☐ DO NOT operate the transmitter of a fixed radio (base station, microwave and rural telephone rf equipment) or marine radio when someone is within two feet (0.6 meter) of the antenna.
- ☐ DO NOT operate the transmitter of any radio unless all RF connectors are secure and any open connectors are properly terminated.
- ☐ DO NOT operate this equipment near electrical caps or in an explosive atmosphere.

All equipment must be properly grounded according to Motorola installation instructions for safe operation.

All equipment should be serviced only by a qualified technician.

Refer to the appropriate section of the product service manual for additional pertinent safety information.

WARNING

POSSIBLE ELECTRICAL SHOCK HAZARD. BEFORE ATTEMPTING REMOVAL OR INSTALLATION OF EQUIPMENT, MAKE SURE THE PRIMARY POWER AND BATTERIES ARE DISCONNECTED.

Refer to publication 68P81106E84, Safe Handling of CMOS Integrated Circuit Devices, for more detailed information on this subject.

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800/900/1500 MHz Base Radio Overview

Overview

This section provides technical information for the 800/900/1500 MHz Base Radio (BR). Table 1-1 describes covered topics.

Table 1-1 **Chapter Topics**

Chapter	Page	Description
Single Carrier Base Radio Overview	1-3	Provides an overview of the BR, performance specifications, and overall theory of operation
QUAD Channel Base Radio Overview	1-8	Provides an overview of the QUAD Channel BR, performance specifications, and overall theory of operation
Base Radio Controller	2-1	Describes the functions and characteristics of the Base Radio Controller (BRC) module
Exciter	3-1	Describes the functions and characteristics of the Exciter module
Power Amplifier	4-1	Describes the functions and characteristics of Single Channel and QUAD Channel Power Amplifier modules
DC Power Supply	5-21	Describes functions and characteristics of DC Power Supply modules for Single Channel and QUAD Channel Base Radios
AC Power Supply	6-33	Describes the functions and characteristics of the AC Power Supply module

Table 1-1 Chapter Topics

Chapter	Page	Description
Receiver	7-39	Describes the functions and characteristics of the 800 MHz and 900 MHz 3X Receiver modules
Troubleshooting Single Channel Base Radios	8-1	Provides troubleshooting procedures, replacement procedures, and receiver/transmitter verification tests for Single Channel Base Radios
Base Radio/Base Radio FRU Replacement Procedures	8-5	Provides instructions and guidelines for Single Channel Base Radio and Base Radio FRU Replacement
Station Verification Procedures	8-9	Provides procedures for verifying station operation following Single Channel Base Radio repairs
Single Channel BR Backplane	8-35	Defines the pinouts, connectors, and signal names for the Single Channel BR backplane
Troubleshooting QUAD Channel Base Radios	9-1	Provides troubleshooting procedures, replacement procedures, and receiver/transmitter verification tests for QUAD Channel base radios
Base Radio/Base Radio FRU Replacement Procedures	9-5	Provides instructions and guidelines for QUAD Channel Base Radio and Base Radio FRU Replacement
Station Verification Procedures	9-10	Provides procedures for verifying station operation following QUAD Channel Base Radio repairs
QUAD Channel BR Backplane	9-22	Defines the pinouts, connectors, and signal names for the QUAD Channel BR backplane
Acronyms	A-39	Defines technical terms that appear in this manual

NOTE

The first section covers the 800 MHz, 900 MHz and 1500 MHz versions of the Base Radio (BR). General information for all versions appears here. The text notes information specific to the 800 MHz, 900 MHz or 1500 MHz BR.

NOTE

For QUAD Channel BR use, all Single Carrier BR modules have undergone a redesign process. Single Carrier BR modules are incompatible with the QUAD Channel BR. QUAD Channel BR modules are incompatible with the Single Carrier BR.

Do not try to insert QUAD Channel BR modules into a Single Carrier BR or Single Carrier BR modules into a QUAD Channel BR.

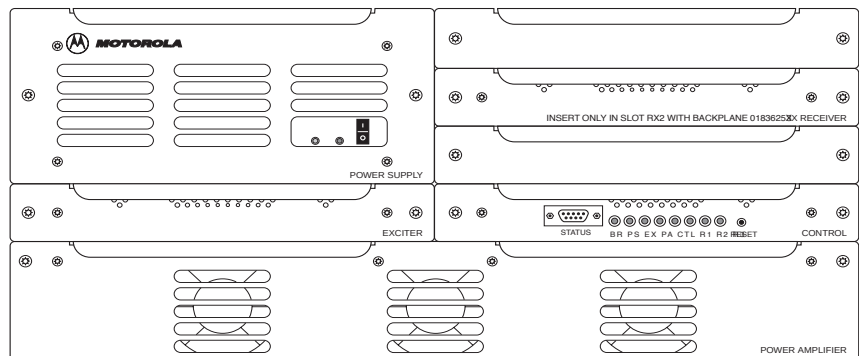
Single Carrier Base Radio Overview

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

The BR contains the five FRUs listed below:

- ☐ Base Radio Controller (BRC)
- ☐ Exciter
- ☐ Power Amplifier
- ☐ Power Supply (AC/DC)
- ☐ Receiver

The modular design of the BR also offers increased shielding and provides easy handling. All FRUs connect to the backplane through blindmate connectors. Figure 1-1 shows the front view of the BR.



EBTS282
101497JNM

Figure:1-1 **Base Radio (Typical)**

Single Carrier Base Radio Overview

Controls and Indicators

The Power Supply and BRC contain controls and indicators that provide a means for monitoring various status and operating conditions of the BR, and also aid in fault isolation. The controls and indicators for both modules are discussed in the Power Supply and BRC sections of this chapter.

The Power Supply contains two front panel indicators; the BRC contains eight front panel indicators. The Power Supply contains a power switch used to apply power to the BR. The BRC contains a RESET switch used to reset the BR.

Performance Specifications

General Specifications

Table 1-2 lists general specifications for the BR.

Table 1-2 BR General Specifications

Specification	Value or Range
Dimensions:	
Height	5 EIA Rack Units (RU)
Width	19" (482.6 mm)
Depth	16.75" (425 mm)
Weight	76 lbs. (34 kg)
Operating Temperature	32° to 104° F (0° to 40° C)
Storage Temperature	-22° to 140° F (-30° to 60° C)
Rx Frequency Range:	
800 MHz iDEN	806 - 821 MHz
900 MHz iDEN	896 - 901 MHz
1500 MHz iDEN	1453 - 1465 MHz
Tx Frequency Range:	
800 MHz iDEN	851 - 866 MHz
900 MHz iDEN	935 - 940 MHz
1500 MHz iDEN	1501 - 1513 MHz
Tx – Rx Spacing:	
800 MHz iDEN	45 MHz
900 MHz iDEN	39 MHz
1500 MHz iDEN	48 MHz
Channel Spacing	25 kHz
Frequency Generation	Synthesized
Digital Modulation	M-16QAM
Power Supply Inputs:	
Vac (option)	90 - 140/180 - 230 Vac (@ 47 - 63 Hz)
Vdc	-48 Vdc (41 - 60 Vdc)
Diversity Branches	Up to 3

Transmit Specifications

Table 1-3 lists transmit specifications for the BR.

*Table 1-3 **Transmit Specifications***

Specification	Value or Range
Average Power Output: (800 MHz) 40 W PA (800 MHz) 70 W PA (900 MHz) 60 W PA (1500 MHz) 40 W PA	2 - 40 W 4 - 70 W 5 - 60 W 10 - 40 W
Transmit Bit Error Rate (BER)	0.01%
Occupied Bandwidth	18.5 kHz
Frequency Stability *	1.5 ppm
RF Input Impedance	50 Ω (nom.)
FCC Designation (FCC Rule Part 90): (800 MHz) 40 W PA (800 MHz) 70 W PA (900 MHz) 60 W PA	ABZ89FC5772 ABZ89FC5763 ABZ89FC5791
* Stability without site reference connected to station.	

Receive Specifications

Table 1-4 lists the receive specifications.

*Table 1-4 **Receive Specifications***

Specification	Value or Range
Static Sensitivity †: 800 MHz BR 900 MHz BR 1500 MHz BR	-108 dBm (BER = 8%) -109 dBm (BER = 10%) -98 dBm (BER = 1%)
BER Floor (BER = 0.01%)	≥ -80 dBm
IF Frequencies 1st IF (All bands): 2nd IF: 800/900 MHz 1500 MHz	73.35 MHz (1st IF) 450 kHz (2nd IF) 455 kHz (2nd IF)
Frequency Stability *	1.5 ppm
RF Input Impedance	50 Ω (nom.)
FCC Designation (FCC Rule Part 15): 800 MHz BR 900 MHz BR	ABZ89FR5762 ABZ89FR5792
† Measurement referenced from single receiver input port of BR.	
* Stability without site reference connected to station.	

Single Carrier Base Radio Overview**NOTE**

FCC Compliance Notice: The Base Radio (BR) is FCC Compliant only when used in conjunction with Motorola supplied RF Distribution Systems. Motorola does not recommend that this BR be used without a Motorola approved RF Distribution System. It is the customer's responsibility to file for FCC approval if the BR is used with a non-Motorola supplied RF Distribution System.

Theory of Operation

The BR operates in conjunction with other site controllers and equipment that are properly terminated. The following description assumes such a configuration. Figures 1-3 and 1-4 show an overall block diagram of the BR.

Power is applied to the AC Power or DC Power inputs located on the BR backplane. The DC Power input is connected if -48 Vdc or batteries are used in the site. The AC Power input is used when 120/240 Vac service is used as a power source within the site.

Power is applied to the BR by setting the Power Supply power switch to the on position. Upon power-up, the BR performs self-diagnostic tests to ensure the integrity of the unit. These tests are primarily confined to the BRC and include memory and Ethernet verification routines.

After the self-diagnostic tests are complete, the BR reports any alarm conditions present on any of its modules to the site controller via Ethernet. Alarm conditions may also be verified locally using service computer and the STATUS port located on the front of the BRC.

The software resident in EPROM on the BRC registers the BR with the site controller via Ethernet. Once registered, the BR software is downloaded via Ethernet and is executed from RAM. Operating parameters for the BR are included in this download. This software allows the BR to perform call processing functions.

The BR 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 6 to 1. Both the receive and transmit signals of the BR are divided into 6 individual time slots. Each receive slot has a corresponding transmit slot; this pair of slots comprises a logical RF channel.

The BR uses diversity reception for increased coverage area and improved quality. The Receiver module within the BR contains up to three receivers. Two Receivers are used with two-branch diversity sites, and three Receivers are used with three-branch diversity sites.

All Receivers within a given BR 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 via Ethernet with the appropriate control information regarding its destination.

The transmit section of the BR is comprised of two separate FRUs, the Exciter and Power Amplifier (PA). Several PA FRUs are available, covering different applications and power levels; these are individually discussed as applicable in later subsections.

The Exciter processes the information to transmit from the BRC in the proper modulation format. This low level signal is sent to the PA 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 BR and adjusts it as necessary to maintain the proper output level.

QUAD Channel Base Radio Overview

QUAD Channel Base Radio Overview

The QUAD Channel BR provides reliable, digital BR capabilities in a compact, software-controlled design. Voice compression techniques, time division multiplexing (TDM) and multi-carrier operation provide increased channel capacity.

The QUAD Channel BR contains the five FRUs listed below:

- ☐ QUAD Channel EX / Cntl
- ☐ QUAD Channel Power Amplifier
- ☐ QUAD Channel Power Supply (DC)
- ☐ QUAD Channel Receiver (qty 4)

The modular design of the QUAD Channel BR also offers increased shielding and provides easy handling. All FRUs connect to the backplane through blindmate connectors. Figure 1-2 shows the front view of the BR.



Figure:1-2 **QUAD Channel Base Radio (Typical)**

Controls and Indicators

Power Supply and EX / CNTL controls and indicators monitor BR status and operating conditions, and also aid in fault isolation. The Power Supply and EX / CNTL sections of this chapter discuss controls and indicators for both modules.

The Power Supply has two front panel indicators. The EX / CNTL has twelve front panel indicators. The Power Supply power switch applies power to the BR. The EX / CNTL RESET switch resets the BR.

Performance Specifications

General Specifications

Table 1-5 lists general specifications for the BR.

Table 1-5 **QUAD Channel BR General Specifications**

Specification	Value or Range
Dimensions:	
Height	5 EIA Rack Units (RU)
Width	19" (482.6 mm)
Depth	16.75" (425 mm)
Weight	91 lbs. (40 kg)
Operating Temperature	32° to 104° F (0° to 40° C)
Storage Temperature	-22° to 140° F (-30° to 60° C)
Rx Frequency Range: 800 MHz iDEN	806 - 825 MHz
Tx Frequency Range: 800 MHz iDEN	851 - 870 MHz
Tx – Rx Spacing: 800 MHz iDEN	45 MHz
Carrier Spacing	25 kHz
Carrier Capacity ^a	1, 2, 3 or 4
Frequency Generation	Synthesized
Digital Modulation	QPSK, M-16QAM, and M-64QAM
Power Supply Inputs: Vdc	-48 Vdc (41 - 60 Vdc)
Diversity Branches	Up to 3

a. Multi-carrier operation must utilize adjacent, contiguous RF carriers.

QUAD Channel Base Radio Overview**Transmit Specifications**

Table 1-6 lists the BR transmit specifications.

*Table 1-6 **Transmit Specifications***

Specification	Value or Range	
Average Power Output:	Total PA	Per Carrier
(800 MHz)Single Carrier	5 - 52 W	5 - 52 W
(800 MHz) Dual Carrier	5 - 52 W	2.5 - 26 W
(800 MHz) Triple Carrier	5 - 48 W	1.7 - 16 W
(800 MHz) QUAD Channel	5 - 42 W	
Transmit Bit Error Rate (BER)	0.01%	
Occupied Bandwidth	18.5 kHz	
Frequency Stability *	1.5 ppm	
RF Input Impedance	50 Ω (nom.)	
FCC Designation (FCC Rule Part 90): (800 MHz) QUAD Channel PA	ABZ89FC5794	
* Transmit frequency stability locks to an external site reference, which controls ultimate frequency stability to a level of 50 ppb.		

Receive Specifications

Table 1-7 lists the receive specifications.

*Table 1-7 **Receive Specifications***

Specification	Value or Range
Static Sensitivity †: 800 MHz BR	-108 dBm (BER = 8%)
BER Floor (BER = 0.01%)	≥ -80 dBm
IF Frequencies 1st IF (All bands): 2nd IF:	73.35 MHz (1st IF) 450 kHz (2nd IF)
Frequency Stability *	1.5 ppm
RF Input Impedance	50 Ω (nom.)
FCC Designation (FCC Rule Part 15): 800 MHz BR	ABZ89FR5793
† Measurement referenced from single receiver input port of BR. * Stability without site reference connected to station. Receive frequency stability locks to an external site reference, which controls ultimate frequency stability to a level of 50 ppb.	

NOTE

FCC Compliance Notice: The Base Radio (BR) is FCC Compliant only when used with Motorola-supplied RF Distribution Systems. Motorola does not recommend using this BR without a Motorola-approved RF Distribution System. If customer uses the BR with a non-Motorola supplied RF Distribution System, the customer is responsible for filing for FCC approval.

Theory of Operation

The QUAD Channel BR operates together with other site controllers and equipment that are properly terminated. The following description assumes such a configuration. Figures 1-5 show an overall block diagram of the QUAD Channel BR.

Power is applied to the DC Power inputs located on the QUAD Channel BR backplane. The DC Power input is connected if -48 Vdc or batteries are used in the site.

Power is applied to the BR by setting the Power Supply power switch to the on position. Upon power-up, the QUAD Channel BR performs self-diagnostic tests to ensure the integrity of the unit. These tests, which include memory and Ethernet verification routines, primarily examine the EX / CN TL.

After completing self-diagnostic tests, the QUAD Channel BR reports alarm conditions on any of its modules to the site controller via Ethernet. Alarm conditions may also be verified locally. Local verification involves using the service computer and the STATUS port located on the front of the QUAD Channel EX / CN TL.

The software resident in FLASH on the EX / CN TL registers the BR with the site controller via Ethernet. After BR registration on initial power-up, the BR software downloads via Ethernet and executes from RAM. The download includes operating parameters for the QUAD Channel BR. These parameters allow the QUAD Channel BR to perform call processing functions.

After software downloads to the BR via Ethernet, FLASH memory stores the software object. Upon future power-ups, the software object in FLASH loads into RAM for execution.

The BR operates in a TDMA (Time Division Multiple Access) mode. This mode, combined with voice compression techniques, increases channel capacity by a ratio of as much as six to one. TDMA divides both the receive and transmit signals of the BR into six individual time slots. Each receive slot has a corresponding transmit slot. This pair of slots comprises a logical RF channel.

QUAD Channel Base Radio Overview

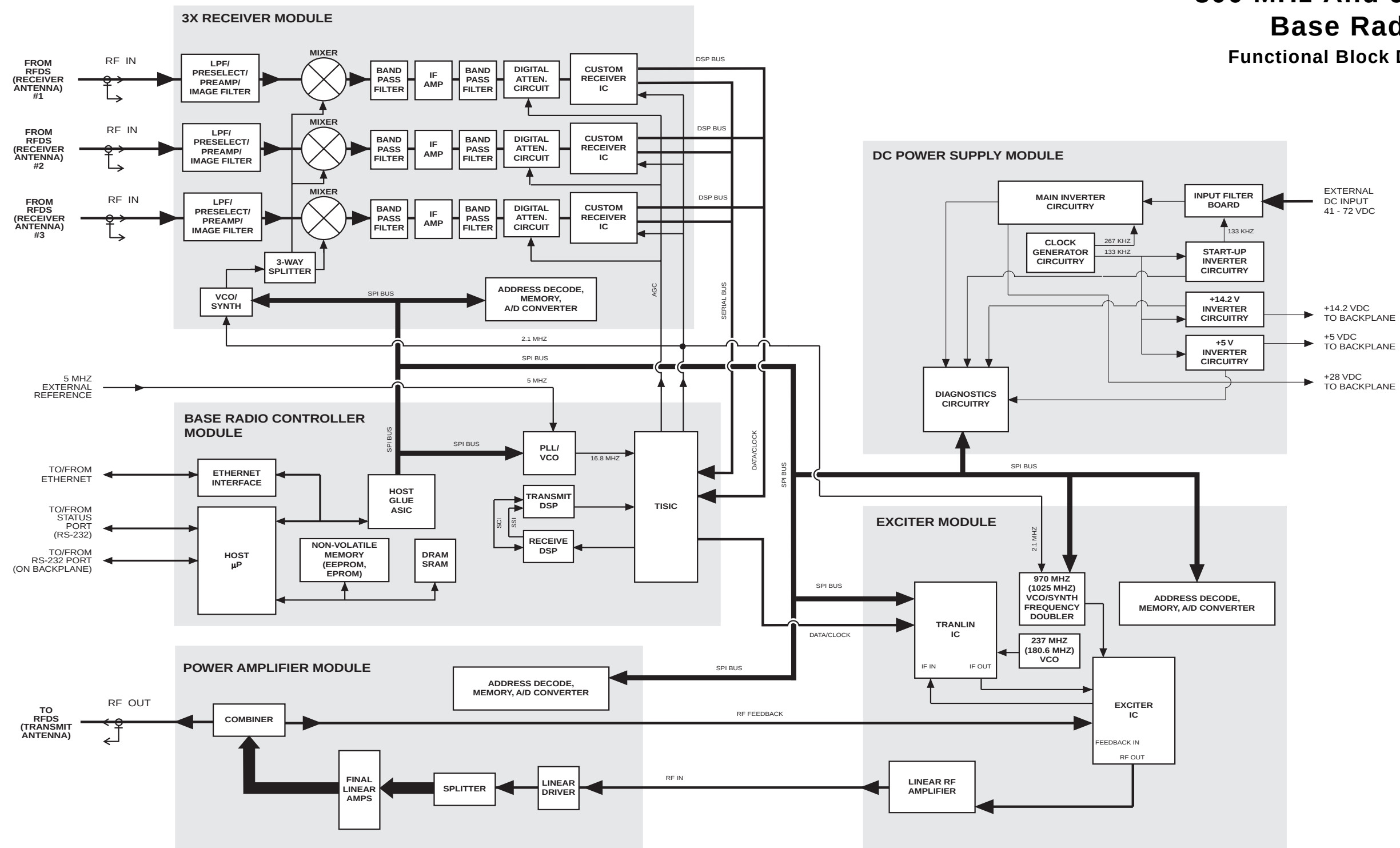
The BR uses diversity reception for increased coverage area and improved quality. The Receiver modules within the QUAD Channel BR contain three receiver paths. Two-branch diversity sites use two Receiver paths, and three-branch diversity sites use three Receiver paths.

All Receiver paths within a given Receiver module are programmed to the same receive frequency. Signals from each receiver arrive at the EX / CNTL module. This module performs a diversity combining algorithm on the signals. The resultant signal undergoes an error-correction process. Then, via Ethernet, the site controller acquires the signal, along with control information about signal destination.

Two separate FRUs comprise the transmit section of the QUAD Channel BR. These are the Exciter portion of the EX / CNTL and the Power Amplifier (PA). The Exciter processes commands from the CNTL, assuring transmission in the proper modulation format. Then the low-level signal enters the PA. The PA amplifies this signal to the desired output power level. The PA is a continuously keyed linear amplifier. A power control routine monitors the output power of the BR. The routine adjusts the power as necessary to maintain the proper output level.

QUAD Channel Base Radio Overview

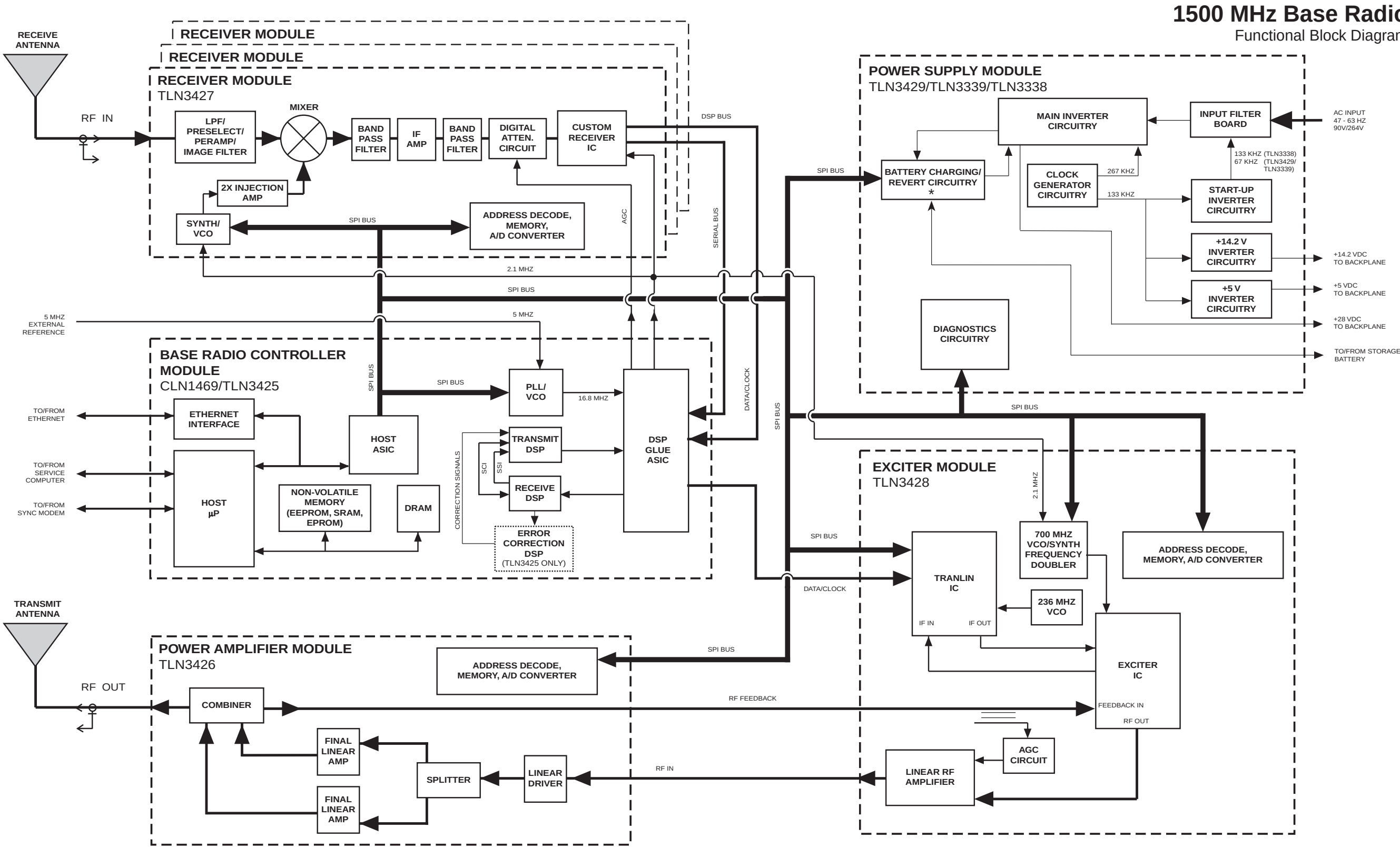
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EBTS284
120497JNM

Figure:1-3 800/900 MHz Base Radio Functional Block Diagram

Base Radio Overview



* Battery Charging/Revert Circuitry is contained only in the TLN3429 and TLN3339 AC Power Supplies.

Figure:1-4 1500 MHz Base Radio Functional Block Diagram

Base Radio Overview

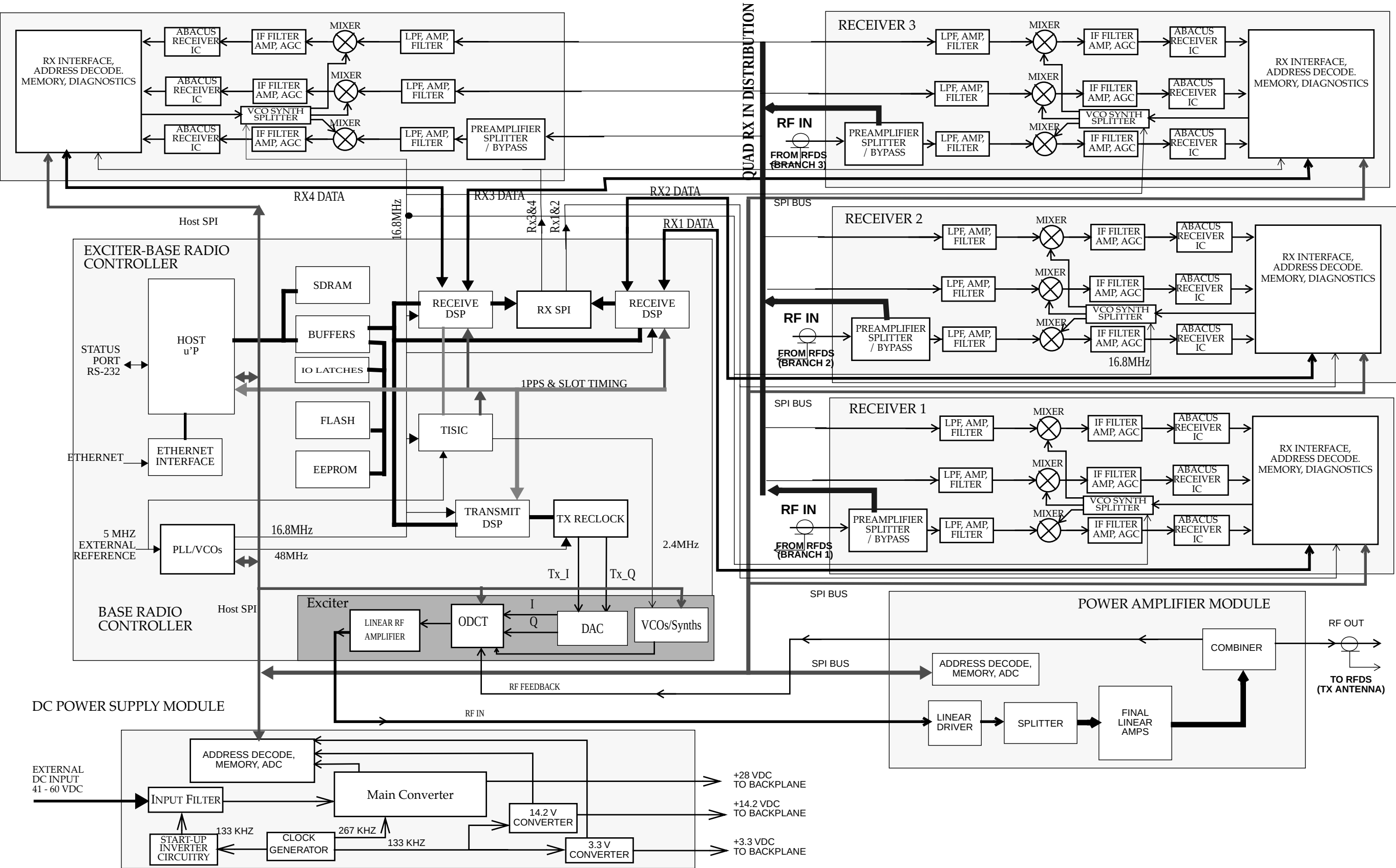


Figure:1-5 800 MHz QUAD Channel Base Radio Functional Block Diagram

Base Radio Overview

Base Radio Controller

Overview

This section provides technical information for the Base Radio Controller (BRC). Table 2-1 describes covered topics.

Table 2-1 **Chapter Topics**

Chapter	Page	Description
800/900/1500 MHz Base Radio Controller – CLN1469; 1500 MHz MC1 Base Radio Controller – TLN3425	2-2	Describes the functions and characteristics of the Base Radio Controller (BRC) module for the single channel Base Radio (BR).
800 MHz QUAD Channel Base Radio Controller	2-13	Describes the functions and characteristics of the Base Radio Controller (BRC) module for the QUAD channel Base Radio (BR).
Single Channel Base Radio Controller	2-25	Functional Block Diagram for the Single Channel Base Radio Controller (BRC)
QUAD Channel Base Radio Controller	2-29	Functional Block Diagram for the QUAD Channel Base Radio Controller (BRC)

FRU Number to Kit Number Cross Reference

Base Radio Controller (BRC) Field Replaceable Units (FRUs) are available for the iDEN EBTS. The FRU contains the BRC kit and required packaging. Table 2-2 provides a cross reference between BRC FRU numbers and kit numbers.

Table 2-2 **FRU Number to Kit Number Cross Reference**

Description	FRU Number	Kit Number
Single Channel Base Radio Controller (800/ 900/ 1500 MHz)	TLN3334	CLN1469
Single Channel Base Radio Controller (1500 MHz MCI)	TLN3425	CLN1472
QUAD Channel Exciter / Base Radio Controller (800 MHz)	CLN1497	CLF1560

800/900/1500 MHz Base Radio Controller – CLN1469; 1500 MHz MC1 Base Radio Controller – TLN3425

Overview

The Base Radio Controller (BRC) provides signal processing and operational control for other Base Radio modules. Figure 2-1 shows a top view of the BRC with the cover removed. The BRC module consists of two printed circuit boards (BRC board and LED/display board), a slide-in housing, and associated hardware.

The BRC memory contains the operating software and codeplug. The software defines operating parameters for the BR, such as output power and operating frequency.

The BRC interconnects to the Base Radio backplane using one 96-pin, DIN connector and one blindmate, RF connector. Two Torx screws secure the BRC to the Base Radio chassis.

NOTE

BRC Modules with board level kit number CLN6989 require System Software Release version SR 3.3 or higher. Using these modules with System Software versions older than 3.3 causes a PENDULUM lock error. The Base Radio will not function.

Two BRC modules serve as the main controller for the 1500 MHz Base Radio. The standard model is the same module that the 800/900 MHz Base Radio uses. Model TLN3425 contains additional Digital Signal Processing power. This additional power supports applications that require a modified error correction routine (available for specific customers only). Figure 2-2 shows a top view of the BRC (model TLN3425) with the cover removed.

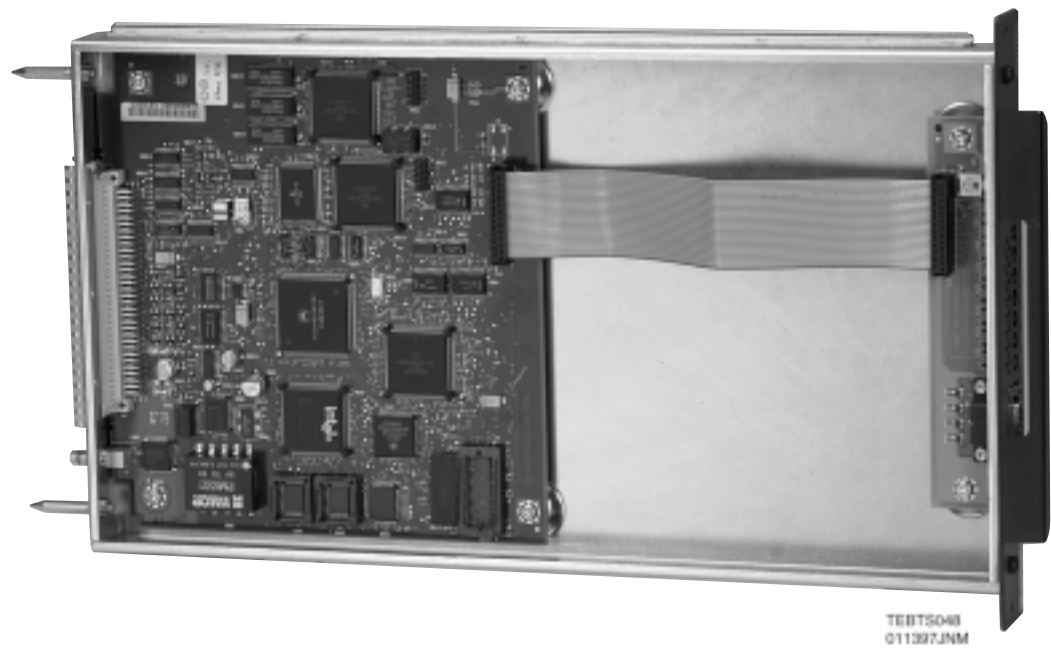


Figure:2-1 **Base Radio Controller, version CLN1469 (with cover removed)**

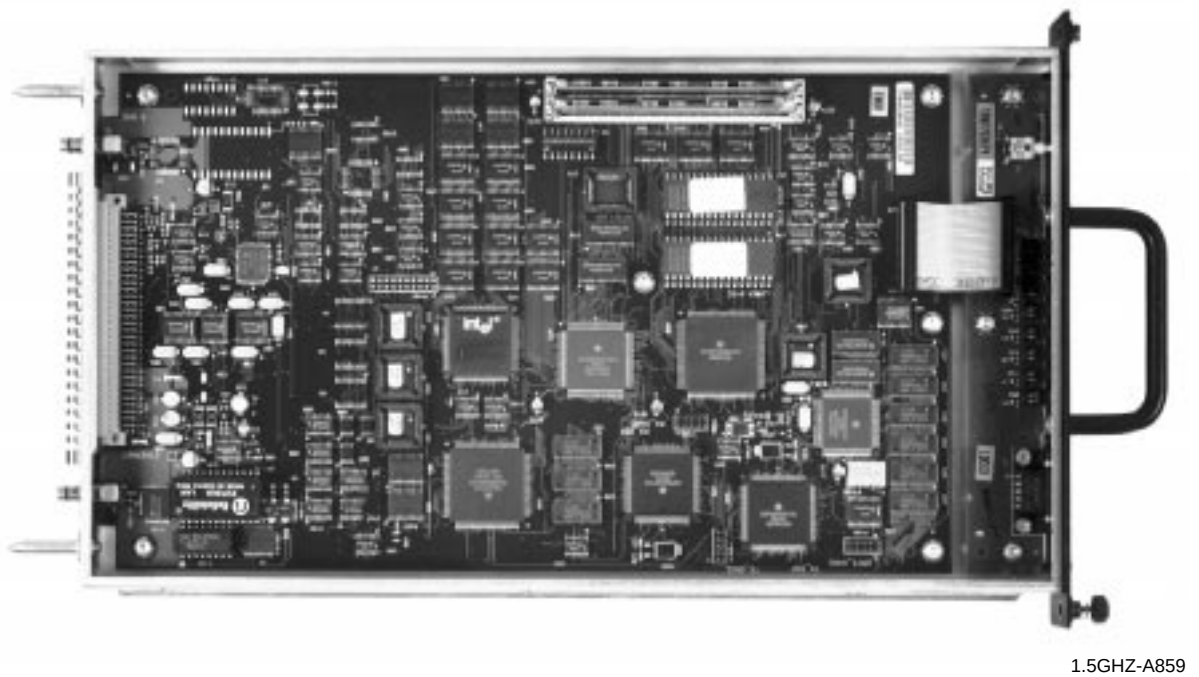


Figure:2-2 **Base Radio Controller, version TLN3425 (with cover removed)**

Controls and Indicators

The BRC monitors the functions of other Base Radio modules. Front panel LEDs indicate the status of modules that the BRC monitors. Upon initial power-up, all front panel LEDs normally flash three times. A RESET switch allows a manual reset of the Base Radio. Figure 2-3 shows the BRC front panel.

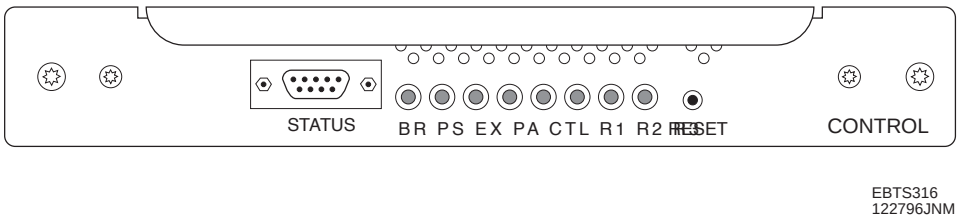


Figure:2-3 BR Controller (Front View)

Indicators

Table 2-3 lists and describes the BRC LEDs.

Table 2-3 BR Controller Indicators

LED	Color	Module Monitored	Condition	Indications
BR	Green	BR	Solid (on)	Station is keyed
			Flashing (on)	Station is not keyed
			Off	Station is out of service or power is removed
PS	Red	Power Supply	Solid (on)	FRU failure indication - Power Supply has a major alarm, and is out of service
			Flashing (on)	Power Supply has a minor alarm, and may be operating at reduced performance
			Off	Power Supply is operating normally (no alarms)

Table 2-3 **BR Controller Indicators (Continued)**

LED	Color	Module Monitored	Condition	Indications
EX	Red	Exciter	Solid (on)	FRU failure indication - Exciter has a major alarm, and is out of service
			Flashing (on)	Exciter has a minor alarm, and may be operating at reduced performance
			Off	Exciter is operating normally (no alarms)
PA	Red	Power Amplifier	Solid (on)	FRU failure indication - PA has a major alarm, and is out of service
			Flashing (on)	PA has a minor alarm and may be operating at reduced performance
			Off	PA is operating normally (no alarms)
CTL	Red	Controller	Solid (on)	FRU failure indication - BRC has a major alarm, and is out of service
			Flashing (on)	BRC has a minor alarm, and may be operating at reduced performance
			Off	BRC is operating normally (no alarms)
R1 R2 R3	Red	Receiver #1, #2, or #3	Solid (on)	FRU failure indication - Receiver (#1, #2, or #3) has a major alarm, and is out of service
			Flashing (on)	Receiver (#1, #2, or #3) has a minor alarm, and may be operating at reduced performance
			Off	Receiver (#1, #2, or #3) is operating normally (no alarms)

Controls

Table 2-4 lists the controls and descriptions.

Table 2-4 **BR Controller Controls**

Control	Description
RESET Switch	A push-button switch used to manually reset the BR.
STATUS connector	A 9-pin connector used for connection of a service computer. Provides a convenient means for testing and configuring.

STATUS Connector

Table 2-5 the pin-outs for the STATUS connector.

800/900/1500 MHz Base Radio Controller – CLN1469; 1500 MHz MC1 Base Radio Controller – TLN3425*Table 2-5 Pin-outs for the STATUS Connector*

Pin-out	Signal
1	CD
2	TXD
3	RXD
4	not used
5	GND
6	not used
7	CTS
8	RTS
9	not used

Theory of Operation

Table 2-6 briefly describes the BRC circuitry. Figures 2-6 and 2-7 are functional block diagrams of the Single Channel BRC.

Table 2-6 BR Controller Circuitry

Circuit	Description
Host Microprocessor and Host Glue ASIC	Contains two integrated circuits that comprise the central controller of the BRC and station.
Non-Volatile Memory	Consists of: • EPROMs containing the station operating software • one EEPROM containing the station codeplug data
Volatile Memory	Contains DRAM to store station software that executes commands. Contains SRAM which the host microprocessor uses for general data space.
Ethernet Interface	Provides the BRC with a 10Base2 Ethernet communication port. The interface networks both control and compressed voice data.
RS-232 Interface	Provides the BRC with two independent RS-232 serial interfaces.
Digital Signal Processors and TISIC	Performs high-speed modulation/demodulation of compressed audio and signaling data.
Station Reference Circuitry	Generates the 16.8 MHz and 2.1 MHz reference signal used throughout the station.
Input Ports	Contains two 16-line input buses. These buses receive miscellaneous inputs from the BR.
Output Ports	Contains three 16-line output buses. These buses provide a path for sending miscellaneous control signals to circuits throughout the BR.
Remote Station Shutdown	Provides software control to cycle power on the BR.

Host Microprocessor

The host microprocessor is the the BR's main controller. The host operates at a clock speed of 16.5 MHz. The Host Glue ASIC provides this clock frequency. The processor controls Base Radio operation according to station software in non-volatile memory. Two EPROMs contain the station software. An EEPROM stores the station codeplug.

Serial Communication Buses

The microprocessor provides a general-purpose SCC2 serial communications bus.

The SCC2 serial communications bus is an asynchronous RS-232 interface. The the BRC front panel includes a 9-pin, D-type connector. This connector provides a port where service personnel may connect a service computer. The service computer allows downloading of application code or diagnostic software. Service personnel can perform programming and maintenance tasks via Man Machine Interface (MMI) commands. The interface between the SCC2 port and the front panel STATUS connector is via EIA-232 Bus Receivers/Drivers.

Address and Data Bus

The microprocessor has a 23-line address bus. The processor uses this bus to access non-volatile and DRAM memory. The processor also uses the bus to provide control for other BRC circuitry via memory mapping.

A 16-line data bus transfers data to and from the BRC memory. Such bus transfers may involve other BRC circuitry, too. Buffers on the data bus allow transfers to and from non-volatile and DRAM memory.

Host Glue ASIC

The Host Microprocessor controls the operations of the Host Glue ASIC. Table 2-7 describes this ASIC's functions.

Table 2-7 **Host Glue ASIC Functions**

Function	Description
SPI Bus	Serves as a general-purpose, serial communications bus. Provides communications between the Host Microprocessor and other Base Radio modules.
DRAM Controller	Provides signals necessary to access and refresh DRAM memory.
System Reset	Generates a BRC Reset at power-up.
Host Microprocessor Clock	Buffers the 33 MHz crystal outputs. Performs a divide-by-2 operation. Outputs a 16.5 MHz clock signal for the Host Microprocessor.
Address Decoding	Decodes addresses from the Host Microprocessor. Generates corresponding chip-select signals for various BRC devices, such as: DRAM, EPROM, I/O Ports, DSPs, and internal Host Glue ASIC registers.
Interrupt Controller	Accepts interrupt signals from various BRC circuits (such as the DSPs). Organizes the interrupts based on hardware-defined priority ranking. Sends interrupt and priority level information to the Host Microprocessor (via IPL lines 1-3).

Non-Volatile Memory

The Base Radio software resides in two 512K x 8 byte EPROMs. The Host Microprocessor addresses these EPROMs via 19 of 23 host address bus lines. The host accesses EPROM data over the 16-line host data bus.

The data that determines the station personality resides in an 8K x 8 byte codeplug EEPROM. The microprocessor addresses the EEPROM over 15 of 23 host address bus lines. The host accesses EEPROM data over the 16-line data bus.

Stations ship with default data programmed into the codeplug. The BRC must download field programming information from network and site controllers. This data includes operating frequencies and output power level. The station permits adjustment of many station parameters, but the station does not store adjustments. Refer to this manual's Software Commands chapter for additional information.

Volatile Memory

Each BRC contains 2MB of DRAM. The BRC downloads station software code into DRAM for station use. Since DRAM is volatile memory, it loses data during a system reset or power failure.

DRAM also provides short-term storage for data generated and required during normal operation. The BRC performs read and write operations over the Host Address and Data buses. Read and write operations also involve column and row select lines. The Host Glue ASIC controls these lines. The Host Glue ASIC also controls address bus and column row signals. During normal operation, the address bus and column row signals sequentially refresh DRAM memory locations.

The BRC also includes two 32K x 8 byte fast Static RAM (SRAM) ICs. The microprocessor accesses SRAM over the Data Bus and Host Address Bus. Access requires the entire Data Bus, and 15 of the Host Address Bus' 23 lines.

Ethernet Interface

The Ethernet Interface includes a Local Area Network (LAN) Controller. This LAN Controller is a 32-bit address, 16-bit data LAN coprocessor. The LAN coprocessor implements the CSMA/CD access method, which supports the IEEE 802.3 10Base2 standard. The LAN coprocessor communicates with the Host Microprocessor via DRAM. The LAN coprocessor uses 22 of its 32 address lines for the Ethernet interface.

The LAN coprocessor supports all IEEE 802.3 Medium Access Control, including the following:

- ☐ framing
- ☐ preamble generation
- ☐ stripping
- ☐ source address generation
- ☐ destination address checking

The LAN coprocessor receives commands from the CPU by reading a specified memory block. The LAN Controller's internal FIFOs optimize microprocessor bus performance.

The LAN coprocessor includes an on-chip, Direct Memory Access (DMA) controller. The DMA controller automatically transfers data blocks (buffers and frames) from Ethernet to DRAM. These automatic data transfers relieve the host CPU of byte transfer overhead.

The Ethernet Serial Interface works with the LAN coprocessor to perform these major functions:

- ☐ 10 MHz transmit clock generation (obtained by dividing the 20 MHz signal provided by an on-board crystal)
- ☐ Manchester encoding and decoding of frames
- ☐ electrical interface to the Ethernet transceiver

An isolation transformer provides high voltage protection. The transformer also isolates the Ethernet Serial Interface (ESI) and the transceiver. The pulse transformer has the following characteristics:

- ☐ Minimum inductance of 75 μ H
- ☐ 2000 V isolation between primary and secondary windings
- ☐ 1:1 Pulse Transformer

The Coaxial Transceiver Interface (CTI) is a coaxial cable line driver/receiver for the Ethernet. CTI provides a 10Base2 connection via a coaxial connector on the board. This device minimizes the number of external components necessary for Ethernet operations.

A DC/DC converter provides a constant voltage of -9 Vdc for the CTI. The converter's input source voltage is 5 Vdc.

The CTI performs the following functions:

- ☐ Receives and transmits data to the Ethernet coaxial connection
- ☐ Reports any collision that it detects on the coaxial connection
- ☐ Disables the transmitter when packets are longer than the legal length (Jabber Timer)

Digital Signal Processors

The BRC includes a Receive Digital Signal Processor (RXDSP) and a Transmit Digital Signal Processor (TXDSP). These DSPs and related circuitry process compressed station transmit and receive audio or data. The related circuitry includes the TDMA Infrastructure Support IC (TISIC) and the TISIC Interface Circuitry. The DSPs only accept input and output signals in digitized form.

The inputs are digitized receiver signals. The outputs are digitized voice audio and data (modulation signals). The output DSP sends these signals to the Exciter. DSPs communicate with the Microprocessor via an 8-bit host data bus. This bus is on the Host Processor side. For all DSPs, interrupts drive communication.

800/900/1500 MHz Base Radio Controller – CLN1469; 1500 MHz MC1 Base Radio Controller – TLN3425

The RXDSP operates from a 40 MHz clock provided by an on-board crystal. The RXDSP accepts redigitized signal from the receivers. The RXDSP also provides address and data buses. These buses receive digitized audio from the TISIC.

The DSP program and signal processing algorithms reside in three 32K x 8 SRAM ICs. The RXDSP accesses this software there. The RXDSP communicates with the host bus via an 8-bit interface.

The Synchronous Serial Interface (SSI) port offers a serial data path to the TXDSP. The Serial Communications Interface (SCI) port provides a serial control path from the TXDSP.

The TXDSP operates at a clock speed of 40 MHz, provided by a clock oscillator. The TXDSP sends the digitized signal to the TISIC. The TSCI then passes the signal to the Exciter.

The TXDSP contains its own address and data buses. It uses these buses to access its DSP program and signal processing algorithms in local memory. The TXDSP memory consists of six 32K x 8 SRAM ICs. The TXDSP communicates with the host bus via an 8-bit interface.

Error Correction Digital Signal Processor (TLN3425 Only)

The Error Correction Digital Signal Processor (U30) in the Model TLN3425A operates at a clock speed of 60 MHz. An on-board oscillator (Y100) operates at 10 MHz. Circuitry inside the ECDSP multiplies this frequency to generate the required clock signal.

Decoding is the main function of the Error Correction Digital Signal Processor (ECDSP). The ECDSP accepts data from the Synchronous Serial Interface (SSI) bus. The ECDSP performs various algorithms on the signal. Then the signal enters the TXDSP via the SSI bus.

The ECDSP contains its own address and data buses. It uses these buses to access its DSP program and signal processing algorithms in local memory. Two 32K x 8 SRAM ICs (U27 and U31) comprise the ECDSP memory. The ECDSP communicates with the host bus via an 8-bit interface.

TISIC

The TISIC controls internal DSP operations. This circuit provides a number of functions, including the following:

- ☐ Interfaces with the DSPs via the DSP address and data buses.
- ☐ Accepts a 16.8 MHz signal and a 1 PPS signal from Station Reference Circuitry.
- ☐ Outputs a 2.1 MHz reference signal used by the Exciter and Receivers.
- ☐ Outputs a 4.8 MHz reference signal used by the Exciter to clock data into the TRANLIN IC.
- ☐ Accepts differential data from the Receiver (RX1 through RX3) via interface circuitry.
- ☐ Accepts and sends serial data from the Receiver (RX1 through RX3) via the serial data bus.
- ☐ Accepts and formats differential data from the TXDSP for transmission to the Exciter via interface circuitry.
- ☐ Generates 15 ms and 7.5 ms ticks. These synchronize to the 1 PPS time mark from the iSC. The system routes these ticks to the TXDSP and RXDSP, respectively.
- ☐ Generates the Receive SSI (RXSSI) frame sync interrupt for the RXDSP.

Station Reference Circuitry

The Station Reference Circuitry is a phase-locked loop (PLL). This PLL consists of a high-stability, Voltage Controlled Crystal Oscillator (VCXO) and a Phase Locked Loop IC. The iSC's GPS output connects to the 5 MHz / 1 PPS A BNC connector on the EBTS junction panel.

The PLL compares the reference frequency to the 16.8 MHz VCXO output. The PLL then generates a DC correction or control voltage. With the control voltage enable switch closed, the PLL's control voltage adjusts the VCXO frequency. This adjustment achieves a stability equivalent to that of the external 5 MHz frequency reference.

The control voltage from the PLL continuously frequency-controls the VXCO. The VXCO outputs a 16.8 MHz clock signal, and applies the signal to the TISIC.

The TISIC divides the 16.8 MHz signal by eight and outputs a 2.1 MHz signal. A splitter separates and buffers this signal. Then via the backplane, the output signal enters the Exciter and Receivers as a 2.1 MHz reference .

The 4.8 MHz reference signal generated by the TISIC enters the Exciter module. There it clocks data into and out of the TRANLIN IC.

Input Ports

Two general purpose, 16-line input ports provide for various input signals from the BRC and station circuitry. These inputs connect to the Host Microprocessor.

Input Port P0 -In and Port P1-In each consist of 16 lines. Via the backplane, these lines carry signals from BRC circuitry and other station modules. The buses communicate with the buffers to make data available to the Host Microprocessor via the Host Data Bus. The DIP switch and Station Reference Circuitry are typical inputs for these ports.

Output Ports

Three general purpose, 16-line output ports provide various control signals from the Host Microprocessor. Via the backplane, these output ports carry control signals to the BRC and station circuitry.

Output ports P0-Out through Port P2-Out each consist of 16 lines. These lines derive from the Host Data Bus via latches.

Typical control signals include front panel LED control signals and SPI peripheral address select lines.

Remote Station Shutdown

BRC circuitry can send a shutdown pulse to the Base Radio Power Supply. After receiving this pulse, the power supply cycles BR power. The shutdown affects 5.1 Vdc, 28.6 Vdc and 14.2 Vdc sources. The BRC produces the shutdown pulse by invoking software control signals. A remote site uses the shutdown function to perform a hard reset of all BR modules.

800 MHz QUAD Channel Base Radio Controller

Overview

The Base Radio Controller (BRC) provides signal processing and operational control for Base Radio modules. The BRC module consists of a printed circuit board, a slide-in housing, and associated hardware.

The BRC memory contains the operating software and codeplug. The software defines BR operating parameters, such as output power and operating frequency.

The BRC connects to the Base Radio backplane with one 168-pin FutureBus+ connector and one blindmate RF connector. Two Torx screws secure the BRC in the Base Radio chassis.

Figure 2-4 shows a top view of the BRC (model CLF6290A) with the cover removed.

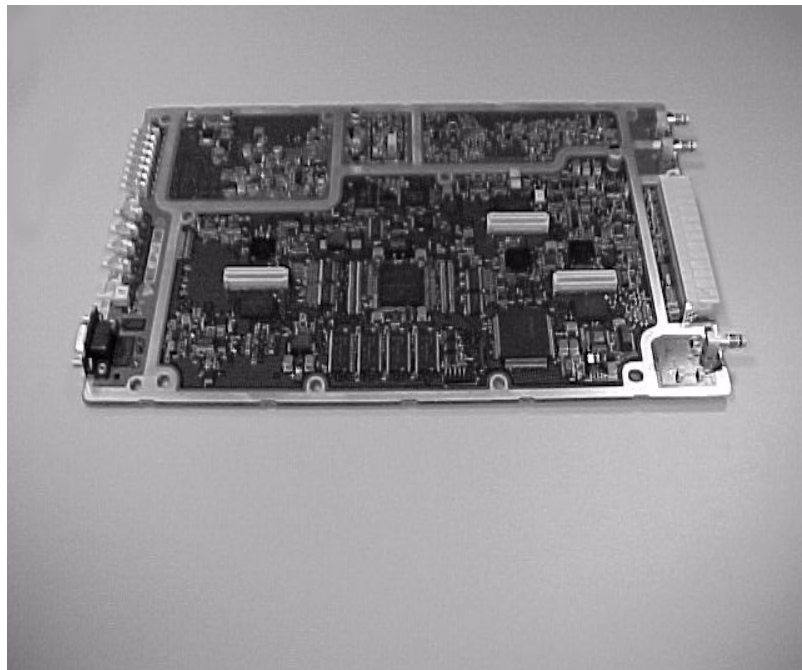


Figure:2-4 **Base Radio Controller, version CLN1469 (with cover removed)**

Controls and Indicators

The BRC monitors the functions of other Base Radio modules. The LEDs on the front panel indicate the status of BRC-monitored modules. All LEDs on the BRC front panel normally flash three times upon initial power-up. A RESET switch

800 MHz QUAD Channel Base Radio Controller

allows a manual reset of the Base Radio. Figure 2-5 shows the front panel of the BRC.



Figure:2-5 **BR Controller (Front View)**

Indicators

Table 2-8 lists and describes the BRC LEDs.

Table 2-8 **BR Controller Indicators**

LED	Color	Module Monitored	Condition	Indications
PS	Red	Power Supply	Solid (on)	FRU failure indication - Power Supply has a major alarm, and is out of service
			Flashing (on)	Power Supply has a minor alarm, and may be operating at reduced performance
			Off	Power Supply is operating normally (no alarms)
EXBRC	Red	Controller/ Exciter	Solid (on)	FRU failure indication - Controller/ Exciter has a major alarm, and is out of service (Note: Upon power-up of the BR, this LED indicates a failed mode until BR software achieves a known state of operation.)
			Flashing (on)	Controller/ Exciter has a minor alarm, and may be operating at reduced performance
			Off	Controller/ Exciter is operating normally (no alarms)
PA	Red	Power Amplifier	Solid (on)	FRU failure indication - PA has a major alarm, and is out of service
			Flashing (on)	PA has a minor alarm, and may be operating at reduced performance
			Off	PA is operating normally (no alarms)
REF	Red	Controller Station Reference	Solid (on)	FRU failure indication - Controller Station Reference has a major alarm, and is out of service
			Flashing (on)	BRC has a minor alarm, and may be operating in a marginal region
			Off	BRC is operating normally (no alarms)

800 MHz QUAD Channel Base Radio Controller**Table 2-8 BR Controller Indicators (Continued)**

LED	Color	Module Monitored	Condition	Indications
RX1 RX2 RX3 RX4	Red	Receiver #1, #2, #3, or #4	Solid (on)	FRU failure indication - Receiver (#1, #2, #3 or #4) has a major alarm, and is out of service
			Flashing (on)	Receiver (#1, #2, #3 or #4) has a minor alarm, and may be operating at reduced performance
			Off	Receiver (#1, #2, #3 or #4) is operating normally (no alarms)
TX1	Green	BR	Solid (on)	Station Transmit Carrier #1 is keyed
			Flashing (on)	Station Transmit Carrier #1 is not keyed
			Off	Station is out of service, or power is removed
TX2	Green	BR	Solid (on)	Station Transmit Carrier #2 is keyed
			Flashing (on)	Station Transmit Carrier #2 is not keyed
			Off	Station is out of service, or power is removed
TX3	Green	BR	Solid (on)	Station Transmit Carrier #3 is keyed
			Flashing (on)	Station Transmit Carrier #3 is not keyed
			Off	Station is out of service, or power is removed
TX4	Green	BR	Solid (on)	Station Transmit Carrier #4 is keyed
			Flashing (on)	Station Transmit Carrier #4 is not keyed
			Off	Station is out of service, or power is removed

Controls

Table 2-9 lists the controls and descriptions.

Table 2-9 BR Controller Controls

Control	Description
RESET Switch	A push-button switch used to manually reset the BR.
STATUS connector	A 9-pin connector used for connection of a service computer, providing a convenient means for testing and configuring.

STATUS Connector

Table 2-10 the pin-outs for the STATUS connector.

800 MHz QUAD Channel Base Radio Controller*Table 2-10 Pin-outs for the STATUS Connector*

Pin-out	Signal
1	not used
2	TXD
3	RXD
4	not used
5	GND
6	not used
7	not used
8	not used
9	not used

Theory of Operation

Table 2-11 briefly describes the BRC circuitry. Figure 2-9 is a functional block diagram of the BRC.

Table 2-11 BR Controller Circuitry

Circuit	Description
Host Microprocessor	Contains integrated circuits that comprise the central controller of the BRC and station
Non-Volatile Memory	Consists of: • FLASH containing the station operating software • EEPROM containing the station codeplug data
Volatile Memory	Contains SDRAM to store station software used to execute commands.

800 MHz QUAD Channel Base Radio Controller*Table 2-11 BR Controller Circuitry*

Circuit	Description
Ethernet Interface	Provides the BRC with a 10Base2 Ethernet communication port to network both control and compressed voice data
RS-232 Interface	Provides the BRC with an RS-232 serial interface
Digital Signal Processors	Performs high-speed modulation/demodulation of compressed audio and signaling data
TISIC	Contains integrated circuits that provide timing reference signals for the station
TX Reclock	Contains integrated circuits that provide highly stable, reclocked transmit signals and peripheral transmit logic
RX DSP SPI	Contains integrated circuits that provide DSP SPI capability and peripheral transmit logic
Station Reference Circuitry	Generates the 16.8 MHz and 48 MHz reference signals used throughout the station
Input Ports	Contains 16 signal input ports that receive miscellaneous inputs from the BR
Output Ports	Contains 40 signal output ports, providing a path for sending miscellaneous control signals to circuits throughout the BR
Remote Station Shutdown	Provides software control to cycle power on the BR

Host Microprocessor

The host microprocessor is the main controller for the BR. The processor operates at a 50-MHz clock speed. The processor controls Base Radio operation according to station software in memory. Station software resides in FLASH memory. For normal operation, the system transfers this software to non-volatile memory. An EEPROM contains the station codeplug.

NOTE

At BR power-up, the EXBRC LED indicates a major alarm. This indication continues until BR software achieves a predetermined state of operation. Afterward, the software turns off the EXBRC LED.

Serial Communication Buses

The microprocessor provides a general-purpose SMC serial management controller bus.

The SMC serial communications bus is an asynchronous RS-232 interface with no hardware handshake capability. The BRC front panel includes a nine-pin, D-type connector. This connector provides a port where service personnel may connect a service computer. Service personnel can perform programming and maintenance tasks via Man-Machine Interface (MMI) commands. The interface between the

800 MHz QUAD Channel Base Radio Controller

SMC port and the front-panel STATUS connector is via EIA-232 Bus Receivers and Drivers.

Host Processor

The microprocessor incorporates 4k bytes of instruction cache and 4k bytes of data cache that significantly enhance processor performance.

The microprocessor has a 32-line address bus. The processor uses this bus to access non-volatile memory and SDRAM memory. Via memory mapping, the processor also uses this bus to control other BRC circuitry.

The microprocessor uses its Chip Select capability to decode addresses and assert an output signal. The eight chip-select signals select non-volatile memory, SDRAM memory, input ports, output ports, and DSPs.

The Host SPI serves as a general-purpose, serial communications bus. This bus...

- ☐ Provides communications between the Host Microprocessor and other Base Radio modules.
- ☐ Provides condition signals necessary to access SDRAM, FLASH, and DSP.
- ☐ Provides refresh capability to SDRAM memory.
- ☐ Accepts interrupt signals from BRC circuits (such as DSPs).
- ☐ Organizes the interrupts, based on hardware-defined priority ranking.

The Host supports several internal interrupts from its Communications Processor Module. These interrupts allow efficient use of peripheral interfaces.

The Host supports 10 Mbps Ethernet/IEEE 802.3.

A 32-line data bus transfers data to and from BRC memory and other BRC circuitry. Buffers on this data bus allow transfers to and from non-volatile and SDRAM memory.

Non-Volatile Memory

Base Radio software resides in 2M x 32 bytes of FLASH memory. The Host Microprocessor addresses the FLASH memory with 20 of the host address bus' 32 lines. The host accesses FLASH data over the 32-line host data bus. A host-operated chip-select line provides control signals for these transactions.

The FLASH contains the operating system and application code. The system stores application code in FLASH for fast recovery from reset conditions. Application code transfers from network or site controllers may occur in a background mode. Background mode transfers allow the station to remain operational during new code upgrades.

The data that determines the station personality resides in a 32K x eight byte codeplug EEPROM. The microprocessor addresses the EEPROM with 15 of the host address bus' 32 lines. The host accesses EEPROM data with eight of the data bus' 32 lines. A host-operated chip-select line provides control signals for these transactions.

During the manufacturing process, the factory programs the codeplug's default data. The BRC must download field programming data from network and site controllers. This data includes operating frequencies and output power level. The station permits adjustment of many station parameters, but the station does not store these adjustments. Refer to the Software Commands chapter for additional information.

Volatile Memory

Each BRC contains 8MB x 32 bytes of SDRAM. The BRC downloads station software code into SDRAM for station use. SDRAM also provides short-term storage for data generated and required during normal operation. SDRAM is volatile memory. A loss of power or system reset destroys SDRAM data.

The system performs read and write operations over the Host Address and Data buses. These operations involve column and row select lines under control of the Host processor's DRAM controller. The Host Glue ASIC's address bus and column row signals sequentially refresh SDRAM memory locations.

Ethernet Interface

The Host processor's Communications Processor Module (CPM) provides the Local Area Network (LAN) Controller for the Ethernet Interface. The LAN function implements the CSMA/CD access method, which supports the IEEE 802.3 10Base2 standard.

The LAN coprocessor supports all IEEE 802.3 Medium Access Control, including the following:

- ☐ framing
- ☐ preamble generation
- ☐ stripping
- ☐ source address generation
- ☐ destination address checking

The PCM LAN receives commands from the CPU.

The Ethernet Serial Interface works directly with the CPM LAN to perform the following major functions:

- ☐ 10 MHz transmit clock generation (obtained by dividing the 20 MHz signal provided by on-board crystal)
- ☐ Manchester encoding/decoding of frames
- ☐ electrical interface to the Ethernet transceiver

An isolation transformer provides high-voltage protection. The transformer also isolates the Ethernet Serial Interface (ESI) and the transceiver. The pulse transformer has the following characteristics:

- ☐ Minimum inductance of 75 μ H
- ☐ 2000 V isolation between primary and secondary windings
- ☐ 1:1 Pulse Transformer

800 MHz QUAD Channel Base Radio Controller

The Coaxial Transceiver Interface (CTI) is a coaxial cable line driver and receiver for the Ethernet. CTI provides a 10Base2 connection via a coaxial connector on the board. This device minimizes the number of external components necessary for Ethernet operations.

A DC/DC converter provides a constant voltage of -9 Vdc for the CTI from a 3.3 Vdc source.

The CTI performs the following functions:

- ❑ Receives and transmits data to the Ethernet coaxial connection
- ❑ Reports any collision that it detects on the coaxial connection
- ❑ Disables the transmitter when packets are longer than the legal length (Jabber Timer)

Digital Signal Processors

The BRC includes two Receive Digital Signal Processors (RXDSPs) and a Transmit Digital Signal Processor (TXDSP). These DSPs and related circuitry process compressed station transmit and receive audio or data. The related circuitry includes the TDMA Infrastructure Support IC (TISIC) and the TISIC Interface Circuitry. The DSPs only accept input and output signals in digitized form.

The inputs are digitized receiver signals. The outputs are digitized voice audio and data (modulation signals). These signals pass from the DSP to the Exciter portion of the EXBRC. DSPs communicate with the Microprocessor via an eight-bit, host data bus on the host processor side. For all DSPs, interrupts drive communication with the host.

The RXDSPs operate from an external 16.8 MHz clock, provided by the local station reference. The RXDSP internal operating clock signal is 150MHz, produced by an internal Phase-Locked Loop (PLL).

The RXDSPs accept digitized signals from the receivers through Enhanced Synchronous Serial Interface (ESSI) ports. Each of two ESSI ports on a RXDSP supports a single carrier (single receiver) digital data input. The DSP circuitry includes two RXDSPs. These allow processing of up to four carriers (four receivers).

The RXDSP accesses its DSP program and signal-processing algorithms in 128k words of internal memory. The RXDSPs communicate with the host bus over an 8-bit interface.

Each RXDSP provides serial communications to its respective receiver module for receiver control via a Serial Peripheral Interface (SPI). The SPI is a parallel-to-serial conversion circuit, connected to the RXDSP data bus. Each RXDSP communicates to two receive modules through this interface.

Additionally, a serial control path connects the two RXDSPs and the TXDSP. The Synchronous Communications Interface (SCI) port facilitates this serial control path.

For initialization and control purposes, one RXDSP connects to the TISIC device.

The TXDSP operates at an external clock speed of 16.8 MHz, provided by the EXBRC local station reference. The TXDSP internal operating clock is 150MHz, produced by an internal Phase Lock Loop (PLL).

The TXDSP sends up to four carriers of digitized signal to the EX11 exciter. The exciter converts the digital signal to analog. Also at the exciter, a highly stable clock reclocks the digital data. Reclocking enhances transmit signal integrity. Two framed and synchronized data streams result. One data stream is I-data, and the other is the Q-data stream.

The TXDSP contains its own, internal address and data memory. The TXDSP can store 128k words of DSP program and data memory. An eight-bit interface handles TXDSP-to-host bus communications.

800 MHz QUAD Channel Base Radio Controller**TISIC**

The TISIC controls internal DSP operations. This circuit provides the following functions:

- ❑ For initialization and control, interfaces with one RXDSP via the DSP address and data buses.
- ❑ Accepts a 16.8 MHz signal from Station Reference Circuitry.
- ❑ Accepts a 5 MHz signal, modulated with one pulse per second (1 PPS) from the site reference.
- ❑ Demodulates the 1 PPS
- ❑ Outputs a 1 PPS signal and a windowed version of this signal for network timing alignment.
- ❑ Outputs a 2.4 MHz reference signal used by the Exciter.
- ❑ Generates 15 ms and 7.5 ms ticks. (These ticks synchronize to the 1 PPS time mark. The system decodes the time mark from the site reference. Then the system routes the reference to the TXDSP and RXDSPs.)

Station Reference Circuitry

The Station Reference Circuitry is a phase-locked loop (PLL). This PLL consists of a high-stability, Voltage-Controlled, Crystal Oscillator (VCXO) and a PLL IC. GPS output from the iSC connects to the 5 MHz/1 PPS BNC connector on the BR backplane. Wiring at this connector routes signals to EXBRC station reference circuitry.

The PLL compares the 5 MHz reference frequency to the 16.8 MHz VCXO output. Then the PLL generates a DC correction voltage. The PLL applies this correction voltage to the VCO through an analog gate. The analog gate closes when three conditions coexist: (1) The 5 MHz tests stable. (2) The PLL IC is programmed. (3) Two PLL oscillator and reference signal output alignments occur.

A loss of the 5 MHz / 1 PPS signal causes the control voltage enable switch to open. This complex PLL control allows the BR to maintain call-handover capability during short disconnects (approximately one minute) of the 5 MHz/1 PPS signal. (For example, during 5 MHz/1 PPS cable maintenance work.)

When the gate enables, the control voltage from the PLL can adjust the high-stability VCXO frequency. The adjustment can achieve a stability nearly equivalent to that of the external, 5 MHz frequency reference.

The correction voltage from the PLL continuously adjusts the VXCO frequency. The VXCO outputs a 16.8 MHz clock signal. The circuit applies this clock signal to the receiver, 48 MHz reference and TISIC.

The receivers use the 16.8MHz as the clock input and synthesizer reference.

The 48 MHz EXBRC synthesizer uses the 16.8 MHz as its synthesizer reference. The 48 MHz synthesizer output is the clock input for the TXDSP I and Q data reclock circuitry.

The TISIC divides the 16.8 MHz signal by seven, and outputs a 2.4 MHz signal. This output signal then becomes the 2.4 MHz reference for the Exciter.

Input Ports

One general-purpose input register provides for BRC and station circuit input signals. The register has 16 input ports. The Host Data Bus conveys input register data to the Host Microprocessor. Typical inputs include 16.8 and 48 MHz Station Reference Circuitry status outputs and reset status outputs.

Output Ports

Two general-purpose output registers distribute control signals from the Host Microprocessor to the BRC and station circuitry. Each register has 40 output ports. Control signal distribution occurs over the backplane. The Host Data Bus drives the output ports' latched outputs. Typical control signals include front-panel LED signals and SPI peripheral enable and address lines.

Remote Station Shutdown

The BRC contains power supply shutdown circuitry. This circuitry can send a shutdown pulse to the Base Radio Power Supply. BRC software generates the shutdown control pulse.

After receiving a shutdown pulse, the power supply turns off BR power. Shut down power sources include 3.3, 28.6 and 14.2 Vdc sources throughout the BR. Due to charges retained by BR storage elements, power supply voltages may not reach zero. The shutdown only assures that the host processor enters a power-on-reset state.

A remote site uses the shutdown function to perform a hard reset of all BR modules.

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Single Channel Base Radio Controller

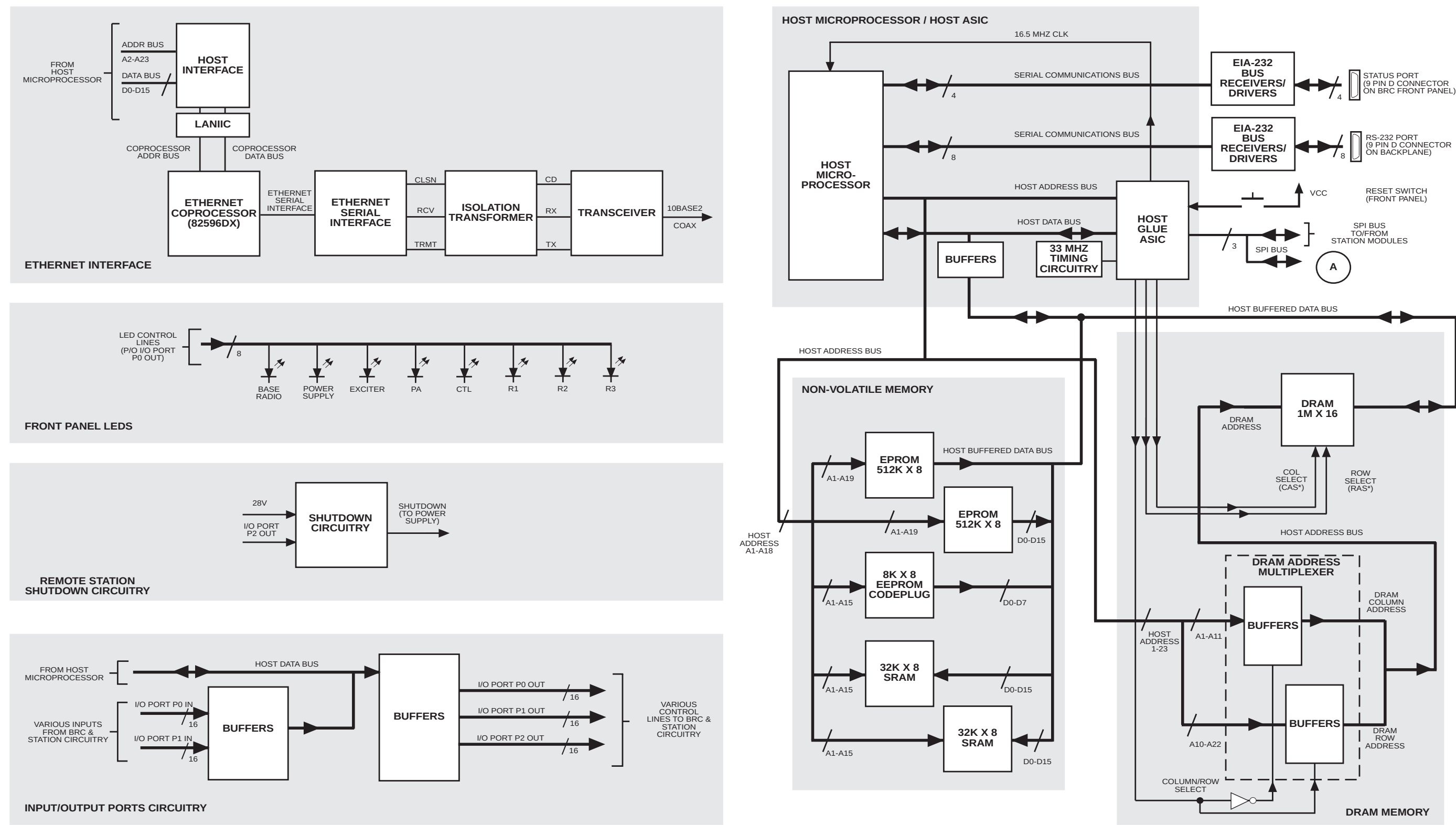


Figure:2-6 800/900 MHz Base Radio Controller Functional Block Diagram (Sheet 1 of 2)

Base Radio Controller

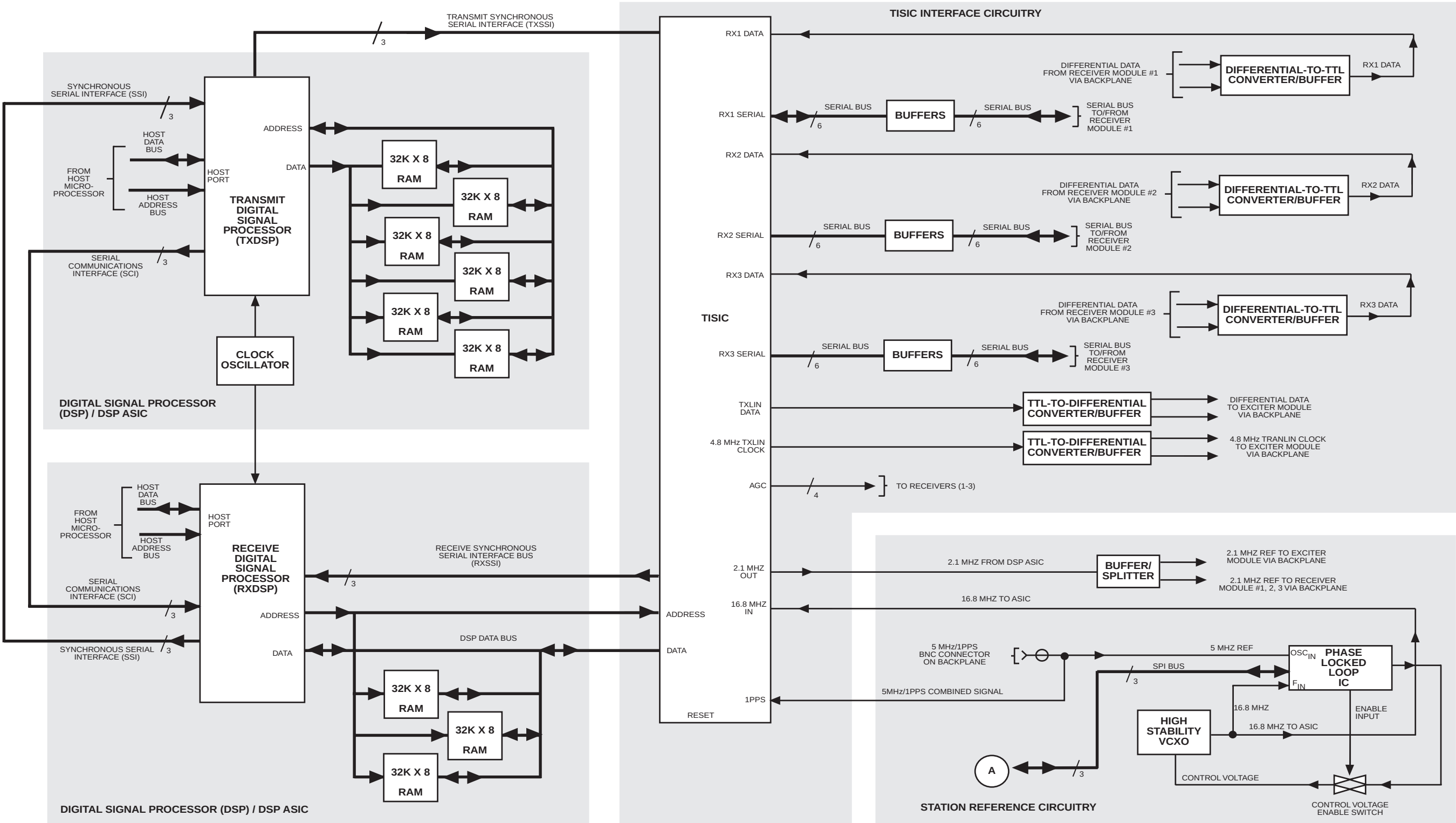


Figure:2-7 800/900 MHz Base Radio Controller Functional Block Diagram (Sheet 2 of 2)

EBTS292
122094JNM

Base Radio Controller

Functional Block Diagram

Model TLN3425

(Includes Front Panel Board)

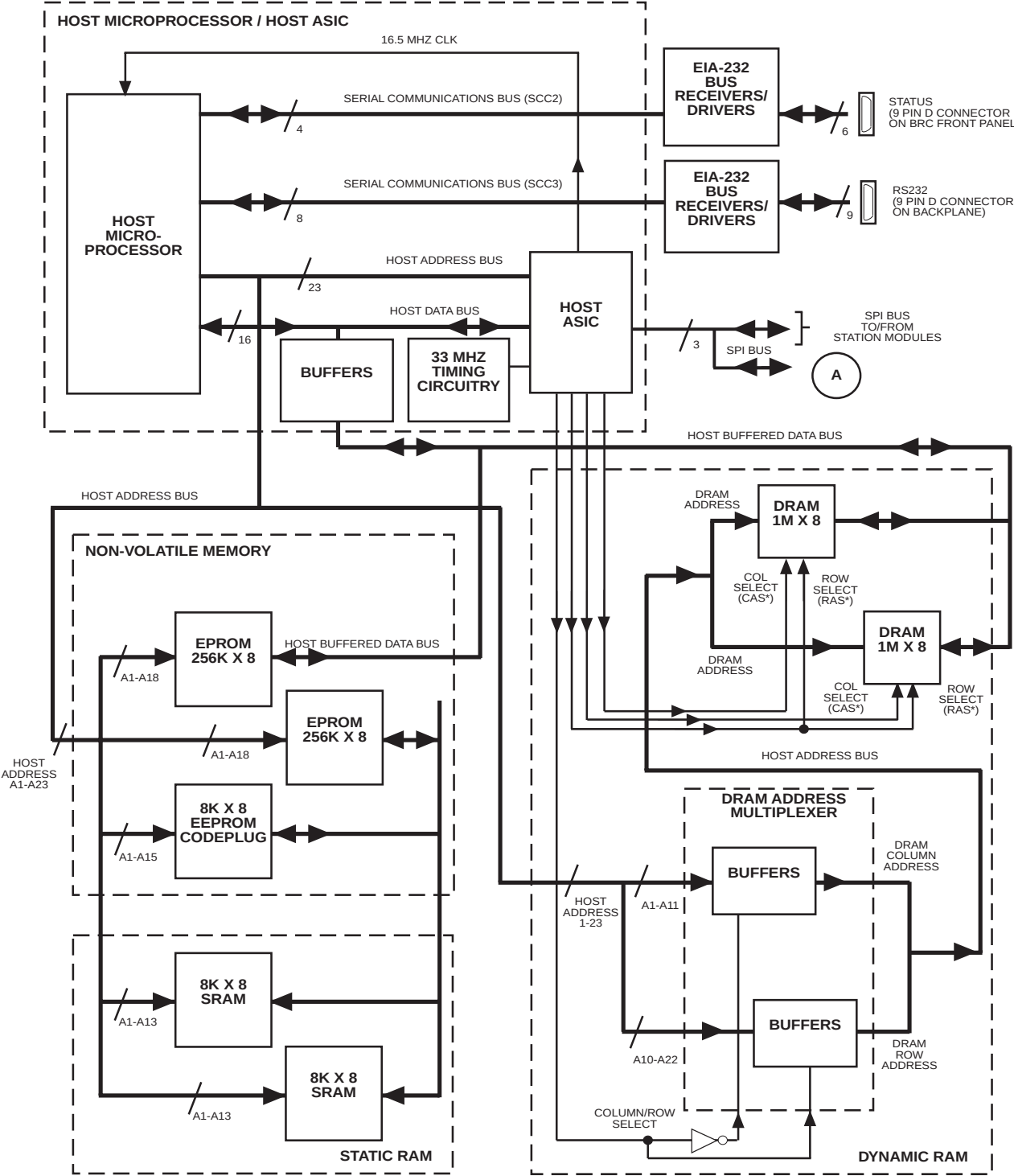
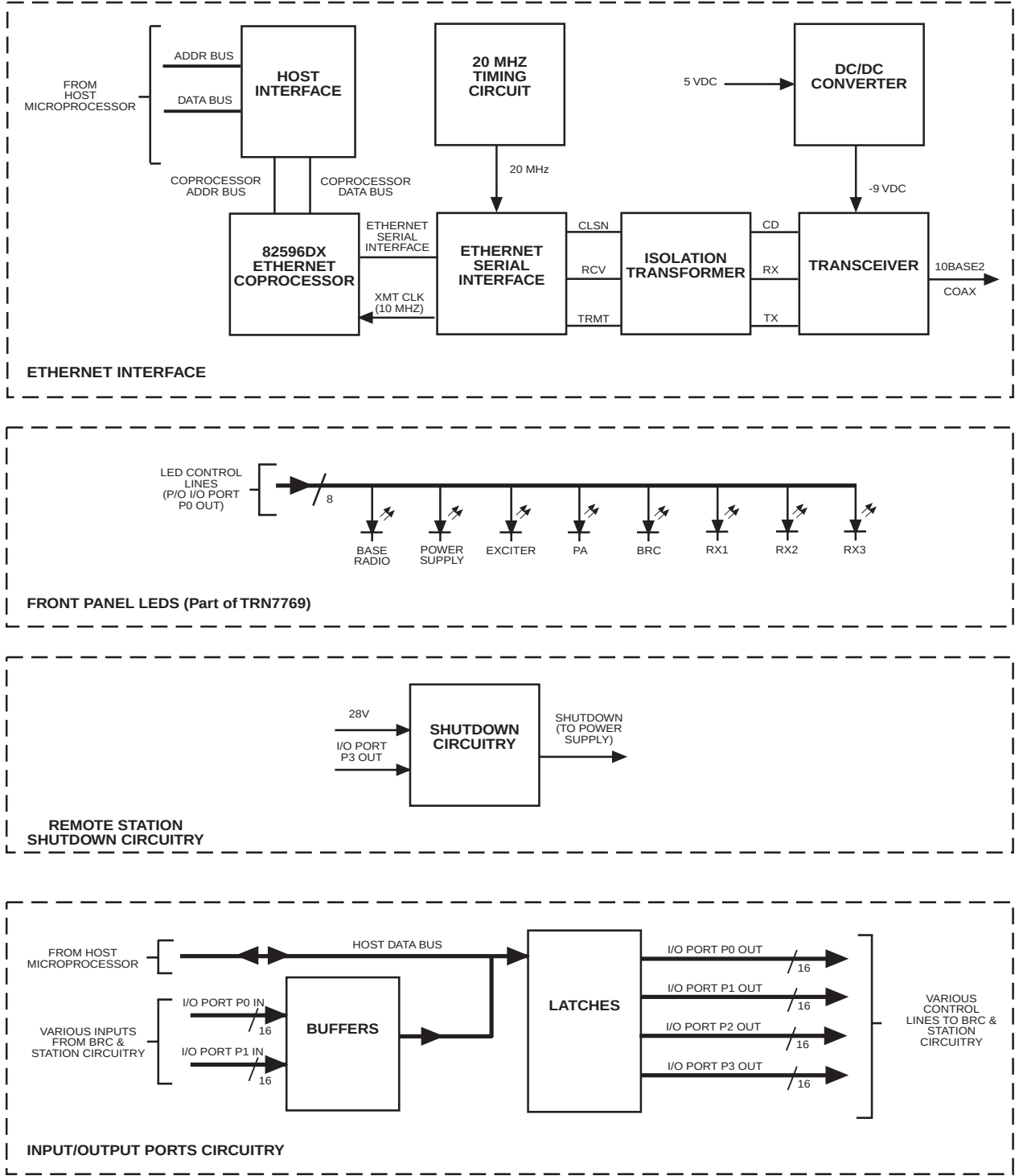


Figure:2-8 1500 MHz Base Radio Controller Functional Block Diagram (Sheet 1 of 2)

Base Radio Controller
Functional Block Diagram
Model TLN3425
(Includes Front Panel Board)

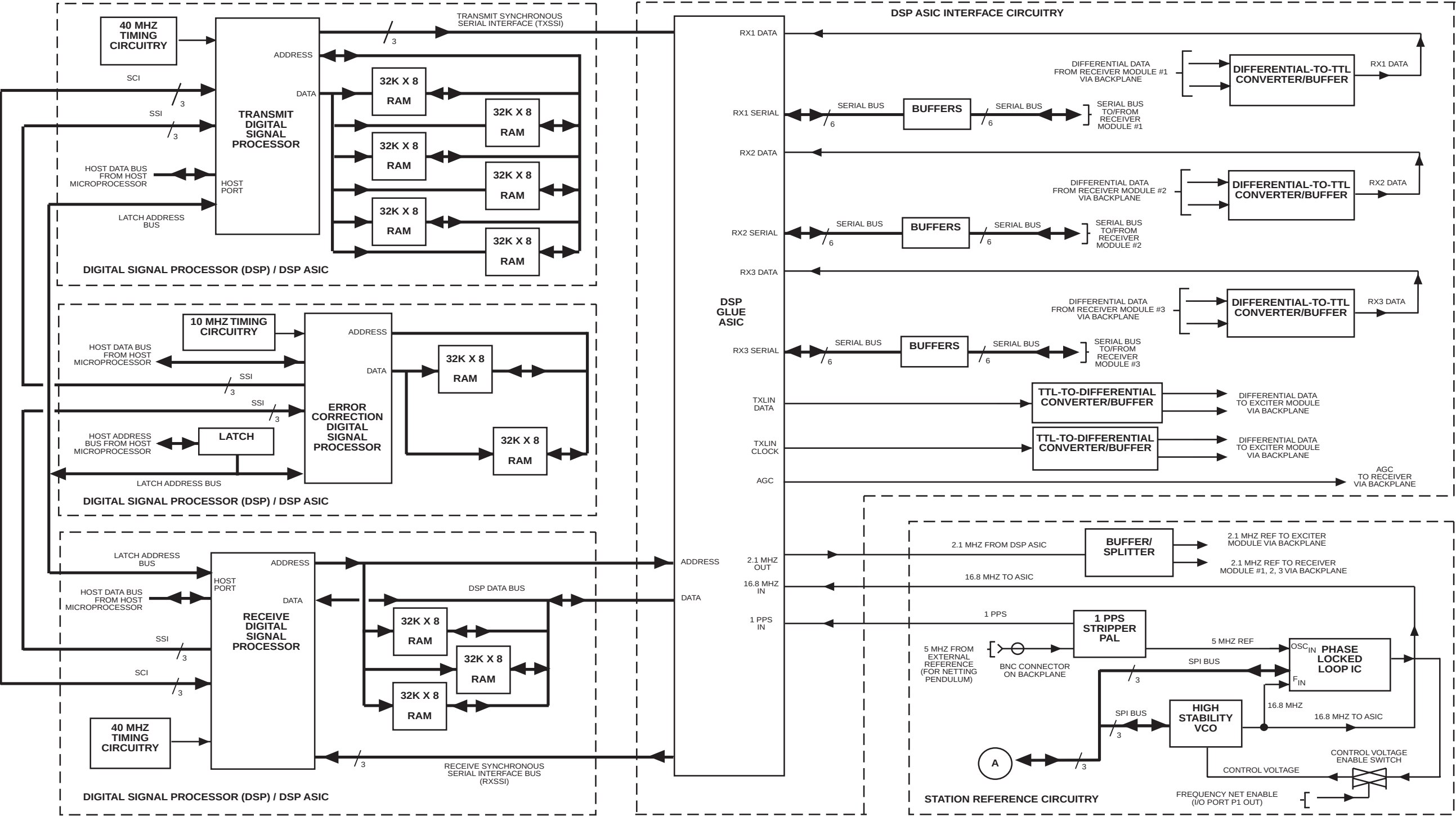


Figure:2-9 1500 MHz Base Radio Controller Functional Block Diagram
(Sheet 2 of 2)

QUAD Channel Base Radio Controller

Functional Block Diagram

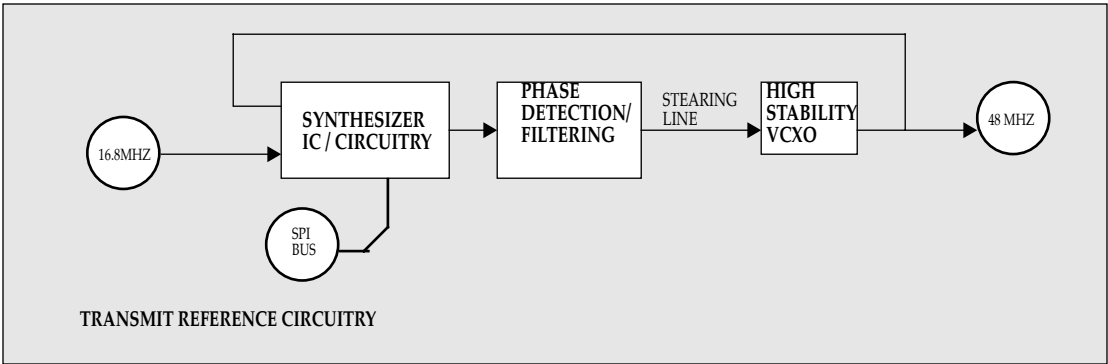
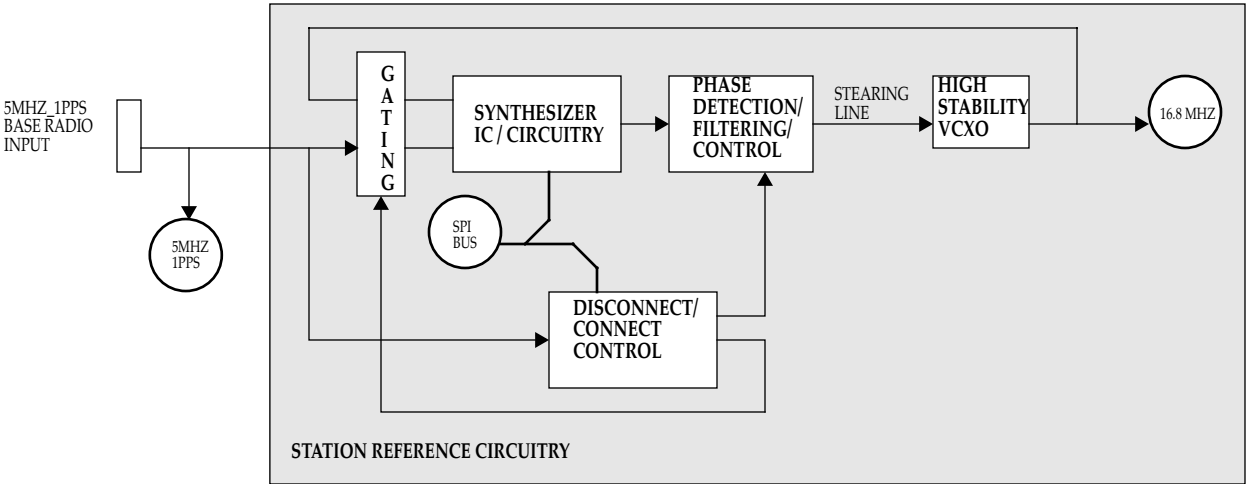
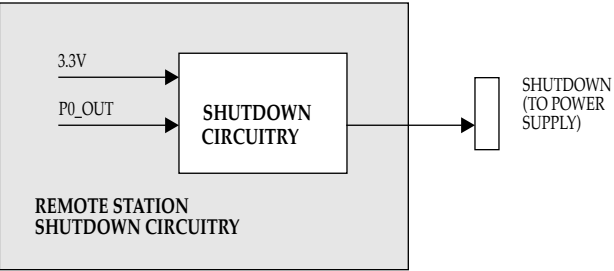
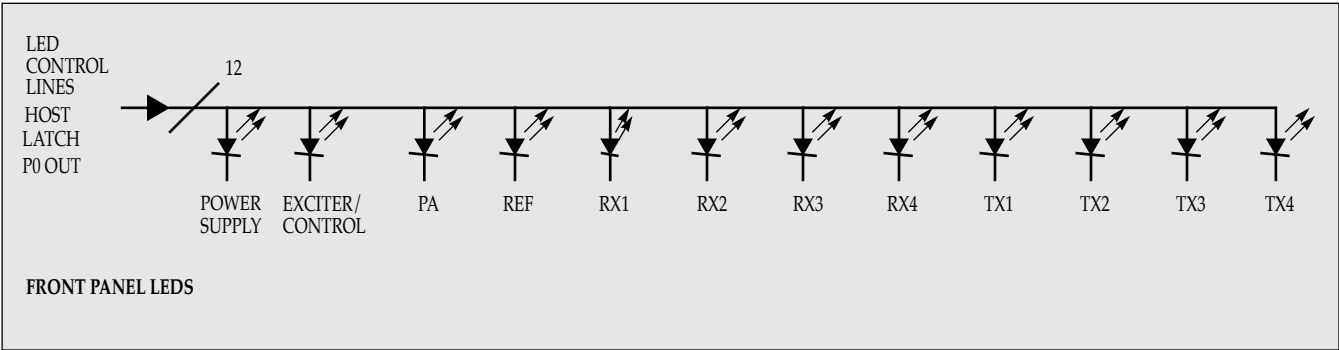


Figure:2-10 **QUAD CHANNEL Base Radio Controller Functional Block Diagram**
(Sheet 1 of 2)

QUAD Channel Base Radio Controller

Functional Block Diagram

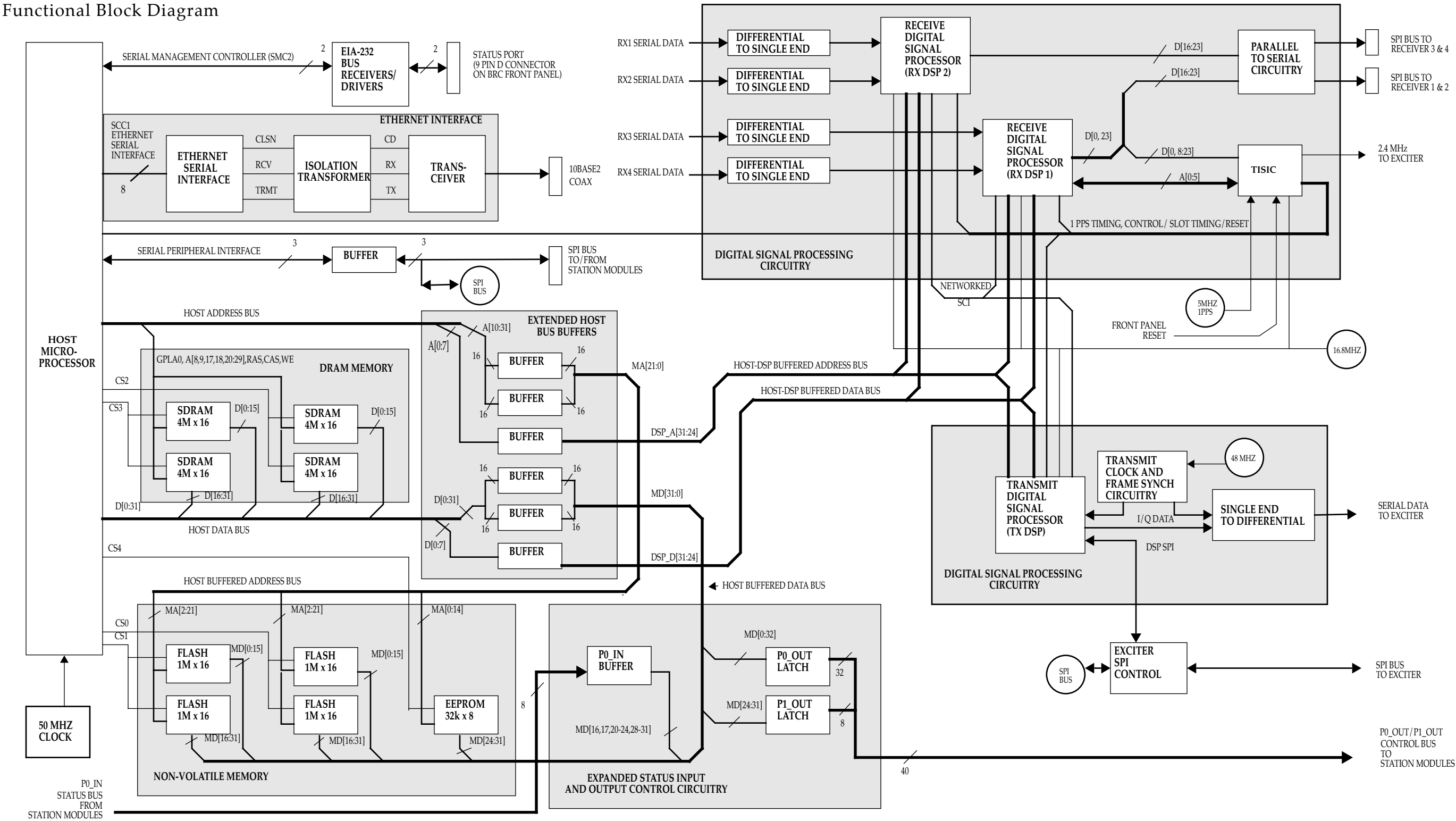


Figure:2-11 QUAD CHANNEL Base Radio Controller Functional Block Diagram
(Sheet 2 of 2)

Exciter

Overview

This section provides technical information for the Exciter (EX). Table 3-1 describes covered topics.

Table 3-1 **Chapter Topics**

Chapter	Page	Description
800 MHz Exciter – TLN3337; 900 MHz Exciter – CLN1357; 1500 MHz Exciter – TLN3428	3-2	Describes the functions and characteristics of the Exciter module for the single channel Base Radio (BR).
QUAD Channel 800 MHz Exciter	3-7	Describes the functions and characteristics of the Exciter module for the QUAD channel Base Radio (BR).
Exciter 800 MHz Functional	3-11	Functional Block Diagram for the Single Channel Base Radio Exciter
800 MHz QUAD Channel Functional Block Diagram	3-13	Functional Block Diagram for the QUAD Channel Base Radio Exciter

FRU Number to Kit Number Cross Reference

Exciter Field Replaceable Units (FRUs) are available for the iDEN EBTS. The FRU contains the Exciter kit and required packaging. Table 3-2 provides a cross reference between Exciter FRU numbers and kit numbers.

Table 3-2 **FRU Number to Kit Number Cross Reference**

Description	FRU Number	Kit Number
Single Channel Exciter (800 MHz)	TLN3337	CLF1490
Single Channel Exciter (900 MHz)	CLN1357	CLF1500
Single Channel Exciter (1500 MHz)	TLN3428	CTX1120
QUAD Channel Exciter/Base Radio Controller (800 MHz)	CLN1497	CLF1560

800 MHz Exciter – TLN3337; 900 MHz Exciter – CLN1357; 1500 MHz Exciter – TLN3428

800 MHz Exciter – TLN3337; 900 MHz Exciter – CLN1357; 1500 MHz Exciter – TLN3428

Exciter Overview

The Exciter, together with the Power Amplifier (PA), provides the transmitter functions for the Base Radio. The Exciter module consists of a printed circuit board, a slide-in housing, and associated hardware.

The Exciter connects to the Base Radio backplane through a 96-pin DIN connector and two blindmate RF connectors. Two Torx screws on the front of the Exciter hold it in the chassis.

The Exciter has no controls or indicators. The manual's Base Radio section supplies transmitter circuitry specifications, including Exciter and PA specifications.

Figures 3-1 and 3-2 show the Exciter with the cover removed.

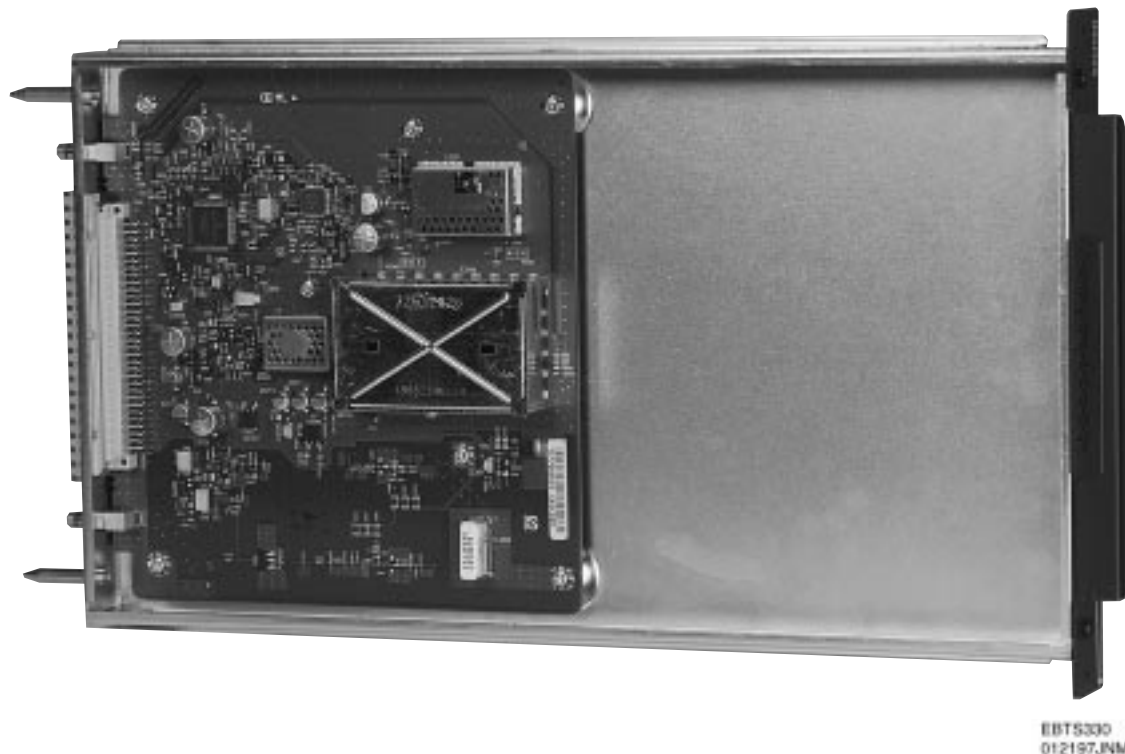


Figure:3-1 800/900 MHz Exciter (with cover removed)

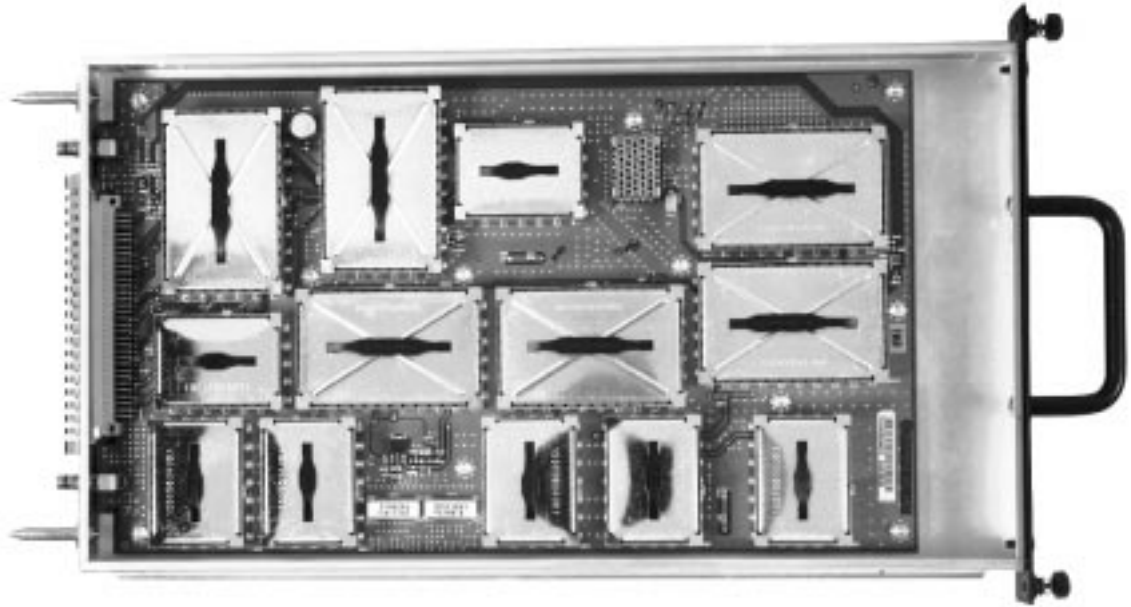


Figure:3-2 1500 MHz Exciter, version TLN3428 (with top removed)

1.5GHZ-B859

Theory of Operation

Table 3-3 lists and describes basic Exciter circuitry. Figures 3-4 and 3-5 show the functional block diagram of the Single Carrier Exciter. Figures 3-6 show the functional block diagram of the QUAD Carrier Exciter.

Address Decoder Circuitry

The address decoder circuitry enables the BRC to use the address bus to control Exciter circuitry. The BRC can select a specific device on the Exciter via the SPI bus for control or data communication purposes.

If board select circuitry decodes address lines A2 through A5 as the Exciter address, the BRC enables the chip select circuitry. The chip select circuitry then decodes address lines A0 and A1 to generate the chip select signals for the EEPROM, A/D converter, Tranlin IC, and PLL IC. Once selected, the BRC uses the SPI bus to send and receive data to and from the device.

Memory Circuitry

The memory circuitry consists of an EEPROM located on the Exciter. The BRC performs all memory read and write operations via the SPI bus. Information

800 MHz Exciter – TLN3337; 900 MHz Exciter – CLN1357; 1500 MHz Exciter – TLN3428**Table 3-3 Exciter Circuitry**

Circuit	Description
Tranlin IC	Performs the following functions: • up-converts the baseband data to the first IF • down-converts the IF feedback signal to baseband • uses a baseband Cartesian feedback loop system, which is necessary to obtain linearity from the transmitter and avoid splattering power into adjacent channels • performs training functions for proper linearization of the transmitter
Exciter IC	Interfaces with Tranlin IC to perform: • up-conversion from the first IF to the transmit operating frequency • down-conversion to the IF of PA output feedback signal for input to the Tranlin IC
Address Decode, Memory, & A/D Converter	Serves as the main interface between the synthesizer, Tranlin IC, A/D, and EEPROM on the Exciter and the BRC via the SPI bus
Frequency Synthesizer Circuitry	Consists of a phase-locked loop and VCO. Provides a LO signal to the Exciter IC for the second up-conversion and for the first down-conversion of the feedback signal from the PA
970 MHz VCO (800 MHz BR) 1025 MHz VCO (900 MHz BR) 760 MHz VCO (1500 MHz BR)	Provides a LO signal to the Exciter IC for the second up-conversion to the transmit frequency
237 MHz VCO (800 MHz BR) 236 MHz VCO (1500 MHz BR)	Provides a LO signal to Tranlin IC for the first up-conversion and for the second down-conversion of the feedback signal. The synthesizer and divide by 2 circuitry within the Tranlin IC set the first IF to 118.5 MHz
180.6 MHz VCO (900 MHz BR)	Provides a LO signal to Tranlin IC for the first up-conversion and for the second down-conversion of the feedback signal. The synthesizer and divide by 2 circuitry within the Tranlin IC set the first IF to 90.3 MHz
Regulator Circuitry	Provides a regulated voltage to various ICs and RF devices located on the Exciter
Linear RF amplifier Stages	Amplifies the RF signal from the Exciter IC to an appropriate level for input to the PA
Automatic Gain Control (AGC)	provides automatic gain control of the transmitter (Exciter and Power Amplifier modules) to maintain a level forward gain of the RF amplifier stages.

stored in this memory device includes the kit number, revision number, module specific scaling and correction factors, and free form information (scratch pad).

A/D Converter Circuitry

Analog signals from various areas throughout the Exciter board are fed to the A/D converter. Upon the BRC's request, these analog signals are converted to a digital signal and are output to the BRC via the SPI lines. The BRC periodically monitors and controls all signals.

The BRC monitors the regulated voltages, the external wattmeter (optional), the PLL circuit, and other internal signals.

Tranlin IC Circuitry

The Tranlin IC is a main interface between the Exciter and BRC. The Digital Signal Processors (DSP) of the BRC send Digitized signals (baseband data) to the Exciter via the DSP data bus. The DSP clock signal from the Receiver clocks these data signals.

The differential data clock signal also serves as a 4.8 MHz reference signal to the internal synthesizer circuit of the Tranlin IC. The Tranlin compares the reference signal with the output of the 237 MHz or 180.6 MHz (900 MHz BR) or 236 MHz (1500 MHz BR) Voltage Controlled Oscillator (VCO). If the VCO output is out of phase or differs in frequency, correction pulses arrive at the Oscillator and adjust the VCO output.

The Tranlin IC up-converts the baseband data received from the BRC to the first IF of 118.5 MHz (90.3 MHz for 900 MHz BR). It also down-converts an IF feedback signal from the Exciter IC to baseband data for summing.

The Serial Peripheral Interface (SPI) bus is used to communicate with the Tranlin IC. The SPI bus serves as a general purpose bi-directional serial link between the BRC and other modules of the Base Radio, including the Exciter. The SPI bus is used to send control and operational data signals to and from the various circuits of the Exciter.

Exciter IC Circuitry

The Exciter IC interfaces directly with the Tranlin IC to perform up-conversion from the first IF to the programmed transmit operating frequency. The first IF signal is passed through a band-pass filter before it reaches the Exciter IC.

The Exciter IC also down-converts the RF feedback signal from the PA to its IF signal. The IF signal is then input to the Tranlin IC for conversion to baseband data, which computes the Cartesian feedback.

Synthesizer Circuitry

The synthesizer circuitry consists of the Phase-Locked Loop (PLL) IC and associated circuitry. The output of this circuit is combined with the 970 MHz VCO (1025 MHz for 900 MHz BR, 700 MHz for 1500 MHz BR) to supply a Local Oscillator (LO) signal to the Exciter IC for the second up-conversion of the programmed transmit frequency. This signal is also used for the first down-conversion of the feedback signal from the PA.

An internal phase detector generates a logic pulse in proportion to the difference in phase or frequency between the reference frequency and loop pulse signal.

If the reference frequency is faster than the VCO feedback frequency, the PLL IC outputs an up signal. If the reference frequency is slower than the VCO feedback frequency, the PLL IC outputs a down signal. These pulses are used as correction signals and are fed to a charge pump circuit.

The charge pump circuit consists of five transistors and its associated biasing components. This circuit generates the correction signal and causes it to move up or down in response to the phase detector output pulses. The correction signal passes through the low-pass loop filter to the 970 MHz Voltage Controlled Oscillator (VCO) circuit (1025 MHz VCO for 900 MHz BR).

970/1025 MHz Voltage Controlled Oscillator (VCO)

The 970 MHz VCO (1025 MHz for 900 MHz BR, 700 MHz for 1500 MHz BR) generates the second injection frequency for the Exciter IC.

The VCO requires a very low-noise DC supply voltage of +10 Vdc for proper operation. A Super Filter, which contains an ultra low-pass filter, drives the oscillator. The Super Filter obtains the required low-noise output voltage for the oscillator.

The output of the oscillator is tapped and sent to the VCO Feedback Filter. This feedback signal is supplied to the Synthesizer circuitry for the generation of correction pulses.

The untapped output of the 970 (or 1025) MHz VCO is sent to the second LO injection circuitry.

236/237/180.6 MHz Voltage Controlled Oscillator (VCO)

The 237 MHz VCO (180.6 MHz for 900 MHz BR, 236 MHz for 1500 MHz BR) provides a LO signal to Tranlin IC for the first up-conversion and for the second down-conversion of the feedback signal. The synthesizer and divide by 2 circuitry within the Tranlin IC set the first IF to 118.5 MHz (90.3 MHz for 900 MHz BR).

Regulator Circuitry

This circuit generates three regulated voltages of +5 Vdc, +10 Vdc, and +11.8 Vdc. All voltages are obtained from the +14.2 Vdc backplane voltage. These voltages provide power to various ICs and RF devices of the Exciter.

Linear RF Amplifier Stages

This circuitry is used to amplify the RF signal from the Exciter IC to an appropriate level for input to the PA.

Automatic Gain Control (AGC) (1500 MHz only)

The Automatic Gain Control (AGC) circuit controls the output gain of the transmitter (Exciter and Power Amplifier modules) so that constant forward gain of the RF amplifier stages is maintained. This is accomplished through the comparison of feedback signals from the Power Amplifier and the first amplifier stage of the Exciter.

The output of the differential amplifiers is used to adjust the Attenuator and Image Filter.

QUAD Channel 800 MHz Exciter

Exciter Overview

The Exciter and the Power Amplifier (PA) provide the transmitter functions of the QUAD Channel Base Radio. The Exciter module consists of a printed circuit board, a slide in housing, and associated hardware. The BRC shares the printed circuit board and housing.

The Exciter connects to the Base Radio backplane through a 168-pin connector and two blindmate RF connectors. Controller and exciter circuitry also interconnect on the Exciter/Controller module. Two Torx screws on the front of the Exciter secure it to the chassis.

An LED identifies the Exciter's operational condition, as described in the manual's Controller section. The Base Radio section of the manual provides specifications for transmitter circuitry. This information includes data on the Exciter and PAs.

Figures 3-3 shows the Exciter with the cover removed.

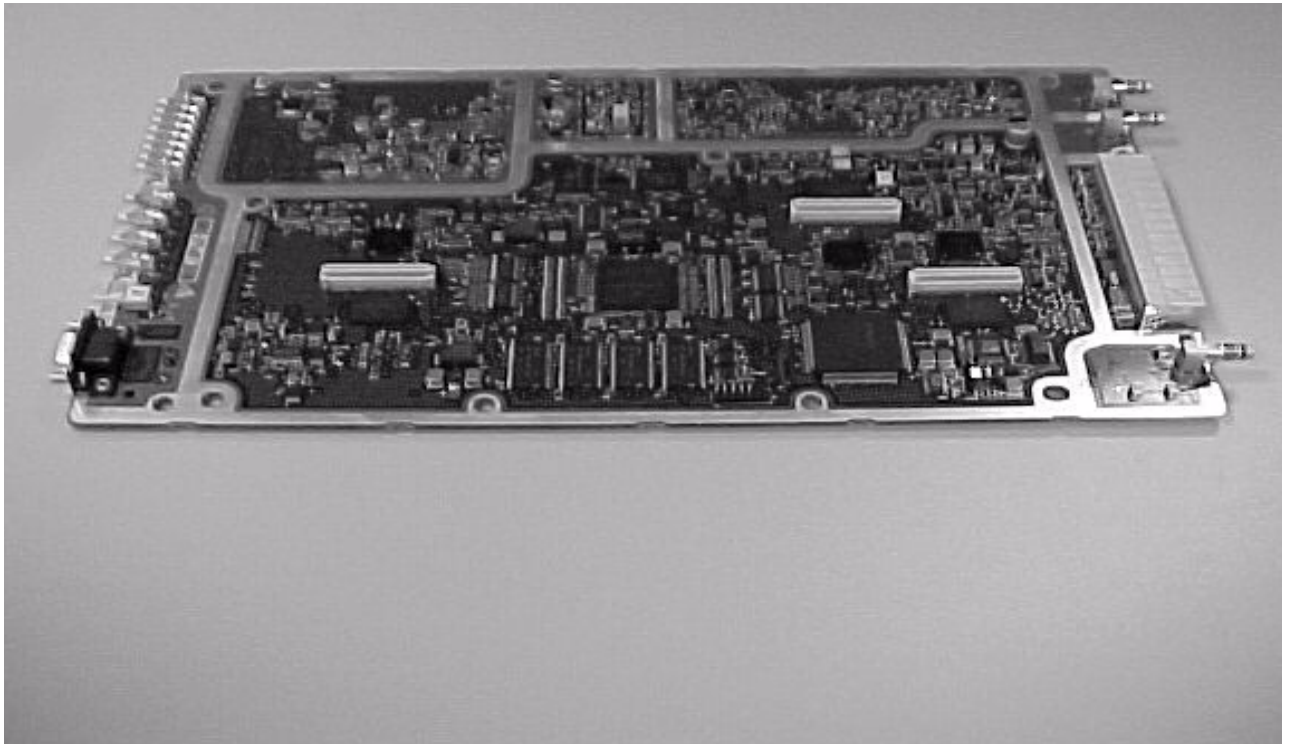


Figure:3-3 800 MHz QUAD Channel Exciter (with cover removed)M

QUAD Channel 800 MHz Exciter**Theory of Operation**

Table 3-4 describes the basic circuitry of the Exciter. Figures 3-4 and 3-5 show the functional block diagram of the Single Carrier Exciter. Figures 3-6 show the QUAD Carrier Exciter's functional block diagram.

Table 3-4 Exciter Circuitry

Circuit	Description
LNODCT IC	- Up-converts baseband data to the transmit frequency - Down-converts the PA feedback signal to baseband - Uses a baseband Cartesian feedback loop system, necessary to obtain linearity from the transmitter and avoid splattering power into adjacent channels - Performs training functions for proper linearization of the transmitter
Memory & A/D Converter	Serves as the main interface between the synthesizer, Tranlin IC, A/D, and EEPROM on the Exciter, and the BRC via the SPI bus
Frequency Synthesizer Circuitry	- Consists of a phase-locked loop and VCO - Provides a LO signal to the LNODCT IC for the second up-conversion and first down-conversion of the feedback signal from the PA
970 MHz VCO (800 MHz BR)	Provides a LO signal to the LNODCT IC, for up-conversion to the transmit frequency
90.3 MHz VCO (800 MHz BR)	Provides a LO signal to LNODCT IC, for the up-conversion and for the down-conversion of the feedback signal. - The LNODCT IC mixes the 970 MHz VCO and 90.3 MHz VCO - The mixed output becomes the LO signal for Transmit signal up- and down-conversion
Regulator Circuitry	Provides a regulated voltage to various ICs and RF devices located on the Exciter
Linear RF amplifier Stages	Amplifies the RF signal from the Exciter IC to an appropriate level for input to the PA
Automatic Gain Control (AGC)	- Provides automatic gain control of the transmitter (Exciter and Power Amplifier modules) - Maintains a level forward gain of the RF amplifier stages

Memory Circuitry

The memory circuitry is an EEPROM on the Controller portion of the Exciter/Controller module. The Controller performs memory read and write operations over the SPI bus. The memory device stores the following data...

- ☐ kit number
- ☐ revision number
- ☐ module specific scaling and correction factors
- ☐ serial number

- ❑ free form information (scratch pad)

A/D Converter Circuitry

Analog signals from various areas throughout the Exciter board enter the A/D converter (A/DC). The A/DC converts these analog signals to digital form. Upon request of the BRC, A/DC output signals enter the BRC via SPI lines. The Controller periodically monitors all signals.

Some of the monitored signals include amplifier bias and synthesizer signals.

LNODCT IC Circuitry

The LNODCT IC is a main interface between the Exciter and BRC. The BRC's Digital Signal Processor (DSP) sends digitized signals (baseband data) to the Exciter over the DSP data bus.

The differential data clock signal serves as a 4.8 MHz reference signal to the LNODCT IC's internal synthesizer. The LNODCT compares the reference signal with the outputs of Voltage Controlled Oscillators (VCOs). The LNODCT might sense that a VCO's output is out of phase or off-frequency. If so, then the LNODCT sends correction pulses to the VCO. The pulses adjust VCO output, thereby matching phase and frequency with the reference.

The LNODCT IC up-converts baseband data from the BRC to the transmit frequency. The LNODCT IC also down-converts the Transmit signal from the Power Amplifier to baseband data for summing.

The BRC uses the Serial Peripheral Interface (SPI) bus to communicate with the LNODCT IC. The SPI bus serves as a general purpose, bi-directional, serial link between the BRC and other Base Radio modules, including the Exciter. The SPI carries control and operational data signals to and from Exciter circuits.

Synthesizer Circuitry

The synthesizer circuit consists of the Phase-Locked Loop (PLL) IC and associated circuitry. This circuit's output combines with the 970 MHz VCO signal. The result is a Local Oscillator (LO) signal for the LNODCT IC. The LNODCT uses this LO signal to up-convert the programmed transmit frequency. The LNODCT also uses the LO signal to down-convert the PA feedback signal.

An internal phase detector generates a logic pulse. This pulse is proportional to the phase or frequency difference between the reference frequency and loop pulse signal.

If the reference frequency is faster than the VCO feedback frequency, the PLL IC outputs an up signal. If the reference frequency is slower than the VCO feedback frequency, the PLL IC outputs a down signal. The synthesizer uses these pulses as correction signals and feed them to a charge pump circuit.

The charge pump circuit consists of five transistors and associated biasing components. This circuit generates the correction signal. The correction signal moves up or down in response to phase detector output pulses. The correction

QUAD Channel 800 MHz Exciter

signal passes through the low-pass loop filter. The signal then enters the 970 MHz Voltage Controlled Oscillator (VCO) circuit.

970 MHz Voltage Controlled Oscillator (VCO)

The 970 MHz VCO generates the second injection frequency for the LNODCT IC.

For proper operation, the VCO requires a very low-noise, DC supply voltage. An ultra low-pass filter prepares the necessary low-noise voltage and drives the oscillator.

The tapped oscillator output signal enters the VCO Feedback Filter. The Synthesizer circuitry uses this feedback signal in the generation of correction pulses.

The untapped output signal of the 970 MHz VCO enters the second LO injection circuit.

90.3 MHz Voltage Controlled Oscillator (VCO)

The synthesizer within the LNODCT IC sets the 90.3 MHz signal. The 90.3 MHz VCO provides a LO signal to the LNODCT IC. The LNODCT uses this signal in up-converting and down-converting the feedback signal.

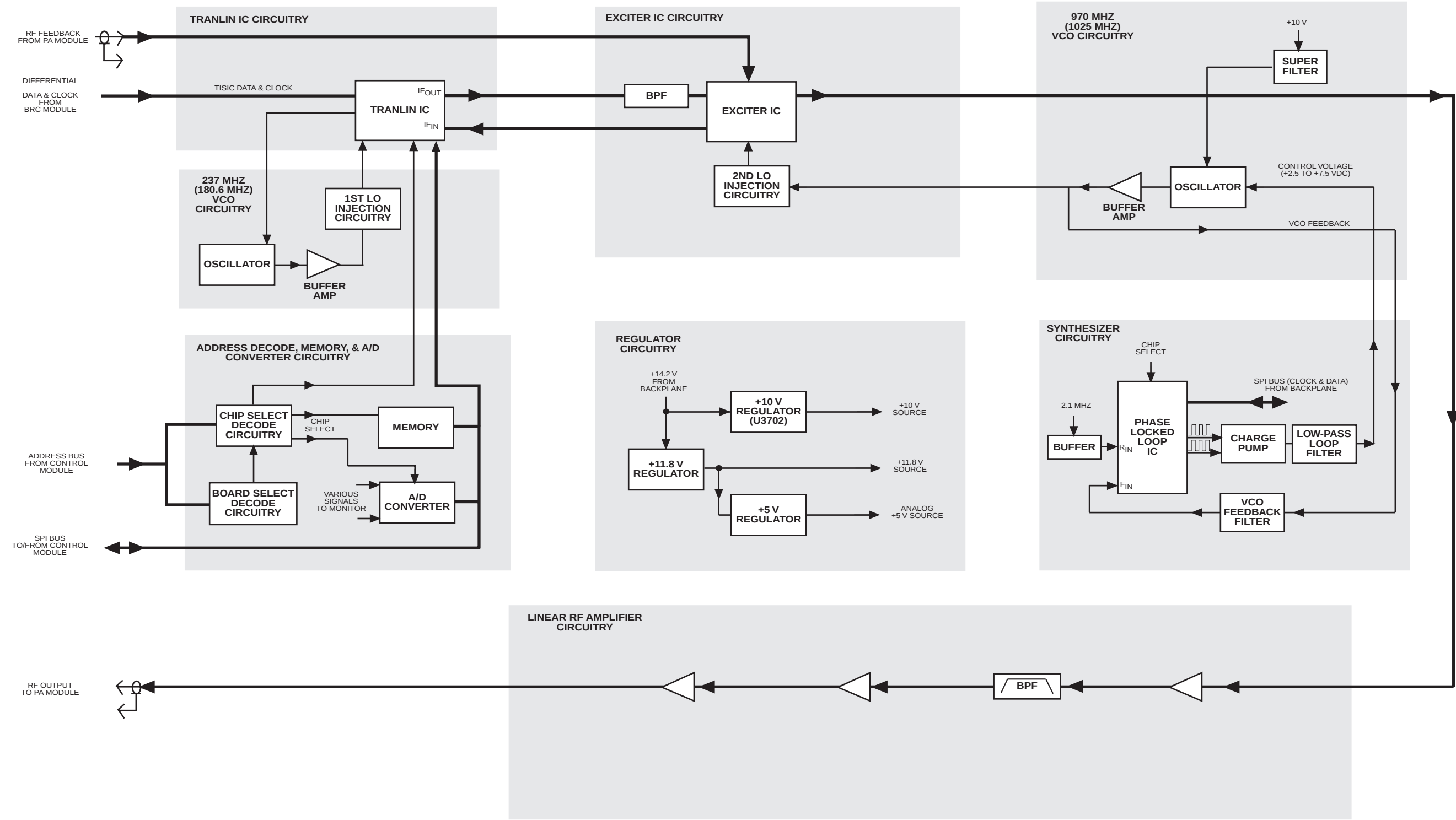
Regulator Circuitry

The voltage regulator generates three regulated voltages: +3 Vdc, +5 Vdc and +11.7 Vdc. The regulator obtains input voltages from the +3.3 Vdc and +14.2 Vdc backplane voltages. The regulated voltages power various ICs and RF devices in the Exciter.

Linear RF Amplifier Stages

The Linear RF Amplifier boosts the RF signal from the LNODCT IC. The RF Amplifier outputs an appropriate signal level to drive the PA.

Exciter^c
800 MHz Functional
Block Diagram



NOTE: Where two frequencies are given, frequency without parentheses applies to 800 MHz BR only and frequency with parentheses applies to 900 MHz BR only.

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Figure:3-4 **Exciter Functional Block Diagram**

Exciter

Exciter

Functional Block Diagram
Model TLN3428

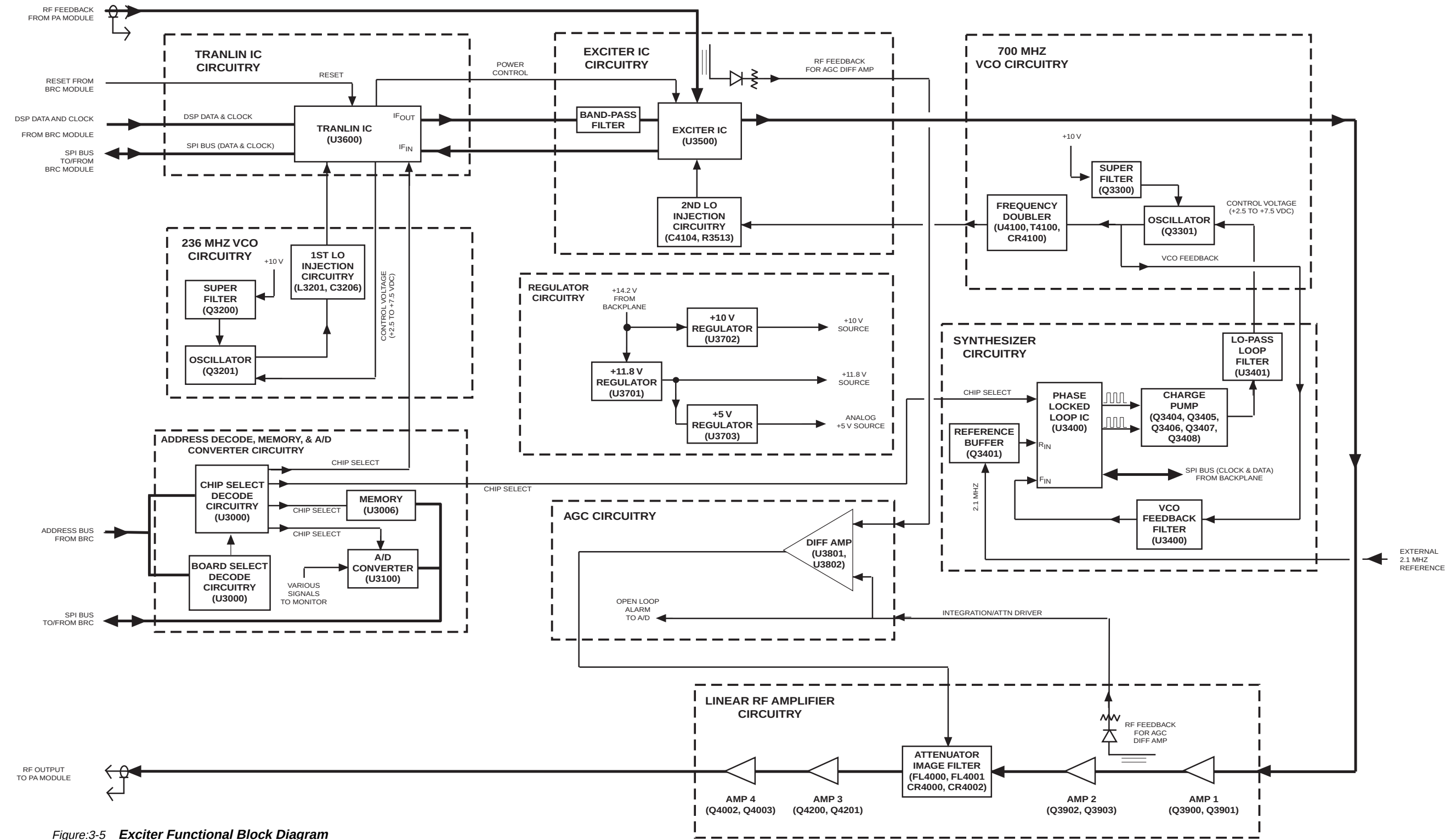
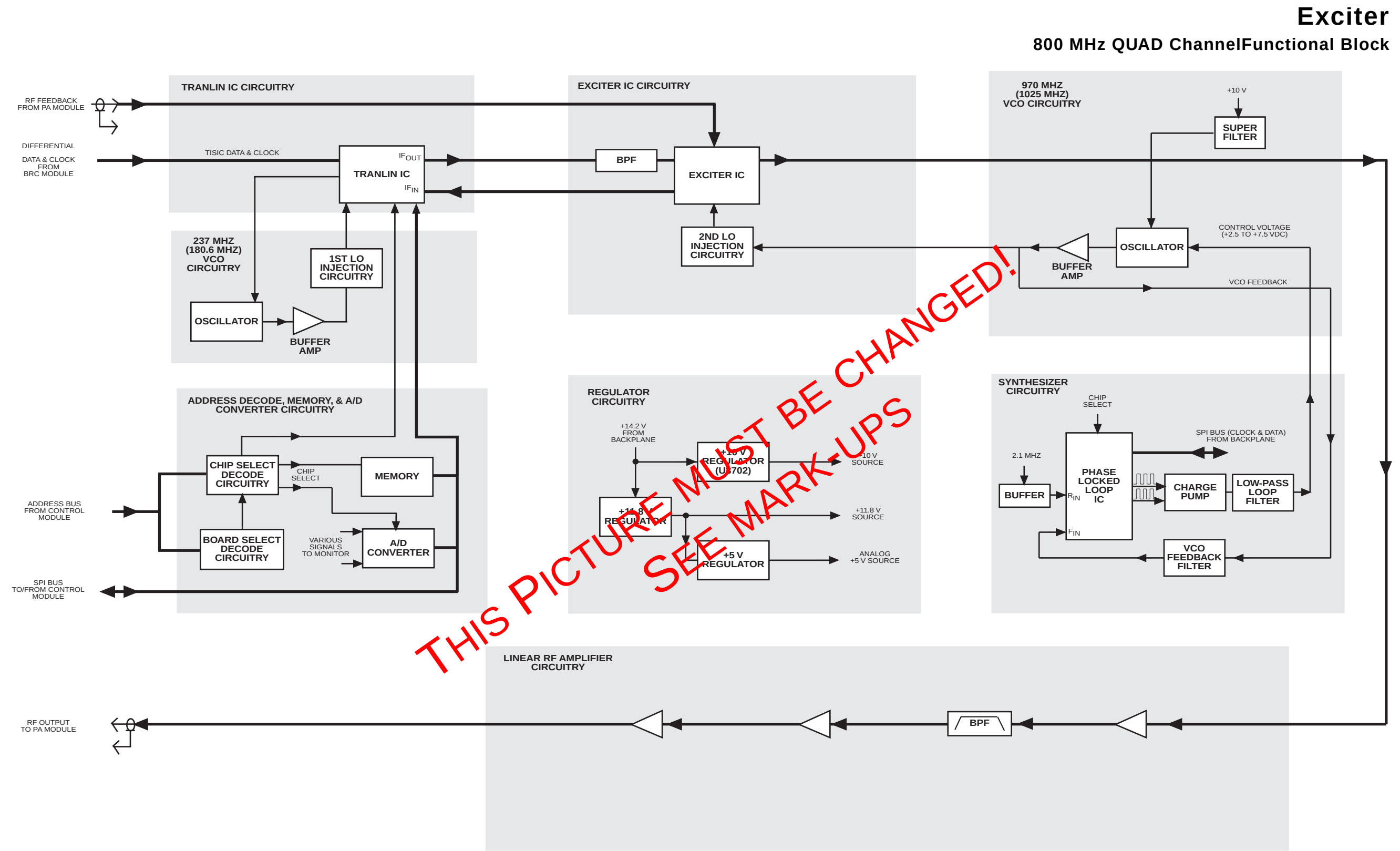


Figure:3-5 Exciter Functional Block Diagram



NOTE: Where two frequencies are given, frequency without parentheses applies to 800 MHz BR only and frequency with parentheses applies to 900 MHz BR only.

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Figure:3-6 Exciter Functional Block Diagram

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Power Amplifier

Overview

This section provides technical information for the Power Amplifier (PA). Table 4-1 describes covered topics.

Table 4-1 **Chapter Topics**

Chapter	Page	Description
40W, 800 MHz – TLF2020 (TTF1580); 70W, 800 MHz – TLN3335 (CTF1040); 60W, 900 MHz – CLN1355 (CLF1300); 40W, 1500 MHz – TLN3426 (TLN3426); 800 MHz QUAD – CLF1400 (CLF1400)	4-2	Describes the functions and characteristics of the Base Radio Power Amplifier (PA) module for the single and QUAD Channel Base Radio (BR).
40W, 800 MHz Power Amplifier – TLF2020 (TTF1580)	4-15	Functional Block Diagram for the 40 Watt, 800 MHz, Single Channel Base Radio Power Amplifier (PA)
70W, 800 MHz Power Amplifier – TLN3335 (CTF1040)	4-16	Functional Block Diagram for the 70 Watt, 800 MHz, Single Channel Base Radio Power Amplifier (PA)
60W, 900 MHz Power Amplifier – CLN1355 (CLF1300)	4-17	Functional Block Diagram for the 60 Watt, 900 MHz, Single Channel Base Radio Power Amplifier (PA)
40W, 1500 MHz Power Amplifier – TLN3426	4-18	Functional Block Diagram for the 40 Watt, 1500 MHz, Single Channel Base Radio Power Amplifier (PA)
800 MHz QUAD Carrier Power Amplifier	4-19	Functional Block Diagram for the 800 MHz QUAD Channel Base Radio Power Amplifier (PA)

FRU Number to Kit Number Cross Reference

Power Amplifier (PA) Field Replaceable Units (FRUs) are available for the iDEN EBTS. The FRU contains the PAKit and required packaging. Table 4-2 provides a cross reference between PA FRU numbers and kit numbers.

Table 4-2 **FRU Number to Kit Number Cross Reference**

Description	FRU Number	Kit Number
40 W, 800 MHz Single Channel Base Radio PA	TLF2020	CLF1772
70 W, 800 MHz Single Channel Base Radio PA	TLN3335	CLF1771
60 W, 900 MHz Single Channel Base Radio PA	CLN1355	CLN7125
40 W, 1500 MHz Single Channel Base Radio PA	TLN3426	TTG1000
800 MHz QUAD Channel Base Radio PA	CLF1499	CLF1400

**40W, 800 MHz – TLF2020 (TTF1580);
70W, 800 MHz – TLN3335 (CTF1040);
60W, 900 MHz – CLN1355 (CLF1300);
40W, 1500 MHz – TLN3426 (TLN3426);
800 MHz QUAD – CLF1400 (CLF1400)**

PA Overview

The Power Amplifier (PA), together with the Exciter, provides transmitter functions for the QUAD Channel Base Radio. The PA accepts the low-level modulated RF signal from the Exciter and amplifies the signal for transmission via the RF output connector.

The 800 MHz Base Radio can be equipped with either 40 Watt PA, TLF2020 (version TTF1580) or 70 Watt PA, TLN3335 (version CTF1040). The 40W PA module consists of five hybrid modules, four pc boards, and a module heatsink/housing assembly. The 70W PA module consists of eight hybrid modules, four pc boards, and a module heatsink/housing assembly.

The 900 MHz Base Radio is equipped with 60 Watt PA, CLN1355 (kit no. CLF1300A). The PA module consists of four hybrid modules, two pc boards, and a module heatsink/housing assembly.

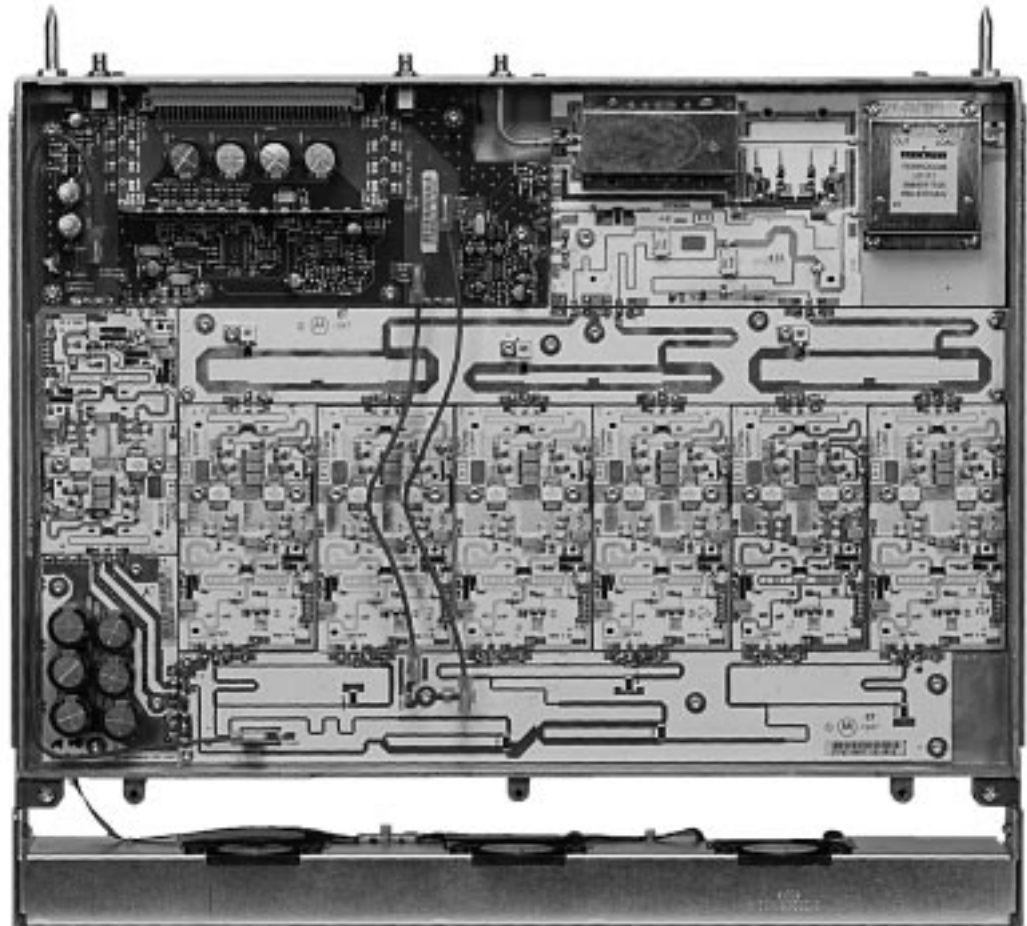
The 1500 MHz Base Radio is equipped with 40 Watt PA, TLN3426. The PA module consists of four hybrid modules, two pc boards, and the module heatsink/housing assembly.

The 800MHz Quad Base Radio is equipped with the Quad PA, CLF1400. The PA module consists of six hybrid modules, two pc boards, and the module heatsink/housing assembly.

The PA connects to the chassis backplane using a 96-pin DIN connector and three blindmate RF connectors. Two Torx screws located on the front of the PA hold it in the chassis.

Specifications of the transmitter circuitry, including the Exciter and PAs, are provided in Base Radio Overview section. Figure 4-1 shows the 70W, 800 MHz PA. Figure 4-2 shows the 60W, 900 MHz PA. Figure 4-3 shows the 40W, 1500 MHz PA.

40W, 800 MHz – TLF2020 (TTF1580); 70W, 800 MHz – TLN3335 (CTF1040); 60W, 900 MHz – CLN1355 (CLF1300); 40W, 1500 MHz – TLN3426 (TLN3426); 800 MHz QUAD – CLF1400 (CLF1400)

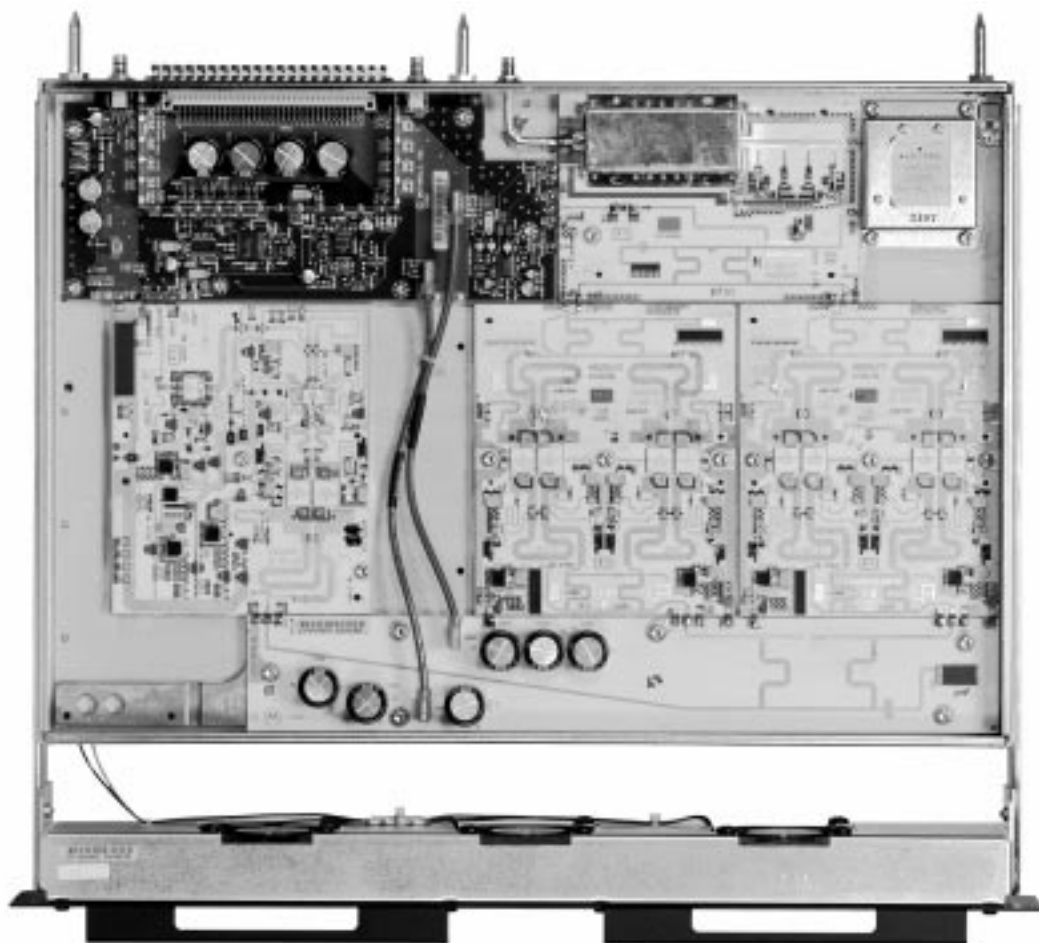


NOTE: 70W PA shown. 40W PA is similar.

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Figure:4-1 70W, 800 MHz PA – TLN3335 (with cover removed)

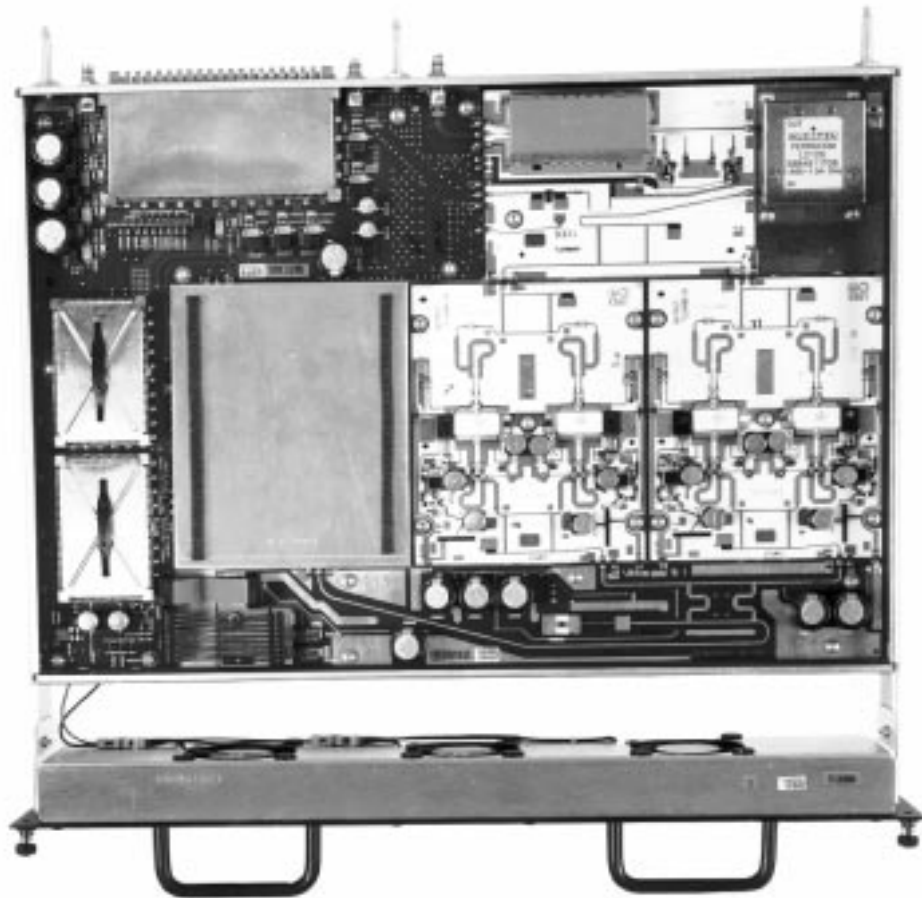
40W, 800 MHz – TLF2020 (TTF1580); 70W, 800 MHz – TLN3335 (CTF1040); 60W, 900 MHz – CLN1355 (CLF1300); 40W, 1500 MHz – TLN3426 (TLN3426); 800 MHz QUAD – CLF1400 (CLF1400)



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Figure:4-2 60W, 900 MHz PA – CLN1355 (with cover removed)

40W, 800 MHz – TLF2020 (TTF1580); 70W, 800 MHz – TLN3335 (CTF1040); 60W, 900 MHz – CLN1355 (CLF1300); 40W, 1500 MHz – TLN3426 (TLN3426); 800 MHz QUAD – CLF1400 (CLF1400)



1.5GHZ-Z858

Figure:4-3 40W, 1500 PA (with cover removed)

40W, 800 MHz – TLF2020 (TTF1580); 70W, 800 MHz – TLN3335 (CTF1040); 60W, 900 MHz – CLN1355 (CLF1300); 40W, 1500 MHz – TLN3426 (TLN3426); 800 MHz QUAD – CLF1400 (CLF1400)

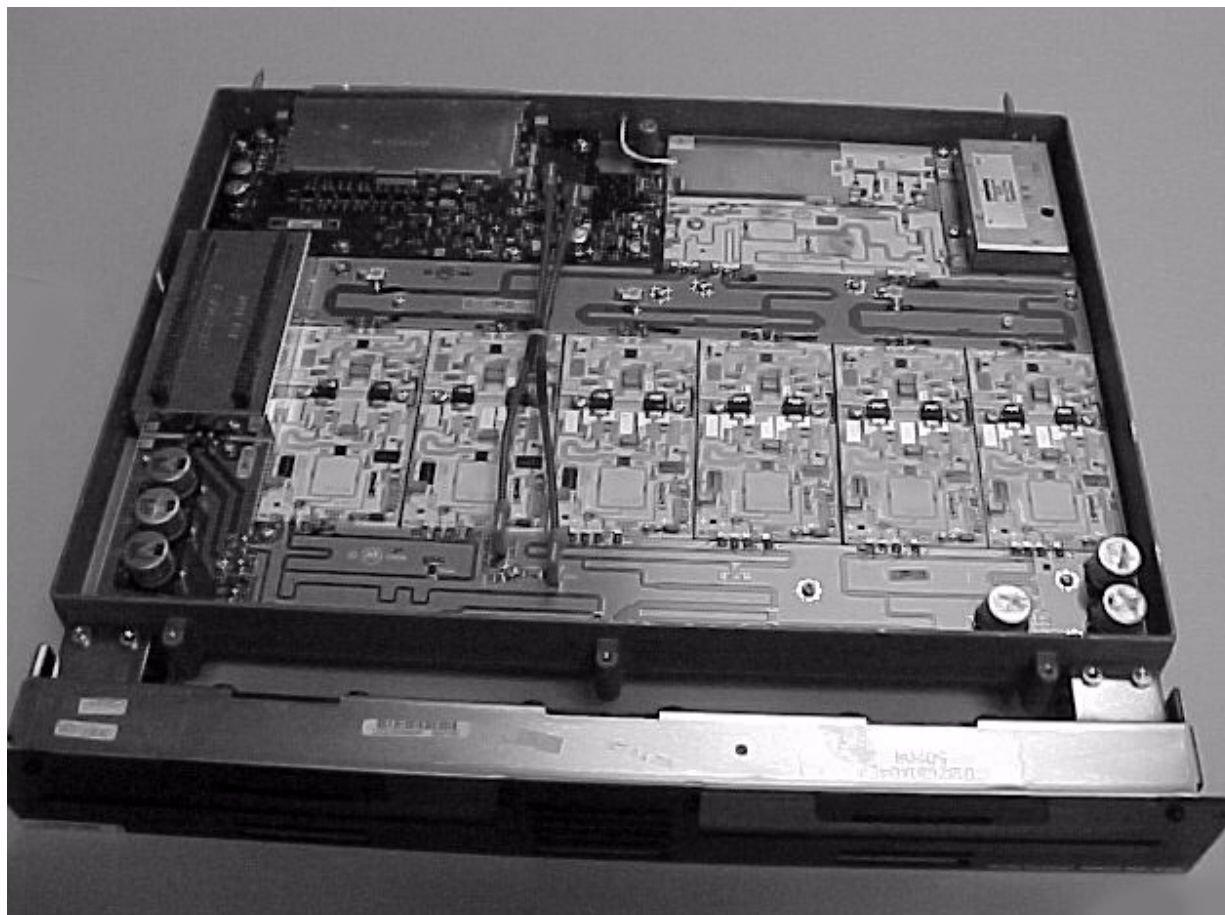


Figure:4-4 QUAD Channel PA (with cover removed)

Theory of Operation

Table 4-3 describes the basic functions of the PA circuitry. Figures 4-5, 4-6 and 4-9 show the functional block diagrams of 40W, 800 MHz PA; 70W, 800 MHz PA and the 800MHz, Quad PA, respectively. Figures 4-7 shows the functional block diagram of the 60W, 900 MHz PA. Figures 4-8 shows a functional block diagram of the 40W, 1500 MHz PA.

Table 4-3 Power Amplifier Circuitry

Circuit	Description
DC/Metering Board	- Serves as the main interface between the PA and the backplane board - Accepts RF input from the Exciter via a blindmate RF connector - Routes the RF input via a 50 Ω stripline to the Linear Driver Module RF amplifier - Routes the RF feedback from the RF Combiner/Peripheral Module to the Exciter via a blindmate RF connector - Provides digital alarm and metering information of the PA to the BRC via the SPI bus - Routes DC power to the fans and PA
Linear Driver Module (LDM)	- Contains one Class AB stage which, in turn, drives a parallel Class AB stage - Amplifies the low-level RF signal ~25 mW average power from the Exciter via the DC/Metering Board (800MHz and 900MHz) - Amplifies the low-level RF signal ~8 mW average power from the Exciter via the DC/Metering Board (1500MHz) - Provides an output of: ~10 W (800MHz) average power ~8 W (800MHz Quad) average power ~17 W (900MHz) average power ~16 W (1500MHz) average power
Interconnect Board (800 MHz only)	- Provides RF interconnection from the LDM to the RF Splitter board - Provides DC supply filtering
RF Splitter/DC board	- Interfaces with the DC/Metering Board to route DC power to the LDMs - Contains splitter circuits that split the RF output signal of the LDM to the three Linear Final Modules (40W, 800MHz) - Contains splitter circuits that split the RF output signal of the LDM to the six Linear Final Modules (70W, 800MHz and 800MHz Quad) - Contains a Quadrature splitter circuit to split the RF output signal of the LDM to the two Linear Final Modules (900 MHz and 1500 MHz)

Table 4-3 Power Amplifier Circuitry (Continued)

Circuit	Description
Linear Final Module (LFM)	- Each module contains two Class AB amplifiers in parallel. Each module amplifies one of three RF signals (~ 8 W average power) from the LDM (via the Splitter/DC board). Three LFMs provide a sum RF output of approximately 48 W average power. (40W, 800MHz) - Each module contains two Class AB amplifiers in parallel. Each module amplifies one of six RF signals (~ 8 W average power) from the LDM (via the Splitter/DC board). Six LFMs provide a sum RF output of approximately 97 W average power. (70W, 800MHz) - Each module contains two Class AB amplifiers in parallel. Each module amplifies one of six RF signals from the LDM (via the Splitter/DC board). Six LFMs sum to provide the final RF power. (800MHz Quad) - Each module contains two Class AB amplifiers in parallel. Each module amplifies one of two RF signals (~ 17 W average power) from the LDM (via the Splitter/DC board). Two LFMs provide a sum RF output of approximately 75 W average power. (900MHz) - Each module contains two Class AB amplifiers in parallel. Each module amplifies one of two RF signals (~ 16 W average power) from the LDM (via the Splitter/DC board). Two LFMs provide a sum RF output of approximately 28 W average power. (1500MHz)
RF Interconnect Board (40W, 800 MHz PA only)	Contains three transmission lines that interconnect the LFMs to the RF Combiner/Peripheral Module
Combiner Board (70W, 800 MHz PA and 800MHz Quad only)	Contains three separate Quadrature combiner circuits that respectively combine the six RF outputs from the LFMs into three signals. These three signals, in turn, are applied to the RF Combiner/Peripheral Module.
RF Combiner/Peripheral Module	- Contains a combiner circuit that combines the three RF signals from the RF Interconnect Board (40W PA) or the Combiner Board (70W PA and Quad PA). It routes the combined RF signal through a circulator and a Low Pass Filter. The final output signal is routed to the blindmate RF connector (800 MHz) - Contains a Quadrature combiner circuit to combine the RF signal from the two LFMs. It routes the combined RF signal through a circulator and a Low Pass Filter. The output signal is routed to the blindmate RF connector (900 MHz and 1500 MHz) - Contains an RF coupler that provides an RF feedback signal to the Exciter via a blindmate RF connector. Also contains a forward and reverse power detector for alarm and power monitoring purposes
Fan Assembly	Consists of three fans used to keep the PA within predetermined operating temperatures

DC/Metering Board(Non-Quad)

The DC/Metering Board provides the interface between the PA and the Base Radio backplane. The preamplified/modulated RF signal is input directly from the Exciter via the Base Radio backplane.

The RF input signal is applied to the input of the Linear Driver Module (LDM). The RF feedback signal is fed back to the Exciter, where it is monitored for errors.

The primary function of the DC/Metering Boards is to monitor proper operation of the PA. This information is forwarded to the Base Radio Controller (BRC) via the SPI bus. The alarms diagnostic points monitored by the BRC on the PA include the following:

- Forward power

- Reflected power
- PA temperature sense

DC/Metering Board (Quad only)

The DC/Metering Board in the Quad Radio serves the same function as does other radios. However, its circuitry is modified to be compatible with the Quad Station. As such, the logic circuitry is 3.3V.

In addition to the functions listed in the non-Quad version, the following metering points are ported to the SPI bus:

- A and B Currents
- Fan Sensor

Linear Driver Module

800 MHz

The Linear Driver Module (LDM) amplifies the low-level RF signal from the Exciter. The LDM consists of a two-stage cascaded amplifier.

The RF input signal applied to the LDM has an average power level of approximately 25 mW. The LDM amplifies this signal to an average output level of approximately 10 Watts. (8W in Quad) The LDM output is fed to the RF Splitter/DC Distribution Board via an Interconnect Board.

900 MHz

The Linear Driver Module (LDM) amplifies the low-level RF signal from the Exciter. The LDM consists of a three-stage cascaded amplifier. This output is fed directly to the RF Splitter/DC Distribution Board.

The RF input signal applied to the LDM has an average power level of approximately 25 mW. The LDM amplifies this signal to an average output level of approximately 17 Watts.

1500 MHz

The Linear Driver Module (LDM) takes the low level RF signal and amplifies it. The LDM consists of a four stage cascaded amplifier. The RF input signal has an average power level of 8 mW. The LDM amplifies the input signal to an average output level of approximately 16 Watts. This output is fed directly to the RF Splitter/DC Distribution Board.

The current drain of the Power Amplifiers is monitored by the A/D converter on the DC/Metering board. A voltage signal representative of the LDM current drain is sent to the BRC. A Power Amplifier alarm is generated if the signal is outside of either the upper or lower limits.

Interconnect Board (800 MHz and 800MHz Quad only)

The output of the LDM is applied to the Interconnect Board, which provides an RF connection to the RF Splitter/DC Distribution Board. As a separate function, area on the Interconnect Board serves as a convenient mounting location for electrolytic capacitors used for filtering the +28 VDC supply.

RF Splitter/DC Distribution Board

800 MHz

The RF Splitter portion of this board accepts the amplified signal from the LDM (via the Interconnect Board). The primary function of this circuit is to split the RF signal into drive signals for the LFMs.

In the 40W PA, this circuit splits the drive signal into three separate paths to be applied to the three LFMs, where the signals will be amplified further. In the 70W PA and Quad PA, this circuit splits the drive signal into six separate paths to be applied to the six LFMs, where the signals will be amplified further.

The DC Distribution portion of this board interfaces directly with the DC/Metering Board to route DC power to the LFMs.

900 MHz and 1500 MHz

The RF Splitter portion of this board accepts the amplified signal from the LDM. The primary function of this circuit is to split the RF signal into two separate paths. These two outputs are fed directly to two separate Linear Final modules where the RF signals will be amplified further.

The DC Distribution portion of this board interfaces directly with the DC/Metering Board to route DC power to the LFMs.

Linear Final Modules

800 MHz

The RF Splitter output signals are applied directly into the LFMs for final amplification. Each LFM contains parallel PAs that amplify the RF signals.

In the 40W PA, the parallel LFMs amplify the input signals to a sum output level of approximately 48 Watts average power. The amplified signal is then sent directly to the RF Interconnect Board. In the 70W PA, the parallel LFMs amplify the input signals to a sum output level of approximately 97 Watts average power. In the Quad PA, the function is similar to the 70W PA. The amplified signal is then sent directly to the Combiner Board.

900 MHz

The RF signals from the outputs of the RF Splitter are applied directly into the Linear Final Module (LFM) for final amplification. Each LFM contains dual PAs that amplify the RF signals to a combined output level of approximately 75 Watts average power. The amplified signal is then sent directly to the RF Combiner circuit for final distribution.

1500 MHz

The two RF signals from the outputs of the RF Splitter are input directly into the Linear Final Module (LFM) for final amplification. Each LFM contains dual power amplifiers that amplify the RF signals to an output equal to approximately 28 Watts average power. The amplified signal is then sent directly to the RF Combiner circuit for final distribution.

The current drain of the Power Amplifiers is monitored by the A/D converter on the DC/Metering board. A voltage signal representative of the LFM current drain is sent to the BRC. A Power Amplifier alarm is generated if the signal is outside of either the upper or lower limits.

RF Interconnect Board (40W, 800 MHz PA Only)

The RF Interconnect Board consists of transmission line paths which route the three output signals from the LFMs to the three inputs of the RF Combiner/Peripheral Module.

Combiner Board (70W, 800 MHz PA and 800MHz Quad PA Only)

The Combiner Board combines pairs of signals into single signals, thereby combining the six signals from the LDMs into three signals. The resulting three signals are applied to the RF Combiner/Peripheral Module.

RF Combiner/Peripheral Module

800 MHz and 800MHz Quad

This module consists of two portions: an RF combiner and a peripheral module. The RF Combiner portion of the module combines the three RF signals from the RF Interconnect Board (40W PA) or the Combiner Board (70W PA) into a single signal using a Wilkinson coupler arrangement.

Following the combiner circuit, the single combined RF signal is then passed through a directional coupler which derives a signal sample of the LFM RF power output. Via the coupler, a sample of the RF output signal is fed to the Exciter as a feedback signal.

Following the coupler, the power output signal is passed through a circulator, which protects the PA in the event of high reflected power.

The peripheral portion of the module provides a power monitor circuit that monitors the forward and reflected power of the output signal. This circuit furnishes the A/D converter on the DC/Metering Board with input signals representative of the forward and reflected power levels.

For forward power, a signal representative of the measured value is sent to the BRC via the SPI bus. The BRC determines if this level is within tolerance of the programmed forward power level. If the level is not within parameters, the BRC will issue a warning to the site controller which, in turn, will shut down the Exciter if required.

Reflected power is monitored in the same manner. The BRC uses the reflected power to calculate the voltage standing wave ratio (VSWR). If the VSWR is determined to be excessive, the forward power is rolled back. . If it is extremely excessive, the BRC issues a shut-down command to the Exciter.

A thermistor is located on the RF Combiner/Peripheral module to monitor the operating temperature of the PA. The thermistor signal indicating excessive temperature is applied to the A/D converter and then sent to the BRC. The BRC rolls back forward power if the monitored temperature is excessive.

900 MHz

The combined LFM output is applied to this module. The RF signal is first passed through a directional coupler which derives a signal sample of the LFM RF power output. Via the coupler, a sample of the RF output signal is fed to the Exciter as a feedback signal, thereby allowing the Exciter to accordingly adjust signal drive. Following the coupler, the power output signal is passed through a circulator, which protects the PA in the event of high reflected power.

A power monitor circuit monitors the forward and reflected power of the output signal. This circuit furnishes the A/D converter on the DC/Metering Board with input signals representative of the forward and reflected power levels.

For forward power, a signal representative of the measured value is sent to the BRC via the SPI bus. The BRC determines if this level is within tolerance of the programmed forward power level. If the level is not within parameters, the BRC will issue a warning to the site controller which, in turn, will shut down the Exciter if required.

Reflected power is monitored in the same manner. The BRC uses the reflected power to calculate the voltage standing wave ratio (VSWR). If the VSWR is determined to be excessive, the forward power is rolled back. If it is extremely excessive, the BRC issues a shut-down command to the Exciter.

A thermistor is located on the RF Combiner/Peripheral module to monitor the operating temperature of the PA. A voltage representative of the monitored temperature is sent from the A/D converter to the BRC. The BRC rolls back forward power if the monitored temperature is excessive.

1500 MHz

Both LFM outputs are input into this module where they are combined for a single output signal. The RF signal is first coupled to the Exciter module so that it can be monitored. The RF output signal is then passed through a circulator that acts as a protection device for the PA in the event of reflected power.

A power monitor circuit monitors the forward and reflected power of the output signal. This circuit provides the A/D converter on the DC/Metering board with an input signal representative of the forward or reflected power levels.

For forward power, a signal representative of the measured value is sent to the BRC module via the SPI bus. The BRC determines if this level is within tolerance of the programmed forward power level. The programmed forward power is set through the use of MMI commands. If the level is not within certain parameters, the BRC will issue a warning to the site controller and may shut-down the Exciter module.

Reflected power is monitored in the same manner except that the BRC determines an acceptable reflected power level. The BRC calculates the reflected power through an algorithm stored in memory. If the reflected power is determined to be excessive, the forward power is rolled back. If the reflected power level is extremely excessive, the BRC will issue a shut-down command to the Exciter module.

A thermistor is located on the RF Combiner/Peripheral module to monitor the operating temperature of the Power Amplifier. A voltage representative of the monitored temperature is sent from the A/D converter to the BRC. The BRC issues a cut-back command to the Exciter module if the monitored temperature is greater than 121° F (85° C).

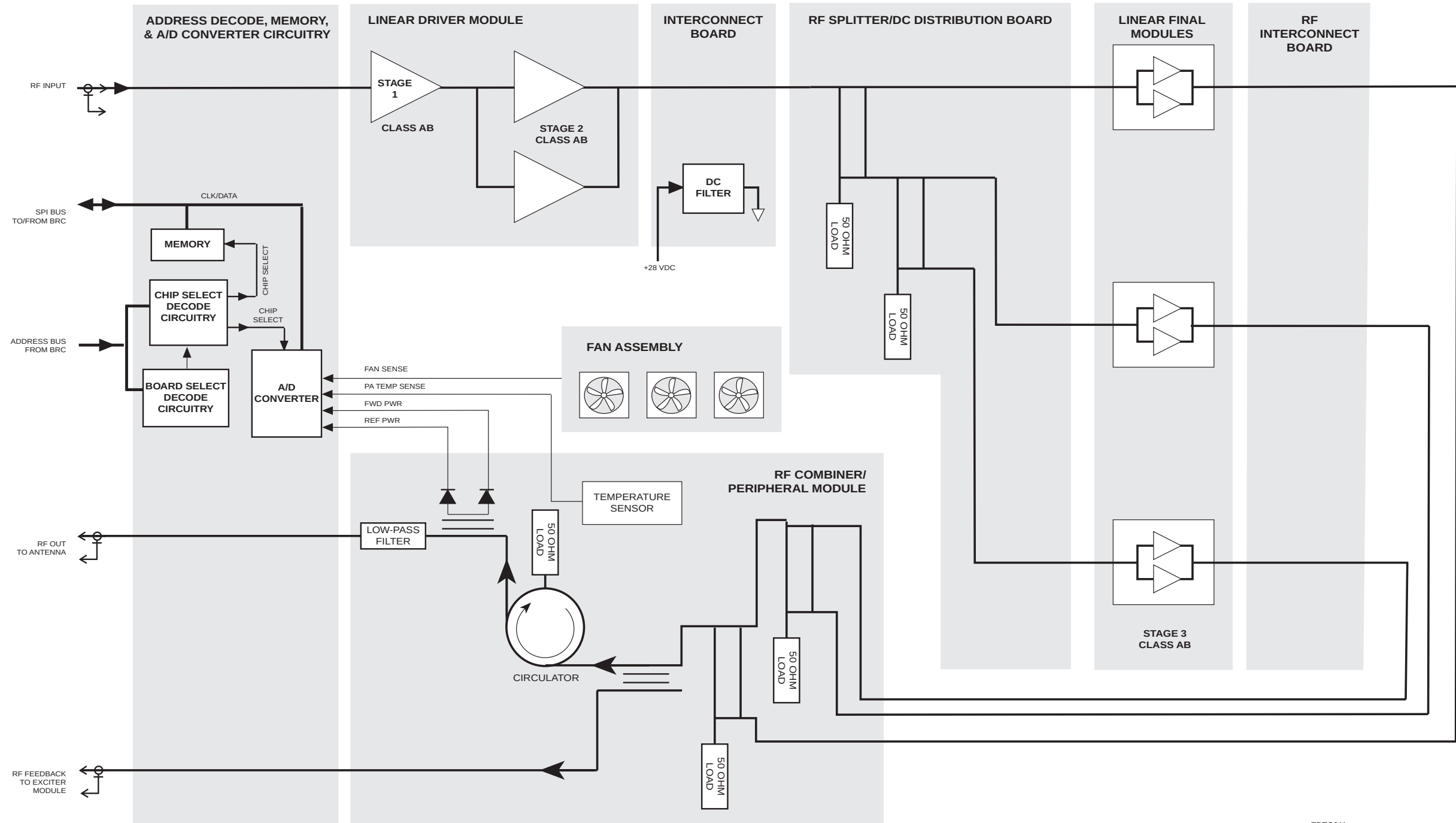
Fan Module

The PA contains a fan assembly to maintain normal operating temperature through the use of a cool air intake. The fan assembly consists of three individual fans in which airflow is directed across the PA heatsink.

The current draw of the fans is monitored by the DC/Metering Board. A voltage representative of the current draw is monitored by the BRC. The BRC flags the iSC if an alarm is triggered. The PA LED on the front panel of the BRC also lights, however the PA does not shut down.

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40W, 800 MHz Power Amplifier – TLF2020 (TTF1580)
Functional Block Diagram



EBTS611
051398LLN

Figure:4-5 TLF2020 (TTF1580B) 40 W, 800 MHz Power Amplifier
Functional Block Diagram (Sheet 1 of 1)

70W, 800 MHz Power Amplifier – TLN3335 (CTF1040)
Functional Block Diagram

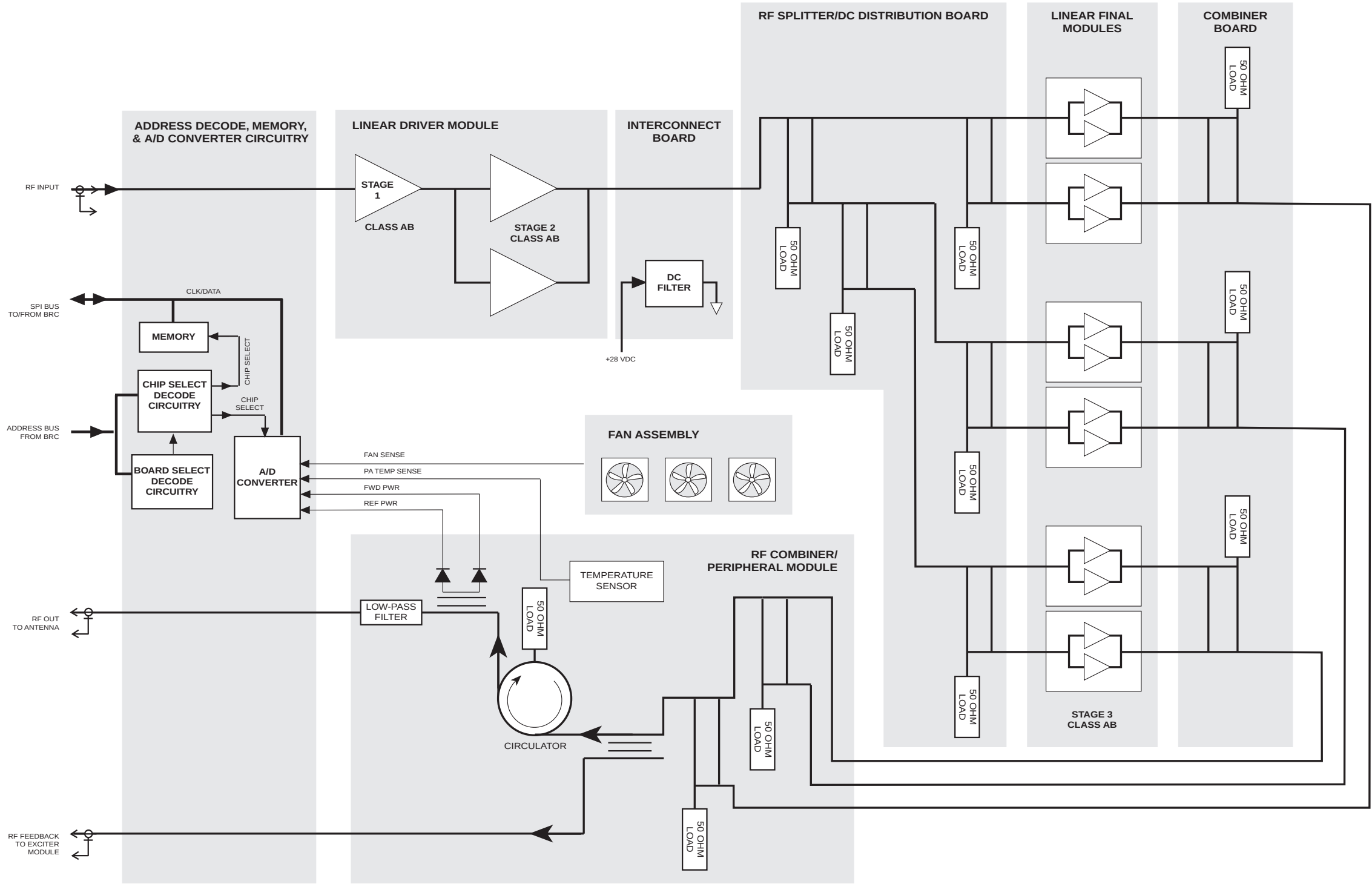
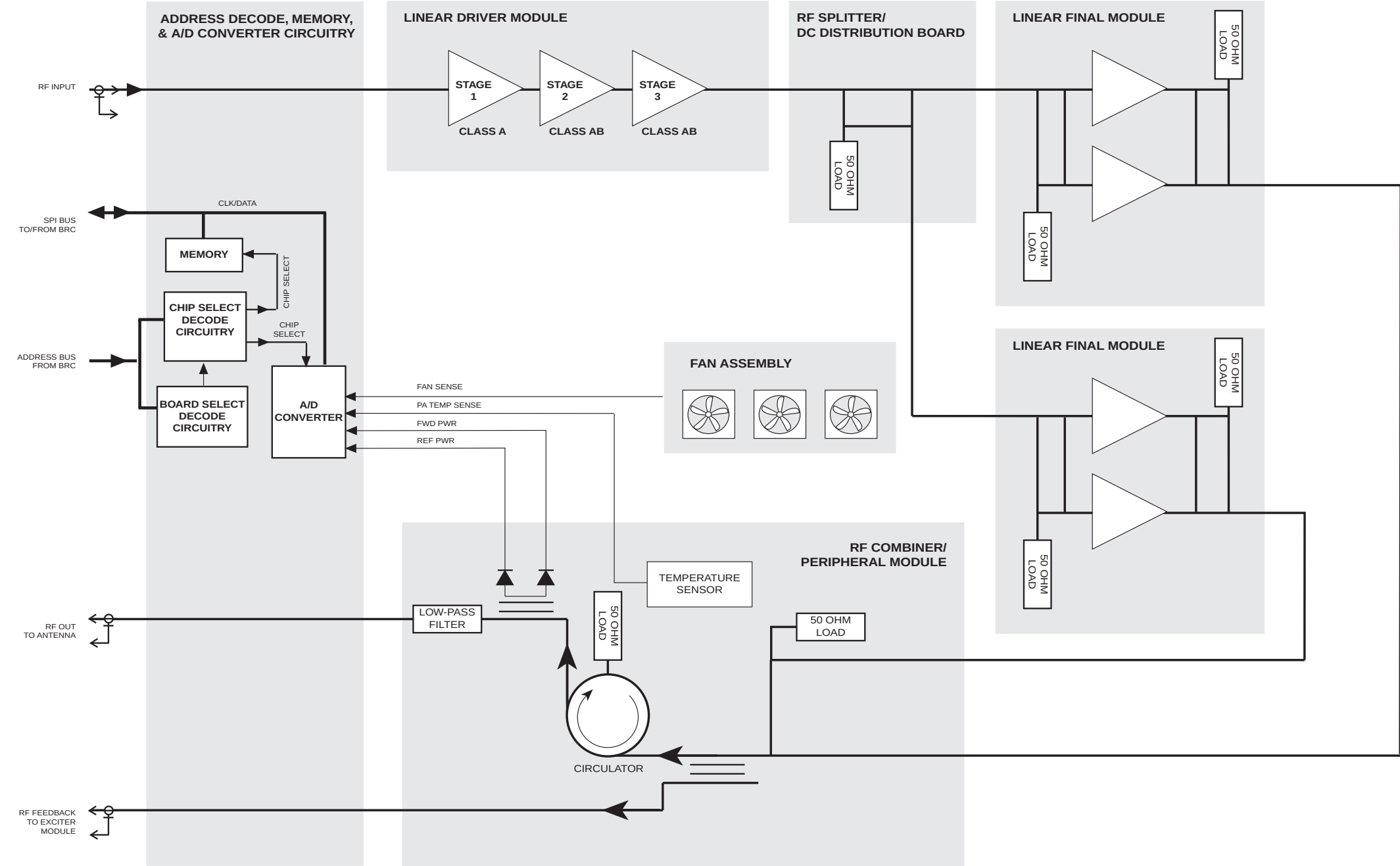


Figure:4-6 TLN3335 (CTF1040) 70 W, 800 MHz Power Amplifier
Functional Block Diagram (Sheet 1 of 1)

EBTS417
1204973JNM

60W, 900 MHz Power Amplifier – CLN1355 (CLF1300)
Functional Block Diagram



EBTS326
011497JNM

Figure:4-7 60W, 900 MHz Power Amplifier Functional Block Diagram
(Sheet 1 of 1)

Power Amplifier

40W, 1500 MHz Power Amplifier – TLN3426

Functional Block Diagram

Power Amplifier

Functional Block Diagram

Model TLN3426

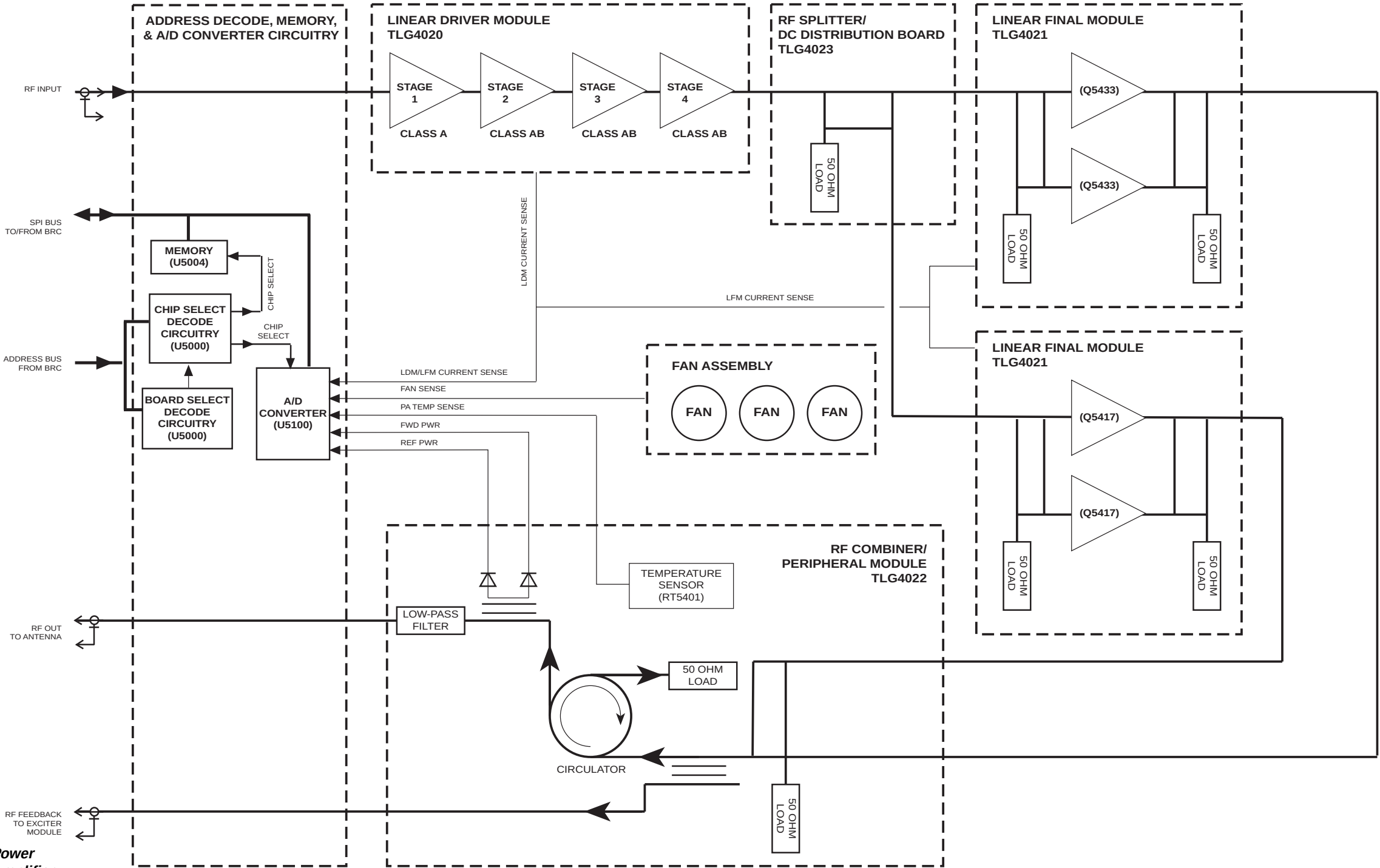


Figure:4-8 Power Amplifier

800 MHz QUAD Carrier Power Amplifier
Functional Block Diagram

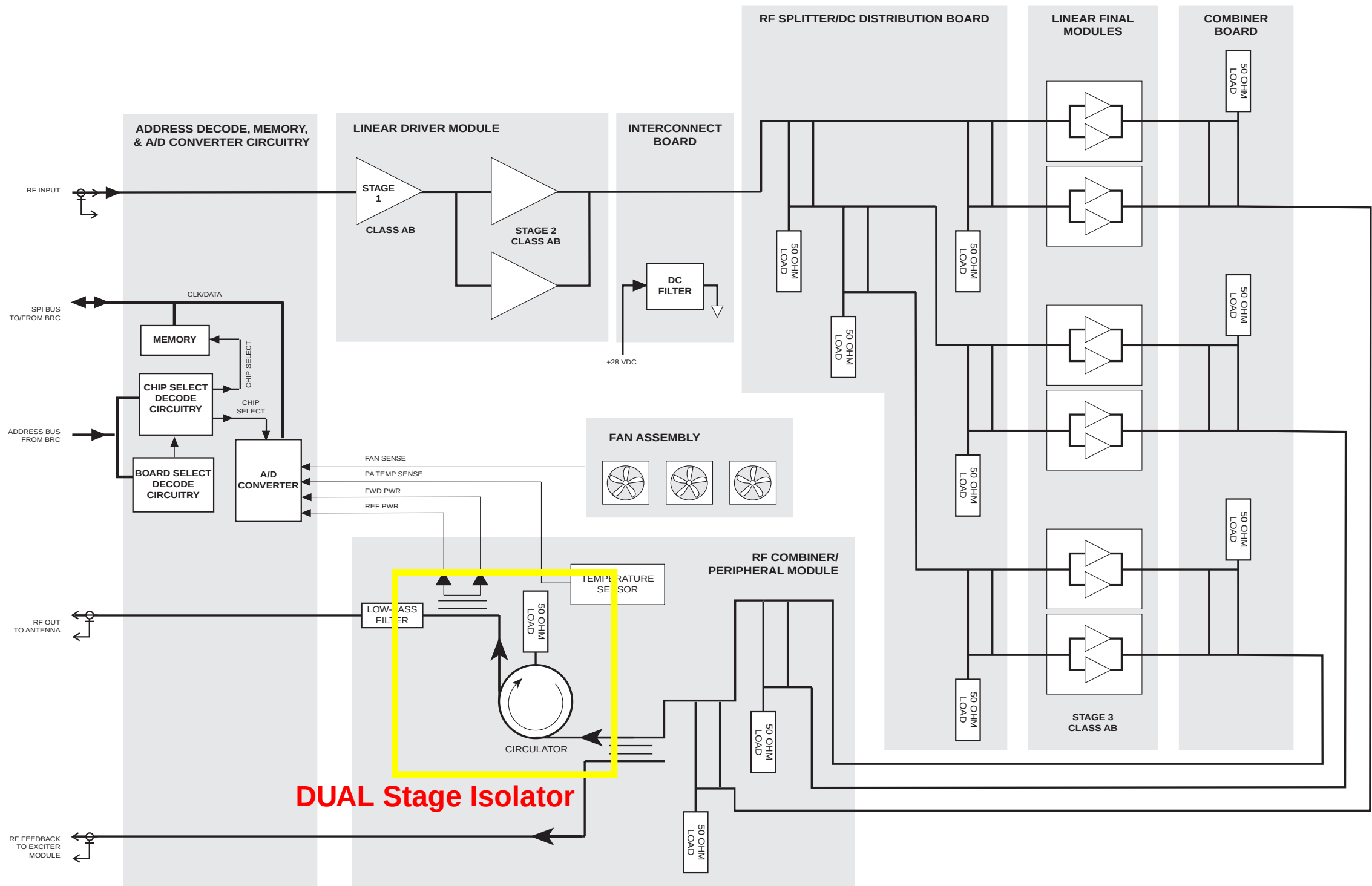


Figure:4-9 QUAD Channel Power Amplifier Functional Block Diagram (Sheet 1 of 1)

EBTS417
120497JNM

Power Amplifier

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DC Power Supply

Overview

This section provides technical information for the DC Power Supply (PS). Table 5-1 describes covered topics.

Table 5-1 Chapter Topics

Chapter	Page	Description
DC Power Supply for Single Channel Base Radios	5-22	Describes the functions and characteristics of the DC Power Supply (PS) module for the single channel Base Radio (BR).
Single Channel DC Power Supply	5-29	Describes the functions and characteristics of the DC Power Supply (PS) module for the QUAD channel Base Radio (BR).
Single Channel DC Power Supply	5-30	Functional Block Diagram for the Single Channel DC Power Supply (PS)
QUAD Channel Power Supply	5-31	Functional Block Diagram for the QUAD Channel DC Power Supply (PS)

FRU Number to Kit Number Cross Reference

DC Power Supply Field Replaceable Units (FRUs) are available for the iDEN EBTS. The FRU contains the Power Supply kit and required packaging. Table 5-2 provides a cross reference between Exciter FRU numbers and kit numbers.

Table 5-2 FRU Number to Kit Number Cross Reference

Description	FRU Number	Kit Number
Single Channel DC Power Supply	TLN3338	CPN1027
QUAD Channel DC Power Supply	CLN1498	CLF1550

DC Power Supply for Single Channel Base Radios

DC Power Supply for Single Channel Base Radios

DC Power Supply Overview

The DC Power Supply provides DC operating voltages to QUAD Channel Base Radio FRUs. The power supply accepts input voltage sources from 41Vdc to 60Vdc. Input sources may be either positively or negatively grounded.

On initial startup, the supply requires a nominal 43 Vdc. If the voltage drops below 41 V, the DC Power Supply enters quiescent mode. In quiescent mode, the power supply outputs no power.

The DC Power Supply is designed for sites with an available DC voltage source. Output voltages from the DC Power Supply are 28.6 Vdc, 14.2 Vdc and 5.1 Vdc, with reference to output ground. The supply is rated for 575 Watts of continuous output power, with up to 113° F (45° C) inlet air. At 140° F (60° C), the 28.6 Vdc output reduces to 80% of maximum power.

The DC Power Supply consists of the Power Supply and front panel hardware. The DC Power Supply connects to the chassis backplane through an edgecard connector. Two Torx screws on the front panel secure the DC power supply to the chassis.

Figure 5-1 shows the DC Power Supply with the cover removed.

Controls and Indicators

Table 5-3 summarizes LED indications on the DC Power Supply during normal operation. The ON/OFF switch behind the front panel turns DC power supply on and off.

Table 5-3 **DC Power Supply Indicators**

LED	Condition	Indications
Green	Solid (on)	Power Supply is on, and operating under normal conditions with no alarms
	Off	Power Supply is turned off or required power is not available
Red	Solid (on)	Power Supply fault or load fault on any output, or input voltage is out of range
	Off	Power Supply is operating normally, with no alarms

Performance Specifications

Table 5-4 lists the specifications for the DC Power Supply.

DC Power Supply for Single Channel Base Radios*Figure:5-1* **DC Power Supply***Table 5-4* **DC Power Supply Specifications**

Description	Value or Range
Operating Temperature	0° to +40° C (no derating) +41° to +60° C (derating)
Input Voltage	41 to 60 Vdc
Input Polarity	Positive (+) ground system
Startup Voltage	43 Vdc (minimum)
Input Current	15.6 A (maximum) @ 41 Vdc
Steady State Output Voltages	28.6 Vdc $\pm 5\%$ 14.2 Vdc $\pm 5\%$ 5.1 Vdc $\pm 5\%$
Total Output Power Rating	575 W (no derating) 485 W (derating)

DC Power Supply for Single Channel Base Radios**Table 5-4 DC Power Supply Specifications (Continued)**

Description	Value or Range	
Output Ripple	All outputs 50mV p-p (measured with 20 MHz BW oscilloscope at 25°C) High Frequency individual harmonic voltage limits (10kHz to 100MHz) are:	
	28.6 Vdc	1.5 mV p-p
	14.2 Vdc	3.0 mV p-p
	5.1 Vdc	5.0 mV p-p
Short Circuit Current	0.5 A average (maximum)	

Theory of Operation

Table 5-5 briefly describes the basic DC Power Supply circuitry. Figure 5-3 shows the functional block diagrams for the DC Power Supply.

Table 5-5 DC Power Supply Circuitry

Circuit	Description
Input Circuit	Routes input current from the DC power input cable through the high current printed circuit edge connector, EMI filter, panel mounted combination circuit breaker, and on/off switch
Startup Inverter Circuitry	Provides Vdc for power supply circuitry during initial power-up
Main Inverter Circuitry	Consists of a switching-type power supply to generate the +28.6 Vdc supply voltage
Temperature Protection	The Power Supply contains a built-in cooling fan that runs whenever the supply is powered on. The supply shuts down if the temperature exceeds a preset threshold
+14.2 Vdc Secondary Converter Circuitry	Consists of a switching-type power supply to generate the +14.2 Vdc supply voltage
+5 Vdc Secondary Converter Circuitry	Consists of a switching-type power supply to generate the +5.1 Vdc supply voltage
Clock Generator Circuitry	Generates the 267 kHz and 133 kHz clock signals used by the pulse width modulators in the four inverter circuits
Address Decode, Memory, & A/D Converter	Serves as the main interface between A/D on the Power Supply and the BRC via the SPI bus

DC Power Supply for QUAD Channel Base Radios

QUAD Channel Power Supply Overview

The QUAD Channel DC Power Supply provides DC operating voltages to QUAD Channel Base Radio FRUs. The power supply accepts input voltage sources from 41Vdc to 60Vdc. Input sources may be either positively or negatively grounded.

On initial startup, the supply requires a nominal 43 Vdc. If the voltage drops below 41 V, the QUAD Channel DC Power Supply enters quiescent mode. In quiescent mode, the power supply outputs no power.

The QUAD Channel DC Power Supply is designed for sites with an available DC voltage source. Output voltages from the DC Power Supply are 28.6 Vdc, 14.2 Vdc and 3.3 Vdc, with reference to output ground. The supply is rated for 575 Watts of continuous output power, with up to 113° F (45° C) inlet air. At 140° F (60° C), the 28.6 Vdc output reduces to 80% of maximum power.

The QUAD Channel DC Power Supply consists of the Power Supply and front panel hardware. The QUAD Channel DC Power Supply connects to the chassis backplane through an edgecard connector. Two Torx screws on the front panel secure the QUAD Channel DC power supply to the chassis.

Figure 5-2 shows the QUAD Channel Power Supply with the cover removed.

Controls and Indicators

Table 5-6 summarizes LED indications on the QUAD Channel DC Power Supply during normal operation. The ON/OFF switch behind the front panel turns DC power supply on and off.

Table 5-6 **DC Power Supply Indicators**

LED	Condition	Indications
Green	Solid (on)	Power Supply is on, and operating under normal conditions with no alarms
	Off	Power Supply is turned off or required power is not available
Red	Solid (on)	Power Supply fault or load fault on any output, or input voltage is out of range
	Off	Power Supply is operating normally, with no alarms

Performance Specifications

Table 5-7 lists the specifications for the QUAD Channel DC Power Supply.

DC Power Supply for QUAD Channel Base Radios



Figure:5-2 Quad Carrier Power Supply

Table 5-7 DC Power Supply Specifications

Description	Value or Range
Operating Temperature	0° to +40° C (no derating) +41° to +60° C (derating)
Input Voltage	41 to 60 Vdc
Input Polarity	Positive (+) ground system
Startup Voltage	43 Vdc (minimum)
Input Current	18.0 A (maximum) @ 41 Vdc
Steady State Output Voltages	28.6 Vdc $\pm$ 5% 14.2 Vdc $\pm$ 5% 3.3 Vdc $\pm$ 5%
Total Output Power Rating	575 W (no derating) 485 W (derating)

DC Power Supply for QUAD Channel Base Radios**Table 5-7 DC Power Supply Specifications (Continued)**

Description	Value or Range	
Output Ripple	All outputs 150mV p-p (measured with 20 MHz BW oscilloscope at 25°C) High Frequency individual harmonic voltage limits (10kHz to 100MHz) are:	
	28.6 Vdc	1.5 mV p-p
	14.2 Vdc	3.0 mV p-p
	3.3 Vdc	5.0 mV p-p
Short Circuit Current	0.5 A average (maximum)	

Theory of Operation

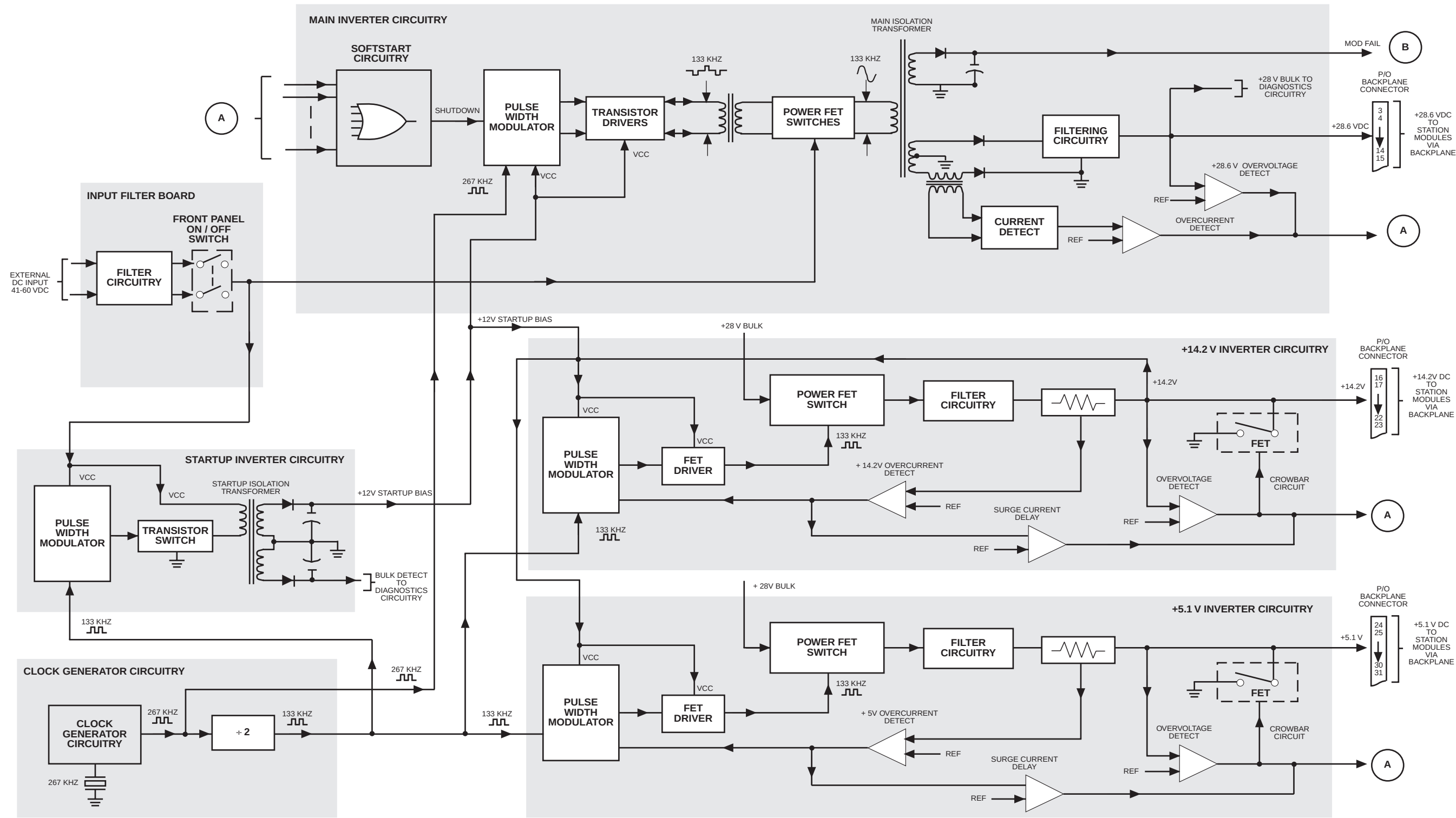
Table 5-8 briefly describes the basic DC Power Supply circuitry. Figure 5-5 shows the functional block diagrams for the DC Power Supply.

Table 5-8 DC Power Supply Circuitry

Circuit	Description
Input Circuit	Routes input current from the DC power input cable through the high current printed circuit edge connector, EMI filter, panel mounted combination circuit breaker, and on/off switch
Startup Inverter Circuitry	Provides Vdc for power supply circuitry during initial power-up
Main Inverter Circuitry	Consists of a switching-type power supply to generate the +28.6 Vdc supply voltage
Temperature Protection	The Power Supply contains a built-in cooling fan that runs whenever the supply is powered on. The supply shuts down if the temperature exceeds a preset threshold
+14.2 Vdc Secondary Converter Circuitry	Consists of a switching-type power supply to generate the +14.2 Vdc supply voltage
+3.3 Vdc Secondary Converter Circuitry	Consists of a switching-type power supply to generate the +3.3 Vdc supply voltage
Clock Generator Circuitry	Generates the 267 kHz and 133 kHz clock signals used by the pulse width modulators in the four inverter circuits
Address Decode, Memory, & A/D Converter	Serves as the main interface between A/D on the Power Supply and the BRC via the SPI bus

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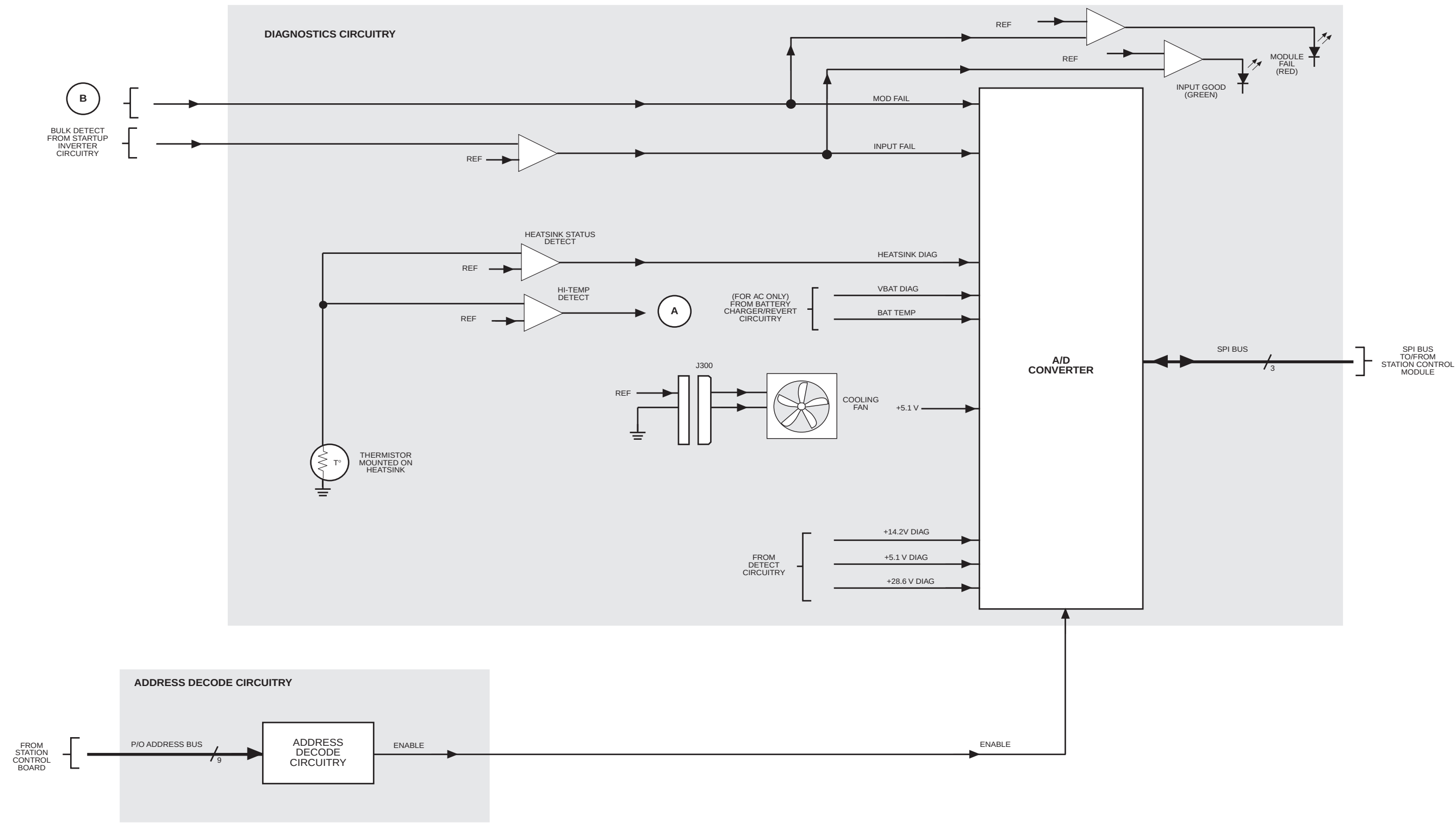
Single Channel DC Power Supply



EBTS323
011497JNM

Figure:5-3 DC Power Supply Functional Block Diagram
(Sheet 1 of 2)

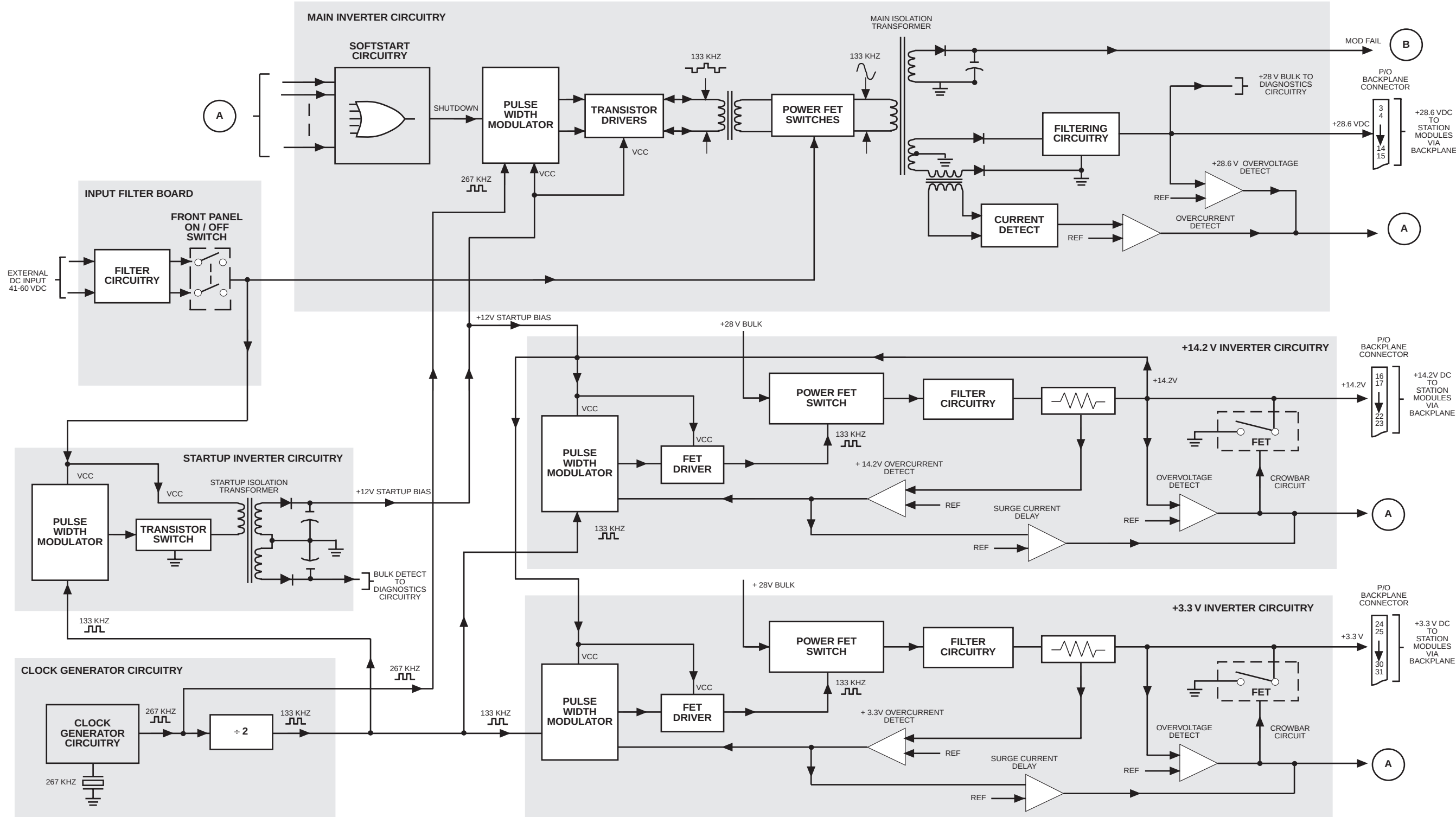
DC Power Supply



EBTS324
012097JNM

Figure:5-4 DC Power Supply Functional Block Diagram
(Sheet 2 of 2)

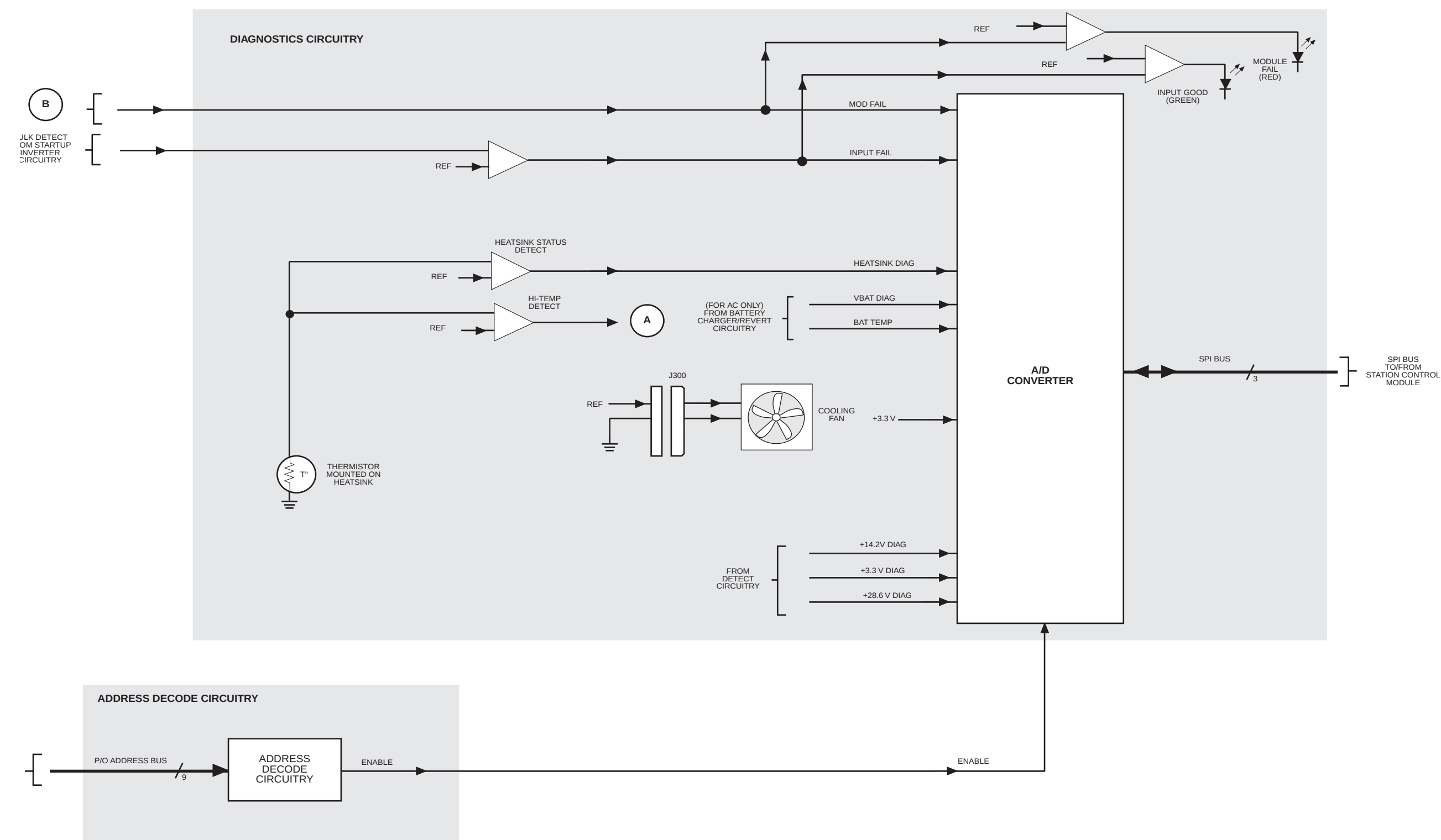
QUAD Channel Power Supply



EBTS323Q
101900 spf

Figure:5-5 QUAD Channel DC Power Supply Functional Block Diagram (Sheet 1 of 2)

DC Power Supply



EBTS324Q
101900spf

Figure:5-6 QUAD Channel DC Power Supply Functional Block Diagram
(Sheet 2 of 2)

AC Power Supply

AC Power Supply Overview

The AC Power Supply provides DC operating voltages for the Base Radio FRUs. The AC Power Supply accepts an AC input (90 to 280 Vac @ 47 to 63 Hz) to generate three output voltages: 28.6 Vdc, 14.2 Vdc and 5.1 Vdc with reference to output ground. The AC Power Supply automatically adjusts to the AC input ranges and supplies a steady output.

The AC Power Supply contains several switching-type power supply circuits, power factor correction circuitry, battery charger/revert circuitry, diagnostics and monitoring circuitry.

The battery charging/revert circuitry charges an external storage battery and automatically reverts to battery power in case of an AC power failure.

The Power Supply interconnects to the chassis backplane using an edgecard connector. Two Torx screws on the front panel of the AC Power Supply secure it in the chassis.

Figure 6-1 shows the front view of the AC Power Supply.

Controls and Indicators

Table 6-1 lists and describes the indicators of the AC Power Supply. The power ON/OFF switch is used to turn the power supply on and off.

Table 6-1 **AC Power Supply Indicators**

LED	Condition	Indications
Green	Solid (on)	Power Supply under normal operation with no alarms (the red LED is normally off when this LED is lit)
	Off	Power Supply is turned off or required power is not available
Red	Solid (on)	In battery revert mode, Power Supply fault, or load fault on any output
	Off	The Power Supply is under normal operation with no alarms

Performance Specifications

Table 6-2 lists the specifications for the AC Power Supply.

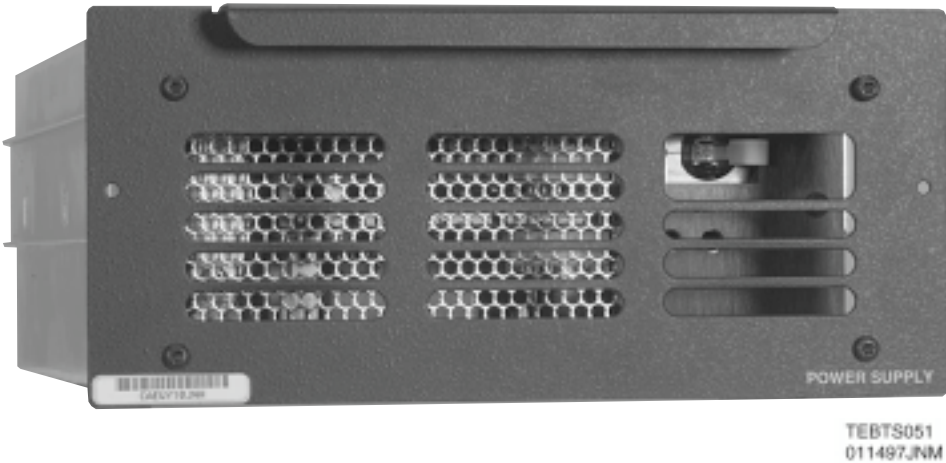


Figure:6-1 AC Power Supply (front view)

Table 6-2 AC Power Supply Specifications

Description	Value or Range
Operating Temperature	-30° to +45° C (no derating) -30° to +60° C (derating)
Input Voltage	90 to 280 Vac
Input Frequency Range	47 to 63 Hz
Input Current	8.5 A (maximum)
Steady State Output Voltages	28.6 Vdc ±5% 14.2 Vdc ±5% 5.1 Vdc ±5%
Total Output Power Rating	625 W (no derating)* 595 W (derating)*
Battery Charging Voltage Range	26 to 32.5 Vdc

Table 6-2 **AC Power Supply Specifications**

Description	Value or Range	
Output Ripple	All outputs 50 mV p-p (measured with 20 MHz BW oscilloscope at 25°C) High Frequency individual harmonic voltage limits (10 kHz to 100 MHz) are:	
	28.6 Vdc	1.5 mV p-p
	14.2 Vdc	3 mV p-p
	5.1 Vdc	5 mV p-p
Short Circuit Current	0.5 A average (maximum)	
* Includes 50 W for the battery charger.		

Theory of Operation

Table 6-3 briefly describes the basic AC Power Supply circuitry. Figure 6-2 shows the functional block diagrams for the AC Power Supply.

Table 6-3 **AC Power Supply Circuitry**

Circuit	Description
Input Conditioning Circuitry	Consists of ac line transient protection, EMI filtering, rectifier, power factor correction circuitry, and filtering
Start-up Inverter Circuitry	Provides Vcc for power supply circuitry during initial power-up
Main Inverter Circuitry	Consists of a switching-type power supply to generate the +28.6Vdc supply voltage
Temperature Protection	Contains a built-in thermostatically controlled cooling fan. The Power Supply shuts down if temperature exceeds a preset threshold
+14.2 Vdc Secondary Converter Circuitry	Consists of a switching-type power supply to generate the +14.2 Vdc supply voltage
+5 Vdc Secondary Converter Circuitry	Consists of a switching-type power supply to generate the +5 Vdc supply voltage
Clock Generator Circuitry	Generates 267 kHz and 133 kHz clock signals for the pulse width modulators in the four inverter circuits
Diagnostics Circuitry	Converts analog status signals to digital format for transfer to BRC
Address Decode, Memory, & A/D Converter	Serves as the main interface between A/D and D/A on the Power Supply and the BRC via the SPI bus
Battery Charging/Revert Circuitry	Offers features such as output short circuit protection, reversed battery protection, ambient battery temperature monitoring, and immediate revert to battery backup leaving no interruption of station operation In the event of an AC power failure, a battery revert relay is energized which places the storage battery on the +28 V bus which maintains station operation under backup power. An SCR in parallel with the relay contacts provides instant battery revert and protection for the relay contacts against arcing

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AC Power Supply

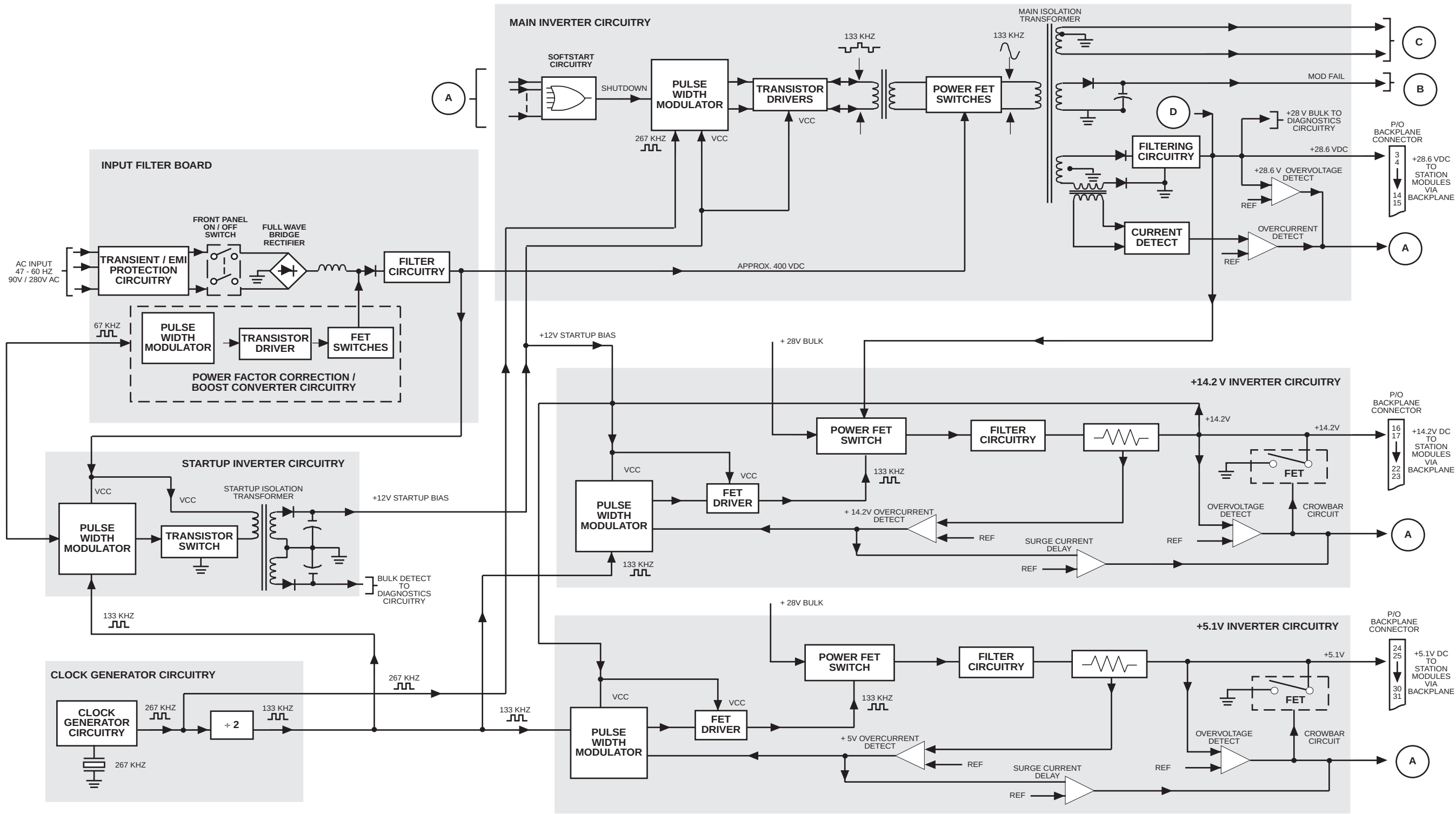
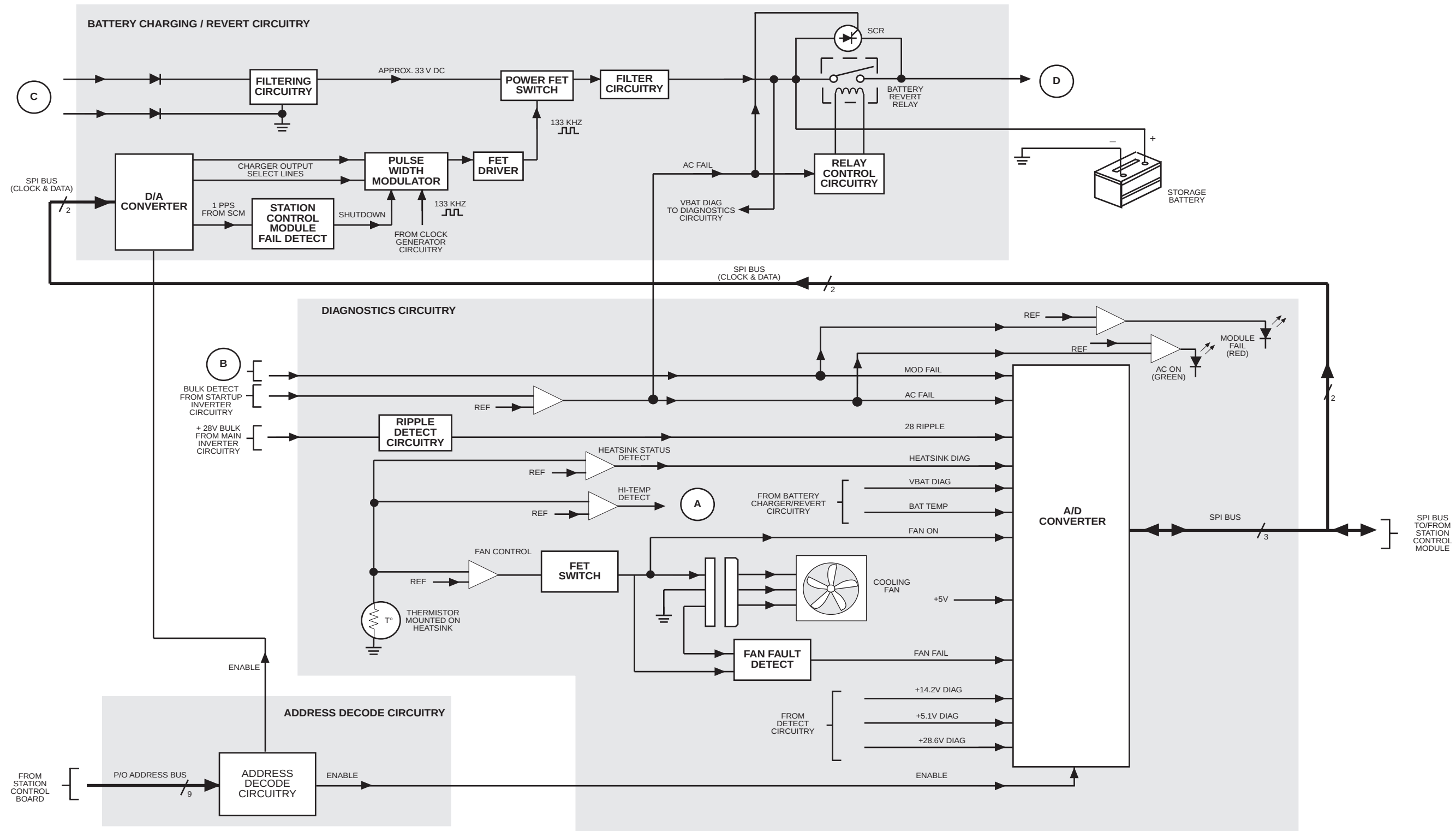


Figure:6-2 AC Power Supply Functional Block Diagram (Sheet 1 of 2)

EBTS009
051594JNM

AC Power Supply



EBTS010
042594JNM

Figure:6-2 AC Power Supply Functional Block Diagram
(Sheet 2 of 2)

Receiver

Overview

This section provides technical information for the Receiver (RX). Table 7-1 describes covered topics.

Table 7-1 **Chapter Topics**

Chapter	Page	Description
800 MHz 3X Receiver – CLN1283; 900 MHz 3X Receiver – CLN1356	7-40	Describes the functions and characteristics of the Receiver (RX) module for the 800 MHz and 900 MHz single channel Base Radio (BR).
1500 MHz Receiver – TLN3427	7-47	Describes the functions and characteristics of the Receiver (RX) module module for the 1500 MHz single channel Base Radio (BR).
800 MHz QUAD Channel Receiver – CLN1283;	7-51	Describes the functions and characteristics of the Receiver (RX) module module for the 800 MHz QUAD channel Base Radio (BR).
3X Receiver Functional Block Diagram	7-57	Functional Block Diagram for the Single Channel Base Radio Receiver (RX)
1500 MHz Receiver Functional Block Diagram	7-58	Functional Block Diagram for the QUAD Channel Base Radio Controller (BRC)
3X Receiver Functional Block Diagram	7-59	Functional Block Diagram for the QUAD Channel Base Radio Receiver (RX)

FRU Number to Kit Number Cross Reference

Receiver (RX) Field Replaceable Units (FRUs) are available for the iDEN EBTS. The FRU contains the RX kit and required packaging. Table 7-2 provides a cross reference between RX FRU numbers and kit numbers.

Table 7-2 **FRU Number to Kit Number Cross Referece**

Description	FRU Number	Kit Number
3 branch Receiver for 800 MHz Single Channel BR	CLN1283	CLF1470
3 branch Receiver for 900 MHz Single Channel BR	CLN1356	CLF1480
Receiver for 1500 MHz Single Channel BR	TLN3427	CRX1020
3 branch Receiver for 800 MHz QUAD Channel BR	CLN1496	CLF1550

800 MHz 3X Receiver – CLN1283; 900 MHz 3X Receiver – CLN1356

Overview

The 3X Receiver provides the receiver functions for the Base Radio. It consists of a receiver board, a slide-in housing, and associated hardware. The 3X Receiver incorporates one to three diversity branches on a single module. Figure 7-1 shows a top view of the Receiver with the cover removed.

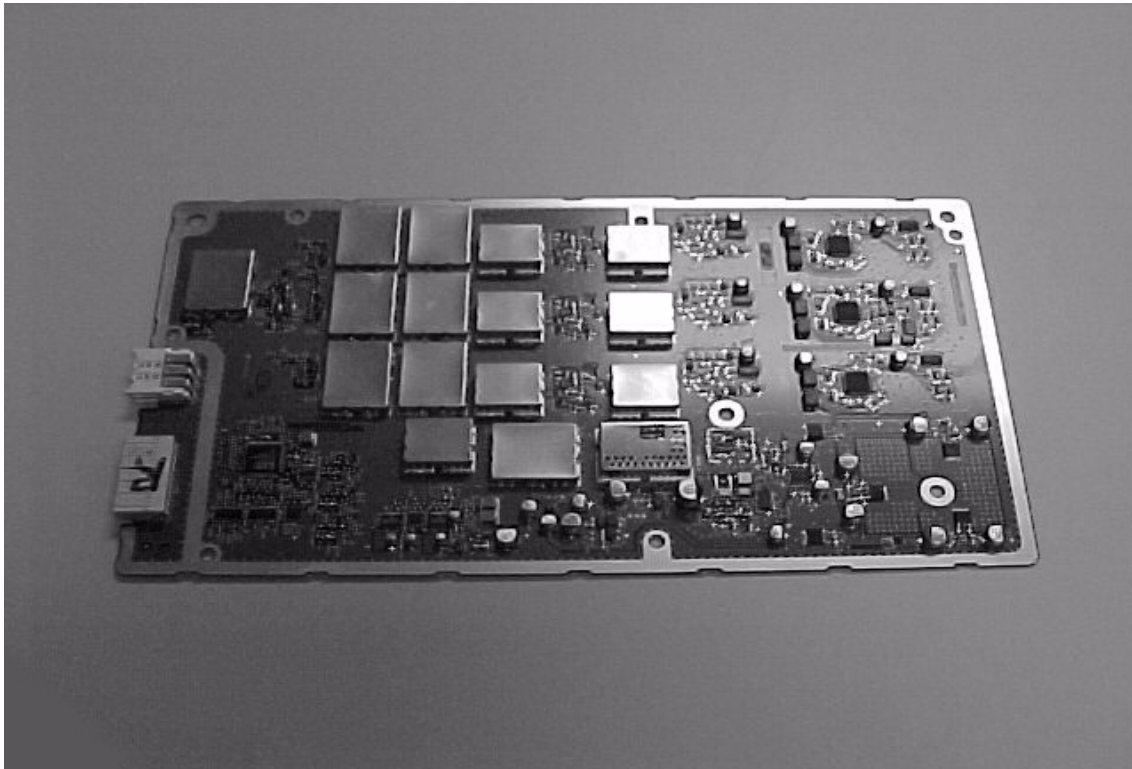


Figure:7-1 **QUAD Channel Receiver (with cover removed)**

Definition and Identification

The 3X receiver kit contains three receivers on a single board. This allows a single module to provide three-branch diversity BR functionality. To identify 3X receiver boards in the EBTS, use the MMI command **get_rx1_kit_no**. This command can be used on all receiver models, and reports the kit number from the receiver's EEPROM. The 3X receiver can also be identified by visual inspection of the front panel. Because the 3X receiver can only be inserted into the middle

receiver slot, the front panel of a 3X receiver reads: **INSERT ONLY IN SLOT RX2 WITH BACKPLANE 0183625X 3X RECEIVER.**

The two remaining receiver slots are covered with blank panels. A summary of the Receiver FRUs available for the Base Radio is provided in the chart below.

Table 7-3 **Receiver FRUs**

Receiver FRUs		Chassis FRUs	
3X Receiver: 800 MHz 900 MHz	CLN1283 CLN1356	With 3x Receiver Backplane: 800 MHz 900 MHz	CLN1282 N/A
Single Receiver: 800 MHz 900 MHz	TLN3336 N/A	With Single Receiver Backplane: 800 MHz 900 MHz	TLN3333 N/A

Replacement Compatibility

The 3X Receiver board (CRF6010 or CRF6030) can only be used in receive slot 2 (middle receiver slot) with backplane 0183625X __. The backplane connector is different than the TRF6560 version of the receiver board. This is why there is a need for a new backplane. The receiver will function only when it is installed in slot 2. The TRF6560 receiver will not make electrical connection in any slot of the new backplane. Compatibility between the new and old receiver boards is summarized in Tables 7-4 and 7-5 for 800 MHz and 900 MHz Base Radios, respectively.

Table 7-4 **800 MHz Base Radio Receiver Board/BR Backplane Compatibility**

	CRF6010 3X Receiver	TRF6560 Receiver
New backplane 0183265X--	Compatible	Not compatible
Old backplane 0182416W--	Not compatible	Compatible

Table 7-5 **900 MHz Base Radio Receiver Board/BR Backplane Compatibility**

	CRF6030A 3X Receiver
New backplane 0183265X--	Compatible
Old backplane 0182416W--	Not compatible

Diversity Configuration

There is a new software parameter used for diversity purposes with the CLN1283 and CLN1356 3X Receivers. The parameter is the **rx_fru_config** parameter. The diversity issues to consider are described in the following paragraph. This parameter can be accessed through the MMI commands using the Motorola password. ROMs prior to version R06.06.17 do not support the **rx_fru_config** parameter. The ROM version in a base repeater can be checked using the MMI command **ver**. If a repeater contains the CRF6010 or CRF6030 receiver, the BRC board must be populated with a compatible version of ROM. Table 7-6 lists the ROM compatibilities.

Table 7-6 **Receiver ROM Compatibility**

	CRF6010/CRF6030	TRF6560
ROM version R06.03.40	Not compatible	Compatible
ROM version R06.06.09	Not compatible	Compatible
ROM version R06.06.17	Not compatible	Compatible
ROM versions newer than R06.06.17	Compatible	Compatible

NOTE

When replacing FRUs, ensure that the ROM version on the BRC installed in the base radio is compatible with the ROM version on the Receiver.

NOTE

If downloaded code is used, then the downloaded code can be used to change the needed parameter (the **rx_fru_config** parameter).

Diversity Uses and Cautions

The 3X receiver board can be used in one, two, or three branch diversity systems. The number of active receivers is determined by the **rx_fru_config** parameter stored on the Base Radio Control (BRC) board. The **rx_fru_config** parameter is only valid, and must be set properly for, systems utilizing the CRF6010 or CRF6030 3X Receiver board. The **rx_fru_config** parameter is ignored by Base Radios that have ROM older than version R06.06.17 installed on the Base Radio Controller board.

To view the **rx_fru_config** parameter, use the MMI command **get rx_fru_config**. The configuration of each repeater can be changed in the field to match the number of receivers connected to antennas. To change the **rx_fru_config** parameter, use the command set **rx_fru_config yyy**, where yyy is the active receiver (yyy is 1 for one branch, 12 for two branch, and 123 for three branch diversity. For the iDEN system to work optimally, the **rx_fru_config** parameter must match the number of receivers connected to antennas.

CAUTION

There will be significant system degradation if the **rx_fru_config** parameter is not properly set in systems with the CLN1283 or CLN1356 3X receiver kit.

Modifying Base Radios from Three Branch to Two Branch Diversity

NOTE

This procedure is applicable only to Base Radios equipped with the CRF6010 or CRF6030 3X Receiver Board.

When modifying a three branch Base Radio to a two branch Base Radio, it is important to observe all precautionary statements in the previous paragraph.

To modify a three branch Base Radio to a two branch Base Radio:

1. Disconnect the RF cable from the RX3 connector on the Base Radio.
2. Connect an SMA male load (Motorola part number 5882106P03) to the RX3 connector on the Base Radio.

The SMA male load is required to limit the amount of radiated emissions.

3. Verify that the **rx_fru_config** parameter is set properly as described in the Diversity Uses and Caution paragraph above.

Modifying Base Radios from Two Branch to Three Branch Diversity

1. Remove the SMA male load from the RX3 connector of the Base Radio you wish to convert from two branch diversity to three branch diversity.
2. Connect the Receive Antenna #3 RF cable to the RX3 connector on the Base Radio.
3. Verify that the **rx_fru_config** parameter is set properly as described in the Diversity Uses and Cautions paragraph.

Theory of Operation

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 differential data format and sends it to the BRC.

Table 7-7 lists the Receiver circuitry and Figure 7-4 shows a functional block diagram for the Receiver.

Table 7-7 **Receiver Circuitry**

Circuit	Description
Frequency Synthesizer Circuitry	Consists of a phase-locked loop and VCO. It generates the 1st LO injection signal for all three receivers.
Receiver Front-End Circuitry	Provides filtering, amplification, and the 1st down conversion of the receive RF signal. Digital step attenuators at the 1st IF are included in this block.
Custom Receiver IC Circuitry	Consists of a custom IC to perform the 2nd down conversion, filtering, amplification, and conversion of the receive signal. This block outputs the receive signal as differential data to the BRC.
Address Decode, A/D Converter, & Memory Circuitry	Performs address decoding for board and chip select signal, converts analog status signals to digital format for use by the BRC. A memory device holds module specific information.
Local Power Supply Regulation	Accepts +14.2 Vdc input from the backplane interconnect board and generates two +10 Vdc, a +11.5 Vdc, and two +5 Vdc signals for the receiver.

Frequency Synthesizer and VCO Circuitry

The synthesizer and VCO circuitry generate the RF signal used to produce the 1st LO injection signal for the first mixer in all the Receiver front end circuits. Functional operation of these circuits involves a Phase-Locked Loop (PLL) and VCO.

The PLL IC receives frequency selection data from the BRC module microprocessor via the SPI bus. Once programmed, the PLL IC compares a 2.1 MHz reference signal from the BRC with a feedback sample of the VCO output from its feedback buffer.

Correction pulses are generated by the PLL IC, depending on whether the feedback signal is higher or lower in frequency than the 2.1 MHz reference. The width of these pulses is dependent on the amount of difference between the 2.1 MHz reference and the VCO feedback.

The up/down pulses are fed to a charge pump circuit that outputs a DC voltage proportional to the pulse widths. This DC voltage is low-pass filtered and fed to the VCO circuit as the control voltage. The control voltage is between +2.5 Vdc and +7.5 Vdc.

The DC control voltage from the synthesizer is fed to the VCO, which generates the RF signal used to produce the 1st LO injection signal. The VCO responds to the DC control voltage by generating the appropriate RF signal. This signal is fed through a buffer to the 1st LO injection amplifier. A sample of this signal is returned to the PLL IC through a buffer to close the VCO feedback loop.

Receiver Front End Circuitry

The station receive RF signal enters the Receiver through the RF-type connector located on the back of the Receiver board. This signal is low-pass filtered and amplified. The amplified output is image filtered before being input to the 1st mixer. The signal mixes with the 1st LO injection signal to produce a 73.35 MHz 1st IF signal.

The 1st IF signal is sent through a 4-pole bandpass filter and fed to a buffer amplifier. The buffer amplifier output signal is 4-pole bandpass filtered again and the resultant signal is then passed through a digital attenuator. This attenuation is determined by the BRC. The resulting signal is then fed to the RF input of the custom receive IC.

Custom Receiver IC Circuitry

The custom Receiver IC provides additional amplification, filtering, and a second down-conversion. The 2nd IF signal is converted to a digital signal and is output via differential driver circuitry to the BRC. This data signal contains the necessary I and Q information, AGC information, and other data transfer information required by the BRC to process the receive signal.

The remainder of the custom Receiver IC circuitry consists of timing and tank circuits to support the internal oscillator, 2nd LO synthesizer circuitry, and 2nd IF circuitry.

A serial bus provides data communications between the custom Receiver IC and the DSP Glue ASIC (DGA) located on the BRC. This bus enables the DGA to control various current and gain settings, establish the data bus clock rate, program the 2nd LO, and perform other control functions.

Address Decode Circuitry

The address decode circuitry enables the BRC to use the SPI bus to select a specific device on a specific Receiver for control or data communication purposes.

If the board select circuitry decodes address lines A2 through A5 as the Receiver address, it enables the chip select circuitry. The chip select circuitry then decodes address lines A0 and A1 to generate the chip select signals for the EEPROM, A/D converter, and PLL IC.

Memory Circuitry

The memory circuitry consists of three EEPROMs located on the Receiver. The BRC performs all memory read and write operations via the SPI bus. Information stored in this memory device includes the kit number, revision number, module specific scaling and correction factors, and free form module information (scratch pad).

A/D Converter Circuitry

Analog signals from various strategic operating points throughout the Receiver board are fed to the A/D converter. These analog signals are converted to a digital signal and are output to the BRC via the SPI lines upon request of the BRC.

Voltage Regulator Circuitry

The voltage regulator circuitry consists of two +10 Vdc, a +10.8 Vdc, and two +5 Vdc regulators. The two +10 Vdc and the +10.8 Vdc regulators accept the +14.2 Vdc input from the backplane interconnect board and generate the operating voltages for the Receiver circuitry.

The +10 Vdc regulators each feed a +5 Vdc regulator, one of which outputs Analog +5 Vdc, and the other Digital +5 Vdc operating voltages for use by the custom Receiver IC.

A +5.1 Vdc operating voltage is also available from the backplane interconnect board to supply +5.1 Vdc to the remainder of the Receiver circuitry.

1500 MHz Receiver – TLN3427

Overview

The Receiver module provides the receiver functions for the Repeater. It consists of a receiver board, a slide-in module housing, and associated hardware.

The receiver module assembly interconnects with the backplane through a 96-pin connector and a blindmate RF connector. Two captive panel fasteners located on the front of the module hold it in the chassis.

Figure 7-2 shows a top view of the Receiver module with the module cover removed.

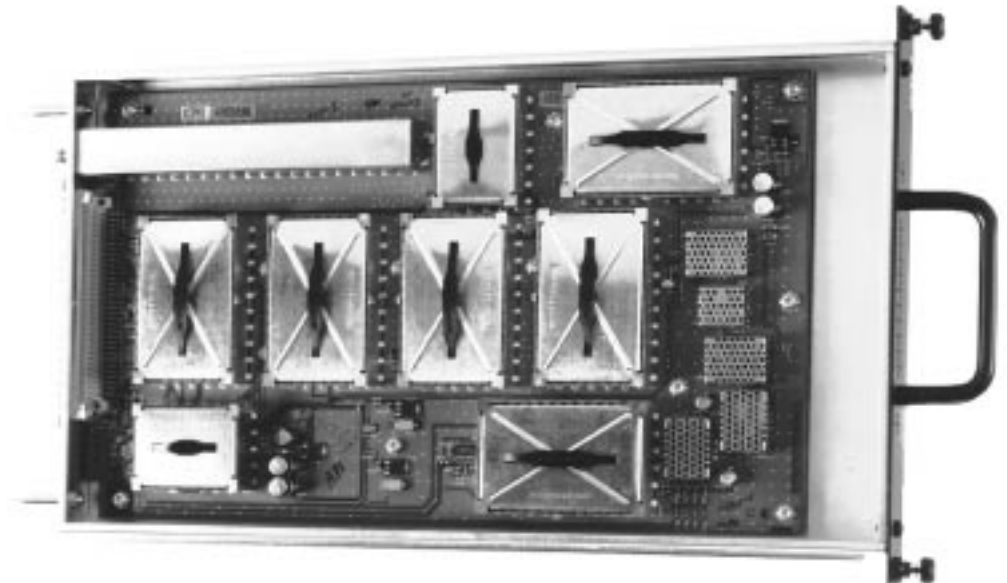


Figure:7-2 **Receiver (with top removed)**

1.5GHZ-B853

Theory of Operation

The Receiver module 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 differential data format and sends it to the Base Radio Controller module (BRC).

Table 7-8 lists and describes the Receiver circuitry and Figure 7-5 shows the functional block diagram.

1500 MHz Receiver – TLN3427**Table 7-8 Receiver Circuitry and Functions**

Receiver Circuit	This Circuit . . .
Frequency Synthesizer Circuitry	consists of a phase-locked loop and VCO. It generates the 1st LO injection signal.
Receiver Front-End Circuitry	provides filtering, amplification, and the 1st down-conversion of the receive RF signal. Digital step attenuators at the 1st IF are included in this block.
Custom Receiver IC Circuitry	consists of a custom IC to perform the 2nd down-conversion, filtering, amplification, and conversion of the receive signal. This block outputs the receive signal as differential data to the BRC module.
Address Decode, A/D Converter, & Memory Circuitry	performs address decoding for board and chip select signal, converts analog status signals to digital format for use by the BRC module. A memory device holds module specific information.
Local Power Supply Regulation	accepts +14.2 Vdc input from the backplane interconnect board and generates two +10 Vdc signals and two +5 Vdc signals for the receiver module.

Frequency Synthesizer and VCO Circuitry

The synthesizer and VCO circuitry generate the RF signal used to produce the 1st LO injection signal for the 1st mixer in the receiver front end circuitry. Functional operation of these circuits involves a Phase-Locked Loop (PLL) and VCO.

Phase-Locked Loop

The PLL IC receives frequency selection data from the BRC module microprocessor via the SPI bus. Once programmed, the PLL IC compares a 2.1 MHz reference signal from the BRC with a feedback sample of the VCO output from its feedback buffer.

Correction pulses are generated by the PLL IC, depending on whether the feedback signal is higher or lower in frequency than the 2.1 MHz reference. The width of these pulses is dependent on the amount of difference between the 2.1 MHz reference and the VCO feedback.

The up/down pulses are fed to a charge pump circuit that outputs a dc voltage proportional to the pulse widths. This dc voltage is low-pass filtered and fed to the VCO circuit as the control voltage. The control voltage is between +2.5 Vdc and +7.5 Vdc.

VCO

The dc control voltage from the synthesizer is fed to the VCO, which generates the RF signal used to produce the 1st LO injection signal. The VCO responds to the dc control voltage by generating the appropriate RF signal. A sample of this signal is returned to the PLL IC through a buffer to close the VCO feedback loop. Most of this signal is fed through a buffer to the doubler.

The frequency doubler is used to double the frequency of the RF signal from the VCO to produce the 1st LO injection signal. This frequency-doubled signal is sent to the injection amplifier to provide the 1st LO injection signal to the mixer in the receiver front end circuitry.

Receiver Front End Circuitry

The station receive RF signal enters the receiver module through the RF-type connector located on the receiver board. This signal is low-pass filtered. It is then sent to the preselector, and amplified. The amplified output is image filtered before being input to the 1st mixer. The signal mixes with the 1st LO injection signal to produce a 73.35 MHz 1st IF signal.

The 1st IF signal is sent through a 4-pole bandpass filter and fed to a buffer amplifier. The signal is 4-pole bandpass filtered again. The resultant signal passes through a digital attenuator. This attenuation is determined by the BRC module. The signal is then fed to the RF input of the custom receive IC.

Custom Receiver IC Circuitry

The custom receiver IC provides additional amplification, filtering, and a second down-conversion. The 2nd IF signal is converted to a digital signal and is output via differential driver circuitry to the BRC. This data signal contains the necessary I and Q information, AGC information, and other data transfer information required by the BRC to process the receive signal.

The remainder of the custom receiver IC circuitry consists of timing and tank circuits to support the internal oscillator, 2nd LO synthesizer circuitry, and 2nd IF circuitry.

A serial bus provides data communications between the custom receiver IC and the DSP Glue ASIC (DGA) located on the BRC. This bus enables the DGA to control various current and gain settings, establish the data bus clock rate, program the 2nd LO, and perform other control functions.

Address Decode, Memory, and A/D Converter Circuitry

The Address Decode, Memory and A/D Converter circuitry performs address decoding for board and chip select signals, converts analog status signals to digital format, and the memory holds module specific information.

Address Decode Circuitry

The address decode circuitry enables the BRC module to use the address bus. The BRC can select a specific device on a specific station module via the SPI bus for control or data communication purposes.

If the board select circuitry decodes address lines A2 through A5 as the receiver module address, it enables the chip select circuitry. The chip select circuitry then decodes address lines A0 and A1 to generate the chip select signals for the EEPROM, A/D converter, and PLL IC.

1500 MHz Receiver – TLN3427***Memory Circuitry***

The memory circuitry consists of an EEPROM located on the receiver module. The BRC module performs all memory read and write operations via the SPI bus. Information stored in this memory device includes the kit number, revision number, module specific scaling and correction factors, and free form module information (scratch pad).

A/D Converter Circuitry

Analog signals from various strategic operating points throughout the receiver board are fed to the A/D converter. These analog signals are converted to a digital signal and are output to the BRC via the SPI lines upon request of the BRC module.

Voltage Regulator Circuitry

The voltage regulator circuitry consists of two +10 Vdc and two +5 Vdc regulators. The +10 Vdc regulators accept the +14.2 Vdc input from the backplane interconnect board. Both regulators generate a +10 Vdc operating voltage for the receiver board circuitry.

One of the +10 Vdc regulators feed two +5 Vdc regulators, which outputs an Analog +5 Vdc and Digital +5 Vdc operating voltages for use by the custom receiver IC.

A +5.1 Vdc operating voltage is also available from the backplane interconnect board to supply +5.1 Vdc to the remainder of the receiver board circuitry.

800 MHz QUAD Channel Receiver – CLN1283;

Overview

The QUAD receiver provides receiver functions for the QUAD Channel Base Radio. The QUAD receiver consists of a receiver board, a slide-in housing, and associated hardware. A single module of the QUAD receiver incorporates one to three diversity branches. Figure 7-3 shows a top view of the Receiver with the cover removed.

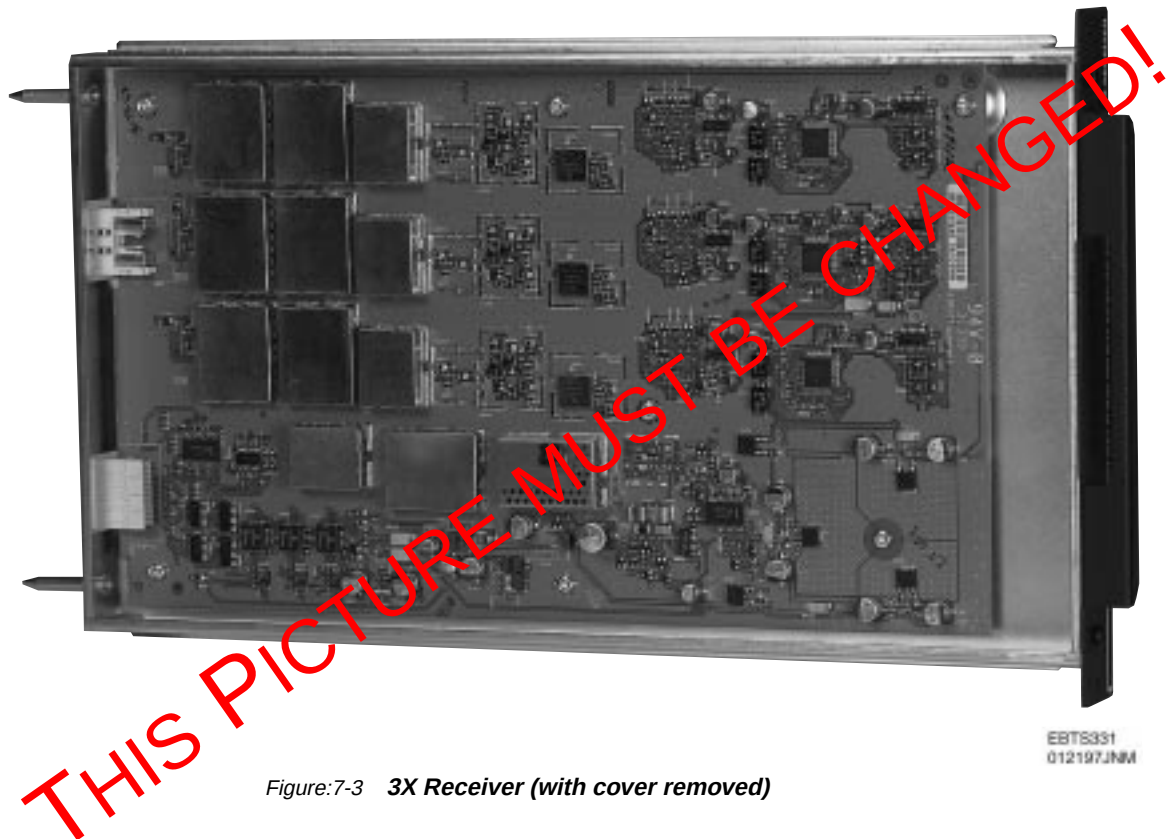


Figure:7-3 3X Receiver (with cover removed)

Diversity Uses and Cautions

The 3X receiver board can be used in one, two, or three-branch diversity systems. The **rx_fru_config** parameter determines the number of active receivers. To view the **rx_fru_config** parameter, use the MMI command. **(See software commands.)** Each repeater's configuration can be changed in the field to match the number of receivers connected to antennas. To change the **rx_fru_config**

800 MHz QUAD Channel Receiver – CLN1283;

parameter, use the command (**reference software commands**). In this command, yyy is the active receiver. (Note: yyy is 1 for one branch, 12 for two branch, and 123 for three branch diversity.) For the iDEN system to work optimally, the **rx_fru_config** parameter must match the number of receivers connected to antennas.

CAUTION

Improperly setting the **rx_fru_config** parameter will cause serious system degradation.

Modifying Base Radios from Three Branch to Two Branch Diversity

When modifying a three-branch Base Radio to a two-branch Base Radio, observing all precautionary statements in the previous paragraph is important.

To modify a three-branch Base Radio to a two-branch Base Radio:

1. Disconnect the RF cable from the RX3 connector on the Base Radio.
2. Connect an SMA male load (Motorola part number 5882106P03) to the RX3 connector on the Base Radio.

The SMA male load is required to limit the amount of radiated emissions.

3. Verify that the **rx_fru_config** parameter is set properly, according to the Diversity Uses and Caution paragraph above.

Modifying Base Radios from Two Branch to Three Branch Diversity

1. Remove the SMA male load from the RX3 connector of the Base Radio that you wish to convert from two-branch diversity to three-branch diversity.
2. Connect the Receive Antenna #3 RF cable to the RX3 connector on the Base Radio.
3. Verify that the **rx_fru_config** parameter is set properly, according to the Diversity Uses and Cautions paragraph.

Theory of Operation

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 differential data format and sends it to the BRC.

Table 7-7 lists the Receiver circuitry. Figure 7-6 shows a functional block diagram for the Receiver.

Table 7-9 **Receiver Circuitry**

Circuit	Description
Frequency Synthesizer Circuitry	Consists of a phase-locked loop and VCO. It generates the 1st LO injection signal for all three receivers.
Receiver Front-End Circuitry	Provides filtering, amplification, and the 1st down conversion of the receive RF signal. This block includes digital step attenuators at the 1st IF.
Custom Receiver IC Circuitry	Consists of a custom IC to perform the 2nd down conversion, filtering, amplification, and conversion of the receive signal. This block outputs the receive signal as differential data to the BRC.
Address Decode, A/D Converter, & Memory Circuitry	Performs address decoding for board and chip-select signals. Converts analog status signals to digital format for use by the BRC. A memory device holds module-specific information.
Local Power Supply Regulation	Accepts +14.2 Vdc input from the backplane interconnect board. Also generates two +10 Vdc, a +11.5 Vdc, and two +5 Vdc signals for the receiver.

Frequency Synthesizer and VCO Circuitry

The synthesizer and VCO circuitry generate the RF signal used to produce the 1st LO injection signal for the first mixer in all the Receiver front end circuits. Functional operation of these circuits involves a Phase-Locked Loop (PLL) and VCO.

The PLL IC receives frequency selection data from the BRC module microprocessor via the SPI bus. Once programmed, the PLL IC compares a 2.1 MHz reference signal from the BRC with a feedback sample of the VCO output from its feedback buffer.

800 MHz QUAD Channel Receiver – CLN1283;

The PLL ICC generates correction pulses, depending on whether the feedback signal is higher or lower in frequency than the 2.1 MHz reference. The width of these pulses depends on the amount of difference between the 2.1 MHz reference and the VCO feedback.

The up/down pulses enter a charge pump circuit. The charge pump outputs a DC voltage proportional to the pulse widths. After low-pass filtering, this DC voltage enters the VCO circuit as the control voltage. The control voltage measures between +2.5 Vdc and +7.5 Vdc.

The DC control voltage from the synthesizer enters the VCO. The VCO generates the RF signal that the circuit uses to produce the 1st LO injection signal. The VCO responds to the DC control voltage by generating the appropriate RF signal. This signal passes through a buffer to the 1st LO injection amplifier. A sample of this signal returns to the PLL IC through a buffer to close the VCO feedback loop.

Receiver Front End Circuitry

The station receive RF signal enters the Receiver through the RF-type connector on the back of the Receiver board. The circuit low-pass filters and amplifies this signal. The amplified output passes through an image filter before entering the 1st mixer. The signal mixes with the 1st LO injection signal to produce a 73.35 MHz 1st IF signal.

The 1st IF signal passes through a four-pole, bandpass filter and enters a buffer amplifier. The buffer amplifier output signal again undergoes four-pole, bandpass filtering. The resultant signal then passes through a digital attenuator. The BRC determines the amount of attenuation. The resulting signal then enters the RF input of the custom Receiver IC.

Custom Receiver IC Circuitry

The custom Receiver IC provides additional amplification, filtering, and a second down-conversion. The IC converts the 2nd IF signal to a digital signal. The digital signal exits the receiver IC via differential driver circuitry, and passes to the BRC. This data signal contains I and Q information, AGC information, and other data transfer information. The BRC uses this information to facilitate processing of the receive signal.

The remainder of the custom Receiver IC circuitry consists of timing and tank circuits. These circuits support the internal oscillator, 2nd LO synthesizer, and 2nd IF circuitry.

A serial bus provides data communications between the custom Receiver IC and the DSP Glue ASIC (DGA). These circuits are on the BRC. The serial bus enables the DGA to perform several control functions...

- ☐ control various current and gain settings
- ☐ establish the data bus clock rate
- ☐ program the 2nd LO
- ☐ perform other control functions

Address Decode Circuitry

Address decode circuitry enables the BRC to use the SPI bus to select a specific device on a specific Receiver for control or data communication purposes.

If board-select circuitry decodes address lines A2 through A5 as the Receiver address, it enables the chip select circuitry. The chip select circuitry then decodes address lines A0 and A1. The decoding process generates the chip select signals for the EEPROM, A/D converter, and PLL IC.

Memory Circuitry

The memory circuitry consists of three EEPROMs located on the Receiver. The BRC performs memory read and write operations via the SPI bus. Information stored in this memory device includes...

- ☐ the kit number
- ☐ revision number
- ☐ module specific scaling and correction factors
- ☐ free form module information (scratch pad)

A/D Converter Circuitry

Analog signals from various strategic operating points throughout the Receiver board pass through the A/D converter. These analog signals become a digital signal. Upon request of the BRC, this signal travels to the BRC via the SPI lines.

Voltage Regulator Circuitry

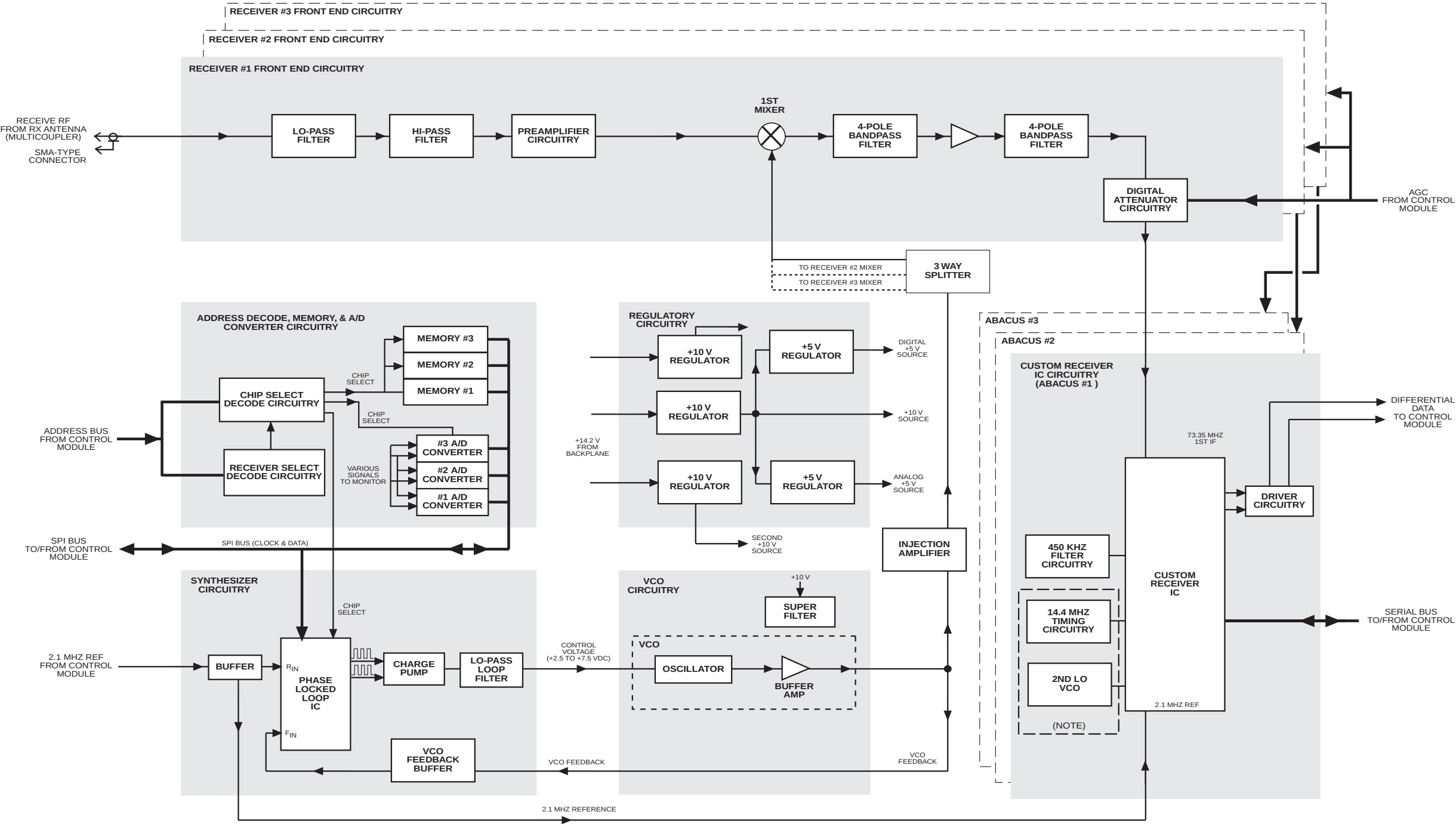
The voltage regulator circuitry consists of two +10 Vdc, a +10.8 Vdc, and two +5 Vdc regulators. The two +10 Vdc and the +10.8 Vdc regulators accept the +14.2 Vdc input from the backplane interconnect board. These regulators produce operating voltages for the Receiver circuitry.

The +10 Vdc regulators each feed a +5 Vdc regulator. One of these regulators outputs Analog +5 Vdc. The other regulator outputs Digital +5 Vdc operating voltages for use by the custom Receiver IC.

The backplane interconnect board also produces a +5.1 Vdc operating voltage. This voltage powers the remainder of the Receiver circuitry.

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3X Receiver
Functional Block Diagram



NOTE: 14.4 MHz TIMING CIRCUITRY AND 2ND LO VCO PRESENT ONLY ON ABACUS #2. FUNCTIONS ARE SHARED FOR ALL THREE ABACUS SECTIONS.

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Figure:7-4 3X Receiver Functional Block Diagram

Receiver

Receiver

Functional Block Diagram
Model TLN3427

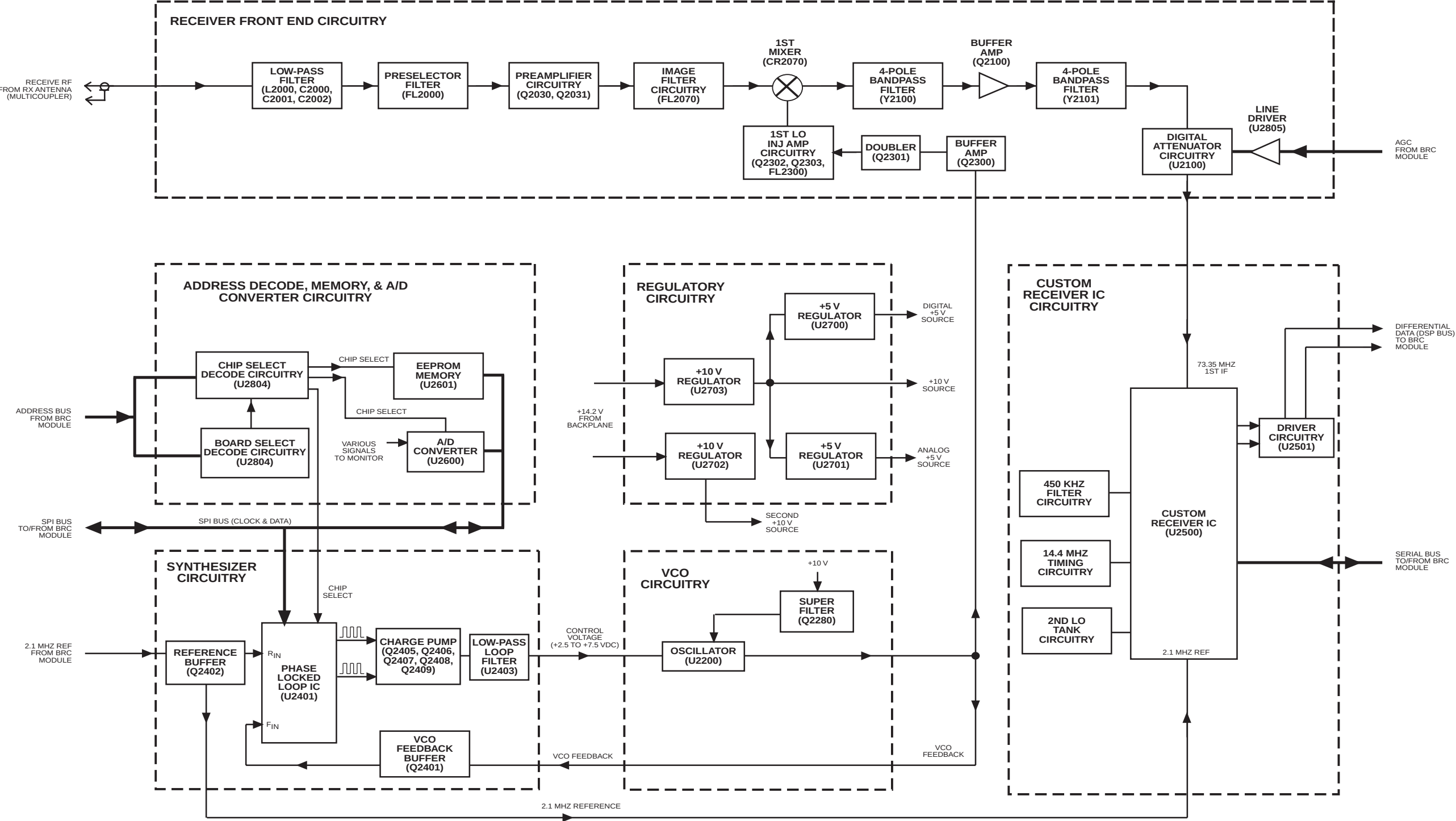


Figure:7-5 1500 MHz Receiver Functional Block Diagram

QUAD Receiver
Functional Block Diagram

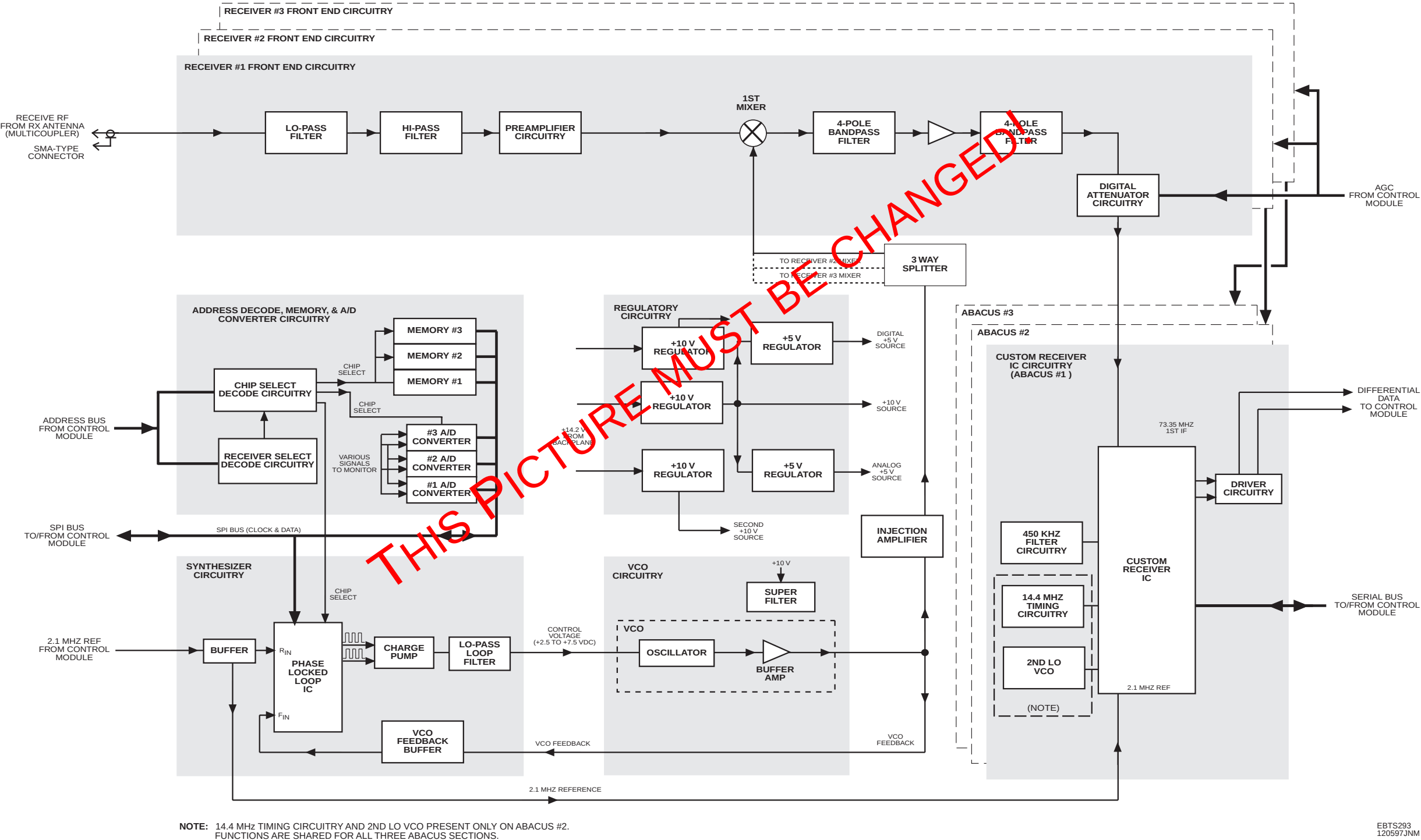


Figure:7-6 3X Receiver Functional Block Diagram

Receiver

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Troubleshooting Single Channel Base Radios

Overview

This chapter isolates single channel Base Radio failures to the FRU level. The chapter contains procedures for:

chapter contains procedures for:

- ☐ Troubleshooting
- ☐ Verification
- ☐ Station Operation

The Base Radio maintenance philosophy is repair by replacing defective FRUs with new FRUs. This maintenance method limits down-time, and quickly restores the Base Radio to normal operation.

Two Base Radio troubleshooting procedures appear here. Each procedure quickly identifies faulty FRUs.

Ship defective FRUs to a Motorola repair depot for repair.

Recommended Test Equipment

Table 8-1 lists recommended test equipment for performing Base Radio troubleshooting and verification procedures.

Table 8-1 **Recommended Test Equipment**

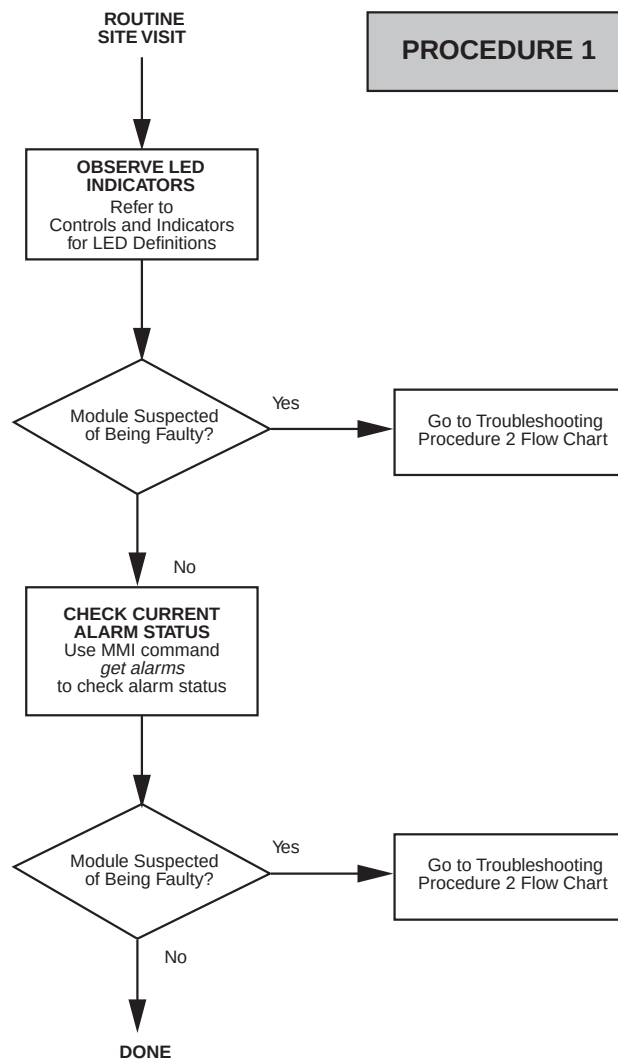
Test Equipment	Model Number	Use
Communications Analyzer	R2660 w/iDEN option	Used for checking receive and transmit operation (iDEN signaling capability) and station alignment
Dummy Load (50 Ω , 150 W)	none	Used to terminate output
Service Computer	IBM or clone, 80286 or better	Local service terminal
Portable Rubidium Frequency Standard	Ball Efratom	Frequency standard for R2660, netting TFR
Power Meter	none	Used to measure reflected and forward power
RF Attenuator, 250 W, 10 dB	Motorola 0180301E72	Protection for R2660
Software: Communication File Compression	Procomm Plus PKZip	Local service computer Compress/Decompress data

Troubleshooting Procedures

Many of the troubleshooting and station operation procedures require Man-Machine Interface (MMI) commands. These commands are used to communicate station level commands to the Base Radio via the RS-232 communications port located on the front of the BRC.

Routine Checkout

Procedure 1 is a quick, non-intrusive test performed during a routine site visit. Use this procedure to verify proper station operation without taking the station out of service. Figure 8-1 shows the Procedure 1 Troubleshooting Flowchart.



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Figure:8-1 Procedure 1 Troubleshooting Flowchart

Reported/Suspected Problem

Use Procedure 2 to troubleshoot reported or suspected equipment malfunctions. Perform this procedure with equipment in service (non-intrusive) and with equipment taken temporarily out of service (intrusive).

Figure 8-2 shows the Procedure 2 Troubleshooting Flowchart.

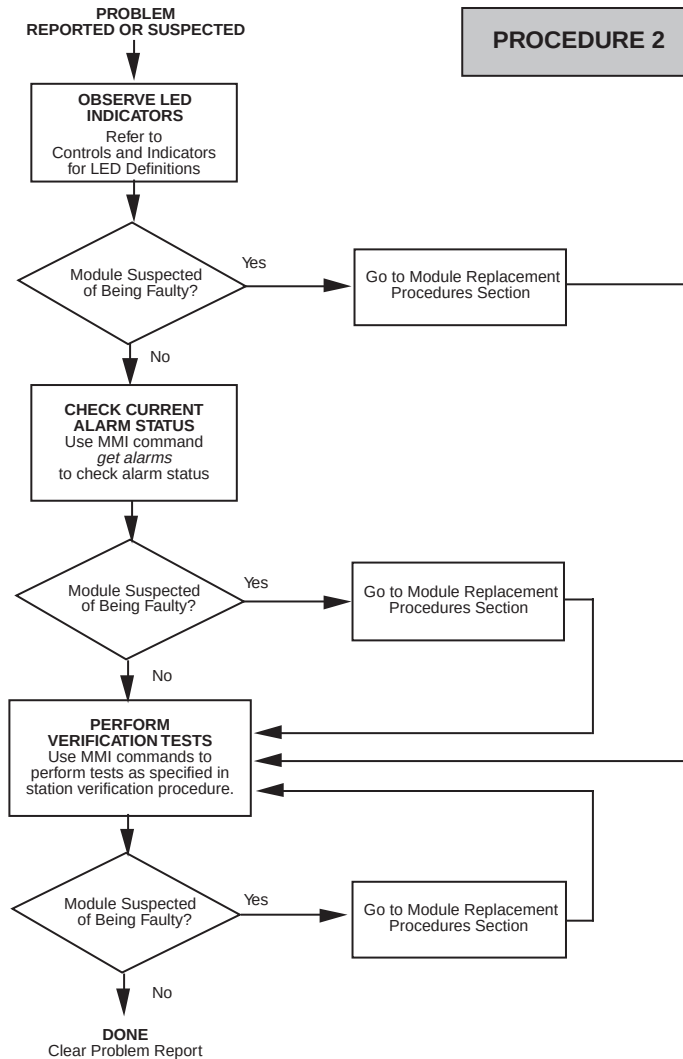


Figure:8-2 Procedure 2 Troubleshooting Flowchart

Base Radio/Base Radio FRU Replacement Procedures

Replace suspected station modules with known non-defective modules to restore the station to proper operation. The following procedures provide FRU replacement instructions and post-replacement adjustments and/or verification instructions.

Base Radio Replacement Procedure

NOTE

The Base Radio removal and installation procedures are included for reference or buildout purposes. Field maintenance of Base Radios typically consists of replacement of FRUs within the Base Radio. Perform Base Radio FRU replacement in accordance with "Base Radio FRU Replacement Procedure" below.

Perform Base Radio (BR) replacement as described in the following paragraphs.

Removal

Remove BR from Equipment Cabinet as follows:

1. Remove power from the Base Radio by setting the Power Supply ON/OFF switch to the OFF position.
2. Tag and disconnect the cabling from the BR rear panel connectors.
3. Remove the four M6 TORX screws which secure the BR front panel to the Equipment Cabinet mounting rails.

 WARNING

BR WEIGHT EXCEEDS 60 LBS (27 KG). USE TWO-PERSON LIFT WHEN REMOVING OR INSTALLING BR FROM EQUIPMENT CABINET. MAKE CERTAIN BR IS FULLY SUPPORTED WHEN BR IS FREE FROM MOUNTING RAILS.

4. While supporting the BR, carefully remove the BR from the Equipment Cabinet by sliding the BR from the front of cabinet.

Base Radio/Base Radio FRU Replacement Procedures**Installation**

Install BR in Equipment Cabinet as follows:

1. If adding a BR, install side rails in the appropriate BR mounting position in the rack.
2. While supporting the BR, carefully lift and slide the BR in the Equipment Cabinet mounting position.
3. Secure the BR to the Equipment Cabinet mounting rails using four M6 TORX screws. Tighten the screws to 40 in-lb (4.5 Nm).
4. Connect the cabling to the BR rear panel connectors as tagged during the BR removal. If adding a BR, perform the required cabling in accordance with the Cabling Information subsection of the RFDS section applicable to the system.
5. Perform BR activation in accordance with Station Verification Procedures below.

Anti-Static Precautions**CAUTION**

The Base Radio contains static-sensitive devices. when replacing Base Radio FRUs, always wear a grounded wrist strap and observe proper anti-static procedures to prevent electrostatic discharge damage to Base Radio modules.

Motorola publication 68P81106E84 provides complete static protection information. This publication is available through Motorola National Parts.

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 grounding clip is provided with each EBTS cabinet. If not available, use another appropriate grounding point.
- ☐ DO NOT insert or remove modules with power applied to the Base Radio. ALWAYS turn the power OFF using the Power Supply rocker switch on the front of the Power Supply module.
- ☐ Keep spare modules in factory packaging for transporting. When shipping modules, always pack in original packaging.

FRU Replacement Procedure

Perform the following steps to replace any of the Base Radio FRUs:

NOTE

When servicing Base Radios (BRs), in situations where the Control Board or the entire BR is replaced, the integrated Site Controller (iSC) will automatically reboot the serviced BR given that the BR has been off-line for a period not less than that stipulated by the "Replacement BRC Accept Timer" (default is 3 minutes). If the BR is turned on prior to the expiration of the "Replacement BRC Accept Timer", power the BR back down and wait the minimum timer length before turning the BR back on.

1. Remove power from the Base Radio by setting the Power Supply rocker switch (located behind the front panel of the Power Supply) to the OFF (0) position.
2. Loosen the front panel fasteners. These are located on each side of the module being replaced.
3. Pull out the module.
4. Insert the non-defective replacement module by aligning the module side rails with the appropriate rail guides inside the Base Radio chassis.
5. Gently push the replacement module completely into the Base Radio chassis assembly using the module handle(s).

CAUTION

DO NOT slam or force the module into the chassis assembly. This will damage the connectors or backplane.

6. Secure the replacement module by tightening the front panel fasteners to the specified torque of 5 in-lbs.
7. Apply power to the Base Radio by setting the switch to the ON position.
8. Perform the Station Verification Procedure provided below.

Base Radio/Base Radio FRU Replacement Procedures**Power Amplifier (PA) Fan FRU Replacement**

Perform the following steps to replace the Power Amplifier (PA) fans.

1. Remove the Power Amplifier from the Base Radio per FRU Replacement Procedure.
2. Disconnect fan power cable from PA housing.
3. Remove front panel from fan assembly.
4. Remove fan assembly from PA chassis.

NOTE

Reverse above procedure to install new fan kit.

Station Verification Procedures

Perform the Station Verification Procedures whenever you replace a FRU. The procedures verify transmit and receive operations. Each procedure also contains the equipment set-up.

Replacement FRU Verification

All module specific information is programmed in the factory prior to shipment. Base Radio specific information (e.g., receive and transmit frequencies) is downloaded to the Base Radio from the network/site controller.

Replacement FRU alignment is not required for the Base Radio.

Base Repeater FRU Hardware Revision Verification

NOTE

The following procedure requires the Base Radio to be out of service. Unless the Base Radio is currently out of service, Motorola recommends performing this procedure during off-peak hours. This minimizes or eliminates disruption of service to system users.

1. Connect one end of the RS-232 cable to the service computer.
2. Connect the other end of the RS-232 cable to the STATUS port, located on the front panel of the BRC.
3. Using the field password, login to the BR.

Station Verification Procedures

4. Collect revision numbers from the station by typing the following commands:

```
BRC>dekey
BRC>test_mode
BRC>get brc_rev_no
BRC>get rx1_rev_no
BRC>get rx2_rev_no
BRC>get rx3_rev_no           (if BR is 3 branch)
BRC>get pa_rev_no
BRC>get ex_rev_no

BRC>
```

5. If all modules return revision numbers of the format "Rxx.xx.xx", then all revision numbers are present and no further action is required. Log out and repeat steps 1 through 4 for each additional BR.

If revision numbers were returned as blank or not in the format "Rxx.xx.xx", contact your local Motorola representative or Technical Support.

6. When all BRs have been checked, log out.

Transmitter Verification

The transmitter verification procedure verifies the transmitter operation and the integrity of the transmit path. This verification procedure is recommended after replacing an Exciter, Power Amplifier, BRC, or Power Supply module.

NOTE

The following procedure requires the Base Radio to be out of service. Unless the Base Radio is currently out of service, Motorola recommends performing this procedure during off-peak hours. This minimizes or eliminates disruption of service to system users.

Equipment Setup

To set up the equipment, use the following procedure:

1. Remove power from the Base Radio by setting the Power Supply rocker switch (located behind the front panel of the Power Supply) to the OFF (0) position.
2. Connect one end of the RS-232 cable to the service computer.

3. Connect the other end of the RS-232 cable to the STATUS port located on the front panel of the BRC.
4. Disconnect the existing cable from the connector labeled PA OUT.
This connector is located on the backplane of the Base Radio.
5. Connect a test cable to the PA OUT connector.
6. Connect a 10 dB attenuator on the other end of the test cable.
7. From the attenuator, connect a cable to the RF IN/OUT connector on the R2660 Communications Analyzer.
8. Remove power from the R2660 and connect the Rubidium Frequency Standard 10MHZ OUTPUT to a 10 dB attenuator.
9. Connect the other end of the 10 dB attenuator to the 10MHZ REFERENCE OSCILLATOR IN/OUT connector on the R2660.

NOTE

Refer to the equipment manual provided with the R2660 for further information regarding mode configuration of the unit (Motorola Part No. 68P80386B72).

10. Set the R2660 to the EXT REF mode.
11. Apply power to the R2660.
12. Set the R2660 to the SPECTRUM ANALYZER mode with the center frequency set to the transmit frequency of the Base Radio under test.
13. Perform the appropriate transmitter verification procedure below for the particular Power Amplifier used in the Base Radio.

**Transmitter Verification Procedure
(40W, 800 MHz Power Amplifier – TLF2020)**

This procedure provides commands and responses to verify proper operation of the transmit path for 800 MHz Base Radios using a 40 Watt Power Amplifier.

Station Verification Procedures

1. Apply power to the Base Radio by setting the switch to the 1 position.

The following message displays on the service computer during power-up.

```
Base Radio
firmware revision RXX.XX.XX
Copyright © 1998
Motorola, Inc. All rights reserved.
```

```
Unauthorized access prohibited
```

```
Enter login password:
```

2. Enter the proper password. After entering the correct password, the BRC> prompt is displayed on the service computer.

The default password is **motorola**

NOTE

Motorola recommends that you change the default password once proper operation of the equipment is verified.

3. At the BRC> prompt, type: **dekey**

This command verifies that there is no RF power being transmitted.

```
BRC> dekey
XMIT OFF INITIATED
```

CAUTION

The following command keys the transmitter. Make sure that transmission only occurs on licensed frequencies or into a RF load.

4. At the BRC> prompt, type: **set tx_power 40**

This command sets the transmitter output to 40 Watts.

```
BRC> set tx_power 40
setting transmitter power to 40 watts

TXLIN ATTENUATION: 5.000000

TARGET POWER: 40.00 watts [46.02 dBm]
ACTUAL POWER: 37.77 watts [45.07 dBm]
POWER WINDOW: 38.20-> 41.89 watts [45.82 -> 46.22 dBm]
TXLIN LEVEL REGISTER REDUCED 59 STEPS [-2.30 dB].
TXLIN LEVEL: 0x6f

completed successfully
```

After keying the Base Radio, verify the forward and reflected powers of the station along with the station VSWR with the parameters listed in Table 8-2.

Table 8-2 **40W, 800 MHz PA Transmitter Parameters**

Parameter	Value or Range
Forward Power	Greater than 38.0 Watts
Reflected Power	Less than 4.0 Watts
VSWR	Less than 2:1

5. At the BRC> prompt, type: **get fwd_pwr**

This command returns the current value of forward power from the RF Power Amplifier.

```
BRC> get fwd_pwr
FORWARD POWER is 39.13 watts [45.92 dBm]
```

Station Verification Procedures

6. At the BRC> prompt, type: **get ref_pwr**

This command returns the current value of reflected power from the RF Power Amplifier.

```
BRC> get ref_pwr  
REFLECTED POWER is 0.27 watts [24.28 dBm]
```

7. At the BRC> prompt, type: **get vswr**

This command calculates the current Voltage Standing Wave Ratio (VSWR) from the RF Power Amplifier.

```
BRC> get vswr  
VSWR is 1.17:1
```

8. At the BRC> prompt, type: **get alarms**

This command returns all active alarms of the Base Radio.

```
BRC> get alarms  
NO ALARM CONDITIONS DETECTED
```

NOTE

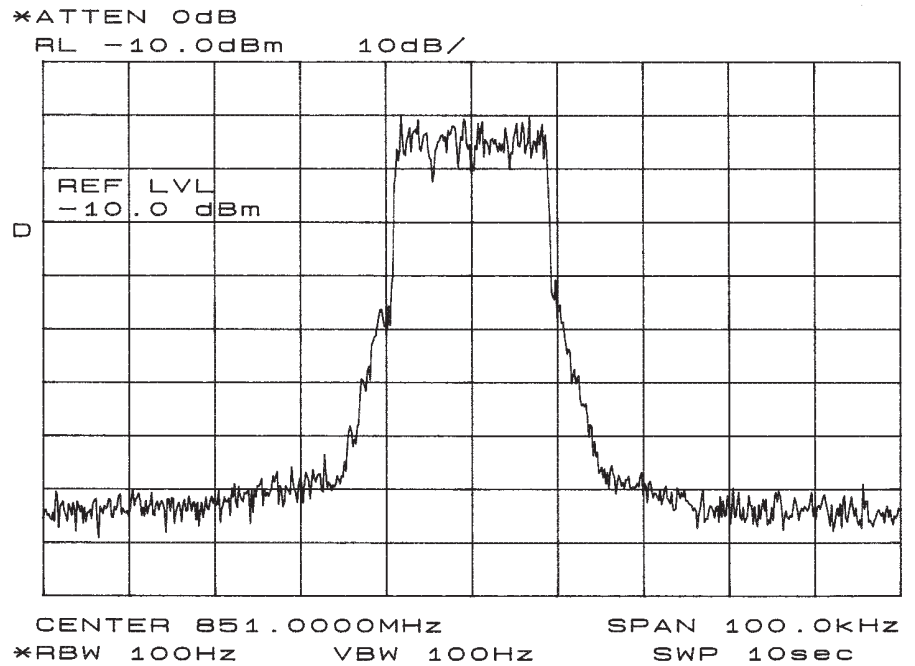
If the **get alarms** command displays alarms, refer to the *System Troubleshooting* section of this manual for corrective actions.

9. View the spectrum of the transmitted signal on the R2660 Communications Analyzer in the Spectrum Analyzer mode. Figure 8-3 shows a sample of the spectrum.

10. At the BRC> prompt, type: **dekey**

This command stops all transmitter activity.

```
BRC> dekey  
XMIT OFF INITIATED
```



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Figure:8-3 Transmitted Signal Spectrum (800 MHz BR)

Transmitter Verification Procedure (70W, 800 MHz Power Amplifiers – CTF1040)

This procedure provides commands and responses to verify proper operation of the transmit path for 800 MHz Base Radios using a 70 Watt Power Amplifier.

1. Apply power to the Base Radio by setting the switch to the 1 position.

The following message displays on the service computer during power-up.

```
Base Radio
firmware revision RXX.XX.XX
Copyright © 1998
Motorola, Inc. All rights reserved.
```

```
Unauthorized access prohibited
```

```
Enter login password:
```

Station Verification Procedures

2. Enter the proper password. After entering the correct password, the BRC> prompt is displayed on the service computer.

The default password is **motorola**

NOTE

Motorola recommends that you change the default password once proper operation of the equipment is verified.

3. At the BRC> prompt, type: **dekey**

This command verifies that there is no RF power being transmitted.

```
BRC> dekey
XMIT OFF INITIATED
```

CAUTION

The following command keys the transmitter. Make sure that transmission only occurs on licensed frequencies or into an RF load.

4. At the BRC> prompt, type: **set tx_power 70**

This command sets the transmitter output to 70 Watts.

```
BRC> set tx_power 70
setting transmitter power to 70 watts

TXLIN ATTENUATION: 5.000000

TARGET POWER: 70.00 watts [48.45 dBm]
ACTUAL POWER: 56.70 watts [47.54 dBm]
POWER WINDOW: 66.85 -> 73.30 watts [48.25 -> 48.65 dBm]
TXLIN LEVEL REGISTER REDUCED 85 STEPS [-3.32 dB].
TXLIN LEVEL: 0x55

completed successfully
```

After keying the Base Radio, verify the forward and reflected powers of the station along with the station VSWR with the parameters listed in Table 8-3.

Table 8-3 **70W, 800 MHz PA Transmitter Parameters**

Parameter	Value or Range
Forward Power	Greater than 66.5 Watts
Reflected Power	Less than 7.0 Watts
VSWR	Less than 2:1

5. At the BRC> prompt, type: **get fwd_pwr**

This command returns the current value of forward power from the RF Power Amplifier.

```
BRC> get fwd_pwr
FORWARD POWER is 68.55 watts [48.36 dBm]
```

Station Verification Procedures

6. At the BRC> prompt, type: **get ref_pwr**

This command returns the current value of reflected power from the RF Power Amplifier.

```
BRC> get ref_pwr  
REFLECTED POWER is 2.10 watts [33.22 dBm]
```

7. At the BRC> prompt, type: **get vswr**

This command calculates the current Voltage Standing Wave Ratio (VSWR) from the RF Power Amplifier.

```
BRC> get vswr  
VSWR is 1.42:1
```

8. At the BRC> prompt, type: **get alarms**

This command returns all active alarms of the Base Radio.

```
BRC> get alarms  
NO ALARM CONDITIONS DETECTED
```

NOTE

If the **get alarms** command displays alarms, refer to the *System Troubleshooting* section of this manual for corrective actions.

9. View the spectrum of the transmitted signal on the R2660 Communications Analyzer in the Spectrum Analyzer mode. Figure 8-4 shows a sample of the spectrum.

10. At the BRC> prompt, type: **dekey**

This command stops all transmitter activity.

```
BRC> dekey  
XMIT OFF INITIATED
```

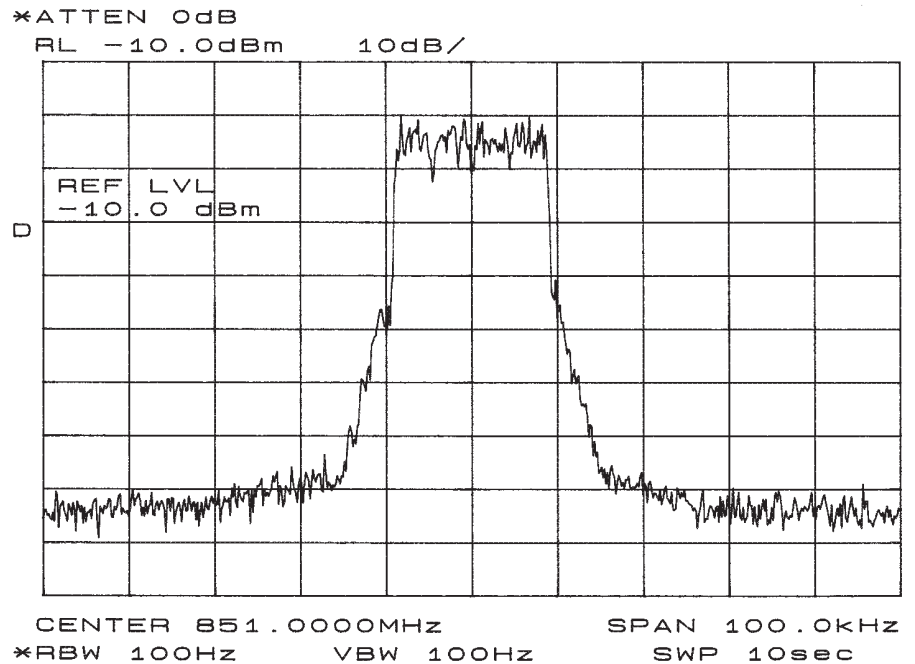
EBTS071
032594JNM

Figure:8-4 Transmitted Signal Spectrum (800 MHz BR)

Transmitter Verification Procedure (60W, 900 MHz Power Amplifier – CLN1355)

This procedure provides commands and responses to verify proper operation of the transmit path for 900 MHz Base Radios using 60 Watt Power Amplifier, CLN1355 (kit no. CTF1300).

1. Apply power to the Base Radio by setting the switch to the 1 position.

The following message displays on the service computer during power-up.

```
Base Radio
firmware revision RXX.XX.XX
Copyright © 1998
Motorola, Inc. All rights reserved.

Unauthorized access prohibited

Enter login password:
```

Station Verification Procedures

2. Enter the proper password. After entering the correct password, the BRC> prompt is displayed on the service computer.

The default password is **motorola**

NOTE

Motorola recommends that you change the default password once proper operation of the equipment is verified.

3. At the BRC> prompt, type: **dekey**

This command verifies that there is no RF power being transmitted.

```
BRC> dekey
XMIT OFF INITIATED
```

CAUTION

The following command keys the transmitter. Make sure that transmission only occurs on licensed frequencies or into an RF load.

4. At the BRC> prompt, type: **set tx_power 60**

This command sets the transmitter output to 60 Watts.

```
BRC> set tx_power 60
setting transmitter power to 60 watts

TXLIN ATTENUATION: 5.000000

TARGET POWER: 60.00 watts [47.78 dBm]
ACTUAL POWER: 56.70 watts [47.54 dBm]
POWER WINDOW: 57.30 -> 62.85 watts [47.58 -> 47.98 dBm]
TXLIN LEVEL REGISTER REDUCED 85 STEPS [-3.32 dB].
TXLIN LEVEL: 0x55

completed successfully
```

After keying the Base Radio, verify the forward and reflected powers of the station along with the station VSWR with the parameters listed in Table 8-4.

Table 8-4 **60W, 900 MHz PA – CLN1355 Transmitter Parameters**

Parameter	Value or Range
Forward Power	Greater than 58.0 Watts
Reflected Power	Less than 6.0 Watts
VSWR	Less than 2:1

5. At the BRC> prompt, type: **get fwd_pwr**

This command returns the current value of forward power from the RF Power Amplifier.

```
BRC> get fwd_pwr
FORWARD POWER is 61.0 watts [47.88 dBm]
```

Station Verification Procedures

6. At the BRC> prompt, type: **get ref_pwr**

This command returns the current value of reflected power from the RF Power Amplifier.

```
BRC> get ref_pwr
REFLECTED POWER is 1.67 watts [32.22 dBm]
```

7. At the BRC> prompt, type: **get vswr**

This command calculates the current Voltage Standing Wave Ratio (VSWR) from the RF Power Amplifier.

```
BRC> get vswr
VSWR is 1.42:1
```

8. At the BRC> prompt, type: **get alarms**

This command returns all active alarms of the Base Radio.

```
BRC> get alarms
NO ALARM CONDITIONS DETECTED
```

NOTE

If the **get alarms** command displays alarms, refer to the *System Troubleshooting* section of this manual for corrective actions.

9. View the spectrum of the transmitted signal on the R2660 Communications Analyzer in the Spectrum Analyzer mode. Figure 8-5 shows a sample of the spectrum.

10. At the BRC> prompt, type: **dekey**

This command stops all transmitter activity.

```
BRC> dekey
XMIT OFF INITIATED
```

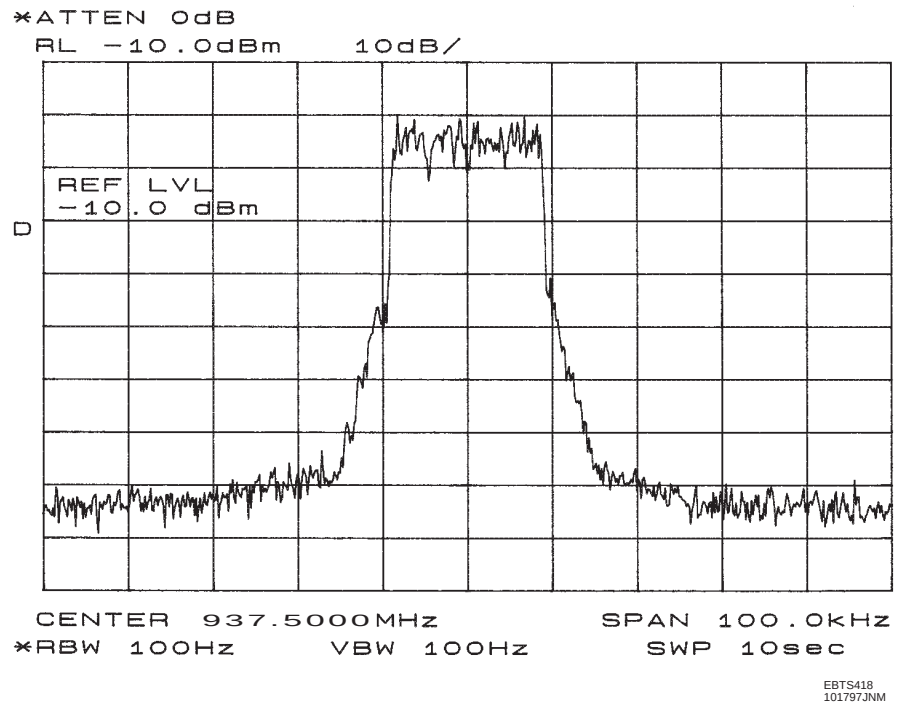


Figure:8-5 Transmitted Signal Spectrum (900 MHz BR)

Transmitter Verification Procedure (40W, 1500 MHz Power Amplifier – TLN3426)

This procedure provides commands and responses to verify proper operation of the transmit path for 1500 MHz Base Radios using a 40 Watt Power Amplifier.

1. Apply power to the Base Radio by setting the switch to the 1 position.

The following message displays on the service computer during power-up.

```
Base Radio
firmware revision RXX.XX.XX
Copyright © 1998
Motorola, Inc. All rights reserved.

Unauthorized access prohibited

Enter login password:
```

Station Verification Procedures

2. Enter the proper password. After entering the correct password, the BRC> prompt is displayed on the service computer.

The default password is **motorola**

NOTE

Motorola recommends that you change the default password once proper operation of the equipment is verified.

3. At the BRC> prompt, type: **dekey**

This command verifies that there is no RF power being transmitted.

```
BRC> dekey
XMIT OFF INITIATED
```

CAUTION

The following command keys the transmitter. Make sure that transmission only occurs on licensed frequencies or into a RF load.

4. At the BRC> prompt, type: **set tx_power 40**

This command sets the transmitter output to 40 Watts.

```
BRC> set tx_power 40
setting transmitter power to 40 watts

TXLIN ATTENUATION: 5.000000

TARGET POWER: 40.00 watts [46.02 dBm]
ACTUAL POWER: 28.38 watts [44.53 dBm]
POWER WINDOW: 38.20-> 41.89 watts [45.82 -> 46.22 dBm]
TXLIN LEVEL REGISTER REDUCED 59 STEPS [-2.30 dB].
TXLIN LEVEL: 0x6f

completed successfully
```

After keying the Base Radio, verify the forward and reflected powers of the station along with the station VSWR with the parameters listed in Table 8-5.

Table 8-5 **40W, 1500 MHz PA Transmitter Parameters**

Parameter	Value or Range
Forward Power	Greater than 38.0 Watts
Reflected Power	Less than 4.0 Watts
VSWR	Less than 2:1

5. At the BRC> prompt, type: **get fwd_pwr**

This command returns the current value of forward power from the RF Power Amplifier.

```
BRC> get fwd_pwr
FORWARD POWER is 39.13 watts [45.92 dBm]
```

Station Verification Procedures

6. At the BRC> prompt, type: **get ref_pwr**

This command returns the current value of reflected power from the RF Power Amplifier.

```
BRC> get ref_pwr  
REFLECTED POWER is 0.27 watts [24.28 dBm]
```

7. At the BRC> prompt, type: **get vswr**

This command calculates the current Voltage Standing Wave Ratio (VSWR) from the RF Power Amplifier.

```
BRC> get vswr  
VSWR is 1.17:1
```

8. At the BRC> prompt, type: **get alarms**

This command returns all active alarms of the Base Radio.

```
BRC> get alarms  
NO ALARM CONDITIONS DETECTED
```

NOTE

If the **get alarms** command displays alarms, refer to the *System Troubleshooting* section of this manual for corrective actions.

9. View the spectrum of the transmitted signal on the R2660 Communications Analyzer in the Spectrum Analyzer mode. Figure 8-3 shows a sample of the spectrum.

10. At the BRC> prompt, type: **dekey**

This command stops all transmitter activity.

```
BRC> dekey  
XMIT OFF INITIATED
```

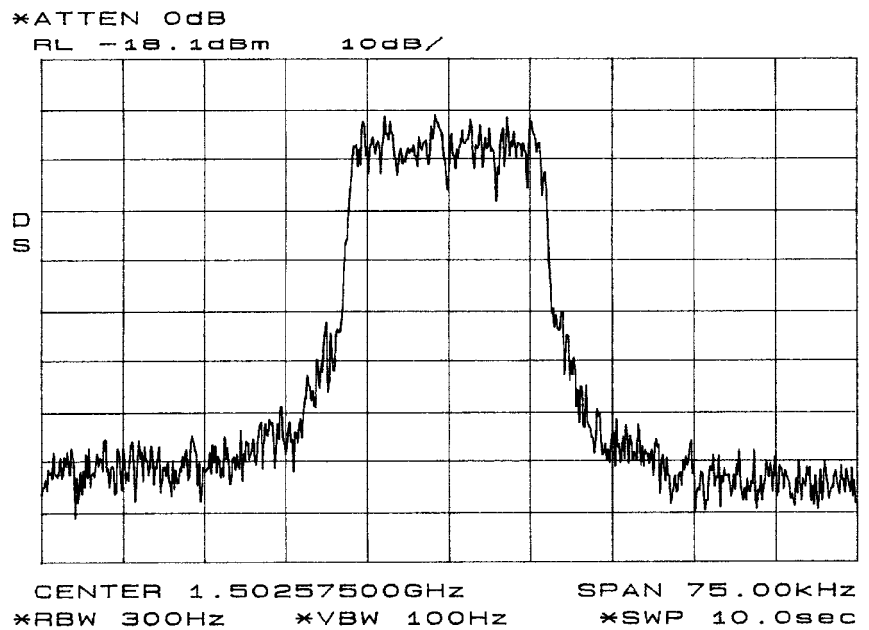


Figure:8-6 Transmitted Signal Spectrum (1500 MHz BR)

Station Verification Procedures**Equipment Disconnection**

Use the following steps to disconnect equipment after verifying the transmitter.

1. Remove power from the Base Radio by setting the Power Supply rocker switch (located behind the front panel of the Power Supply) to the OFF (0) position.
2. Disconnect the RS-232 cable from the connector on the service computer.
3. Disconnect the other end of the RS-232 cable from the RS-232 connector located on the front panel of the BRC.
4. Disconnect the test cable from the PA OUT connector located on the backplane of the Base Radio.
5. Connect the standard equipment cable to the PA OUT connector.
6. Disconnect the 10 dB attenuator from the other end of the test cable.
7. From the attenuator, disconnect the cable to the R2660 Communications Analyzer.
8. Restore power to the Base Radio by setting the Power Supply rocker switch to the ON (1) position.

If necessary, continue with the Receiver Verification Procedure.

Receiver Verification

The receiver verification procedure sends a known test signal to the Base Radio to verify the receive path. This verification procedure is recommended after replacing a Receiver, BRC, or Power Supply module.

NOTE

The following procedure requires the Base Radio to be out of service. Unless the Base Radio is currently out of service, Motorola recommends performing this procedure during off-peak hours. This minimizes or eliminates disruption of service to system users.

Equipment Setup

Set up the equipment for the receiver verification procedure as follows:

1. Remove power from the Base Radio by setting the Power Supply rocker switch (located behind the front panel of the Power Supply) to the OFF (0) position.
2. Connect one end of the RS-232 cable to the service computer.

3. Connect the other end of the RS-232 cable to the STATUS port located on the front panel of the BRC.
4. Disconnect the existing cable from the connector labeled RX1 (or the connector corresponding to the receiver under test).

This connector is located on the backplane of the Base Radio.
5. Connect a test cable to the RX 1 connector.
6. Connect the other end of the test cable to the RF IN/OUT connector on the R2660 Communications Analyzer.
7. Remove power from the R2660 and connect the Rubidium Frequency Standard 10MHZ OUTPUT to a 10 dB attenuator.
8. Connect the other end of the 10 dB attenuator to the 10MHZ REFERENCE OSCILLATOR IN/OUT connector on the R2660.
9. Set the R2660 to the EXT REF mode.
10. Apply power to the R2660.

NOTE

Refer to the equipment manual provided with the R2660 for further information regarding mode configuration of the unit (Motorola Part No. 68P80386B72).

11. Set the R2660 to the receive frequency of the Base Radio under test.

All receivers within a single Base Radio have the same receive frequency.
12. Set the R2660 to generate the test signal at an output level of -80dBm.

Receiver Verification Procedure

This procedure provides commands and responses to verify proper operation of the Base Radio receive path. Perform the procedure on all three receivers in each Base Radio in the EBTS.

The Bit Error Rate (BER) measurement meets specifications at less than 0.01% (1.0e-02%) to pass the process.

Before you begin the verification procedure, put the Base Radio into the test mode of operation to take it out of service. Enable the desired receiver under test and disable the other receiver(s). In this case the receiver under test is receiver #1.

In the following procedures, enter the software commands as they appear after the prompt. These commands are in bold letters.

For example, BRC> **get rx_freq**

Station Verification Procedures

13. Restore power to the Base Radio by setting the Power Supply rocker switch to the ON (1) position.

The following message displays on the service computer during power-up.

```
Base Radio
firmware revision RXX.XX.XX
Copyright © 1998
Motorola, Inc. All rights reserved.
```

```
Unauthorized access prohibited
```

```
Enter login password:
```

14. Enter the proper password. After entering the correct password, the BRC> prompt is displayed on the service computer.

The default password is **motorola**

NOTE

Motorola recommends that you change the default password once proper operation of the equipment is verified.

15. At the BRC> prompt, type: **get rx_freq**

This command displays the receive frequency for the current Base Radio. For 800/900/1500 MHz Base Radios, the message respectively appears as:

800 MHz BR:

```
BRC> get rx_freq
The RX FREQUENCY is: 806.00000
```

900 MHz BR:

```
BRC> get rx_freq
The RX FREQUENCY is: 896.000
```

1500 MHz BR:

```
BRC> get rx_freq
The RX FREQUENCY is: 1453.000
```

16. Verify that the R2660 transmit frequency is set to the frequency determined in the previous step.
17. At the BRC> prompt, type: **set rx_mode 1**

This command is used to enable the antenna/receiver under test.

```
BRC>set rx_mode 1
set RECEIVER 1 to ENABLED in RAM
set RECEIVER 2 to DISABLED in RAM
set RECEIVER 3 to DISABLED in RAM
```

Station Verification Procedures

18. At the BRC> prompt, type: **get rssi 1 1000**

This commands returns the receive signal strength indication. To pass the BER floor test, the Bit Error Rate must be less than 0.01% (1.0e-02%) for the displayed results.

BRC> **get rssi 1 1000**

Starting RSSI monitor for 1 repetitions averaged each 1000 reports.

Line	RSSI1 dBm	RSSI2 dBm	RSSI3 dBm	SGC dB	CI dBm	BER dBm %	OffsetSyncMiss Hz%
0	-80.0	-131.5	-131.5	0	-79.2	-121.90.000e+00	-5.4.000e+00

19. Verify that the RSSI dBm signal strength, for the receiver under test, is -80.0 dBm $\pm$ 1.0 dBm. Adjust the R2660 signal output level to get the appropriate RSSI dBm level. The BER floor % value is valid only if the RSSI signal strength is within the limits of -81.0 dBm to -79.0 dBm.
20. At the BRC > prompt, type: **get alarms**

This command returns all active alarms of the Base Radio.

BRC> **get alarms**

NO ALARM CONDITIONS DETECTED

NOTE

If the **get alarms** command displays alarms, refer to the System Troubleshooting section for corrective actions.

21. At the BRC> prompt, type: **get rx1_kit_no**

As shown below respectively for 800 / 900 / 1500 MHz Base Radios, this command returns the kit number of the receiver.

800 MHz BR:

```
BRC> get rx1_kit_no
RECEIVER 1 KIT NUMBER IS CRF6010A
```

900 MHz BR:

```
BRC> get rx1_kit_no
RECEIVER 1 KIT NUMBER IS CRF6030A
```

1500 MHz BR:

```
BRC> get rx1_kit_no
RECEIVER 1 KIT NUMBER IS CRX1020B
```

NOTE

If the kit number is CRF6010 or CRF6030, continue to step 22, otherwise to Equipment Disconnection.

22. At the BRC> prompt, type: **get rx_fru_config**

This command lists the receivers active for diversity.

```
BRC> get rx_fru_config
RECEIVER CONFIGURATION {RX1 RX2 RX3}
```

NOTE

If the antenna configuration does not match the receiver configuration, use the **set rx_fru_config** MMI command to properly set the parameter.

Station Verification Procedures**Equipment Disconnection**

Disconnect equipment after verifying the receiver as follows:

1. Remove power from the Base Radio by setting the Power Supply rocker switch (located behind the front panel of the Power Supply) to the OFF (0) position.
2. Disconnect the RS-232 cable from the connector on the service computer.
3. Disconnect the other end of the RS-232 cable from the RS-232 connector on the front panel of the BRC.
4. Disconnect the test cable from the RX 1 connector located on the backplane of the Base Radio.
5. Connect the standard equipment cable to the RX 1 connector.
6. Disconnect the cable to the R2660 Communications Analyzer.
7. Restore power to the Base Radio by setting the Power Supply rocker switch to the ON (1) position.

This completes the Receiver Verification Procedure for the receiver under test.

Repeat the Receiver Verification Procedure for each receiver in every Base Radio in the EBTS.

Single Channel BR Backplane

Backplane Connectors

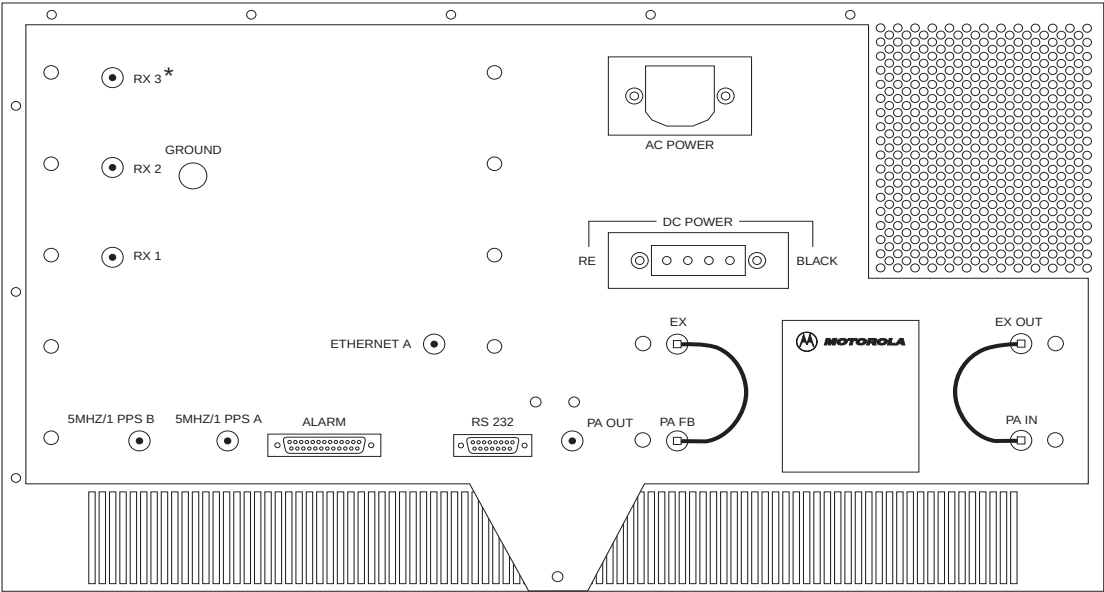
All external equipment connections are made on the Base Radio backplane. Table 8-6 lists and describes each of the connectors on the backplane.

Table 8-6 **Base Radio Backplane Connectors**

Connector	Description	Type
RX 1 through RX 3	Provides the input path for the received signal to the Base Radio. Each receiver has an input for one of these signals. Connect these ports to a multicoupler distribution system and surge protection circuitry before connecting them to the receive antennas.	RF-type connector in Table 8
EX OUT/EX FB PA IN/PA FB	Connects the exciter and PAs together to form the transmitter for the Base Radio. These connections are usually made at the factory These four ports close the feedback loop between these two modules by connecting EX OUT to the PA IN and the EX FB to the PA FB	RF-type connectors in Table 21 and Table 22
PA OUT	Transmits the RF output of the Base Radio. Connect this port to a combiner or duplexer before connecting to the transmit antenna	RF-type connector in Table 22
ETHERNET A (or labeled ETHERNET on some production units)	Provides Ethernet connectivity to the Base Radio from the site controller. This Ethernet port connects directly to the BRC	BNC-type connector in Table 18
5MHZ/ 1 PPS-A (or labeled SPARE on some production units)	Serves as both the timing and frequency reference port for the Base Radio This port is connected to the site timing/frequency reference.	BNC-type connector in Table 20
RS-232	This is a DTE RS-232 interface provided for future use and is not currently enabled	DB-9-type connectors in Table 17
ALARM	Provides the connection for external calibrated power monitors to the Base Radio This connector also provides station DC voltages and programming lines (SPI) for monitoring/potential future expansion	DB-25-type connector
AC POWER	Provides connection to AC power supply, if the Base Radio is equipped with an AC power supply	Line cord connector
DC POWER	Provides DC power connection, if the Base Radio is equipped with a DC power supply or an AC power supply to support the battery revert feature	Card edge connector
GROUND	Connects the station to ground. A ground stud and a ground braid on the back of the Base Radio connect the station to a site ground, such as an appropriately grounded cabinet This ground provides increased transient/surge protection for the station	Ground stud

Single Channel BR Backplane

Figure 8-7 shows the locations of the Base Radio external connections.



* This port must be terminated by 50Ω load when configured for 2 Branch Diversity. Also, the rx_fru_config parameter must be set to R12. EBTS327
021997JNM

Figure:8-7 Base Radio Backplane Connectors

Backplane RF Connections

When Base Radios are shipped from the factory as FRUs, each connection on the back of a repeater has a designated color dot beside it as listed in Table 8-7. To find where a cable should be connected, match the label wrapped around the cable to the dot on the back of the repeater.

Table 8-7 Color Codes for RF Connections on Rear of Base Radio

Connectors	Color Dot Code
TX	Orange
RX 1	Red
RX 2	Green
RX 3	Yellow
Ethernet	White
5 MHz/1 pps A or Spare	Gray

Backplane Connector Pinouts

Table 8 lists the pin-outs for the 96-pin P1 connector of the Base Radio Controller board.

Table 8 **P1 Connector Pin-outs**

Pin No.	Row A	Row B	Row C
1	AGC3	14.2V	AGC1
2	AGC4	14.2V	AGC2
3	GND	GND	GND
4	RESET	GND	GND
5	BATT_STAT	GND	GND
6	CTS	GND	GND
7	RTS	5V	5V
8	5V	5V	5V
9	5V	5V	5V
10	SHUTDOWN	5V	
11	RCLK	5V	DATA1
12	ODC_1	5V	DATA1*
13	TCLK	GND	DATA3
14	ODC_3	GND	DATA3*
15	RXD	GND	DATA2
16	ODC_2		DATA2*
17	TXD		
18	SSI		SBI_1
19	SSI*		SBI_3
20	BRG	GND	SBI_2
21	CLK		
22	CLK*	GND	A4
23	GND		A3
24	A5	GND	A2
25	A0	GND	A1
26	CD	GND	5MHZ/ SPARE
27	METER_STAT	GND	SPI_MISO
28	WP*	GND	SPI_CLK
29	GND	GND	SPI_MOSI
30	GND	GND	GD
31	1PPS_GPS	GND	2.1MHZ_TX
32	GND	GND	2.1MHZ_RX
NOTE: * = enabled low			

Table 12 lists the pin-outs for the 96-pin P1 connector for Receiver 1.

Table 9 **P1 Connector Pin-outs**

Pin No.	Row A	Row B	Row C
1	AGC3	GND	AGC1
2	AGC4	GND	AGC2
3	GND	GND	GND
4	GND	GND	GND
5	14.2V	14.2V	14.2V
6	14.2V	14.2V	14.2V
7	GND	GND	GND
8	GND	GND	GND
9	5V	5V	5V
10	5V	5V	5V
11	GND	GND	GND
12	GND	GND	GND
13	DATA1*	GND	GND
14	DATA1	GND	GND
15	ODC_1	GND	GND
16	GND	GND	GND
17	GND	GND	GND
18	SBI_1	GND	GND
19	GND	GND	GND
20	GND	GND	GND
21			A0_CS1
22	A1_CS2		
23			A5
24			WP*
25	A4_RXSEL		
26			
27	SPI_MISO		
28			SPI_MOSI
29	SPI_CLK		
30	GND	GND	GND
31	GND	GND	GND
32	GND	GND	2.1MHZ_RX
NOTE: * Enabled low			

Single Channel BR Backplane

Table 13 lists the pin-outs for the 96-pin P2 connector for Receiver 2.

Table 10 P2 Connector Pin-outs

Pin No.	Row A	Row B	Row C
1	AGC3	GND	AGC1
2	AGC4	GND	AGC2
3	GND	GND	GND
4	GND	GND	GND
5	14.2V	14.2V	14.2V
6	14.2V	14.2V	14.2V
7	GND	GND	GND
8	GND	GND	GND
9	5V	5V	5V
10	5V	5V	5V
11	GND	GND	GND
12	GND	GND	GND
13	DATA2*	GND	GND
14	DATA2	GND	GND
15	ODC_2	GND	GND
16	GND	GND	GND
17	GND	GND	GND
18	SBI_2	GND	GND
19	GND	GND	GND
20	GND	GND	GND
21			A0_CS1
22	A1_CS2		
23			A5
24			WP*
25	A3_RXSEL		
26			
27	SPI_MISO		
28			SPI_MOSI
29	SPI_CLK		
30	GND	GND	GND
31	GND	GND	GND
32	GND	GND	2.1MHZ_RX

NOTE: * Enabled low

Table 11 lists the pin-outs for the 96-pin P3 connector for Receiver 3.

Table 11 P3 Connector Pin-outs

Pin No.	Row A	Row B	Row C
1	AGC3	GND	AGC1
2	AGC4	GND	AGC2
3	GND	GND	GND
4	GND	GND	GND
5	14.2V	14.2V	14.2V
6	14.2V	14.2V	14.2V
7	GND	GND	GND
8	GND	GND	GND
9	5V	5V	5V
10	5V	5V	5V
11	GND	GND	GND
12	GND	GND	GND
13	DATA3*	GND	GND
14	DATA3	GND	GND
15	ODC_3	GND	GND
16	GND	GND	GND
17	GND	GND	GND
18	SBI_3	GND	GND
19	GND	GND	GND
20	GND	GND	GND
21			A0_CS1
22	A1_CS2		
23			A5
24			WP*
25	A2_RXSEL		
26			
27	SPI_MISO		
28			SPI_MOSI
29	SPI_CLK		
30	GND	GND	GND
31	GND	GND	GND
32	GND	GND	2.1MHZ_RX

NOTE: * Enabled low

Single Channel BR Backplane

Table 12 lists the pin-outs for the 48-pin P2 connector of the 3X Receiver.

Table 12 **P2 Connector Pin-outs**

Pin No.	Row A	Row B	Row C	Row D
1	GND	AGC4	AGC3	GND
2	GND	AGC2	AGC1	A0
3	GND	RX1_DAT A	RX1_DAT A	A1
4	GND	RX1_SBI	RX1_ODC	A2
5	GND	RX2_DAT A	RX2_DAT A	A3
6	5V	RX2_SBI	RX2_ODC	A4
7	GND	RX3_DAT A	RX3_DAT A	A5
8	GND	RX3_SBI	RX3_ODC	WP*
9	14.2V	SCLK	MOSI	MISO
10	14.2V	GND	GND	GND
11	14.2V	GND	REF	GND
12	GND	GND	GND	GND
NOTE: Row A is make first, break last.				

Table 13 lists the pin-outs for the 16-pin P3 connector of the 3X Receiver.

Table 13 **P3 Connector Pin-outs**

Pin No.	Row A	Row B	Row C	Row D	Row E
1	GND		GND		GND
2		RX1			
3	GND		GND		GND
4					
5					
6					
7	GND		GND		GND
8		RX2		RX3	
9	GND		GND		GND

Table 14 lists the pin-outs for the 96-pin P5 connector of the Exciter.

Table 14 **P5 Connector Pin-outs**

Pin No.	Row A	Row B	Row C
1	28V	28V	28V
2	28V	28V	28V
3	14.2V	14.2V	14.2V
4	14.2V	14.2V	14.2V
5	5V	5V	5V
6	5V	5V	5V
7	GND	GND	EXT_VFWD
8	GND	GND	EXT_VREF
9			
10	GND	GND	GND
11	GND	GND	VB LIN
12	GND	GND	RESET
13			
14	GND	GND	GND
15	GND	GND	SPI_MISO
16	A0	GND	GND
17	GND	GND	SPI_CLK
18	A1	GND	WP*
19	GND	GND	GND
20	A5	GND	SPI_MOSI
21	GND	GND	GND
22	A4	GND	GND
23	GND	GND	CLK*
24	A3	GND	GND
25	GND	GND	CLK
26	GND	GND	GND
27	GND	GND	SSI*
28	GND	GND	GND
29	GND	GND	SSI
30	GND	GND	GND
31	GND	GND	2.1MHz_TX
32	GND	GND	GND
NOTE: * = enabled low			

Single Channel BR Backplane

Table 15 lists the pin-outs for the 96-pin P6 connector of the Power Amplifier.

Table 15 P6 Connector Pin-outs

Pin No.	Row A	Row B	Row C
1	VBLIN	GND	28V
2	GND	GND	28V
3	A0	GND	28V
4	GND	GND	28V
5	A1	GND	28V
6	GND	GND	28V
7	A2	GND	28V
8	GND	GND	28V
9	A3	GND	28V
10	GND	GND	28V
11	SPI_MISO	GND	28V
12	GND	GND	28V
13	SPI_MOSI	GND	28V
14	GND	GND	28V
15	SPI_CLK	GND	28V
16	GND	GND	28V
17	WP*	GND	28V
18	GND	GND	28V
19	GND	GND	28V
20	GND	GND	28V
21	GND	GND	28V
22	GND	GND	28V
23	GND	GND	28V
24	GND	GND	28V
25	GND	5V	28V
26	GND	5V	28V
27	GND	14.2V	28V
28	GND	14.2V	28V
29	GND	14.2V	28V
30	GND	14.2V	28V
31	GND	28V	28V
32	GND	28V	28V

NOTE: * = enabled low

Table 16 P7 Connector Pin-outs

Pin No.	Signal
1	SPI_MISO
2	SPI_MOSI
3	SPI_CLK
4	A0
5	A1
6	A2
7	A3
8	A4
9	A5
10	GND
11	28V
12	14.2V
13	14.2V
14	WP*
15	5V
16	GND
17	BATT_STAT
18	MTR_STAT
19	EXT_VFWD
20	EXT_VREF
21	GND
22	GND
23	BAT_TEMP
24	VAT_TEMP
25	GND

NOTE: * = enabled low

Table 17 lists the pin-outs for the 9-pin P8 RS-232 connector.

Table 18 lists the pin-outs for P13. Tables 19 through 22 list the pin-outs for the SMA and blindmate connectors for Receivers 1- 3, BRC, Exciter and PA.

Table 23 lists the pin-outs for 78-pin P9 connector of the Power Supply.

Table 16 lists the pin-outs for the 25-pin P7 Alarm

Table 17 **P8 Connector Pin-outs**

Pin No.	Signal
1	CD
2	RxD
3	TxD
4	RCLK
5	GND
6	TCLK
7	RTS
8	CTS
9	BRG

Table 18 **P13 Connector Pin-outs**

Connector	Signal
1	ETHERNET - A (or 5MHZ IN*)
* May appear as indicated in parenthesis on some production units.	

Table 19 **SMA Connectors- Receivers**

Connector	Signal
P19	RCV ONE RF IN
P20	RCV TWO RF IN
P21	RCV THREE RF IN

Table 20 **Blind Mates - BRC**

Connector	Signal
P10	SPARE* (or 5MHZ/1 PPS - A)
P11	ETHERNET* (or ETHERNET - A)
*May appear as indicated in parenthesis on some production units.	

Table 21 **Blind Mates - Exciter**

Connector	Signal
P14	EXCITER OUT
P15	EXCITER FEEDBACK

Single Channel BR Backplane*Table 22 Blind Mates - PA*

Connector	Signal
P16	PA FEEDBACK
P17	PA IN
P18	PA RF OUT

Table 23 P9 Connector Pin-outs

Pin No.	Signal
1	GND
2	GND
3	28V
4	28V
5	28V
6	28V
7	28V
8	28V
9	28V
10	28V
11	28V
12	28V
13	28V
14	28V
15	28V
16	14.2V
17	14.2V
18	14.2V
19	14.2V
20	14.2V
21	14.2V
22	14.2V
23	14.2V
24	5V
25	5V
26	5V
27	5V
28	5V
29	5V
30	5V
31	5V

Table 23 **P9 Connector Pin-outs (Continued)**

Pin No.	Signal
32	GND
33	GND
34	GND
35	GND
36	GND
37	GND
38	GND
39	GND
40	GND
41	GND
42	GND
43	GND
44	GND
45	GND
46	GND
47	GND
48	GND
49	GND
50	GND
51	GND
52	GND
53	GND
54	SCR_SHUT
55	SCR_THRESH
56	RELAY_ENABLE
57	SHUTDOWN
58	28V_AVG
59	BATT_TEMP
60	SPI_MISO
61	SPI_MOSI
62	SPI_CLK
63	
64	
65	
66	
67	A0(CS1)
68	A1(CS2)

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Table 23 **P9 Connector Pin-outs (Continued)**

Pin No.	Signal
69	A5
70	
71	A4
72	
73	A3
74	GND
75	A2
76	GND
77	GND
78	GND

Base Radio Signals

Table 8-24 lists and describes the Base Radio signals.

Table 8-24 **Base Radio Signal Descriptions**

Signal Name	Signal Description
GND	Station ground
28V	28VDC
14.2V	14.2VDC
5.1V	5.1 VDC
A0,A1,A2,A3,A4,A5	The BRC uses these lines to address station modules and devices on those modules
SPI_MOSI	Serial Processor Interface - Master out slave in Data
SPI_MISO	Serial Processor Interface - Master in slave out Data
SPI_CLK	Serial Processor Interface - Clock signal (100 KHz - 1 MHz)
AGC1, AGC2, AGC3, AGC4	BRC uses these lines to set the digital attenuator's on the receiver(s) for SGC functionality
2.1MHz_RX	2.1MHz generated on the BRC and used as a reference by the Receiver(s)
2.1MHz_TX	2.1MHz generated on the BRC and used as a reference by the Exciter
DATA1, DATA1*	This differential pair carries receiver 1 data to the Base Radio Controller
DATA2 DATA2*	This differential pair carries receiver 2 data to the Base Radio Controller
DATA3, DATA3*	This differential pair carries receiver 3 data to the Base Radio Controller
ODC_1, ODC_2, ODC_3	Clocks used to clock differential receive data from each respective receiver to the BRC
SBI_1, SBI_2, SBI_3	Serial Bus Interface - These lines are used to program the custom receiver IC on each receiver
SSI, SSI*	Differential transmit data from the Exciter to the BRC
CLK, CLK*	Differential Data clock used to clock transmit data from the BRC to the Exciter
BRCVBLIN	Programmable bias voltage generated on the Exciter and used to bias the Power amplifier devices
VBLIN	Programmable bias voltage generated on the Exciter and used to bias the Power amplifier devices
RESET	Output from BRC to Exciter (currently not used)
EXT_VFWD	DC voltage representing the forward power at the antenna as measured by the external wattmeter
EXT_VREF	DC voltage representing the reflected power at the antenna as measured by the external wattmeter
WP*	Write protect line used by the BRC to write to serial EEPROMs located on each module
BAT_STAT	Binary flag used to signal BRC to monitor the External battery supply alarm

Single Channel BR Backplane

Table 8-24 **Base Radio Signal Descriptions (Continued)**

Signal Name	Signal Description
METER_STAT	Binary flag used by the BRC to indicate to the BRC it should monitor
1PPS	Global Positioning System - 1 pulse per second (this may be combined with 5MHz at the site frequency reference)
RCLK	RS-232 - Receive clock
TCLK	RS-232 - Transmit clock
CTS	RS-232 - Clear to send
RTS	RS-232 - Request to send
CD	RS-232 - Carrier detect
RXD	RS-232 - Receive data
TXD	RS-232 - Transmit data
BRG	RS-232 - Baud rate generator
5MHz / Spare	signal currently not used
EXCITER_OUT	Forward transmit path QQAM at approximately a 11dBm level
EXCITER_FEEDBACK	Signal comes from the PA at approximately a 16dBm. Used to close the cartesian RF_LOOP
PA_IN	4 dBm QQAM forward path of the transmitter
PA_FEEDBACK	Signal to the Exciter at approximately 16dBm. Used to close the cartesian RF_LOOP
RX1_IN	RF into Receiver 1
RX2_IN	RF into Receiver 2
RX3_IN	RF into Receiver 3
5MHZ REFERENCE	5MHz station/site reference. Signal comes from the redundant site frequency reference and usually is multiplexed with the 1PPS signal from the global positioning satellite input to the site frequency reference
ETHERNET	Interface between the BRC and the ACG. This connects the Base to the 10 MHz LAN
SCR_SHUT	Signal currently not used
SCR_THRESH	Signal currently not used
RELAY ENABLE	Signal currently not used
SHUTDOWN	Input signal from the BRC to the Power supply. Used to exercise a station "hard start"
28V_AVG	Signal currently not used
BATT_TEMP	DC voltage from the external batteries used to represent the temperature of the batteries. Signal used only with AC power supplies
NOTE: * = enabled low	

Troubleshooting QUAD Channel Base Radios

Overview

This chapter is a guide for installing a Quad Base Radio and isolating Base Radio failures to the FRU level. The chapter contains procedures for:

- ☐ Troubleshooting
- ☐ Installation
- ☐ Verification
- ☐ Station Operation

The Base Radio maintenance philosophy is repair by replacing defective FRUs with new FRUs. This maintenance method limits down-time, and quickly restores the Base Radio to normal operation.

Two Base Radio troubleshooting procedures appear here. Each procedure quickly identifies faulty FRUs.

Ship defective FRUs to a Motorola repair depot for repair.

Recommended Test Equipment

Table 9-1 lists recommended test equipment for performing Base Radio troubleshooting and verification procedures.

Table 9-1 **Recommended Test Equipment**

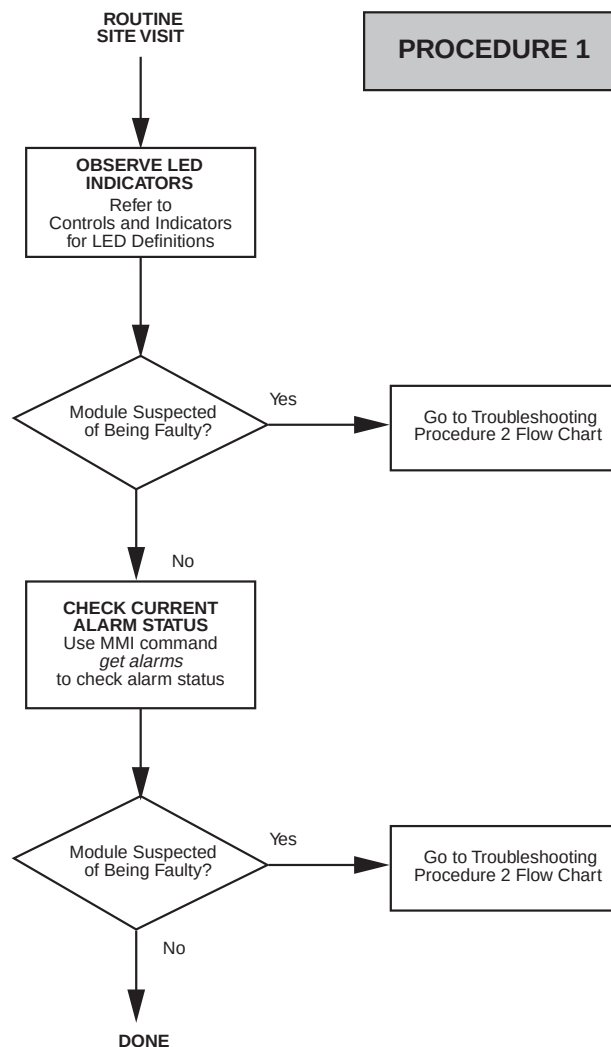
Test Equipment	Model Number	Use
Communications Analyzer	R2660 w/iDEN option	Used for checking receive and transmit operation (iDEN signaling capability) and station alignment
Signal Generator	HP4432b	RX testing
Dummy Load (50 Ω , 150 W)	none	Used to terminate output
3 way RF splitter	none	Used to connect Hp4432b to Base radio
Service Computer	IBM or clone, 80286 or better	Local service terminal
Portable Rubidium Frequency Standard	Ball Efratom	Frequency standard for R2660, netting TFR
Power Meter	none	Used to measure reflected and forward power
RF Attenuator, 250 W, 10 dB	Motorola 0180301E72	Protection for R2660
Software: Communication Quad BR waveform	Procomm Plus Motorola supplied	Local service computer with HP4432b

Troubleshooting Procedures

Many troubleshooting and station operation procedures require Man-Machine Interface (MMI) commands. These commands communicate station level commands to the Base Radio via the RS-232 communications port on the front of the BRC.

Routine Checkout

Procedure 1 is a quick, non-intrusive test performed during a routine site visit. Use this procedure to verify proper station operation without taking the station out of service. Figure 9-1 shows the Procedure 1 Troubleshooting Flowchart.



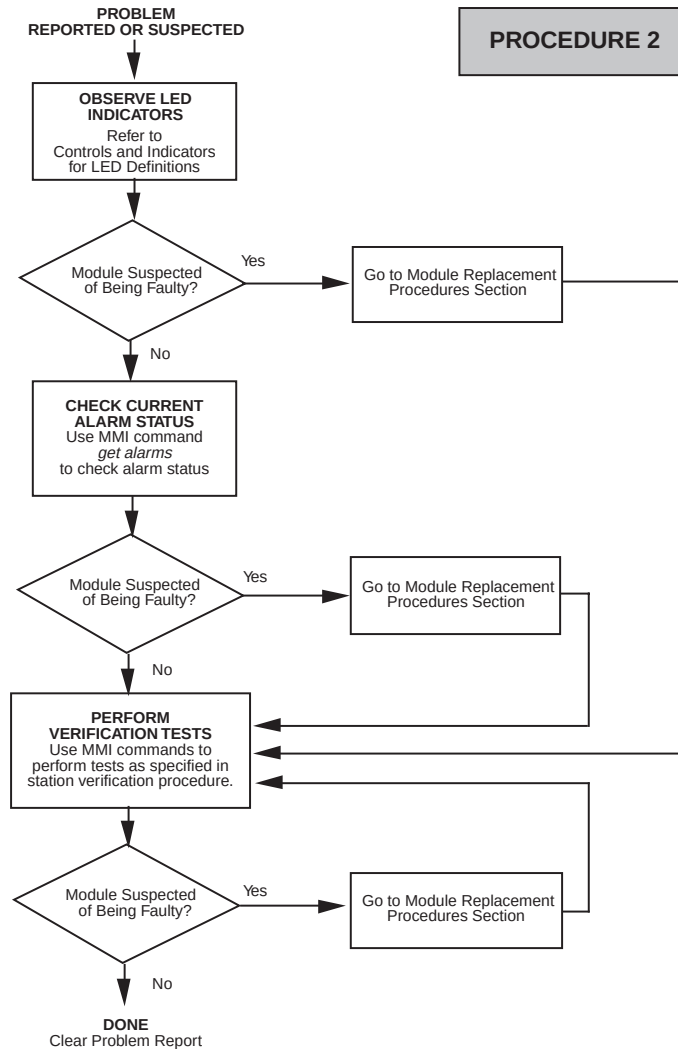
EBTS021
071895JNM

Figure:9-1 **Procedure 1 Troubleshooting Flowchart**

Reported/Suspected Problem

Use Procedure 2 to troubleshoot reported or suspected equipment malfunctions. Perform this procedure with equipment in service (non-intrusive) and with equipment taken temporarily out of service (intrusive).

Figure 9-2 shows the Procedure 2 Troubleshooting Flowchart.



EBTS022
071895JNM

Figure:9-2 **Procedure 2 Troubleshooting Flowchart**

Base Radio/Base Radio FRU Replacement Procedures

Replace suspected station modules with known non-defective modules to restore the station to proper operation. The following procedures provide FRU replacement instructions, post-replacement adjustments and verification instructions.

Base Radio Replacement Procedure

NOTE

Base Radio removal and installation procedures appear for reference or buildout purposes. Field maintenance of Base Radios typically consists of replacement of FRUs within the Base Radio. Perform Base Radio FRU replacement according to "Base Radio FRU Replacement Procedure" below.

Perform Base Radio (BR) replacement as described in the following paragraphs.

 CAUTION

Improper lifting or dropping the BR could result in serious personal injury or equipment damage.

Base Radios are HEAVY!

Handle the BR with extreme caution, and according to local health and safety regulations.

Removal

Remove the BR from the Equipment Cabinet as follows:

 CAUTION

A Single Carrier BR can weigh up to 76 LBS (34 KG). A Quad Carrier BR can weigh up to 91 LBS (41 KG). Handle the BR with extreme caution, and according to local health and safety regulations.

Base Radio/Base Radio FRU Replacement Procedures

1. Remove power from the Base Radio by setting the Power Supply ON/OFF switch to the OFF position.
2. Tag and disconnect the cabling from the BR rear panel connectors.
3. Remove the Power Amplifier module to reduce the BR weight. Remove the two M10 Torx screws that secure the Power Amplifier module. Slide the module out of the chassis.
4. Remove the four M30 TORX screws which secure the BR front panel to the Equipment Cabinet mounting rails.
5. While supporting the BR, carefully remove the BR from the Equipment Cabinet by sliding the BR from the front of cabinet. *When the BR becomes free from its mounting rails, be sure to fully support it.*

Installation

Install BR in Equipment Cabinet as follows:

 CAUTION

A Single Carrier BR can weigh up to 76 LBS (34 KG). A Quad Carrier BR can weigh up to 91 LBS (41 KG). Handle the BR with extreme caution, and according to local health and safety regulations.

1. If adding a BR, install side rails in the appropriate BR mounting position in the rack.
2. Remove the Power Amplifier module to reduce the BR weight. Remove the two M10 Torx screws that secure the Power Amplifier module. Slide the module out of the chassis.
3. While supporting the BR, carefully lift and slide the BR in the Equipment Cabinet mounting position.
4. Secure the BR to the Equipment Cabinet mounting rails using four M30 Torx screws. Tighten the screws to 40 in-lb (4.5 Nm).
5. Slide the Power Amplifier module back into the BR chassis. Replace two M10 Torx screws that secure the Power Amplifier module. Secure the module by tightening the screws to the specified torque of 5 in-lbs.
6. Connect the cabinet cabling to the BR. Refer to Backplane figure XX.
7. Perform BR activation as described below.

NOTE

Base Radio removal and installation procedures appear for reference or buildout purposes. Field maintenance of Base Radios typically consists of replacement of FRUs within the Base Radio. Perform Base Radio FRU replacement according to "Base Radio FRU Replacement Procedure" below.

Anti-Static Precautions**CAUTION**

The Base Radio contains static-sensitive devices. Prevent electrostatic discharge damage to Base Radio modules! When replacing Base Radio FRUs, wear a grounded wrist strap. Observe proper anti-static procedures.

Motorola publication 68P81106E84 provides complete static protection information. This publication is available through Motorola National Parts.

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 grounding clip is provided with each EBTS cabinet. If not available, use another appropriate grounding point.
- ☐ DO NOT insert or remove modules with power applied to the Base Radio. ALWAYS turn the power OFF using the Power Supply rocker switch on the front of the Power Supply module.
- ☐ Keep spare modules in factory packaging for transporting. When shipping modules, always pack in original packaging.

FRU Replacement Procedure

Perform the following steps to replace any of the Base Radio FRUs:

Base Radio/Base Radio FRU Replacement Procedures**NOTE**

After a Control Board or BR replacement, the integrated Site Controller (iSC) reboots the BR. Whenever the BR goes off-line, the Replacement BRC Accept Timer begins counting down. A BR reboot occurs if the BR remains off-line as the timer times out. (The timer's default period is three minutes.) If someone turns on the BR before the timer times out, power down the BR. Then wait for the minimum timer period before turning on the BR.

1. Notice the Power Supply rocker switch, behind the front panel of the Power Supply. Set the Power Supply rocker switch to the OFF (0) position. Turning off this switch removes power from the Base Radio.
2. Loosen the front panel fasteners. These are located on each side of the module being replaced.
3. Pull out the module.
4. Insert the non-defective replacement module by aligning the module side rails with the appropriate rail guides inside the Base Radio chassis.
5. Gently push the replacement module completely into the Base Radio chassis assembly using the module handle(s).

CAUTION

DO NOT slam or force the module into the chassis assembly. Rough handling can damage the connectors or backplane.

6. Secure the replacement module by tightening the front panel fasteners to the specified torque of 5 in-lbs.
7. Apply power to the Base Radio by setting the switch to the ON position.
8. Perform the Station Verification Procedure.

Power Amplifier (PA) Fan FRU Replacement

Perform the following steps to replace the Power Amplifier (PA) fans.

1. Remove the Power Amplifier from the Base Radio per FRU Replacement Procedure.
2. Disconnect fan power cable from PA housing.
3. Remove front panel from fan assembly.
4. Remove fan assembly from PA chassis.

NOTE

To install the new fan kit, reverse above procedure.

Station Verification Procedures

Station Verification Procedures

Perform the Station Verification Procedures whenever you replace a FRU. The procedures verify transmit and receive operations. Each procedure also contains the equipment setup.

Replacement FRU Verification

Before shipment, the factory programs all module-specific information. Base Radio specific information (e.g., receive and transmit frequencies) involves a download to the Base Radio from the network/site controller.

The Base Radio does not require replacement FRU alignment.

Base Repeater FRU Hardware Revision Verification

NOTE

The following procedure requires the Base Radio to be out of service. Unless the Base Radio is currently out of service, Motorola recommends performing this procedure during off-peak hours. Performing this procedure then minimizes or eliminates disruption of service to system users.

1. Connect one end of the RS-232 cable to the service computer.
2. Connect the other end of the RS-232 cable to the STATUS port, located on the front panel of the EX/CNTL module.
3. Power on the BR using the front switch on the Power Supply Module. Press the reset button on the Control Module front panel. At the prompt, hit a Carriage Return on the service computer to enter the test application mode. Using the password **Motorola**, log in to the BR.

```
:> login -ufield
password: *****

field>motorola

field>
```

4. Collect revision numbers from the station by typing the following command:

```
field> fv -oplatform  
field>
```

5. If all modules return revision numbers of the format "Rxx.xx.xx", then all revision numbers are present. In that case, verification requires no further action. If revision numbers return as blank, or not in the format "Rxx.xx.xx", contact your local Motorola representative or Technical Support.
6. Set desired cabinet id and position and of BR by typing the following commands with the final number on each command being the desired cabinet id and position. The command example below sets cabinet id to 5, and cabinet position to 2.

```
field> ci -oplatform -c5  
field> pi -oplatform -p2  
  
field>
```

7. After checking all BRs, log out by keying the following command:

```
field> logout  
field>
```

Transmitter Verification

The transmitter verification procedure verifies transmitter operation and transmit path integrity. Motorola recommends this verification procedure after replacing an Exciter, Power Amplifier, BRC, or Power Supply module.

Station Verification Procedures**NOTE**

The following procedure requires the Base Radio to be out of service. Unless the Base Radio is currently out of service, Motorola recommends performing this procedure during off-peak hours. Performing this procedure then minimizes or eliminates disruption of service to system users.

Equipment Setup

To set up the equipment, use the following procedure:

1. Remove power from the Base Radio by setting the Power Supply rocker switch (located behind the front panel of the Power Supply) to the OFF (0) position.
2. Connect one end of the RS-232 cable to the service computer.
3. Connect the other end of the RS-232 cable to the STATUS port located on the front panel of the BRC.
4. Disconnect the existing cable from the connector labeled PA OUT. This connector is located on the backplane of the Base Radio.
5. Connect a test cable to the PA OUT connector.
6. Connect a 10 dB attenuator on the other end of the test cable.
7. From the attenuator, connect a cable to the RF IN/OUT connector on the R2660 Communications Analyzer.
8. Remove power from the R2660. Connect the Rubidium Frequency Standard 10MHZ OUTPUT to a 10 dB attenuator.
9. Connect the other end of the 10 dB attenuator to the 10MHZ REFERENCE OSCILLATOR IN/OUT connector on the R2660.

NOTE

Refer to the R2660 equipment manual for further information regarding mode configuration of the unit. (Motorola Part No. 68P80386B72.)

10. Set the R2660 to the EXT REF mode.
11. Apply power to the R2660.
12. Set the R2660 to the SPECTRUM ANALYZER mode with the center frequency set to the transmit frequency of the Base Radio under test.

13. Perform the appropriate transmitter verification procedure below for the particular Power Amplifier used in the Base Radio.

Transmitter Verification Procedure (QUAD Carrier 800 MHz Power Amplifiers)

This procedure provides commands and responses to verify proper operation of the transmit path for 800 MHz Base Radios using a 70 Watt Power Amplifier.

1. Power on the BR using the front switch on the Power Supply Module. Press the reset button on the Control Module front panel. At the prompt, hit a Carriage Return on the service computer to enter the test application mode. Using the password **Motorola**, login to the BR.

```
:> login -ufield
password: *****

field>motorola

field>
```

2. Dekey the BR to verify that no RF power is being transmitted. Set the transmit DSP test mode to "stop." At the field> prompt, type:

```
field> ptm -otx_all -mstop
field> power -otxch1 -p0

field>
```

CAUTION

The following command keys the transmitter. Make sure that transmission only occurs on licensed frequencies, or into an RF dummy load.

3. Key the BR to 40 watts, following the steps below from the field> prompt :
 - 3.1 Set the frequency of transmit channel 1 through 4.

Station Verification Procedures

```
field> freq -otxch1 -f860
field> freq -otxch2 -f860.025
field> freq -otxch3 -f860.05
field> freq -otxch4 -f860.075

field>
```

3.2 Set the transmit DSP test mode to “dnlk_framed.”

```
field> ptm -otx_all -mdnlk_framed

field>
```

3.3 Enable the channels by setting a data pattern to “iden.”

```
field> dpm -otxch1 -miden
field> dpm -otxch2 -miden
field> dpm -otxch3 -miden
field> dpm -otxch4 -miden

field>
```

3.4 Set the transmit power to 40 watts and key the BR.

```
field> power -otxch1 -p40

field>
```

4. After keying the Base Radio, verify the station’s forward and reflected power and VSWR. Check these figures against the parameters in Table 9-2.

Table 9-2 **QUAD BR Transmitter Parameters**

Parameter	Value or Range
Forward Power	Greater than 36 Watts
Reflected Power	Less than 2.0 Watts
VSWR	Less than 1.6:1

- 4.1 Check channel 1. At the field> prompt, type:

```
field> power -otxch1
```

```
field>
```

- 4.2 Check channel 2. At the field> prompt, type:

```
field> power -otxch2
```

```
field>
```

- 4.3 Check channel 3. At the field> prompt, type:

```
field> power -otxch3
```

```
field>
```

- 4.4 Check channel 4. At the field> prompt, type:

```
field> power -otxch4
```

```
field>
```

5. This command returns all active alarms of the Base Radio. At the field> prompt, type:

```
field> alarms -ofault_hdlr
```

```
field>
```

NOTE

If the **alarms** command displays alarms, refer to the *System Troubleshooting* chapter for corrective actions.

6. View the spectrum of the transmitted signal on the R2660 Communications Analyzer. Use the Spectrum Analyzer mode. Figure 9-3 shows a sample of the spectrum.

Station Verification Procedures

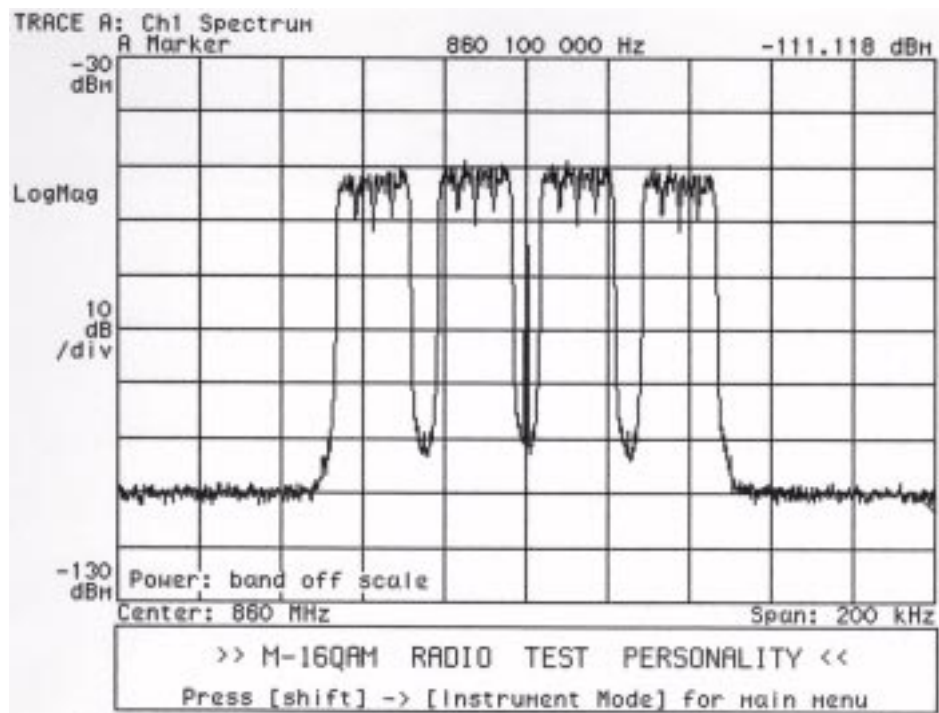


Figure:9-3 Quad Channel Spectrum (800 MHz BR)

7. Dekey the BR to verify that no RF power is being transmitted. Set the transmit DSP test mode to "stop." At the field> prompt, type:

```
field> ptm -otx_all -mstop
field> power -otxch1 -p0

field>
```

Equipment Disconnection

Use the following steps to disconnect equipment after verifying the transmitter.

1. Remove power from the Base Radio by setting the Power Supply rocker switch (located behind the front panel of the Power Supply) to the OFF (0) position.
2. Disconnect the RS-232 cable from the connector on the service computer.
3. Disconnect the other end of the RS-232 cable from the RS-232 connector located on the front panel of the BRC.

4. Disconnect the test cable from the PA OUT connector located on the backplane of the Base Radio.
5. Connect the standard equipment cable to the PA OUT connector.
6. Disconnect the 10 dB attenuator from the other end of the test cable.
7. From the attenuator, disconnect the cable to the R2660 Communications Analyzer.
8. Restore power to the Base Radio by setting the Power Supply rocker switch to the ON (1) position.
9. If necessary, continue with the Receiver Verification Procedure.

Receiver Verification

The receiver verification procedure sends a known test signal into the Base Radio to verify the receive path. This verification procedure is recommended after replacing a Receiver.

NOTE

The following procedure requires the Base Radio to be out of service. Unless the base radio is currently out of service, Motorola recommends performing this procedure during off-peak hours. Performing this procedure then minimizes or eliminates disruption of services to system users.

Equipment Setup

Set up equipment for the receiver verification procedure as follows:

1. Remove power from the Base Radio by setting the Power Supply rocker switch (located behind the front panel of the Power Supply) to the OFF (0) position.
2. Connect one end of the RS-232 cable to the service computer.
3. Connect the other end of the RS-232 cable to the STATUS port located on the front panel of the BRC.
4. Disconnect the existing cable from the connector labeled RX1 (or the connector corresponding to the receiver under test). Connector RX1 is on the Base Radio backplane.
5. Connect a test cable to the RX 1 connector.
6. Use an HP4432b to measure BR performance

Station Verification Procedures

7. Attach RF output from the HP4432b to a 3 way splitter. Attach the output of the three way splitter to the antenna connections in the back of the BR.
8. Attach the 'event 2' port in the rear panel to pin 6 on the front panel of the BR.
9. The 4432b must have the Proprietary Tornado downlink files to be configured correctly.
10. Turn on the 4432b. Press the 'mode' key. Select the 'arbitrary waveform generator'. Select 'Dual Arb'. Goto 'waveform select' and choose Tornado. Choose 'waveform segments'. Select the 'load' softkey. Choose the softkey 'Store all To NVARB Memory'. Press the 'return' softkey.
11. Select 'ARB setup' and set the sample clock to 100khz.
12. Attach the TFR 5Mhz to the 'Gen ref in'.
13. Set the reference frequency to the correct frequency (5Mhz) and select 'ARB Reference' EXT for external reference.
14. Select the I/Q key. Goto the next page by selecting 'More (1 of 2)'. Turn 'ALC' off by selecting the softkey.
15. Select the 'Mode' key again, followed by the 'arbitrary waveform generator' softkey, 'Dual Arb'
16. Set the frequency and power out and turn on the modulation and RF out.

Receiver Verification Procedure

This procedure provides commands and responses to verify proper operation of Base Radio receiver paths. Perform the procedure on all four receivers in the BR.

1. Power on the BR using the front switch on the Power Supply Module. Press the reset button on the Control Module front panel. At the prompt, hit a Carriage Return on the service computer to enter the test application mode. Using the password Motorola, login to the BR..

```
>login -ufield
>password: *****
field>motorola

field>
```

2. Configure the arbitrary waveform generator (ARB) and Vector Signal Generator A to generate the desired Q-QAM test signal in a 3RX mode at the desired frequency. The RF Power Out of Vector Signal Generator A should be set to -108 dBm

3. Using the MMI commands below, issue the command to put the BR into 3RX mode. If the resulting bit error rates for receiver branches 1, 2, and 3 are less than 8%, the receiver has passed the test.

3.1 Start by checking Receiver 1. At the field> prompt, type:

```
field> freq -orxch1 -f810
field> enable -orxch1 -son
field> sge -orx_all -soff
field> es -orx_all -text_trigger
field> peer_performance_config -orxch1 -mpath -pall
field> peer_performance_report -orxch1 -a100 -r1

field>
```

3.2 Check Receiver 2. At the field> prompt, type:

```
field> freq -orxch2 -f810
field> enable -orxch2 -son
field> sge -orx_all -soff
field> es -orx_all -text_trigger
field> peer_performance_config -orxch2 -mpath -pall
field> peer_performance_report -orxch2 -a100 -r1

field>
```

3.3 Check Receiver 3. At the field> prompt, type:

```
field> freq -orxch3 -f810
field> enable -orxch3 -son
field> sge -orx_all -soff
field> es -orx_all -text_trigger
field> peer_performance_config -orxch3 -mpath -pall
field> peer_performance_report -orxch3 -a100 -r1

field>
```

Station Verification Procedures**3.4 Check Receiver 4.** At the field> prompt, type:

```
field> freq -orxch4 -f810
field> enable -orxch4 -son
field> sge -orx_all -soff
field> es -orx_all -text_trigger
field> peer_performance_config -orxch4 -mpath -pall
field> peer_performance_report -orxch4 -a100 -r1

field>
```

4. Enter the command to return all active alarms of the Base Radio. At the field> prompt, type:

```
field> alarms_ofault_hndlr

field>
```

NOTE

If the command displays alarms, refer to the System Troubleshooting section for corrective actions.

5. As an option, you may check kit numbers for the receiver and other modules. The following command returns this data. (The example below specifies 800 MHz Quad Base Radios.) At the field> prompt, type:

```
field> fv -oplatform

field>
```

Equipment Disconnection

After verifying receiver operation, disconnect equipment as follows:

1. Notice the Power Supply rocker switch, behind the front panel of the Power Supply. Set the Power Supply rocker switch to the OFF (0) position. Turning off this switch removes power from the Base Radio.
2. Disconnect the RS-232 cable from the connector on the service computer.

3. Disconnect the other end of the RS-232 cable from the RS-232 connector on the front panel of the BRC.
4. Disconnect the test cable from the RX1, RX2, and RX3 connectors located on the backplane of the Base Radio.
5. Connect the standard equipment cable to the RX1 connector.
6. Restore power to the Base Radio by setting the Power Supply rocker switch to the ON (1) position. This step completes the Receiver Verification Procedure for the receiver under test.
7. Repeat the Receiver Verification Procedure for each Quad receiver in every Base Radio in the EBTS.

QUAD Channel BR Backplane

QUAD Channel BR Backplane

Backplane Connectors

The Base Radio backplane includes all external equipment connections. Table 9-3 lists and describes the backplane connectors.

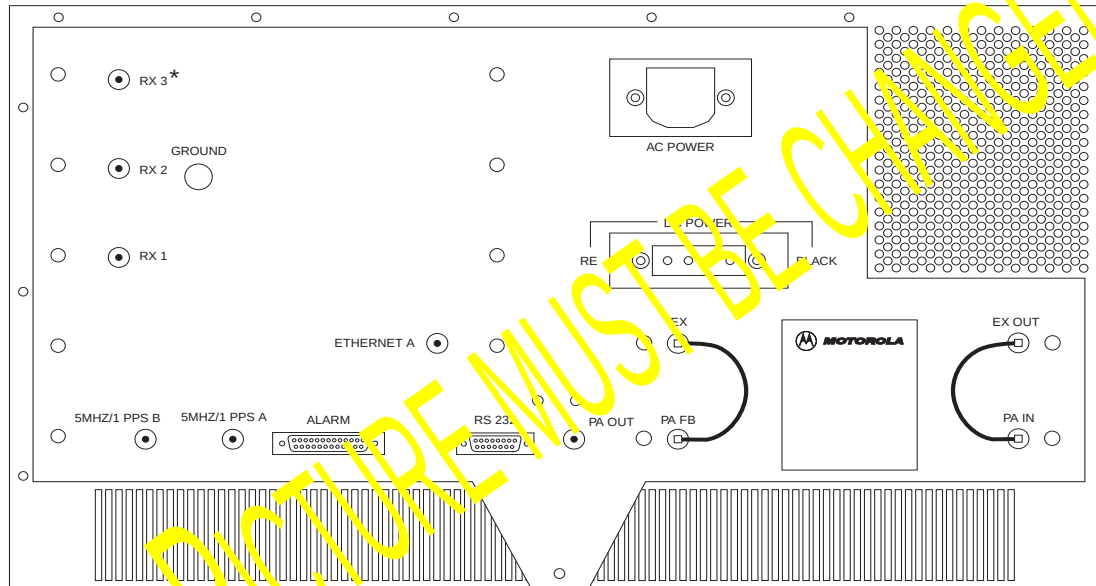
Table 9-3 **Backplane Connectors**

Connector	Module	Description	Connector Type
P1	EXBRC	Signal	168 Pin AMP Z-Pack Futurebus
P2	RX1	Signal	72 Pin AMP Z-Pack Futurebus
P3	RX1	RF	6 coax Harting Harpak
P4	RX2	Signal	72 Pin AMP Z-Pack Futurebus
P5	RX2	RF	6 coax Harting Harpak
P6	RX3	Signal	72 Pin AMP Z-Pack Futurebus
P7	RX3	RF	6 coax Harting Harpak
P8	RX4	Signal	72 Pin AMP Z-Pack Futurebus
P9	RX4	RF	6 coax Harting Harpak
P10	PA	Signal	96 Pin EURO
P11	PS	Signal & Power	78 Pin AMP Teledensity
P12a	PS	-48 Vdc Power In	8 Pin AMP 530521-3
P13	EX	RF(EX from PA)	SMA blindmate
P14	EX	RF(EX to PA)	SMA blindmate
P15	External / EXBRC	Ethernet	BNC blindmate
P16	External / PA	RF (PA from EX)	SMA blindmate
P17	External / PA	RF (PA to EX)	SMA Blindmate
P18	External / PA	TX Output	SMA blindmate
P19	RX Branch 1	RF	SMA
P20	RX Branch 2	RF	SMA
P21	RX Branch 3	RF	SMA
P22b	External	RS232	Dsub-9
P23	External	Alarm	Dsub-25
P24	External	5MHz/1PPS	BNC

a. P12 is a cutout in the backplane with threaded inserts for securing the connector which mates directly to the power supply.

b. P22 will not be placed on the Tornado backplane. However, the backplane shall be designed with P22 to allow for reuse on other products.

Figure 9-4 shows the locations of the Base Radio external connections.



* This port must be terminated by 50Ω load when configured for Branch Diversity. Also, the rx_fru_config parameter must be set to R12.

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Figure:9-4 **Base Radio Backplane Connectors**

Backplane RF Connections

When the factory ships Base Radios as FRUs, each connection on the back of a repeater has a designated color dot beside it. See Table 9-4. To find where a cable should be connected, match the label wrapped around the cable to the dot on the back of the repeater.

Table: 9-4**Color Codes for RF Connections on Rear of Base Radio**

Connectors	Color Dot Code
TX	Orange
RX 1	Red
RX 2	Green
RX 3	Yellow
Ethernet	White
5 MHz / 1 pps A or Spare	Gray

QUAD Channel BR Backplane

Backplane Connector Pinouts

Table 9-5 lists the pin-outs for the Base Radio Controller board's 168-pin P1 connector.

Table: 9-5 **EXBRC P1 Pinout, Signal and Power**

Row	A	B	C	D
1	GND	3.3 Vdc	3.3 Vdc	NC
2	GND	3.3 Vdc	14.2 Vdc	14.2 Vdc
3	GND	3.3 Vdc	14.2 Vdc	14.2 Vdc
4	GND	GND	GND	GND
5	NC	NC	NC	NC
6	GND	GND	GND	GND
7	GND	16.8MHz_RX	16.8MHz_RX_RTN	GND
8	GND	GND	GND	GND
9	GND	5 MHz/1 PPS	3.3 Vdc	3.3 Vdc
10	NC	NC	NC	3.3 Vdc
11	TxD	CTS	DTR	BRG
12	RTS	RxD	DSR	CD
13	NC	NC	NC	3.3 Vdc
14	NC	NC	SHUTDOWN_	SLEEP_
15	PA_ENABLE	NC	28.6 Vdc	14.2 Vdc
16	NC	NC	NC	3.3 Vdc
17	EXT_GPI_1_	EXT_GPI_2_	EXT_GPO_1_	EXT_GPO_2_
18	BAT_STAT_	MTR_STAT_	EXT_VFWD	EXT_VREV
19	SPI_M3	SPI_M2	SPI_M1	SPI_M0
20	SPI_ENABLE	SPI_MOSI	SPI_MISO	SPI_CLK
21	SPI_A2	SPI_A1	SPI_A0	WP_
22	NC	RxRESET_	NC	NC
23	NC	Clock_SyncB_	NC	NC
24	GND	GND	3.3 Vdc	3.3 Vdc
25	SSI_Data_D	SSI_CLK_D	SSI_FS_D	3.3 Vdc
26	SSI_Data_D_RTN	SSI_CLK_D_RTN	NC	3.3 Vdc
27	GND	GND	3.3 Vdc	3.3 Vdc
28	DSPIb_MOSI	DSPIb_CLK	DSPIb_EN_1	DSPIb_EN_2
29	DSPIb_MOSI_RTN	DSPIb_CLK_RTN	DSPIb_EN_3	NC
30	GND	GND	3.3 Vdc	3.3 Vdc
31	GND	SSI_Data_C	SSI_CLK_C	SSI_FS_C
32	GND	SSI_Data_C_RTN	SSI_CLK_C_RTN	NC
33	NC	Clock_SyncA_	NC	NC
34	GND	GND	3.3 Vdc	3.3 Vdc
35	SSI_Data_B	SSI_CLK_B	SSI_FS_B	3.3 Vdc

Table: 9-5 **EXBRC P1 Pinout, Signal and Power**

Row	A	B	C	D
36	SSI_Data_B_RTN	SSI_CLK_B_RTN	NC	3.3 Vdc
37	GND	GND	3.3 Vdc	3.3 Vdc
38	DSPIa_MOSI	DSPIa_CLK	DSPIa_EN_1	DSPIa_EN_2
39	DSPIa_MOSI_RTN	DSPIa_CLK_RTN	DSPIa_EN_3	NC
40	GND	GND	3.3 Vdc	3.3 Vdc
41	GND	SSI_Data_A	SSI_CLK_A	SSI_FS_A
42	GND	SSI_Data_A_RTN	SSI_CLK_A_RTN	NC

Table: 9-6 **EXBRC P13 Pinout, Exciter from PA**

Coaxial	Description
Center	PA IN
Outer	GND

Table: 9-7 **EXBRC P14 Pinout, Exciter to PA**

Coaxial	Description
Center	PA Feedback
Outer	GND

Table: 9-8 **EXBRC P15 Pinout, Ethernet**

Coaxial	Description
Center	Ethernet
Outer	GND

QUAD Channel BR Backplane**RX1 Connections***Table 9-9 RX1 P2 Pinout, Signal and Power*

Row	A	B	C	D
1	NC	GND	GND	Clock_SyncA_
2	GND	DSPIa_MOSI_RTN	DSPIa_CLK_RTN	DSPIa_EN_1
3	GND	DSPIa_MOSI	DSPIa_CLK	DSPIa_EN_2
4	GND	GND	GND	GND
5	14.2	SSI_CLK_A_RTN	SSI_FS_B	SSI_CLK_B_RTN
6	14.2	SSI_CLK_A	SSI_FS_A	SSI_CLK_B
7	14.2	GND	GND	GND
8	14.2	SSI_Data_A_RTN	GND	SSI_Data_B
9	GND	SSI_Data_A	GND	SSI_Data_B_RTN
10	GND	NC	NC	NC
11	3.3	RxRESET_	GND (ID0)	GND (ID1)
12	3.3	WP_	SPI_A0	SPI_A1
13	3.3	SPI_MISO	SPI_CLK	SPI_A2
14	GND	SPI_M0	SPI_ENABLE	SPI_MOSI
15	GND	SPI_M1	SPI_M2	SPI_M3
16	GND	GND	GND	NC
17	GND	16.8MHz_RX	GND	NC (WB switch)
18	GND	16.8MHz_RX_RTN	GND	NC (MC switch)

Table 9-10 RX1 P3 Pinout, RF Input and Output Connection

Row	A	B	C	D	E
1	GND	-	GND	-	GND
2	-	RX3_EXP3	-	RX1_EXP3	-
3	GND	-	GND	-	GND
4	GND	-	GND	-	GND
5	-	RX2_EXP2	-	RX1_EXP2	-
6	GND	-	GND	-	GND
7	GND	-	GND	-	GND
8	-	RX Branch 1	-	RX1_EXP1	-
9	GND	-	GND	-	GND

RX2 Connections

Table 9-11 **RX2 P4 Pinout, Signal and Power**

Row	A	B	C	D
1	NC	GND	GND	Clock_SyncA_
2	GND	DSPIa_MOSI_RTN	DSPIa_CLK_RTN	DSPIa_EN_3
3	GND	DSPIa_MOSI	DSPIa_CLK	DSPIa_EN_2
4	GND	GND	GND	GND
5	14.2	SSI_CLK_B_RTN	NC	NC
6	14.2	SSI_CLK_B	SSI_FS_B	NC
7	14.2	GND	GND	GND
8	14.2	SSI_Data_B_RTN	GND	NC
9	GND	SSI_Data_B	GND	NC
10	GND	NC	NC	NC
11	3.3	RxRESET_	NC (ID0)	GND (ID1)
12	3.3	WP_	SPI_A0	SPI_A1
13	3.3	SPI_MISO	SPI_CLK	SPI_A2
14	GND	SPI_M0	SPI_ENABLE	SPI_MOSI
15	GND	SPI_M2	SPI_M1	SPI_M3
16	GND	GND	GND	NC
17	GND	16.8MHz_RX	GND	NC (WB switch)
18	GND	16.8MHz_RX_RTN	GND	NC (MC switch)

Table 9-12 **RX2 P5 Pinout, RF Input and Output Connection**

Row	A	B	C	D	E
1	GND	-	GND	-	GND
2	-	RX3_EXP2	-	RX2_EXP3	-
3	GND	-	GND	-	GND
4	GND	-	GND	-	GND
5	-	RX1_EXP1	-	RX2_EXP2	-
6	GND	-	GND	-	GND
7	GND	-	GND	-	GND
8	-	RX Branch 2	-	RX2_EXP1	-
9	GND	-	GND	-	GND

QUAD Channel BR Backplane**RX3 Connections***Table 9-13 RX3 P6 Pinout, Signal and Power*

Row	A	B	C	D
1	NC	GND	GND	Clock_SyncB_
2	GND	DSPIb_MOSI_RTN	DSPIb_CLK_RTN	DSPIb_EN_1
3	GND	DSPIb_MOSI	DSPIb_CLK	DSPIb_EN_2
4	GND	GND	GND	GND
5	14.2	SSI_CLK_C_RTN	SSI_FS_D	SSI_CLK_D_RTN
6	14.2	SSI_CLK_C	SSI_FS_C	SSI_CLK_D
7	14.2	GND	GND	GND
8	14.2	SSI_Data_C_RTN	GND	SSI_Data_D
9	GND	SSI_Data_C	GND	SSI_Data_D_RTN
10	GND	NC	NC	NC
11	3.3	RxRESET_	GND (ID0)	NC (ID1)
12	3.3	WP_	SPI_A0	SPI_A1
13	3.3	SPI_MISO	SPI_CLK	SPI_A2
14	GND	SPI_M2	SPI_ENABLE	SPI_MOSI
15	GND	SPI_M1	SPI_M0	SPI_M3
16	GND	GND	GND	NC
17	GND	16.8MHz_RX	GND	GND (WB switch)
18	GND	16.8MHz_RX_RTN	GND	NC (MC switch)

Table 9-14 RX3 P7 Pinout, RF Input and Output Connection

Row	A	B	C	D	E
1	GND	-	GND	-	GND
2	-	RX1_EXP2	-	RX3_EXP3	-
3	GND	-	GND	-	GND
4	GND	-	GND	-	GND
5	-	RX2_EXP1	-	RX3_EXP2	-
6	GND	-	GND	-	GND
7	GND	-	GND	-	GND
8	-	RX Branch 3	-	RX3_EXP1	-
9	GND	-	GND	-	GND

RX4 Connections

Table 9-15 **RX4 P8 Pinout, Signal and Power**

Row	A	B	C	D
1	NC	GND	GND	Clock_SyncB_
2	GND	DSPIb_MOSI_RTN	DSPIb_CLK_RTN	DSPIb_EN_3
3	GND	DSPIb_MOSI	DSPIb_CLK	DSPIb_EN_2
4	GND	GND	GND	GND
5	14.2	SSI_CLK_D_RTN	NC	NC
6	14.2	SSI_CLK_D	SSI_FS_D	NC
7	14.2	GND	GND	GND
8	14.2	SSI_Data_D_RTN	GND	NC
9	GND	SSI_Data_D	GND	NC
10	GND	NC	NC	NC
11	3.3	RxRESET_	NC (ID0)	NC (ID1)
12	3.3	WP_	SPI_A0	SPI_A1
13	3.3	SPI_MISO	SPI_CLK	SPI_A2
14	GND	SPI_M0	SPI_ENABLE	SPI_MOSI
15	GND	SPI_M3	SPI_M2	SPI_M1
16	GND	GND	GND	NC
17	GND	16.8MHz_RX	GND	NC (WB switch)
18	GND	16.8MHz_RX_RTN	GND	GND (MC switch)

Table 9-16 **RX4 P9 Pinout, RF Input and Output Connection**

Row	A	B	C	D	E
1	GND	-	GND	-	GND
2	-	RX1_EXP3	-	NC	-
3	GND	-	GND	-	GND
4	GND	-	GND	-	GND
5	-	RX2_EXP3	-	NC	-
6	GND	-	GND	-	GND
7	GND	-	GND	-	GND
8	-	RX3_EXP1	-	NC	-
9	GND	-	GND	-	GND

QUAD Channel BR Backplane**PA Connections***Table 9-17 PA P10 Pinout, Signal and Power*

Row	A	B	C
1	SPI_ENABLE	GND	28.6 Vdc
2	GND	GND	28.6 Vdc
3	SPI_A0	GND	28.6 Vdc
4	GND	GND	28.6 Vdc
5	SPI_A1	GND	28.6 Vdc
6	GND	GND	28.6 Vdc
7	SPI_A2	GND	28.6 Vdc
8	GND	GND	28.6 Vdc
9	SPI_M0	GND	28.6 Vdc
10	GND	GND	28.6 Vdc
11	SPI_M1	GND	28.6 Vdc
12	GND	GND	28.6 Vdc
13	SPI_M2	GND	28.6 Vdc
14	GND	GND	28.6 Vdc
15	SPI_M3	GND	28.6 Vdc
16	GND	GND	28.6 Vdc
17	SPI_MISO	GND	28.6 Vdc
18	GND	GND	28.6 Vdc
19	SPI_MOSI	GND	28.6 Vdc
20	GND	GND	28.6 Vdc
21	SPI_CLK	GND	28.6 Vdc
22	GND	3.3 Vdc	28.6 Vdc
23	WP*	3.3 Vdc	28.6 Vdc
24	GND	GND	28.6 Vdc
25	PA_ENABLE	GND	28.6 Vdc
26	GND	14.2 Vdc	28.6 Vdc
27	GND	14.2 Vdc	28.6 Vdc
28	GND	14.2 Vdc	28.6 Vdc
29	GND	14.2 Vdc	28.6 Vdc
30	GND	28.6 Vdc	28.6 Vdc
31	GND	28.6 Vdc	28.6 Vdc
32	GND	28.6 Vdc	28.6 Vdc

Table: 9-18 EXBRC P16 Pinout, PA from Exciter

Coaxial	Description
Center	PA IN
Outer	GND

Table: 9-19 **EXBRC P17 Pinout, PA to Exciter**

Coaxial	Description
Center	PA Feedback
Outer	GND

Table: 9-20 **EXBRC P18 Pinout, PA RF OUT**

Coaxial	Description
Center	PA RF OUT
Outer	GND

External Connections

Table: 9-21 **Backplane Coaxial and DC**

	Signal
P12	-48 Vdc Power
P13	EX Out
P14	Feedback
P15	Ethernet
P16	PA In
P17	PA Feedback
P18	PA RF OUT
P19	RX Branch 1
P20	RX Branch 2
P21	RX Branch 3
P24	5 MHz/1 PPS

)

Table: 9-22 **Backplane Alarm 25Pin Dsub (P23)**

	Alarm Signal
1	EXT_GPI_1_
2	EXT_GPO_1_
3	GND
4	EXT_GPI_2_
5	EXT_GPO_2_
6	

QUAD Channel BR Backplane*Table: 9-22***Backplane Alarm 25Pin Dsub (P23)**

	Alarm Signal
7	
8	
9	
10	GND
11	
12	
13	
14	
15	
16	GND
17	BAT_STAT_
18	MTR_STAT_
19	EXT_VFWD
20	EXT_VREV
21	GND
22	GND
23	
24	
25	GND

*Table: 9-23***Backplane RS-232 9 Pin Dsub (P22)**

	RS-232 Signal
1	CD
2	RxD
3	TxD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	BRG*

PS Connections

Table: 9-24 **PS Power and Signal (P11)**

Pin	Description	Pin	Description	Pin	Description
1	GND (Plug In)	31	3.3 Vdc	61	SPI_MOSI
2	GND	32	GND	62	SPI_CLK
3	GND	33	GND	63	N.C.
4	28.6 Vdc	34	GND	64	N.C.
5	28.6 Vdc	35	GND	65	N.C.
6	28.6 Vdc	36	GND	66	N.C.
7	28.6 Vdc	37	GND	67	SPI_A0
8	28.6 Vdc	38	GND	68	SPI_A1
9	28.6 Vdc	39	GND	69	SPI_M2
10	28.6 Vdc	40	GND	70	SPI_M3
11	28.6 Vdc	41	GND	71	SPI_M1
12	28.6 Vdc	42	GND	72	SLEEP_
13	28.6 Vdc	43	GND	73	SPI_M0
14	28.6 Vdc	44	GND	74	WP_
15	28.6 Vdc	45	GND	75	SPI_A2
16	14.2 Vdc	46	GND	76	GND
17	14.2 Vdc	47	GND	77	GND
18	14.2 Vdc	48	GND	78	GND
19	14.2 Vdc	49	GND		
20	14.2 Vdc	50	GND		
21	14.2 Vdc	51	GND		
2	14.2 Vdc	52	GND		
23	14.2 Vdc	53	GND		
24	3.3 Vdc	54	NC (FAN CON- TROL)		
25	3.3 Vdc	55	N.C.		
26	3.3 Vdc	56	N.C.		
27	3.3 Vdc	57	SHUTDOWN_		
28	3.3 Vdc	58	NC (Power shar- ing)		
29	3.3 Vdc	59	SPI_ENABLE		
30	3.3 Vdc	60	SPI_MISO		

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QUAD Channel BR Backplane*Table: 9-25***48 Vdc Battery Power (P12)**

Pin	Description	Description	Pin
1	+ BATTERY	+ BATTERY	5
2	+ BATTERY	+ BATTERY	6
3	- BATTERY (RTN)	- BATTERY (RTN)	7
4	- BATTERY (RTN)	- BATTERY (RTN)	8

QUAD Base Radio Signals

Table 9-26 lists and describes signals for the QUAD Base Radio .

Table: 9-26 **QUAD Base Radio Signal Descriptions**

Signal Name	Description	Special
28.6 Vdc	28.6 Vdc output from PS	
14.2 Vdc	14.2 Vdc output from PS	
3.3 Vdc	3.3 Vdc output from PS	
GND	Station Ground	
RX Branch 1	RX Branch 1 from RFDS	50 Ω
RX Branch 2	RX Branch 2 from RFDS	50 Ω
RX Branch 3	RX Branch 3 from RFDS	50 Ω
RX1_EXP1	RX1 (branch 1) expansion output 1	50 Ω
RX1_EXP2	RX1 (branch 1) expansion output 2	50 Ω
RX1_EXP3	RX1 (branch 1) expansion output 3	50 Ω
RX2_EXP1	RX2 (branch 2) expansion output 1	50 Ω
RX2_EXP2	RX2 (branch 2) expansion output 2	50 Ω
RX2_EXP3	RX2 (branch 2) expansion output 3	50 Ω
RX3_EXP1	RX3 (branch 3) expansion output 1	50 Ω
RX3_EXP2	RX3 (branch 3) expansion output 2	50 Ω
RX3_EXP3	RX3 (branch 3) expansion output 3	50 Ω
5 MHz/1 PPS	5 MHz/1 PPS reference to the BRC	
SPI_ENABLE	Host Centric SPI Enable	
SPI_MISO	Host Centric SPI MISO	
SPI_MOSI	Host Centric SPI MOSI	
SPI_CLK	Host Centric SPI Clock	
SPI_A0	Host SPI Device Address Line A0	
SPI_A1	Host SPI Device Address Line A1	
SPI_A2	Host SPI Device AddressLine A2	
SPI_M0	Host SPI Module Address Line M0	
SPI_M1	Host SPI Module Address Line M1	
SPI_M2	Host SPI Module Address Line M2	
SPI_M3	Host SPI Module Address Line M3	
WP_	Write Protect (active low)	
PA_ENABLE	Turns off PA bias with active low	
SLEEP_	Sleep signal from PS	
SHUTDOWN_	PS reset line from BRC	
CD	RS232 Carrier Detect	
RxD	RS232 RX Data	

QUAD Base Radio Signals*Table: 9-26* **QUAD Base Radio Signal Descriptions**

Signal Name	Description	Special
TxD	RS232 TX Data	
DTR	RS232 Data Terminal Ready	
DSR	RS232 Data Set Ready	
RTS	RS232 Request to Send	
CTS	RS232 Clear to Send	
BRG	Baud Rate Generator	
RxRESET_	Reset Signal to RX modules	
16.8MHz_RX	16.8 MHz reference to RX	differential
16.8MHz_RX_RTN	16.8 MHz reference to RX return	differential
Clock_SyncA_	Clock Sync signal to RX1 & RX2	For Abacus III
Clock_SyncB_	Clock Sync signal to RX3 & RX4	For Abacus III
SSI_Data_A	RX Data from RX module 1	differential
SSI_Data_A_RTN	RX Data from RX module 1 return	differential
SSI_Data_B	RX Data from RX module 2	differential
SSI_Data_B_RTN	RX Data from RX module 2 return	differential
SSI_Data_C	RX Data from RX module 3	differential
SSI_Data_C_RTN	RX Data from RX module 3 return	differential
SSI_Data_D	RX Data from RX module 4	differential
SSI_Data_D_RTN	RX Data from RX module 4 return	differential
SSI_CLK_A	RX Clock from RX module 1	differential
SSI_CLK_A_RTN	RX Clock from RX module 1 return	differential
SSI_CLK_B	RX Clock from RX module 2	differential
SSI_CLK_B_RTN	RX Clock from RX module 2 return	differential
SSI_CLK_C	RX Clock from RX module 3	differential
SSI_CLK_C_RTN	RX Clock from RX module 3 return	differential
SSI_CLK_D	RX Clock from RX module 4	differential
SSI_CLK_D_RTN	RX Clock from RX module 4 return	differential
SSI_FS_A	RX Frame Sync from RX module 1	
SSI_FS_B	RX Frame Sync from RX module 2	
SSI_FS_C	RX Frame Sync from RX module 3	
SSI_FS_D	RX Frame Sync from RX module 4	
DSPla_En_1	DSPa SPI RX1 Abacus enable	
DSPla_En_3	DSPa SPI RX2 Abacus enable	
DSPla_En_2	DSPa SPI RX1 & RX2 SGC enable	
DSPlb_En_1	DSPb SPI RX3 Abacus enable	
DSPlb_En_3	DSPb SPI RX4 Abacus enable	
DSPlb_En_2	DSPb SPI RX3 & RX4 SGC enable	
DSPla_MOSI	DSPa SPI MOSI	differential
DSPla_MOSI_RTN	DSPa SPI MOSI return	differential
DSPlb_MOSI	DSPb SPI MOSI	differential

QUAD Base Radio Signals*Table: 9-26* **QUAD Base Radio Signal Descriptions**

Signal Name	Description	Special
DSP1b_MOSI_RTN	DSPb SPI MOSI return	differential
DSP1a_CLK	DSPa SPI Clock	differential
DSP1a_CLK_RTN	DSPa SPI CLK return	differential
DSP1b_CLK	DSPb SPI Clock	differential
DSP1b_CLK_RTN	DSPb SPI CLK return	differential
MTR_STAT_	External Wattmeter Status	
BAT_STAT_	Battery Status	
EXT_VFWD	External Wattmeter Forward meter	
EXT_VREV	External Wattmeter Reflected meter	
EXT_GPO_1_	General purpose output 1	
EXT_GPO_2_	General purpose output 2	
EXT_GPI_1_	General purpose input 1	
EXT_GPI_2_	General purpose input 2	
NC	Not connected	reserved

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Acronyms

A/D	Analog-to-Digital	CC	Control Cabinet
A	Amperes	CD	Carrier Detect
AC	Alternating Current	cd	change directory
ACT	active	CLK	Clock
ADA	Americans with Disabilities Act	CLT	Controller
AGC	Automatic Gain Control	cm	centimeter
AIC	Ampere Interrupting Capacity	CMOS	Complementary Metal Oxide Semiconductor
AIS	Alarm Indication Signal (Keep Alive)	CPU	Central Processing Unit
ANSI	American National Standards Institute	CSMA/CD	Carrier Sense Multiple Access with Collision Detect
ASCII	American National Standard Code for Information Interchange	CTI	Coaxial Transceiver Interface
ASIC	Application Specific Integrated Circuit	CTL	Control (Base Radio Control)
Aux	auxiliary	CTS	Clear-to-Send
avg	average	D/A	Digital-to-Analog
AWG	American Wire Gauge	DAP	Dispatch Application Processor
bd	baud	DB-15	15-pin D-subminiature
BDM	Background Debug Mode	DB-9	9-pin D-subminiature
BER	Bit Error Rate	dB	Decibel
BERT	Bit Error Rate Test	dBc	Decibels relative to carrier
BMR	Base Monitor Radio	dBm	Decibels relative to 1mW
BNC	Baby "N" Connector	DC	Direct Current
BPV	Bipolar Variation	DCE	Data Circuit-Terminating Equipment
BR	Base Radio	DCSPLY	DC Supply
BRC	Base Radio Controller	DDM	Dual Device Module
BSC	Base Site Controller	deg	degree
BTU	British Thermal Unit	DIN	<i>Deutsche Industrie-Norm</i>
BW	bandwidth	DIP	Dual In-line Package
C/N + 1	Carrier Power to Noise + Interference Ratio	div	division

DMA	Direct Memory Access	HSO	High Stability Oscillator
DOP	Dilution of Precision	HVAC	Heating/Ventilation/ Air Conditioning
DRAM	Dynamic Random Access Memory	Hz	Hertz
DSP	Digital Signal Processor	I/O	Input/Output
DTE	Data Terminal Equipment	IC	Integrated Circuit
DTTA	Duplexed Tower-Top Amplifier	iDEN	integrated Dispatch Enhanced Network
DVM	Digital Volt Meter	IEEE	Institute of Electrical and Electronic Engineers
E1	European telephone multiplexing standard	IF	intermediate frequency
EAS	Environmental Alarm System	iMU	iDEN Monitor Unit
E-NET	Ethernet	in	inches
EBTS	Enhanced Base Transceiver System	in	injection
EGB	Exterior Ground Bar	ISA	Industry Standard Architecture
EIA	Electronics Industry Association	iSC	integrated Site Controller
EMI	Electro-Magnetic Interference	kg	kilogram
EPROM	Erasable Programmable Read Only Memory	kHz	kiloHertz
EEPROM	Electrically Erasable Programmable Read Only Memory	LAN	Local Area Network
ERFC	Expansion RF Cabinet	LANIIC	Local Area Network Interface IC
ESI	Ethernet Serial Interface	LAPD	Link Access Procedure D-Channel
ESMR	Enhanced Special Mobile Radio	lbs	pounds
EX	Exciter	LDM	Linear Driver Module
FB	feedback	LED	Light Emitting Diode
FCC	Federal Communications Commission	LFM	Linear Final Module
FIFO	First-In, First-Out	LIU	Line Interface Unit
FNE	Fixed Network Equipment	LLC	Link Layer Controller
freq	frequency	LNA	Low Noise Amplifier
FRU	Field Replaceable Unit	LO	Local Oscillator
GFI	Ground Fault Interrupter	LOS	Loss of Signal
GND	ground	MAU	Media Access Unit
GPS	Global Positioning System	max	maximum
GPSR	Global Positioning System Receiver	MC	Multicoupler
HDLC	High-level Data Link	MGB	Master Ground Bar
HSMR	High Elevation Specialized Mobile Radio	MGN	Multi-Grounded Neutral
		MHz	MegaHertz
		min	minimum

min	minute	PS	Power Supply
MISO	Master In/Slave Out	PSTN	Public Switched Telephone Network
mm	millimeter	PVC	Polyvinyl Chloride
MMI	Man-Machine-Interface	pwr	power
MOSI	Master Out/Slave In	QAM	Quadrature Amplitude Modulation
MPM	Multiple Peripheral Module	QRSS	Quasi Random Signal Sequence
MPS	Metro Packet Switch	Qty	Quantity
MS	Mobile Station	R1	Receiver #1
ms	millisecond	R2	Receiver #2
MSC	Mobile Switching Center	R3	Receiver #3
MSO	Mobile Switching Office	RAM	Random Access Memory
MST	Modular Screw Terminals	RCVR	Receiver
mV	milliVolt	Ref	Reference
mW	milliWatt	RF	Radio Frequency
N.C.	Normally Closed	RFC	RF Cabinet
N.O.	Normally Open	RFDS	RF Distribution System
NEC	National Electric Code	RFS	RF System
NIC	Network Interface Card	ROM	Read Only Memory
no.	number	RPM	Revolutions Per Minute
NTM	NIC Transition Module	RSSI	Received Signal Strength Indication
NTWK	Network	RTN	Return
OMC	Operations and Maintenance Center	RU	Rack Unit
OSHA	Occupational Safety and Health Act	Rx	Receive
PA	Power Amplifier	RXDSP	Receive Digital Signal Processor
PAL	Programmable Array Logic	SCI	Serial Communications Interface
PC	Personal Computer	SCON	VME System Controller
PCCH	Primary Control Channel	SCRf	Stand-alone Control and RF Cabinet (configuration)
PDOP	Position Dilution of Precision	SCSI	Small Computer System Interface
pF	picoFarad	sec	second
PLL	Phase Locked Loop	SGC	Software Gain Control
P/N	Part Number	SINAD	Signal Plus Noise Plus Distortion to Noise Plus Distortion Ratio
P/O	Part Of	SMART	Systems Management Analysis, Research and Test
ppm	parts per million		
PPS	Pulse Per Second		

SPI	Serial Peripheral Interface	Vac	Volts - alternating current
SQE	Signal Quality Error	VCO	Voltage Controlled Oscillator
SRAM	Static Random Access Memory	VCXO	Voltage Controlled Crystal Oscillator
SRC	Substrate Controller	Vdc	Volts - direct current
SRI	Site Reference Industry standard	VFWD	Voltage representation of Forward Power
SRIB	SMART Radio Interface Box	VME	Versa-Module Eurocard
SRRC	Single Rack, Redundant Controller (configuration)	Vp-p	Voltage peak-to-peak
SRSC	Single Rack, Single Controller (configuration)	VREF	Voltage representation of Reflected Power
SS	Surge Suppressor	VSWR	Voltage Standing Wave Ratio
SSC	System Status Control	W	Watt
SSI	Synchronous Serial Interface	WDT	Watchdog Timer
ST	Status	WP	Write Protect
STAT	Status	WSAPD	Worldwide Systems and Aftermarket Products Division
Std	Standard		
S/W	Software		
T1	North american telephone mutiplexing standard		
TB	Terminal Board		
TDM	Time Division Multiplex		
telco	telephone company		
SCON	VME System Controller		
TISIC	TDMA Infrastructure Support IC		
TSI	Time Slot Interface		
TSI	Time Slot Interchange		
TTA	Tower-Top Amplifier		
TTL	Transistor - Transistor Logic		
Tx	Transmit		
TXD	Transmit Data		
TXDSP	Transmit Digital Signal Processor		
Txlin	Tranlin IC		
typ	typical		
UL	Underwriters Laboratories		
V	Volts		

B**Base Radio**

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