

SC™ 4812T BTS Optimization/ATP

System Software Release 2.16.0

800/1700/1900 MHz

CDMA

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English
Mar 2001
68P09253A61-1



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CDMA 800/1700/1900 MHz

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Product Information

Model & Options Charts

Refer to the *SC 4812T Field Replaceable Units* manual (68P64114A08) for detailed model structure and option information.

This document covers only the steps required to verify the functionality of the Base Transceiver Subsystem (BTS) equipment prior to system level testing, and is intended to supplement site specific application instructions. It also should be used in conjunction with existing product manuals. Additional steps may be required.

FCC Part 15

FCC Part 15 Requirements

This section conveys FCC Part 15 requirements for the T/ET/ETL series BTS cabinets.

Part 15.19a(3) – INFORMATION TO USER

NOTE

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

Part 15.21 – INFORMATION TO USER



CAUTION

Changes or modifications not expressly approved by Motorola could void your authority to operate the equipment.

15.105(b) – INFORMATION TO USER

NOTE

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment OFF and ON, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Part 68

FCC Part 68 Requirements

This equipment complies with Part 68 of the Federal Communications Commission (FCC) Rules and regulations. A label inside the cabinet frame easily visible with the door open in the upper portion of the cabinet contains, among other information, the FCC Registration Number and Ringer Equivalence Number (REN) for this equipment. If requested, this information must be provided to the telephone company.

The REN is useful to determine the quantity of the devices which may connect to the telephone line. Excessive RENs on the telephone line may result in the devices not ringing in response to incoming calls. In most, but not all areas, the sum of the RENs should not exceed five (5.0). To be certain of the number of devices that may be connected to the line as determined by the total RENs, contact the telephone company to determine the maximum REN for the calling area.

If the dial-in site access modem causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. If advance notice is not practical, the telephone company will notify you of the discontinuance as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of your dial-in site access modem. If this happens, the telephone company will provide advance notice so that you can modify your equipment as required to maintain uninterrupted service.

If you experience trouble with the dial-in site access modem, please contact:

Motorola Cellular Service Center (MCSC)
1501 W. Shure Drive
Arlington Heights, Illinois 60004
Phone Number: (847) 632-5390

for repair and/or warranty information. If the trouble is causing harm to the telephone network, the telephone company may request you to disconnect the equipment from the network until the problem is solved. You should not attempt to repair this equipment yourself. This equipment contains no customer or user-serviceable parts.

Changes or modifications not expressly approved by Motorola could void your authority to operate this equipment.

Foreword

Scope of manual

This manual is intended for use by cellular telephone system craftspersons in the day-to-day operation of Motorola cellular system equipment and ancillary devices. It is assumed that the user of this information has a general understanding of telephony, as used in the operation of the Public Switched Telephone Network (PSTN), and is familiar with these concepts as they are applied in the cellular mobile/portable radiotelephone environment. The user, however, is not expected to have any detailed technical knowledge of the internal operation of the equipment.

This manual is not intended to replace the system and equipment training offered by Motorola, although it can be used to supplement or enhance the knowledge gained through such training.

Text conventions

The following special paragraphs are used in this manual to point out information that must be read. This information may be set-off from the surrounding text, but is always preceded by a bold title in capital letters. The four categories of these special paragraphs are:

NOTE

Presents additional, helpful, non-critical information that you can use.



IMPORTANT

Presents information to help you avoid an undesirable situation or provides additional information to help you understand a topic or concept.



CAUTION

Presents information to identify a situation in which equipment damage could occur, thus avoiding damage to equipment.



WARNING

Presents information to warn you of a potentially hazardous situation in which there is a possibility of personal injury.

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The following typographical conventions are used for the presentation of software information:

- In text, sans serif **BOLDFACE CAPITAL** characters (a type style without angular strokes: i.e., SERIF versus SANS SERIF) are used to name a command.
- In text, *typewriter* style characters represent prompts and the system output as displayed on an operator terminal or printer.
- In command definitions, sans serif **boldface** characters represent those parts of the command string that must be entered exactly as shown and *typewriter* style characters represent command output responses as displayed on an operator terminal or printer.
- In the command format of the command definition, *<typewriter>* style characters represent the command parameters.
- After typing a command, press the **<Enter>** key to initiate the action.

Changes to manual

Changes that occur after the printing date are incorporated into your manual by Cellular Manual Revisions (CMRs). The information in this manual is updated, as required, by a CMR when new options and procedures become available for general use or when engineering changes occur. The cover sheet(s) that accompany each CMR should be retained for future reference. Refer to the Revision History page for a list of all applicable CMRs contained in this manual.

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In the event that you locate an error or identify a deficiency in your manual, please take time to write to us at the address above. Be sure to include your name and address, the complete manual title and part number (located on the manual spine, cover, or title page), the page number (found at the bottom of each page) where the error is located, and any comments you may have regarding what you have found. We appreciate any comments from the users of our manuals.

24-hour support service

If you have any questions or concerns regarding the operation of your equipment, please contact the Customer Network Resolution Center for immediate assistance. The 24 hour telephone numbers are:

Arlington Heights, IL	800-433-5202
Arlington Heights, International	+1-847-632-5390
Cork, Ireland	44-1793-565444
Swindon, England	44-1793-565444

**Material Available from
Motorola Infrastructure Group
Worldwide Cellular Services**

Material available from Motorola Infrastructure Group Worldwide Cellular Services, identified by a Motorola part number can be ordered from your sales account manager or by calling (800) 453-7988.

General Safety

Remember! . . . Safety depends on you!!

The following general safety precautions must be observed during all phases of operation, service, and repair of the equipment described in this manual. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment. Motorola, Inc. assumes no liability for the customer's failure to comply with these requirements. The safety precautions listed below represent warnings of certain dangers of which we are aware. You, as the user of this product, should follow these warnings and all other safety precautions necessary for the safe operation of the equipment in your operating environment.

Ground the instrument

To minimize shock hazard, the equipment chassis and enclosure must be connected to an electrical ground. If the equipment is supplied with a three-conductor ac power cable, the power cable must be either plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter. The three-contact to two-contact adapter must have the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable must meet International Electrotechnical Commission (IEC) safety standards.

Do not operate in an explosive atmosphere

Do not operate the equipment in the presence of flammable gases or fumes. Operation of any electrical equipment in such an environment constitutes a definite safety hazard.

Keep away from live circuits

Operating personnel must:

- not remove equipment covers. Only Factory Authorized Service Personnel or other qualified maintenance personnel may remove equipment covers for internal subassembly, or component replacement, or any internal adjustment.
- not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed.
- always disconnect power and discharge circuits before touching them.

Do not service or adjust alone

Do not attempt internal service or adjustment, unless another person, capable of rendering first aid and resuscitation, is present.

General Safety – continued

Do not substitute parts or modify equipment

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of equipment. Contact Motorola Warranty and Repair for service and repair to ensure that safety features are maintained.

Dangerous procedure warnings

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed. You should also employ all other safety precautions that you deem necessary for the operation of the equipment in your operating environment.



WARNING

Dangerous voltages, capable of causing death, are present in this equipment. Use extreme caution when handling, testing, and adjusting.

Revision History

Manual Number

68P09253A61-1

Manual Title

SC™ 4812T CDMA BTS Optimization/ATP
CDMA 800/1700/1900 MHz

Version Information

The following table lists the manual version, date of version, and remarks on the version.

Version Level	Date of Issue	Remarks
1	Mar 2001	Draft manual
2		Preliminary manual
3		FOA manual
0		General Release manual

Patent Notification

Patent numbers

This product is manufactured and/or operated under one or more of the following patents and other patents pending:

4128740	4661790	4860281	5036515	5119508	5204876	5247544	5301353
4193036	4667172	4866710	5036531	5121414	5204977	5251233	5301365
4237534	4672657	4870686	5038399	5123014	5207491	5255292	5303240
4268722	4694484	4872204	5040127	5127040	5210771	5257398	5303289
4282493	4696027	4873683	5041699	5127100	5212815	5259021	5303407
4301531	4704734	4876740	5047762	5128959	5212826	5261119	5305468
4302845	4709344	4881082	5048116	5130663	5214675	5263047	5307022
4312074	4710724	4885553	5055800	5133010	5214774	5263052	5307512
4350958	4726050	4887050	5055802	5140286	5216692	5263055	5309443
4354248	4729531	4887265	5058136	5142551	5218630	5265122	5309503
4367443	4737978	4893327	5060227	5142696	5220936	5268933	5311143
4369516	4742514	4896361	5060265	5144644	5222078	5271042	5311176
4369520	4751725	4910470	5065408	5146609	5222123	5274844	5311571
4369522	4754450	4914696	5067139	5146610	5222141	5274845	5313489
4375622	4764737	4918732	5068625	5152007	5222251	5276685	5319712
4485486	4764849	4941203	5070310	5155448	5224121	5276707	5321705
4491972	4775998	4945570	5073909	5157693	5224122	5276906	5321737
4517561	4775999	4956854	5073971	5159283	5226058	5276907	5323391
4519096	4797947	4970475	5075651	5159593	5228029	5276911	5325394
4549311	4799253	4972355	5077532	5159608	5230007	5276913	5327575
4550426	4802236	4972432	5077741	5170392	5233633	5276915	5329547
4564821	4803726	4979207	5077757	5170485	5235612	5278871	5329635
4573017	4811377	4984219	5081641	5170492	5235614	5280630	5339337
4581602	4811380	4984290	5083304	5182749	5239294	5285447	D337328
4590473	4811404	4992753	5090051	5184349	5239675	5287544	D342249
4591851	4817157	4998289	5093632	5185739	5241545	5287556	D342250
4616314	4827507	5020076	5095500	5187809	5241548	5289505	D347004
4636791	4829543	5021801	5105435	5187811	5241650	5291475	D349689
4644351	4833701	5022054	5111454	5193102	5241688	5295136	RE31814
4646038	4837800	5023900	5111478	5195108	5243653	5297161	
4649543	4843633	5028885	5113400	5200655	5245611	5299228	
4654655	4847869	5030793	5117441	5203010	5245629	5301056	
4654867	4852090	5031193	5119040	5204874	5245634	5301188	

Chapter 1: Introduction
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Scope of This Document

This document provides information pertaining to the optimization and audit tests of Motorola SC 4812T Base Transceiver Subsystem (BTS) equipment frames equipped with trunked high-power Linear Power Amplifiers (LPAs) and their associated internal and external interfaces.

This document assumes the following prerequisites:

- The BTS frames and cabling have been installed per the *BTS Frame Installation Manual* – 68P09226A18, which covers the physical “bolt down” of all SC series equipment frames, and the *SC 4812T CDMA BTS Installation Manual* –68P64113A87 which covers BTS specific cabling configurations.

In most applications the same test procedure is used for all equipment variations. However, decision break points are provided throughout the procedure when equipment specific tests are required.



IMPORTANT

As the Code Division Multiple Access (CDMA) Local Maintenance Facility (LMF) capability comes on-line, applicable LMF based procedures will be incorporated. Eventually, only the CDMA LMF platform will be supported as the recommended customer method of interfacing with and servicing the SC series BTS equipment.

We at Motorola Technical Education & Documentation have strived to incorporate into this document the many suggestions and inputs received from you, the customer, since the inception of the SC product line. At the same time, we have tried to insure that **the scope of the document targets both the novice and expert site technician and engineer with the information required to successfully perform the task at hand.** If in some areas, the manual seems to cover the test in too much detail (or not enough detail) we hope you will keep this in mind.

Document Composition

This document covers the following major areas.

- Introduction, consisting of preliminary background information (such as component and subassembly locations and frame layouts) to be considered by the Cellular Field Engineer (CFE) before optimization or tests are performed.
- Preliminary Operations, consisting of pre-power up tests, jumper configuration of BTS sub-assemblies, and initial application of power to the BTS equipment frames. Download of all BTS processor boards, and LPAs.
- Optimization/Calibration, consisting of downloading all BTS processor boards, LPA verification, radio frequency (RF) path verification, Bay Level Offset (BLO) calibration, and Radio Frequency Diagnostic System (RFDS) functions and calibration
- Acceptance Test Procedures (ATP), consisting of automated ATP scripts executed by the LMF and used to verify all major transmit (TX) and receive (RX) performance characteristics on all BTS equipment. Also generates an ATP report.
- Optional manual performance tests used to verify specific areas of site operation or to verify regulation compliance. These tests are typically used to isolate faults down to the module level and information necessary to better understand equipment operation.
- Site turnover after ATP is completed.
- Appendices that contain pertinent data sheets that are filled out manually by the CFE at the site, Pseudorandom Noise (PN) Offset information, an optimization/ATP matrix, output power data tables, CDMA operating frequency programming information, manual test setup information, procedures for verifying that the Voltage Standing Wave Ratio (VSWR) of all antennas and associated feed lines fall within acceptable limits, procedures for downloading ROM and RAM code, and procedures for performing in-service ATP.

CDMA LMF Product Description

The CDMA LMF is a graphical user interface (GUI) based LMF. This product is specifically designed to provide cellular communications field personnel the vehicle to support the following CDMA BTS operations:

- Installation
- Maintenance
- Calibration
- Optimization

Graphical User Interface Overview

The LMF uses a GUI, which works in the following way:

- Select the device or devices.
- Select the action to apply to the selected device(s).
- While action is in progress, a status report window displays the action taking place and other status information.
- The status report window indicates when the action is complete and displays other pertinent information.
- Clicking the **OK** button closes the status report window.

Command Line Interface Overview

The LMF also provides Command Line Interface (CLI) capability. Activate the CLI by clicking on a shortcut icon on the desktop. The CLI cannot be launched from the GUI, only from the desktop icon.

Refer to the *LMF CLI Commands, R15.x* manual for a complete explanation of the CLI commands and their use.

Online Help

Task oriented online help is available in the CDMA LMF by clicking on **Help** from the menu bar.

Purpose of the Optimization

Why Optimize?

Proper optimization and calibration assures:

- Accurate downlink RF power levels are transmitted from the site.
- Accurate uplink signal strength determinations are made by the site.

What Is Optimization?

Optimization compensates for the site-specific cabling and normal equipment variations. Cables that interconnect the BTS and Duplexer assemblies (if used), for example, are cut and installed at the time of the BTS frame installation at the site. Site optimization guarantees that the combined losses of the new cables and the gain/loss characteristics and built-in tolerances of each BTS frame do not accumulate, causing improper site operation.

Optimization identifies the accumulated loss (or gain) for all receive and transmit paths at the BTS site, and stores that value in a database.

- The RX path for the starter frame starts at the ancillary equipment frame RFDS RX directional coupler antenna feedline port, through the ancillary equipment frame RFDS RX directional coupler antenna feedline port, through the RX input port on the top of the frame, through the bandpass filter, Combiner Input/Output (CIO) card, Multicoupler Preselector Card (MPC), and additional splitter circuitry, ending at a CDMA Channel Processor (C-CCP) backplane Broad Band Transceiver (BBX) slot in the C-CCP shelf.
- The RX path for the expansion frame starts at the ancillary equipment frame RFDS RX directional coupler antenna feedline port, through the ancillary equipment frame RFDS RX directional coupler antenna feedline port, through the RX input port on the top of the starter frame, through the bandpass filter and CIO card, out the expansion port at the top of the starter frame, through the expansion cable to the expansion port on the expansion frame, through the Expansion Multicoupler Preselector Card (EMPC) and CIO, ending at a BBX slot in the C-CCP shelf.
- The TX path starts at the BBX, through the C-CCP backplane slot, travels through the LPA/Combiner TX Filter and ends at the top of the RFDS TX directional coupler antenna feedline port (CDMA), installed on the ancillary equipment frame. If the RFDS option is added, then the TX path continues and ends at the top of the RFDS TX directional coupler antenna feedline port installed in the ancillary equipment frame. The TX paths are identical for the starter and expansion frames.

. . . continued on next page

These values are factored in by the BTS equipment internally, leaving only site specific antenna feed line loss and antenna gain characteristics to be factored in by the CFE when determining site Effective Radiated Power (ERP) output power requirements.

Each C-CCP shelf BBX board is optimized to a specific RX and TX antenna port. (One BBX board acts in a redundant capacity for BBXs 1–12, and is optimized to all antenna ports.) A single value is generated for each path, thereby eliminating the accumulation of error that would occur from individually measuring and summing the gain and loss of each element in the path.

When to Optimize

New Installations

After the initial site installation, it must be prepared for operation. This preparation includes verifying hardware installation, initial power-up, download of operating code, and Clock Synchronization Module (CSM) verification.

Next, the optimization is performed. Optimization includes performance verification and calibration of all transmit and receive RF paths, and download of accumulated calibration data.

After optimization, a series of manual pre-ATP verification tests are covered that address alarm/redundancy tests.

After manual pre-Acceptance Test Procedure (pre-ATP) verification tests, a series of manual ATP CDMA verification tests are covered using the actual equipment set up. An ATP is also required before the site can be placed in service.

Site Expansion

Optimization is also required after expansion of a site.

Periodic Optimization

Periodic optimization of a site may also be required, depending on the requirements of the overall system.

Repaired Sites



IMPORTANT

Refer to Appendix C for detailed basic guideline tables and detailed Optimization/ATP Test Matrix outlining the minimum tests that must be performed *anytime* a BTS subassembly or RF cable associated with it is replaced.

Required Test Equipment

Policy

The LMF is used in conjunction with Motorola recommended test equipment and is part of a “calibrated test set”. To ensure consistent, reliable, and repeatable optimization test results, only recommended test equipment supported by the LMF must be used to optimize the BTS equipment.

NOTE

During manual testing, you can, of course, substitute test equipment with other test equipment models not supported by the LMF, *but those models must meet the same technical specifications.*

The customer has the responsibility of accounting for any measurement variances and/or additional losses/inaccuracies that can be introduced as a result of test equipment substitutions. Before beginning optimization or troubleshooting, make sure that the test equipment needed is on hand and operating properly.

Test Equipment Calibration

Optimum system performance and capacity depend on regular equipment service, calibration, and characterization prior to BTS optimization. Follow the original equipment manufacturer (OEM) recommended maintenance and calibration schedules closely.

Test Cable Calibration

Equipment test cables are very important in optimization. Motorola recommends that the cable calibration be run at every BTS with the test cables attached. This method compensates for test cable insertion loss within the test equipment itself. No other allowance for test cable insertion loss needs to be made during the performance of tests.

Another method is to account for the loss by entering it into the LMF during the optimization procedure. This method requires accurate test cable characterization in a shop. The cable should be tagged with the characterization information prior to field optimization.

Equipment Warm-up

After arriving at the a site, the test equipment should be plugged in and turned on to allow warm up and stabilization to occur for as long as possible. The following pieces of test equipment must be warmed-up for *a minimum of 60 minutes* prior to using for BTS optimization or RFDS calibration procedures.

- Communications Test Set
- Rubidium Time Base
- Power Meter

Test Equipment Specifications

Test equipment specification requirements for the test equipment (or configuration of test equipment) used to make up the general test equipment (DVM, etc) are given in the following paragraphs.

LMF Hardware Requirements

Motorola recommends an LMF computer platform that meets the following requirements:

- Notebook computer
- 266 MHz (32-bit CPU) processor
- 4 GB internal hard disk drive
- Color display with 1024 x 768 (recommended) or 800 x 600 pixel resolution and capability to display more than 256 colors
- 64 MB RAM
- CD ROM drive
- 3 1/2 inch floppy drive
- Serial port (COM 1)
- Parallel port (LPT 1)
- PCMCIA Ethernet interface card (for example, 3COM Etherlink III) with a 10Base-T-to-coax adapter
- Windows 98/NT operating system

Test Equipment List

The following pieces of test equipment are required during the optimization procedure. Common assorted tools like screwdrivers and frame keys are not listed but are still required. Read the owner's manual on all of the following major pieces of test equipment to understand their individual operation prior to use in optimization.

NOTE

Always refer to specific OEM test equipment documentation for detailed operating instructions.

Ethernet LAN Transceiver

- PCMCIA Ethernet Adapter + Ethernet UTP Adapter: 3COM Model – Etherlink III 3C589B

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Required Test Equipment – continued

10BaseT/10Base2 Converter

- Transition Engineering Model E–CX–TBT–03 10BaseT/10Base2 Converter
- or –
- Transition Engineering Model E–CX–TBT–03 10BaseT/10Base2 Converter

NOTE

Xircom Model PE3–10B2 or equivalent can also be used to interface the LMF Ethernet connection to the frame.

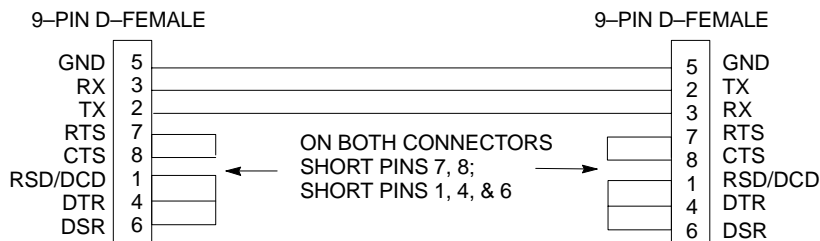
3C–PC–COMBO CBL

- Connects to the 3COM PCMCIA card and eliminates the need for a 10BaseT/10base2 Converter.

RS–232 to GPIB Interface

- National Instruments GPIB–232–CT with Motorola CGDSEDN04X RS232 serial null modem cable or equivalent; used to interface the LMF to the test equipment.
- Standard RS–232 cable can be used with the following modifications (see Figure 1-1):
 - This solution passes only the 3 minimum electrical connections between the LMF and the General Purpose Information Bus (GPIB) interface. The control signals are jumpered as enabled on both ends of the RS–232 cable (9–pin D). TX and RX signals are crossed as Null Modem effect. Pin 5 is the ground reference.
 - Short pins 7 and 8 together, and short pins 1, 4, and 6 together on each connector.

Figure 1-1: Null Modem Cable Detail



FW00362

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Model SLN2006A Man Machine Interface (MMI) Interface Kit

- Motorola Model TRN9666A null modem board. Connectors on opposite sides of the board must be used as this performs a null modem transformation between cables. This board can be used for 10-pin to 8-pin, 25-pin to 25-pin and 10-pin to 10-pin conversions.
- Motorola 30-09786R01 MMI cable or equivalent; used to interface the LMF serial port connection to Group Line Interface (GLI2), CSM and LPA debug serial ports.
- 25-pin D to 25-pin D serial cable; used to interface the PC to the null modem board.

Communications System Analyzer

The communication system analyzer is used during optimization and testing of the RF communications portion of BTS equipment and provides the following functions:

- (1) Frequency counter
- (2) RF power meter (average and code domain)
- (3) RF Signal Generator (capable of CDMA modulation)
- (4) Spectrum Analyzer
- (5) CDMA Code Domain analyzer

Four types of Communication System Analyzer are currently supported by the LMF. They are:

- **HP8921A/600 Analyzer** – Including 83203B CDMA Interface, manual control system card, and 83236A/B Personal communication Interface (PCS) Interface for 1700/1900 MHz BTS.
- **Advantest R3465 Analyzer** – Including R3561L Test Source Unit
- **HP8935 Analyzer**
- **CyberTest Communication Analyzer**

GPIB Cables

- Hewlett Packard 10833A or equivalent; 1 to 2 meters (3 to 6 feet) long used to interconnect test equipment and LMF terminal.

Power Meter

One of the following power meters is required with the HP8921 and Advantest analyzers:

- Hewlett Packard Model HP HP437B with HP8481A power sensor
- Gigatronics 8541C with model 80601A power sensor

Timing Reference Cables

- *Two* BNC-male to BNC-male RG316 cables; 3.05 m (10 ft.) long. Used to connect the communications analyzer to the front timing reference of the CSM cards in the BTS frame.

Digital Multimeter

- Fluke Model 8062A with Y8134 test lead kit or equivalent; used for precision dc and ac measurements, requiring 4-1/2 digits.

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Required Test Equipment – continued

Directional Coupler

- Narda Model 30661 30 dB (Motorola part no. 58D09732W01) 1900 MHz coupler terminated with two Narda Model 375BN–M loads, or equivalent.
- Narda Model 30445 30 dB (Motorola Part No. 58D09643T01) 800 MHz coupler terminated with two Narda Model 375BN–M loads, or equivalent.

RF Attenuator

- 20 dB fixed attenuator, 20 W (Narda 768–20); used with 1.7/1.9 GHz test cable calibrations or during general troubleshooting procedures.

RF Terminations/Loads

- At least three 100–Watt (or larger) non–radiating RF terminations/loads.

Miscellaneous RF Adapters, Loads, etc

- As required to interface test cables and BTS equipment and for various test set ups. Should include at least two 50 Ohm loads (type N) for calibration and one RF short, two N–Type Female–to–Female Adapters.

LAN Cable

- BNC–to BNC 50 ohm coaxial cable [.91 m (3 ft) maximum] with an F–to–F adapter, used to connect the 10BaseT–to–coaxial adapter to the BTS LAN connector.

High–impedance Conductive Wrist Strap

- Motorola Model 42–80385A59; used to prevent damage from Electrostatic Discharge (ESD) when handling or working with modules.

Optional Equipment

NOTE

Not all optional equipment specified here will be supported by the LMF in automated tests or when executing various measure type command line interface (CLI) commands. It is meant to serve as a list of additional equipment that might be required during maintenance and troubleshooting operations.

Frequency Counter

- Stanford Research Systems SR620 or equivalent. If direct measurement of the 3 MHz or 19.6608 MHz references is required.

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Spectrum Analyzer

- Spectrum Analyzer (HP8594E with CDMA personality card) or equivalent; required for *manual* tests.

Local Area Network (LAN) Tester

- Model NETcat 800 LAN troubleshooter (or equivalent); Used to supplement LAN tests using the ohmmeter.

Span Line (T1/E1) Verification Equipment

- As required for local application

Oscilloscope

- Tektronics Model 2445 or equivalent; for waveform viewing, timing, and measurements or during general troubleshooting procedure.

2-way Splitter

- Mini-Circuits Model ZFSC-2-2500 or equivalent; provides the diversity receive input to the BTS

High Stability 10 MHz Rubidium Standard

- Stanford Research Systems SR625 or equivalent – required for CSM and Low Frequency Receiver/High Stability Oscillator (LFR/HSO) frequency verification.

Itasca Alarms Test Box

- Itasca CGDSCMIS00014 – This test box may be used as a tool to assist in the testing of customer alarms.

Required Documentation

Required Documents

The following documents are required to perform optimization of the cell site equipment:

- Site Document (generated by Motorola Systems Engineering), which includes:
 - General Site Information
 - Floor Plan
 - RF Power Levels
 - Frequency Plan (includes Site PN and Operating Frequencies)
 - Channel Allocation (Paging, Traffic, etc.)
 - Board Placement
 - Site Wiring List
 - CDF files (bts-#.cdf and cbsc-#.cdf)
- *SC 4812T CDMA BTS Hardware Installation*; 68P64113A87
- Demarcation Document (Scope of Work Agreement)
- *CDMA LMF Operator's Guide*; 68P64114A78
- *CDMA RFDS Hardware Installation* manual; 68P64113A93
- *CDMA RFDS User's Guide*, 68P64113A37
- *LMF CLI Commands, R15.x*, 68P09251A59
- Equipment Manuals for non-Motorola test equipment

Intended Reader Profile

The information in this manual set is intended for use by the cellular communications craftsperson(s) in the initial installation and configuration, as well as the day-to-day operation and maintenance of a BTS.

The user of this information has a general understanding of telephony, as used in the operation of the Public Switched Telephone Network (PSTN), and is familiar with these concepts as they are applied in the cellular and maintenance mobile/portable radiotelephone environment.

The user also needs a working knowledge of the computer platform operating system being used (for example, Windows 95™ or Windows 98™).

Equipment Overview

The Motorola SC 4812T BTS can consist of the following equipment frames:

- At least one BTS starter frame
 - +27 V BTS (see Figure 1-2)
 - –48 V BTS (see Figure 1-3)
- Ancillary equipment frame (or wall mounted equipment)
- Expansion frames
 - +27 V BTS (see Figure 1-4)
 - –48 V BTS (see Figure 1-5)

Ancillary Equipment Frame Identification

NOTE

Equipment listed below can be wall mounted or mounted in a standard 19 inch frame. The description assumes that all equipment is mounted in a frame for clarity.

If equipped with the RFDS option, the RFDS and directional couplers are the interface between the site antennas and the BTS or Modem frame. The RFDS equipment includes:

- Directional couplers
- Site receive bandpass/bandreject filters
- RFDS

Logical BTS

The BTS software implements the logical BTS capability. Previously, all BTS frames co-located at a single site had to be identified in the network with separate and distinct BTS ID numbers. In the Logical BTS feature, all frames located at a single BTS site are identified with unique Frame ID numbers (Frame ID Numbers 1, 101, 201, 301) under a single (site) BTS ID number. A logical BTS can consist of up to four SC 4812T frames. When the LMF is connected to frame 1 of a logical BTS, you can access all devices in all of the frames that make up the logical BTS. A logical BTS requires a CDF file that includes equipage information for all of the logical BTS frames and their devices and a CBSC file that includes channel data for all of the logical BTS frames.

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Logical BTS Numbering

The first frame of a logical BTS has a **-1** suffix (e.g., **BTS-812-1**). Other frames of the logical BTS are numbered with suffixes, **-101**, **-201**, and **-301** (e. g. **BTS-812-201**). When you log into a BTS, a **FRAME** tab is displayed for each frame. If there is only one frame for the BTS, there is only one tab (e.g., **FRAME-282-1**) for **BTS-282**. If a logical BTS has more than one frame, there is a separate **FRAME** tab for each frame (e.g. **FRAME-438-1**, **FRAME-438-101**, and **FRAME-438-201** for a **BTS-438** that has three frames). If an RFDS is included in the CDF file, an **RFDS** tab (e.g., **RFDS-438-1**) is displayed.

Actions (e.g., ATP tests) can be initiated for selected devices in one or more frames of a logical BTS. Refer to the Select devices help screen for information on how to select devices.

C-CCP Shelf Card/Module Device ID Numbers

All cards/modules/boards in the frames at a single site, assigned to a single BTS number, are also identified with unique Device ID numbers dependent upon the Frame ID number in which they are located. Refer to Table 1-1 and Table 1-2 for specific C-CCP Shelf Device ID numbers.

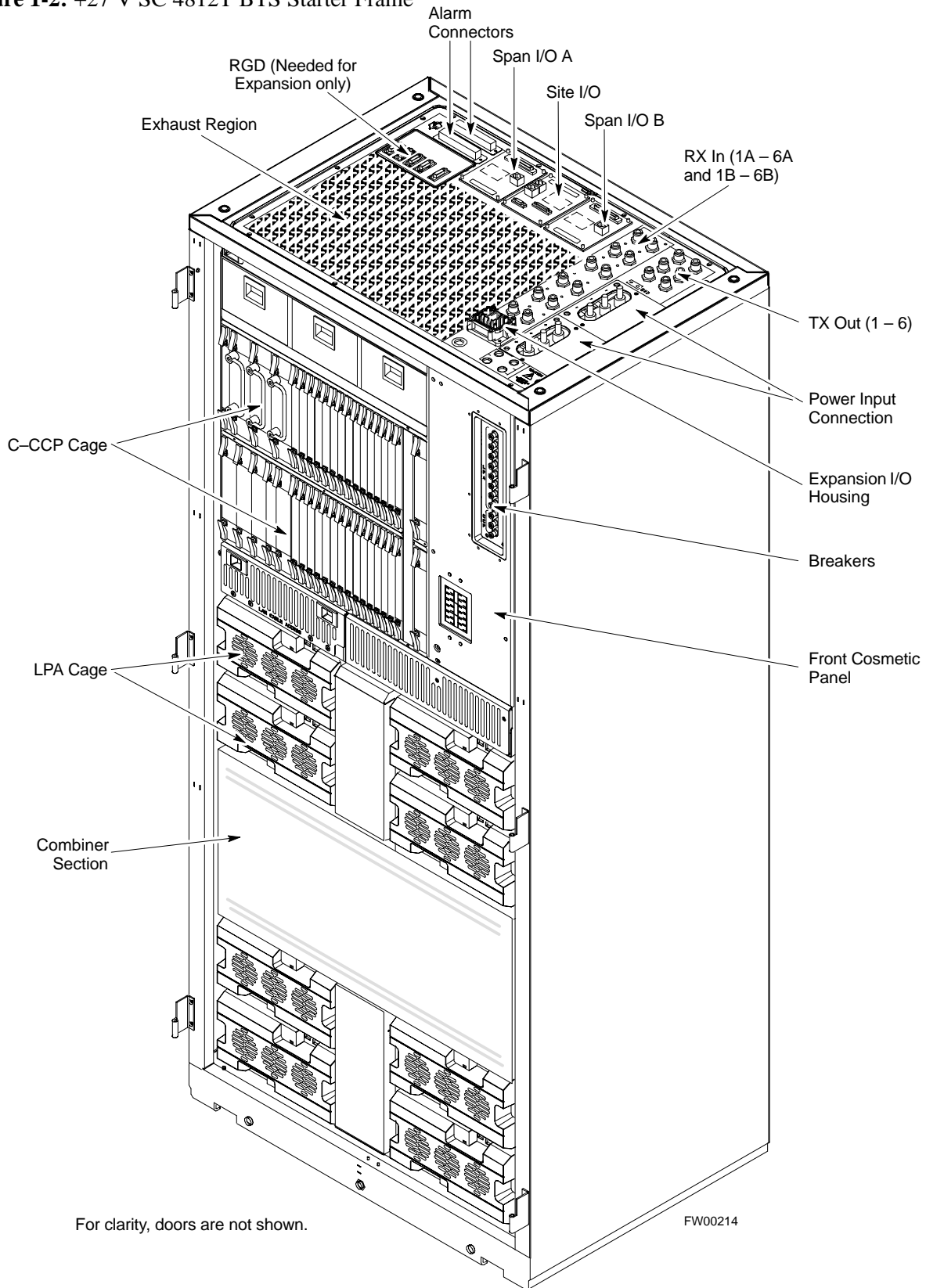
Table 1-1: C-CCP Shelf/Cage Card/Module Device ID Numbers (Top Shelf)

Frame #	Card/Module ID Number (Left to Right)																		
	Power (PS-1)	Power (PS-2)	Power (PS-3)	AMR -1	GLI2 -1	MCC						BBX						BBX-R	MPC/EMPC -1
1	-	-	-	1	1	1	2	3	4	5	6	1	2	3	4	5	6	R1	-
101	-	-	-	101	101	101	102	103	104	105	106	101	102	103	104	105	106	R101	-
201	-	-	-	201	201	201	202	203	204	205	206	201	202	203	204	205	206	R201	-
301	-	-	-	301	301	301	302	303	304	305	306	301	302	303	304	305	306	R301	-

Table 1-2: C-CCP Shelf/Cage Card/Module Device ID Numbers (Bottom Shelf)

Frame #	Card/Module ID Number (Left to Right)																					
	HSO/LFR	CSM -1	CSM -2	CCD A	CCD B		AMR -2	GLI2-2	MCC						BBX						SW	MPC/EMPC -2
1	-	1	2	-	-	-	2	2	7	8	9	10	11	12	7	8	9	10	11	12	-	-
101	-	101	102	-	-	-	102	102	107	108	109	110	111	112	107	108	109	110	111	112	-	-
201	-	201	202	-	-	-	202	102	207	208	209	210	211	212	207	208	209	210	211	212	-	-
301	-	301	302	-	-	-	302	102	307	308	309	310	311	312	307	308	309	310	311	312	-	-

Figure 1-2: +27 V SC 4812T BTS Starter Frame



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BTS Equipment Identification – continued

Figure 1-3: -48 V SC 4812T BTS Starter Frame

Alarms

RGD (Needed for Expansion only)

Exhaust Region

Span I/O A

Site I/O

Span I/O B

RX In (1A - 6A and 1B - 6B)

TX Out (1 - 6)

Power Input Connection

Expansion I/O Housing

Breakers

Front Cosmetic Panel

C-CCP Cage

LPA Cage

Combiner Section

Power Conversion Shelf

Breakers

For clarity, doors are not shown.

FW00477

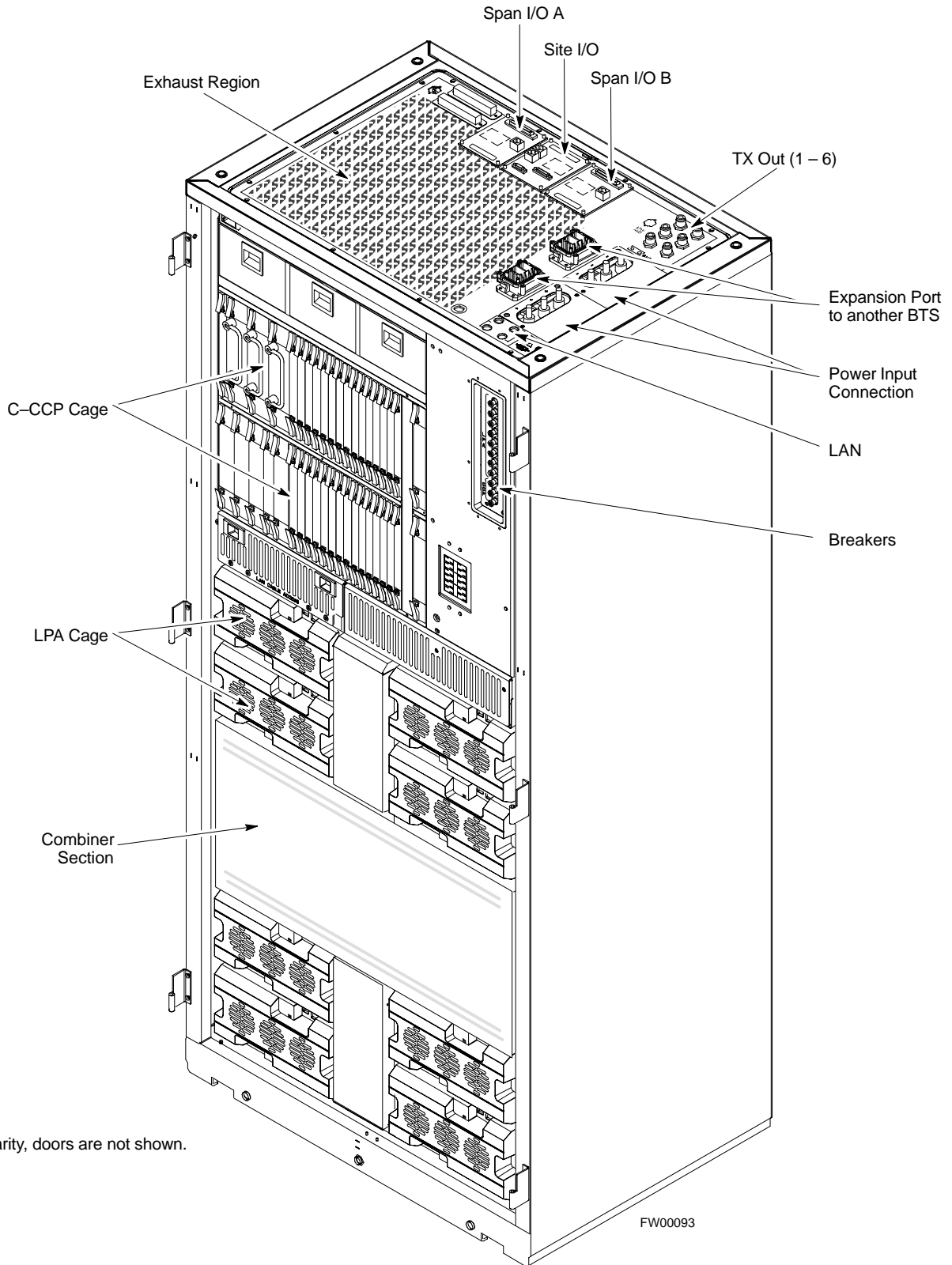
1-16

SC™ 4812T CDMA BTS Optimization/ATP

DRAFT

Mar 2001

Figure 1-4: +27 V SC 4812T BTS Expansion Frame



For clarity, doors are not shown.

1

BTS Equipment Identification – continued

Figure 1-5: -48 V SC 4812T BTS Expansion Frame

Alarms

Span I/O A

Site I/O

Span I/O B

Exhaust Region

TX Out (1 – 6)

Expansion Port to another BTS

Power Input Connection

LAN

Breakers

C-CCP Cage

LPA Cage

Combiner Section

Power Conversion Shelf

Breakers

For clarity, doors are not shown.

FW00478

Detailed description: This is a technical exploded view diagram of a -48 V SC 4812T BTS Expansion Frame. The diagram shows the internal layout of the equipment, including various cages and sections. At the top, there is an Exhaust Region and a TX Out (1-6) section. Below these are the Alarms, Span I/O A, Site I/O, and Span I/O B sections. The main body of the frame contains a C-CCP Cage, LPA Cage, and Combiner Section. At the bottom, there is a Power Conversion Shelf and another Breakers section. On the right side, there are labels for Expansion Port to another BTS, Power Input Connection, LAN, and Breakers. The diagram is labeled FW00478 and includes a note: 'For clarity, doors are not shown.'

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SC™ 4812T CDMA BTS Optimization/ATP

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BTS Frame Description

The BTS is the interface between the span lines to/from the Cellsite Base Station Controller (CBSC) and the site antennas. This frame is described in three sections:

- The top interconnect plate where all connections are made.
- The upper portion of the frame which houses circuit breakers, cooling fans, and the C–CCP shelf.
- The lower portion of the frame which houses the LPA fans, LPAs, and TX filter/combiners.
- The –48 V version of the BTS also has a section below the LPAs containing a power conversion shelf that supplies power to the LPAs.

Use the illustrations that follow to visually identify the major components, that make up the Motorola SC 4812T BTS frame.

Top Interconnect Plate (see Figure 1-6 or Figure 1-7)

All cabling to and from the BTS equipment frames is via the interconnect panel on the top of each frame. Connections made here include:

- Span lines
- RX antennas
- TX antenna
- Alarm connections
- Power input
- LAN connections
- GPS input or Remote Global Positioning System (RGPS) on the Site I/O Board
- Remote Global Positioning System Distribution (RGD)
- LORAN–C Low Frequency Receiver (LFR) input
- Expansion frame connection
- Ground connections

C–CCP Shelf (see Figure 1-10)

- C–CCP backplane and cage
- Power supply modules
- CDMA clock distribution (CCD) boards
- CSM and HSO/LFR boards
- Alarm Monitoring and Reporting (AMR) boards
- GLI2 cards
- MPC boards (starter frame only)
- EMPC boards (expansion frames)

. . . continued on next page

- Switch card
- MCC boards (may be MCC8E, MCC24, or MCC-1X)
- BBX boards (may be BBX2 or BBX-1X)
- CIO boards

PA Shelves (see Figure 1-11 or Figure 1-12)

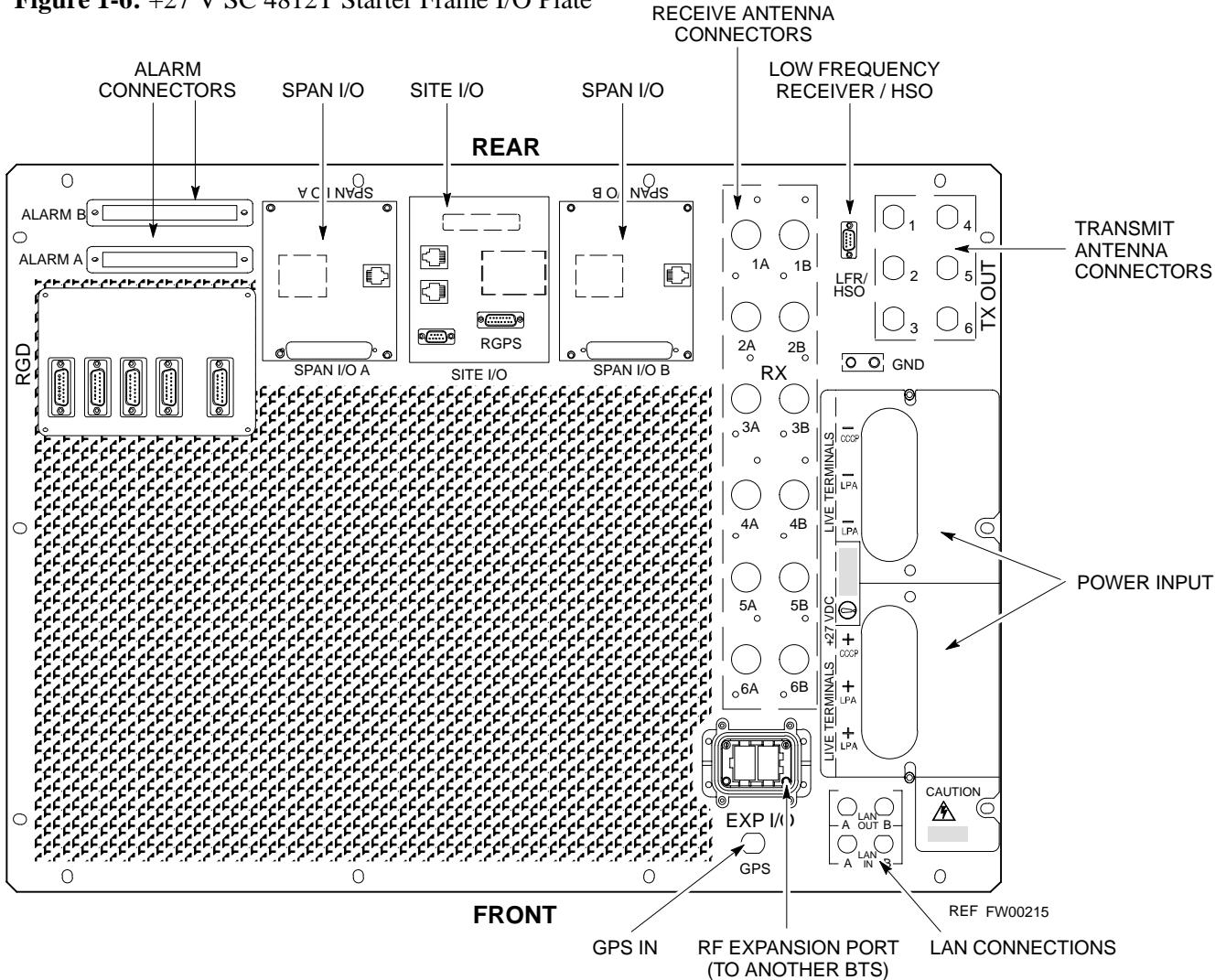
- LPA cages
- LPA trunking backplanes
- Single Tone Linear Power Amplifier (STLPA, or more commonly referred to as “LPA”) modules
- LPA fan modules
- LPA Combiner Cage (+27 V BTS)
- TX filter combiners or bandpass filters

-48 V Power Conversion Shelf (see Figure 1-15)

- Power conversion backplane and shelf
- Power conversion boards
- Power conversion alarm card
- Fan modules
- Power distribution assembly
- Air plenum

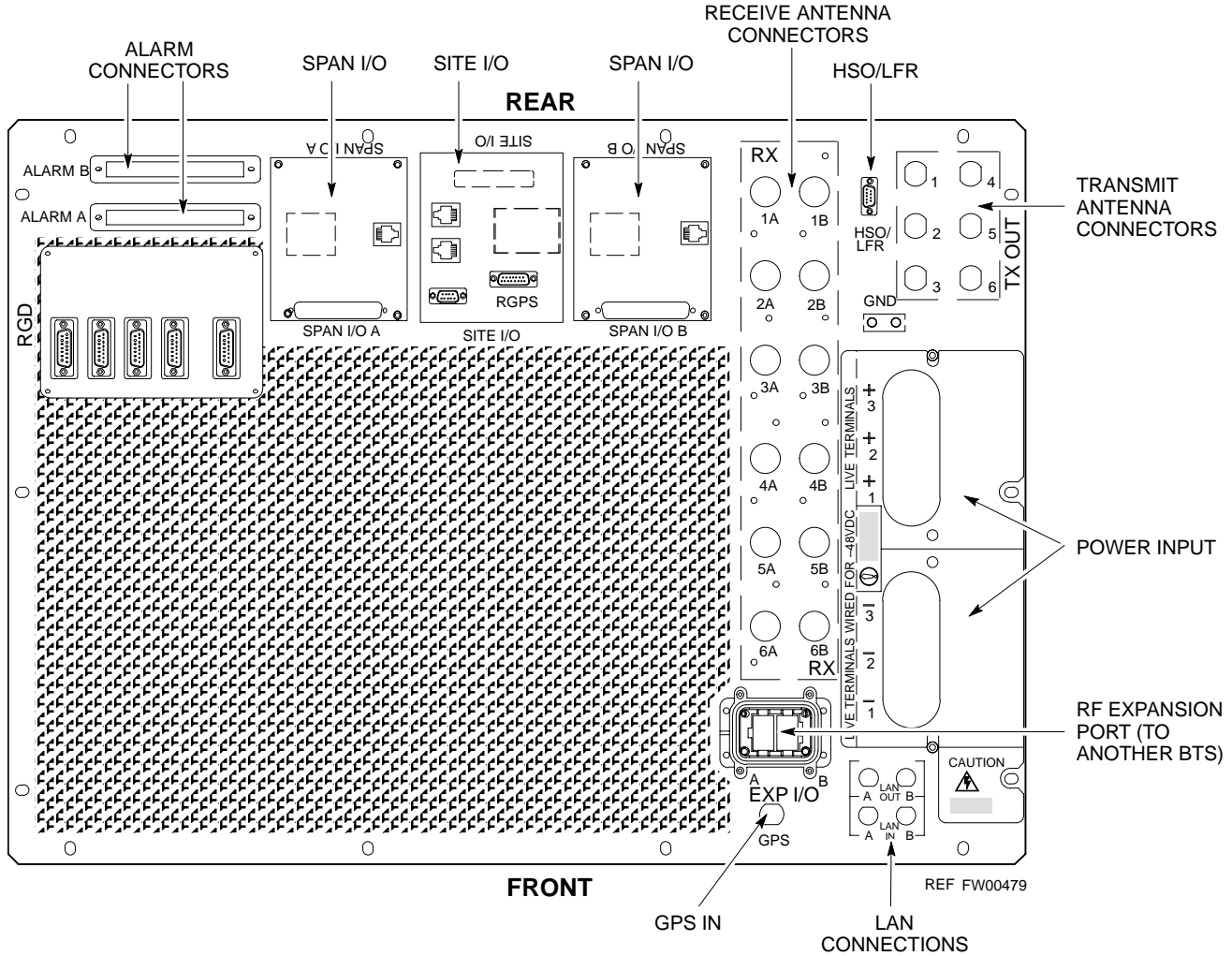
Frame Module Location & Identification

Figure 1-6: +27 V SC 4812T Starter Frame I/O Plate



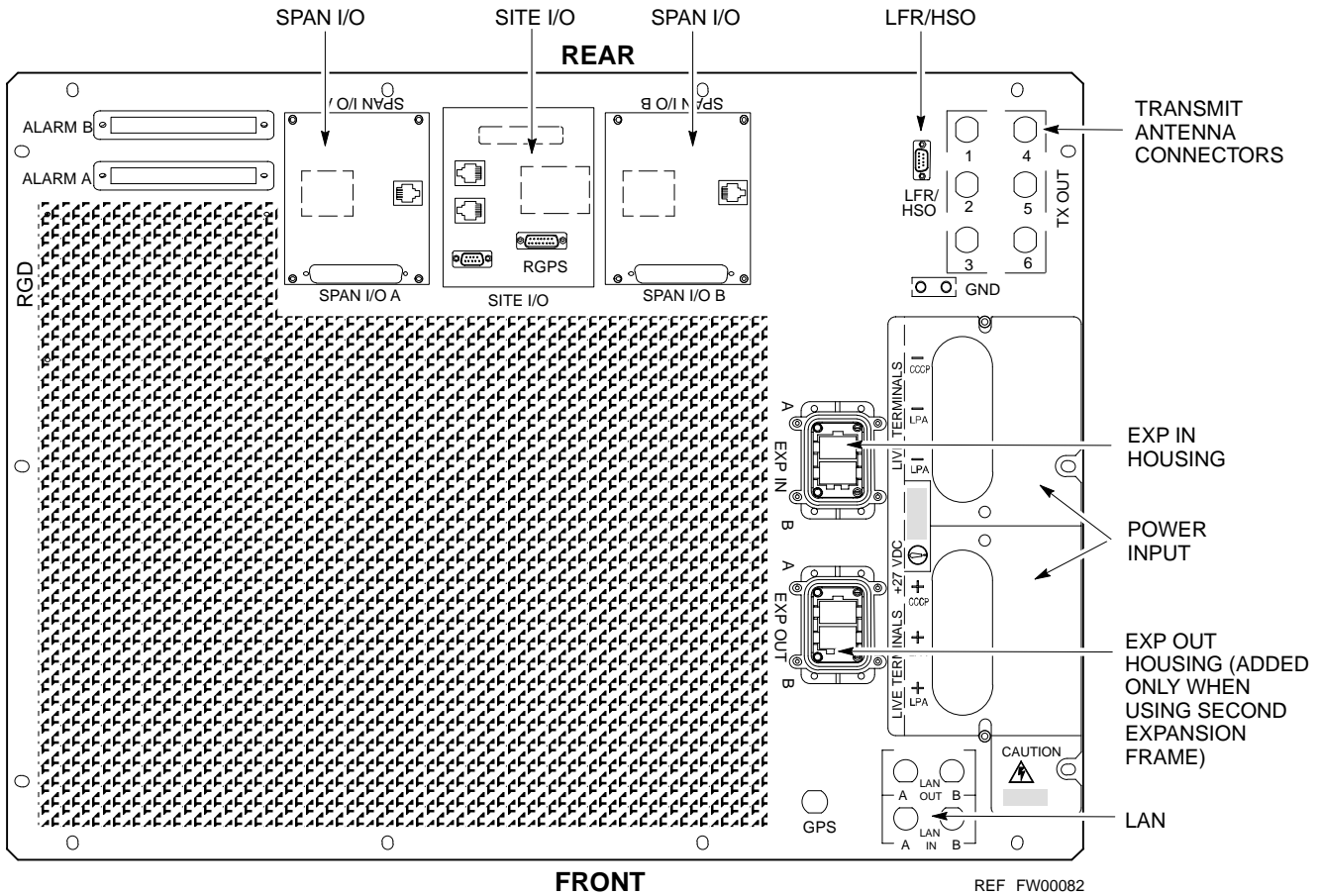
Frame Module Location & Identification – continued

Figure 1-7: –48 V SC 4812T Starter Frame I/O Plate



Frame Module Location & Identification – continued

Figure 1-8: +27 V SC 4812T Expansion Frame I/O Plate



Frame Module Location & Identification – continued

Figure 1-9: -48 V SC 4812T Expansion Frame I/O Plate

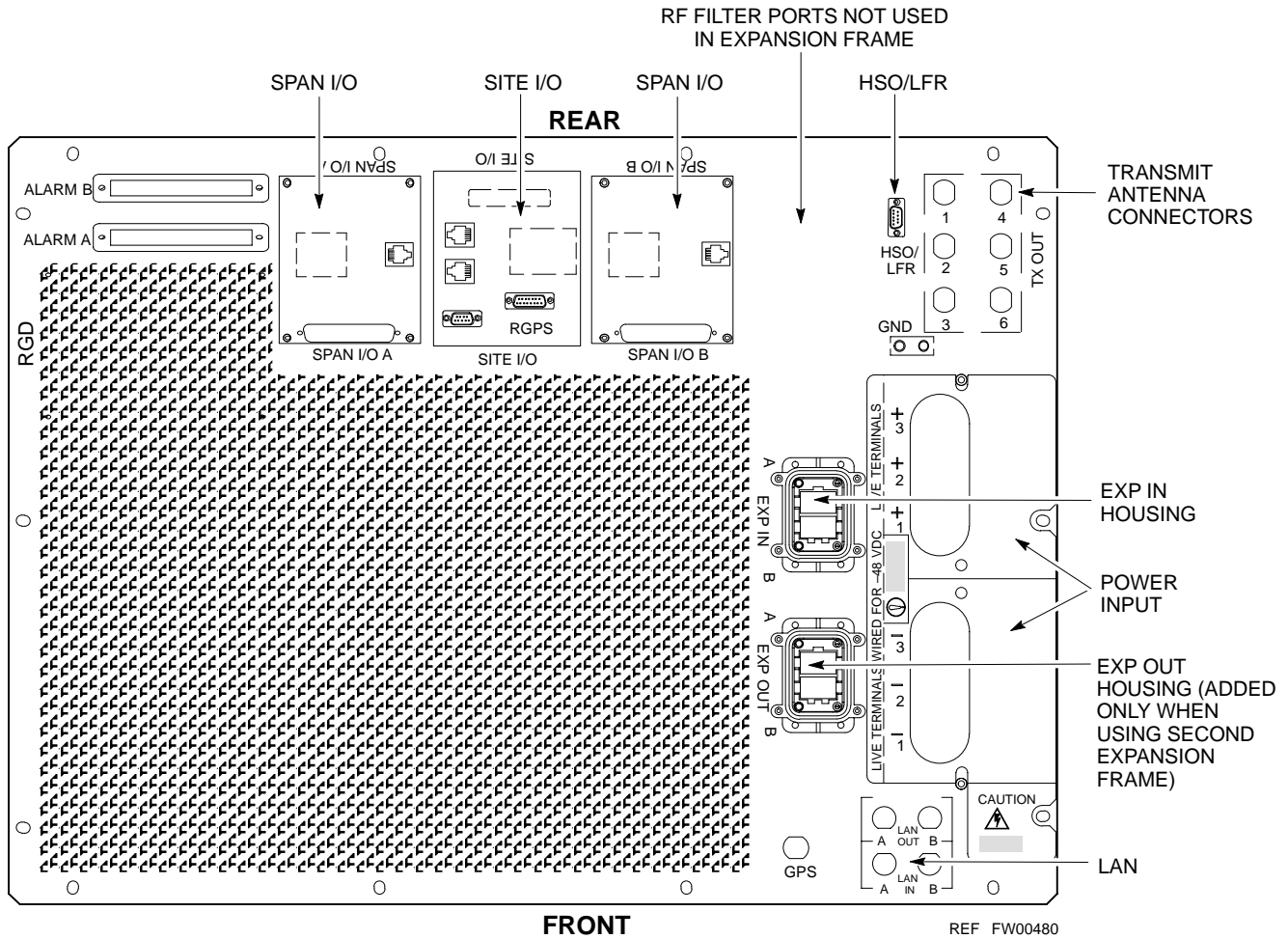
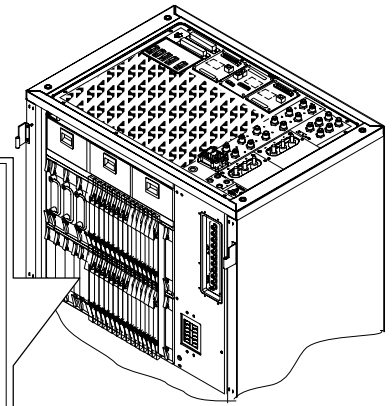
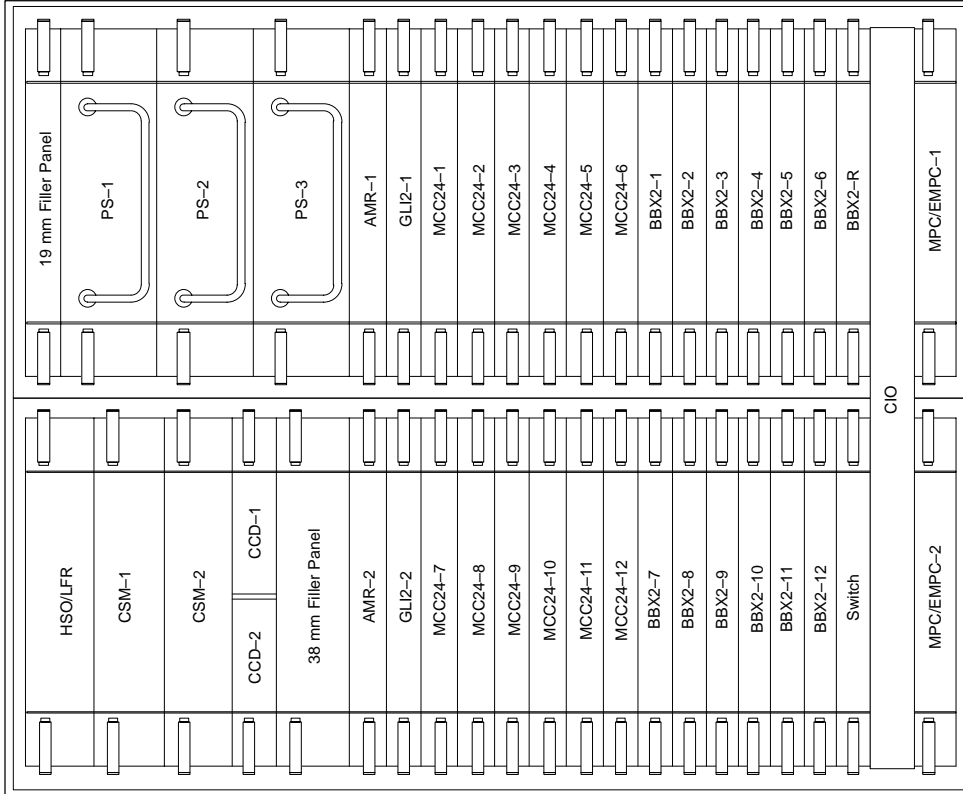


Figure 1-10: SC 4812T C-CCP Shelf

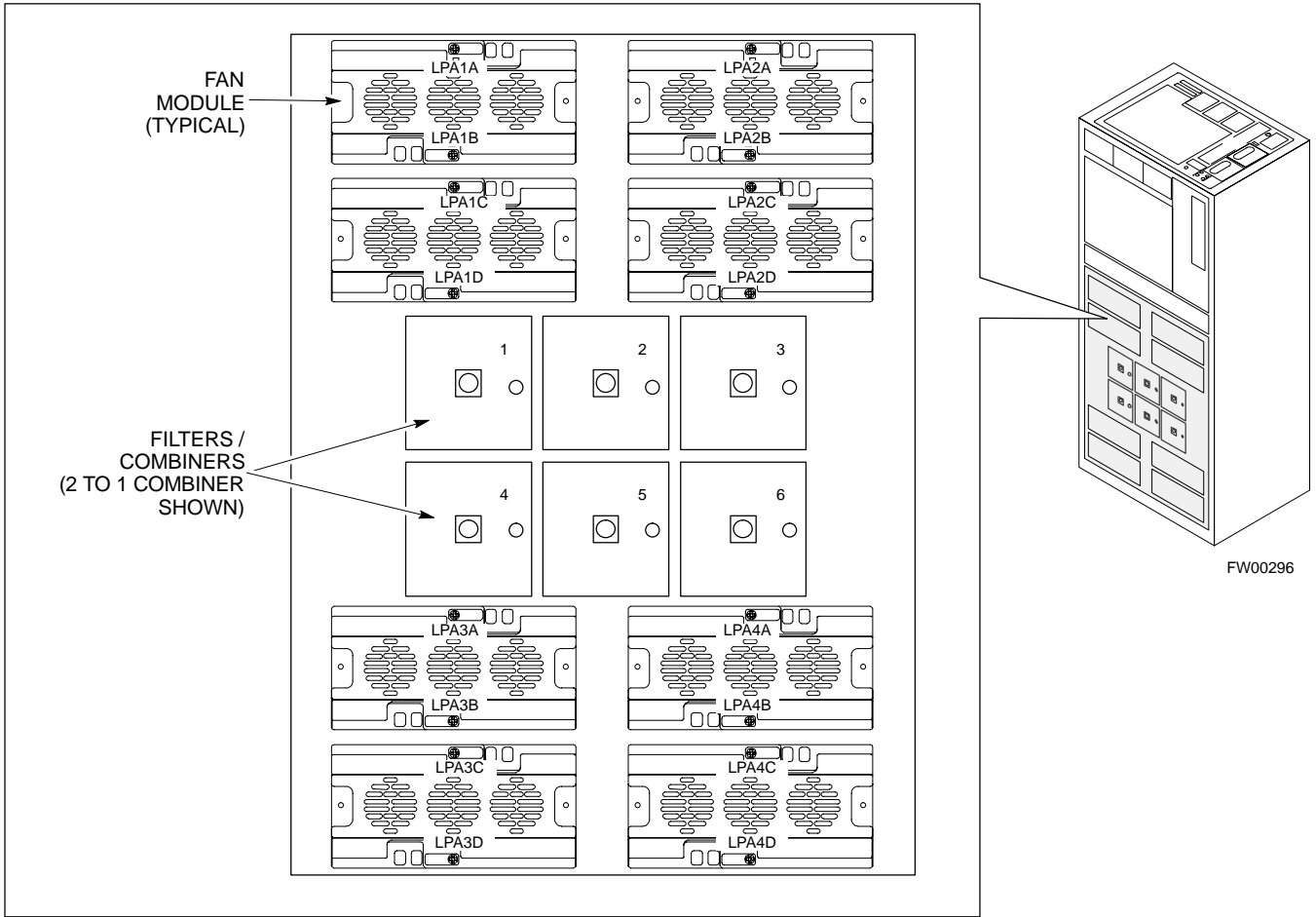


NOTE: MCCs may be MCC8Es, MCC24s, or MCC-1Xs. BBXs may be BBX2s or BBX-1Xs.

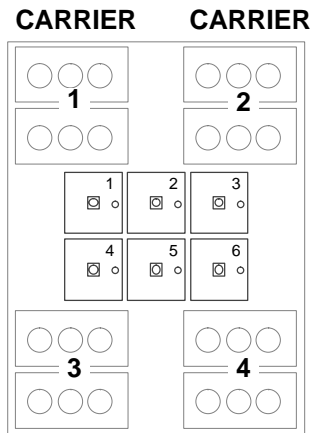
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Frame Module Location & Identification – continued

Figure 1-11: +27 V SC 4812T LPA Configuration – 4 Carrier with 2:1 Combiners



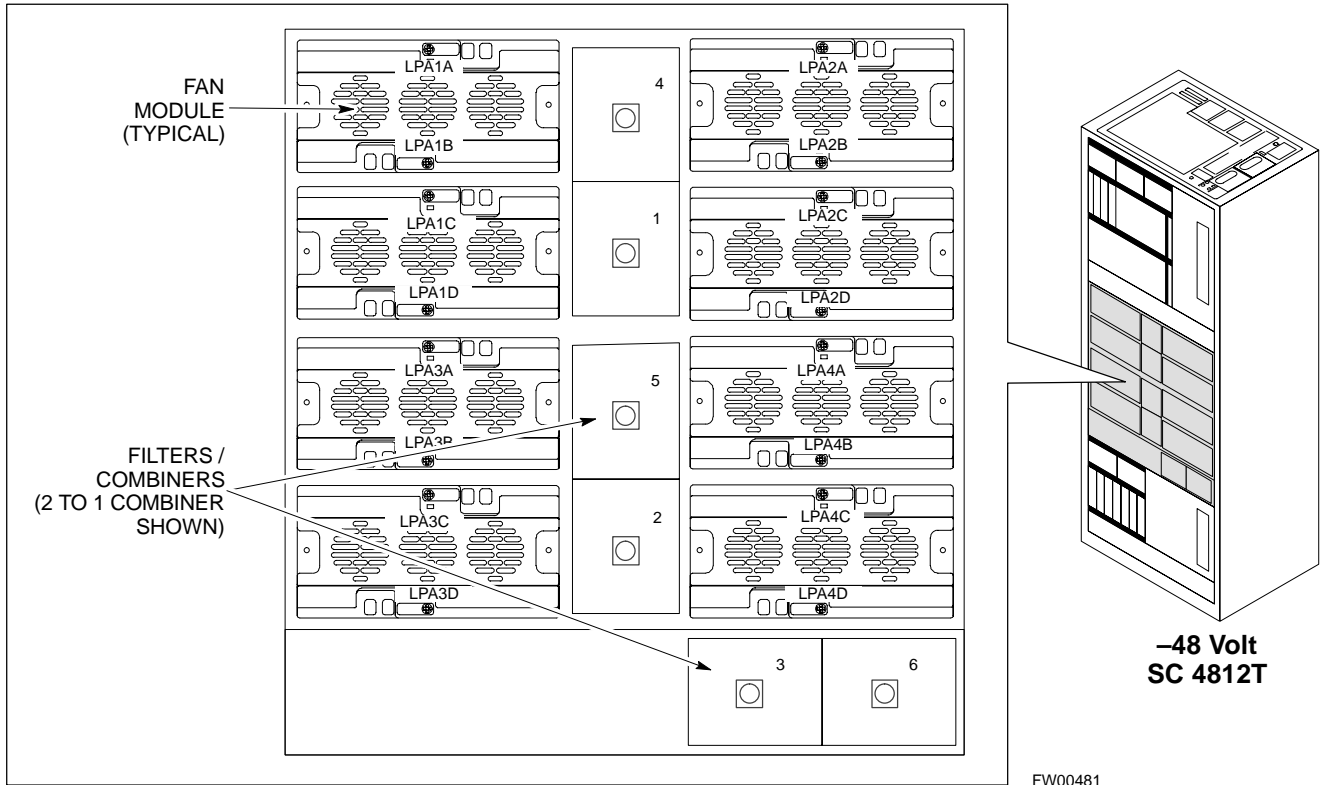
4-CARRIER CONFIGURATION



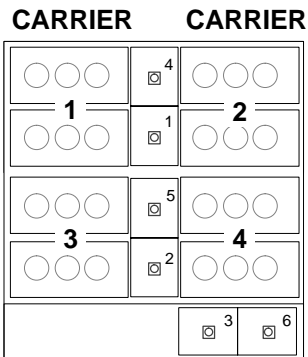
Note
 No adjacent carriers may exist within the same TX filter combiner. "Adjacent" is defined as f_{c1} and f_{c2} being 1.25 MHz apart (center-to-center). "Non-adjacent" is defined as f_{c1} and f_{c2} being ≥ 2.50 MHz apart (center-to-center).

Frame Module Location & Identification – continued

Figure 1-12: –48 V SC 4812T LPA Configuration – 4 Carrier, 3-Sector with 2:1 Combiners



4-CARRIER CONFIGURATION



Note
 No adjacent carriers may exist within the same TX filter combiner. "Adjacent" is defined as f_{c1} and f_{c2} being 1.25 MHz apart (center-to-center). "Non-adjacent" is defined as f_{c1} and f_{c2} being ≥ 2.50 MHz apart (center-to-center).

Sector Configuration

There are a number of ways to configure the BTS frame. Table 1-3 outlines the basic requirements. When carrier capacity is greater than two, a 2:1 or 4:1 cavity combiner must be used. For one or two carriers, bandpass filters or cavity combiners may be used, depending on sectorization and channel sequencing.

Table 1-3: BTS Sector Configuration			
Number of carriers	Number of sectors	Channel spacing	Filter requirements
1	3 or 6	N/A	Bandpass Filter, Cavity Combiner (2:1 or 4:1)
2	6	Non-adjacent	Cavity Combiner (2:1 Only)
2	6	Adjacent	Not supported in single frame
2	3	Non-adjacent	Cavity Combiner (2:1 or 4:1)
2	3	Adjacent	Bandpass Filter
3,4	3	Non-adjacent	Cavity Combiner (2:1 or 4:1)
3,4	3	Adjacent	Cavity Combiner (2:1 Only)

NOTE

In Table 1-4, BBXs may be BBX2s or BBX-1Xs.

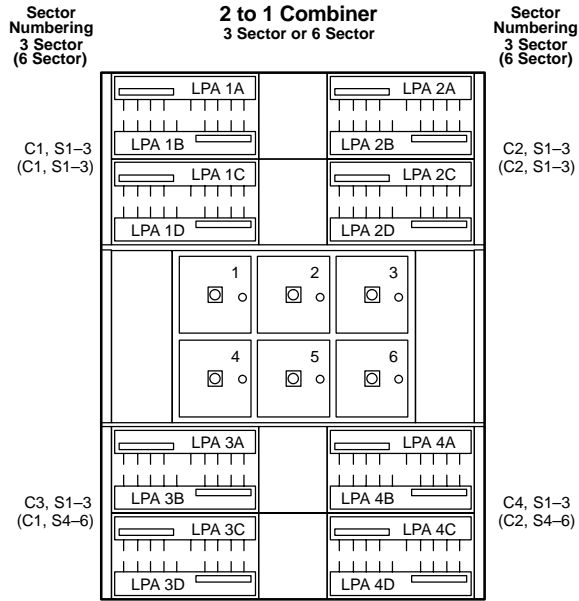
Table 1-4: Sector Configurations

Config Ref. No.	Description						
1	3-Sector/2-ADJACENT Carriers – The configuration below maps TX with optional 2:1 cavity combiners for 3 sectors/2 carriers for <i>adjacent</i> channels. Note that 2:1 cavity combiners are used (6 total).						
	TX1	TX2	TX3	TX4	TX5	TX6	Carrier#
	BBX-1 N/A	BBX-2 N/A	BBX-3 N/A	N/A BBX-4	N/A BBX-5	N/A BBX-6	1 2
2	6-Sector/2-NON-ADJACENT Carriers – The configuration below maps TX with 2:1 cavity combiners for 6 sectors/2 carriers for <i>non-adjacent</i> channels.						
	TX1	TX2	TX3	TX4	TX5	TX6	Carrier#
	BBX-1 BBX-7	BBX-2 BBX-8	BBX-3 BBX-9	BBX-4 BBX-10	BBX-5 BBX-11	BBX-6 BBX-12	1 2
3	3-Sector/2-NON-ADJACENT Carriers – The configuration below maps TX with 2:1 cavity combiners for 3 sectors/2 carriers for <i>non-adjacent</i> channels.						
	TX1	TX2	TX3	TX4	TX5	TX6	Carrier#
	BBX-1 BBX-7	BBX-2 BBX-8	BBX-3 BBX-9	N/A N/A	N/A N/A	N/A N/A	1 2
4	3-Sector/4-ADJACENT Carriers – The configuration below maps TX with 2:1 cavity combiners for 3 sector/4 carriers for <i>adjacent</i> channels.						
	TX1	TX2	TX3	TX4	TX5	TX6	Carrier#
	BBX-1	BBX-2	BBX-3	N/A	N/A	N/A	1
	BBX-7	BBX-8	BBX-9	N/A	N/A	N/A	2
	N/A	N/A	N/A	BBX-4	BBX-5	BBX-6	3
N/A	N/A	N/A	BBX-10	BBX-11	BBX-12	4	
5	3-Sector / 2-ADJACENT Carriers – The configuration below maps TX with bandpass filters for 3 sectors/2 carriers for <i>adjacent</i> channels.						
	TX1	TX2	TX3	TX4	TX5	TX6	Carrier#
	BBX-1 N/A	BBX-2 N/A	BBX-3 N/A	N/A BBX-7	N/A BBX-8	N/A BBX-9	1 2
6	3-Sector/3 or 4-NON-ADJACENT Carriers – The configuration below maps TX with 4:1 cavity combiners for 3 sectors/3 or 4 carriers for <i>non-adjacent</i> channels.						
	TX1	TX2	TX3	TX4	TX5	TX6	Carrier#
	BBX-1	BBX-2	BBX-3	N/A	N/A	N/A	1
	BBX-7	BBX-8	BBX-9	N/A	N/A	N/A	2
	BBX-4	BBX-5	BBX-6	N/A	N/A	N/A	3
BBX-10	BBX-11	BBX-12	N/A	N/A	N/A	4	
7	6-Sector/1-Carrier – The configuration below maps TX with either bandpass filters or 2:1 cavity combiners for 6 sector/1 carrier.						
	TX1	TX2	TX3	TX4	TX5	TX6	Carrier#
	BBX-1	BBX-2	BBX-3	BBX-4	BBX-5	BBX-6	1

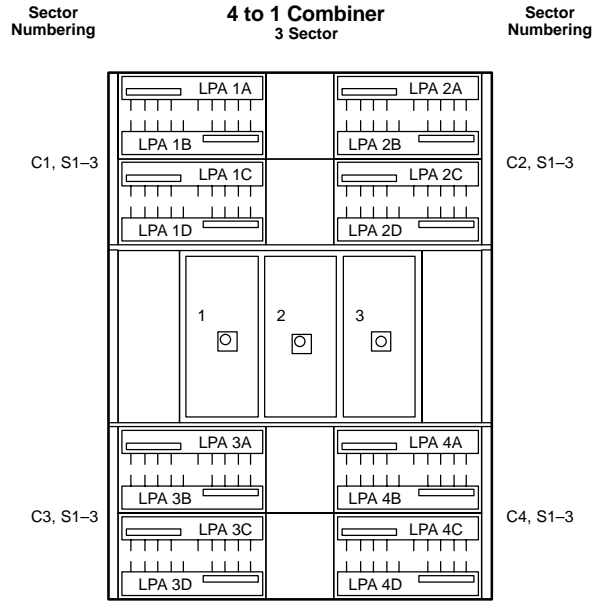
Frame Module Location & Identification – continued

Figure 1-13: +27 V SC4812T LPA Configuration with Combiners/Filters

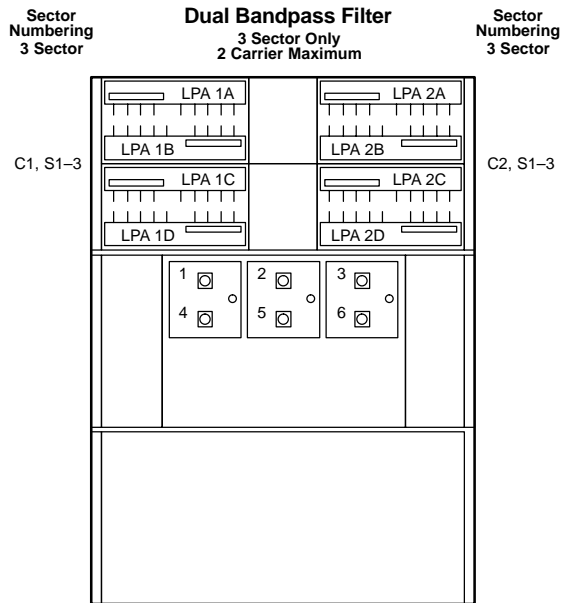
Note: See Table 1-4 Configuration Reference Numbers 1, 2, 3, 4.



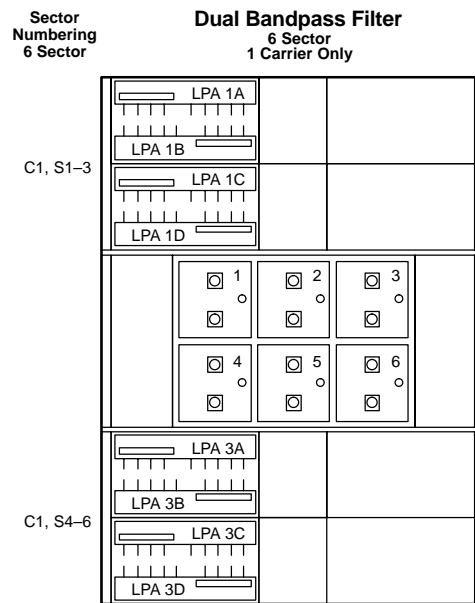
Note: See Table 1-4 Configuration Reference Number 6.



Note: See Table 1-4 Configuration Reference Number 5.



Note: See Table 1-4 Configuration Reference Number 7.

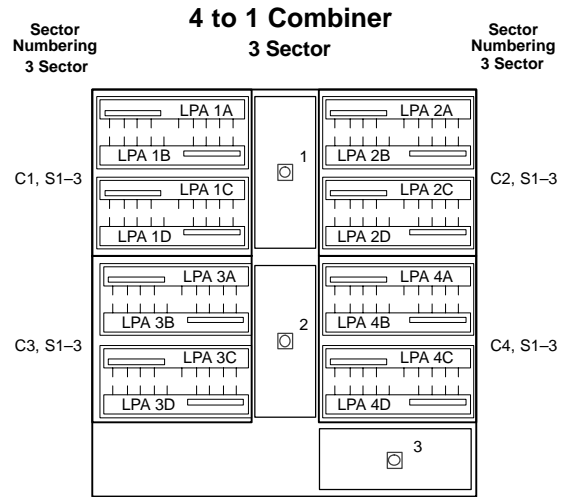
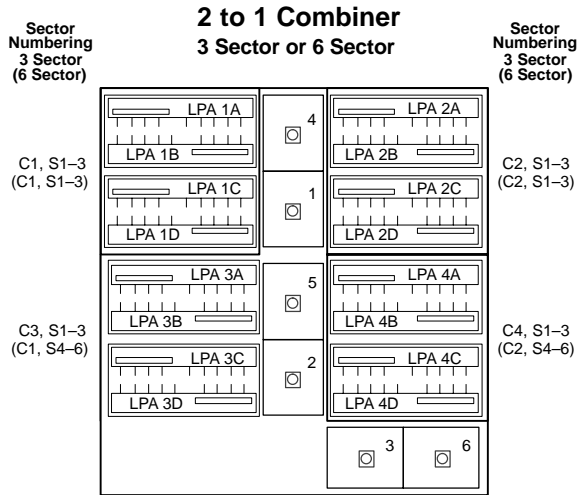


FW00297

Figure 1-14: -48 V SC4812T LPA Configuration with Combiners/Filters

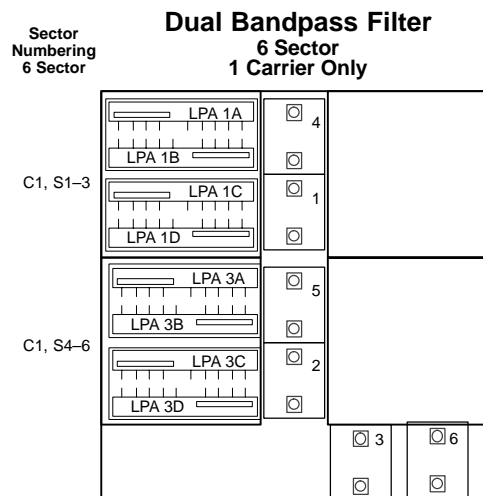
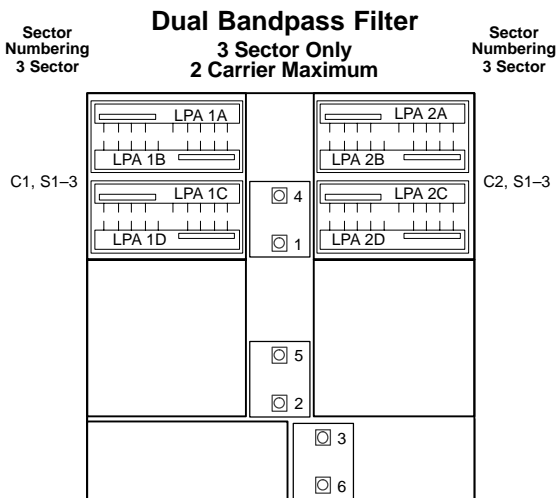
Note: See Table 1-4 Configuration Reference Numbers 1, 2, 3, 4.

Note: See Table 1-4 Configuration Reference Number 6.



Note: See Table 1-4 Configuration Reference Number 5.

Note: See Table 1-4 Configuration Reference Number 7.



REF FW00482

Frame Module Location & Identification – continued

Figure 1-15: -48 V BTS Power Conversion Shelf

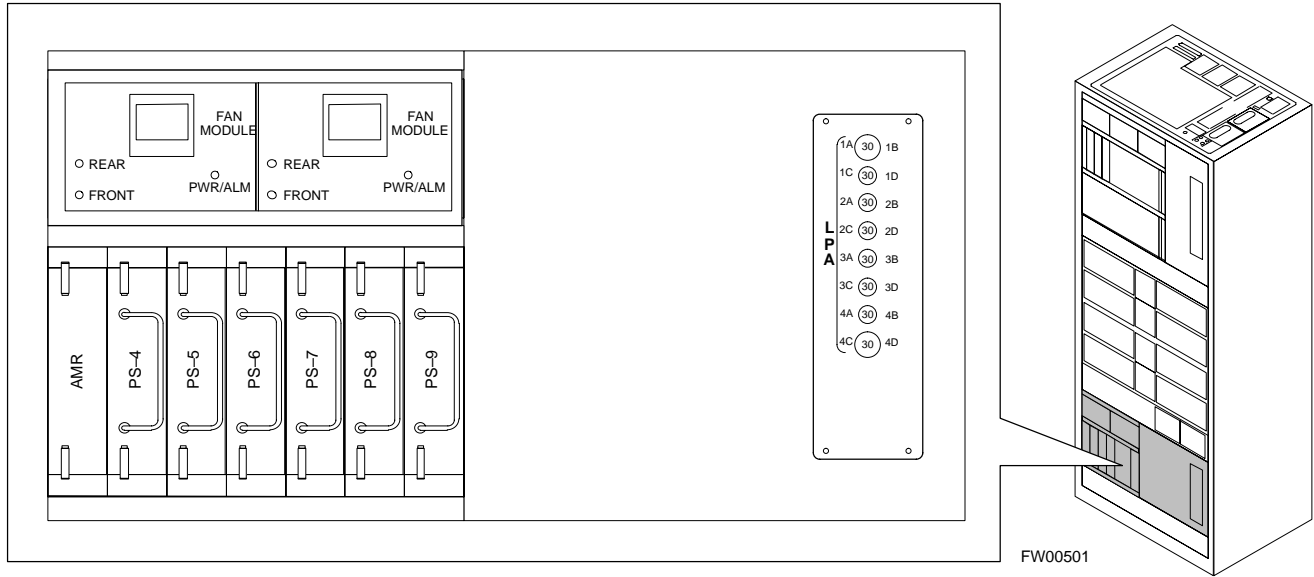


Figure 1-16: CDMA (COBRA) RFDS Layout

