Technical Information

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1X SC 4812T-MC Multicarrier BTS Optimization/ATP

Software Release R2.16.1.x

800 Mhz

CDMA

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Sept 2003
68P64115A21–B

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Read Me First

SC^{TM}4812T-MC vs SC 4812T BTS Read Me First (Comparison)

This *Read-me-first* document describes a summary of changes between the existing SC 4812T BTS and the SC 4812T-MC (Multicarrier) BTS. The SC 4812T-MC is based on the existing SC 4812T platform and employs similar hardware and architecture. The differences between these products are briefly described and illustrated below. This section is not intended to replace the SC 4812T-MC manual set. This information applies generally to both +27V and –48V frames, although only +27V illustrations are shown.

Multicarrier provides the capability for all PAs in all quadrants to provide trunked power across all sector/carriers. This differs from the previous architecture in which PA modules within a quadrant provided trunked power to only one carrier. Furthermore, in SC 4812T-MC, adjacent channels can be combined onto one antenna versus being transmitted on separate antennas in SC 4812T.

An overview of the BTS differences is illustrated in the following table and in illustrations on the following pages (Figure 1 thru Figure 4).

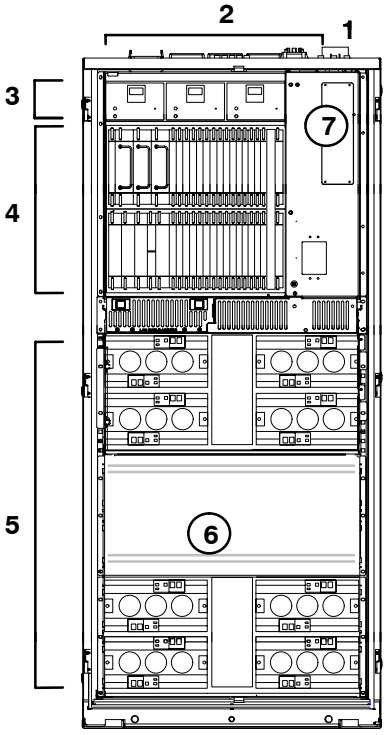
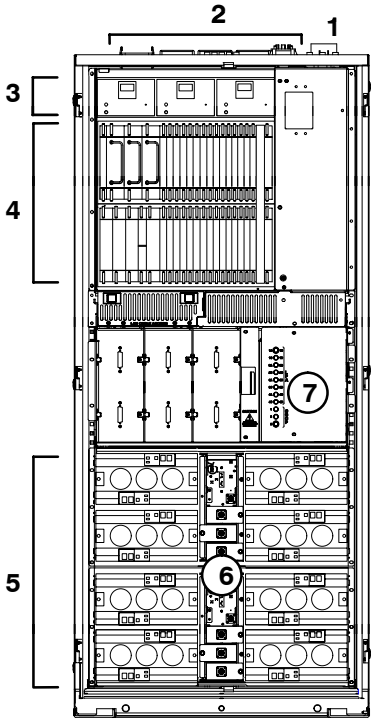
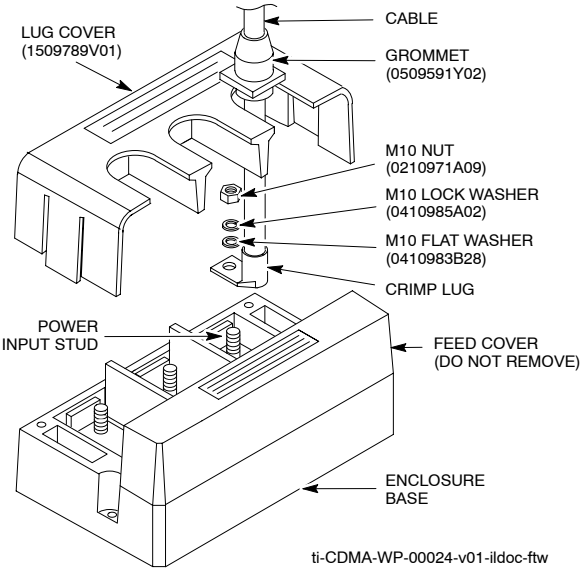
SC 4812T	Description	#	Description	SC 4812T-MC
 ti-CDMA-WP-00098-v01-ildoc-ftw	3x3 DC Power Input (see Figure 1)	1	2x2 DC Power Input (see Figure 1)	 ti-CDMA-WP-00196-v01-ildoc-ftw
	I/O Plate supporting 3x3 DC Power Input (see Figure 2)	2	I/O Plate supporting 2x2 DC Power Input (see Figure 2)	
	CCCP Fan Tray	3	CCCP Speed Controlled Fan Tray	
	C-CCP Cage: • CIO (3- or 6-Sector) • BBX-1X • Switch	4	**C-CCP Cage:** • MCIO (3- or 6-Sector) • High Power BBX-1X • High Power Switch	
	PA Shelves: • SC 4812T LPA • 4x4 TX Backplane • PA Location and Mapping (see Figure 3) • Shelf Qty: 1 for up to 2 carriers; 2 for 3 or more carriers.	5	**PA Shelves:** • SC 4812T CLPA • Multicarrier module • (Switched) Parallel Linear amplifier Combiner • Enhanced Trunking Module • LPA/PLC Filler Panel • PA Location and Mapping (see Figure 3) • Shelf Qty: 2 for all configurations	
	2:1 or 4:1 Combiners or Dual Bandpass TX Filters	6	TX Filters and/or TX Output Terminator	
	PA Breaker Mapping (see Figure 4)	7	PA Breaker Mapping (see Figure 4)	

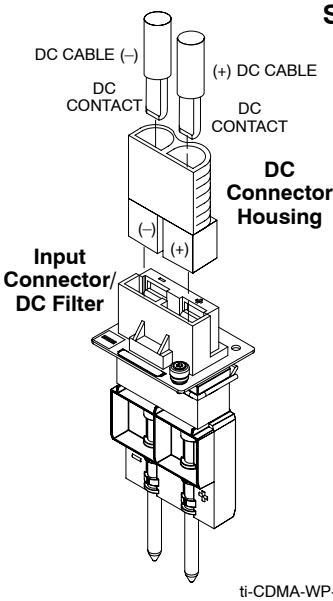
Figure 1: DC Power Input Connector Comparison

SC 4812T



ti-CDMA-WP-00024-v01-ildoc-ftw

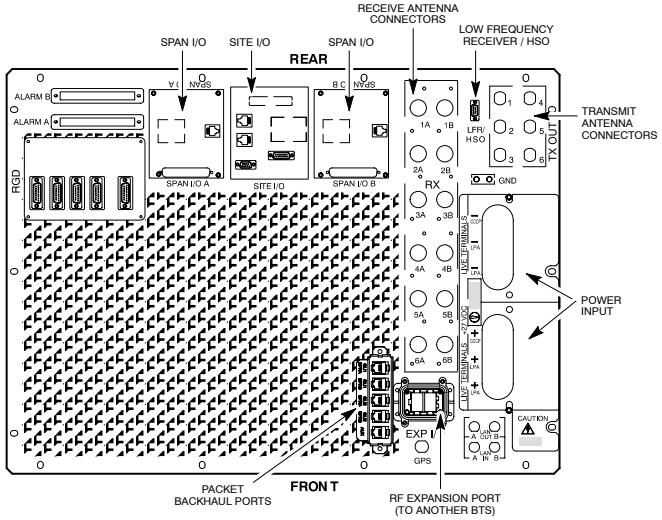
SC 4812T–MC



ti-CDMA-WP-00074-v01-ildoc-ftw

Figure 2: I/O Plate Comparison

SC 4812T



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SC 4812T–MC

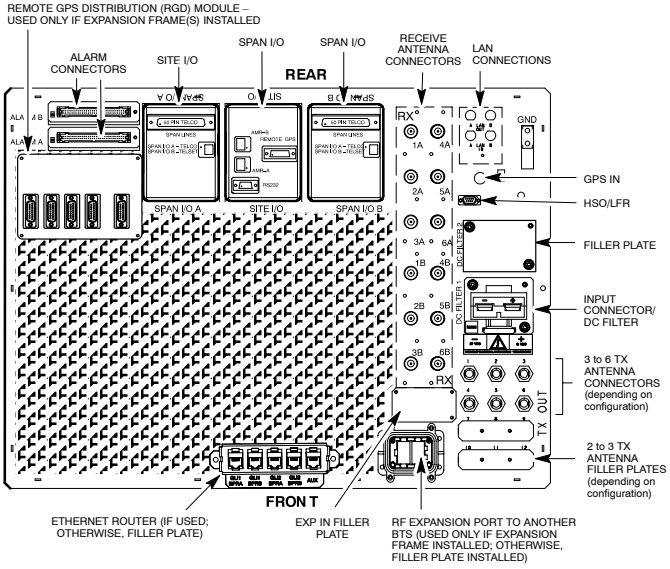

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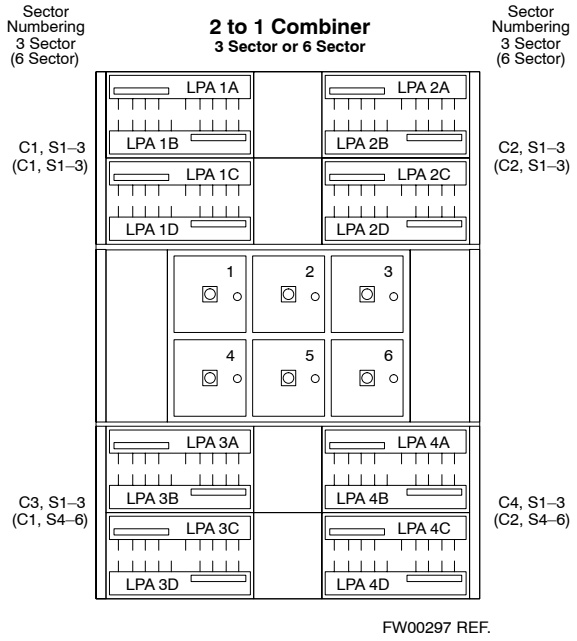
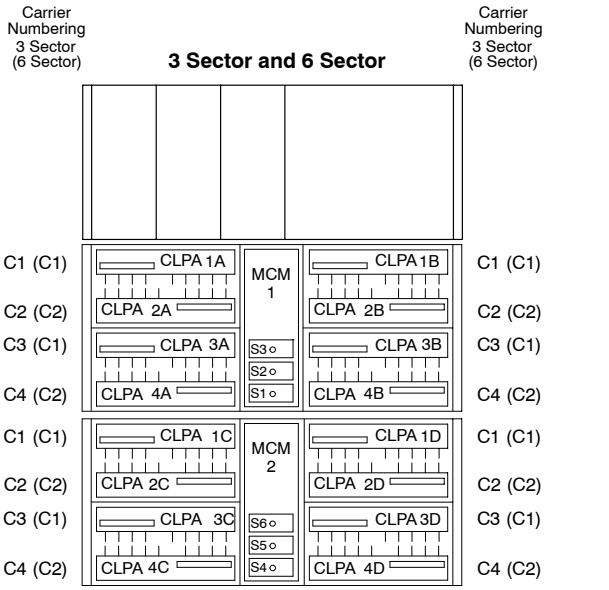
Figure 3: PA Location Comparison

SC 4812T



FW00297 REF.

SC 4812T–MC



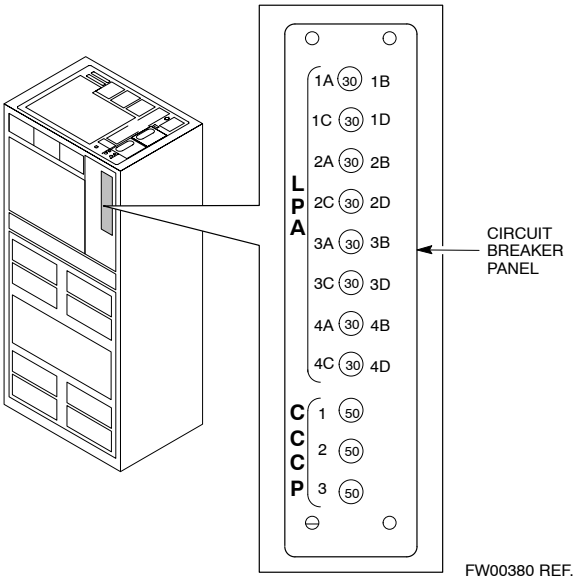
NOTES:

- MCM CAN BE EITHER 3X3 OR 4X4.
- MCM2 IS REQUIRED ONLY IN A 6–SECTOR CONFIGURATION.
- LOWER RIGHT QUADRANT WILL ONLY HAVE CLPAS IN IT IN A 4X4 CONFIGURATION.

ti-CDMA-WP-00197-v01-ildoc-ftw

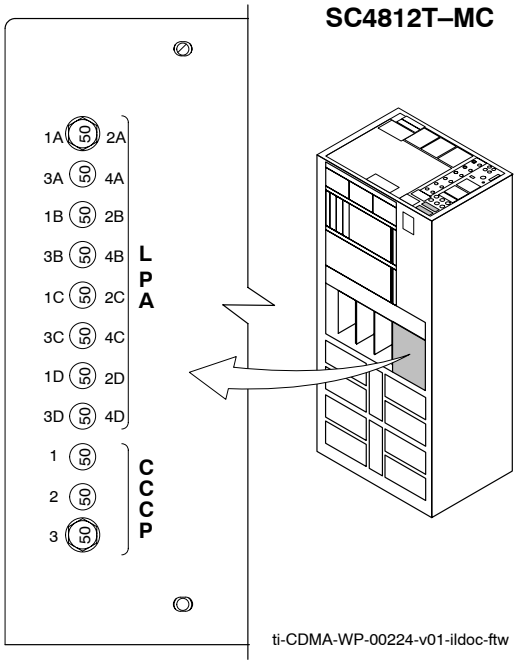
Figure 4: PA Breaker Mapping Comparison

SC 4812T



FW00380 REF.

SC4812T–MC



ti-CDMA-WP-00224-v01-ildoc-ftw

NOTE	**IMPORTANT:** A breaker supports a pair of PAs. In SC4812T–MC, disengaging (pulling) a PA breaker while the BTS is operational will degrade the TX Output power of **ALL** sector–carriers, not just a specific carrier as in SC4812T.

SC 4812T-MC BTS READ-ME-FIRST (Optimization/ATP)

General Test Procedural Changes in SC 4812T-MC

NOTE	The GENERAL information herein summarizes procedural changes introduced with the SC 4812T–MC BTS. Detailed procedures are provided in the Optimization and ATP sections.

Before executing any test or calibration procedures, **ALL** PAs must be in–service (INS).

For all TX ATP tests, carriers-not-under-test must also be keyed.

For TX Bay Level Offset, carriers-not-under-test need to be keyed at VERY LOW power level. Also:

- The TX BLO is approximately 40dB ±5 dB for 3-sector BTS and 43dB ±5 dB for 6-sector BTS.
- Single-sided BLO spec is ≥35dB. Double-sided BLO spec is 40dB ±5 dB.

For Rho and Code Domain Power tests, carriers-not-under-test need to be keyed to a LOW level to avoid overloading the test equipment.

Specific Test Procedural Changes

Spectral Mask Testing:

Channels of carriers not under test must be offset (as outlined in the following example) to eliminate interference from adjacent channels (or inaccurate 'fail' result) while spectral mask is executed on carrier under test. For carriers not under test, recommended channel offsets are 200 AMP Channels from the channel of the carrier under test (if equipped), 42 AMP channels for next carrier (if equipped) and 42 AMP channels for next carrier (if equipped).

Example: Customer has 4 carrier/3 sector configuration and channel for first carrier is 283

F= Channel of carrier under test=283

F1=Channel of nearest carrier = F+200 AMP Channels

F2=Channel of next carrier = F1+42 AMP Channels

F3=Channel of next carrier = F2+42 AMP Channels

After new channels are determined, implement these new channels when BBXs of carriers not under test are keyed. Perform Spectral Mask testing and dekey when carrier under test has been tested. Repeat offset exercise and test remaining carriers.

Customer ATP

Pilot Power Setting Accuracy Verification With a Wide Band RF Power Meter

The SC4812T–MC requires all equipped PAs be enabled during TX test. If the "tuned" RF power meter, such as Agilent VSA E4406A, is available then one can enable all sectors carriers simultaneously and measure each sector–carrier power level setting. The following work–around procedure is suggested when used with a wide band RF power meter and the BTS is under control of CBSC/OMC–R.

1-Carrier Configuration (requires 3 measurements)

The 1-carrier procedure is identical to the current SC 4812T, which is to enable all three sector BBXs, then measure with each sector with the RF power meter.

2–Carrier Configuration (requires 6 measurements)

The procedure below allows taking measurements with both carriers enabled, yet more than one carrier on same sector.

Sector	Carrier 1	Carrier 2	Sector	Carrier 1	Carrier 2
1	BBX-1		1		BBX-7
2	BBX-2		2		BBX-8
3		BBX-9	3	BBX-3	

Procedure:

1. Enable BBX-1 (C1–S1), BBX-2 (C1–S2), and BBX-9 (C2–S3).	4. Enable BBX-3 (C1–S3), BBX-7 (C2–S1), and BBX-8 (C2–S2).
2. Measure TX power from each of all 3 sectors.	5. Measure TX power from each of all 3 sectors.
3. Disable BBX-1, BBX-2, and BBX-9.	6. Disable BBX-3, BBX-7, and BBX-8.

3-Carrier Configuration (requires 9 measurements)

The procedure below allows taking measurements with all 3 carriers enabled, yet more than one carrier on same sector.

Sector	Carrier 1	Carrier 2	Carrier 3	Sector	Carrier 1	Carrier 2	Carrier 3	Sector	Carrier 1	Carrier 2	Carrier 3
1	BBX-1			1			BBX-4	1		BBX-7	
2		BBX-8		2	BBX-2			2			BBX-5
3			BBX-6	3		BBX-9		3	BBX-3		

Procedure:

1. Enable BBX-1 (C1–S1), BBX8 (C2–S2), and BBX6 (C3–S3)	4. Enable BBX-2 (C1–S2), BBX-9 (C2–S3), and BBX-4 (C3–S1)	7. Enable BBX-3 (C1–S3), BBX-7 (C2–S1), and BBX-5 (C3–S2)
2. Measure TX power from each of all 3 sectors	5. Measure TX power from each of all 3 sectors	8. Measure TX power from each of all 3 sectors
3. Disable BBX1, BBX8, and BBX6	6. Disable BBX-2, BBX-9, and BBX-4	9. Disable BBX-3, BBX-7, and BBX-5

4-Carrier Configuration (requires 12 measurements)

Use this procedure to take measurements with all 4 carriers enabled. The sector with 2 carriers active will not be measured.

Sector	Carrier 1	Carrier 2	Carrier 3	Carrier 4	Sector	Carrier 1	Carrier 2	Carrier 3	Carrier 4
1	BBX-1				1			BBX-4	BBX-10
2		BBX-8			2	BBX-2			
3			BBX-6	BBX-12	3		BBX-9		

Procedure:

1. Enable BBX-1, BBX-8, BBX-6, and BBX-12.
2. Measure TX power from at sector 1 carrier 1 (C1-S1) and sector 2 carrier 2 (C2-S2).
3. Disable BBX-1, BBX-8, BBX-6, and BBX-12.
4. Enable BBX-2, BBX-9, BBX-4, and BBX-10.
5. Measure TX power of C1-S2 and C2-S3.
6. Disable BBX-2, BBX-9, BBX-4, and BBX-10.

Sector	Carrier 1	Carrier 2	Carrier 3	Carrier 4	Sector	Carrier 1	Carrier 2	Carrier 3	Carrier 4
1		BBX-7			1	BBX-1	BBX-7		
2			BBX-5	BBX-11	2			BBX-5	
3	BBX-3				3				BBX-12

Procedure:

7. Enable BBX-3, BBX-7, BBX-5, and BBX-11.
8. Measure TX power of C1-S3 and C2-S1.
9. Disable BBX-3, BBX-7, BBX-5, and BBX-11.
10. Enable BBX-1, BBX-7, BBX-5, and BBX-12.
11. Measure TX power of C3-S2 and C4-S3.
12. Disable BBX-1, BBX-7, BBX-5, and BBX-12.

Sector	Carrier 1	Carrier 2	Carrier 3	Carrier 4	Sector	Carrier 1	Carrier 2	Carrier 3	Carrier 4
1				BBX-10	1			BBX-4	
2	BBX-2	BBX-8			2				BBX-11
3			BBX-6		3	BBX-3	BBX-9		

Procedure:

13. Enable BBX-2, BBX-8, BBX-6, and BBX-10.
14. Measure TX power of C3-S3 and C4-S1.
15. Disable BBX-2, BBX-8, BBX-6, and BBX-10.
16. Enable BBX-3, BBX-9, BBX-4, and BBX-11.
17. Measure TX power C3-S1 and C4-S2.
18. Disable BBX-3, BBX-9, BBX-4, and BBX-11.

2-Carrier, 6-Sector Configuration (requires 12 measurements)

Use this procedure to take measurements with both carriers enabled.

Sector	Carrier 1	Carrier 2	Sector	Carrier 1	Carrier 2
1	BBX-1		1		BBX-7
2	BBX-2		2		BBX-8
3		BBX-9	3	BBX-3	
4	BBX-4		4		BBX-10
5		BBX1–11	5	BBX-5	
6		BBX1–12	6	BBX-6	

Procedure:

1. Enable the following BBXs:
   - BBX-1 (C1–S1)
   - BBX-2 (C1–S2)
   - BBX-4 (C1-S4)
   - BBX-9 (C2–S3)
   - BBX-11 (C2-S5)
   - BBX-12 (C2-S6)
2. Measure TX power from each of all 6 sectors.
3. Disable BBXs.
4. Enable the following BBXs:
   - BBX-3 (C1–S3)
   - BBX-5 (C1-S5)
   - BBX-6 (C1-S6)
   - BBX-7 (C2–S1)
   - BBX-8 (C2–S2)
   - BBX-10 (C2-S4)
5. Measure TX power from each of all 6 sectors.
6. Disable BBXs.

Notes

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1X SC 4812T-MC Multicarrier BTS Optimization/ATP

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FCC Requirements

Content

This section presents Federal Communications Commission (FCC) Rules Parts 15 and 68 requirements and compliance information for the SC™ 4812T/ET/ET Lite series Radio Frequency Base Transceiver Stations.

FCC Part 15 Requirements

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: 7. This device may not cause harmful interference, and 8. 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 Requirements

This equipment complies with Part 68 of the Federal Communications Commission (FCC) Rules. A label on the GLI3 board, easily visible with the board removed, contains the FCC Registration Number for this equipment. If requested, this information must be provided to the telephone company.

FCC Part 68 Registered Devices	
Device	**FCC Part 68 ID**
Group Line Interface (GLI2)	US: IHEUSA–32769–XD–E
Group Line Interface (GLI3)	US: IHEXDNANGLI3–1X

The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of your T1. If this happens, the telephone company will provide advance notice so that you can modify your equipment as required to maintain uninterrupted service.

If this equipment 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 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.

If you experience trouble operating this equipment with the T1, please contact:

Global Customer Network Resolution Center (CNRC)
1501 W. Shure Drive, 3436N
Arlington Heights, Illinois 60004
Phone Number: (847) 632–5390

for repair and/or warranty information. 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.

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.

Obtaining Manuals

To view, download, order manuals (original or revised), visit the Motorola Lifecycles Customer web page at http://services.motorola.com, or contact your Motorola account representative.

If Motorola changes the content of a manual after the original printing date, Motorola publishes a new version with the same part number but a different revision character.

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 three categories of these special paragraphs are:

NOTE	Presents additional, helpful, non-critical information that you can use. **Bold-text notes indicate 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.

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.

Reporting manual errors

To report a documentation error, call the CNRC (Customer Network Resolution Center) and provide the following information to enable CNRC to open an MR (Modification Request):
– the document type
– the manual title, part number, and revision character
– the page number(s) with the error
– a detailed description of the error and if possible the proposed solution
Motorola appreciates feedback from the users of our manuals.

Contact us

Send questions and comments regarding user documentation to the email address below:
cdma.documentation@motorola.com

Motorola appreciates feedback from the users of our information.

Manual banner definitions

A banner (oversized text on the bottom of the page, for example, **PRELIMINARY**) indicates that some information contained in the manual is not yet approved for general customer use.

24-hour support service

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

NA CNRC	+1–800–433–5202
EMEA CNRC	+44– (0) 1793–565444
ASPAC CNRC	+86–10–88417733
Japan & Korea CNRC	+81–3–5463–3550
LAC CNRC	+51–1–212–4020

For further CNRC contact information, contact your Motorola account representative.

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.

NOTE	Refer to *Grounding Guideline for Cellular Radio Installations – 68P81150E62.*

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.

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

68P64115A21–B

Manual Title

1X SC 4812T-MC Multicarrier BTS Optimization/ATP

Version Information

The following table lists the manual version, date of version, and remarks on the version. Revision bars printed in page margins (as shown to the side) identify material which has changed from the previous release of this publication.

Version Level	Date of Issue	Remarks
1	Feb 2003	Preliminary manual
2	Mar 2003	Preliminary manual – scrubbed for "LPA"
3	Mar 2003	DV&V Review
4	Mar 2003	Controlled Introduction (+27V)
5	Mar 2003	Controlled Introduction (Temporarily removed tables)
6	May 2003	Preliminary Phase II (–48 V added)
7	May 2003	(Interim Phase II review 1)
8	May 2003	Engineering review Phase II (–48 V added)
9	May 2003	Final Eng. review Phase II (–48 V added)
10	May 2003	DV&V review Phase II (–48 V added)
11	Jun 2003	Controlled Introduction (+27V and –48V)
12	Aug 2003	Packet Backhaul and Agilent E7495A Test Set Support
13	Aug 2003	Final Engineering review. Incorporate DE comments from Preliminary review
14	Aug 2003	DVV, Incorporate DE comments from DE review. Adds Packet Backhaul and Agilent E7495A Test Set Support and removes LFR (Low Frequency Rate) as LFR is no longer supported.
B	Sept 2003	FOA Packet Backhaul Addition

MOTOROLA

Chapter 1

Introduction

1

Optimization Manual: Scope and Layout

Scope of This Document

This document provides information pertaining to the optimization and audit tests of 1X SC™4812T–MC BTS equipment frame (Models ST12xx/ST14xx) equipped with trunked Power Amplifiers and their associated internal and external interfaces.

Also covered is software release 2.16.1.X which supports the following versions of SC 4812T BTS sites:
– 1X Circuit BTS
– 1X Packet backhaul BTS

The 1X packet BTS has a packet backhaul network interface which is provided via a routers together with a GLI (GLI3) that can handle voice (IS-95A/B, 1X) and data (IS-95B, 1X).

This BTS equipment is configured with all 1X cards (BBX–1X and MCC–1X) or a mix of 1X cards and non–1X cards (BBX2 and MCC8E/24E). This configuration is compliant with all applicable cdma2000 1X specifications. It provides the forward link and reverse link RF functions to support 2G features and 3G-1X features (i.e., high capacity voice and high bit rate data).

The 1X circuit BTS has an option of using a split backhau (circuit/packet pipe) network interface that can handle circuit based voice (IS-95A/B, 1X) and data (IS-95B) as well as packet based data (1X).

Assumptions and Prerequisites

This document assumes that the BTS frames and cabling have been installed according to the following manuals:

- *SC Product Family Frame Mounting Guide* (which covers the physical “bolt down” of all SC series equipment frames)
- *1X SC 4812T-MC BTS Hardware Installation* (which covers BTS specific cabling configurations for Packet Backhaul and the addition of carriers to the BTS)

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.

NOTE	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 Information Products and Services 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 frame, and download of all BTS processor boards and power amplifiers.
- Optimization/Calibration, consisting of downloading all BTS processor boards, PA 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, and procedures for downloading ROM and RAM code.

1

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.

What Happens During Optimization?

Overview – During optimization, the accumulated path loss or gain is first determined for each RF transmit path in the BTS. These transmit path loss or gain values are then stored in a database along with RF receive path default values.

- 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 TX filter, Multicarrier Combiner Input/Output (MCIO) 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.

NOTE	In this manual, all variations of the BBX usable in this BTS, are generically identified as BBX, unless otherwise specified. Also, all variations of the MCC cards usable in this BTS, are generically identified as MCC unless otherwise specified.

- 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 TX filter and MCIO 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 MCIO, 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 PA/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.

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.

1

When to Optimize

New Installations

The following operations and optimization/test actions should be accomplished for a new BTS or frame installation:

1. 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.
2. Next, the optimization is performed. Optimization includes performance verification and calibration of all transmit and receive RF paths, and download of accumulated calibration data.
3. A calibration audit of all RF transmit paths may be performed any time after optimization to verify BTS calibration.
4. After optimization, a series of manual pre–Acceptance Test Procedure (ATP) verification tests are performed to verify alarm/redundancy performance.
5. After manual pre–ATP verification tests, an ATP is performed to verify BTS performance. An ATP is also required to demonstrate regulation compliance before the site can be placed in service.

Site Expansion

Optimization is required after expansion of a site with additional BTS frames.

Periodic Optimization

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

Repaired Sites

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

Required Test Equipment and Software

Overview

Test equipment and software described in this section is required for the optimization procedure. Common assorted tools such as screwdrivers and frame keys are also needed. Read the owner's manual for all of the test equipment to understand its individual operation before using the tool in the optimization.

Policy

To ensure consistent, reliable, and repeatable optimization test results, test equipment and software meeting the following technical criteria should be used to optimize the BTS equipment. Test equipment can, of course, be substituted with other test equipment models *if the equipment meets the same technical specifications*.

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***.

It is the responsibility of the customer to account for any measurement variances and/or additional losses/inaccuracies that can be introduced as a result of these 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 and calibration prior to BTS optimization. Follow the original equipment manufacturer (OEM) recommended maintenance and calibration schedules closely.

Test Cable Calibration

Test cables can make critical differences in optimization accuracy. It is recommended that cable calibration be run at every BTS with the complete *test equipment set*. 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 to account for cable loss is by entering it into the LMF during the optimization procedure. This method requires accurate test cable characterization using shop test equipment. Characterized cables should be tagged with the characterization information, and the measured losses entered into the LMF before field optimization.

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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 procedures.

- Communications Test Set
- Power Meter

LMF Computer and Software

LMF Hardware Requirements

An LMF computer platform that meets the following requirements (or better) is recommended:

- Notebook computer
- 266 MHz (32–bit CPU) Pentium processor
- MS® Windows 98® Second Edition (SE) or *Windows* 2000 operating system
- 4 GB internal hard disk drive
- SVGA 12.1–inch active matrix color display with 1024 x 768 (recommended) or 800 x 600 pixel resolution and capability to display more than 265 colors

NOTE	If 800 x 600 pixel resolution is used, the LMF window must be maximized after it is displayed.

- Memory requirements:
  - Minimum required RAM: 96 MB
  - Recommended RAM:
    - 128 MB for Windows 98 SE
    - 256 MB for Windows 2000
- 20X CD ROM drive
- 3 1/2 inch floppy drive
- 56kbps V.90 modem
- Serial port (COM 1)
- Parallel port (LPT 1)
- PCMCIA Ethernet interface card (for example, 3COM Etherlink III) with a 10Base–T–to–coax adapter

LMF Software

The Local Maintenance Facility (LMF ver. 2.16.1.2.08) application program is a graphical user interface (GUI) based software tool. This product is specifically designed to provide cellular communications field personnel with the capability to support the following CDMA Base Transceiver Station (BTS) operations:

- Installation
- Maintenance
- Calibration
- Optimization

Ethernet LAN Transceiver

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

10BaseT/10Base2 Converter

- 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.

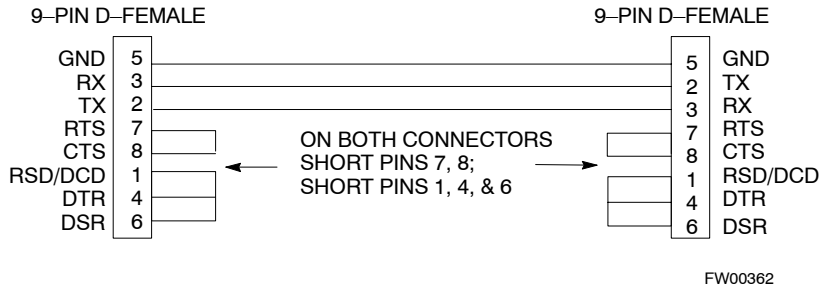
3C–PC–COMBO CBL

- 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



MMI Interface Kit

Motorola cable part number CGDSMMICABLE219112 is used to connect the LMF to the BTS.

Communications System Analyzer CDMA/analog

Table 1-1: CDMA LMF Test Equipment Support Table

Item	Description	Test Capability
Test Sets		
Hewlett Packard, model HP 8921A (with 83203B)	Communications analyzer (includes 83203B CDMA interface option)	IS–95A/B only
Hewlett Packard, model HP 83236A	PCS interface for PCS band	IS–95A/B only
Motorola CyberTest	Communications analyzer	IS–95A/B only
Advantest R3465 (with 3561L)	Communications analyzer (with 3561 CDMA option)	IS–95A/B only
Agilent E4406A (with E4432B)	Communications analyzer (with Generator)	IS–95A/B and CDMA 2000 testing
Advantest R3267 Analyzer (with R3562)	Communciations Analyzer with Advantest R3562 Generator	IS–95A/B and CDMA 2000 testing
Agilent 8935 series E6380A (formerly HP 8935) with option 200 or R2K	Communications test set	IS–95A/B and CDMA 2000 testing
Agilent E7495A	Communications test set	IS–95A/B and CDMA 2000 testing
Power Meters		
Gigatronix 8541C	Power meter	
HP437B (with HP8481A sensor)	Power meter with sensor – capable of measuring –30 dBm to 20 dBm	

A combination of test equipment supported by the LMF may also be used during optimization and testing of the RF communications portion of BTS equipment when the communications system analyzer does not perform all of the following functions:

- Frequency counter
- Deviation meter
- RF power meter (average and code domain)
- RF signal generator (capable of DSAT/CDMA modulation)
- Audio signal generator
- AC voltmeter (with 600–ohm balanced audio input and high impedance input mode)
- Noise measurement meter
- C–Message filter
- Spectrum analyzer
- CDMA code domain 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.

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.

Directional Coupler

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

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.

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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.

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 or NECF files (bts–#.cdf or bts–#.necf and cbsc–#.cdf)
- Demarcation Document (Scope of Work Agreement)
- Equipment Manuals for non-Motorola test equipment

Related Publications

Additional, detailed information about the installation, operation, and maintenance of the 1X SC™ 4812T–MC BTS and its components is included in the following publications:

- *SC Product Family Frame Mounting Guide* – 68P09226A18
- *1X SC 4812T-MC BTS Hardware Installation* – 68P64115A19
- *1X SC 4812T-MC BTS FRU Guide* – 68P64115A20
- *WinLMF On-Line Help SR2.16.x* – 68P09257A16
- *LMF CDMA CLI Reference SR2.16.1.x* – 68P09255A76
- Cisco MWR 1941 Router Hardware Installation Guide, 78–15827–01
- Cisco MWR 1941 Router Software Guide, 78–xxxxx–01

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 Windows 98™ or Windows 2000™.

1

Terms and Abbreviations

Standard and Non–standard Terms and Abbreviations

Standard terms and abbreviations used in this manual are defined in *Cellular Glossary of Terms and Acronyms; 68P09213A95*. Any non–standard terms or abbreviations included in this manual are listed in Table 1-2.

Table 1-2: Abbreviations and Acronyms

Acronym	Definition
1X	One of two bandwidths currently defined in the IS–2000 CDMA specification, which extends the capability of the IS–95A and B specifications. 1X bandwidth provides wireless packet voice and data transmission capability at up to 144 Kbps.
AMR	Alarm Monitor Reporting
ASIC	Application Specific Integrated Circuit
ATP	Acceptance Test Plan
BBX	Broadband Transceiver
BLO	Bay Level Offset
BPR	BTS Packet Router. Markings on GLI3 Fast Ethernet connectors and SC4812T Fast Ethernet interface housing.
BSSAN	Base Station System (BSS) Access Network. The BSSAN consists of a Radio Access Network (see *RAN*), and an AN. It may also include a Digital Access and Cross–connect System to support split backhaul and, under Software Release 2.16.1.x, a Selector Distribution Unit (SDU).
BTS	Base Transceiver Station
BTSRTR R	BTS Router (see *BTS router*)
BTSRTRGRP	BTS Router Group (see *BTS router group*)
BTS router	One of the two routers in a BTS router group.
BTS router group	The 1+1 redundant router pair required for network interface when operating on packet backhaul.
cage	Used interchangeably with “shelf” in SC4812T/ET/ET Lite BTSs, as in Combined CDMA Channel Processor shelf.
canned configuration	See *minimum standard configuration*.
CBSC	Centralized Base Station Controller
C–CCP	Combined CDMA Channel Processor
CCD	CDMA Clock Distribution
CDMA	Code Division Multiple Access
CE	Channel Element
CF	Compact Flash. Type of flash memory card used in the BTS router to store the Internetworking Operating System and configuration files.
CHI	Concentration Highway Interface

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Table 1-2: Abbreviations and Acronyms

Acronym	Definition
circuit backhaul	Conventional, non–Internet Protocol (IP) backhaul between the BTS and the Central Base Station Controller (CBSC) transcoder (XC) which carries IS–95A/B traffic.
CLI	Command Line Interface
CLPA	High Power Linear Amplifier
CM	Channel Module
CMR	Cellular Manual Revision
CSM	Clock Synchronization Manager
DBM	Debug Monitor
CNEOMI	Common Network Element Operation & Maintenance Interface
DSP	Digital Signal Processor
EMPC	Expansion Multicoupler Preselector Card
ETM	Enhanced Trunking Module
FE	Fast Ethernet. 100base–T mode of 10/100base–T Ethernet used for transmitting packetized control and bearer traffic between the BTS router group and GLI3 cards in the BTS.
FRU	Field Replaceable Unit
FSI	Frame Status Indicator
GLI	Group Line Interface
GLI3	Third generation Group Line Interface card. Replaces GLI2 cards in a BTS when upgrading to packet backhaul capability under Software Release 2.16.1.x. Provides all the functionality of GLI2 cards plus additional capabilities needed for packet backhaul. GLI3 cards may only be installed in BSSs operating with Software Release 2.16.1.x software.
GPS	Global Positioning System
HSO	High Stability Oscillator
I&Q	In–phase and Quadrature
LAPD	Link Access Protocol “D”
LFR	Low Frequency Receiver
LMF	Local Maintenance Facility
LORAN	LOng RAnge Navigational
MCC	Multi–Channel CDMA
MCIO	Multicarrier Combiner Input/Output
MCM	Multicarrier Module
MGLI	Master Group Line Interface

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Table 1-2: Abbreviations and Acronyms

Acronym	Definition
minimum standard configuration	The initial minimum configuration data which must be loaded into a BTS router to enable it to communicate on the network. This standard "canned configuration" is generated by a script included in the R16.1 software load for the OMC–R/CBSC. Separate configuration files for the primary BTS router on each FE LAN at a site is created by the script and can be copied to the Compact Flash (CF) memory card containing the IOS for BTS routers. Once the CF card with the IOS and minimum standard configuration is installed, the BTS router can communicate with the OMC–IP and the full, site–specific router configuration file can be downloaded from the Mobile Wireless Center to the router. Different configuration files are required for circuit and packet backhaul operation.
mixed backhaul	See *split backhaul*.
MM	Mobility Manager
MMI	Man Machine Interface
MPC	Multicoupler Preselector Card
MSC	Mobile Switching Center
MWC	Mobile Wireless Center. One element of the OMC–IP which provides management and control for the MWR 1900 BTS routers installed in BTSs operating on packet backhaul.
OMCR	Operations Maintenance Center – Radio
PA	Power Amplifier
PAC	Power Alarms Card
PBH	Packet Backhaul: IP–based backhaul between the BTS and the network. Packet backhaul capability is implemented in Software Release 2.16.1.x and requires equipping a BTS with BTS routers and GLI3 cards. With the packet backhaul upgrade, a BTS can be configured for circuit operation with the capability to switch to packet backhaul or for packet–only operation.
PCS	Personal Communication System
PLC	Parallel Linear Amplifier Combiner
PN	Pseudo–random Noise
PSM	Power Supply Module
PSTN	Public Switched Telephone Network
PWM	Pulse Width Monitor
QPSK	Quadrature Phase Shift Keyed
R15.x	Motorola Software Release 2.15.0.39.10 or later. The version of the software which must be installed on BSS equipment to allow upgrading to Software Release 2.16.0.x.
R16.0	Motorola Software Release 2.16.0.x. The version of the software which must be loaded on BSS equipment to upgrade it to software release 2.16.1.x.
R16.1	Motorola Software Release 2.16.1.x.
RFDS	Radio Frequency Diagnostic Subsystem
RSSI	Received Signal Strength Indicator
RX Filter	Receive Filter

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Table 1-2: Abbreviations and Acronyms

Acronym	Definition
SC4812TX	An expansion frame version of the SC4812T–series BTS equipped with trunked RF power amplifiers and no receiver antenna ports.
SCAP	Super Cell Application Protocol
SPLC	Switch Parallel Linear Amplifier Combiner
split backhaul	Backhaul serving a network in which IS–95A/B traffic and 1X data traffic are mixed on circuit backhaul from CDMA2000 1X BTSs. 1X data traffic is "split" from IS–95A/B on a single span by being transported on DS0 time slots dedicated to a "packet pipe." IS–95A/B traffic is transported on the remaining DS0 time slots. Split backhaul on a single span must be connected to a Digital Access and Cross–connect System (DACS) which directs IS–95A/B traffic to the CBSC XC and 1X data traffic to the Access Node (AN), as required. If a DACS is not used, a CDMA2000 1X BTS must be equipped with separate spans for 1X data packet and IS–95A/B voice/data traffic, respectively. The 1X data packet–dedicated span would connect directly to the AN. The IS–95A/B–only span would connect directly to the CBSC XC.
SNI	Serial Network Interface
STRAU	SC 9600 Transcoder/Rate Adaption Unit
TCH	Traffic Channel
TSI	Time Slot Interchanger
TX Filter	Transmit filter
UTC	Universal Time Coordinates
VWIC	Voice Wide Area Network Interface Card
WIC	WAN Interface Card (also *VWIC*)

1

BTS Equipment Identification

Equipment Overview

The BTS can consist of the following equipment frames:

- At least one BTS starter frame –

  –48 V configuration shown in Figure 1-2

  +27 V configuration shown in Figure 1-3
- Ancillary equipment frame (or wall mounted equipment)
- One or more Expansion frames (see Figure 1-4 and Figure 1-5). Expansion frames are essentially the same as starter frames, but which incorporate unique components on the I/O (Interconnect) panel.

NOTE

– I/O panel detail is provided for Starter Frame in Figure 1-8 (page 1-27) and Expansion Frame in Figure 1-9 (page 1-28).

– C–CCP cage details are provided in Figure 1-10 (page 1-29).

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 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 fames.

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).

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 1-3 and Table 1-4 for specific C–CCP Shelf Device ID numbers.

Table 1-3: 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	GLI–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 1-4: 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	GLI–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	202	207	208	209	210	211	212	207	208	209	210	211	212	–	–
301	–	301	302	–	–	–	302	302	307	308	309	310	311	312	307	308	309	310	311	312	–	–

Figure 1-2: BTS Starter Frame (–48 V configuration)

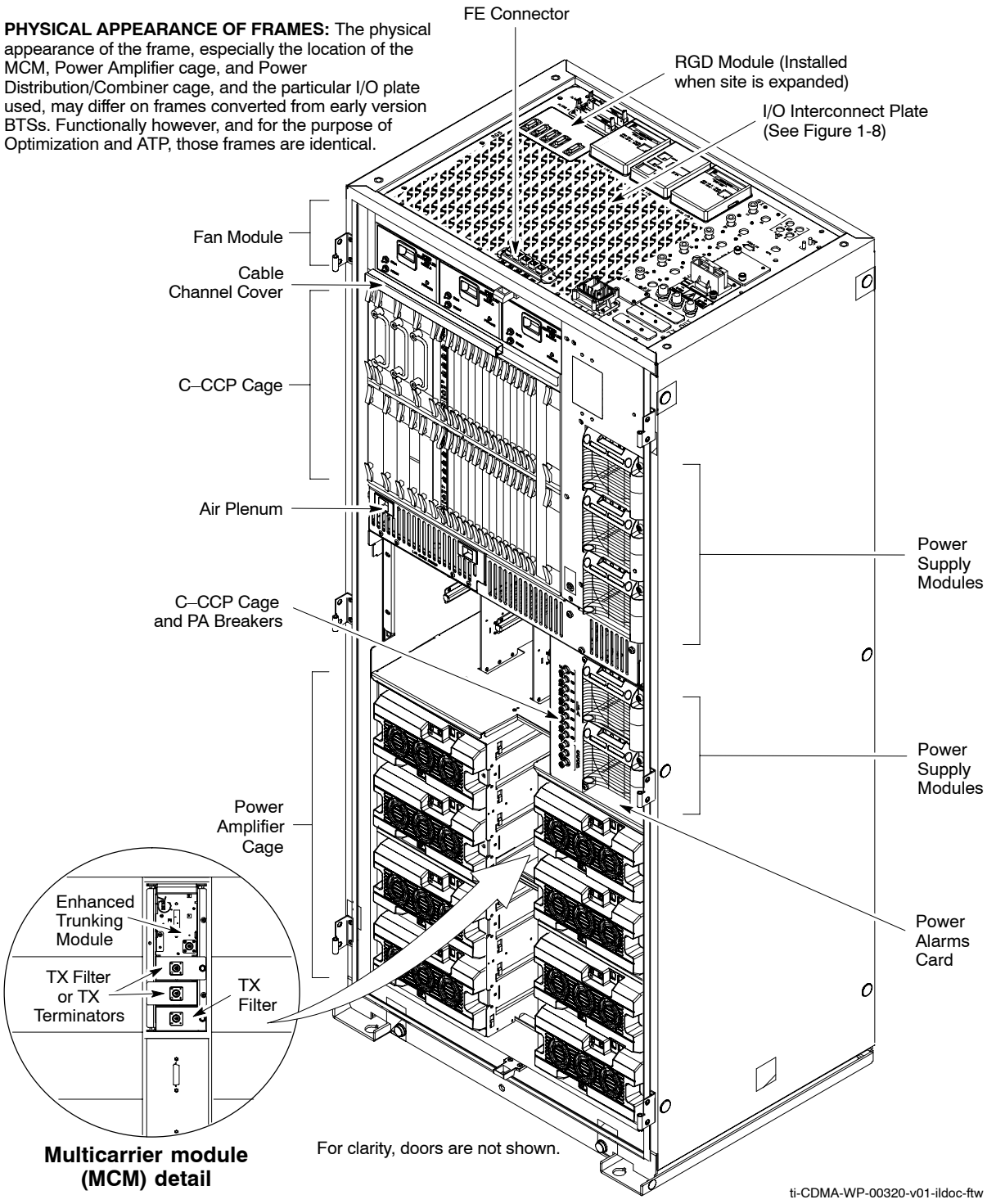


Figure 1-3: BTS Starter Frame (+27 V configuration)

PHYSICAL APPEARANCE OF FRAMES: The physical appearance of the frame, especially the location of the MCM, Power Amplifier cage, and Power Distribution/Combiner cage, and the particular I/O plate used, may differ on frames converted from early version BTSs. Functionally however, and for the purpose of Optimization and ATP, those frames are identical.

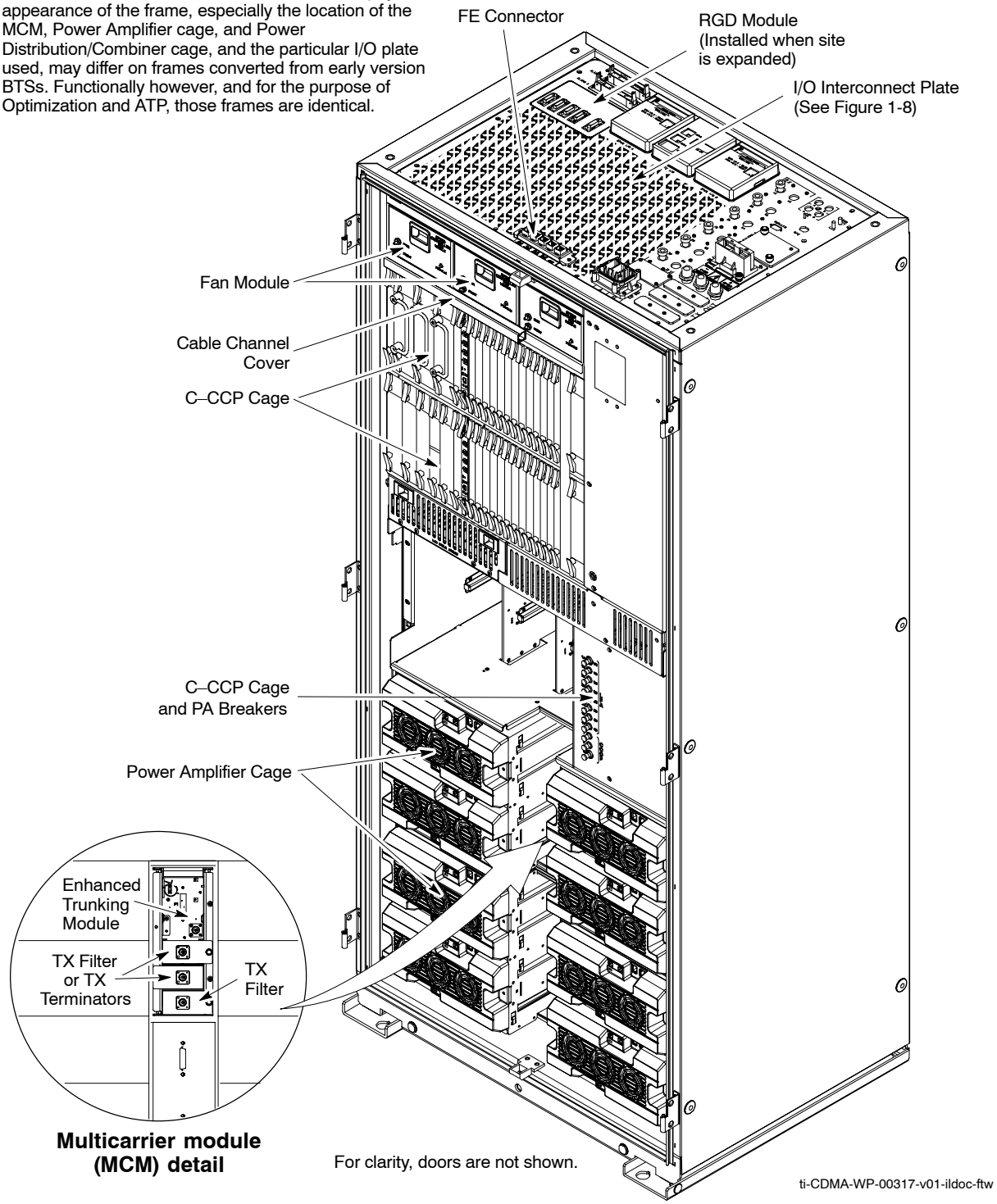


Figure 1-4: BTS Expansion Frame (–48 V configuration)

PHYSICAL APPEARANCE OF FRAMES: The physical appearance of the frame, especially the location of the MCM, Power Amplifier cage, and Power Distribution/Combiner cage, and the particular I/O plate used, may differ on frames converted from early version BTSs. Functionally however, and for the purpose of Optimization and ATP, those frames are identical.

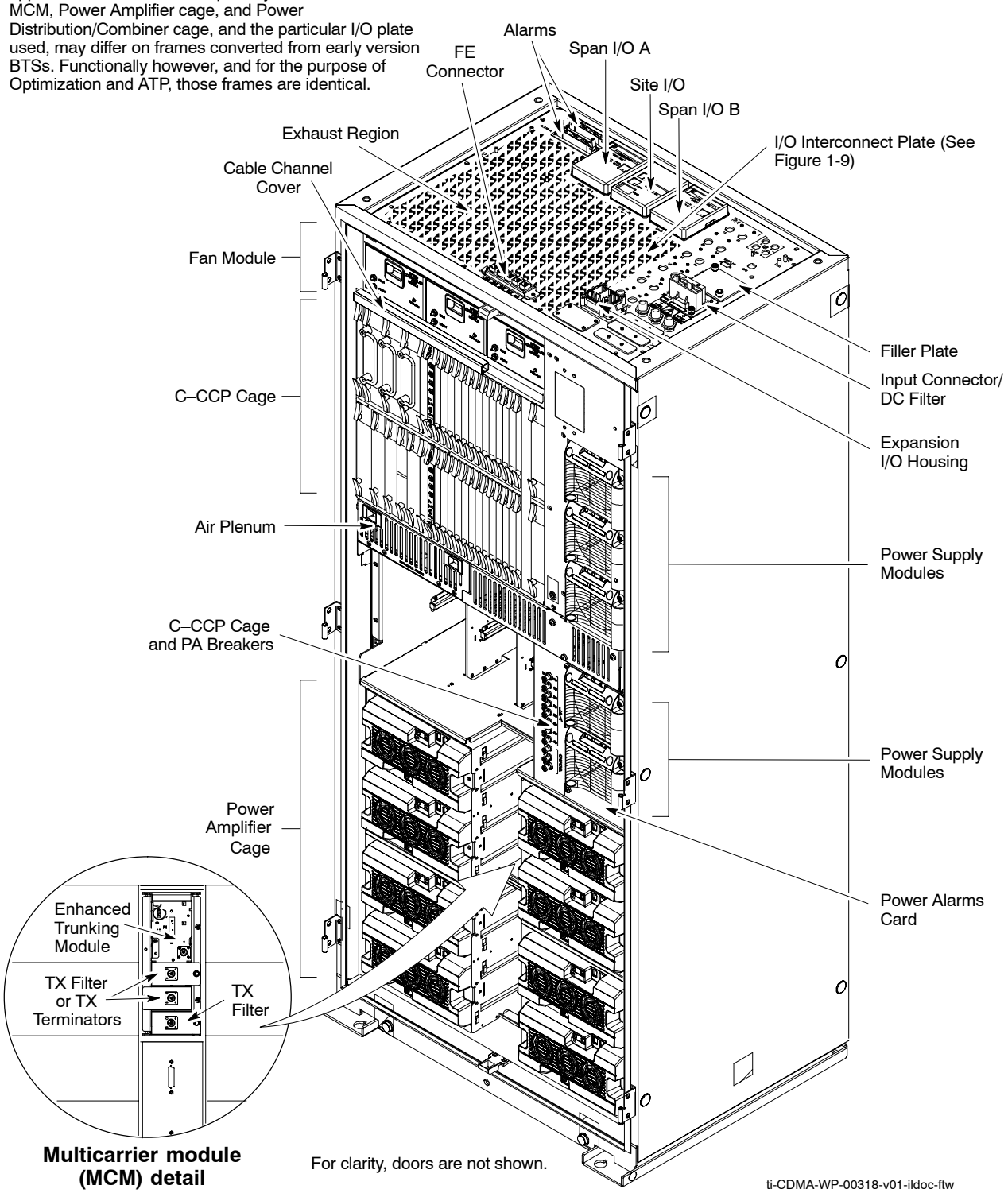


Figure 1-5: BTS Expansion Frame (+27 V configuration)

PHYSICAL APPEARANCE OF FRAMES: The physical appearance of the frame, especially the location of the MCM, Power Amplifier cage, and Power Distribution/Combiner cage, and the particular I/O plate used, may differ on frames converted from early version BTSs. Functionally however, and for the purpose of Optimization and ATP, those frames are identical.

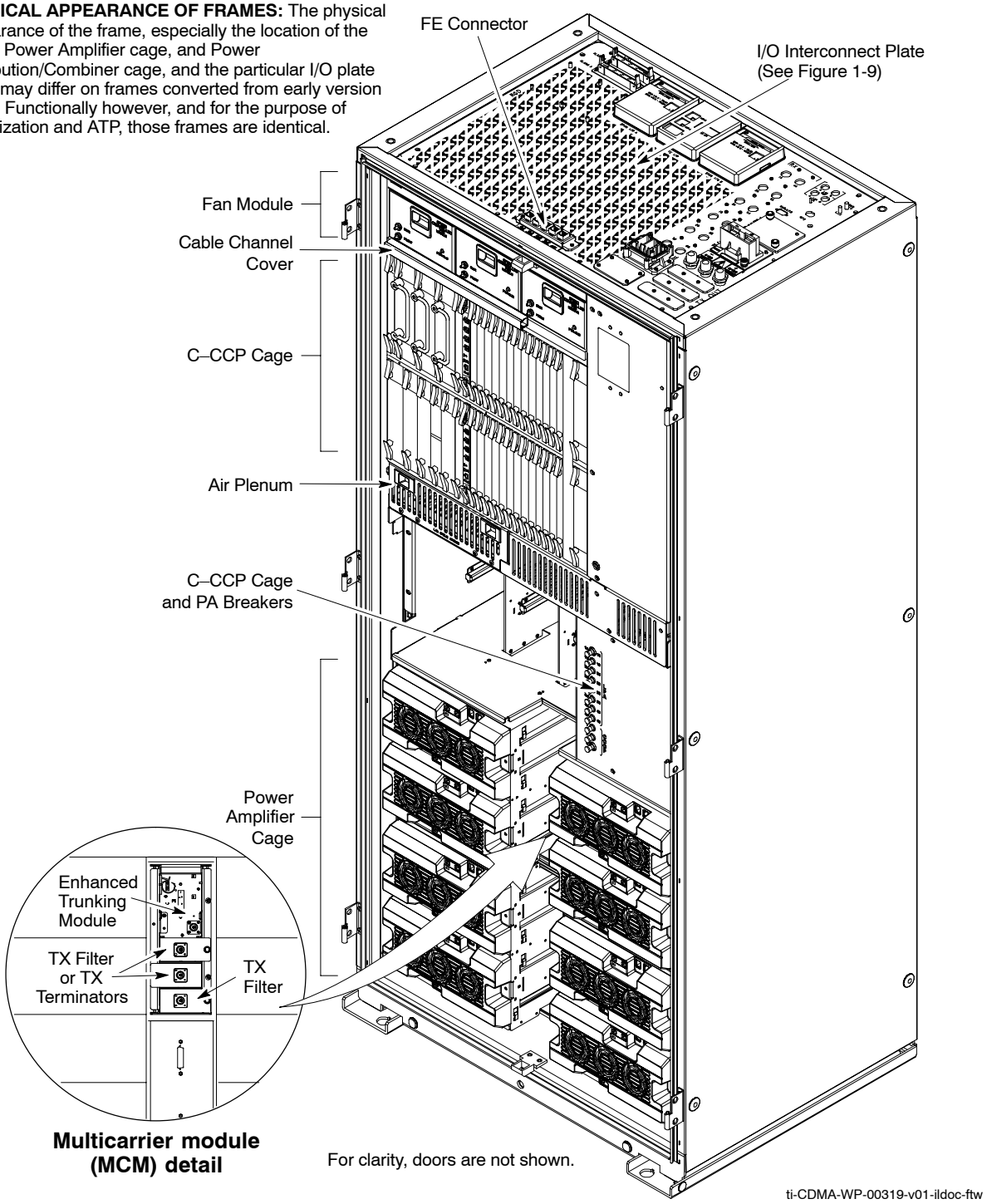
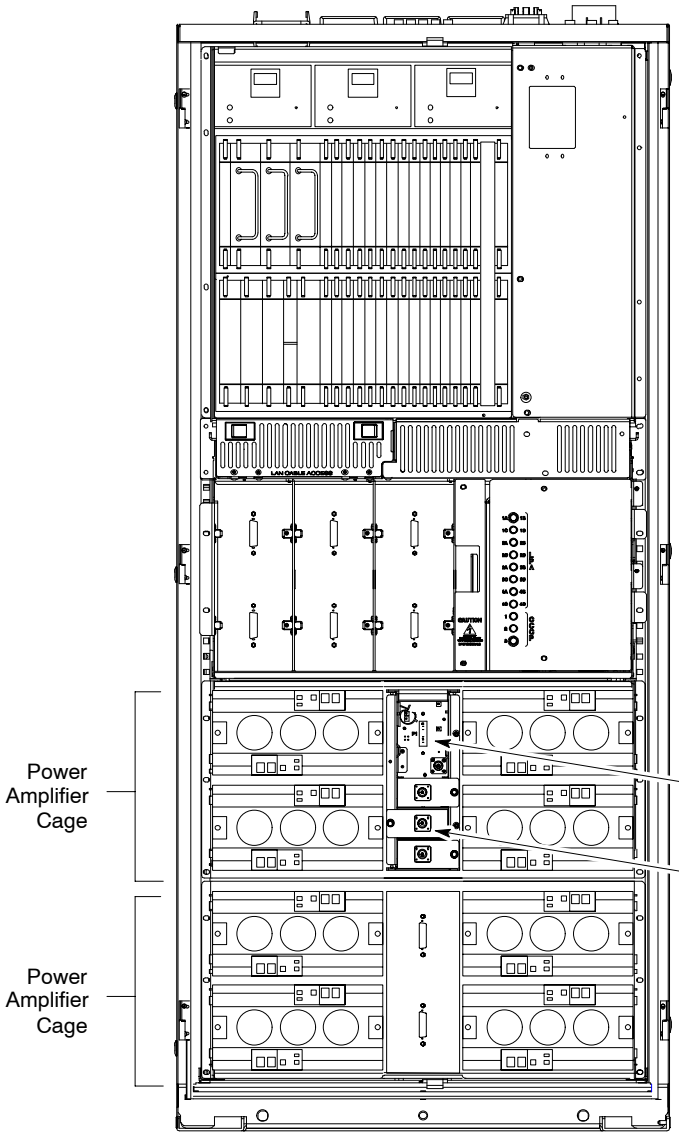


Figure 1-6: BTS Multicarrier Frame Power Amplilfier Configuration – 3 Sector (+27V Shown)

NOTE	The fourth PA quadrant (1D, 2D, 3D, 4D) is populated with CLPAs only when the 4x4 ETM is used. The 4th carrier BBX10–12 is NOT supported in a frame converted to Multicarrier from early version BTS. An upcoming feature release will address 4th carrier support.



PHYSICAL APPEARANCE OF FRAMES: The physical appearance of the frame, especially the location of the MCM, Power Amplifier cage, and Power Distribution/Combiner cage, and the particular I/O plate used, may differ on frames converted from early version BTSs. Functionally however, and for the purpose of Optimization and ATP, those frames are identical.

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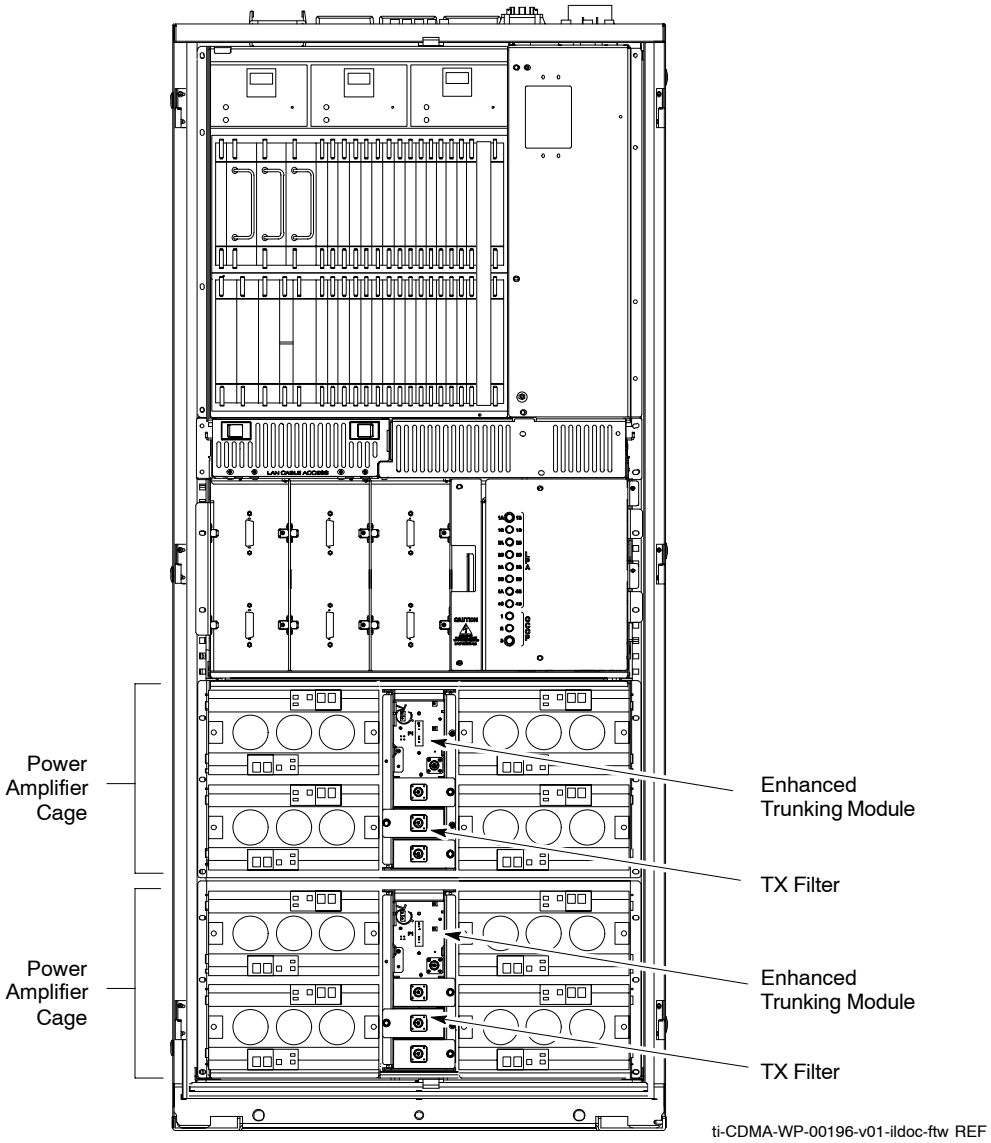
Figure 1-7: BTS Multicarrier Frame Power Amplilfier Configuration – 6 Sector (+27V Shown)

NOTE	The fourth PA quadrant (1D, 2D, 3D, 4D) is populated with CLPAs only when the 4x4 ETM is used. The 2nd carrier BBX7–12 is NOT supported in a frame converted to Multicarrier from early version BTS. An upcoming feature release will address 2nd carrier support.



BTS Frame Description

The BTS is the interface between the span lines to/from the Centralized 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 power amplifiers and PA fans, Parallel Linear Amplifier Combiner, enhanced trunking module(s) and TX filters.

Top I/O (Interconnect) Plate

All cabling to and from the BTS equipment frames is via the I/O interconnect panel (see Figure 1-8 and Figure 1-9) on top of each frame. The IO Plate layout is identical for +27V and –48V frames starter and expansion frames with the exception that the power input label is voltage specific and the RX Expansion port location changes as shown in Figure 1-8 and Figure 1-9. 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)
- Expansion frame connection
- Ground connections

Figure 1-8: Starter Frame I/O (Interconnect) Plate

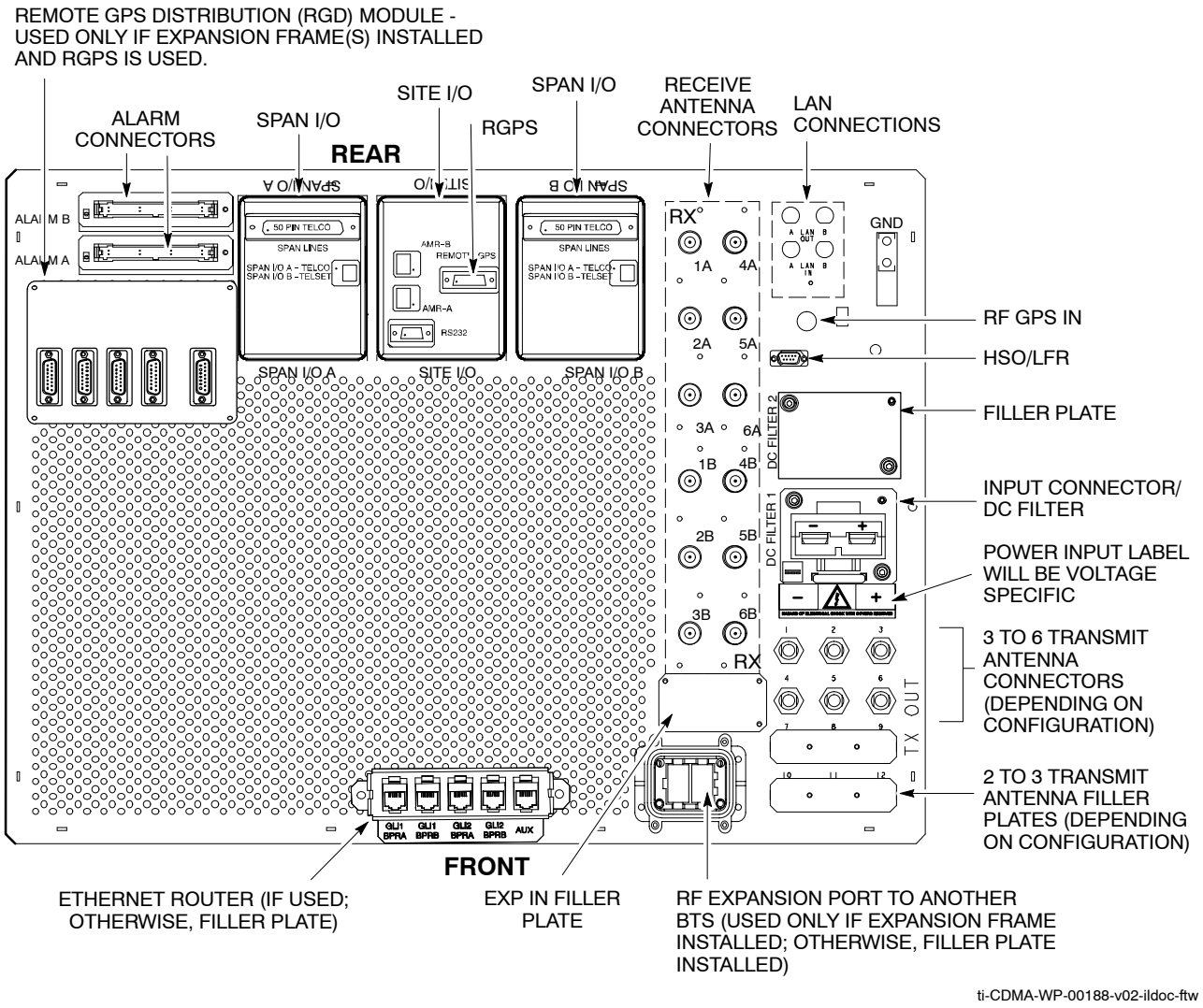


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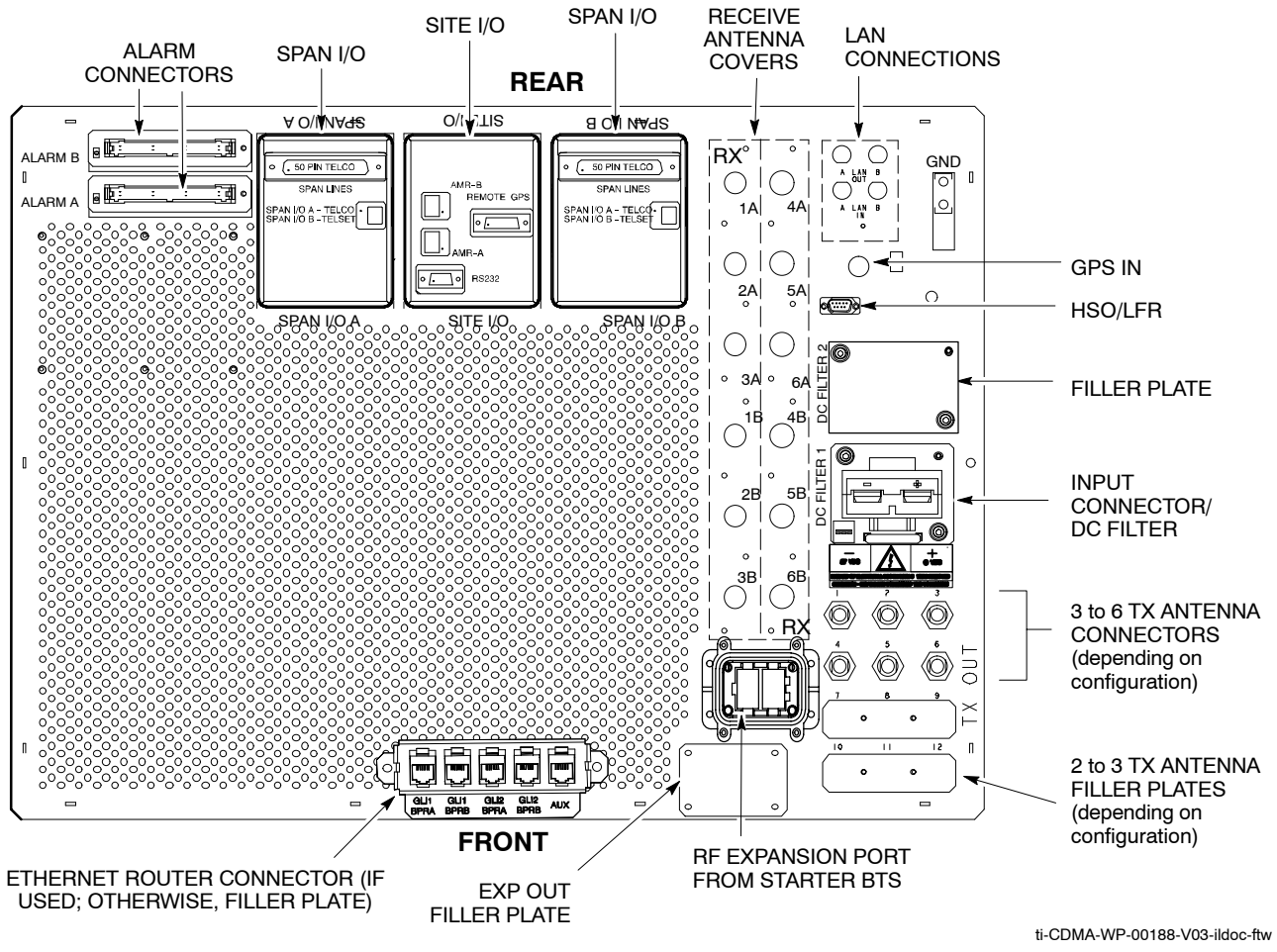
Figure 1-9: Expansion Frame I/O (Interconnect) Plate



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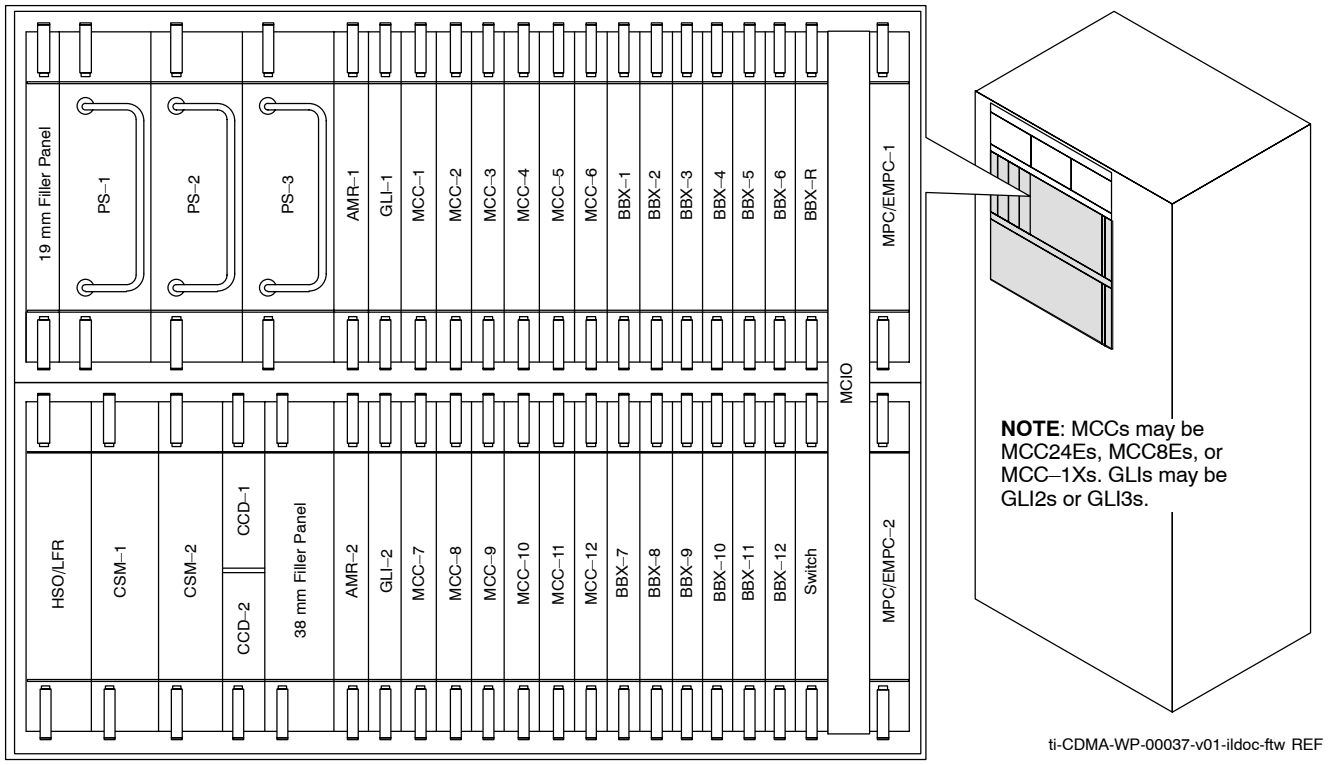
C–CCP Shelf

The upper portion of the frame houses circuit breakers, cooling fans, and the Combined–CDMA Channel Processor (C–CCP) shelf (see Figure 1-10). The C–CCP shelf includes:

- C–CCP backplane and cage
- C–CCP Power supplies
- CDMA clock distribution (CCD) boards
- CSM and HSO/LFR boards
- Alarm Monitoring and Reporting (AMR) boards
- GLI cards
- MPC (starter frame)/EMPC (expansion frame) boards
- Switch card
- MCC boards
- BBX boards
- MCIO boards

Figure 1-10: C–CCP Shelf



NOTE	The 4th carrier (BBX10–12) is not supported in a converted SC 4812T MC BTS at this time. An upcoming feature release will address 4th carrier support.

Power Amplifier (PA) Shelves

The lower shelves house the power amplifier cages which include:

- PA modules, PA fans, and Parallel Linear amplifier Combiners (PLCs) or Switched Parallel Linear amplifier Combiners (SPLCs).
- multicarrier module (MCM) which includes the enhanced trunking modules (ETMs), and TX filters.

These components may be configured differently depending upon customer requirements. Figure 1-11 illlustrates the available configurations. Table 1-5 describes BTS sector/carrier/BBX configurations and mapping, and TX Filter requirements.

Table 1-5: BTS Carrier/Sector/BBX/ETM/CLPA Mapping

Sectors	Carriers	BBXs assigned to carrier	ETM (MCM) Qty	TX Filter Qty	3x3 ETM			4x4 ETM		
					#CLPAs/ Carrier	CLPA Position	PLC/ SPLC Qty	#CLPAs/ Carrier	CLPA Position	PLC/ SPLC Qty
3	1	1,2,3	1	3	3	1 of quadrants A - C *PLC Filler in position 2 of quadrants A – C only when PLCs are used.	3	4	1 of quadrants A - D *PLC Filler in position 2 of quadrants A - D only when PLCs are used.	4
	2	7,8,9			6	2 of quadrants A - C		8	2 of quadrants A - D	
	3	4,5,6			9	3 of quadrants A - C		12	3 of quadrants A - D	
	4	10,11,12			12	4 of quadrants A - C		16	4 of quadrants A - D	
6	1	1,2,3, 4,5,6	2	6	6	1&3 of quadrants A - C	3	8	1&3 of quadrants A - D	4
	2	7,8,9, 10,11,12			12	2&4 of quadrants A - C		16	2&4 of quadrants A - D	

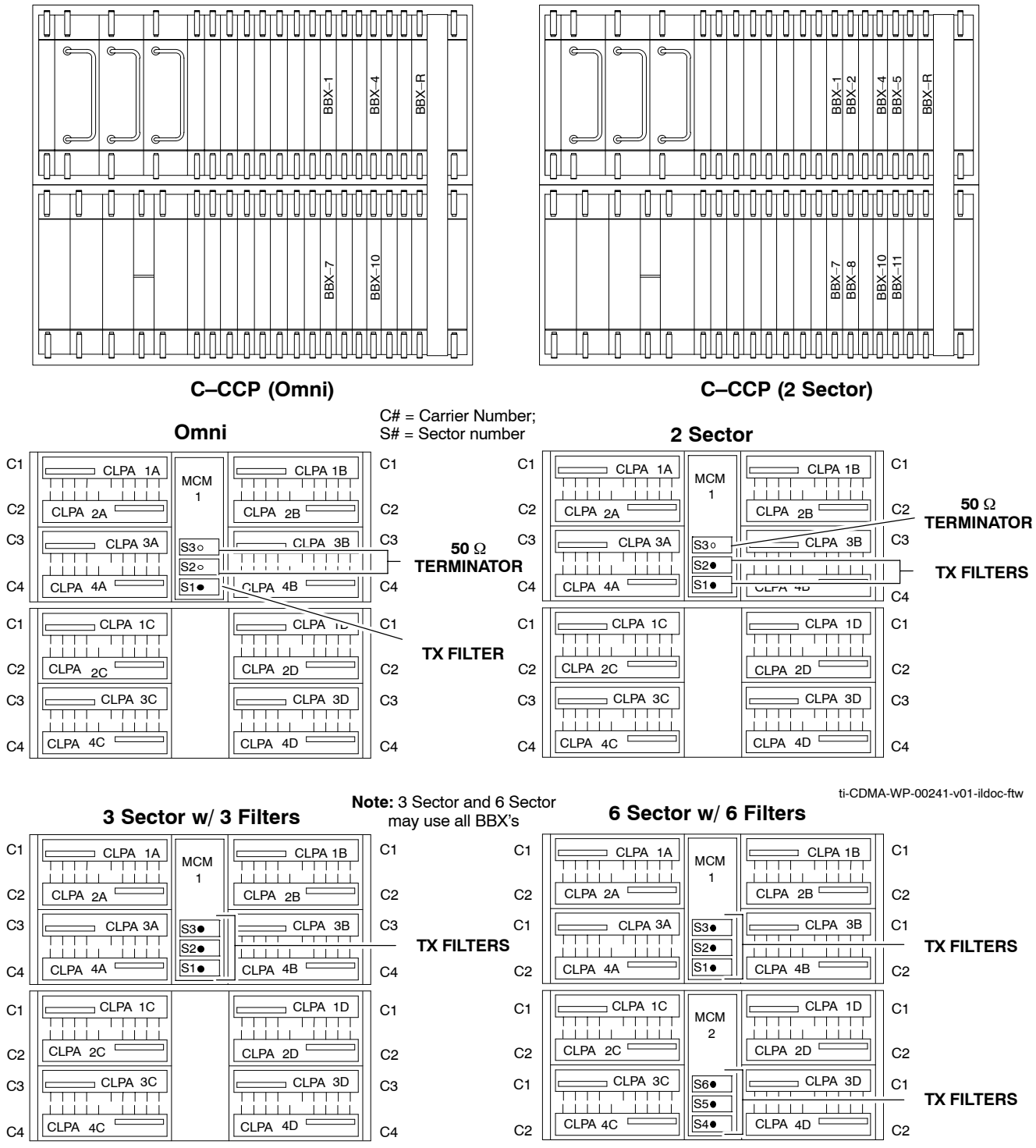
NOTE

In the case where SPLCs are used, PLC Filler Panels are not required.

NOTE

- The configurations in Figure 1-11 show a maximum configuration of 16 CLPAs.
- The C-CCP part of the diagram identifies which BBXs are used for Omni and 2-Sector configuration.
- The fourth PA quadrant (1D, 2D, 3D, 4D) is populated with CLPAs only when the 4x4 ETM is used.
- **PHYSICAL APPEARANCE OF FRAMES:** The physical appearance of the frame, especially the location of the MCM, Power Amplifier cage, and Power Distribution/Combiner cage, and the particular I/O plate used, may differ on frames converted from early version BTSs. Functionally however, and for the purpose of Optimization and ATP, those frames are identical.
- The 4th carrier (BBX10–12) is not supported in a converted SC 4812T MC BTS at this time. An upcoming feature release will address 4th carrier support.

Figure 1-11: Power Amplifier (PA) and BBX Configurations



Notes

Chapter 2

Preliminary Operations

Preliminary Operations: Overview

Introduction

This section first verifies proper frame equipage. This includes verifying module placement, jumper, and dual in–line package (DIP) switch settings against the site-specific documentation supplied for each BTS application. Next, pre-power up and initial power-up procedures are presented.

Cell Site Types

Sites are configured as Omni with a maximum of 4 carriers, 3–sectored with a maximum of 4 carriers, and 6–sectored with a maximum of 2 carriers. Each type has unique characteristics and must be optimized accordingly. For more information on the differences in site types, please refer to the *1X SC 4812T-MC BTS Hardware Installation* manual.

CDF/NECF

The Configuration Data File (CDF) or Network Element Configuration File (NECF) contains site type and equipage data information and passes it directly to the LMF during optimization. The number of modem frames, C–CCP shelves, BBX boards, MCC boards (per cage), and linear power amplifier assignments are some of the equipage data included in the CDF/NECF.

CAUTION	Be sure that the correct **bts–#.cdf** and **cbsc–#.cdf** files are used for the BTS. These should be the CDF/NECF files that are provided for the BTS by the CBSC. Failure to use the correct CDF/NECF files can cause system errors.. **Failure to use the correct CDF/NECF files to log into a live (traffic carrying) site can shut down the site.**

Site Equipage Verification

Review the site documentation. Match the site engineering equipage data to the actual boards and modules shipped to the site. Physically inspect and verify the equipment provided for the BTS or Modem frame and ancillary equipment frame.

CAUTION	Always wear a conductive, high impedance wrist strap while handling any circuit card/module to prevent damage by ESD. After removal, the card/module should be placed on a conductive surface or back into the anti–static shipping bag.

Initial Installation of Boards/Modules

Follow the procedure in Table 2-1 to verify the initial installation of boards/modules.

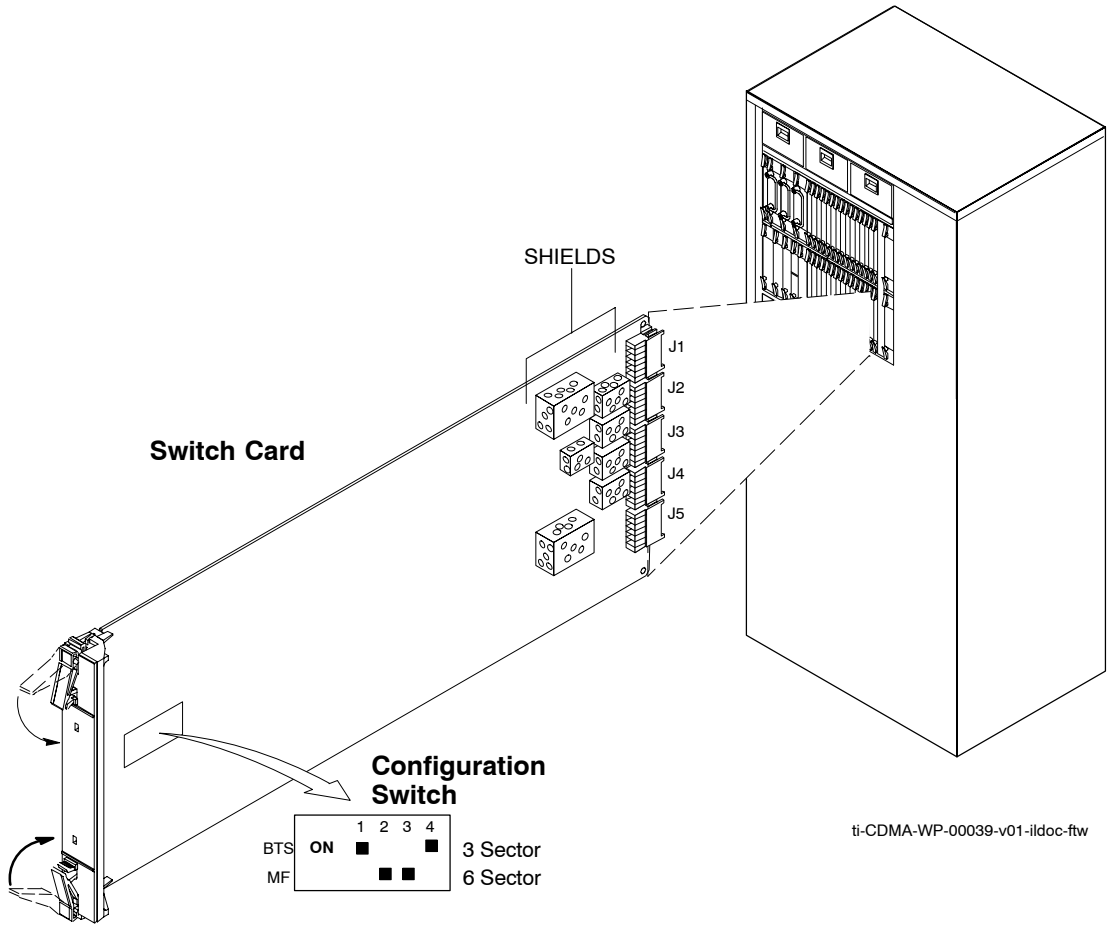
Table 2-1: Initial Installation of Boards/Modules

Step	Action
1	Refer to the site documentation and install all boards and modules into the appropriate shelves as required. **Verify they are NOT SEATED at this time.** **NOTE** The Switch Card has a configuration switch that must match the site configuration (see Figure 2-1).
2	As the actual site hardware is installed, record the serial number of each module on a "Serial Number Checklist" in the site logbook.

NOTE Configuration Switch in Figure 2-1 shown for 3 Sector Multicarrier BTS. (Switches 1 and 4 control configuration.)

For Multicarrier, switch 1 should be Down; switch 4 depends on whether the frame supports 3 or 6 sector.

Figure 2-1: Switch Card



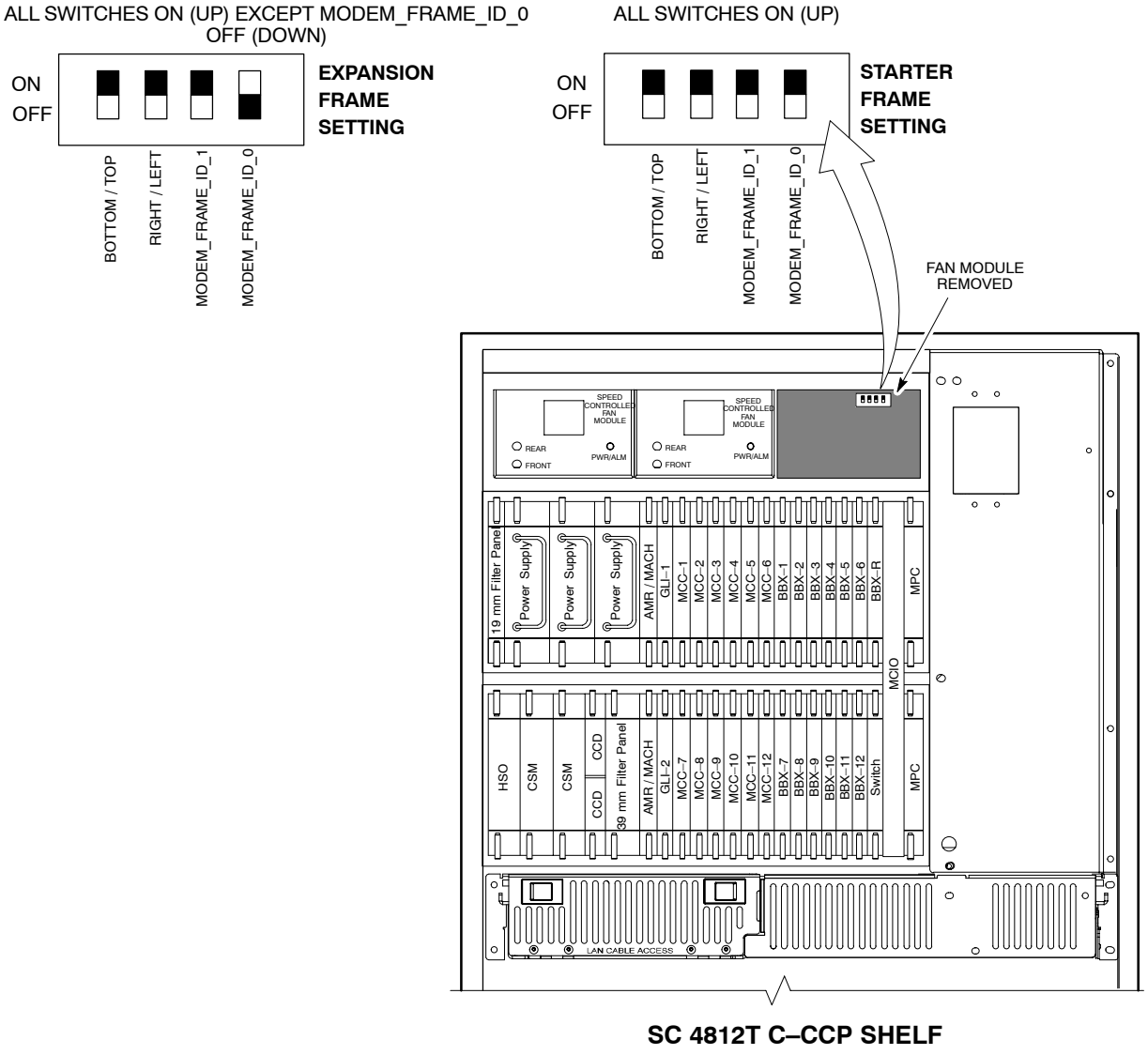
Setting Frame C–CCP Shelf Configuration Switch

The backplane switch settings behind the fan module nearest the breaker panel should be set as shown in Figure 2-2.

The switch setting must be verified and set before power is applied to the BTS equipment.

- Starter Frame – all dip switches set to ON (UP)
- Expansion Frame – all dip switches ON (UP) except MODEM_FRAME_ID_0 OFF (DOWN)

Figure 2-2: Backplane DIP Switch Settings



SC 4812T C–CCP SHELF

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Pre–Power–up Tests

Objective

This procedure checks for any electrical short circuits and verifies the operation and tolerances of the cellsite and BTS power supply units prior to applying power for the first time.

Test Equipment

The following test equipment is required to complete the pre–power–up tests:

- Digital Multimeter (DMM)

CAUTION	Always wear a conductive, high impedance wrist strap while handling the any circuit card/module to prevent damage by ESD.

Cabling Inspection

Using the site-specific documentation generated by Motorola Systems Engineering, verify that the following cable systems are properly connected:

- Receive RF cabling – up to 12 RX cables
- Transmit RF cabling – up to six TX cables
- GPS

DC Power Pre-test (BTS Frame)

Before applying any power to the BTS frame, follow the procedure in Table 2-2 while referring to Figure 2-3 to verify there are no shorts in the BTS frame DC distribution system.

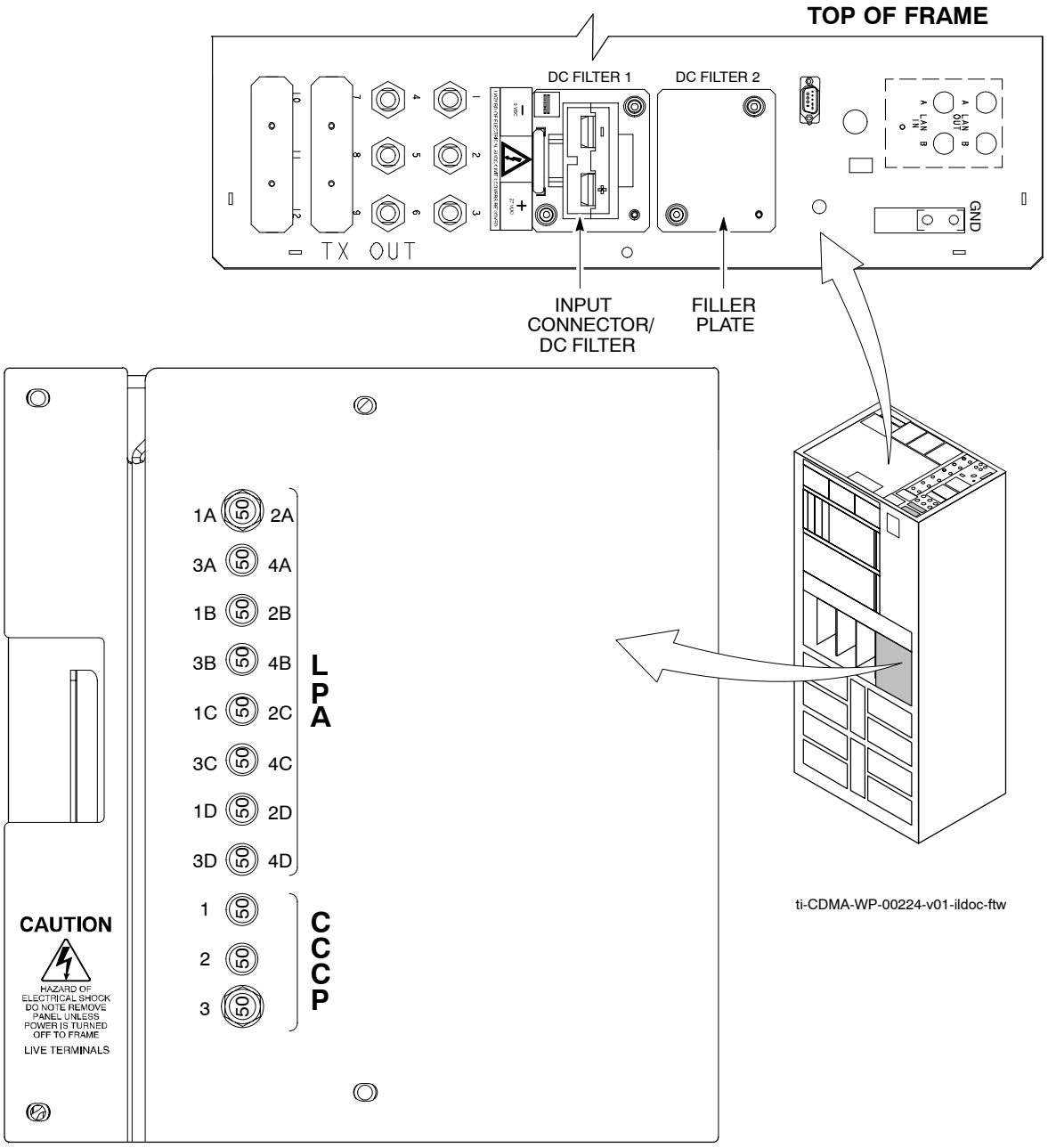
Table 2-2: DC Power Pre–test (BTS Frame)

Step	Action
1	*Physically verify* that all DC power sources supplying power to the frame are **OFF** or disabled.
2	*On each frame:* • *Unseat* all circuit boards (except CCD and CIO cards) in the C–CCP shelf and LPA shelves, but leave them in their associated slots. • Set C–CCP shelf breakers to the **OFF** position by *pulling out* power distribution breakers (labeled **C–CCP 1, 2, 3**) located on the power distribution panel. • Set LPA breakers to the **OFF** position by *pulling out* the LPA breakers (8 breakers, labeled **1A–1B** through **4C–4D**) located on the power distribution panel. Continue with Step 3 for –48 V or Step 4 for +27 V.
3	***For –48 V configurations ONLY:*** Verify the resistance on the –48 V bus: – Remove the Power Supply Modules (PSMs). – Verify that the resistance from the power (–) feed terminal with respect to the ground terminal on the top of the frame measures **≥ 500 Ω** (see Figure 2-3). Verify the resistance on the +27 V bus: – Remove PSM#1 or the filler panel.
	! CAUTION Do not put probes inside *Elcon* connectors. – Place the Digital Multimeter probes on the mounting screws on the Elcon connector (bottom two Elcon connectors). – If reading is **< 500** Ω, a short may exist somewhere in the DC distribution path supplied by the breaker. Isolate the problem before proceeding. A reading **> 3 MΩ** could indicate an open (or missing) bleeder resistor (installed across the filter capacitors behind the breaker panel).
4	***For +27 V configurations ONLY:*** Verify that the resistance from the power (+ or –) feed terminals with respect to the ground terminal on the top of the frame measures **≥ 500 Ω** (see Figure 2-3). – If reading is **< 500** Ω, a short may exist somewhere in the DC distribution path supplied by the breaker. Isolate the problem before proceeding. A reading **> 3 MΩ** could indicate an open (or missing) bleeder resistor (installed across the filter capacitors behind the breaker panel).
5	Set the **C–CCP** breakers to the **ON** position by pushing them IN *one at a time*. Repeat Step 3 (for –48 V) or Step 4 (for +27 V) after turning on each breaker. **NOTE** If the multimeter stays at **0 Ω** after inserting any board/module, a short probably exists in that board/module. Replace the suspect board/module and repeat the test. If test still fails, isolate the problem before proceeding.

. . . continued on next page

Table 2-2: DC Power Pre–test (BTS Frame)	
Step	**Action**
6	Insert and lock the DC/DC converter modules for the C–CCP shelf and into their associated slots *one at a time*. Repeat Step 3 (for –48 V) or Step 4 (for +27 V) after inserting each module. – A typical response is that the ohmmeter steadily climbs in resistance as capacitors charge, finally indicating approximately **500** Ω.
	! CAUTION Verify the correct power/converter modules by observing the locking/retracting tabs appear as follows: STPN4009B PWR C–CCP 4812 +27V
7	Insert and lock all remaining circuit boards and modules into their associated slots in the C–CCP shelf. Repeat Step 3 (for –48 V) or Step 4 (for +27 V) after inserting and locking each board or module. – A typical response is that the ohmmeter steadily climbs in resistance as capacitors charge, stopping at approximately **500** Ω.
8	Set the **LPA** breakers **ON** by pushing them in. Repeat Step 3 (for –48 V) or Step 4 (for +27 V) after turning on each breaker. – A typical response is that the ohmmeter will steadily climb in resistance as capacitors charge, stopping at approximately **500** Ω.
	NOTE Engage circuit breakers only for LPAs that are equipped.
9	In the –48V BTS, insert PSMs one at a time in their associated slots, verifying that LED is green. Repeat Step 3 after inserting each module.
10	Seat all LPA and associated LPA fan modules into their associated slots in the shelves *one at a time*. Repeat Step 3 (for –48 V) or Step 4 (for +27 V) after seating each LPA and associated LPA fan module. • A typical response is that the ohmmeter will steadily climb in resistance as capacitors charge, stopping at approximately **500** Ω.

Figure 2-3: Breaker Panel – 27 V shown (–48 V is Similar)



Initial Power–up Tests and Procedures

Power-up Procedures

WARNING	Potentially lethal voltage and current levels are routed to the BTS equipment. This test must be performed with a second person present, acting in a safety role. Remove all rings, jewelry, and wrist watches prior to beginning this test.

DC Input Power

In the tests to follow, power will first be verified at the input to each BTS frame. After power is verified, cards and modules within the frame itself will be powered up and verified one at a time.

Before applying any power, verify the correct power feed and return cables are connected between the power supply breakers and the power connectors at the top of each BTS frame. Verify correct cable position referring to Figure 2-3 on page 2-8.

NOTE

For positive power applications (+27 V):

- The positive power cable is red.
- The negative power cable is black.

For negative power applications (–48 V):

- The negative power cable is red or blue.
- The positive power cable (ground) is black.

Motorola recommends that the DC input power cable used to connect the frame to the main DC power source conforms to the guidelines outlined in Table 2-3.

Table 2-3: DC Input Power Cable Guidelines

Maximum Cable Length	Wire Size
30.38 m (100 ft)	107 mm^2 (AWG #4/0)
54.864 m (180 ft)	185 mm^2 (350 kcmil)
Greater that 54.864 m (180 ft)	Not recommended

NOTE Make sure the connector adapters are securely attached to each of the BTS power feeds and returns. Also, make sure the cables have been properly installed into each connector.

Common Power Supply Verification

The procedure in Table 2-4 must be performed on any BTS frame connected to a common power supply at the site *after the common power supply has been installed and verified per the power supply OEM suggested procedures.*

Perform the following steps to verify the power input is within specification *before* powering up the individual cards/modules with the frames themselves.

CAUTION	**While handling any circuit card/module, always wear a conductive, high impedance wrist strap to prevent damage by ESD**. Extreme care should be taken during the removal and installation of any card/module. After removal, the card/module should be placed on a conductive surface or back into the anti–static bag in which it was shipped.

Table 2-4: Common Power Supply Verification

Step	Action
1	Physically verify that all DC power sources supplying the frame are **OFF** or disabled.
2	*On each frame:* • *Unseat* all circuit boards (except CCD and CIO cards) in the C–CCP shelf and LPA shelves, but leave them in their associated slots. • Set breakers to the **OFF** position by *pulling out* C–CCP and LPA breakers (see Figure 2-3 for breaker panel layout if required). – C–CCP shelf breakers are labeled **CCCP–1**, **2**, **3**. – LPA breakers are labeled **1A–1B** through **4C–4D.**
3	*On –48 V BTS:* Remove the –48 V to +27 V Power Supply Modules.
4	Inspect input cables, verify correct input power polarity via decal on top of frame.
5	Apply power to BTS frames, *one at a time*, by setting the appropriate breaker in the power supply that supplies the frame to the **ON** position.
6	After power is applied to each frame, use a digital voltmeter to verify power supply output voltages at the top of each BTS frame are within specifications: *On –48 V BTS:* **–48 Vdc nominal** *On +27 V BTS:* **+27 Vdc nominal**
7	*On –48 V BTS:* Plug in PSMs one at a time and verify 'Green' LEDs on PSMs light.

Initial Power-up (BTS)

The procedure must be performed on each frame after input power from the common power supply has been verified. Follow the steps in Table 2-5 to apply initial power to the cards/modules within the frame itself, verifying that each is operating within specification.

Table 2-5: Initial Power–up (BTS)

Step	Action
1	At the BTS, set the C–CCP (POWER) power distribution breakers (see Figure 2-3 on page 2-8) to the **ON** position by *pushing in* the breakers.
2	Insert the C–CCP fan modules. Observe that the fan modules come on line.
3	**! CAUTION** Verify the correct C–CCP power supplies by observing the locking/retracting tabs appear as follows: STPN 4009B PWR C–CCP 4812 +27V Insert and lock the power supplies into their associated slots *one at a time*. • If no boards have been inserted, all three **PWR/ALM** LEDs would indicate RED to notify the user that there is no load on the power supplies. – If the LED is RED, do not be alarmed. After Step 4 is performed, the LEDs should turn GREEN; if not, then a faulty power supply is indicated and should be replaced *before proceeding*.
4	Seat and lock all remaining circuit cards and modules in the C–CCP shelf into their associated slots.
5	Seat the first equipped PA module pair into the assigned slot in the upper PA shelf including PA fan.
6	Repeat Step 5 for all remaining PAs. **NOTE** Engage circuit breakers only for PAs that are equipped.
7	Set the PA breakers to the ON position *(per configuration*) by pushing them IN. See Figure 2-3 for breaker panel layout. Engage (push) PA circuit breakers. • Confirm LEDs on PAs light.
8	After all cards/modules have been seated and verified, use a digital voltmeter to verify power supply output voltages at the top of the frame remain within specifications: *On –48 V BTS:* **–48 Vdc nominal** *On +27 V BTS:* **+27 Vdc nominal**
9	Repeat Steps 1 through 8 for additional co–located frames (if equipped).