LPA50/LPA100

50/100W LINEAR POWER AMPLIFIER

System Manual

CA44–VER05

(Replaces CA44-VER04)

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Printed December 2003

LPA50/ LPA100

System Manual

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Changes Since the Last Publication

Change bars, like the ones in the left margin on this page, (||), are next to new information that may affect the operation of the LPA50/LPA100. Note also that in some cases text and graphics may have flowed to a different page than in the previous publication due to formatting or other changes.

	Chapter Number & Title	Publication Date	Pages with Changes
||	Front Section	**December 2003**	ii, vii
|| 1.	Product Description	**December 2003**	1-5, 6, 9 - 12
2.	Applications and Ordering Information	December 2002	
3.	Installation	December 2002	
|| 4.	Test Equipment	**December 2003**	4-1
5.	Initial Adjustment	December 2002	
6.	Maintenance	December 2002	
7.	Power Supply Module	June 2001	
8.	12.5W PA Module	December 2002	
9.	50W Combiner Module	December 2002	
10.	100W Combiner Module	December 2002	

IMPORTANT

We recommend that you become acquainted with the information in this manual before energizing your LPA50 or LPA100. Failure to do so may result in injury to personnel or damage to the equipment, and may affect the equipment warranty. If you mount the LPA chassis in a cabinet, it must be bolted to the floor or otherwise secured before you swing out the equipment, to prevent the installation from tipping over.

You should neither remove nor insert printed circuit modules while the unit is energized. Failure to observe this precaution can cause component damage.

PULSAR does not assume liability arising out of the application or use of any product or circuit described herein. PULSAR reserves the right to make changes to any products herein to improve reliability, function or design. Specifications and information herein are subject to change without notice. All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If you desire further information regarding a particular installation, operation, or maintenance of equipment, please contact your local Pulsar Technologies, Inc. representative.

ESD Warning!

YOU MUST BE PROPERLY GROUNDED, TO PREVENT DAMAGE FROM STATIC ELECTRICITY, BEFORE HANDLING ANY AND ALL MODULES OR EQUIPMENT FROM PULSAR.

*All semiconductor components used, are sensitive to and can be **damaged** by the discharge of static electricity. Be sure to observe all Electrostatic Discharge (ESD) precautions when handling modules or individual components.*

Preface

Scope

This manual describes the functions and features of the LPA50 and LPA100 linear power amplifiers.

It is intended primarily for use by engineers and technicians involved in the installation, alignment, operation, and maintenance of the LPA50/LPA100.

Equipment Identification

The LPA50/LPA100 equipment is identified by the Catalog Number on the chassis nameplate. You can decode the Catalog Number using Tables 2-1 and 2-2 (see Chapter 2).

Production Changes

When engineering and production changes are made to the LPA50/LPA100 equipment, a revision notation (Sub number) is reflected on the style number, related schematic diagram, and associated parts information. A summary of all Sub numbers for the particular release is shown on the following page.

Warranty

Our standard warranty extends for 60 months after shipment. For all repaired modules or advance replacements, the standard warranty is 90 days or the remaining warranty time, whichever is longer. Damage clearly caused by improper application, repair, or handling of the equipment will void the warranty.

Equipment Return & Repair Procedure

To return equipment for repair or replacement:

1. Call your PULSAR representative at **1–800–785–7274**.
2. Request an **RMA number** for proper authorization and credit.
3. Carefully pack the equipment you are returning.

   Repair work is done most satisfactorily at the factory. When returning any equipment, pack it in the original shipping containers if possible. Be sure to use anti-static material when packing the equipment. Any damage due to improperly packed items will be charged to the customer, even when under warranty.

   Pulsar Technologies, Inc. also makes available interchangeable parts to customers who are equipped to do repair work. When ordering parts (components, modules, etc.), always give the complete PULSAR style number(s).
4. Make sure you include your return address and the RMA number on the package.
5. Ship the package(s) to:

   Pulsar Technologies, Inc.
   Communications Division
   4050 NW 121st Avenue
   Coral Springs, FL 33065

Document Overview

The LPA50/LPA100 circuitry is divided into three (3) modules. The power supply and power amplifier modules are the same modules used in the TC-10B/TCF-10B systems. The combiner modules were specially designed for the LPA50/LPA100 system.

Chapter 1 provides the Product Description. Chapter 2 presents applications and related catalog numbers for ordering purposes. The LPA50/LPA100 installation is described in Chapter 3. Chapters 4, 5, and 6 identify test equipment, initial adjustments, and maintenance procedures, respectively. Module circuit descriptions and troubleshooting procedures are in Chapters 7 thru 10.

Contents of LPA50 and LPA100

The LPA50 and LPA100 include the modules and parts listed below. The style number and latest revision level for each module and part is shown, as is the the quantity included with each set. (For ordering information, please see Table 2-1 in Chapter 2.)

Module/Part	Style #	Sub Number (Revision Level)	Quantity per LPA50	Quantity per LPA100
Power Supply	1617C38G01, 2, or 3	2	2	4
12.5W Power Amplifier	1606C33G01	21	4	8
50W Power Combiner	CA20-CMBMN-001 or 003	02	1	2
100W Power Combiner	CA20-CMBMN-002 or 004	02	0	1
19” Chassis	1353D63G04	n/a	1	2
Chassis Front Cover	1606C49G01	n/a	1	2
Interconnecting Cables		n/a	0	1 lot

FIGURES

TABLES

Pulsar
Technologies, Inc.

Chapter 1. Product Description

1.1 General Description

The PULSAR Linear Power Amplifier (LPA) comes in two versions:

1) The LPA50 (with a 50 W output)
2) The LPA100 (with a 100 W output)

Both are class A amplifiers that put out their rated power of 50 and 100 watts continuously over a frequency range of 30–535 kHz. Both units are designed for inserting between an existing carrier set and the line tuner to boost the normal power output of the carrier system.

1.2 Standard Nomenclature

The standard nomenclature for PULSAR's linear power amplifier equipment is as follows:

Cabinet – contains fixed-racks, swing-racks, or open racks

Rack – contains one or more chassis (e.g., the LPA–100)

Chassis – contains several printed circuit boards, called modules (e.g., Power Supply or Power Amplifier)

Module – contains a number of functional circuits

Circuit – a complete function on a printed circuit board

1.3 LPA50/LPA100 Chassis

As explained in the "LPA50/LPA100 Configurations" section later, there are two possible chassis configurations for the linear power amplifier. All chassis have the following standard dimensions:

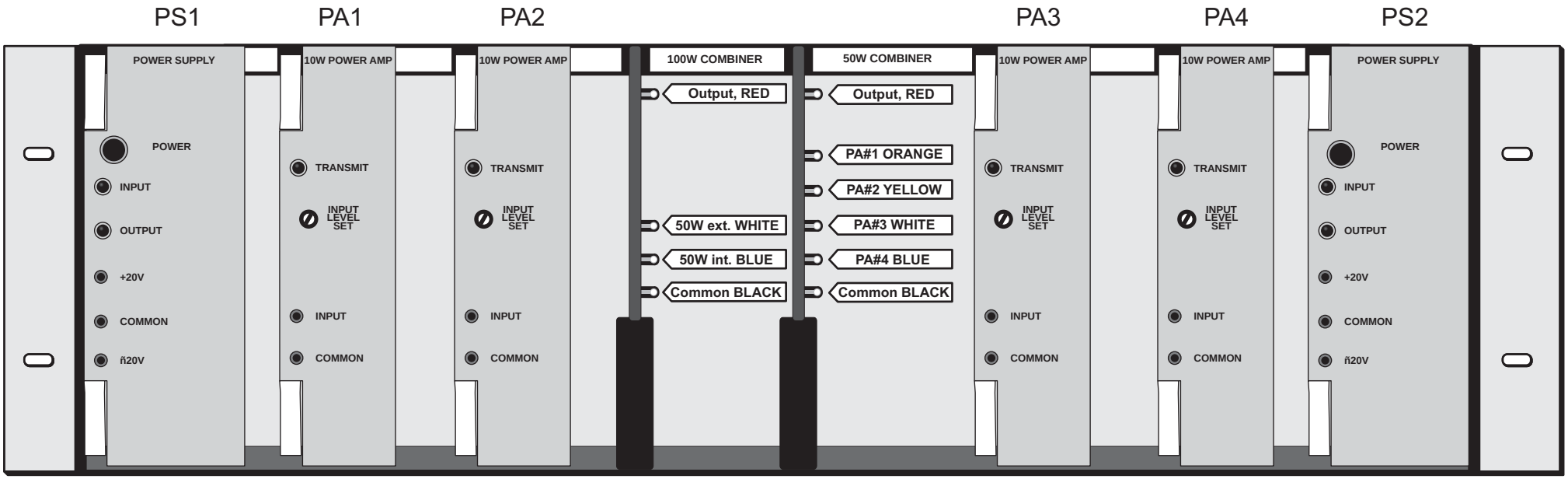
Height – 5.25" (133.35 mm), requiring 3 rack units, each measuring 1.75" (44.45 mm)

Width – 19.00" (482.6 mm)

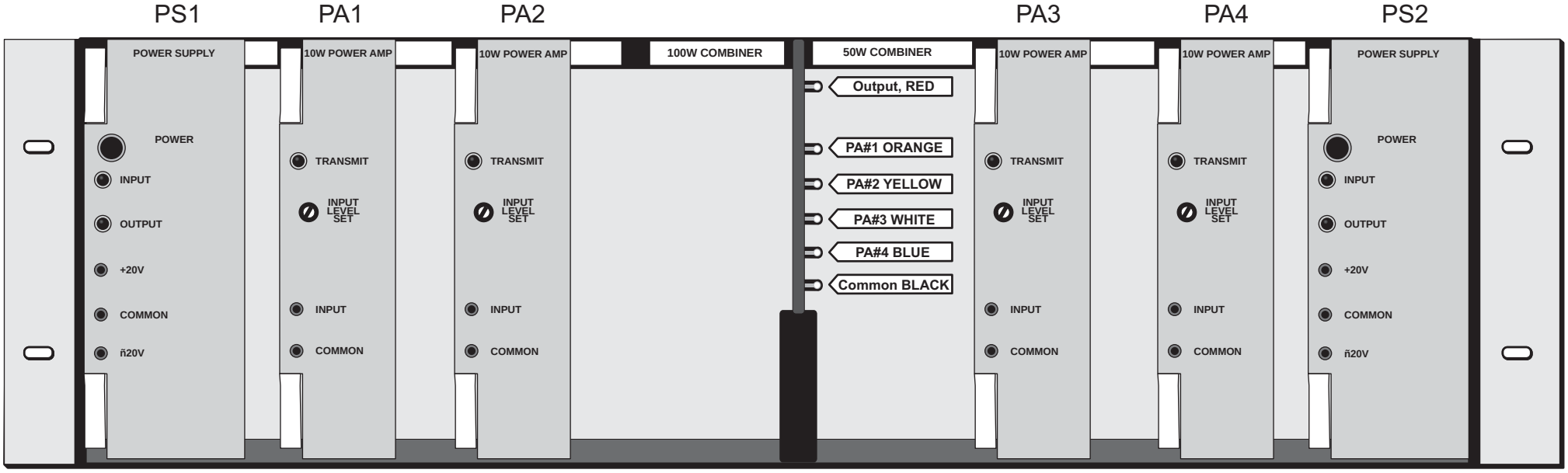
Depth – 13.50" (342.9 mm)

This is the same size chassis used for PULSAR's TC-10B/TCF-10B carrier sets. Each chassis is notched for mounting in a standard relay rack.

Figure 1–1. Front View of the LPA Chassis



LPA100 Chassis 1 of 2



LPA50 Chassis or LPA100 Chassis 2 of 2

1.4 LPA50/LPA100 Modules

The LPA50 and LPA100 functional block diagrams are shown at the end of this chapter . Circuit descriptions, complete with schematic diagrams and parts lists for each module, are shown in Chapters 7 through 10, along with sub numbers indicating the current revisions for each module, as follows:

Chapter	Module	Schematic	Parts List
7.	Power Supply	1617C38-2	1617C38-2
8.	12.5W Power Amplifier	1606C33-21	1606C33-21
9.	50W Combiner	CA30-CMBMN*	CA40-CMBMN*
10.	100W Combiner	CA30-CMBMN*	CA40-CMBMN*

* Differences for each module are noted on document.

1.5 LPA50/LPA100 Configurations

The PULSAR Linear Power Amplifier (LPA) comes in two configurations:

1) The LPA50 (one chassis with a 50 W output)
2) The LPA100 (two chassis with a combined 100 W output)

1.5.1 LPA50 Configuration

The LPA50 comprises one chassis assembly and the following:

- Power Supply Module (2)
- 12.5W Power Amplifier Module (4)
- 50W Combiner Module (1)

The modular layout for the LPA50/LPA100 chassis is shown in Figure 1-1. At each end of the chassis is a Power Supply Module and two 12.5W Power Amplifier Modules. Each Power Supply Module powers the two 12.5W Power Amplifier Modules closest to it. This gives a measure of redundancy such that if you lose one Power Supply Module, the remaining Power Supply Module will still power the other two 12.5W Power Amplifier Modules. The Power Combiner Module is in the center of the chassis. It combines the output from the four Power Amplifier Modules into a single 50 watt output.

The 50W Power Combiner Module is completely passive and thus requires no dc power. It requires equal amplitude and in-phase carrier frequency signals for minimum loss in the combiner circuit. Whatever difference there is between the two signals being combined is dissipated as heat in the high wattage resistors on this module. In normal operation all of the 12.5W Power Amplifier Modules are putting out equal amplitude and in-phase signals, and there is almost zero loss in the combiner circuit.

1.5.2 LPA100 Configuration

The LPA100 comprises two chassis assemblies and the following:

- Power Supply Module (2 in each chassis for a total of 4)
- 12.5W Power Amplifier Module (4 in each chassis for a total of 8)
- 50W Combiner Module (1 in each chassis for a total of 2)
- 100W Combiner Module (1)
- Interconnecting cables (1 lot)

The first LPA100 chassis (1 of 2) has a Power Supply Module and two 12.5W Power Amplifier Modules at each end. In between are both a 50W Power Combiner Module and a 100W Power Combiner Module. The second LPA100 chassis (2 of 2) is just like the LPA50 chassis. It has a Power Supply Module and two 12.5W Power Amplifier Modules at each end and a 50W Combiner Module in the center.

In both chassis, the 50W Power Combiner Module combines the output from the four Power Amplifier Modules into a single 50 watt output. The 100W Power Combiner Module in chassis 1 combines the output from the two 50W Power Combiner Modules into a single 100 watt output. The 50W/100W Power Combiner Modules are completely passive and thus require no dc power. They require equal amplitude and in-phase carrier frequency signals for minimum loss in the combiner circuit. Whatever difference there is between the two signals being combined is dissipated as heat in the high wattage resistors on this module. In normal operation all of the 12.5W Power Amplifier Modules are putting out equal amplitude and in-phase signals, and there is almost zero loss in the combiner circuit.

As with the LPA50, each Power Supply Module in each chassis powers the two 12.5W Power Amplifier Modules closest to it. This gives a measure of redundancy for each chassis such that if you lose one Power Supply Module, the remaining Power Supply Module will still power the other two 12.5W Power Amplifier Modules.

The only difference between the LPA100's two chassis is the addition of the 100W Power Combiner Module in chassis 1 and the backplane jumper settings (see figures at the end of chapter 3)**.**

1.6 LPA50/LPA100 Module Front Panels

The front (control) panel for each module could include the following types of controls:

- Switches
- LEDs
- Meter
- Potentiometers
- Test points

The front panels for the LPA50 chassis and the two LPA100 chassis are the same, except for the 100W Power Combiner Module's test points. This module is only in chassis 1 of 2 of the LPA100.

1.7 LPA50/LPA100 Printed Circuit Boards (PCBs)

A module's printed circuit board (PCB) could include the following types of controls:

- Switches
- Jumpers
- Variable Capacitors
- Potentiometers
- Test Points
- Impedance Matching Jumpers

1.8 LPA50/LPA100 Rear Panel ("Mother Board")

(See Chapter 3 for a description of the Rear Panel.)

1.9 Specifications

The LPA50 and LPA100 meet or exceed all applicable ANSI/IEEE standards. Table 1-1 shows the technical specifications for the LPA50. The technical specifications for the LPA100 are shown in Table 1-2.

Table 1–1. LPA50 Technical Specifications.

Frequency Bandwidth	30kHz–535kHz
Input impedance	50Ω with all four 12.5W Power Amplifiers plugged in
Output impedance	50Ω with all four 12.5W Power Amplifiers plugged in -or- 75Ω (per catalog number)
Maximum power input	10W (+40 dBm, 50Ω reference)
Minimum power input (to get 50 W output)	10mW (+10dBm, 50Ω reference)
Maximum power output	50W continuous single frequency into 50Ω or 75Ω load (+50dBm, 50Ω or 75Ω reference)
Harmonic & spurious noise output	55dB below 50W
Overall power loss for failure of the 12.5W Power Amplifier(s):	
One 12.5W Power Amplifier failure	-2.9dB
Two 12.5W Power Amplifier failures	-6.4dB
Three 12.5W Power Amplifier failures	-12.8dB

Table 1–2. LPA100 Technical Specifications.

Frequency Bandwidth	30kHz–535kHz
Input impedance	25Ω with all eight 12.5W Power Amplifiers plugged in
Output impedance	50Ω or 75Ω (Per Catalog Number) with all eight 12.5W Power Amplifiers plugged in
Maximum power input	10W (+40dBm, 50Ω reference)
Minimum power input (to get 100W output)	10mW (+10dBm, 50Ω reference)
Maximum power output	100W continuous single frequency into 50Ω or 75Ω load (+50dBm, 50Ω or 75Ω reference)
Harmonic & spurious noise output	55dB below 100W
Overall power loss for failure of the 12.5W Power Amplifier(s):	
One 12.5W Power Amplifier failure	-1.1dB
Two 12.5W Power Amplifier failures	-2.5dB
Three 12.5W Power Amplifier failures	-4.1dB
Four 12.5W Power Amplifier failures	-6.0dB
Five 12.5W Power Amplifier failures	-8.5dB
Six 12.5W Power Amplifier failures	-12.0dB
Seven 12.5W Power Amplifier failures	-18.0dB

1.10 Environmental Requirements

This section provides three tables depicting the LPA50/LPA100 environmental requirement specifications, broken down as follows:

- Environmental Requirements (Table 1-3)
- Altitude Dielectric Strength De-Rating for Air Insulation (Table 1-4)
- Altitude Correction For Maximum Temperature Of Cooling Air (ANS C93.5) (Table 1-5)

Table 1–3. Environmental Requirements.

Ambient temperature range	-20 to + 60°C (derated per Table 1-5) of air-contacting equipment
Relative humidity	Up to 95% (non-condensing) at 40°C (for 96 hours cumulative)
Altitude	Up to 1,500m (without derating) Up to 6,000m (using Table 1-4 and Table 1-5)
Transient withstand capability	All external user interfaces meet SWC specifications of ANS C37.90.1 (1989)
1-minute withstand	Only isolated inputs and outputs, and all alarms: 2,500 Vdc from each terminal to ground, derated per Table 1-4.
Center conductor of coaxial	3,000Vdc impulse level, cable to ground using 1.2 x 50 cable to ground msec impulse
Electro-Magnetic Interface Capability	IEEE Standard ANS C37.90.2

Table 1–4.
Altitude Dielectric Strength
De-Rating for Air Insulation

Altitude (Meters)	Correction Factor
1,500	1.00
1,800	0.97
2,100	0.94
2,400	0.91
2,700	0.87
3,000	0.83
3,600	0.79
4,200	0.74
4,800	0.69
5,400	0.64
6,000	0.59

Table 1–5.
Altitude Correction For Maximum
Temperature Of Cooling Air (ANS C93.5)

		Temperatures (Degrees C)		
Altitude (Meters)		Short-Time	Long-Time	Difference From Usual
Usual	1,500	55	40	—
Unusual	2,000	53	38	2
Unusual	3,000	48	33	7
Unusual	4,000	43	28	12

1.11 Power Requirements and Dimensions

The power requirement specifications for the LPA50 are shown in Table 1–6.

Table 1–7 shows the power requirement specifications for the LPA100.

The weight and dimensions for the LPA50 & LPA100 are shown in Table 1–8.

Table 1–6.
LPA50 Power Requirement Specifications

LPA50		**Max Supply Current (Amps) at Nominal Voltage**		
Nominal Battery Voltage	Permissable Voltage Range	Standby	10 Watt Transmit	100 Watt Transmit
48/60Vdc	38–70Vdc	1.25A	2.0A	5.0A
110/125Vdc	88–140Vdc	0.5A	0.75A	1.75A
220/250Vdc	176–280Vdc	0.25A	0.4A	1.0A

Table 1–7
LPA100 Power Requirement Specifications

LPA100		**Max Supply Current (Amps) at Nominal Voltage**		
Nominal Battery Voltage	Permissable Voltage Range	Standby	10 Watt Transmit	100 Watt Transmit
48/60Vdc	38–70Vdc	2.5A	4.0A	10.0A
110/125Vdc	88–140Vdc	1.0A	1.5A	3.5A
220/250Vdc	176–280Vdc	0.5A	0.75A	1.75A

Table 1–8 LPA Weight and Dimension Specifications.

Equipment	**Net Weight**		**Height**		**Width**		**Depth**		**Rack Space**
	lbs	**Kg**	**inches**	**mm**	**inches**	**mm**	**inches**	**mm**	
LPA50	21	9.53	5.25	133.4	19.00	482.6	13.50	342.9	3 RU
LPA100	42	21	10.50	266.8	19.00	482.6	13.50	342.9	6 RU

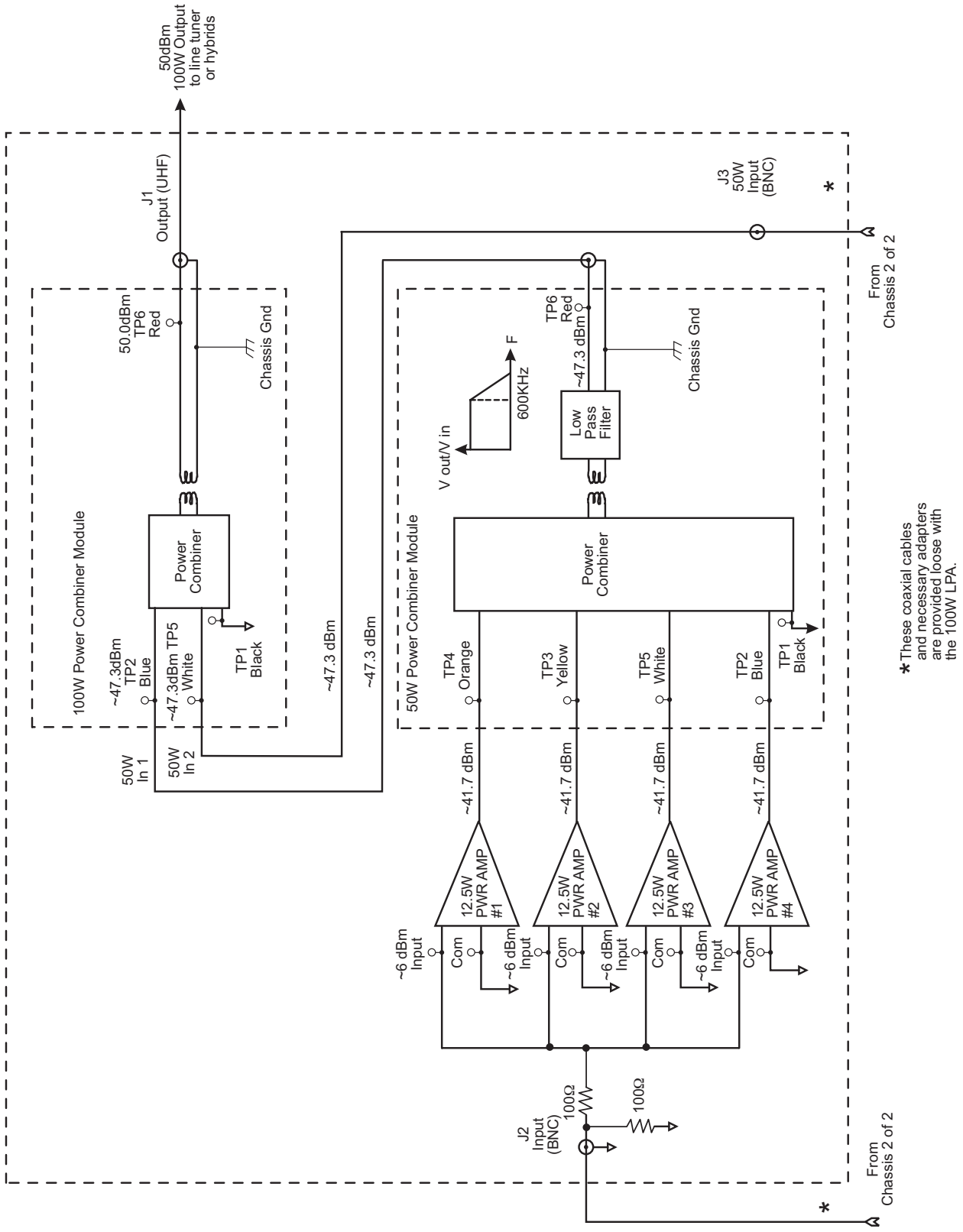


Figure 1–2. LPA100 Functional Diagram (1 of 2)

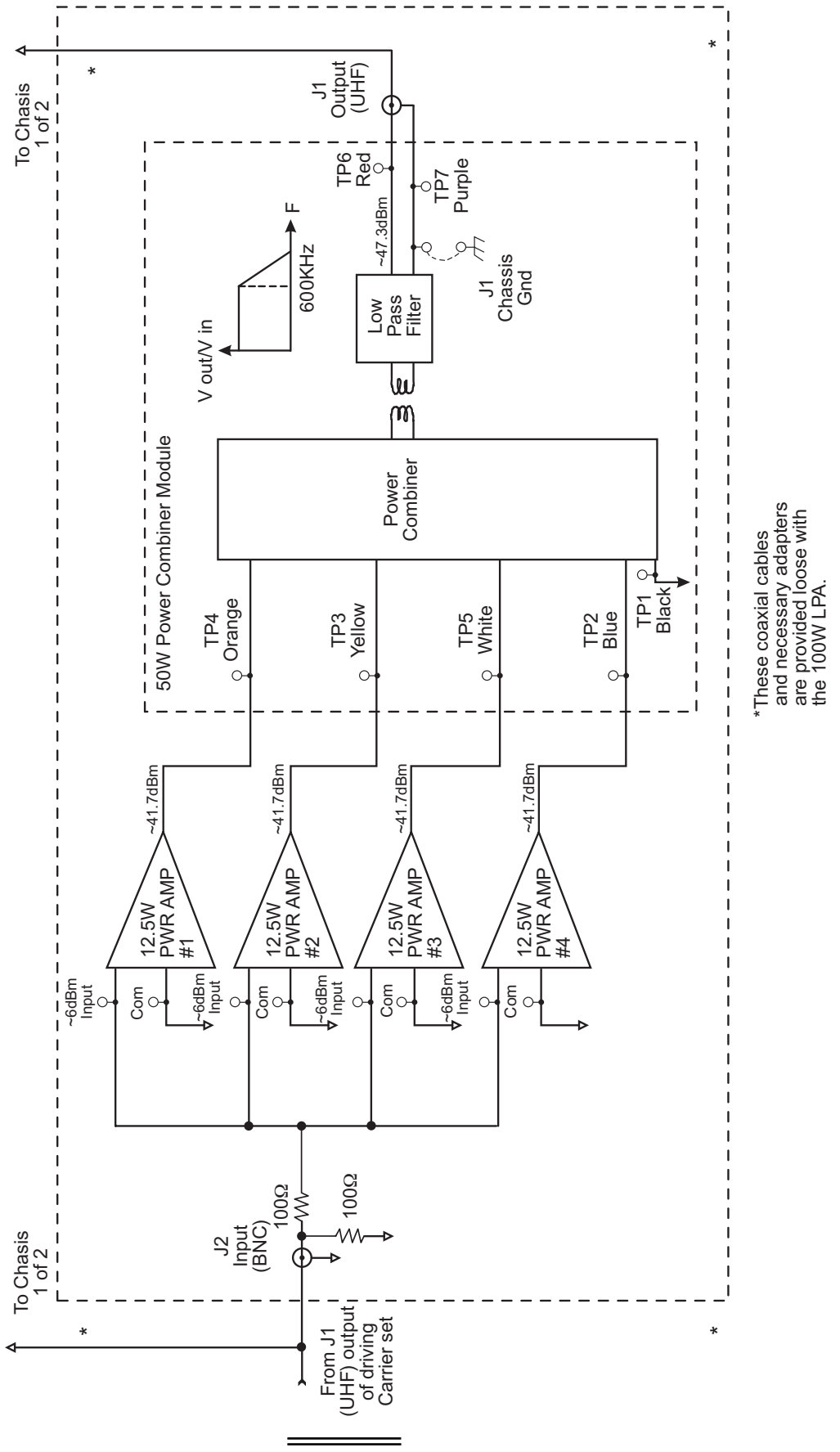


Figure 1–3. LPA100 Functional Diagram (2 of 2)

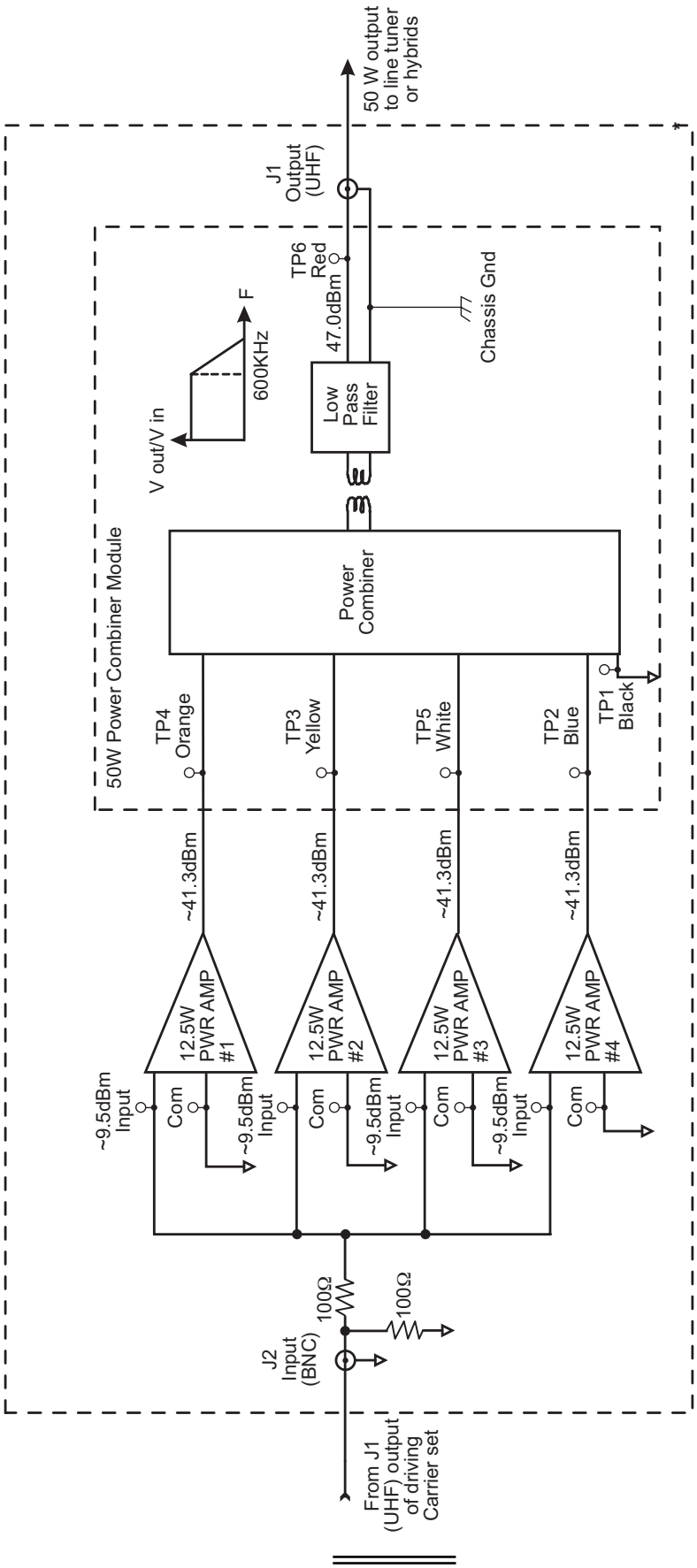


Figure 1–4. LPA50 Functional Diagram

Chapter 2. Applications and Ordering Information

2.1 LPA50/LPA100 Applications

The LPA50 and LPA100 are used in applications where the losses between the transmitting and receiving carrier sets are greater than a 10W system can handle. Usually this is due to high loss on the power line because of an extremely long line, underground cable, or a combination of underground cable and overhead lines.

We recommend that before applying a high power linear power amplifier (LPA), you do a thorough analysis of the expected power line loss, including all tuners, hybrids, coupling capacitors, etc. You can often decrease total loss in a system by properly tuning the line, using the optimum hybrids for the application, removing any unnecessary attenuators in carrier receiver sets, and selecting the proper carrier frequency. Using the lowest possible carrier frequency (generally 30-50kHz) is especially important on underground cables, as their loss significantly increases at the higher frequencies.

When applying high power LPAs, you must treat the following three types of systems differently:

- Directional Comparison Blocking systems
- Phase Comparison Blocking systems
- Systems using frequency shift carrier sets

2.1.1 Directional Comparison Blocking systems

For Directional Comparison Blocking systems, where the receiver can hear its own transmitter without any problems, you do not need to connect hybrids between the output of the LPA and the local receiver. Also, you should bridge the receiver of the local carrier set directly to the output of the LPA. See Figure 2-1. You can only bridge the carrier receiver across the output of the LPA100 if it is capable of sustaining 70.7 Vrms, 50Ω reference or 86.6Vrms 75Ω reference across its input without saturating. When using a TC-10B in a blocking system, you should set up the TC-10B for 4-wire operation (separate transmit and receive paths) and set the receiver sensitivity jumper to NORM. This means that on the RF Interface Module you would set JU1 and JU5 in the OUT position to give 4-wire operation and JU6 to NORM to give 13 dB of attenuation to the incoming local transmit signal.

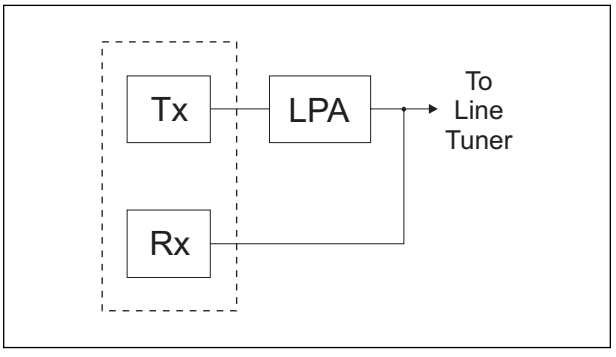


Fig. 2–1. TC-10B with LPA RF connections.

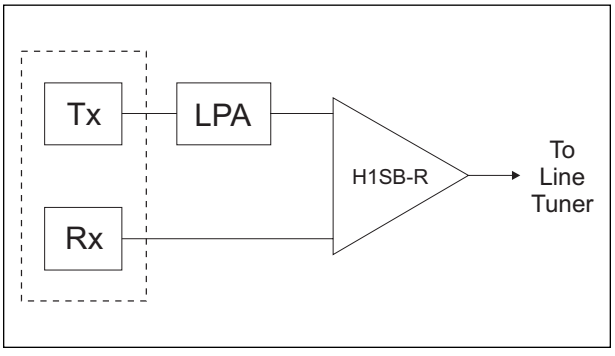


Fig. 2–2. TC-10B (Analog Receiver) or TCF-10B RF connections.

2.1.2 Phase Comparison Blocking and systems using frequency shift carrier sets

For Phase Comparison Blocking Systems that have the analog receiver, a skewed hybrid (H1SB-R or equivalent) must be used on the output of the LPA to prevent the local receiver from being over-driven. See Figure 2-2. Having two separate modules, one for the receiver and one for the detector/CLI will identify the analog receiver. The RF interface will need to be set for 4-wire operation by putting JU1 and JU5 in the OUT position. The receiver may need to be set to HIGH SENSITIVITY (JU6) if the system requires more signal strength.

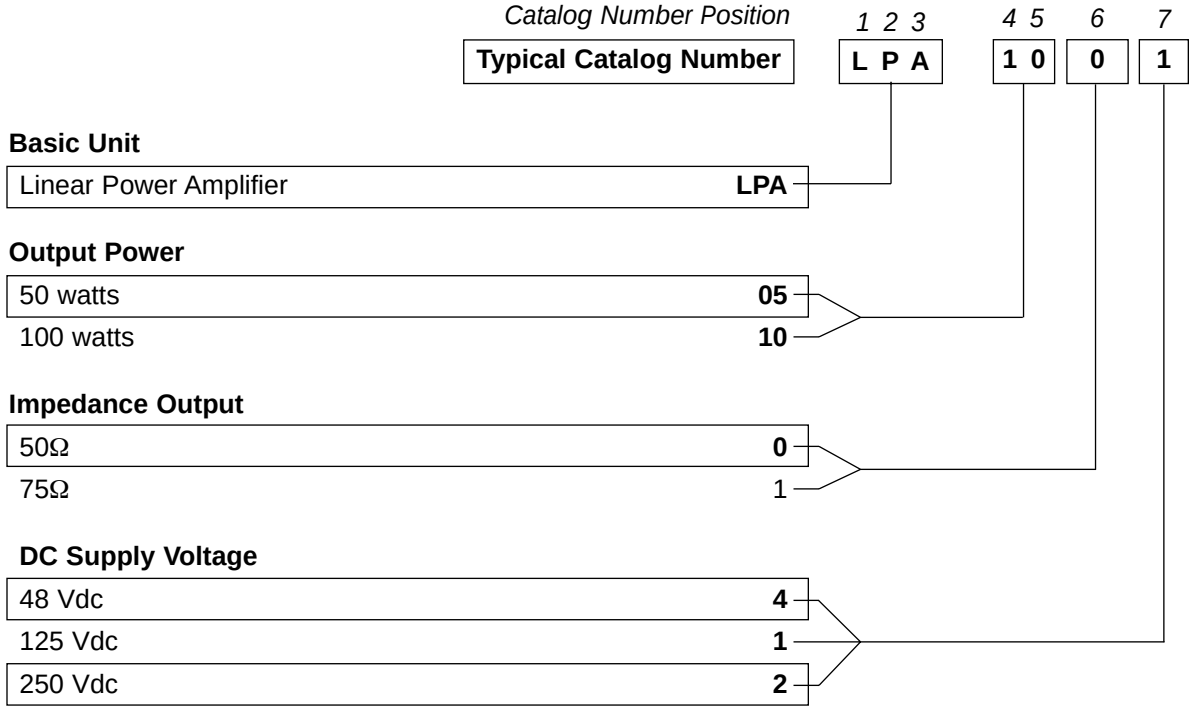
For systems using frequency shift carrier sets, a Skewed Hybrid (H1SB-R or equivalent) must be used between the output of the LPA and the input of the receiver, to prevent intermodulation. The RF Interface Module of the TCF-10B must be set for 4-wire operation by putting JU1 and JU5 in the OUT position.

2.2 Ordering Information

The LPA50/LPA100 equipment identification number (catalog number) is located on the left, front inner side of the chassis. The LPA50/ LPA100 catalog number comprises seven (7) characters, each in a specific position. This number tells you whether the chassis is a stand-alone LPA50 or one of the two chassis for an LPA100. It also identifies the type of DC power supply for the chassis and the output impedance, 50 or 75Ω.

Table 2-1 provides a complete listing of the options for ordering an LPA50 or LPA100 assembly, as well as a sample catalog number. To order one or more LPA50 or LPA100 assemblies, simply identify the output power, DC voltage supply and output impedance you want for each assembly. For example, the typical catalog number shown in Table 2-1 —L P A 1 0 0 1 — orders an LPA100 assembly with a 125 Vdc power supply, 50Ω output.

Table 2–1. LPA50/LPA100 Catalog Numbers.



In addition to the catalog number identifying a complete LPA50/LPA100 assembly, each module and chassis component has its own style number. You can use this style number to order individual modules and chassis components. A complete listing of the LPA50/LPA100 style numbers is provided in Table 2-2.

*Table 2–2. LPA50/LPA100 Module and Chassis Style Numbers. **

Part Type	Module / Item Description	Style Number	Quantity per LPA50	Quantity per LPA100
Module	Power Supply Module – 48Vdc	1617C38G01	2	4
Module	Power Supply Module – 125Vdc	1617C38G02	2	4
Module	Power Supply Module – 250Vdc	1617C38G03	2	4
Module	12.5W Power Amplifier (PA) Module	1606C33G01	4	8
Module	50W Power Combiner module, 50Ω	CA20-CMBMN-001	1	2
Module	50W Power Combiner module, 75Ω	CA20-CMBMN-003	1	2
Module	100W Power Combiner module, 50Ω	CA20-CMBMN-002	0	1
Module	100W Power Combiner module, 75Ω	CA20-CMBMN-004	0	1
Chassis	LPA50/LPA100 Chassis Assembly	1353D63G04	1	2
Cover	Lexan cover / LPA50/LPA100 Chassis	1606C49G01	1	2
Cables	Interconnecting cables / LPA100 Chassis	N/A	0	1 lot

** Only one type of Power Supply Module, 50W Power Combiner and 100W Power Combiner is needed for each LPA. Choose the appropriate voltage and impedance.*

USER NOTES

Chapter 3. Installation

3.1 Installing Your New LPA50/LPA100

Installing your LPA50 or LPA100 is a three-step process:

1. Unpack and check all components
2. Assemble and mount the chassis
3. Connect your equipment and dc power source to the chassis backplane

3.1.1 Unpacking & Inspecting

The LPA50 and LPA100 are shipped with each chassis in its own box. Special inserts are used to protect the equipment from damage.

Whether you are planning to install the unit immediately or place it into storage, you should unpack the box(es) and check to make sure all parts are present and undamaged.

⚠ CAUTION

UNPACK EACH PIECE OF EQUIPMENT CAREFULLY SO THAT NO PARTS ARE LOST. INSPECT THE CONDITION OF THE LPA50/LPA100 AS YOU REMOVE IT FROM ITS CARTON(S). YOU MUST REPORT ANY DAMAGED EQUIPMENT TO THE CARRIER. DAMAGES ARE THE RESPONSIBILITY OF THE CARRIER, AND ALL DAMAGE CLAIMS ARE MADE GOOD BY THE CARRIER. PLEASE SEND A COPY OF ANY CLAIM TO PULSAR TECHNOLOGIES, INC.

Each chassis has an identifying label inside the left front. The label tells you whether the chassis is a standalone LPA50 or one of the two chassis for an LPA100. If it is one of the LPA100 chassis, the label tells you whether it is chassis 1 (of 2) or chassis 2 (of 2).

Each chassis also has a serial number located on the outside on the right side of the chassis. Because the input level potentiometers on the 12.5W Power Amplifier modules are factory set for a particular chassis, the front panel access to these potentiometers is covered with a label that also has the chassis serial number on it. You should not switch these (12.5W PA) modules between chassis without checking their levels as discussed in the calibration instructions in Chapter 5.

Storage

If you are setting the equipment aside before use, be sure to store it in its special cartons (in a moisture-free area) away from dust and other foreign matter.

Installation Location

Install your LPA50/LPA100 in an area which is free from:

- Temperature exceeding environmental limits (See “Environmental Requirements” in Chapter 1)
- Corrosive fumes
- Dust
- Vibration

3.1.2 Assembling & Mounting

Both the LPA50 and LPA100 chassis come to you already assembled. They are ready to mount when you take them out of the carton. If you ordered an LPA100, one of the boxes also contains the cables for connecting the two chassis and a coaxial “T” connector (see “Rear Panel Connections” later in this chapter).

You can mount your LPA50/LPA100 in any of the following configurations:

- Mounted in a fixed-rack cabinet.
- Mounted in a swing-rack cabinet
- Mounted on an open rack.

or in your own, customer-specified configuration.

⚠ CAUTION

IF YOU ARE MOUNTING YOUR LPA50/LPA100 IN A SWING-RACK CABINET, MAKE SURE THAT THE CABINET IS FIRMLY FASTENED BEFORE OPENING THE RACK (TO PREVENT TIPPING).

To mount your chassis, refer to Figures 3-1 and 3-2 for chassis dimensions and mounting measurements. Figure 3-1 shows a mechanical outline drawing of the LPA50/LPA100 chassis from an overhead view. Figure 3-2 shows the "footprint" measurements.

Both the LPA50 and LPA100 chassis can be rack mounted and have standard-spaced mounting holes (see Figure 3-2). Because of the heat produced by the LPA100 and LPA50, and also to allow for better air circulation around the chassis, we recommend that you always mount them at the top of a rack or panel. If space isn't a problem it is best to leave one (1) rack unit (R.U.) of space, i.e., 1.75" (44.45 mm) directly beneath and above the chassis. For the LPA100, you ***must*** leave 1 R.U. of space between its two chassis.

3.1.3 Rear Panel Connections

The LPA50 and LPA100 rear panel connections are shown at the end of this chapter.

You can make all necessary connections to the LPA50/100 chassis via the backplane, or rear panel. For the LPA50 connections, these include:

- Terminal block connections
- Coaxial cables
- Jumper

All connections are made via the backplane terminal block (TB1) and the 3 coaxial connectors (J1,J2, & J3) per the connection diagram. For the dc input, #14 AWG wire is recommended with #20 AWG being sufficient for the alarm connections. Normal current drain for 125Vdc is between 1.5–2.5 A per chassis. The jumper settings to the system are shown on the connection diagram and module alarm jumpers may be changed to normally open if desired. The one backplane jumper must be in either the JU1 position (if the chassis contains a 100W Combiner module) or the JU2 position (if the chassis doesn't contain a 100W Combiner module). For the LPA50 only the backplane jumper JU2 would be on the board. The backplane jumper is factory set but can be changed if the application changes.

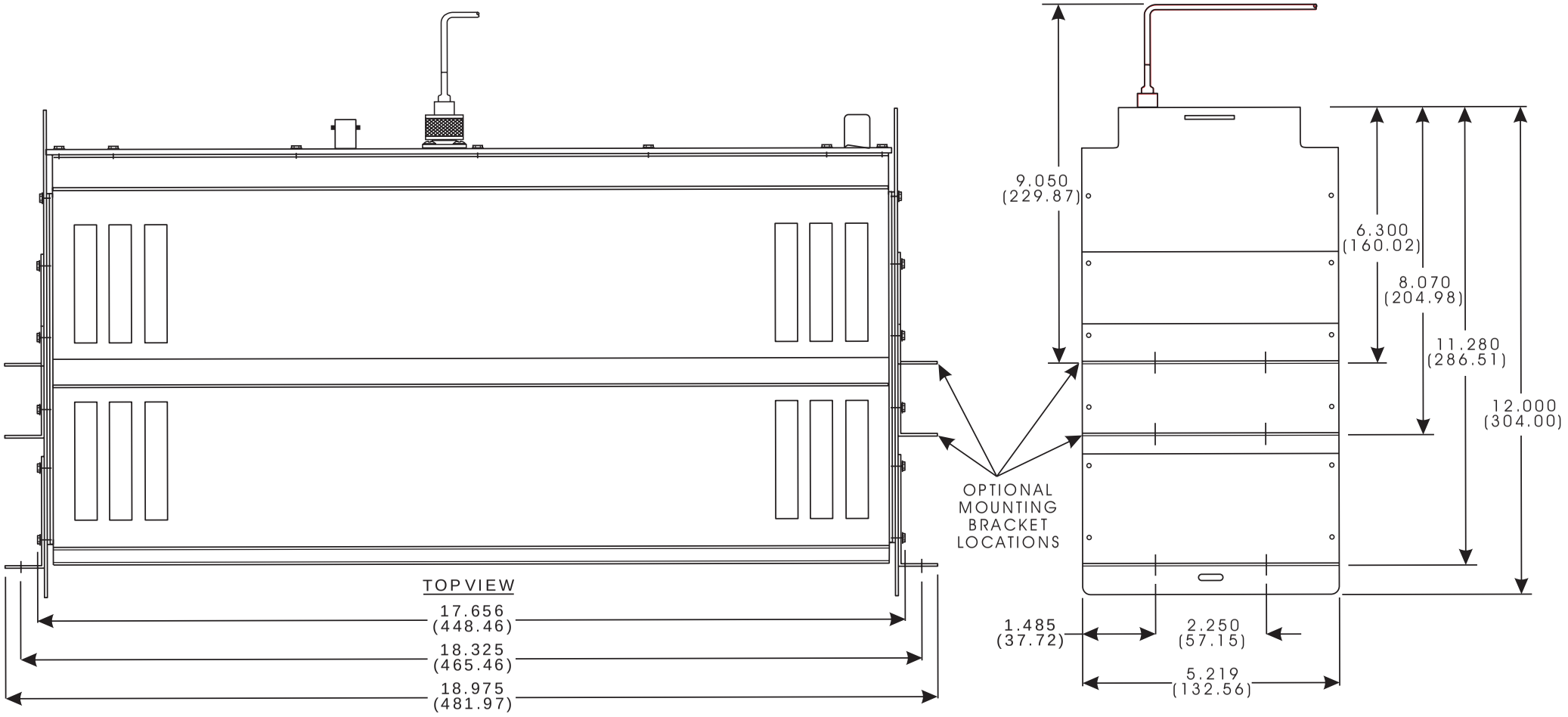
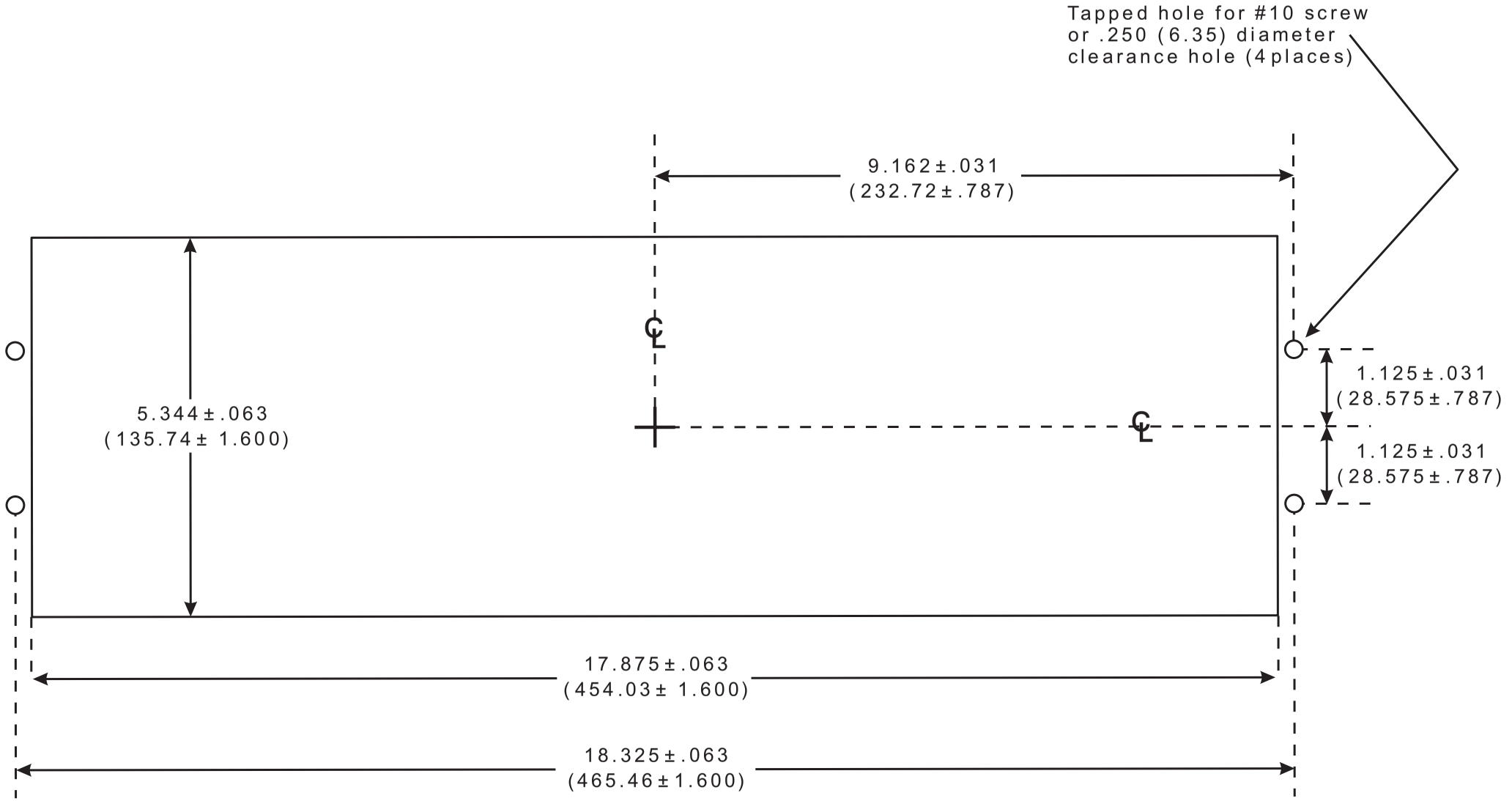


Figure 3–1. LPA50/LPA100 Chassis dimensions.

Figure 3–2. LPA50/LPA100 Chassis footprint dimensions.



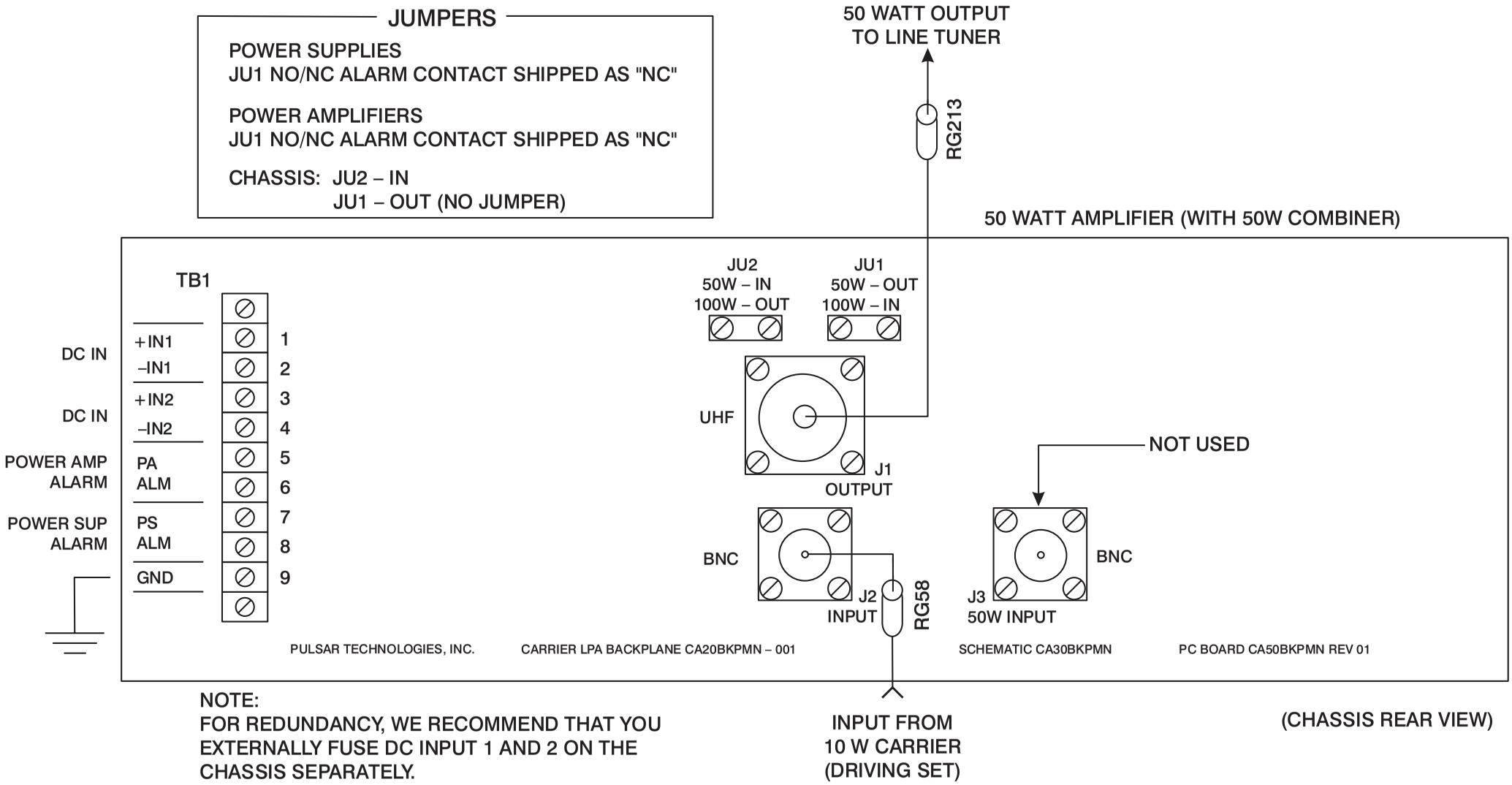
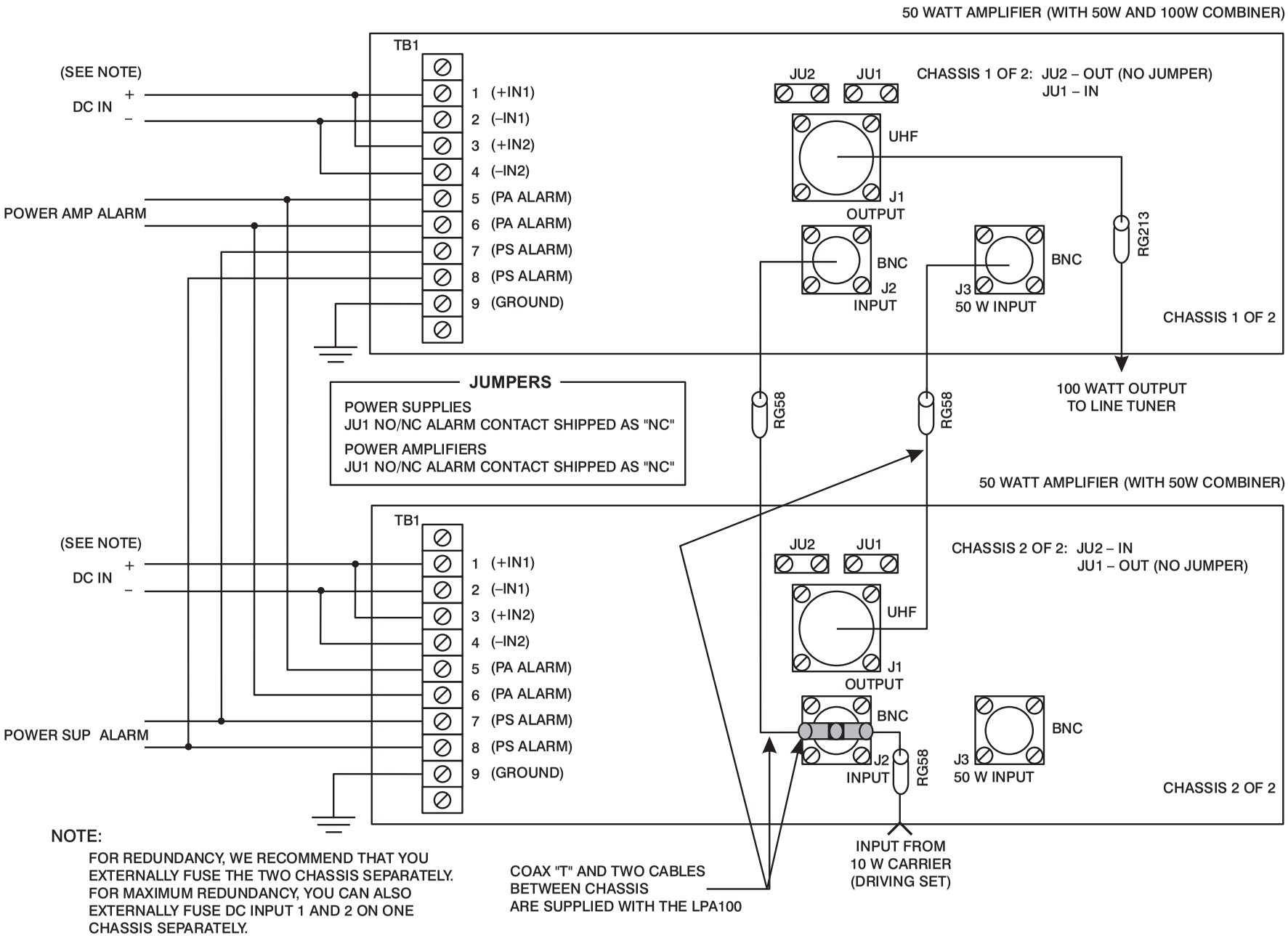


Figure 3–3. LPA50 Connection diagram

Figure 3–4. LPA100 Connection diagram



NOTE:

FOR REDUNDANCY, WE RECOMMEND THAT YOU EXTERNALLY FUSE THE TWO CHASSIS SEPARATELY. FOR MAXIMUM REDUNDANCY, YOU CAN ALSO EXTERNALLY FUSE DC INPUT 1 AND 2 ON ONE CHASSIS SEPARATELY.

Chapter 4. Test Equipment

TEST EQUIPMENT

The same type of test equipment used to test carrier sets is also used to test and adjust the LPA50 and LPA100. The following test equipment is recommended:

Table 4–1. LPA50/LPA100 Recommended Test Equipment.

Equipment	Application
High-Impedance Selective Level Meter, 300Hz-1 MHz (Rycom 6021A)1 -or- Acterna/Wandel-Golterman SPM-3A	• Impedance Matching • Transmitter Power Adjustment
Digital Multimeter (Fluke 75)*	Check dc Supply/general troubleshooting
Reflected Power Meter, Auto VLF Power SWR Meter (Signal Crafter 70)*	Impedance Matching at Carrier Output
Oscilloscope (Tektronix)*	• Transmitter Power
Non-Inductive Resistor, 50 or 75Ω, 100 W (Pacific)*	Output Termination
Signal Generator (H/P 3325A)*	General ac output for lab measurements
Extender Board (1353D70G01)	(See Figure 4-1.)

* or equivalent

⚠ *CAUTION*

WE RECOMMEND THAT THE USER OF THIS EQUIPMENT BECOME THOROUGHLY ACQUAINTED WITH THE INFORMATION IN THESE INSTRUCTIONS BEFORE ENERGIZING THE LPA50/LPA100 AND ASSOCIATED ASSEMBLIES. YOU SHOULD NOT REMOVE OR INSERT PRINTED CIRCUIT MODULES WHILE THE UNIT IS ENERGIZED. ALL INTEGRATED CIRCUITS USED ON THE MODULES ARE SENSITIVE TO AND CAN BE DAMAGED BY THE DISCHARGE OF STATIC ELECTRICITY. YOU SHOULD ALWAYS OBSERVE ELECTROSTATIC DISCHARGE PRECAUTIONS WHEN HANDLING MODULES OR INDIVIDUAL COMPONENTS. FAILURE TO OBSERVE THESE PRECAUTIONS CAN RESULT IN COMPONENT DAMAGE.

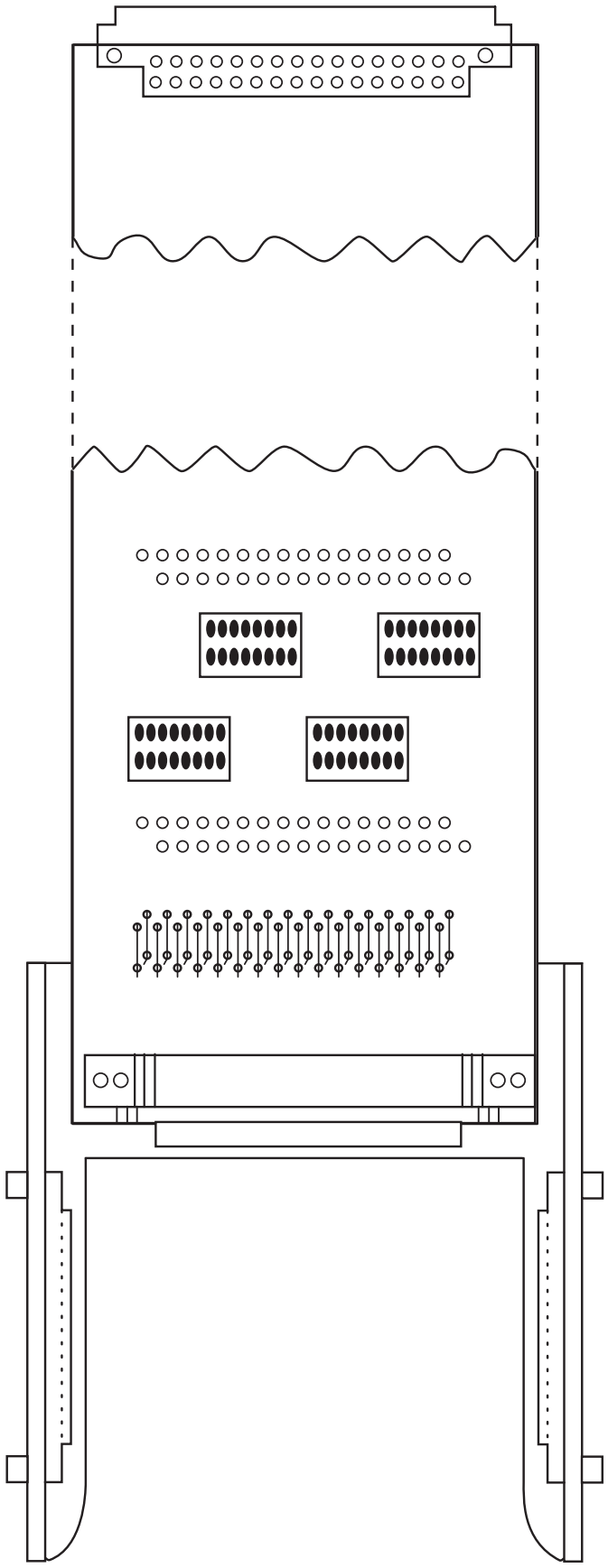


Figure 4–1. Extender Board

Chapter 5. Installation and Initial Adjustment

5.1 INITIAL ADJUSTMENT

Following are step-by-step procedures to properly power up and do initial adjustment on the LPA50 and LPA100. These procedures are only intended for use with a properly working LPA that still has its factory settings. Basically only the input power to the LPA needs to be set, since all the other adjustments were made before shipment. Refer to Figures 5-1 for module and test point locations. If there are any problems with this procedure or if a new module that did not originally ship in these chassis is being inserted, then please refer to the calibration/troubleshooting procedure in section 5.2.

5.1.1 LPA50 Adjustment Procedure

1. Verify proper connections per the connection diagram, Figure 5-2. Terminate the output of the LPA50 (coax connector J9), that would normally connect to the line tuner, with a 50 or 75Ω non-inductive resistor rated at 50W or greater (per catalog number).
2. Turn the INPUT LEVEL potentiometer on the driving carrier set's Power Amplifier module to **minimum** (fully counterclockwise). This will prevent it from overdriving the LPA when initially powered up.
3. Turn on all the Power Supply modules one at a time noting that both the INPUT and OUTPUT red LEDs come on for each Power Supply module. If all the power supplies are not turned on within a few minutes of one another, the Power Combiner module(s)'s balance resistors will heat up which is normal since only part of the Power Amplifier modules would be energized causing imbalance in the Power Combiner module. This heating will disappear after all Power Supplies are turned on and all the Power Amplifier modules are energized.
4. Turn on the driving carrier set.

Power Sequence Quick Reference

Power Up Sequence:

Turn all LPA Power Supplies on first before energizing any driving carrier set.

Power Down Sequence:

Power down the driving carrier set before turning off any Power Supplies in the LPA.

⚠ CAUTION

BE CAREFUL TO NOT LET THE TEST POINTS SHORT TOGETHER SINCE THEY ARE PHYSICALLY CLOSE TOGETHER.

5. With the carrier's set transmitter on, on any one of the four 12.5W Power Amplifiers in the chassis, measure between the INPUT and COMMON front panel test points. Since all four of these amplifiers' inputs are tied together the signal level will be the same. Set the level at this point to 0.67Vrms (+9.5dBm, 50Ω reference), by turning up the INPUT LEVEL pot on the driving carrier set's Power Amplifier module. This level should never exceed 1Vrms (+13.0dBm, 50Ω reference), in order to prevent overdriving the LPA. Also this level is approximately 20dB lower than the level coming from the driving carrier set's output since there is a 20dB attenuator on the backplane input of the LPA chassis. The driving carrier set should be keyed to its maximum output power (high level keying) if it has a 1W/10W setting when setting the above 0.67Vrms level.
6. Next, read between the red and black test points (50W output) on the 50W Power Combiner module and the level should be at [50Vrms +/- 1V (141Vpp or +47.0dBm +/- 0.3dB, 50Ω reference)] or [61.3Vrms at 75Ω reference] which is equal to 50W output for a rated load. If this level needs to be slightly changed, then adjust the driving carrier set amplifier's INPUT level potentiometer again. Then recheck the level on the INPUT test point of one of the 12.5W Power Amplifiers to make sure it doesn't exceed 1Vrms, 50Ω or 1.22Vrms, 75Ω as set in the previous step. It is recommended that the 50W output level be measured with an oscilloscope to verify the accuracy of the selective level meter and also to check that the output sine wave is not distorted. This is important because a 1dB difference in level is equal to being off by 13 watts.
7. Finally, measure between any one of the 50W Power Combiner's four input test points (orange, yellow, blue, & white - see Figure 5-1) and the input common test point (black) in order to verify that the levels are equal to one another and approximately 26Vrms (41.3 dBm, 50Ω reference). If not then go to the calibration/troubleshooting procedure in Section 5.2 for instructions on adjusting the individual 12.5W Power Amplifiers. It is important that these 4 levels be equal to one another, but the absolute value of 26 Vrms is not very important.
8. This concludes the adjustment of the LPA50.

5.1.2 LPA100 Adjustment Procedure

1. Verify proper connections per the connection diagram, Figure 5-3. Terminate the output of the LPA100 (coax connector J9), that would normally connect to the line tuner, with a 50Ω or 75Ω non-inductive resistor rated at 100W (per rated load).
2. Turn the INPUT LEVEL potentiometer on the driving carrier set's Power Amplifier module to minimum (fully counterclockwise). This will prevent it from overdriving the LPA when initially powered up.
3. Turn on all four Power Supply modules one at a time noting that both the INPUT and OUTPUT red LEDs come on for each Power Supply module. If all the power supplies are not turned on within a few minutes of one another, the Power Combiner module(s)'s balance resistors will heat up which is normal since only part of the Power Amplifier modules would be energized causing imbalance in the Power Combiner module. This heating will disappear after all Power Supplies are turned on and all the Power Amplifier modules are energized.
4. On any one of the four 12.5W Power Amplifiers in each of the two chassis, measure between the INPUT and COMMON front panel test points. Since all

⚠ CAUTION

BE CAREFUL TO NOT LET THE TEST POINTS SHORT TOGETHER SINCE THEY ARE PHYSICALLY CLOSE TOGETHER.

four of these amplifiers' inputs are tied together in each chassis and the two chassis inputs (coax connector J1) are tied together, the signal level will be the same on the input of all eight 12.5W Power Amplifiers. Set the level at this point to 0.45Vrms (+6.0 dBm, 50Ω reference) by turning up the INPUT LEVEL pot on the driving carrier set's Power Amplifier module. This level should never exceed +13dBm in order to prevent overdriving the LPA. NOTE: This level is approximately 23 dB lower than the level coming from the driving carrier set's output since there is a 20 dB attenuator on the backplane input of both chassis.

5. Next read between the red and black test points (100W output) on the 100W Combiner module and the level should be at 70.7Vrms +/- 2V at 50Ω or 86.6Vrms at 75Ω (+50.0 dBm +/- 0.3dB). If this level needs to be slightly changed, then adjust the driving carrier set amplifier's INPUT level potentiometer again. Then recheck the level on the INPUT test point of one of the 12.5W Power Amplifiers to make sure it doesn't exceed 1Vrms set in step 4. It is recommended that this final output level be measured with an oscilloscope to verify the accuracy of the selective level meter and also to check that the output sine wave is not distorted. This is important because a 1dB difference in level is equal to being off by 26 watts.

⚠ CAUTION

THE POWER SUPPLY MODULES SHOULD BE TURNED OFF WHEN INSERTING OR REMOVING ANY MODULES.

6. Next, measure between each one of the 50W Power Combiner's four input test points (orange, yellow, blue, & white - see Figure 5-1) and the input common test point (black) for both chassis in order to verify that the levels are equal to one another and approximately 27.2Vrms, (+41.7 dBm 50Ω Reference). If not then go to the calibration & troubleshooting procedure in Section 5.2 for instructions on adjusting the individual 12.5W Power Amplifiers.
7. On the 100W Combiner module (in chassis 1 of 2) measure between each of the two 50W input test jacks (blue = 50W output generated internally in the chassis, & white = 50W output of external chassis) and the input common test jack (black). These two levels should be equal to one another and approximately at 51.8Vrms (+47.3 dBm 50Ω reference). If not then go to the calibration/troubleshooting procedure in Section 5.2.
8. This concludes the adjustment of the LPA100.

5.2 CALIBRATION & TROUBLESHOOTING

Following are step-by-step procedures to calibrate and troubleshoot the LPA50 and LPA100. These steps should be followed if there are any problems noted during the initial adjustment or if a new module that did not originally ship with the LPA is being inserted into the LPA chassis.

5.2.1 LPA50 Calibration Procedure

1. Re-verify all the connections per the connection diagram in Figure 5-2.
2. If the driving carrier set's output signal level hasn't been set previously, then turn the INPUT LEVEL potentiometer on the driving carrier set's Power Amplifier module to minimum (fully counterclockwise). This will prevent it from overdriving the LPA when initially powered up.
3. Turn on all the Power Supply modules and check that the INPUT and OUTPUT red LEDs on each Power Supply module in the LPA are illuminated. If the INPUT LED is not lit then verify presence of DC voltage on the input of the Power Supply module and if present replace the Power Supply

module. If the OUTPUT LED is not lit there may be a bad 12.5W Power Amplifier that is dragging down the output of the Power Supply module so remove the corresponding 2 amplifier modules one at at a time to verify if this is the case. Replace any bad amplifier modules. NOTE: If all the Power Supply modules are not turned on within a few minutes of one another, the Power Combiner module balance resistors will heat up which is normal since only part of the Power Amplifier modules would be energized causing imbalance in the Power Combiner module. This heating will disappear after all Power Supplies are turned on and all the Power Amplifier modules are energized.

4. The output level of the driving carrier set should be set to approximately 6.3Vrms (+29dBm 50Ω reference). The driving carrier set should be keyed to its maximum output power (high level keying) if it has a 1W/10W setting when setting this level.
5. The signal level between the INPUT and COMMON test points on any one of the 12.5W Power Amplifiers should read approximately 0.67Vrms (+9.5dBm 50Ω reference). This level should never exceed 1Vrms in order to prevent overdriving the LPA. Also this level is approximately 20 dB lower than the level coming from the driving carrier set's output since there is a 20 dB attenuator on the backplane input of the LPA chassis. This attenuator is made up of two 100Ω resistors located on the backplane.
6. Next in order to check that all 4 of the 12.5W Power Amplifiers are balanced with one another, their output levels should be checked on the input test points of the 50W Power Combiner module. Measure between any one of the four Power Combiner input test points (orange, yellow, blue, & white - see Figure 5-1) and the input common test point (black) in order to verify that the levels are equal to one another and approximately 26Vrms (41.3 dBm 50Ω reference). If not then the serial # sticker must be removed from the front of whichever 12.5W Power Amplifier that needs to be adjusted in order to adjust its front panel input potentiometer. When first inserting a new 12.5W Power Amplifier that was not factory adjusted for the LPA turn the front panel input potentiometer fully counterclockwise to avoid overdriving the LPA. Before turning the LPA power on, set up to measure the corresponding Power Combiner input test point for this 12.5W Power Amplifier. Then after turning the power on, quickly adjust the input potentiometer on the 12.5W Power Amplifier to be the same level as the other three amplifiers on the Power Combiner input test points. Any difference in power level at these 4 test points will be dissipated in the Power Combiner high wattage resistors so it's important to balance these levels as close to equal as possible in order to maximize transfer of signal power to the line tuner.
7. Next read between the red and black test points (50W output) on the 50W Power Combiner module and the level should be at 50Vrms +/- 1V, 50Ω or 61.3Vrms +/- 1V, 75Ω (+47.0 dBm +/- 0.3dB) which is equal to 50W output for a rated load. This level should be approximately 6 dB higher than the 4 equal levels on the input test points of the Power Combiner. If this level needs to be slightly changed, then adjust the driving carrier set amplifier's INPUT level potentiometer again. Then recheck the level on the INPUT test point of one of the 12.5W Power Amplifiers to make sure it doesn't exceed 1Vrms as set in the previous step. It is recommended that the 50W output level be measured with an oscilloscope to verify the accuracy of the selective level meter

⚠ CAUTION

BE CAREFUL TO NOT LET THE TEST POINTS SHORT TOGETHER SINCE THEY ARE PHYSICALLY CLOSE TOGETHER.

and also to check that the output sine wave is not distorted. This is important because a 1dB difference in level is equal to being off by 13 watts.

8. This concludes the calibration of the LPA50.

5.2.2 LPA100 Calibration Procedure

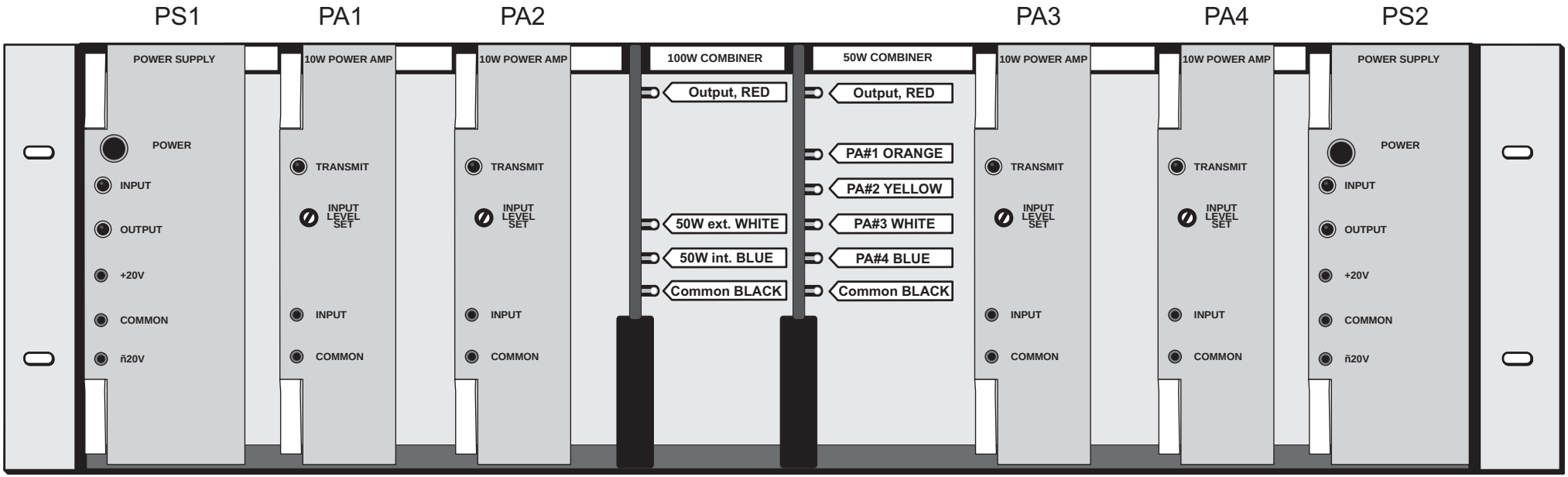
1. Re-verify all the connections per the connection diagram in Figure 5-3.
2. If the driving carrier set's output signal level hasn't been set previously, then turn the INPUT LEVEL potentiometer on the driving carrier set's Power Amplifier module to minimum (fully counterclockwise). This will prevent it from overdriving the LPA when initially powered up.
3. Turn on all four Power Supply modules and check that the INPUT and OUTPUT red LEDs on each Power Supply module in the LPA are illuminated. If the INPUT LED is not lit then verify presence of DC voltage on the input of the Power Supply module and if present replace the Power Supply module. If the OUTPUT LED is not lit there may be a bad 12.5W Power Amplifier that is dragging down the output of the Power Supply module so remove the corresponding 2 amplifier modules one at at a time to verify if this is the case. Replace any bad amplifier modules. NOTE: If all the Power Supply modules are not turned on within a few minutes of one another, the Power Combiner modules' balance resistors will heat up which is normal since only part of the Power Amplifier modules would be energized causing imbalance in the Power Combiner module. This heating will disappear after all Power Supplies are turned on and all the Power Amplifier modules are energized.
4. The output level of the driving carrier set should be set to approximately 6.3Vrms, (+29 dBm 50Ω reference). The driving carrier set should be keyed to its maximum output power (high level keying) if it has a 1W/10W setting when setting this level.
5. On any one of the four 12.5W Power Amplifiers in each of the two chassis, measure between the INPUT and COMMON front panel test points. Since all four of these amplifiers' inputs are tied together in each chassis and the two chassis inputs (coax connector J9) are tied together, the signal level will be the same on the input of all eight 12.5W Power Amplifiers. Set the level at this point to 0.45Vrms (+6.0 dBm 50Ω reference). This level should never exceed 1Vrms in order to prevent over-driving the LPA. NOTE: This level is approximately 23 dB lower than the level coming from the driving carrier set's output since there is a 20 dB attenuator on the backplane input of both chassis.
6. Next in order to check that all eight of the 12.5W Power Amplifiers are balanced with one another, their output levels should be checked on the input test points of the 50W Power Combiner modules in both chassis. Measure between each one of the 50W Power Combiner's four input test points (orange, yellow, blue, & white - see Figure 5-1) and the input common test point (black) for both chassis in order to verify that all eight levels are equal to one another and approximately 27.2Vrms (+41.7dBm, 50Ω reference). If not then the serial # sticker must be removed from the front of whichever 12.5W Power Amplifier that needs to be adjusted in order to adjust its front panel input potentiometer. If inserting a new

⚠ CAUTION

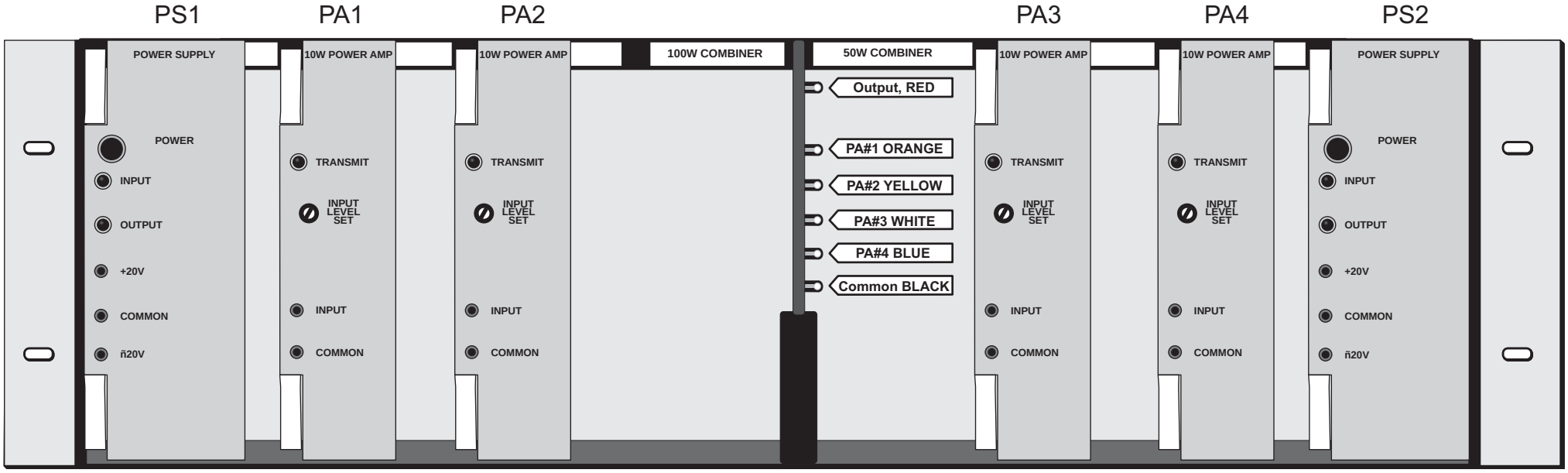
BE CAREFUL TO NOT LET THE TEST POINTS SHORT TOGETHER SINCE THEY ARE PHYSICALLY CLOSE TOGETHER.

12.5W Power Amplifier that was not factory adjusted for the LPA, then turn the front panel input potentiometer fully counterclockwise to avoid overdriving the LPA. Before turning the LPA power on, set up to measure the corresponding 50W Power Combiner input test point for this 12.5W Power Amplifier. Then after turning the power on, quickly adjust the input potentiometer on the 12.5W Power Amplifier to be the same level as the other three amplifiers on this particular 50W Power Combiner's input test points. Any difference in power level at these eight input test points will be dissipated in the Power Combiners' high wattage resistors so it's important to balance these levels as close to equal as possible in order to maximize transfer of signal power to the line tuner.

7. Then read between the red and black test points (50W output) on the two 50W Power Combiner modules and the level should be at 51.8Vrms (+47.3 dBm 50Ω reference). This level should be approximately 6 dB higher than the 4 equal levels on the input test points of the 50W Power Combiner. (NOTE: Be careful to not let the test points short together since they are physically close together.)
8. On the 100W Power Combiner module (in chassis 1 of 2) measure between each of the two 50W input test jacks (blue = 50W output generated internally in the chassis, & white = 50W output of external chassis) and the input common test jack (black). These two levels should be equal to one another and approximately at 51.8Vrms, 50Ω or 63.5Vrms, 75Ω (+47.3 dBm). These input test points on the 100W Power Combiner module are connected directly to the outputs of the two 50W Power Combiner modules.
9. Next read between the red and black test points (100W output) on the 100W Power Combiner module and the level should be at 70.7Vrms +/- 2Vrms, 50Ω or 86.6Vrms, 75Ω (50.0 dBm +/- 0.3dB). This level should be approximately 3 dB higher than the 2 equal levels on the input test points of the 100W Power Combiner. (NOTE: Be careful to not let the test points short together since they are physically close together.) If this level needs to be slightly changed, then adjust the driving carrier set amplifier's INPUT level potentiometer again. Then recheck the level on the INPUT test point of one of the 12.5W Power Amplifiers to make sure it doesn't exceed 1Vrms as set in step 4. It is recommended that this final output level be measured with an oscilloscope to verify the accuracy of the selective level meter and also to check that the output sine wave is not distorted. This is important because a 1dB difference in level is equal to being off by 26 watts.
10. This concludes the adjustment of the LPA100.



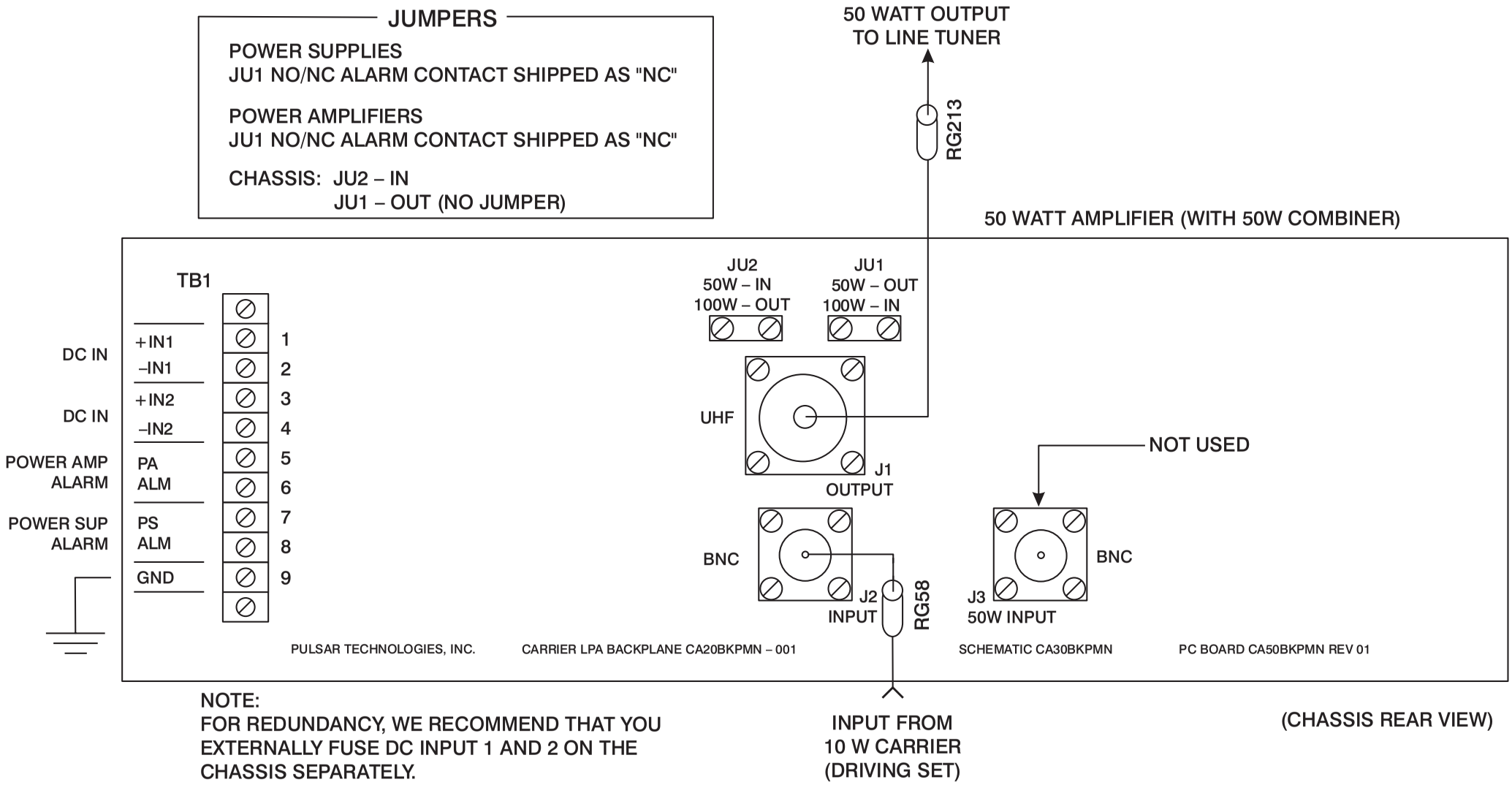
LPA100 Chassis 1 of 2



LPA50 Chassis or LPA100 Chassis 2 of 2

Figure 5–1. LPA100 Front panels & Test Points

Figure 5–2. LPA50 Connection Diagram



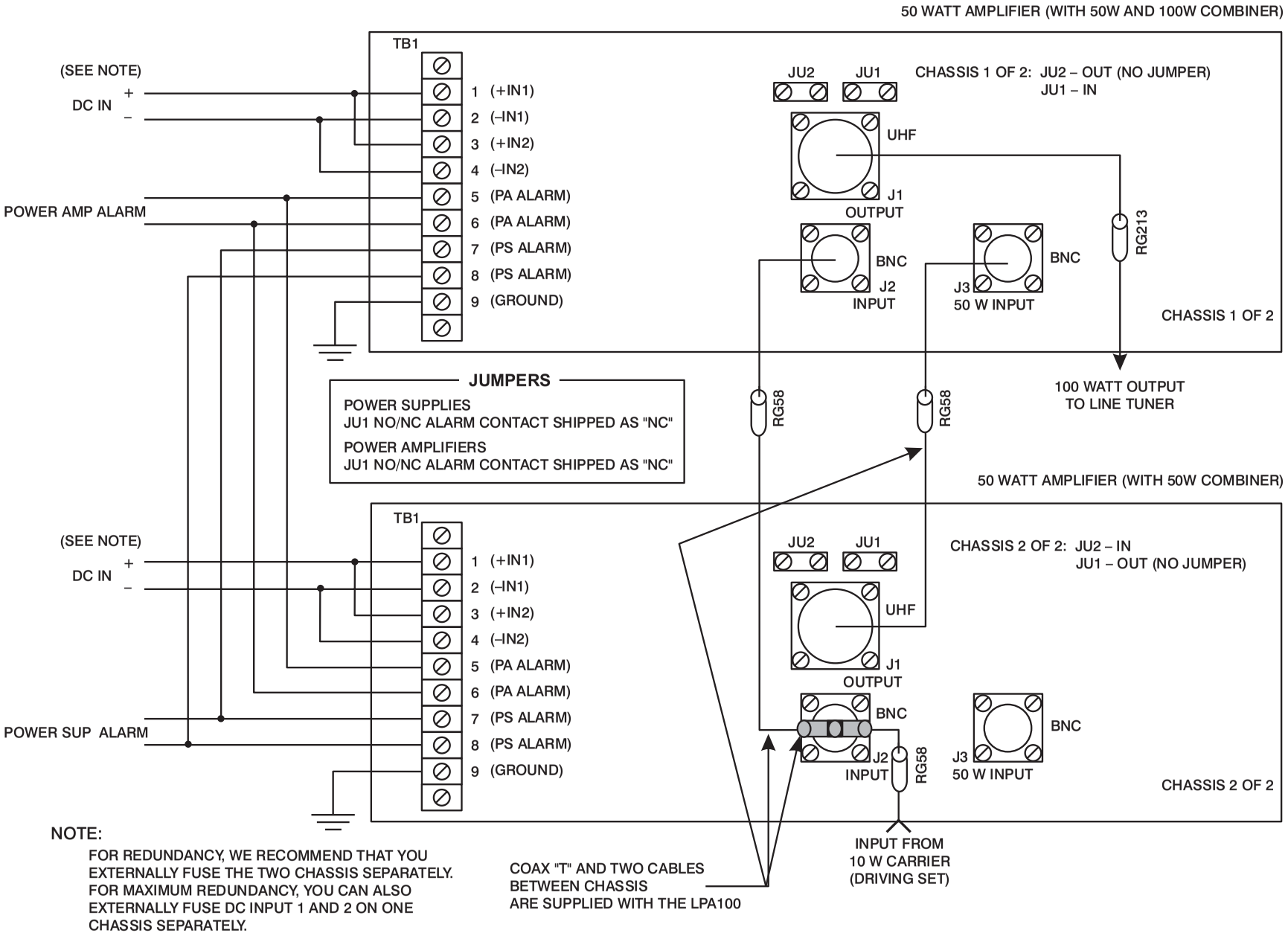


Figure 5–3. LPA100 Connection Diagram

USER NOTES

Chapter 6. Maintenance

When individual module maintenance is required, either at the factory or at the customer installation (beyond the scope of routine alignment), the following procedures are applicable.

6.1 Precautions When Selecting Test Equipment

(See Chapter 4, Test Equipment for test equipment specifications.)

To prevent damage to solid-state components:

1) Use transformer-type signal generators, VTVMs and signal tracers, which isolate the test equipment from the power line. Whenever the test equipment uses a transformerless power supply, use an isolation type transformer. The test equipment ground should be isolated from the ac source ground.
2) Use multi-meters with at least 20,000Ω-per-volt sensitivity.

6.2 Precautions When Using Test Equipment

1. Use a common ground between the chassis of the test equipment and the transistor equipment.
2. When testing transistors and diodes, give special attention to the polarity of the meter leads.

   For example: When measuring the forward resistance of a diode using a meter that has the internal battery connected to the metering circuit, be sure that:

   - The lead marked (–) touches the diode anode (opposite striped end).
   - The lead marked (+) touches the diode cathode (striped end).
3. When checking circuits with an oscillographic probe, be sure to discharge any built-up capacitive voltage by touching the probe to a ground before touching the circuit.

6.3 Periodic Checks

Every six months, take the following readings on the LPA50/LPA100 Test Jacks (on the front of the modules).

We recommend that you keep a ***log book*** as a visible record of periodic checks, as well as a source for indicating any gradual degradation in a module's performance.

⚠ CAUTION

HIGH CURRENTS FROM A LOW-SENSITIVITY METER CAN DAMAGE SOLID STATE DEVICES.

METERING TRANSISTOR CIRCUITS CAN CAUSE DAMAGE.

FOR EXAMPLE: A BASE-TO-COLLECTOR SHORT DURING TRANSISTOR OPERATION CAN DESTROY THE TRANSISTOR.

6.3.1 Power Supply Module

- TJ1 (+20Vdc)
- TJ2 (Common)
- TJ3 (-20Vdc)

6.3.2 12.5W PA Module

- TJ1 (Input)
- TJ2 (Common)

Measure any one of the 4 PA modules in each chassis.

6.3.3 50W Power Combiner Module

- TP4 Orange (PA#1 input)
- TP3 Yellow (PA#2 input)
- TP5 White (PA#3 input)
- TP2 Blue (PA#4 input)
- TP6 Red (50W output)

Take all measurements relative to TP1 Black (common).

6.3.4 100W Power Combiner Module (when used)

- TP5 White (External 50W input)
- TP2 Blue (Internal 50W input)
- TP6 Red (100W output)

Take all measurements relative to TP1 Black (common).

6.4 Inspection

A program of routine visual inspection should include:

- Condition of cabinet or other housing
- Tightness of mounting hardware and fuses
- Proper seating of plug-in relays and sub-assemblies
- Condition of internal and external wiring (the location where external wiring enters the cabinet should be sealed)
- Appearance of printed circuit boards and components
- Signs of overheating in equipment:
  - Interference with proper heat dissipation from surfaces
  - Clogged air vents (air filters should be removed and washed out)
- Dust which may cause short circuits

NOTE

Before touching a module with a test probe, connect the ground lead from the test equipment to the module. Always disconnect the test probe before removing the ground lead equipment.

6.5 Solid-State Maintenance Techniques

Use the following techniques when servicing solid state equipment.

6.5.1 Preliminary Precautions

1. To avoid damage to circuits and components from a current surge, disconnect power before replacing or removing components or circuits.
2. Before placing new components into a

⚠ CAUTION

WE RECOMMEND THAT THE USER OF THIS EQUIPMENT BECOME ACQUAINTED WITH THE INFORMATION IN THESE INSTRUCTIONS BEFORE ENERGIZING THE LPA50/LPA100 AND ASSOCIATED ASSEMBLIES.

FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN DAMAGE TO THE EQUIPMENT. YOU SHOULD NEITHER REMOVE NOR INSERT PRINTED CIRCUIT MODULES WHILE THE LPA50/LPA100 IS ENERGIZED. FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN COMPONENT DAMAGE.

ALL INTEGRATED CIRCUITS USED ON THE MODULES ARE SENSITIVE TO AND CAN BE DAMAGED BY THE DISCHARGE OF STATIC ELECTRICITY. BE SURE TO OBSERVE ELECTROSTATIC DISCHARGE PRECAUTIONS WHEN HANDLING MODULES OR INDIVIDUAL COMPONENTS.

defective circuit, check the circuit so that it cannot damage the new components.

6.5.2 Trouble-Detection Sequence

1. Evaluate test jack readings and other records of routine alignment.
2. Evaluate any symptoms detected audibly or visually.
3. Replace suspected plug-in components.
4. Further isolation of faults includes:
   - Voltage readings
   - Resistance readings
   - Signal injection
   - Re-alignment
   - Sensitivity measurements
   - Gain measurements
5. Replace suspected faulty components.
6. Check-out and adjust affected circuits.

6.5.3 Servicing Components Soldered Directly to Terminals

1. Avoid overheating from soldering by using a low-wattage soldering iron (60 watt maximum).
2. Make sure there is no current leakage from the soldering iron.

   You may use an isolation transformer to prevent current leakage.
3. When soldering leads from transistors or diodes, use heat sinks, e.g., alligator clips.
4. You can remove molten solder from the board with a solder-sucker.
5. When removing a multi-lead component from a printed circuit board, first cut all leads and then remove the leads individually (to prevent overheating). If there are only a few leads, you can use a broad-tip soldering iron.

6.5.4 Servicing Components Mounted Directly on Heat Sinks

1. Remove the heat sink and bracket from the chassis by loosening the securing devices.
2. Remove the transistor, diode, or other device from the heat sink.
3. When replacing the transistor, diode, or other device, make certain that the device and the heat sink make secure contact for good heat dissipation. Mount a device first on the heat sink, and then on the board. Also, make sure that you replace all insulators, washers, spring washers and other mounting hardware as you originally found them.

   We recommend a very light coating of DC-4 (Dow-Corning 4 Compound Silicon Lubricant) for transistors and diodes that are mounted on heat sinks. This heat sink compound promotes efficient dissipation of heat through the heat sink.

6.5.5 Servicing Metal Oxide Semiconductor (MOS) Devices

MOS devices may be vulnerable to static changes. Be sure to observe the special precautions described below both before and during assembly.

Precautions to take before assembly:

- Avoid wearing silk or nylon clothing, as this contributes to static buildup.
- Avoid carpeted areas and dry environments.
- Discharge body static by placing both hands on a metal, earth-grounded surface.

Precautions to take during assembly to avoid the possibility of electrostatic discharge:

- Wear a ground strap during assembly
- Avoid touching electrically-conductive circuit parts by hand
- When removing a module from the chassis, always place it on a conductive surface which is grounded through a resistance of approximately 100 KΩ.
- Make sure that all electrically-powered test equipment is properly grounded.

USER NOTES

Chapter 7. Power Supply Module

Schematic	1617C38-2
Parts List	1617C38-2

7.1 Power Supply Module Description

The Power Supply Module for the LPA50/LPA100 has dual dc/dc high-frequency switching regulators which generate regulated voltage outputs of ±20Vdc (between 1.5 and 2.0 Amps) for operation of the modules. It also provides protection from battery surge, transients, short circuits, and reverse voltage. The Power Supply Module can receive inputs from three available groups of station batteries: 38-70Vdc, 88-140Vdc, and 176-280Vdc.

Table 7–1. 1617C38 Styles and Descriptions.

Group	Description
G01	48V WITH ALARM RELAY
G02	125V WITH ALARM RELAY
G03	250V WITH ALARM RELAY

7.1.1 Power Supply Control Panel

(This panel is shown in Figure 7-1.)

Front panel controls are as follows:

1) Push-button Switch (with power-on indicator), ON/OFF (S1).
2) LEDs for indicating power:
   - INPUT, Red (LED1)
   - OUTPUT, Red (LED2)
3) Test Jacks:
   - +20 Vdc, Red (TP3)
   - Common, Green (TP2)
   - -20 Vdc, Black (TP1)

An optional low-voltage alarm relay indicating loss of power is available. When the alarm is activated, LED2 is “OFF”. LED1 may be “OFF” if input power is lost.

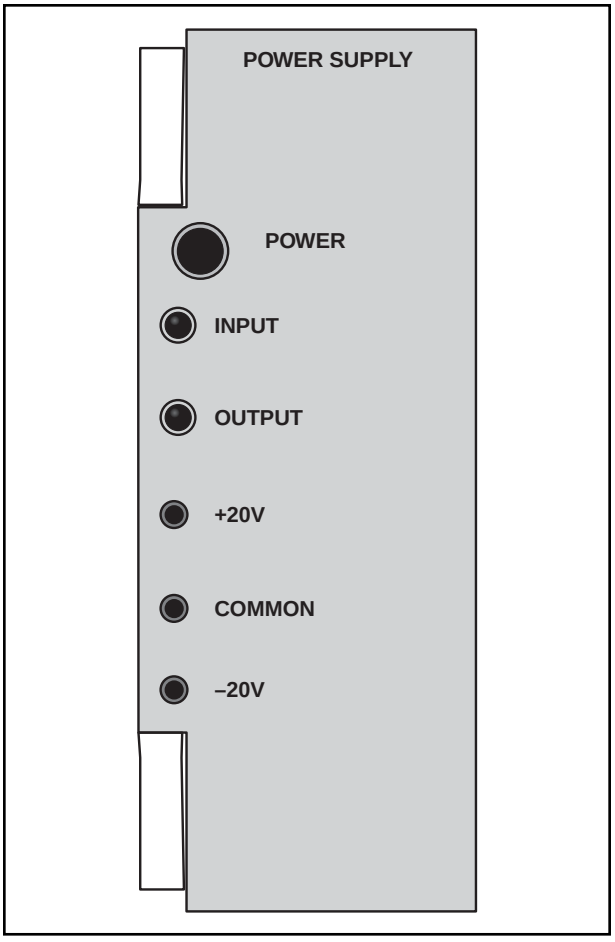


Figure 7–1. Power Supply 1617C38 Front panel.

7.1.2 Power Supply PC Board

The PC board and schematic for the Power Supply Module are shown at the end of this chapter.

Control is as follows:

Jumper J1 for Alarm Relay; establishes loss of power condition (NO/NC).

7.2 Power Supply Circuit Description

The module comprises the following circuits:

- Fuses
- ON/OFF Switch
- Input Filter
- Power Alarm Failure Relay
- dc/dc Converter (2)
- Output Filter

Fuses

	48V	125V	250V
F1, F2	3A	1.6A	3/4A

ON/OFF Switch

S1 - Push-button Switch (DPDT)

When in the "ON" position (pins 1 and 4), dc current flows through the input filter to the dc/dc converter.

Input Filter

The input filter (C1, C2, C3) contains zener diodes (Z1, Z2) that provide protection against surges, a diode (D1) that provides protection against reverse polarity, a differential choke XFMR (L1), and the Red Input LED1.

Power Alarm Failure Relay

This circuit includes:

- K1 - Alarm Relay
- J1 - Jumper (NO/NC)

In versions G01, G02, and G03 the field-selectable option can change the alarm contact de-energized state to NO or NC. (It is currently shipped in the NC de-energized state, and can be changed to NO if desired.)

DC/DC Converter

The two dc/dc converters (PS1 and PS2) operate at a maximum of 1MHz and, as a result, switching noise is outside the 30-535kHz range of the TC–10B/TCF–10B. The converter outputs, +20 Vdc and -20Vdc, is fed to the output filter. (See Figure 7-3.)

Output Filter

The output filter for the +20V consists of C4, C6, C8, and Z4. The output filter for the -20V consists of C5, C7, C9, and Z3.

7.3 Power Supply Troubleshooting

The three test jacks on the control panel:

- TP3 (+20Vdc)
- TP2 (Common)
- TP1 (-20Vdc)

can be used to determine if the two voltages (+20 Vdc, -20Vdc) are present. In addition, the LED2 output indicates that the dc/dc converters are generating voltage. The LED1 input indicates that voltage is present at the input of the dc/dc converter.

For basic troubleshooting, perform the following procedure:

1. If LED1 is not on with the module de-energized, remove and check the fuses (F1, F2) with an ohmmeter.
2. With the module de-energized, check the ON/OFF switch (S1) with an ohmmeter to be sure it opens and closes accordingly.
3. If LED2 is not on with the module energized, check the +20V and -20V outputs at TP3 and TP1, respectively. The one with voltage absent will require replacement of the associated dc/dc converter.

⚠ CAUTION

BE CAREFUL NOT TO MISPLACE SCREWS, SPRING WASHER OR INSULATING WASHER USED FOR MOUNTING TRANSISTORS.

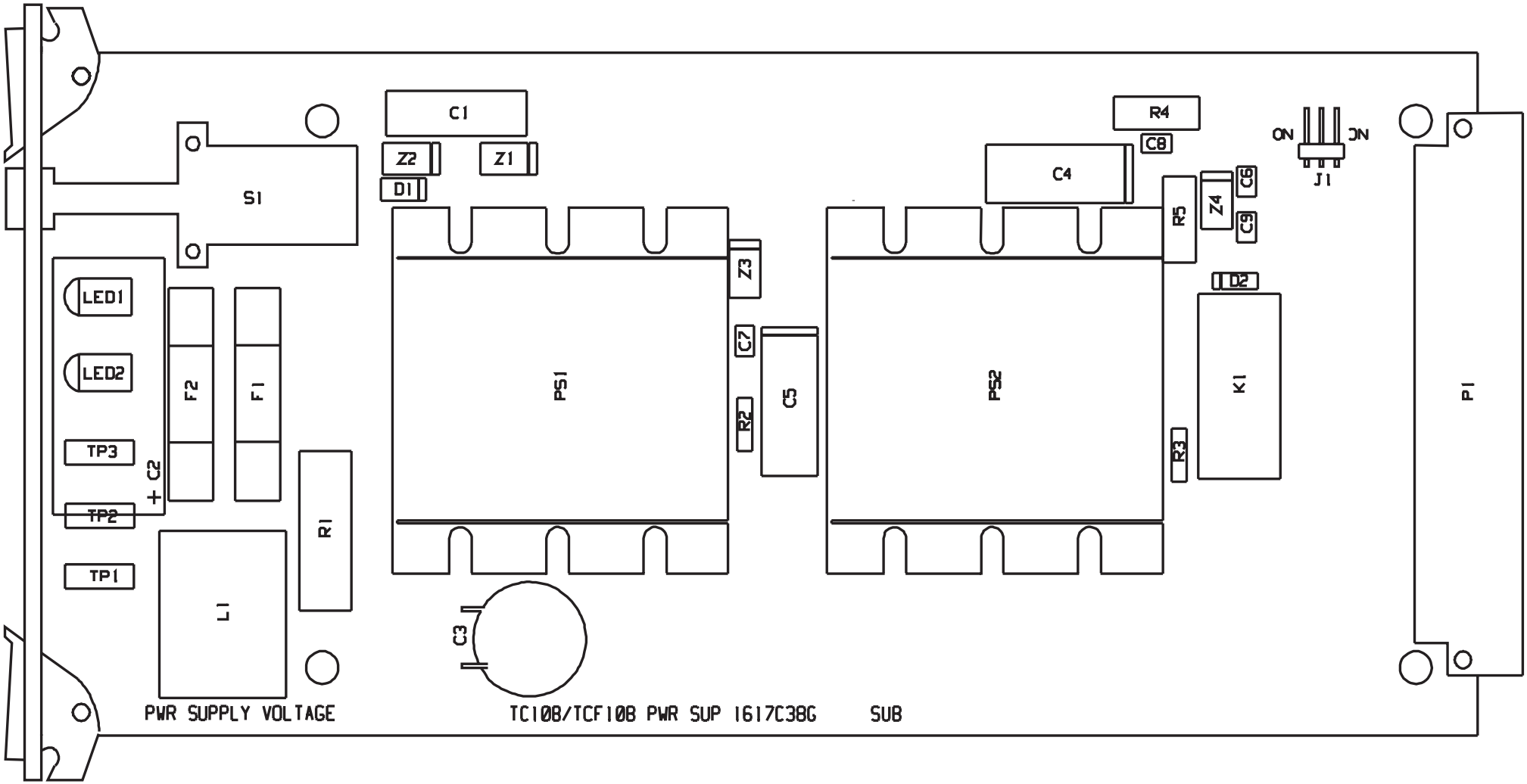
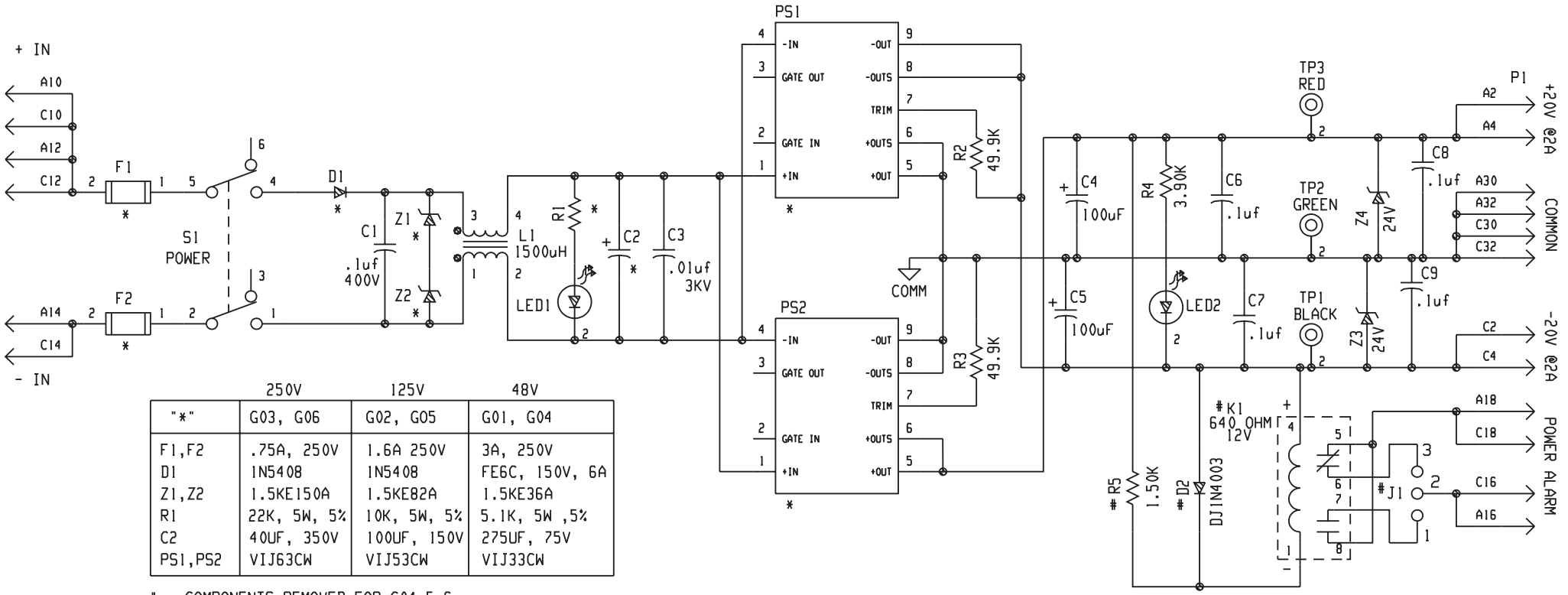


Figure 7–2. LPA50/LPA100 Power Supply Component Location (1617C38).

Figure 7–3. LPA50/LPA100 Power Supply Schematic (1617C39).



	250V	125V	48V
"*"	G03, G06	G02, G05	G01, G04
F1,F2	.75A, 250V	1.6A 250V	3A, 250V
D1	1N5408	1N5408	FE6C, 150V, 6A
Z1,Z2	1.5KE150A	1.5KE82A	1.5KE36A
R1	22K, 5W, 5%	10K, 5W, 5%	5.1K, 5W ,5%
C2	40UF, 350V	100UF, 150V	275UF, 75V
PS1,PS2	VIJ63CW	VIJ53CW	VIJ33CW

= COMPONENTS REMOVED FOR G04,5,6

Chapter 8. 12.5W PA Module

8.1 12.5W PA Module Description

The function of the LPA 12.5W PA Module is to amplify a 0 dBm (1mW) input to an output power level of 12.5W. You may also adjust the 12.5W PA for input power levels from 0.5mW to 2mW.

Note:
The 12.5W PA used in the LPA is the same as used in TC-10B/TCF-10B only calibrated for 12.5W.

The 12.5W PA Module operates in a 30 to 535 kHz range without tuning. The amplifier has a fixed gain of approximately 49dB (class A, complementary symmetry push-pull stage). Negative feedback is used to derive a nominal output impedance of 50Ω.

8.1.1 12.5W PA Control Panel

(This panel is shown in Figure 8–1.)

Operator controls are as Described below.

Potentiometer (R53) INPUT LEVEL SET

Adjusts power output level to 10W with 1mW input.

LED, TRANSMIT, RF Power Indication, Red (D6)

Test Jacks

- INPUT (TJ1)
- COMMON (TJ2)

Optional relay alarm for RF voltage

8.1.2 12.5W PA PC Board

The PC board and schematic for the 12.5W PA are shown at the end of this chapter. Operator controls consist of a Jumper (JU1) for the transmitter on Alarm Relay (NO/NC). The relay is energized if RF power (1W or more) is present.

Schematic	1606C33-20
Part List	1606C33-20

Table 8–1. 1606C33 Styles and Descriptions.

Group	Description
G01	WITH POWER ON RELAY

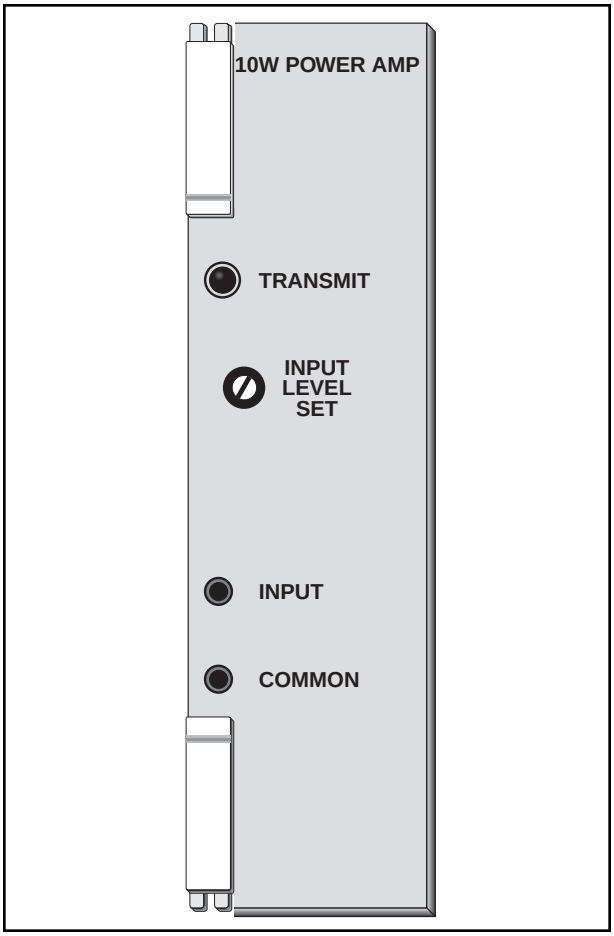


Figure 8–1. 12.5W PA 1606C33 Front panel.

8.2 12.5W PA Circuit Description

The function of the 12.5W PA Module (see Figure 8-3) is to amplify a 0dBm (1mW) input to an output power level of 10W. The input from pins C28/A28 passes thru a 700 kHz low pass filter (LPF) consisting of L1 and C1. Potentiometer (R53), labeled "INPUT LEVEL SET" on the front panel, is used to adjust the power level to 10W output with 1mW applied at the input.

The 12.5W PA Module operates in a 30 to 535 kHz range without tuning. The amplifier has a maximum gain of approximately 49dB (class A, complementary symmetry push-pull stage). Negative feedback is used to derive a nominal output impedance of 50Ω.

All bypassing is done to common (pins A30/C30, A32/C32). Transistors QN1, QN2 and QN3 are 14 pin DIPs, each containing four individual transistors; QN1 is PNP, while QN2 and QN3 are NPN.

The LPF output drives the amplifier QN1 and QN2. QN1A/QN1B and QN2A/QN2B are configured as a differential amplifier, while QN1C and QN2C are constant current sources. The input signal is applied to the bases of QN1A and QN2A. Negative feedback is applied to the bases of QN1B and QN2B. At the positive side (QN2), the differential output from QN2A and QN2B is amplified by QN2D and Q2. At the negative side (QN1), the differential output from QN1A and QN1B is amplified by QN1D and Q1. The positive side power output transistor (Q6) is driven by Q5; the negative side power output transistor (Q7) is driven by Q4.

The no-load feedback is from transformer (T1) back thru the RC network of R21, C7, C2, C5 and R18 to the junction of R16 and R17, for the purpose of stability. The loaded feedback is derived from a sampling resistor (R33, R35, R36, R37, R38, and R39, all in parallel) and fed back thru C28, C29 and R23. The overall no-load voltage gain is approximately 282. The overall loaded voltage gain is approximately 141. The partial loaded gain, between C28/A28 and the primary of T1, is approximately 38.

The alarm circuit (loss of RF signal condition) consists of QN3, Q8, K1 and associated components. The RF signal is monitored by C22, at T1 pin 1. The signal sample is amplified in QN3A and fed to QN3B and QN3C (QN3B and QN3C are configured as diodes). A voltage doubler is formed from C30, QN3C and QN3B. The output of QN3B drives QN3D, via R44 and R45. QN3D is saturated for an input of 1W to C22 (with reference to T1 secondary). As QN3D saturates, Q8 conducts, driving the front panel LED (D6, power monitor), causing K1 to energize (or de-energize), indicating loss of signal condition. Jumper JU1 allows the selection of an open circuit or a closed circuit for the loss of signal condition.

The +20Vdc line (leading to the alarm circuit, etc.) is filtered by C10, C11, L2, L4, C19, C20 and C21. The -20 Vdc (leading to C2/C4) is filtered by C12, C13, L3, C16, C17, C18 and L5.

8.3 12.5W PA Troubleshooting

To check individual transistors, e.g., Q1 thru Q8, QN1, QN2 and QN3, remove them first from the PC Board. Ohmmeter measurements of the transistors while in the PC Board are misleading because of other paths on the board.

You may remove the heat sink by unscrewing the four (4) corner screws and the hold-down screws of Q1 thru Q8. The 12.5W PA Module can operate at no-load conditions without the heat sink for short periods of time while you are troubleshooting.

⚠ CAUTION

THE 12.5W PA IS AN OP-AMP PROVIDING VERY HIGH GAIN WITH NEGATIVE FEEDBACK. TRANSISTORS Q1 THROUGH Q5, Q6, & Q7 ARE THERMALLY CONNECTED, I.E., THEY ARE MOUNTED ON THE SAME PART OF THE HEAT SINK. ANY FAILING TRANSISTOR MAY AFFECT OTHER TRANSISTORS. CHECK EACH TRANSISTOR SEPARATELY. IF NO FAULTS ARE FOUND, CHECK OTHER COMPONENTS.

BE CAREFUL NOT TO MISPLACE SCREWS, SPRING WASHER OR INSULATING WASHER USED TO MOUNT Q1 – Q8. DAMAGED SCREWS OR INSULATORS SHOULD NOT BE USED.

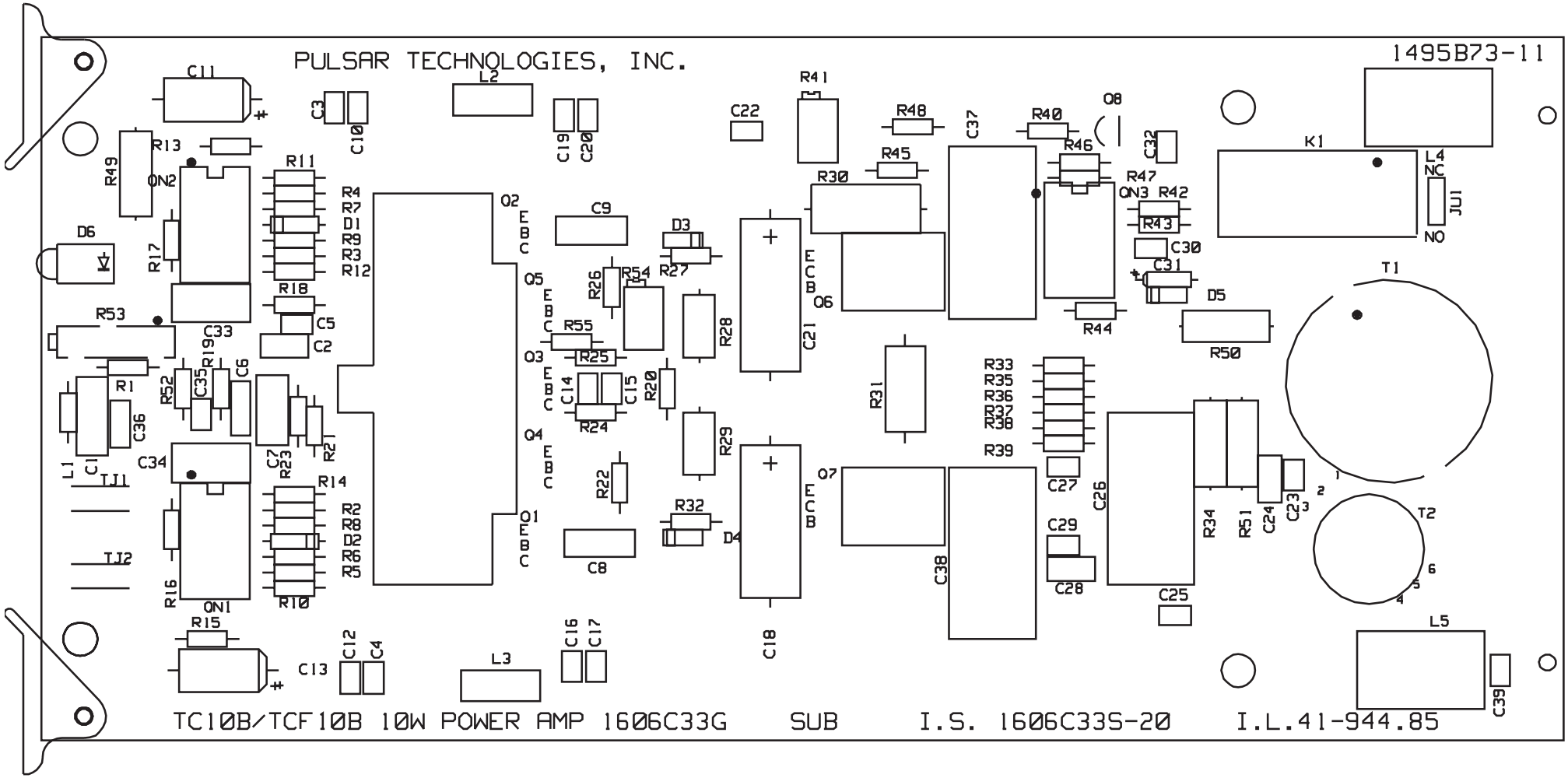
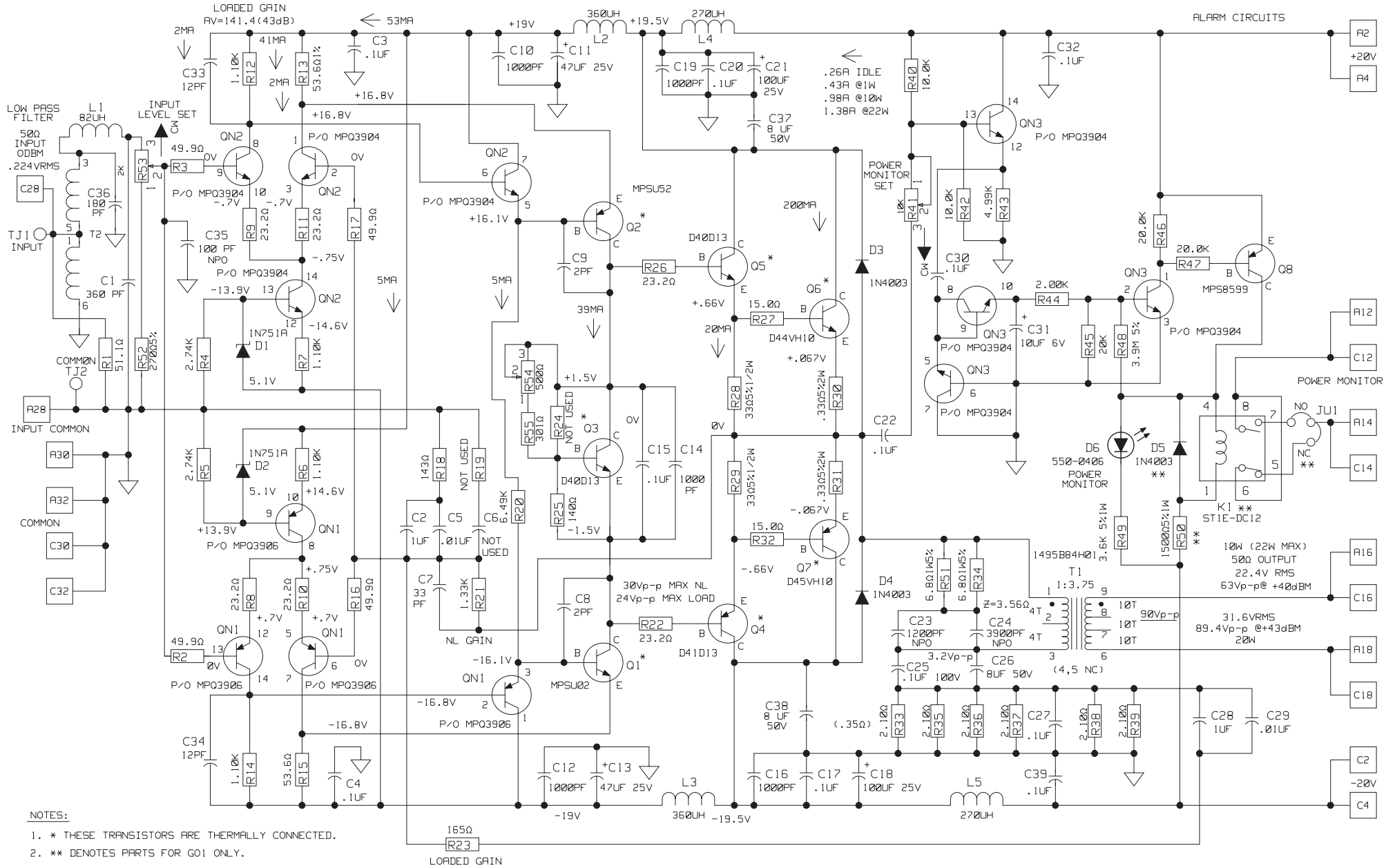


Figure 8–2. LPA50/LPA100 12.5W PA PC Board (1495B73)

[redacted]

Figure 8–3. 12.5W PA Schematic (1606C33).



Chapter 9. 50W Combiner Module

Schematic	CA30-CMBMN
Part List	CA40-CMBMN

Table 9–1. CA20-CMBMN Styles and Descriptions.

Group	Styles & Description
001	50Ω Impedance
003	75Ω Impedance

9.1 50W Combiner Module Description

The function of the 50W Combiner Module is to take the outputs of four (4) 12.5W PA Modules and combine them to form one 50W output. The 50W Combiner Modules are completely passive, meaning they require no dc power.

The power combiner modules must have equal amplitude and in-phase carrier frequency signals. This is to ensure minimum loss in the combiner circuit. Whatever difference there is between the 4 input signals is dissipated as heat through the high wattage resistors on this module. In normal operation all of the 12.5W Power Amplifier modules are putting out equal amplitude, in-phase signals and there is almost zero loss in the combiner circuit.

If all the Power Supply modules are not turned on within a few minutes of one another, the Power Combiner module balance resistors will heat up. This is normal since only part of the Power Amplifier modules would be energized causing imbalance in the Power Combiner module. This heating will disappear after all Power Supplies are turned on and all the Power Amplifier modules are energized.

At the output of the 50W Power Combiner is an impedance matching transformer followed by a low pass filter with a cutoff frequency of approx. 600kHz. The matching transformer matches to a 50 or 75Ω line impedance depending on the style selected.

The PC board and schematic for the 50W Combiner Module are shown at the end of this chapter.

9.2 50W Combiner Modules Test Points

9.2.1 Calibration & Troubleshooting checks

If problems are noted with the 50W Combiner check that all 4 of the 12.5W Power Amplifiers are balanced with one another. Their output levels must be checked on the input test points of the 50W Power Combiner module. Measure between any one of the four Power Combiner input test points (orange, yellow, white, & blue - see Figure 9-1) and the common test point (black) in order to verify that the levels are equal to one another and approximately 26Vrms (41.3 dBm 50Ω reference). If not then the serial # sticker must be removed from the front of whichever 12.5W Power Amplifier that needs to be adjusted in order to adjust its front panel input potentiometer.

Before turning the LPA power on, set up to measure the corresponding Power Combiner input test point for the 12.5W Power Amplifier. Then after turning the power on, quickly adjust the input potentiometer on the 12.5W Power Amplifier to be the same level as the other three amplifiers on the Power Combiner input test points. Any difference in power level at these 4 test points will be dissipated in the Power Combiner high wattage resistors. It's important to balance these levels as close to equal as possible in order to maximize transfer of signal power to the line tuner.

⚠ CAUTION

BE CAREFUL TO NOT LET THE TEST POINTS SHORT TOGETHER SINCE THEY ARE PHYSICALLY CLOSE TOGETHER.

9.2.2 In-service checks

Read between the red and black test points (50W output) on the 50W Power Combiner module (see Fig. 9-1). The level should be at 50Vrms +/- 1V, 50Ω or 61.3Vrms, 75Ω (+47.0dBm +/- 0.3dB) which is equal to 50W output for a rated load. This level should be approximately 6dB higher than the 4 equal levels on the input test points of the Power Combiner. If this level needs to be slightly changed, then adjust the driving carrier set amplifier's INPUT level potentiometer again. Then recheck the level on the INPUT test point of one of the 12.5W Power Amplifiers to make sure it doesn't exceed 1Vrms (+13.0dBm 50Ω reference) as set in the previous step. It is recommended that the 50W output level be measured with an oscilloscope to verify the accuracy of the selective level meter and also to check that the output sine wave is not distorted. This is important because a 1dB difference in level is equal to being off by 13 watts.

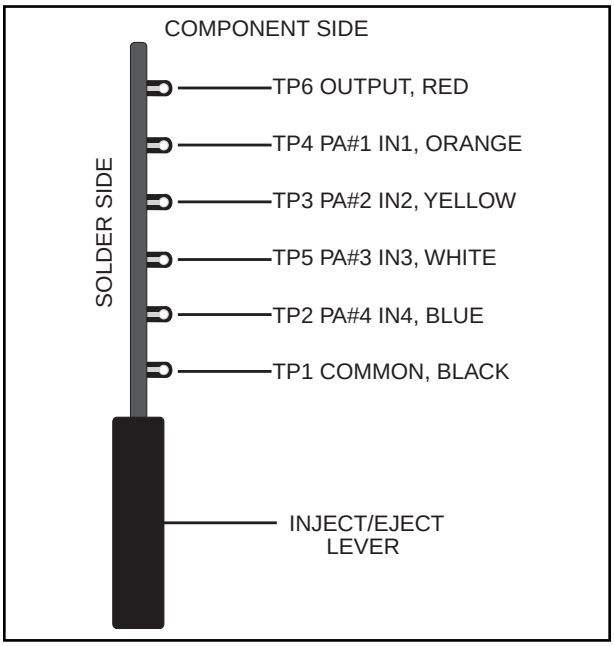


Figure 9–1. 50W Combiner Module

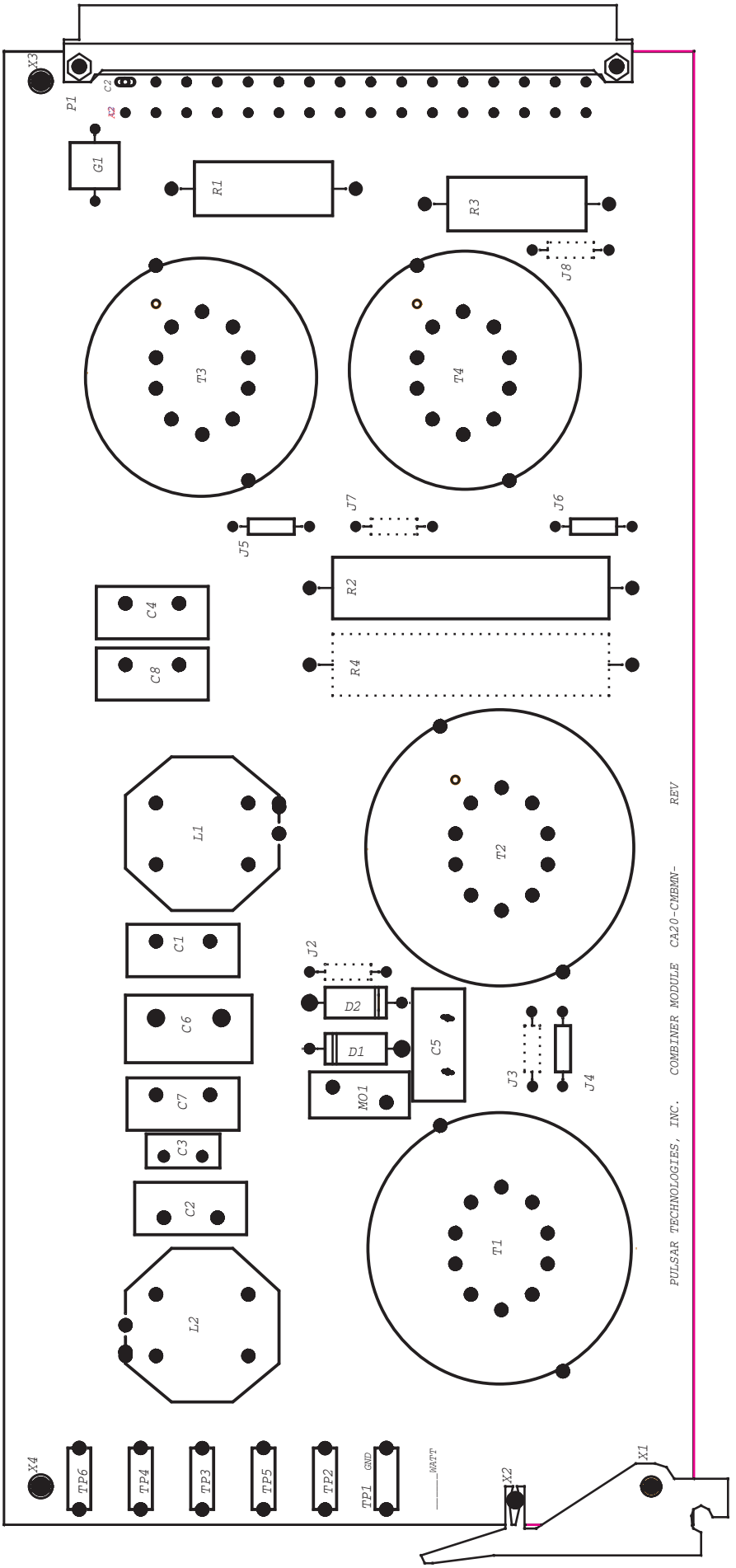
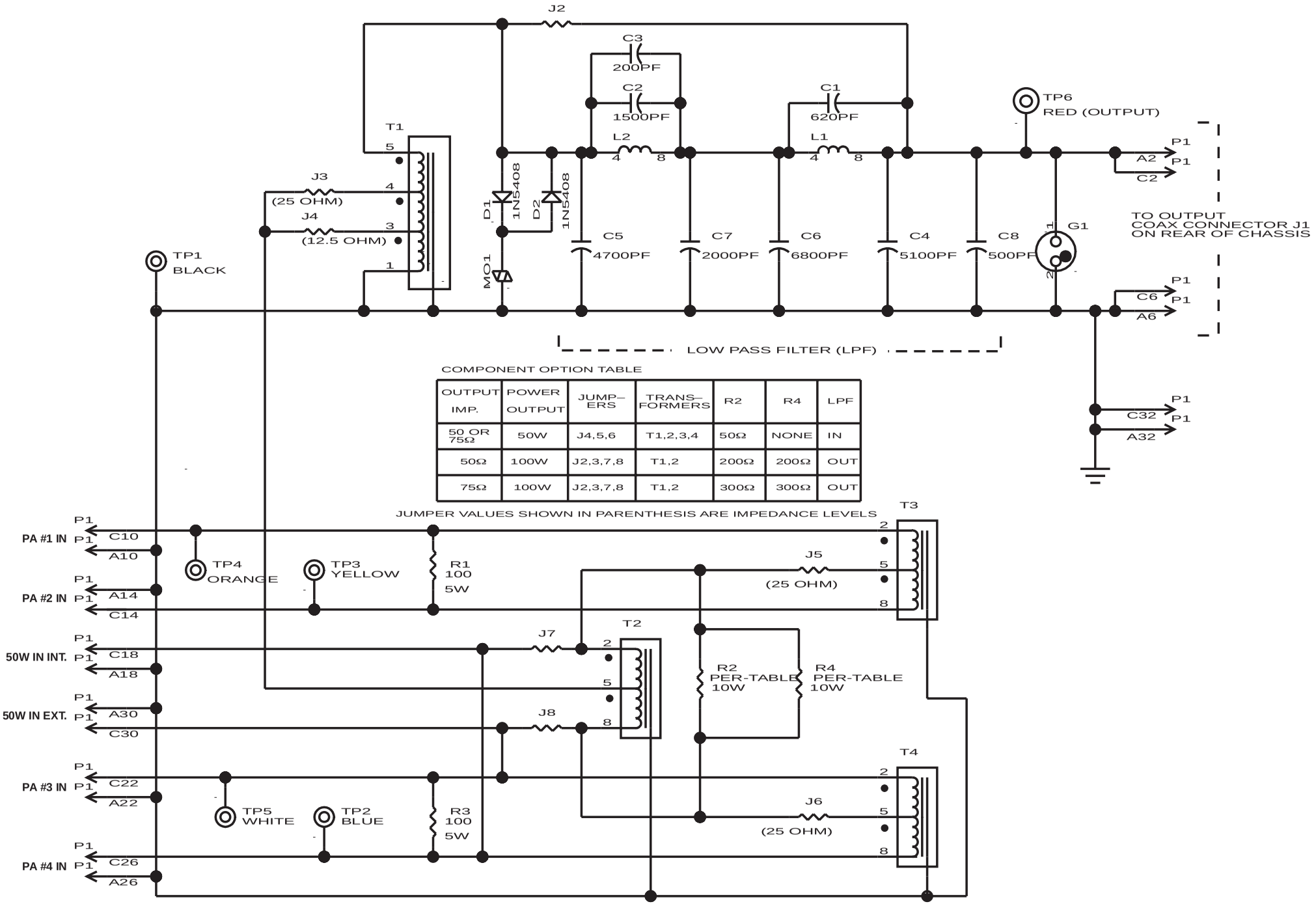


Figure 9–2. 50W Combiner Module Component Layout

Figure 9–3. Combiner Module Schematic (CA30CMBMN).



OUTPUT IMP.	POWER OUTPUT	JUMP–ERS	TRANS–FORMERS	R2	R4	LPF
50 OR 75Ω	50W	J4,5,6	T1,2,3,4	50Ω	NONE	IN
50Ω	100W	J2,3,7,8	T1,2	200Ω	200Ω	OUT
75Ω	100W	J2,3,7,8	T1,2	300Ω	300Ω	OUT

Chapter 10. 100W Combiner Module

Schematic	CA30-CMBMN
Part List	CA40-CMBMN

Table 10–1. CA20-CMBMN Styles and Descriptions.

Group	Styles & Description
002	50Ω Impedance
004	75Ω Impedance

10.1 100W Combiner Module Description

The function of the 100W Combiner Module, in essence, is to take the outputs of eight Power Amplifiers and combine them to form one 100W output. The 100W Combiner Modules are completely passive, meaning they require no power.

The power combiner modules must have equal amplitude and in-phase carrier frequency signals. This is to ensure minimum loss in the combiner circuit. Whatever difference there is between the 2 input signals (4 modules in chassis plus input from the other 50W chassis) is dissipated as heat through the high wattage resistors on this module. In normal operation all of the 12.5W Power Amplifier modules are putting out equal amplitude, in-phase signals and there is almost zero loss in the combiner circuit.

If all the Power Supply modules are not turned on within a few minutes of one another, the Power Combiner module balance resistors will heat up. This is normal since only part of the Power Amplifier modules would be energized causing imbalance in the Power Combiner module. This heating will disappear after all Power Supplies are turned on and all the Power Amplifier modules are energized.

At the output of the 100W Power Combiner is an impedance matching transformer for matching to a 50 or 75Ω line impedance, depending on the style selected.

The PC Board and schematic for the 100W Combiner Module are shown at the end of this chapter.

10.2 100W Combiner Modules Test Points

10.2.1 Calibration & Troubleshooting checks

If problems are noted with the 100W Combiner Module, check that both of the 50W Power Amplifiers are balanced with one another. Their output levels must be checked on the input test points of the 100W Power Combiner module.

On the 100W Power Combiner module (in chassis 1 of 2) measure between each of the two 50W input test jacks (blue = 50W output generated internally in the chassis, & white = 50W output of external chassis) and the common test jack (black). These two levels should be equal to one another and approximately at 51.8Vrms, 50Ω or 63.46Vrms, 75Ω (+47.3 dBm). These input test points on the 100W Power Combiner module are connected directly to the outputs of the two 50W Power Combiner modules.

10.2.2 In-Service Checks

Measure between the red & black test points (100W output) on the 100W Power Combiner module and the level should be at 70.7Vrms +/- 2Vrms, 50Ω or 86.6Vrms, 75Ω (+50.0dBm +/- 0.3dB). This level should be approximately 3dB higher than the 2 equal levels on the input test points of the 100W Power Combiner. If this level needs to be slightly changed, then adjust the driving carrier set amplifier's INPUT level potentiometer again. Then recheck the level on the INPUT test point of one of the 12.5W Power Amplifiers to make sure it doesn't exceed 1Vrms, 50Ω or (+13.0dBm). It is recommended that this final output level be measured with an oscilloscope to verify the accuracy of the selective level meter and also to check that the output sine wave is not distorted. This is important, a 1dB difference in level equals being off by 26 watts.

⚠ CAUTION

BE CAREFUL TO NOT LET THE TEST POINTS SHORT TOGETHER SINCE THEY ARE PHYSICALLY CLOSE TOGETHER.

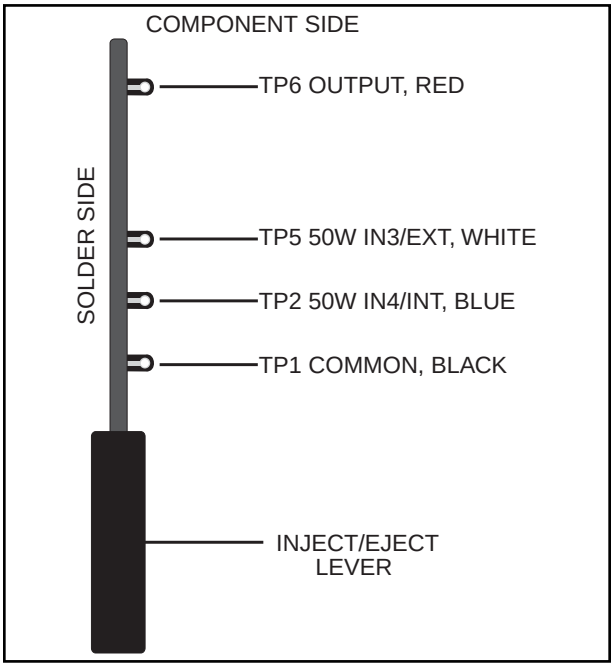


Figure 10-1 100W Combiner Module

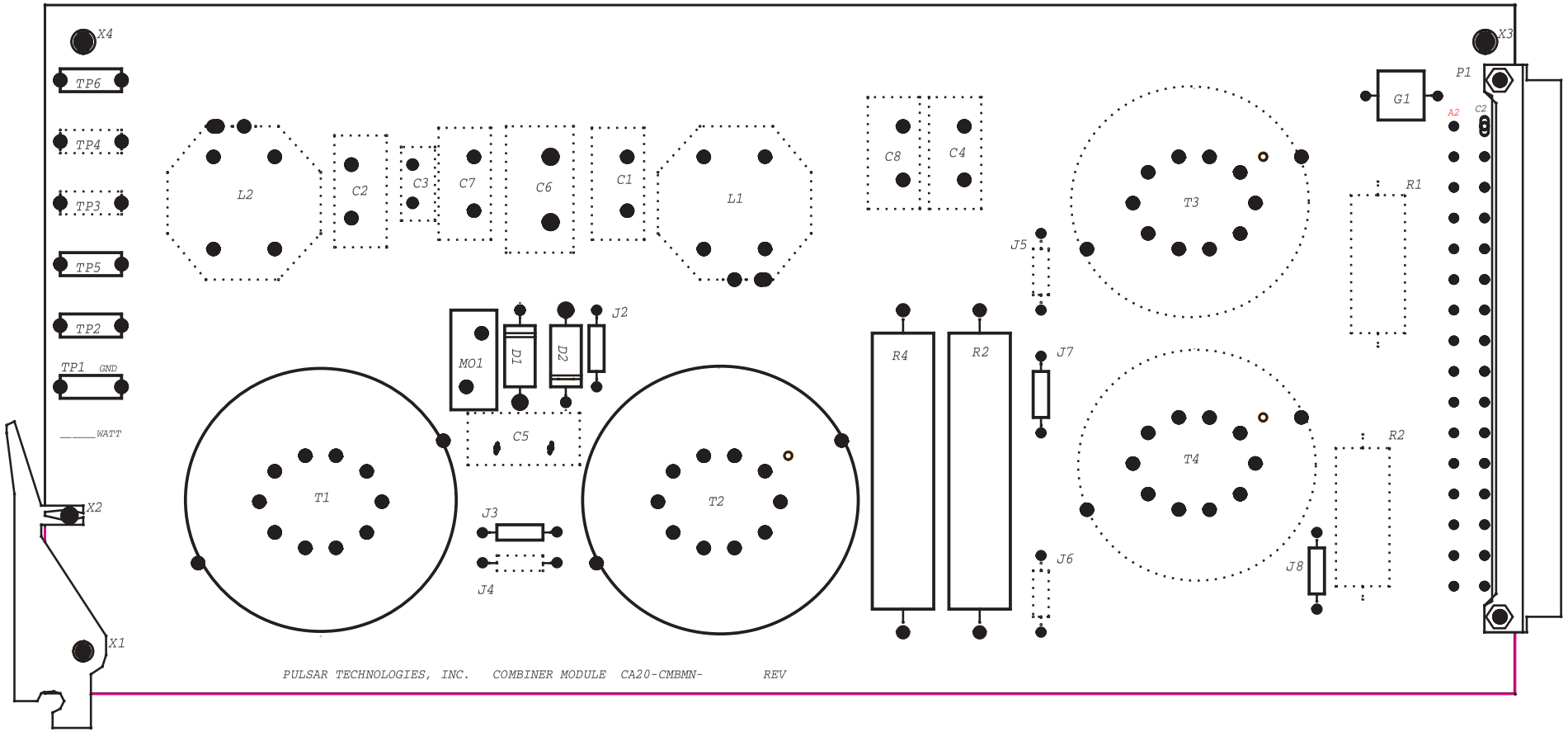
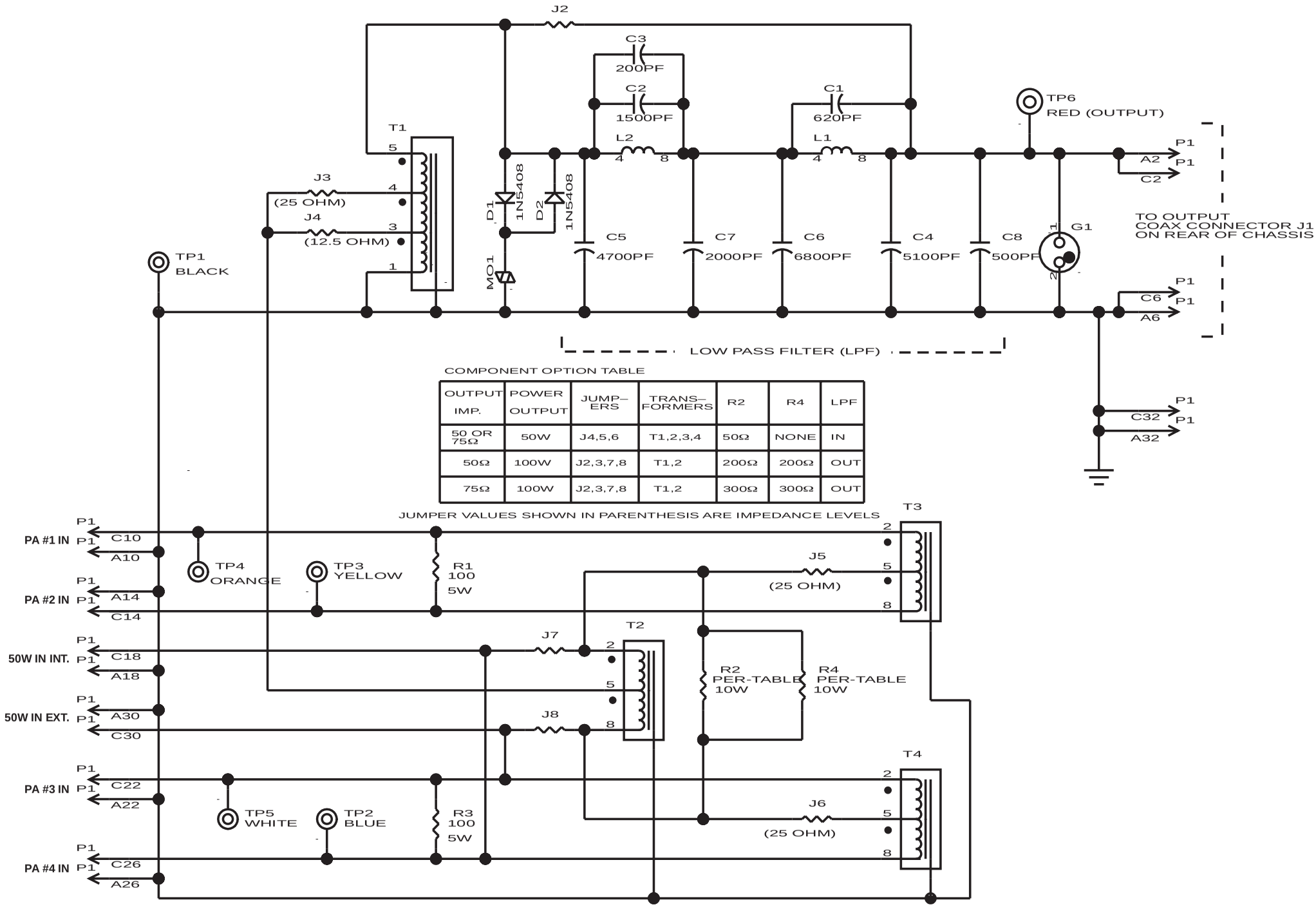


Figure 10-2. 100W Combiner Module Component Layout

Figure 10–3. Combiner Module Schematic (CA30CMBMN).



OUTPUT IMP.	POWER OUTPUT	JUMP–ERS	TRANS–FORMERS	R2	R4	LPF
50 OR 75Ω	50W	J4,5,6	T1,2,3,4	50Ω	NONE	IN
50Ω	100W	J2,3,7,8	T1,2	200Ω	200Ω	OUT
75Ω	100W	J2,3,7,8	T1,2	300Ω	300Ω	OUT

Pulsar
Technologies, Inc.