POWERWAVE
TECHNOLOGIES

INSTALLATION & SERVICE MANUAL

SPS9301-100 AMPLIFIER SYSTEM
SPA9301-50 AMPLIFIER

SINGLE CHANNEL GSM AMPLIFIER SYSTEM

1930-1990 MHz
50 WATTS AVERAGE POWER

31 March 1998

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SECTION 1
GENERAL DESCRIPTION

1-1. INTRODUCTION.

This manual contains information and procedures for installation, operation, and maintenance of the SPS9301-100, a GSM1900 single channel amplifier system. The manual is organized into five sections as follows:

Section 1. General Description
Section 2. Installation
Section 3. Operating Instructions
Section 4. Principles of Operation
Section 5. Maintenance

1-2. GENERAL DESCRIPTION

The SPS9301-100 amplifier system is a single channel GSM power amplifier that operates from 1930 MHz to 1990 MHz. The amplifier system is modular in design, and is ideally suited for use in GSM base stations. The amplifier system is available in a minirack with two plug-in amplifier modules, a power supply, and low-loss cable extensions (figure 1-1) The plug-in amplifier modules each provide 50 watts of power and function completely independently of each other. The amplifier modules are designed for individual sector operation, providing sector continuous operation via fail-safe bypassing. All solid-state, the system is designed to provide trouble-free operation with minimum maintenance. The system's modular construction plus its unique and highly effective LED-based operational status and fault indicators help minimize downtime. The all fail-safe design provides protection in the event of an RF overpower input, an over-temperature condition, or loss of DC power. In the P.A. mode, each amplifier module provides a gain increase of 6 dB per sector. Inadvertent operator damage from front panel manipulation is virtually impossible.

The front panel of each amplifier module has the system RF input and output connectors that interface with the host system. The front panel of each amplifier module also has unit level fault indicators and a power on/off switch. Primary power for the amplifier system is +27 Vdc. Cooling for each plug-in amplifier module is provided by two fans mounted on the top and bottom of the minirack (figure 1-1). The fans draw outside air through the bottom of each module and exhaust hot air through the top of the minirack.

1-3. FUNCTIONAL AND PHYSICAL SPECIFICATIONS

Functional and physical specifications for the amplifier system are listed in table 1-1.

1-4. EQUIPMENT CHANGES

Powerwave Technologies, Inc. reserves the right to make minor changes to the equipment without notice, including but not necessarily limited to component substitution and circuitry changes. Such changes may or may not be incorporated in this manual, although it is our intention to keep each manual as up-to-date as possible. To that end, we ask that you, our customer, share with us information acquired in field situations which might be of assistance to another user. If you share it with us, we'll pass it around.

1-5. ORDERING INFORMATION

Table 1-1 following gives the component numbers and descriptions to be used when ordering either an entire system or individual components that comprise the system.

Table 1-1. Major System Components

COMPONENT NUMBER	DESCRIPTION
SPS9301-100	Minirack (holds two amplifiers, one 24 V power supply)
SPA9301-50	50-Watt Amplifier

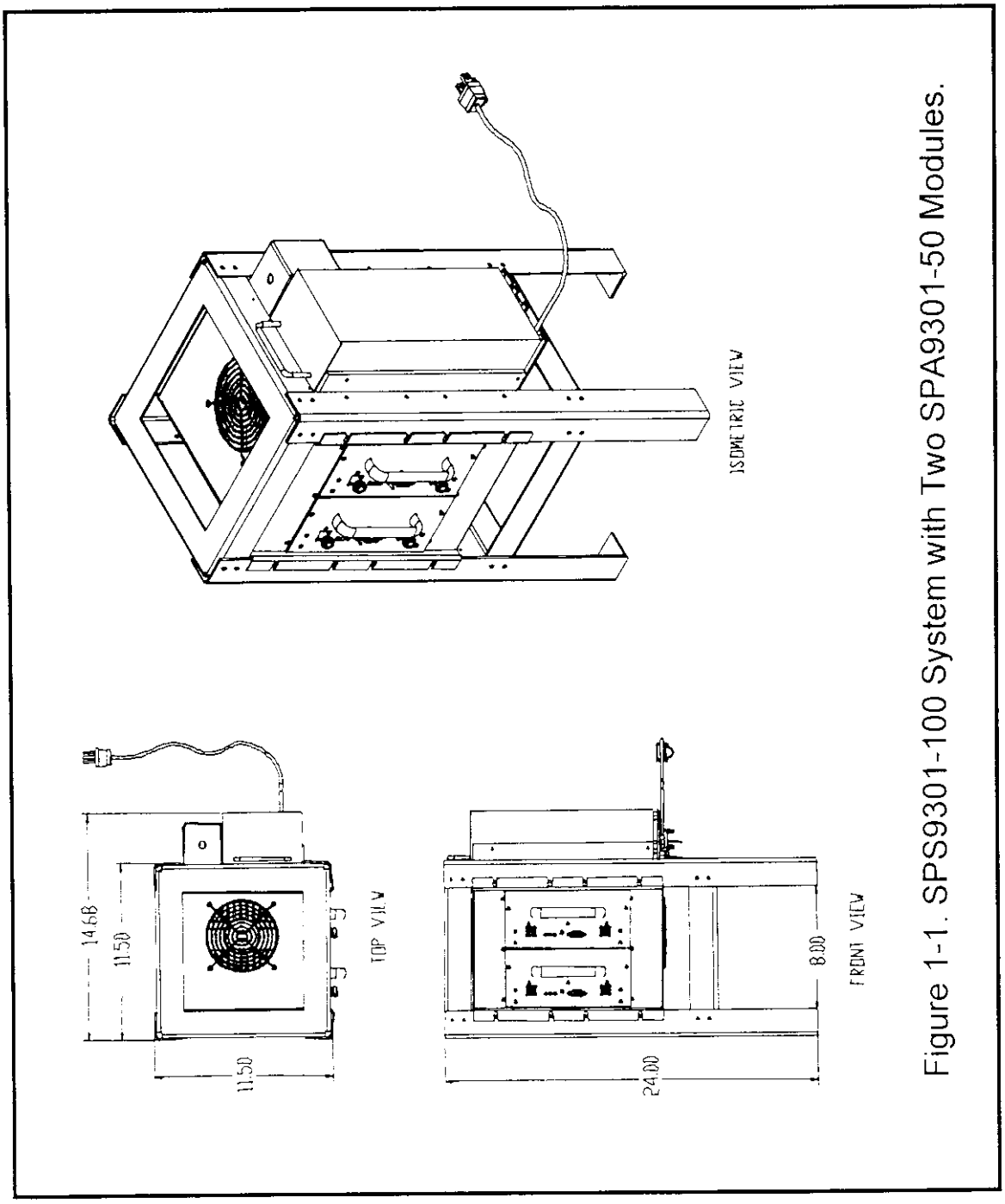


Figure 1-1. SPS9301-100 System with Two SPA9301-50 Modules.

Table 1-2. SPS9301-100 Single Channel Amplifier System Functional Specifications

Parameter (System)	Specification
Frequency	1930-1990 MHz
Temperature Range	
Ambient Temperature	-10 °C – +60 °C
Mounting Base Temp.	-10 °C – +80 °C
DC Power Supply	23.5–27.5 V, 22 Amps Max (11 Amps Max per Module)
VSWR	< 1.3:1 Input/Output Connector
Dimensions	See figure 1
Parameter (Module)	**Specification**
Output Power Range	
Operational Power Range	0–+ 48 dBm
Input Power Range	
P_{in} @ CW	-7–+42 dBm
Gain @ T_{amb} = 25 °C **P_O = +47 dBm**	6.0 +0.5/-0.2 dB @ P_O = +47dBm, V_{CC} = 27.5V (Note 1)
Efficiency	17 % min @ P_O = +47 dBm, V_{CC} = 27.5V
Junction Temperature	+145 °C max @ P_O = + 49 dBm
Harmonics	
2nd Harmonic	< -40 dBc
3rd or Higher Harmonic	< - 50 dBc
Spurious Emissions	
Within DCS Tx Band	< -38 dBm
Within DCS Rx Band	< -29 dBm
Outside Rx & Tx bands	< +9 dBm

Note 1. As measured at far end of output cables/host system interface.

SECTION 2
INSTALLATION

2-1. INTRODUCTION

This section contains installation recommendations as well as unpacking, inspection, and installation instructions for the SPS9301-100 Amplifier System. Carefully read all material in this section prior to equipment unpacking or installation. Also read and review the operating procedures in Section 3 prior to installing the equipment.

2-2. ELECTRICAL SERVICE RECOMMENDATIONS

All electrical service should be installed in accordance with any applicable government or local regulations (codes) and good engineering practice. Special consideration should be given to lightning protection of all systems in view of the vulnerability of most transmitter sites to lightning. Lightning arrestors are recommended in the service entrance. Straight, short ground runs are recommended. The electrical service must be well grounded.

Each amplifier system is supplied with its own AC and DC circuit breakers, so that a failure in one does not shut off the whole sector. Circuit breakers are thermal type, capable of handling an inrush current of 125 amps, in a load center with a master switch.

2-3. UNPACKING AND INSPECTION

This equipment has been operated, tested and calibrated at the factory. Only in the event of severe shocks or other mistreatment should any substantial readjustment be required. Check the outside of each shipping container for instructions regarding unpacking. Carefully open the containers and remove the rack and amplifier modules. Retain all packing material that can be reassembled in the event the that the unit must be returned to the factory.

CAUTION

Exercise care in handling equipment
during inspection to prevent damage
caused by rough or careless handling.

Visually inspect the amplifier rack and modules for damage that may have occurred during shipment. Check for evidence of water damage, bent or warped chassis, loose screws or nuts, or extraneous packing material in connectors or fans. Inspect all connectors for bent connector pins. If the equipment is damaged, a claim should be filed with the carrier once the extent of any damage is assessed. We cannot stress too strongly the importance of IMMEDIATE careful inspection of the equipment and the subsequent IMMEDIATE filing of the necessary claims against the carrier if necessary. If possible, inspect the equipment in the presence of the delivery person. If the equipment is damaged, the carrier is your first area of recourse. If the equipment is damaged and must be returned to the factory, write or phone for a return authorization. Powerwave may not accept returns without a return authorization. Claims for loss or damage may not be withheld from any payment to Powerwave, nor may any payment due be withheld pending the outcome thereof. WE CANNOT GUARANTEE THE FREIGHT CARRIER'S PERFORMANCE.

2-4. INSTALLATION INSTRUCTIONS (See figure 3-1)

The SPS9301-100 contains two amplifier modules, a power supply, and two RF cables. The system is designed for installation in a base station that permits access to the front of the amplifier system minirack for connection of RF signals and has access to a 120 volt U.S. conventional AC outlet (two blade plus ground pin) capable of supplying 20 amps.

To install the amplifier system proceed as follows:

1. Install the plug-in amplifier modules (if not already in place) in the slots of the subrack.
2. Verify that the POWER switch on the front of each module is in the down (OFF) position.
3. At bottom of power supply, verify that jumper connectors are in place and secure.
4. Assemble power supply in accordance with figure 1-1.
5. See figure 2-3; attach each fan connector from power supply to each fan on the minirack.
6. DO NOT connect 25-pin D-sub connectors to each amplifier at this time.
7. Refer to figure 2-2 for the location of all input/output connectors.
8. Connect each input cable to corresponding RF IN connector on front of amplifier module.
9. Connect each output cable to corresponding RF OUT connector on front of amplifier module.
10. Check your work before applying DC voltage to the amplifier. Make certain all connections are tight and correct.
11. Plug power supply line cord into a 120 volt U.S. conventional AC outlet (two blade plus ground pin) capable of supplying 20 amps.
12. Turn on power supply.
13. At bottom of power supply, measure primary DC input voltage at DC connectors. DC input voltage should be between +26.5 and 27.5 Vdc. If the DC input voltage is above or below the limits, call and consult Powerwave before you apply power to your amplifier.
14. Turn off power supply.
15. See figure 2-3; connect each +27 Vdc power cable from power supply to each amplifier module.
16. Secure minirack to floor with four screws.
17. Refer to section 3 for initial turn-on and checkout procedures.

2-5. AMPLIFIER MODULE POWER CONNECTOR

Each amplifier in the subrack has a separate connector. Power connections on the amplifier connector are made through a 25-pin D-Sub male connector (figure 2-1) and are listed and described in table 2-1.

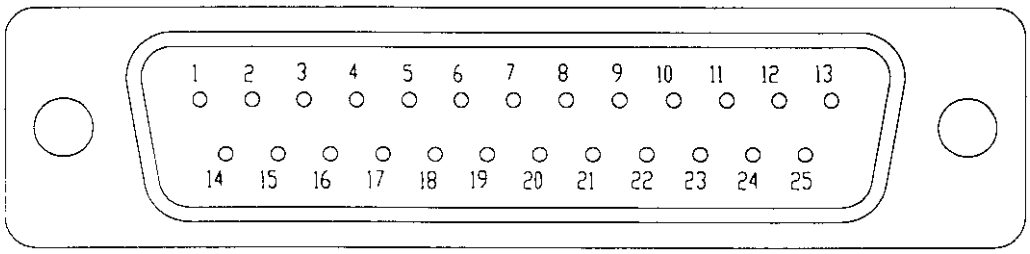


Figure 2-1. Male D-Sub Connector (on Rear of Amplifier Module)

Table 2-1. Amplifier Module D-Sub Connector Definition

PIN NUMBER	FUNCTION	DESCRIPTION
1-10	NC (No Connection)	
11-13	Input Power	+27 Vdc
14-22	NC (No Connection)	
23-25	Input Power	27 Vdc Return

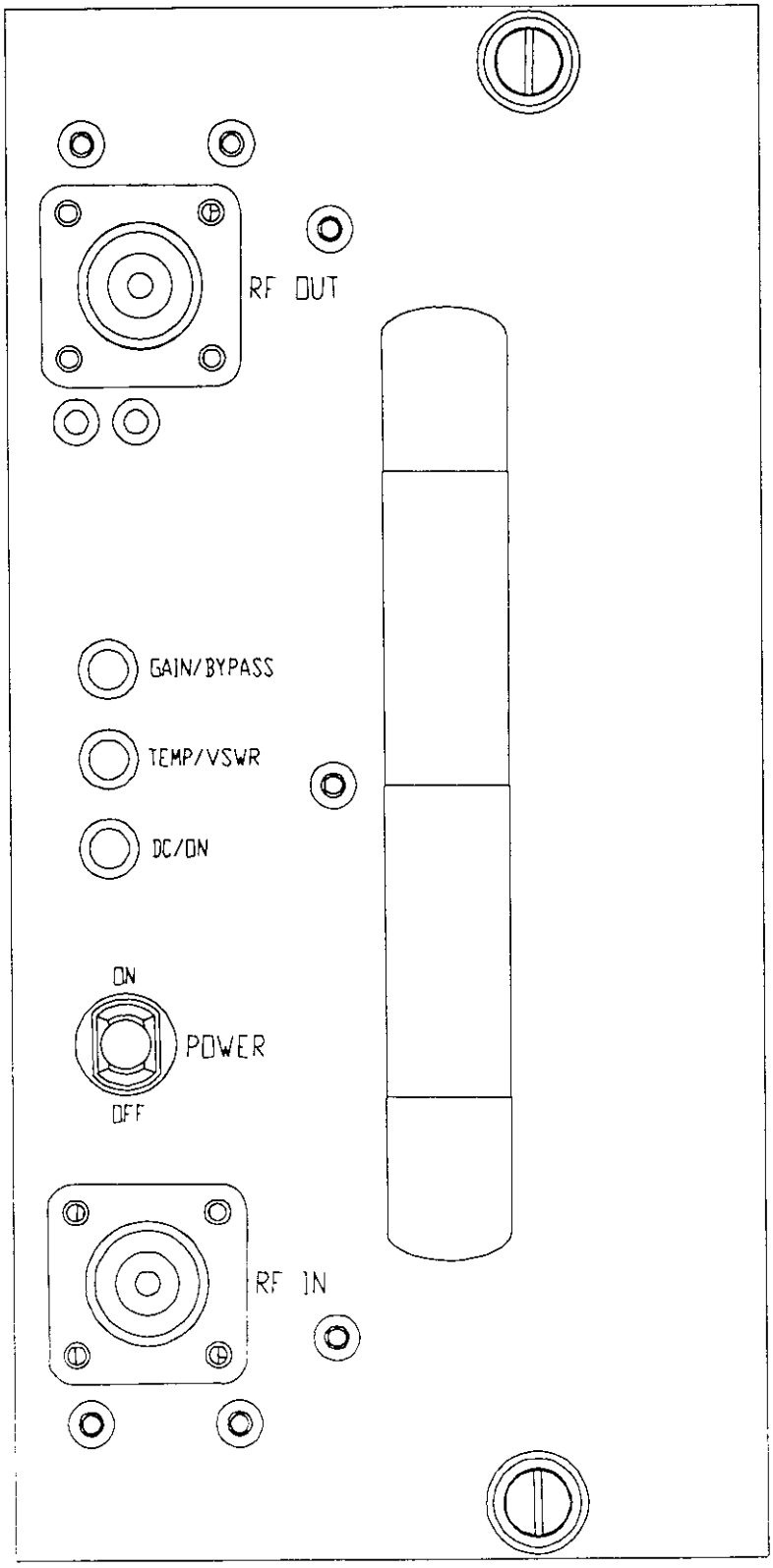


Figure 2-2. SPS9301-50 Amplifier Module Front Panel

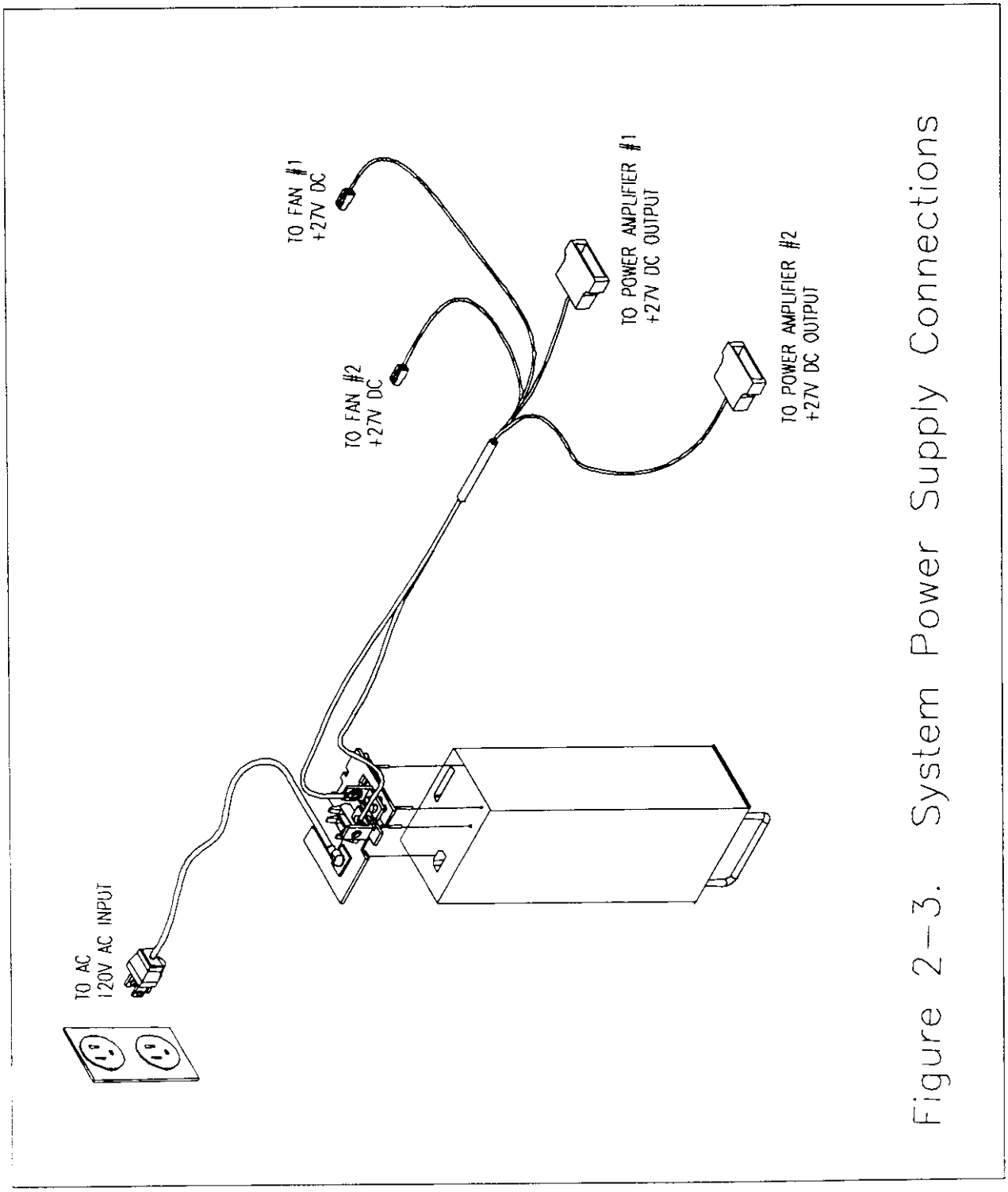


Figure 2-3. System Power Supply Connections

SECTION 3
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

This section contains operating instructions for the SPS9301-100 Amplifier System.

3-2. LOCATION AND FUNCTION OF AMPLIFIER MODULE CONTROLS AND INDICATORS.

The amplifier system consists of a stand-alone rack-style minirack containing a single subrack that houses two SPA9301-50 amplifier modules. A separate power supply is supplied which mounts along one side of the minirack to provide power to each of the two minirack fans and to each amplifier. The location and function of the amplifier interface connectors, indicators, and power switch are shown in figure 3-1 and are described in table 3-1.

Table 3-1. SPA9301-50 Interface Connectors, Indicators, and Power Switch

NAME	FUNCTION
RF OUT	RF Output, Type N Coaxial Connector
RF IN	RF Input, Type N Coaxial Connector
POWER ON / OFF Switch	Circuit Breaker Control of DC Power to Amplifier
GAIN / BYPASS Indicator	Red LED. When lit, indicates that amplifier is in bypass mode.
TEMP / VSWR Indicator	Yellow LED. When lit, indicates that overtemperature condition exists.
DC / ON Indicator	Green LED. When lit, indicates that +27 Vdc is applied to the amplifier module.
J2	25-Pin D-Sub Connector (+27 Vdc and Return)

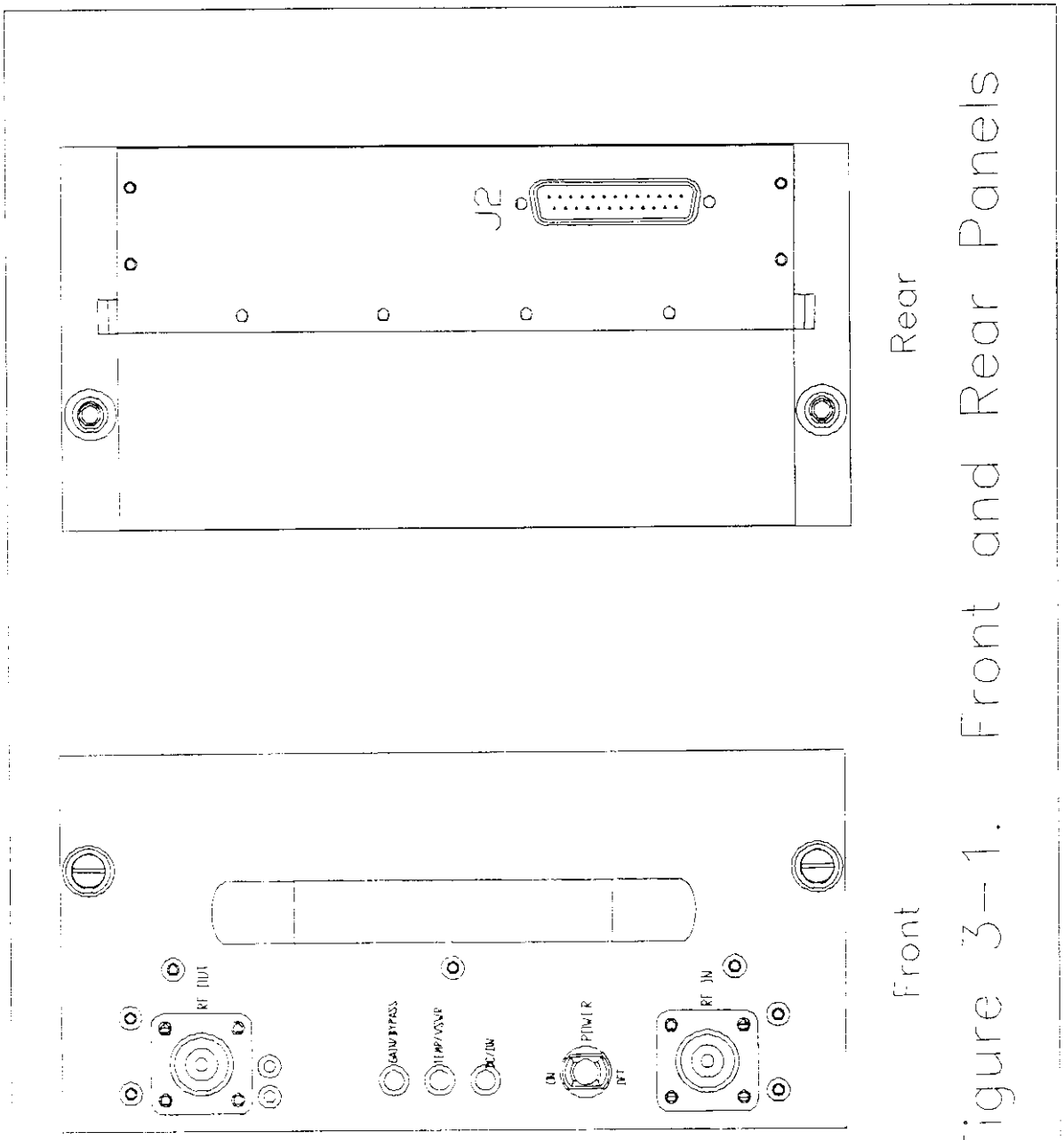


Figure 3-1. Front and Rear Panels

3-3. INITIAL START-UP AND OPERATING PROCEDURES.

The only operating control on each amplifier module is the ON/OFF switch. To perform the initial start-up, proceed as follows:

1. Double check to ensure that all input and output cables are properly connected.

WARNING

Before applying power, make sure that the input and output of each amplifier are properly terminated at 50 ohms. Do not operate the amplifier without a load attached. Refer to table 1-2 for input power requirements. Excessive input power may damage the amplifier

NOTE

The output coaxial cable between the amplifier and the antenna must be 50-ohm coaxial cable. Use of any other cable will distort the output.

2. Verify that front panel switches on both amplifiers are in the OFF position.

3. Turn on supply that provides +27 Vdc to the amplifier system. Do not apply an RF signal to the amplifier system at this time.

4. Visually check each amplifier module as it is turned on, and verify that the DC ON indicator (green) comes on. The TEMP / VSWR and GAIN / BYPASS indicators should be off.

5. Apply RF input signals to either or both amplifiers.

6. Allow the amplifiers to warm up for a minimum of five (5) minutes.

SECTION 4
PRINCIPLES OF OPERATION

4-1. INTRODUCTION
This section contains a functional description of the SPS9301-100 linear amplifier system.

4-2. RF INPUT SIGNAL
The maximum input power for all carrier frequencies should not exceed the limits specified in table 1-2. The input VSWR should be 1.3:1 maximum (or better).

4-3. RF OUTPUT LOAD
The load impedance should be as good as possible (1.3:1 or better) in the working band for good power transfer to the load. If the amplifier is operated into a filter, it will maintain its distortion characteristics outside the signal band even if the VSWR is infinite.

4-4. SYSTEM FUNCTIONAL DESCRIPTION

The amplifier system is comprised of a minirack and two fan assemblies, two SPA9301-50 plug-in power amplifier modules, input and output coaxial cables, and an ac-dc converter. The SPA9301-50 is a TDMA amplifier that operates in a 60MHz bandwidth from 1930 MHz to 1990MHz. A typical two-module system is shown in figure 1-1. Power output specifications are listed in table 1-2. Each amplifier is a self-contained pug-in module and is functionally independent of the other amplifier module. The rear panel of each amplifier as well as each fan in the minirack assembly has a connector that interfaces with the minirack power converter which, in turn, plugs into a conventional (U.S.) 120-volt ac outlet. Each amplifier front panel has I/O connectors that interface with the host RF signal source and system antenna.

4-5. SPA9301-50 AMPLIFIER MODULE
The amplifier module, figure 4-1, has an average power output of 50 watts. It is comprised of:

An input splitter / digital section,
An output amplifier section,
A switch driver section,
A DC circuit breaker, and
A 12 volt voltage regulator

The main amplifier employs class AB amplification for maximum efficiency.

4-5.1 MAIN AMPLIFIER
The amplifier employs a single parallel class AB amplifier which provides at least 6 dB of gain in any 30 MHz frequency band from 1930 MHz to 1990 MHz. The amplifier operates on +27 Vdc with a bias voltage of +5 Vdc, and is mounted directly on a heat sink. The alarm logic controls the +5 Vdc bias voltage which shuts down the amplifier on an input overpower condition.

4-5.2. AMPLIFIER MONITORING
In routine operation, input, output, and reflected power is continuously monitored. When large variations occur the modules generate alarm outputs. The alarms are displayed on the front panel indicator.

4-5.3. AMPLIFIER MODULE COOLING
Although each amplifier module contains its own heat sink, it is cooled with forced air. Two fans are used for forced air cooling and redundancy. The fans are located on the top and bottom of the minirack assembly. They draw air in through the bottom of the amplifier and exhaust hot air out the top of the module. The fans are field replaceable.

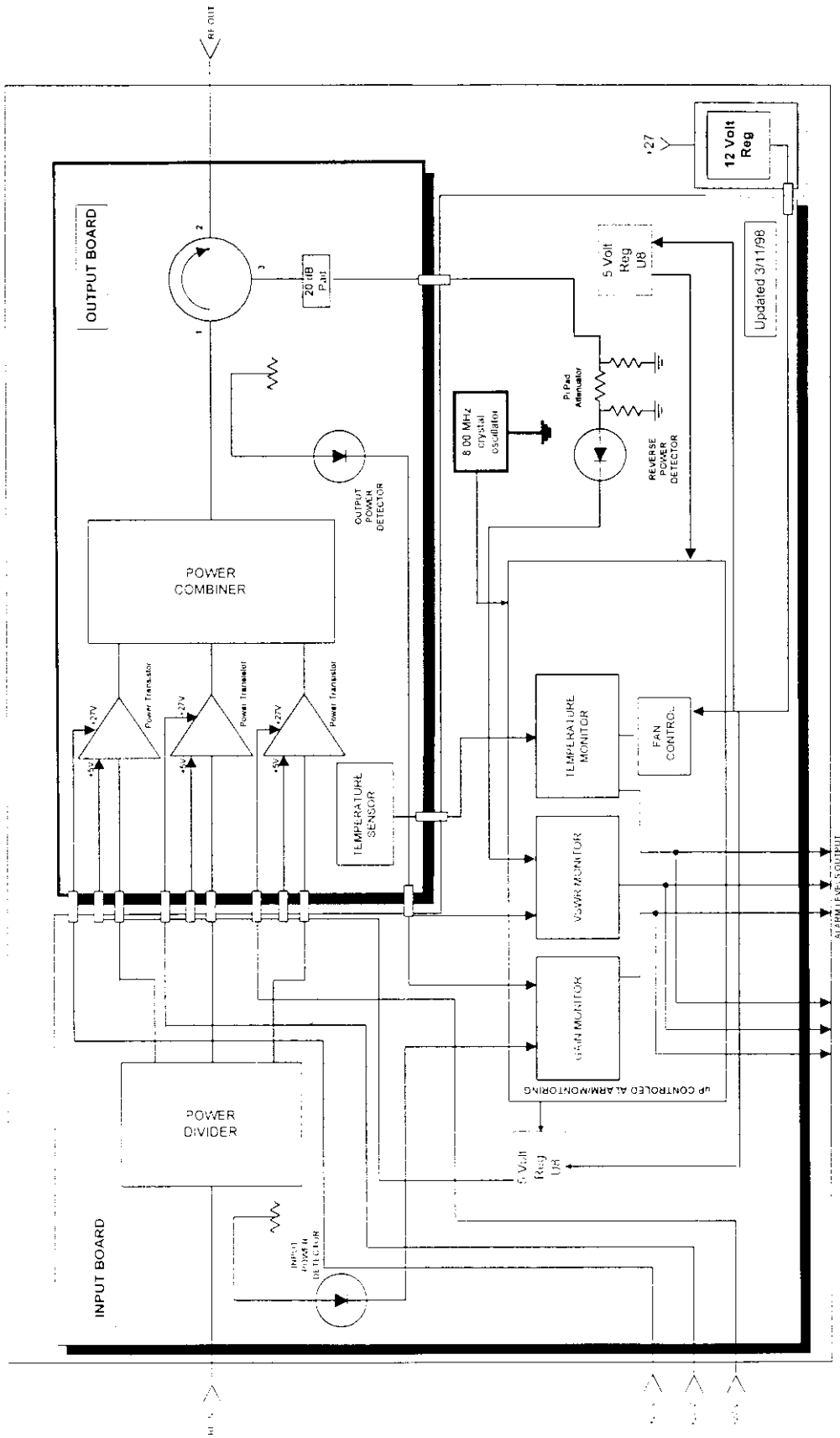


Figure 4-1. SPA9301-50 Main Amp Palette Block Diagram

4-6. POWER DISTRIBUTION

Primary DC power for the system is provided by a one-kilowatt power supply attached to the minirack. The power supply provides each amplifier module and both fans with +27 Vdc.

4-7. ALARMS

A number of plug-in amplifier and system parameters and alarms can be monitored locally or remotely (optional).

SECTION 5
MAINTENANCE

5-1. INTRODUCTION

This section contains periodic maintenance and performance test procedures for the SPS9301-100 Amplifier System. It also contains a list of test equipment required to perform the identified tasks.

NOTE

Check your sales order and equipment warranty before attempting to service or repair the unit. Do not break the seals on equipment under warranty or the warranty may be null and void. Do not return equipment for warranty or repair service until proper shipping instructions are received from the factory.

5-2. PERIODIC MAINTENANCE

Periodic maintenance requirements are listed in Table 5-1. Table 5-1 also lists the intervals at which the tasks should be performed.

WARNING

Wear proper eye protection to avoid eye injury when using compressed air.

Table 5-1. Periodic Maintenance

TASK	INTERVAL	ACTION
Cleaning		
Air Vents	30 Days	Inspect and clean per paragraph 5-4
Inspection		
Cables and Connectors	12 Months	Inspect signal and power cables for frayed insulation. Check RF connectors to be sure that they are tight
Performance Tests	12 Months	Perform annual test per paragraph 5-5.

5-3. CLEANING AIR INLETS/OUTLETS

The air inlets and outlets should be cleaned every 30 days. If the equipment is operated in a severe dust environment, they should be cleaned more often as necessary. Turn off DC power source before removing fans. If dust and dirt are allowed to accumulate, the cooling efficiency may be diminished. Using either compressed air or a brush with soft bristles, loosen and remove accumulated dust and dirt from the air inlet panels.

5-4. TEST EQUIPMENT REQUIRED FOR TEST

Test equipment required to test the SPS9301-100 amplifier system is listed in appendix A. Equivalent test equipment may be substituted for any item, keeping in mind that a thermistor-type power meter is required.

NOTE

All RF test equipment must be calibrated to 0.05 dB resolution. Any deviation from the nominal attenuation must be accounted for and factored into all output readings.

5-5. PERFORMANCE TEST

Performance testing should be conducted in accordance with appendix A every 12 months to ensure that the amplifier system meets the operational specifications listed on data sheet DS SPA9301-50 (appendix B). Also verify system performance after any amplifier module is replaced in the field.

5-6. FIELD REPLACEABLE PARTS AND MODULES

The following parts and modules can be replaced in the field, on-site, by a qualified technician with experience maintaining RF power amplifiers and similar equipment.

1. SPA9301-50 Power Amplifier Module
2. Cooling Fans

5-6.1. SPA9301-50 POWER AMPLIFIER MODULE

To replace a power amplifier module, proceed as follows:

NOTE

Power supply may remain on (active) with one module fully operational while the following is performed.

1. Turn off the power switch on the front panel of the amplifier module.
2. Disconnect power cable from J2 at rear of amplifier module.
3. Loosen two screws that secure amplifier module to subrack.
4. Use handle on front of module, and with a steady even pressure, pull module out of chassis.
5. Replace amplifier module in reverse sequence. Make sure that power switch on front of module is in the OFF position.

5-6.2. COOLING FANS

To replace a cooling fan, proceed as follows:

1. Loosen four screws that secure fan to minirack. Disconnect fan power connector from amplifier module.
2. Install replacement fan in reverse order.

APPENDIX A
PERFORMANCE TEST

1. INTRODUCTION

1.1 Specification Variables

FL = 1930 MHz
FC = 1960 MHz
FH = 1990 MHz

1.2 Referenced Documents

Data Sheet: DS SPA 9301-50 (see appendix B)

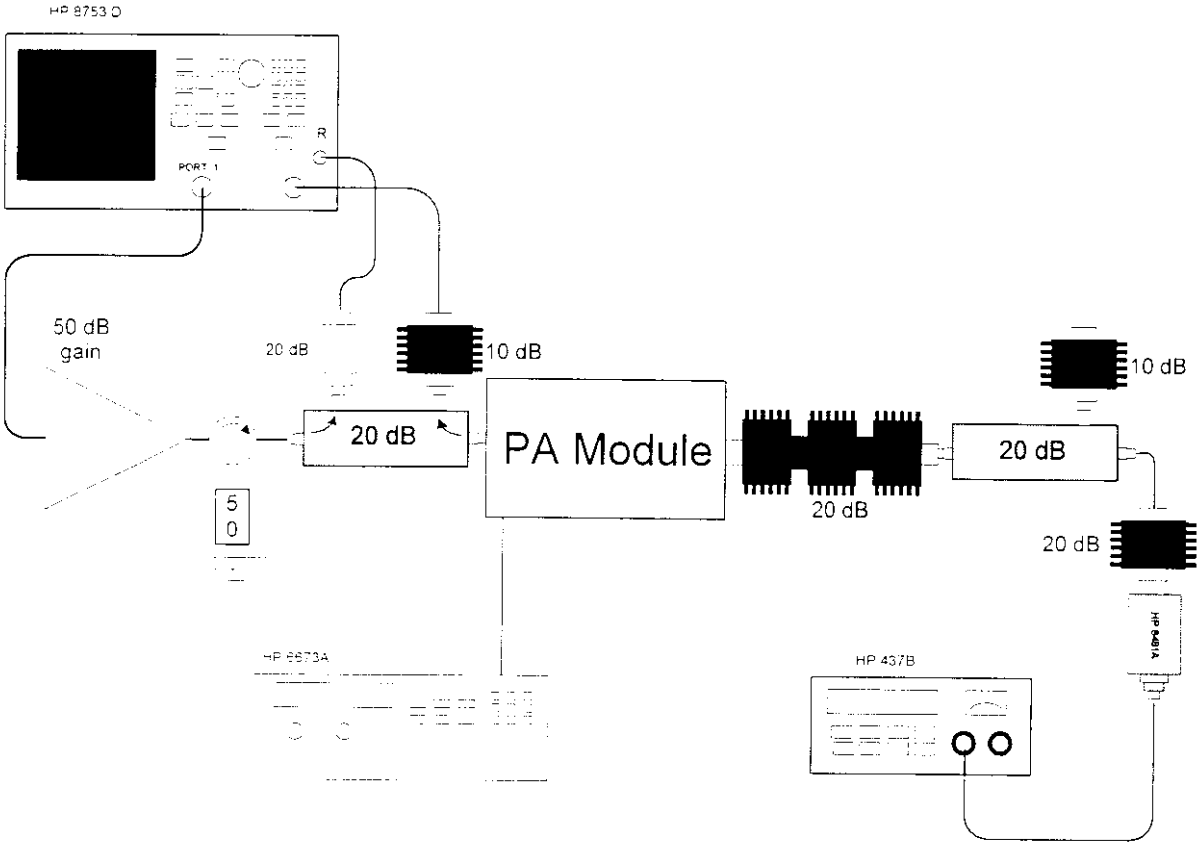
1.3 Test Equipment

1. Isolator, PCS
2. Preamp, 30W out, 0dBm in, 1900 MHz
3. Isolator, PCS, 30W, Midisco M3C0120 with high power termination
4. Coupler, High Power, 20dB, HP778D, 50W
5. DCPS, 24-26V, 15A, HP6673A
6. Isolator, 60 dB Ditom D3C0120 with high power termination
7. High Power Coupler, 10dB, Narda 3043BD, 500W
8. High Power Attenuator, 20dB, 250W
9. Coupler, HP86205A
10. Coupler, 10dB
11. Notch Filter, variable, Trilithic 3VNF 1000/2000-50-AB
12. Attenuator, 20 dB, N, 5W
13. Power Sensor, HP8481A
14. RF Power Meter, HP437A
15. Signal Generator, HP8648A
16. Network Analyzer, HP8753D
17. Spectrum Analyzer, HP 8561E
18. Peak Power Meter, HP8991A with 84815A power sensor

2. TEST

2.1. VSWR

2.1.1. Test Configuration



2.1.2. Test Procedure

Determine Drive Required to get +47dBm from PA

1) Configure the setup shown above by connecting the input and output loadstrings together (The PA Module is removed).

2) The output loadstring should be already calibrated so that we can now accurately read the power coming out of the Input Loadstring.

3) Set up the Network Analyzer per below:

   Preset, S21, Log Mag, 5dB/Div, Ref -17.8 dB, Smoothing 5%

   Start 1900 MHz, Stop 2000 MHz, Markers at FL, FC FH

   Power set initially to -15dBm, adjust for +40.6dBm into PA

   Calibrate: Interpol On, Cal kit N 50 ohm, Cal: Response

Power range set to range #1

Turn off RF

4) Set the Network Analyzer sweep type to CW at FC MHz, RF output power to -15dBm.

5) Increase the drive until the power meter reads 47-6.2=40.8 dBm. Note and keep the drive level from the Network Analyzer required to do this.

6) Turn off RF and disconnect the Output Loadstring from the Input Loadstring.

Calibrate Network Analyzer

1) Set the Network Analyzer back to Lin Freq Sweep.

2) Connect an N(m) short circuit to the output of the input directional coupler.

3) Turn the Network Analyzer RF power ON and perform an S21 response calibration.

4) Turn the Network Analyzer RF OFF.

Measurement

1) Connect the calibrated Input loadstring to the input of the PA.

2) Connect the 50 ohm 150W attenuator to the output of the PA.

3) Turn on the PA Module and then turn the Network Analyzer RF ON.

4) Measure S21 with the response calibration performed in previous section.

5) Record the highest point in the band as the input return loss of the PA module.

6) Turn the Network Analyzer RF OFF. Turn off the PA module.

7) Swap the RF connections to the PA Module so that the Input Loadstring is connected to the output of the PA and the Output Loadstring is used as a termination for the RF Input connector on the PA.

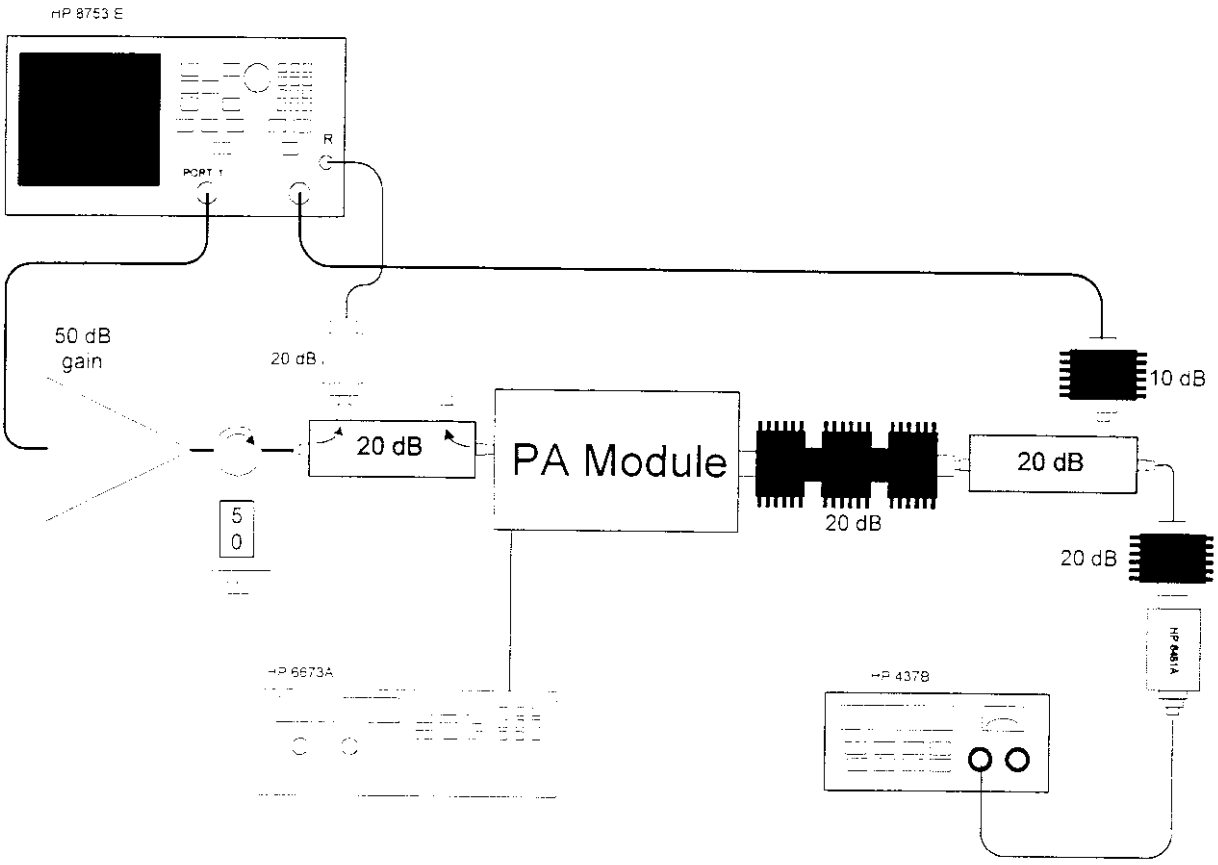
8) Turn the PA on and the Network Analyzer RF ON

9) Measure S21 as in step 4.

10) Record the highest point in the band as the Output Return Loss of the PA.

2.2. Gain and Current

2.2.1 Test Configuration



2.2.2 Test Procedure

Calibration

1) Zero and Calibrate the power meter.

2) The Output Loadstring should already be calibrated and the offset entered in the Power Meter, along with the operating frequency FC.

3) Remove the PA from the RF path and connect the Input and Output loadstrings back-to-back.

4) Recall the NA setup or go to refer to setup below to set up the Network Analyzer.

   Preset, S21, Log Mag, 2dB/Div, Ref 6.4dB, Start 1900 MHz, Stop 2000 MHz

   Markers at FL, FC, FH, Smoothing 5%, Avg 16

   Power about -3.5, use power meter to find 40.6 dBm out.

   Power Range Manual, Range 1 (to protect preamp from overdrive)

<Cal> Interpolation On. Cal Kit N 50 ohm. Calibrate menu: Response

Use 20dB pad to the R Port for +47 dBm calibration

5) Set the output power of the network analyzer to -20dBm at FC MHz CW.

6) Apply DC power to the preamp and let the equipment warm up.

7) After the equipment has warmed up. set the NA RF Drive to read 47-6.4 = 40.6dBm at the Power Meter.

8) Change the sweep type on the network analyzer from CW to linear sweep.

9) Perform a response calibration. and save the calibration in a register in the analyzer.

Gain Measurement

1) The PA module is installed in its housing and connected to the test setup. Check that there is air flow around the unit. Use all the screws and screw down the cover.

2) Recall the gain calibration for a PA output power level of 47dBm.

3) With RF off. Turn on the PA.

Nominal Vcc

1) Adjust the DC power supply so that the voltage at the connector to the unit is 27VDC nominal.

2) Go to CW mode on the NA and set output power to +47 dBm at FC. then go back to Lin Sweep.

3) Measure and record the PA Module Max gain and Min gain. Avg. ON. (Use <Marker Function>. Marker Search. Max. Min)

Low Vcc

1) Adjust the DC power supply so that the voltage at the connector to the unit is 27V-.5VDC.

2) Go to CW mode on the NA and reset output power to +47 dBm at FC. then go back to Lin Sweep.

3) Current measurements may be done at this time with CW at FC. FL & FH. .

4) Measure and record the PA Module Max gain and Min gain. Avg ON.

High Vcc

1) Adjust the DC power supply so that the voltage at the connector to the unit is 27+0.5VDC.

2) Go to CW mode on the NA and reset output power to +47 dBm at FC, then go back to Lin Sweep.

3) Measure and record the PA Module Max gain and Min gain. Avg ON.

2.3. Spurious Emissions

2.3.1. Test Configuration

Starting with the setup for gain, disconnect the Network Analyzer and add the Spectrum Analyzer and the Digital GSM generator.

Connect the loadstring that was going to Port 2 to the Spectrum Analyzer.

Connect the preamp (and attached arm) that was going to Port 1 to the digital signal generator.

Connect the variable notch filter to the input of the Spectrum Analyzer.

2.3.2. Calibration

1) Set the PA to read +47dBm out with the calibrated output loadstring and power meter, using CW mode at FL.

2) Monitor the CW signal at the Spectrum Analyzer and make sure the variable filter is adjusted so that it presents minimal attenuation to the signal (the signal is not being filtered at this time).

3) Adjust the amplitude offset of the Spectrum Analyzer until it reads the same value for power (+47dBm) as the power meter reads.

2.3.3. Measurement

1) Set the spectrum analyzer settings as indicated below:

   VBW = 100kHz
   RBW = 100kHz
   Span = 60MHz
   Scale = 10 dB/ Div
   Peak Hold
   Center Frequency = FC MHz

2) Configure the signal generator to provide a CW signal at frequency of FL MHz and a power level of -15dBm.

3) Adjust the variable filter to minimise the carrier power on the Spectrum Analyzer.

4) Switch the generator to GMSK modulation ON

5) Adjust the output power level of the generator to provide a peak power level of +47dBm at the output of the PA module.

6) Measure the power level of any spurious tones that show up in this band, and record them as spurious emissions in the TX Band.

7) Repeat steps 2 through 6 for carrier frequencies of FC MHz and FH MHz.

8) Change the center frequency of the spectrum analyzer to 1880 MHz.

9) Repeat steps 2 thru 7, and record the level of the measured spurious tone as the spurious emissions in the RX band.

2.4. VSWR Alarm

2.4.1. Test Configuration

Use the same setup that is used to measure gain.

2.4.2. Test Procedure

With PA on at +47dBm at FC MHz, disconnect output cable at the test equipment end to simulate a VSWR fault.

Check that the yellow VSWR LED comes on and verify that the RF transfer relays are switching to bypass mode. The easiest way to see this is in the dramatic reduction of Vcc current. In bypass mode, even the bias supply is shut off.

Reconnect the output cable and verify that the only power coming out is the drive power.

To reset the bypass mode, turn off RF and turn off Vcc to the PA.

2.5. Gain Alarm

2.5.1. Test Configuration

Use Spurious Emissions setup without Spectrum analyzer

Use Digital Signal generator and Peak power sensor in place of HP437 power sensor.

2.5.2. Test Procedure:

Calibration

1) The output loadstring should already be calibrated with the offset and frequency entered into the power meter, which is zeroed and calibrated.

2) Set the digital generator to put out an unmodulated signal at FC so that the (437) output power meter reads about 47dBm.

3) Remove the sensor for the HP437 power meter and replace it with the sensor for the peak power meter. Adjust the offset for this channel until it reads the same as the HP437 power meter did.

Measurement

1) Remove the cover from the PA module.

2) Set the Digital Generator to CW at FL MHz for +47dBm out, peak., using 1 time slot.

3) To reduce the total gain, short the input trace to ground on the third transistor (farthest from the front plate) at the output of the input power divider.

4) Note that the Red disable LED comes on and that Bypass transfer takes place.

5) Remove the short. To reset the Bypass, turn off RF and then turn off Vcc momentarily.

2.6. Temperature Alarm

2.6.1. Test Configuration

RF to the PA off, PA output loaded, Vcc on. Same configuration as gain alarm.

2.6.2 Test Procedure

1) Turn on the PA with 47 dBm peak driven by the GMSK generator with 1 bit on.

2) Apply 4.5V to pin 7, 2nd pin from left on the bottom

3) Verify that the Yellow LED goes on and the Green LED goes off, while the voltage is applied.

2.7. Overdive Alarm

2.7.1. Test Configuration

1) GMSK Generator

2) Calibrated Input Loadstring with Peak Power Sensor

3) Output terminated with high power load

2.7.2 Test Procedure

With Generator at Center Freq., DC at Vcc 27V, Increase drive until unit shuts off or until drive level reaches 44dBm. Input peak drive level should be 41.5 to 42.5 dBm peak.

Verify that Bypass operation comes on with Overdrive Alarm.

Verify that the Red and yellow LEDs are on and that the Green LED goes off with Overdrive Alarm.

To reset Bypass Mode, turn unit off and then on again.

3. CALIBRATION – EQUIPMENT SETUP

3.1. Loadstrings Calibration

Calibrate a network Analyzer for gain response in the relevant freq band.

Use N cal kit and cables. N(f) at Port 1, N(m) at Port 2

Insert Loadstring and note loss at Center Freq.

Program the power meter with the offset and frequency.

3.2. Peak Power Meter – HP8991A

Setup routine:

1) <RECALL> <CLEAR>

2) <CARRIER FREQ> (Enter FH or FL as appropriate. This will change during testing.)

3) <TIME BASE> 500 us/Div

4) <DISP> Grid ON

5) <CHAN/VERT> CH 1: Scale 10 dB/Div, Ref 50 dB, Ext. Loss
(about 30 dB, to calibrate)
CH 2 Scale ....

6) <TRIG> 24 dBm

7) <MKS> Time Markers ON, Amb @ time ON. (position marker later over peak.)

8) To calibrate, set up generator to CW mode at FC frequency.

9) Set the Carrier Freq on the Peak Power Meter and the Frequency on the Power Meter.

10) Read power using power meter calibrated for loadstring.

11) Remove the Power Meter Sensor and substitute the Peak Power Meter Sensor.

12) Vary Ext. Loss until the reading is the same.

3.3. Operation of Digital Signal Generator ESG D2000A

1) Press <Preset>

2) Press <Mode> under "Menus" grouping on front panel.

3) Press Softkey "GSM"

4) Select Softkey "Data Format: Framed"

5) Configure Timeslot as required

6) Press <Frequency> and set frequency

7) Press <RF ON>

8) Press <Modulation ON>

9) Press <Amplitude> and set desired amplitude, not to exceed 0dBm.

APPENDIX B

DS SPA9301-50

POWERWAVE TECHNOLOGIES

TEST DATA SHEET Page 1 of 1
MODEL SPA 9301-50 (1900 MHz)

Date: _____
Tested By: _____
Pass/Fail: _____
S/N: _____

Title: PCS SINGLE CHANNEL RF ASSY TEST - Ambient 22 °C

Test Conditions: Load and source impedance: 50 ohms, VSWR < 1.2:1
Supply voltage: +27 Vdc (Unless otherwise noted)
Gain measurements are made with external coax cables attached.

TEST	CONDITION	MIN	MAX	DATA		
2.1	**VSWR, at drive for +47 dBm out**				**FL-FH**	
2.1.a	VSWR at Input, Highest across Band		1.3:1			
2.1.b	VSWR at Output, Highest across Band		1.3:1			
2.2	**Gain (Unit on for >10 min)**			**26.5 VDC**	**27 VDC**	**27.5 VDC**
2.2.a	Max Gain @+47dBm, 1930 – 1990 MHz	5.8 dB	6.4 dB			
2.2.b	Min Gain @+47dBm, 1930 – 1990 MHz	5.8 dB	6.4 dB			
	Current at +47 dBm Pout			**1930 MHz**	**1960 MHz**	**1990 MHz**
2.2.c	Current from 27VPS @ 26.5 Vdc,		11 A			
2.3	**Spurious Emissions**			**1930 MHz**	**1960 MHz**	**1990 MHz**
2.3.a	TX Band Spurious, 1960 MHz SA Cf		-38 dBm			
2.3.b	RX Band Spurious, 1880 MHz SA Cf		-29 dBm			
2.4	**VSWR Alarm**					
2.4.a	VSWR Alarm ON @+47 dBm out, disconnect output		Check			
2.4.b	Check Bypass operates with VSWR alarm		Check			
2.4.c	Check Yel. VSWR LED ON with VSWR alarm		Check			
2.5	**Gain Alarm**					
2.5.a	Gain Alarm ON @+47 dBm out, GMSK		Check			
2.5.b	Check Bypass with gain alarm		Check			
2.5.f	Gain Alarm red LED indicator ON		Check			
2.6	**Temperature Alarm Check**					
2.6.a	Fan Voltage OFF/ON, 4.5 V @ pin 7		Check			
2.6.b	Yellow LED OFF/ON, 4.5 V @ pin 7		Check			
2.6.c	Check green LED indicator goes off		Check			
2.7	**Overdrive Alarm**					
2.7.a	Overdrive Alm. GMSK drive, unit shuts off, 8ts. FL	41.5 dBm	42.5 dBm			
2.7.b	Overdive Alarm, GMSK drive, unit shuts off, 1ts. FH	41.5 dBm	42.5 dBm			
2.7.c	Check Red & Yel LED on, Grn LED off		Check			
2.7.d	Check Bypass operates with Overdrive Alarm		Check			