750W Compact High Power Amplifier

for Satellite Communications

C-Band

The VZC-6967AM

750 Watt TWT High Power Amplifier—high efficiency in a compact package.

Compact

Provides 750 watts of power in a 5 rack unit package, digital ready, for wideband, single- and multi-carrier satellite service in the 5.850-6.650 GHz frequency band. Ideal for transportable and fixed earth station applications where space and prime power are at a premium.

Efficient

Employs a high efficiency dual-depressed collector helix traveling wave tube backed by many years of field-proven experience in airborne and military applications.

Simple to Operate

User-friendly microprocessor-controlled logic with integrated computer interface, digital metering, pin diode attenuation and optional integrated linearizer for improved intermodulation performance.

Global Applications

Meets International Safety Standard EN-60215, Electromagnetic Compatibility 89/336/EEC and Harmonic Standard EN-61000-3-2 to satisfy worldwide requirements.

Easy to Maintain

Modular design and built-in fault diagnostic capability with convenient and clearly visible indicators for easy maintainability in the field.

Worldwide Support

Backed by over three decades of satellite communications experience, and CPI's worldwide 24-hour customer support network that includes fifteen regional factory service centers.

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C-Band

750W Compact High Power Amplifier

OPTIONS:

- *Integral Linearizer*
- *Remote Control Panel*
- *Redundant and Power Combined Subsystems*
- *Extended Frequency (5.850 to 6.725 GHz, Model Number VZC-6967AT; and 5.850 to 7.075 GHz, Model Number VZC-6967AN)*
- *External Receive Band Reject Filter (increases loss by a minimum of 70 dB up to 4.8 GHz)*

SPECIFICATIONS, VZC-6967AM

Electrical

Frequency	5.850-6.650 GHz
Output Power	
TWT	750 W min. (58.75 dBm)
Flange	650 W min. (58.13 dBm)
Bandwidth	800 MHz
Gain	75 dB min. at rated power, 88 dB max. 78 dB min. at small signal, 90 dB max.
RF Level Adjust Range	0 to 20 dB (via PIN diode attenuator)
Gain Stability	
At constant drive & temp.	±0.25 dB/24 hrs. max. (after 30 min. warmup)
Over temp., constant drive (any frequency)	±1.0 dB over oper. temp. range ±0.75 dB over ±10°C
Small Signal Gain Slope	±0.02 dB/MHz max.
Small Signal Gain Variation	
Across any 40 MHz band	0.5 dB pk-pk max.
Across the 800 MHz band	2.5 dB pk-pk max.
Across 800 MHz, with linearizer option	5.0 dB pk-pk max.
Input VSWR	1.25:1 max.
Output VSWR	1.25:1 max.
Load VSWR	
Continuous operation	2.0:1
Full spec compliance	1.5:1
Operation without damage	Any value
Residual AM, max.	-50 dBc below 10 kHz -20[1.5 +log F(kHz)] dBc, 10 kHz to 500 kHz -85 dBc above 500 kHz
Phase Noise	
IESS-308/309 phase noise profile	-6 dB
AC fundamentals related	-36 dBc
Sum of spurs (370 Hz to 1 MHz)	-47 dBc
AM/PM Conversion	2.5°/dB max. for a single-carrier at 8 dB below rated power. With optional integral linearizer, can be tuned to 1.0 deg/dB max.
Harmonic Output	-60 dBc at rated power, second and third harmonics
Noise and Spurious	<-130 dBW/4 kHz, 3.4 to 4.2 GHz <-65 dBW/4 kHz, 4.2 to 12.0 GHz <-60 dBW/4 kHz, 4.2 - 12.0 GHz with linearizer option <-110 dBW/4 kHz, 12.0 to 40.0 GHz
Noise Figure	10 dB max.; 15 dB max. with optional integral linearizer

Electrical (continued)

Intermodulation	-23 dBc max. with two equal carriers at total output power 7 dB (4 dB with optional integral linearizer) below rated single-carrier output
Group Delay (in any 40 MHz band)	0.01 ns/MHz linear max. 0.001 ns/MHz sq. parabolic max. 0.5 ns pk-pk ripple max.
Primary Power	
Voltage	Single phase, 208-240 VAC ±10%
Frequency	47- 63 Hz
Power Consumption	2.5 kVA typ. (at saturated RF output power) 2.8 kVA max.
Power Factor	0.95 min.
Inrush Current	200% max.

Environmental

Ambient Temperature	-10°C to + 50°C operating -40°C to + 70°C non-operating
Relative Humidity	95% non-condensing
Altitude	10,000 ft. with standard adiabatic derating of 2°C/1000 ft., operating; 50,000 ft. non-operating
Shock and Vibration	Designed for normal transportation environment per Section 514.4 MIL-STD-810E. Designed to withstand 20G at 11 ms (1/2 sine pulse) in non-operating condition.

Mechanical

Cooling	Forced air w/ integral blower. Rear air intake & exhaust. Maximum external pressure loss allowable: 0.5 inches water column.
RF Input Connection	Type N female
RF Output Connection	CPR-137 waveguide flange, grooved, threaded UNF 2B 10-32
RF Output Monitor	Type N female
Dimensions (W x H x D)	19 x 8.75 x 24 in. (483 x 222 x 610 mm)
Weight	95 lbs (43 kg) max.

Heat and Acoustic

Heat Dissipation	2000 Watts max.
Acoustic Noise	68 dBA (as measured at 3 ft.)

ISO 9001 Certificate Number: 30515

KEEPING YOU ON THE AIR
not up in the air

For more detailed information, please refer to the corresponding CPI Technical Description.

Note: Specifications may change without notice as a result of additional data or product refinement. Please contact CPI before using this information for system design.

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Technical Description

C-Band 750 Watt Compact High Power Amplifier

Models VZC-6967AM, VZC-6967AT and VZC-6967AN

INTRODUCTION

This document provides a detailed technical description of the CPI C-band Compact High Power Amplifier (CHPA), a 750 watt traveling wave tube amplifier designed specifically for uplink service in fixed satellite terminals, 'fly-aways' and digital satellite news gathering (DSNG) vehicles. Its compact, lightweight implementation of a wide band traveling wave tube (TWT) permits continuous, efficient operation across the entire 5.850 to 6.650 GHz frequency range (AM), the 5.850 to 6.725 GHz frequency range (AT), or the 5.85 to 7.075 GHz frequency range (AN). Improved RF performance can be achieved with the optional internally mounted and controlled linearizer. A microprocessor-based system performs all of the CHPA's monitor and control functions. Flash-RAM based program instructions are easily updated via a serial port using a PC, instead of requiring unit disassembly to access an integrated chip (EPROM). Additionally, the CHPA features power factor correction (0.95 min.) allowing the unit to meet the total harmonic distortion requirement of EN61000-3-2. It is also certified to meet EN-60215 safety requirements.

The VZC-6967AM/AT/AN CHPA is a member of a comprehensive line of communication amplifiers comprising TWT Amplifiers (TWTAs), Klystron Power Amplfiiers (KPAs) and Solid State Power Amplifiers (SSPAs). All are designed specifically for service in satellite earth stations operating in standard frequency bands.

CPI (formerly Varian Electron Device Group) has been active in the design and manufacture of microwave power amplifiers and related products for more than 30 years. CPI Satcom Division (formerly Varian MEP) was organized in the mid-1970s to bring together under a single business center the strengths of existing groups involved with Satcom and Industrial power amplifiers.

Since then, CPI Satcom Division has provided thousands of fully integrated satellite uplink power amplifiers in the S, C, X, Ku, DBS and Ka- band frequency ranges to worldwide users and has become the leading supplier of this class of products.

EQUIPMENT DESCRIPTION

General

The VZC-6967AM/AT/AN CHPA (Figure 1) is packaged in an 8.75-inch tall slide-mounted drawer suitable for standard 19-inch rack mounting. This enclosed assembly houses both the RF and power supply sections of the amplifier. The RF section includes the TWT, solid state intermediate power amplifier (IPA), optional internal linearizer, input/output isolation circuits, RF detectors and output harmonic filter. The power supply section includes power factor correction, the power processor, and high voltage regulation circuitry. It also contains the microprocessor based monitor and control system necessary to permit safe, efficient and reliable operation of the CHPA.

The VZC-6967AM/AT/AN CHPA is protected from operational damage caused by insufficient cooling and abnormal AC, DC or RF faults. The amplifier will automatically recycle itself after a prime power interruption or transient fault condition.

Personnel safety is of utmost importance and is safeguarded by proper grounding and by access interlocks and shields, which prevent physical entry into the high voltage sections. The front panel of the unit serves as the primary user interface housing the monitor and control system including a type N RF connector to sample and measure output RF power. The front panel of the unit includes a keypad, indicator LEDs and a vacuum fluorescent alphanumeric display. All unit functions can be controlled and monitored via the front panel.

Principal functions are also brought to the five user interface connectors located on the rear panel for remote monitor and control. Control, fault and monitoring functions are available via: the RS-422/485 computer interface (CIF), designed to interface directly with a computer; a second RS-422/485 port to be used when the optional CPI remote control panel is purchased; a separate switching port for use with switching/power combining subsystems; and a user interlock port for use when interfacing other equipment or controls with the CHPA. Also, an RS-232 serial port is used for flash programming.

Digitally controlled attenuation allows for RF drive attenuation adjustment via the serial remote and CIF interface ports, thereby enhancing remote monitor and control capabilities.

To expedite field maintenance procedures, the VZC-6967AM/AT/AN CHPA utilizes a modular design approach consisting of Line Replaceable Units (LRUs), which permit service personnel to maintain the CHPA in the field without need of returning the entire unit to the depot or factory. Comprehensive fault reporting and diagnostic procedures allow field personnel to localize the fault to the individual LRU, make the necessary replacement and return the amplifier to service with a minimum of operational downtime.

The overall amplifier enclosure measures approximately 19" (w) x 8.75" (h) x 24" (d), not including air duct adapters, and weighs approximately 95 lbs. The TWTA can be installed in a 1:1, 1:2 or 1:3 auto switching or power combined configuration as needed by end user mission.

RF Subsystem

A conservative field-proven approach is utilized in the CHPA RF subsystem. The RF block diagram (Figure 2) identifies all major circuit elements for this technical description.

A low level RF input signal is applied to the CHPA via a type N connector (isolator) located at the rear of the enclosure. The isolator limits the input VSWR to a level of 1.25:1 or less back to the source. The RF input is then routed to the SSIPA which includes an internal variable attenuator. The attenuator has a control range of a nominal 20 dB with quick response and excellent linearity. The SSIPA is designed to be transparent to final amplifier RF parameters and is temperature compensated to minimize drift. As a result, the overall TWT CHPA gain is specified to be stable within $\pm$0.25 dB/24 hours with $\pm$10% line voltage variations. The output of the SSIPA is then fed to the input of the TWT unless the optional integral linearizer is installed. The SSIPA and TWT provide a combined subsystem gain of at least 75 dB at rated power.

The optional integral linearizer extends the effective linear range of the CHPA. It obtains DC power from the power processor, and is adjusted via the microprocessor based monitor and control system. Three user settable linearizer controls (gain, phase and amplitude) are available through the front panel, the optional remote panel and the CIF port.

The TWTs employed in these power amplifiers are the CPI VTC-6361D3 Series, which features forced-air cooled, dual depressed collectors for efficient operation, and Periodic Permanent Magnet (PPM) focused helix design. They are designed especially for compact, lightweight applications involving satellite uplink service.

The output waveguide assembly interfaces with the TWT and protects the TWT from abnormal or transient conditions that could permanently damage the TWT. This assembly consists of an isolator, harmonic filter, and three-port directional coupler. The high power isolator provides a low VSWR to the external waveguide run and antenna feed. The isolator assists in protecting the TWT from excessive reflected power due to damaged/broken waveguides or antenna components. The isolator is rated such that it will safely dissipate all reflected power equal to the full rated output of the CHPA for the duration of time until the protection circuits shut off the high voltage power supplies. In addition, the isolator is designed such that it can safely dissipate a VSWR mismatch of 2.0:1 (11% of forward RF power) indefinitely.

The harmonic filter contained in the output waveguide assembly provides a minimum of 60 dB attenuation to all harmonic products other than the fundamental signal. The

three-port directional coupler provides one reflected power port coupled via a detector to the RF power monitor assembly for reverse power protection, and two forward power meters: one for the user to monitor forward RF power via a type N connector on the front panel; and one for use by the front panel forward power metering circuit, which uses a similar detector to process the RF signal. The RF sample port, calibrated in coupling ratio versus frequency, permits independent monitoring of CHPA output power levels through the use of an external spectrum analyzer or portable power meter. High reflected RF protection is standard and reflected power information is sent to the front panel for display. User settable low and high RF power alarms via the front panel are controlled via remote panel or CIF port.

The output and reflected power level readouts are also available for remote monitoring via the optional CPI remote panel or the computer interface (CIF) port located on the rear panel. RF drive is adjustable via these ports as well. The standard RF output interface to connect the CHPA to the external waveguide run is a CPR-137 (grooved flange) termination. The CHPA comes with a CPR-137 (grooved, threaded) rear connector and a waveguide gasket.

Power Supply Subsystem

Overview

The power supply portion of the CHPA provides all of the internal voltages necessary to operate the TWT, RF driver (IPA), and auxiliary circuits for control, monitoring and protection of the CHPA. Only the AC input power is required for operation. The traveling wave tube derives its operation from four DC power supplies: a filament heater low voltage supply, a helix high voltage supply, and two collector high voltage supplies. The power supply design utilized in the VZC-6967AM/AT/AN is of the switch mode power conditioner (SMPC) type, which has an excellent reputation for reliability and stability. An added advantage of the SMPC approach over outdated linear power supplies is its intrinsic high efficiency and safe operation. By limiting the amount of the instantaneous stored energy in the power supply, the risk of permanent damage to the CHPA due to abnormal or transient conditions is avoided. The momentary level of stored energy (measured in joules) is well below the maximum limit of energy that the tube can safely dissipate during normal operation. A simplified block diagram of the power supply is shown in Figure 3. The principal circuit modules are discussed in the following paragraphs.

Power Factor Correction Module

Input primary power (single phase, 208-240 VAC, 47-63 Hz) flows via an EMI filter and the main circuit breaker to both the cooling system blower and the Power Factor Correction Module. This module provides a regulated 375 VDC to the Power Processor and allows the CHPA to meet the requirements of EN61000-3-2 regarding total harmonic distortion. In the event of a failure of this module, a DC bus fault flag is sent to the micro-controller for proper fault handling and display.

Power Processor Module

The power processor circuits provide the necessary line and load regulation of the input 375 volt DC bus, which is converted via a switch regulator and bridge circuit to a nominal 200 volt, 25 kHz to drive the high voltage module. A sample of the helix high voltage output is returned to the switch regulator for error feedback correction and sends a pulse-width modulated signal through an optical isolator to the switching transistors. This approach allows careful regulation of the TWT helix and collector voltages and protects both supplies from over voltage/under voltage or short circuit conditions. Low voltage outputs are also produced by this assembly (+5 V, +5 isolated, +16 V, $\pm$15 V) which are used to operate various internal circuit functions as well as provide power for the RF monitor circuit, micro-controller assembly, front panel display, and IPA. Internal sensors provide the necessary over-current protection functions for these supplies.

High Voltage Module

The high voltage module provides the following key power supply functions: regulated TWT heater supply, regulated TWT high voltage helix and collector supplies, helix supply current/voltage monitoring and fault protection. The high voltage module contains the transformers, rectifiers, filters and voltage/current sense resistors for critical TWT voltages. The incoming 200 volt, 25 kHz signal is applied to the primary of a multi-section high voltage transformer which provides all of the high voltage levels necessary to operate the traveling wave tube. Since the helix and collectors share the same transformer and regulator, the high voltage circuit design establishes the collector voltages at 52% (collector #1) and 26% (collector #2) depression below the helix voltage. This relationship permits optimum efficiency and substantial energy savings while extending the useful life of the TWT. A separate step-down transformer with rectifier and filter network is employed to provide the heater voltage.

Control and Display Modules

The microprocessor based monitor and control system is designed to assure proper operation of the power amplifier and easy maintainability with minimal operator training and activity. The microprocessor based monitor and control system includes three parts: a main controller board, an interface board and keyboard/vacuum fluorescent display. The system provides required operational sequencing and monitoring of critical parameters. If a fault should occur, the unit either recycles back to its state prior to the fault or latches into the FAULT state. In either case, the front panel display will provide fault information; also, the user can consult the Fault Log for time/date stamped fault information.

To make most software updates easier to install, the CHPA features Flash RAM based program instructions. A flash RAM is a memory device with the two best characteristics of a disk drive - non-volatile memory and read/write capability. Software upgrades are easy to install in a Flash RAM based CHPA because the upgrade consists of connecting a

PC to the CHPA, then executing a PC program. In about two and half minutes the transfer is complete without the hassle of removing the CHPA's cover.

To enhance the reliability of this approach, a backup version of the CHPA's software exists in an EPROM. This version is not updated (nor can it be via the auxiliary serial port) when the Flash RAM contents are updated. If the Flash RAM contents are corrupted, the CHPA can use the EPROM based program. Also, when the CHPA is powered up, the user may force the CHPA to use the EPROM based program.

The Product Specification section below presents a complete list of controls, displays, and LED indicators on the front panels.

When control power is turned on, the microprocessor self-tests all internal functions and starts HTD (Heater Time Delay). Once the HTD is completed, the STANDBY indicator illuminates to tell the operator that the high voltage may be applied. Pressing the TRANSMIT key initiates the BONS (Beam On Sequence). At the successful conclusion of BONS, the unit is in the TRANSMIT state (high voltage is on). Alternatively, the operator may press the TRANSMIT key during HTD causing TX SELECT to be displayed on the front panel.

In this case, the BONS is initiated automatically at the completion of HTD. In the interest of promoting long TWT life, the heater voltage is reduced by 10 percent whenever the CHPA is in any beam off state (either STANDBY or FAULT states) for more than one minute.

In the event of AC prime power interruptions, the power supply will automatically recycle when the AC power is reapplied. If the loss of power is less than a few seconds, the amplifier will return immediately to its previous state. If the outage is of longer duration, a proportional HTD is performed before returning to the previous state. The longest HTD is three minutes.

If a fault occurs during any normal operating state (the following text will use TRANSMIT as an example), the FAULT LED will light and the unit will switch from TRANSMIT to FAULT. Two scenarios are possible.

The first scenario occurs when fewer than three faults occur within twenty seconds. In this case, the unit will recycle back to TRANSMIT. Each fault will generate a recycle. Each recycle from FAULT to TRANSMIT will be delayed by one second.

The second scenario occurs when at least three faults occur within twenty seconds. In this case the unit will be latched into FAULT and the FAULT LED will flash. To reset the unit for normal operation, clear the source of the fault. Then, press CANCEL. If the fault was successfully cleared, the FAULT LED will extinguish and the unit will be in STANDBY. Press TRANSMIT to resume transmitting.

In either case, the time/date stamped Fault Log will capture each fault event. If multiple faults were detected during one event, they will be listed together. This allows the able user or technician to identify individual faults to a specific module or subassembly.

RF Power Monitor Module

The RF power monitor assembly receives signals from the forward and reflected power RF detectors for use in fault/alarm sensing and forward power metering. The reflected RF fault sensor and the microprocessor based controller protects the TWT against excessive reflected power due to abnormal waveguide or antenna conditions. Additionally, the forward power meter circuit measures both continuous-wave (CW) and peak RF signals. Another RF metering feature is a forward low RF alarm. The output power is compared with a user-settable low RF set point; an alarm is triggered should output power fall below this level.

Mechanical Design

The VZC-6967AM/AT/AN is packaged in a standard rack mounted drawer measuring 19" wide by 8.75" high and 24" deep (not including connectors, fan and air duct adapters). The unit is cooled via a forced air cooling system consisting of one AC blower, an air filter and an exhaust duct. Allowances are made for 0.5" H_20 drop due to customer ducting losses.

LRU Philosophy

The CHPA utilizes a modular design approach incorporating LRUs for ease of maintainability in the field. The maintenance concept employed in the VZC-6967AM/AT/AN is to localize a malfunction or circuit failure down to the level of an LRU, extract the LRU and replace with an equivalent part provided in the spares kit. This procedure can be completed in the field without resorting to the costly practice of returning the entire CHPA to the depot for servicing. The philosophy is to configure the CHPA LRUs as building blocks with a specific function that can be monitored by sensors and fault indicators on a real-time basis.

PRODUCT SPECIFICATIONS

The following specification limits and characteristics apply to the 750 W VZC-6967AM/AT/AN Series unless otherwise specified.

Electrical

Frequency	VZC-6967AM	5.850 – 6.650 GHz
	VZC-6967AT	5.850 – 6.725 GHz
	VZC-6967AN	5.850 – 7.075 GHz
Output Power		
•TWT		58.75 dBm min. (750 W min.)
•flange		58.13 dBm min. (650 W min.)
Bandwidth	VZC-6967AM	800 MHz
	VZC-6967AT	875 MHz
	VZC-6967AN	1225 MHz
Gain		
•at rated power		75 dB min., 88 dB max.
•small signal		78 dB min., 90 dB max.
RF Level Adjust Range		0 to 20 dB (via Pin Diode Attenuator)
Attenuator Step Size		±0.1 dB
Gain Stability		
•at constant drive & temperature		±0.25 dB/24 hr max.(after 30 min. warm-up)
•over temperature, const. dr. (any frequency)		±1.0 dB over oper. temp. range (typical) +0.75 dB over +10ºC (typical)
Gain Slope		0.02 dB/MHz max.
Small Signal Gain Variation		
•across any 40 MHz band		0.5 dB pk-pk max.
•across the passband		2.5 dB pk-pk max.
•across full bandwidth w/linearizer		5.0 dB pk-pk max.
VSWR		
•Input		1.25:1 max.
•Output		1.25:1 max.

Electrical, continued

Load VSWR	
•full spec compliance	1.5:1 max.
•operation without damage	any value
•continuous operation	2.0:1 max.
Residual AM	
•below 10 kHz	-50 dBc
•10 to 500 kHz	-20 [(1.5 + log F (kHz)] dBc
•above 500 kHz	-85 dBc
Phase Noise	
•IESS 308/309 phase noise profile	-6 dB
•AC fundamental	-36 dBc
•Sum of all spurs	-47 dBc
AM/PM Conversion	2.5°/dB max. for a single carrier at 8 dB below rated power. (Improves to 1°/dB max. with optional integral linearizer)
Harmonic Output	-60 dBc at rated power, second and third harmonics
Noise and Spurious	< -130 dBW/4 kHz, 3.4 to 4.2 GHz; < -65 dBW/4 kHz, 4.2 to 12.0 GHz; < -110 dBW/ 4 kHz, 12.0 to 40.0 GHz.
Noise Figure	10 dB max., (15 dB max. with optional integral linearizer)
Intermodulation	-23 dBc or better with two equal carriers at total output power level 7 dB below rated single carrier output. (4 dB with optional integral linearizer)
Group Delay (in any 40 MHz band)	0.01 ns/MHz linear max. 0.001 ns/MHz^2 parabolic max. 0.5 ns pk-pk ripple max.
Primary Power	Single phase, 208-240 VAC $\pm$10%, 47-63 Hz
Power Factor	0.95 min. (meets requirements of EN-61000-3-2 total harmonic distortion)

Electrical, continued

Power Consumption	2.3 kVA typ. (at saturated RF output power) 2.8 kVA max. 1.95 kVA typ. (at –6 dB backoff from rated)
Inrush Current	200% max.

Environmental

Ambient Temperature	
•operating	-10° to +50°C
•non-operating	-40° to +70°C
Relative Humidity	95% non-condensing
Altitude	
•operating	10,000 ft., w/standard adiabatic derating of 2°C/1,000 ft.
•non-operating	50,000 ft.
Shock and Vibration	Designed for normal transportation environment per Section 514.4 MIL-STD-810E. Designed to withstand 20G at 11 ms (1/2 sine pulse) in non-operating condition.

Mechanical

Cooling	Forced air w/integral blower. Rear intake and exhaust. Maximum external pressure loss allowable: 0.5 inches water column.
RF Input Connection	Type N Female
RF Output Connection	CPR-137 waveguide flange, grooved, threaded UNF 2B 10-32
RF Output Monitor	Type N Female
Dimensions, (W x H x D)	19 x 8.75 x 24 in. (483 x 222 x 610 mm)
Weight	95 lbs (43 kg) max.

Heat and Acoustic

Heat Dissipation	2,000 Watts max.
Acoustic Noise	68 dBA (as measured at 3 ft.)

Characteristics and performance limits are based on current data and are subject to change without notice. Please contact CPI Satcom Division before using this information for system design.

Front Panel Monitors and Controls

Control Functions	Main Power On/Off TX (Transmit) Select Transmit (Beam On) Standby (Beam Off) Local/Remote/Computer (CIF) Select RF Power Setting Automatic Leveling Control (ALC) Attenuator Setting RF Inhibit RF Switch Port Relay Preferences Indicator Test Fault Reset Fault Settings Remote Port Settings/Tests CIF Port Settings/Tests Time date Settings Power Supply Test Mode Peak Detect Enable/Disable Integral Linearizer Settings (optional) Beeper Mute
Monitoring	RF Output Power (watts, dBW or dBm) Attenuator Setting RF Reflected Power (watts, dBW or dBm) RF Output Sample Port (-40 dB nominal, Type N female) Helix Current (mA) Helix Voltage (kV) Beam Current (mA) Heater Elapsed Time Meter Beam On Elapsed Time Meter Integral Linearizer Settings (optional)

Front Panel Monitors and Controls, continued

Status Display	Power On Heater Time Delay (HTD) TX (Transmit) Select Standby Transmit (Beam On) Local/Remote/CIF ALC Time RF Inhibit w/source
Fault/Alarm Display	Fault Fault Log Low RF Fault and Alarm High RF Fault and Alarm High Reflected Power Interlocks Open (power supply temp. or amplifier cover) Helix Over Current Helix Over Voltage Helix Under Voltage Power Supply Arc DC Bus Fault TWT Over Temperature Fault Blower Fault External Interlocks Fault

Remote Control Interface

Control Functions	TX (Transmit) Select Transmit (Beam On) Standby (Beam Off) Remote/Computer (CIF) Select RF Power Setting Automatic Leveling Control (ALC) Attenuator Setting RF Inhibit RF Switch Port Relay Preferences Indicator Test Fault Reset Fault Settings CIF Port Setting/Tests

Remote Control Interface, continued

Control Functions, continued	Time Date Settings Peak Detect Enable/Disable Integral Linearizer Settings (optional)
Monitoring	RF Output Power (watts, dBW or dBm) Attenuator Setting RF Reflected Power (watts, dBW or dBm) Helix Current (mA) Helix Voltage (kV) Beam Current (mA) Heater Elapsed Time Meter Beam On Elapsed Time Meter Integral Linearizer Settings (optional)
Status Display	Heater Time Delay (HTD) TX (Transmit) Select Standby Transmit (Beam On) Local/Remote/CIF ALC Time RF Inhibit w/source
Fault/Alarm Display	Fault Fault Log Low RF Fault and Alarm High RF Fault and Alarm High Reflected Power Interlocks Open (power supply temp. or amplifier cover) Helix Over Current Helix Over Voltage Helix Under Voltage Power Supply Arc DC Bus Fault TWT Over Temperature Fault Blower Fault External Interlocks Fault

Computer Interface (CIF)

Control Functions	TX (Transmit) Select Transmit (Beam On) Standby (Beam Off) RF Power Setting

Computer Interface (CIF), continued

Control Functions, continued	Automatic Leveling Control (ALC) Attenuator Setting RF Inhibit Fault Reset RF Alarm/Fault Settings Peak Detect Enable/Disable Integral Linearizer Settings (optional)
Monitoring	RF Output Power (watts and dBW) Attenuator Setting RF Reflected Power (watts and dBW) Helix Current (mA) Helix Voltage (kA) Beam Current (mA) Heater Elapsed Time Meter Beam On Elapsed Time Meter Integral Linearizer Settings (optional)
Status Display	Heater Time Delay (HTD) TX (Transmit) Select Standby Transmit (Beam On) Local/Remote/CIF ALC RF Inhibit w/source
Fault/Alarm Display	Fault Low RF Fault and Alarm High RF Fault and Alarm High Reflected Power Interlocks Open (power supply temp. or amplifier cover) Helix Over Current Helix Over Voltage Helix Under Voltage Power Supply Arc DC Bus Fault TWT Over-temperature Fault Blower Fault External Interlocks Fault

RF Switch Port Interface

Features	RF Inhibit Command Low RF Relay Fault Relay (can be reassigned) Sum Fault Relay

External Interlock Interface

Features	External Interlocks Latching (User Induced Fault) External Interlocks Non-Latching (RF Inhibit)

Options and Compatibility

Features	•Alphanumeric Menu-driven 4-line display and front panel • Meets EN60215 and EN61000-3-2 Safety/Harmonic standards as well as EEC 89/336 EMC standards • Filament voltage reduction of 10% in standby • RS-232/422/485 (4 wire) computer interface standard • Auto Fault Recycle (except for Power Supply Arc and External Interlocks) • Internal test points for ease of maintenance • MTTR < 1 hr • Forward power metering • Pin Diode Attenuator standard • Also available in: (5.715 - 6.525 GHz), 700 W C-Band (5.85 - 6.65 GHz), 700 W C-Band (5.85 – 7.075 GHz), 700 W C-band (12.75 - 14.50 GHz), 750 W Ku-Band (13.75 - 14.50 GHz), 700/750 W Ku-Band (14.0 - 14.8 GHz), 700 W Ku-band (14.7 - 15.3 GHz), 700 W Ku-band (17.3 - 18.4 GHz), 500 W DBS-band
Options	• Integral Linearizer • Remote Control Panel • Redundant and Power Combined Systems • Rear Sample Port

ACCESSORIES

Several optional accessory items have been designed for use with the CPI 750 W C-band CHPAs. Brief descriptions of the items now available are given on the following paragraphs.

Protection Switching

The Switching System consists of an output waveguide switch, dummy load and local control unit. These assemblies are usually mounted on the upper part of a rack/cabinet intended to house the two CHPAs. The circuit provides 1:1 redundant protection with automatic transfer, or manual operation (local or remote) as selected by the operator. For servicing, the logic assembly can be removed from the front panel without disturbing the RF connections. Options are available for the addition of an input power divider or a ganged input transfer switch.

Phase Combining

The Phase Combiner consists of a coaxial input divider network and phase shifter and an output waveguide combining system. The combiner is an electrically operated variable-ratio hybrid, which provides the following operating modes:

1) PA1 and PA2 combined on line
2) PA1 on line, PA2 to dummy load
3) PA2 on line, PA1 to load
4) PA1 and PA2 combined to dummy load

In the normal combining mode a fault in one PA will automatically index the combiner to mode (2) or (3), providing the "soft fail" protection of full output from the surviving PA. In the manual mode the operator may select by push-button any one of the four operating modes.

The combiner assembly is packaged in a 19-inch rack-mountable enclosure measuring 7 inches high and 24 inches deep.

The combiner assembly can also be supplied mounted in the rack/cabinet which houses the two CHPAs to provide an integrated power-combined CHPA system.

Integral Linearizer

The Integral Linearizer is an input device intended to improve the intermodulation characteristics of the CPI CHPAs. The unit functions to predistort the RF input signal to compensate for the amplitude and phase non-linearities inherent in the TWT. In most applications the CHPA then can be operated 3 dB or more higher in output power (i.e. less back-off) for a given intermodulation ratio.

Remote Control Panels

The Remote Control/Monitor panel is a rack-mountable unit 3.5 inches high that provides an output RF power meter and all of the remote controls and indicators listed in this brochure. The panel requires a source of AC power and it does not include the interconnect cable from the CHPA. The ideal interconnect cable would include two

twisted pairs enclosed in a shield; several wire manufacturers build cable specifically for RS-422/485 applications. Since the RS-422/485 serial format is used, cable lengths are limited to 4,000 feet.

Remote control/monitor panels are also available for use with the switching system and phase combiner systems.

SUPPORT SERVICES

Documentation

CPI Satcom Division provides a commercial documentation package for all products. The content of this package is determined by the nature of the product concerned, and the quantity is governed by contractual requirements. The standard package for satcom power amplifiers includes a comprehensive Operation and Maintenance Manual, outline and interface drawings, Manufacturing Test Report and spare parts lists. Outline and interface drawings provide dimensions and the location and size of mounting holes, duct work, and waveguide, so that site preparations can be accomplished prior to receipt of the equipment.

The Service Manual provides instruction for unpacking and installation, initial set-up, calibration, normal operation, maintenance and repair of the equipment. The manual

includes schematic diagrams, block diagrams, and wiring information sufficient for use by maintenance personnel.

The Acceptance Test Report outlines the test performed limits established. Space is provided on the test report for recording and certifying the test results, consolidating all related information in one document. The spare parts documentation consists of a recommended spare parts list to support the equipment for a one-to-two year period of operation. A CSI Acceptance Test can be performed at customer's option which will repeat and verify results of selected performance tests that were already recorded in the standard acceptance test.

Training

CPI Satcom Division is prepared to conduct training courses covering the installation, operation and maintenance of its equipment. The training course on high power amplifiers consists of lectures using training material, such as technical manuals and drawings, plus actual operation and adjustments demonstrated on the equipment.

Small training groups (up to five students) assure the customer that each student has an opportunity to participate fully in demonstration activities. Courses may be conducted at the CPI factory or on-site. Course duration varies from several days to one or two weeks, depending on the scope of work agreed upon and the skill level of the students.

Field Service

The product support activity of CPI includes a staff of experienced, professional service technicians to assist users in maintaining full performance from their CPI power amplifiers. A telephone “hot line” permits access to one of these technicians on a 24-hour per day basis. Operational problems often can be diagnosed, corrective action prescribed, and normal operation restored through such telephone consultation. When appropriate, the service technicians are prepared to give on-site assistance.

Product Support carries an inventory of spare parts that can be made ready for shipment within 24 hours. Coupled with a dedicated dial-in telephone line, this service is effective in aiding users to restore equipment to operational status with minimum downtime. Technical assistance and factory-approved replacement parts are also available at strategically located Regional Service Centers in the U.S.A., South America, Europe, Africa and the Pacific Rim.

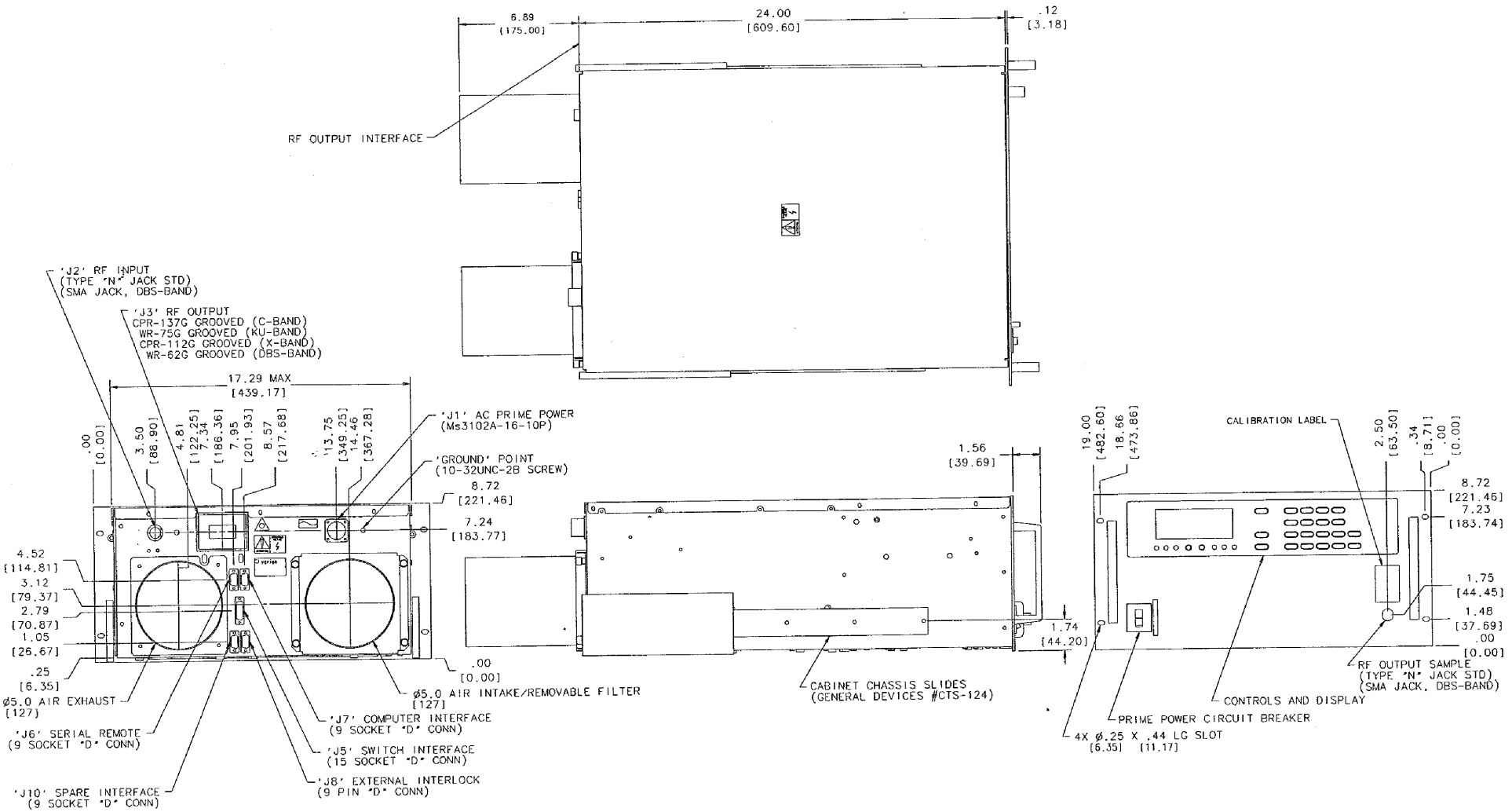


Figure 1. CHPA Outline Drawing (ref. 01020269)

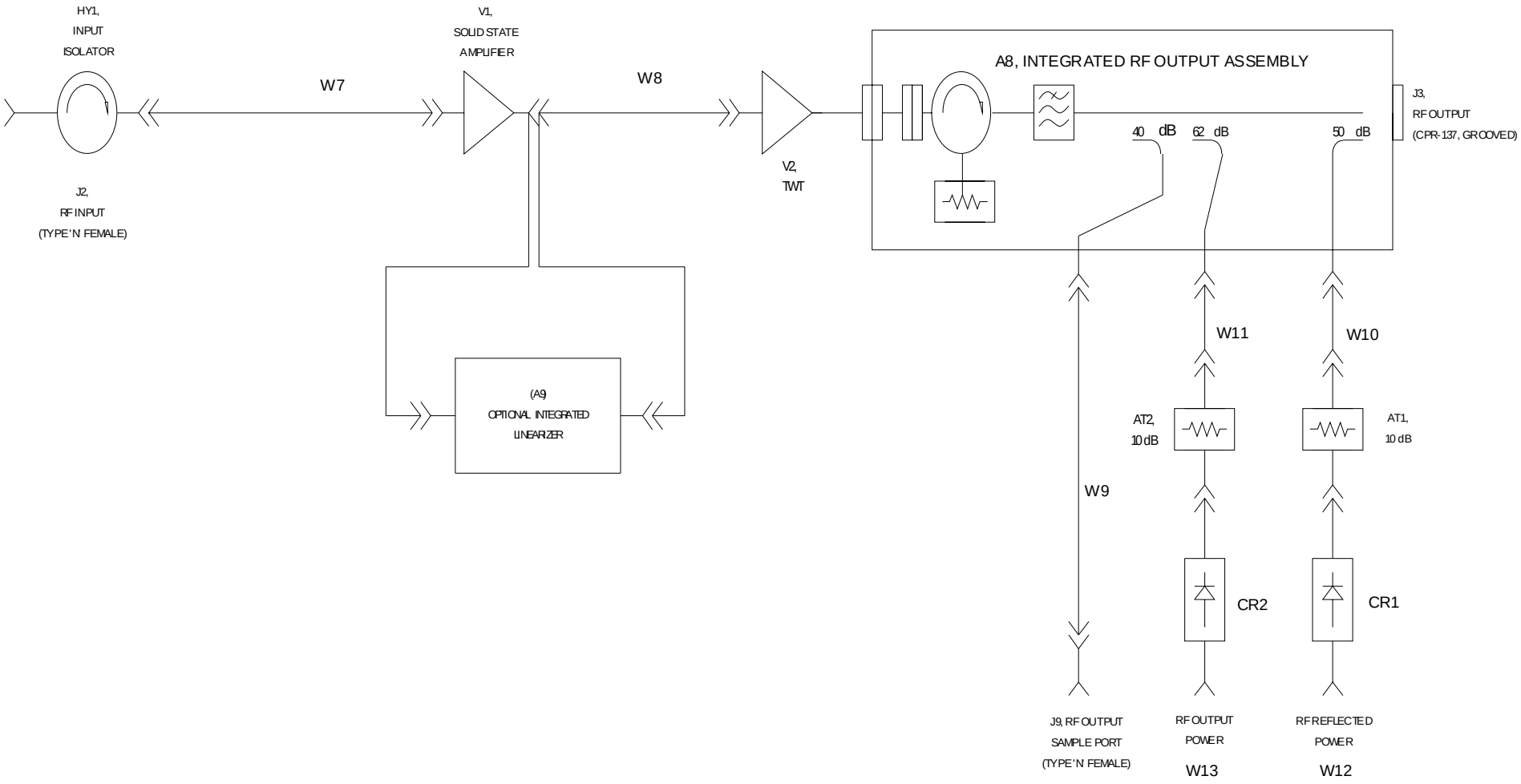


Figure 2. CHPA RF Block Diagram

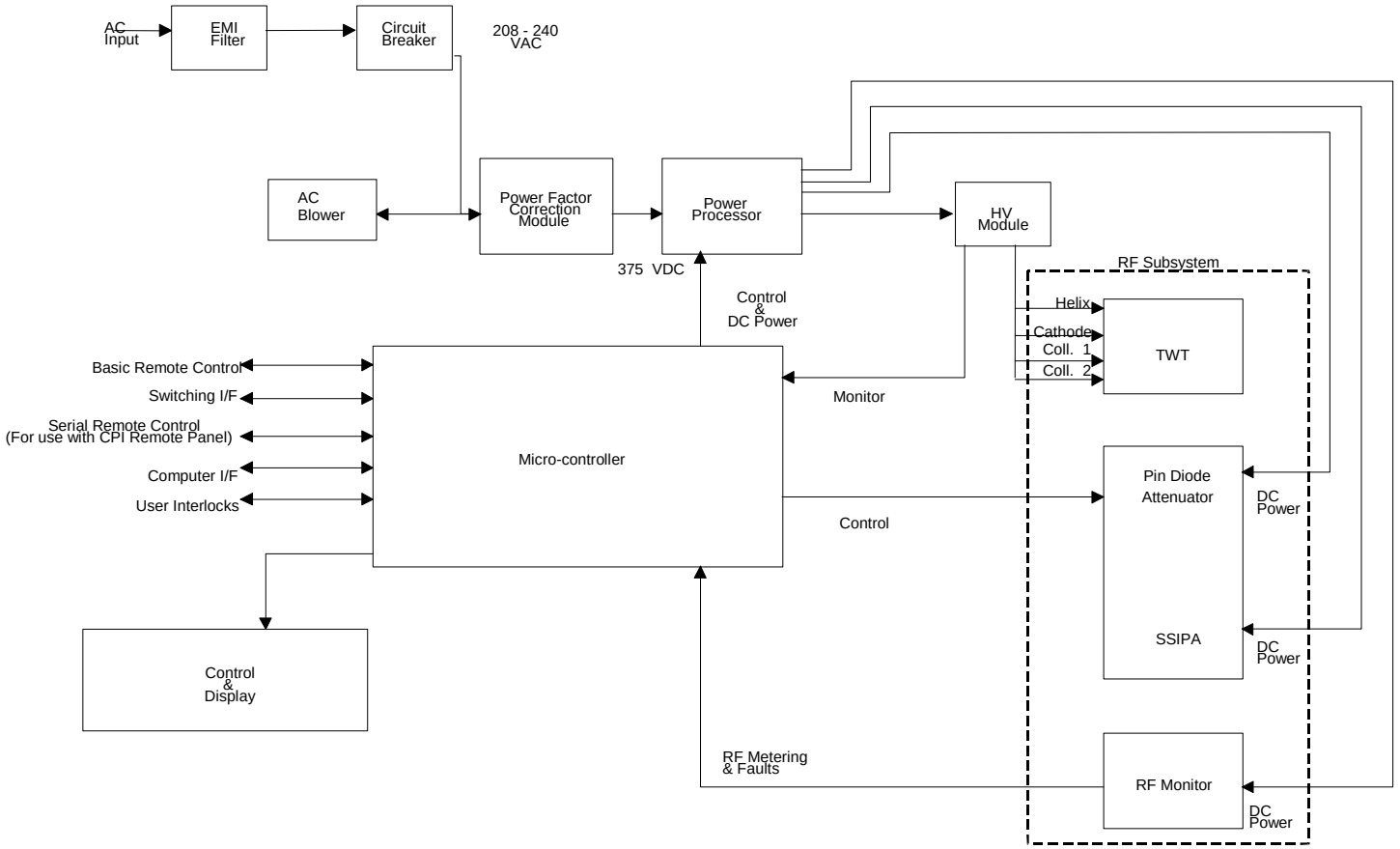
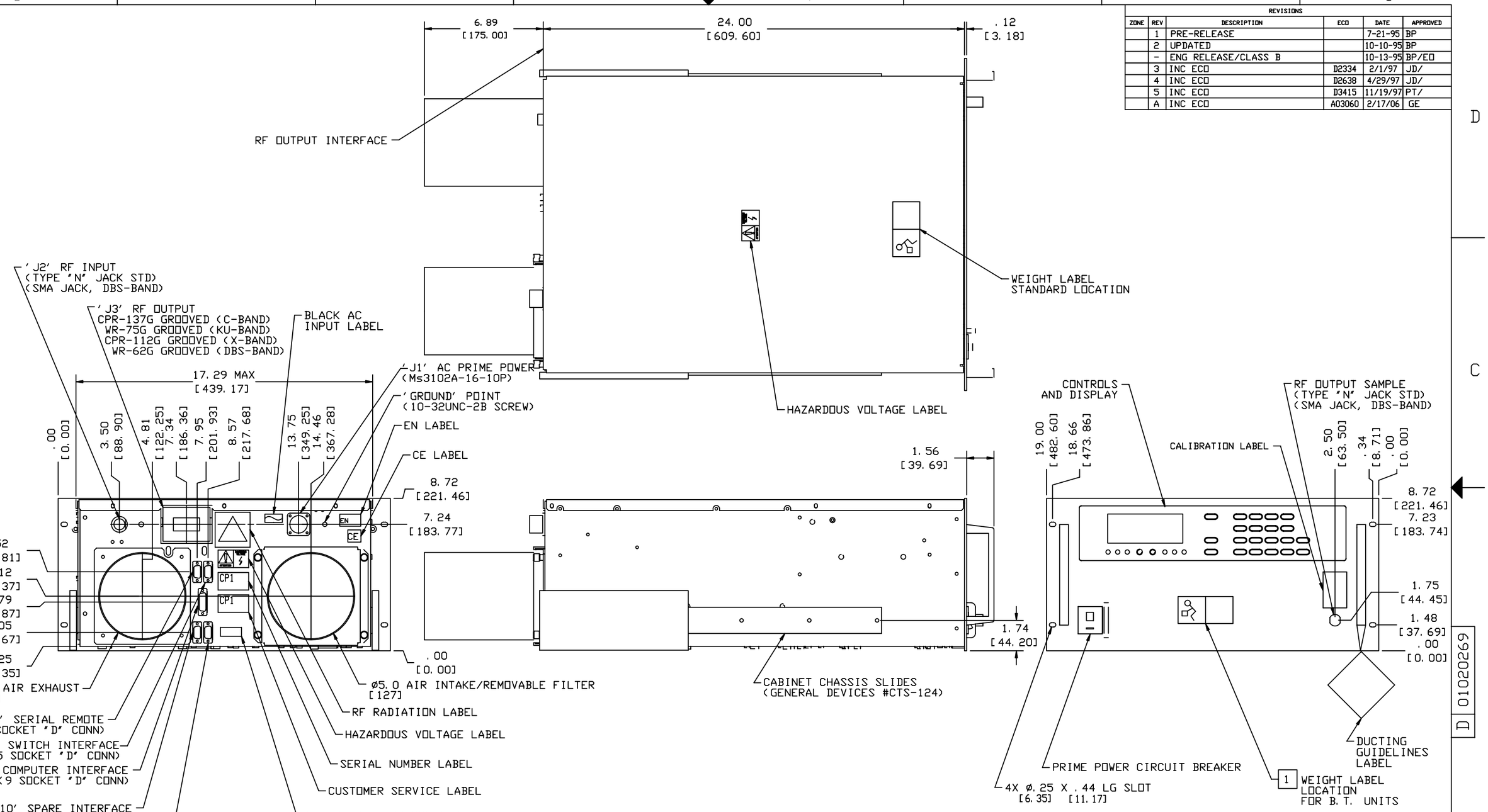


Figure 3. CHPA Power Supply Block Diagram

REVISIONS					
ZONE	REV	DESCRIPTION	ECO	DATE	APPROVED
	1	PRE-RELEASE		7-21-95	BP
	2	UPDATED		10-10-95	BP
	-	ENG RELEASE/CLASS B		10-13-95	BP/EO
	3	INC ECO	D2334	2/1/97	JD/
	4	INC ECO	D2638	4/29/97	JD/
	5	INC ECO	D3415	11/19/97	PT/
	A	INC ECO	A03060	2/17/06	GE



1 LOCATION OF WEIGHT LABEL FOR B.T. UNITS.

NOTES: UNLESS OTHERWISE SPECIFIED.

01024448	VZX-6985A7	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	
01020288	VZU-6997AC	DEC: 1PL ± .1 2PL ± .02	
01020275	VZU-6996AB	3PL ± 005	FRAC±1/64
01020262	VZC-6967AA	ANG ± 1°	SURFACE FINISH ✓
01020265	VZC-6967A7	MATERIAL	
NEXT ASSEMBLY	USED ON		
APPLICATION		SPEC NO.	

PROJECTION INCH [MM]

DASH NO. -00

QTY	IDENTIFYING NUMBER	DESCRIPTION	CODE IDENT	ITEM

LIST OF MATERIALS

DR	B. PATO	7-21-95
CHK	B. PATO	10-13-95
APPD	EO	10-14-95
APPD		
DESIGN ACTIVITY APPROVAL		
CUSTOMER APPROVAL		

Communications & Power Industries
SATCOM DIVISION

OUTLINE, COMPACT HPA

SIZE	FSCM NO.		
D	59782	01020269	A

SCALE: 3/8 CLASS B SHEET 1 OF 1

D 01020269

CAD= chpa->01020269.dwg

SPECIFICATIONS	Cage Code	Sheet 1 of **3**	Class	Size	DWG. NO.	Rev
	59782		**A**	**A**	**01031608**	**A**

APPLICATION		REVISIONS				
Next Assembly	Used On	LTR	DESCRIPTION	ECO	DATE	Approved
	VZC-6967AM	A	Manufacturing Release / Class A	A03756		

FAMILY CONFIGURATION AND OPTIONS, COMPACT HPA, 5.850 – 6.65 GHz

MODEL NO.	OPTION CODES	RF ASSEMBLY
VZC-6967AM-	XXXXXXXX (8 spaces)	01020370-05

EXAMPLE:
VZC-6967AM-200H0000 is a 5.85 - 6.725 GHz 750W Compact HPA for 220 VAC input, standard front panel, no integral linearizer, CIF port factory set at RS-232, has no special options, and no L to C Block Up-Converter.

Note: '0' (zero) must be filled in where no option is required. All spaces following the (mandatory) dash after the basic model number MUST be filled in to define the complete unit.

UNLESS OTHERWISE SPECIFIED		CONTRACT NUMBER			MATERIAL:	
DIMENSIONS ARE IN INCHES		DR.	Gordon Ellis	09/09/02	SPEC NO.	
DEC: 1PL ± .1 2PL ± .02		CHK			FINISH:	
3PL ± .005	FRAC ± 1/64	APPD			Design Activity Approval	
ANG ± 1 deg	SUR	APPD			Customer Approval	

Frequency	**Compact HPA Model Number**	**Option Codes**
5.850 - 6.65 GHz	VZC-6967AM-	XXXXXXXX (8 spaces)

Space	**Code**	**Option Description**	**Option Part Number**
1		**Prime Power**	
	2	220 VAC (Standard)	01020260-00
	3	Conformal Coated P/S	01020260-01
2		**Front Panel Assembly**	
	0	Standard	None
	S	SPECIAL COLOR FRONT PANEL	01020380-XX
3		**Integral Linearizer**	
	0	None (Standard)	None
	T	Include Integral LTI Linearizer (space 8 must be 0 only)	01024281-03
	L	LIPA (5.85-7.1GHz)	01032189-00
4		**Computer I/F Port Configuration**	
	0	Factory Pre-set at RS-422/485 (4-wire)	01020381-00
	H	Factory Pre-set at RS-232	01020381-01
	S	Factory Pre-set at RS-422/485 (4-wire with SA Bus Adapter)	01020381-02
5		**Reserved (formerly Remote Control Option code R)**	
	0	None	None
6 & 7		**Special Option Description**	
	00	None	None
	02	CMPA Protocol compatibility	01026057-00
	03	W/Rear Sample Port	01026966-00
	05	DESCRETE REMOTE INTERFACE	0103155000

8		**L to C-Band Block Up-Converter** (Space 3 must be 0, or L only)	
	0	None (Standard)	None
	M	MUX Ref (5.85-6.725GHz)	01032190-00
	P	Reserved	
	W	Reserved	
	A	INTL 10MHz Ref (5.85-6.725GHz)	01032190-03
	B	Reserved	
	C	Reserved	
	D	Reserved	
	E	Reserved	
	F	Reserved	
	G	Reserved	
	H	Reserved	
	J	Reserved	
	K	Reserved	
	L	Reserved	
	N	Reserved	

Accessories

Single Remote:

Remote Control Panel (VJW-6769B1)	01020350-00
Remote Control Interface Cable (Note 2)	01018231-XX
1 RU Remote Controller	01032300-00
1 RU Remote Interconnect Cable (see Note 2)	01032346-XX
1 RU Remote Connector	51308773-00
External Receive Band Filter	01020178-00

Note 2: -XX indicates length in feet, ie: (example: -05 = 5 feet) to be specified on Job Authorization form