350/400W Compact Medium Power Amplifier
for Satellite Communications

Ku-Band

The VZU-6994

Up to 400 Watt TWT Medium Power Amplifier — high efficiency in a compact package.

Compact
Provides up to 400 watts of power in a 3 rack unit package, digital ready, for wideband, single- and multi-carrier satellite service in the Ku-Band frequency range. 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 behind front panel door 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.

satcom division

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OPTIONS:

- *Remote Control Panel*
- *Integral Linearizer*
- *Redundant and Power Combined Subsystems*
- *External Receive Band Reject Filter (Increases loss - consult factory for details)*

SPECIFICATIONS, VZU-6994

Electrical

Frequency	13.75 to 14.50 GHz, 12.75 to 14.50 GHz, or 14.7 to 15.2 GHz
Output Power	
TWT	350W min. (55.44 dBm), all configurations; 400W min. (56.02 dBm), 13.75 to 14.5 GHz
Flange	275W min. (54.39 dBm), all configurations; 340W min. (55.31 dBm), 13.75 to 14.5 GHz
Bandwidth	500 to 1750 MHz, depending on configuration
Gain	73 dB min. at rated power output; 78 dB min. at small signal
RF Level Adjust Range	0 to 20 dB
Gain Stability	±0.25 dB/24hr max. (at constant drive and temp.)
Small Signal Gain Slope	±0.015 dB/MHz max., 13.75 - 14.5 GHz ±0.02 dB/MHz max., all other configurations
Small Signal Gain Variation	1.0 dB pk-pk across any 80 MHz band; 2.5 dB pk-pk across the entire passband
Input VSWR	1.3:1 max.
Output VSWR	1.3:1 max.
Load VSWR	2.0:1 max. operational; any value for operation without damage
Residual AM	-50 dBc below 10 kHz -20[1.3 +log F(kHz)] dBc, 10 kHz to 500 kHz -85 dBc above 500 kHz
Phase Noise	
IESS Phase Noise Profile	-6 dBc
AC Fundamental	-42 dBc
Sum of All Spurs	-47 dBc
AM/PM Conversion	2°/dB max. for a single carrier at 8 dB below rated power for 350W 13.75 to 14.5 GHz; 2.5°/dB max. at 8 dB below rated power for all other configurations
Harmonic Output	-60 dBc at rated power, second and third harmonics
Noise Density	<-150 dBW/4 kHz in Receive/Reject Band <-65 dBW/4 kHz in Passband <-60 dBW/4 kHz in Passband w/linearizer
Intermodulation	-24 dBc max. with two equal carriers at total output power 7 dB (4 dB with optional integral linearizer) below rated single-carrier output; -22 dBc max. at 7 dB OBO (4 dB w/lin.) for 14.7 - 15.2 GHz config.
Group Delay (in any 80 MHz band)	0.01 ns/MHz linear max. 0.001 ns/MHz^2 parabolic max. 0.5 ns pk-pk ripple max.

Environmental (Operating)

Primary Power	110 - 240 VAC ±10%, single phase 47-63 Hz (100 VAC optional)
Power Consumption	1.3 kVA typ., 1.4 kVA, max. for 350W configurations; 1.35 kVA typ., 1.5 kVA max. for 400W configuration
Power Factor	0.95 min.
Ambient Temperature	-10° to +50°C operating -40° to +70°C non-operating
Relative Humidity	95% non-condensing
Altitude	10,000 ft. with standard adiabatic derating of 2°C/1000 ft., operating; 40,000 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 configuration.
Acoustic Noise	65 dBA @ 3 ft. from amplifier

Mechanical

Cooling (TWT)	Forced air with integral blower Rear air intake & exhaust
RF Input Connection	Type N female
RF Output Connection	WR 75 waveguide flange, grooved with UNC 2B 6-32 threaded holes
RF Output Monitor	Type N female
Dimensions (W x H x D)	19 x 5.25 x 24 in. (483 x 133 x 610 mm)
Weight	60 lbs (27.3 kg) max.

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

Ku-Band Rack-Mount Medium Power Amplifier

Model VZU-6994

INTRODUCTION

This document provides a detailed technical description of the Communications & Power Industries (CPI) VZU-6994 Series MPA, a Ku-band traveling wave tube amplifier providing up to 400 watts of power and designed specifically for uplink service in satellite terminals, 'fly-aways' and satellite news gathering (SNG) vehicles. This compact medium power amplifier (CMPA) is 5.25" high, is lightweight and employs a dual depressed collector helix, permitting continuous, efficient operation across the Ku-band frequency range. The CMPA also incorporates the use of a microprocessor control system, thereby simplifying interfacing with remote control and monitor facilities speeding the integration process. Features include PIN diode attenuation and power factor correction (0.95 min.) allowing the unit to meet the total harmonic distortion requirement of EN61000-3-2 and providing for universal voltage input 100-240 VAC. It is also designed to meet EN60215 safety and 2004/108/EC electromagnetic compatibility requirements.

The VZU-6994 CMPA is a member of a comprehensive line of communication amplifiers comprising TWT Amplifiers (TWTAs), High Power Klystron Amplifiers (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 VZU-6994 CMPA (Figure 1) is packaged in a 5.25 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), input/output isolation circuits, input attenuator, RF detectors and output harmonic filter. The power supply section includes the power factor correction, power processor, and high voltage regulation circuitry. It also contains all monitor, control and protection circuits necessary to permit safe, efficient and reliable operation of the CMPA.

The VZU-6994 CMPA is protected from operational damage caused by abnormal AC, DC, RF faults or insufficient cooling. 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 all monitor and control functions including a type N RF connector to sample and measure output RF power. Opening the small access door on the front panel allows easy access to configuration DIP switches that can be set during installation, up/down buttons that permit setting high and low alarm trip points (such as Low RF), and a set of detail fault LEDs to help troubleshoot during operation.

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 more basic analog command/status port designed for users who will not be operating remotely via a computer; 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 CMPA.

Digital attenuation is available which allows for RF drive attenuation adjustment via the serial remote interface ports, thereby enhancing remote monitor and control capabilities.

To expedite field maintenance procedures, the VZU-6994 TWTA utilizes a modular design approach consisting of Line Replaceable Units (LRUs), which permit service personnel to maintain the CMPA in the field without need of returning the entire unit to the depot or factory. Comprehensive built-in-test (BIT) sequences 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 5.25" (h) x 24" (d), plus air duct adapters, and weighs approximately 60 lbs. The TWT Amplifier 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 CMPA 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 CMPA via a type N connector (isolator) located at the rear of the enclosure. The isolator limits the input VSWR to a level of 1.3 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 IPA is designed to be transparent to final amplifier RF parameters and is temperature compensated to minimize drift. As a result, the overall TWT CMPA gain is specified to be stable within ±0.25 dB/24 hours with ±10% line voltage variations. The output of the isolator is then fed to the input of the TWT. The IPA and TWT provide a combined subsystem gain of at least 73 dB at rated power.

The primary TWT employed in this power amplifier is a CPI TWT featuring conduction cooling, dual depressed collectors for efficient operation and a Periodic Permanent Magnet (PPM) focused helix design. It is designed especially for compact, lightweight applications involving satellite uplink service.

The output waveguide assembly interfaces to the TWT and protects the tube from abnormal or transient conditions which could permanently damage the TWT. This assembly consists of an isolator, harmonic filter, receive reject 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 CMPA 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 (12% 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 receive band reject filter serves as a high pass filter cutting off below band signals. The filters used in the VZU-6994 series are designed to minimize noise power density in their respective receive bands. Finally, 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 CMPA output power levels through the use of an external spectrum analyzer or portable power meter. High reflected RF protection circuitry is standard and reflected power information is sent to the front panel for display. With forward power metering comes user settable low and high RF power alarms settable via the front panel access door.

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 CMPA to the external waveguide run is a WR-75F (flange) termination. The CMPA comes with a WR-75G (grooved, threaded) rear connector and a waveguide gasket.

Power Supply Subsystem

Overview

The power supply portion of the CMPA provides all of the internal voltages necessary to operate the TWT, RF driver (IPA), forced air cooling system and auxiliary circuits for control, monitoring and protection of the CMPA. Only the AC input power is required for operation. The travelling 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 VZU-6994 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 CMPA 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, 110-240 VAC) flows via a EMI filter and the main circuit breaker to both the cooling system power supply and the Power Factor Correction Module. This module provides a regulated 375 VDC to the Power Processor and allows the CMPA 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 via the detail fault LEDs located through the front panel access door.

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, 21 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 (+/-15 VDC and 16 VAC) 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, 21 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 50% (collector #1) and 32% (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 Control and Display Modules are designed to assure correct operation of the power amplifier and easy maintainability with minimal operator training and activity. Microprocessor circuits along with status and fault LEDs provide automatic sequencing of CMPA operation and continuous monitoring of critical parameters. If a fault should occur, the CMPA either recycles back to its state prior to the fault or latches into the FAULT state. In either case, the appropriate front panel lamp will illuminate. Also, a detail fault display is located inside the front panel access door which can be used in assisting a maintenance technician in isolating the fault to a replaceable component or subassembly. The front panel access door also provides a convenient means of allowing the user to set features such as system configuration and low RF alarm.

Figure 4 and the Product Specifications below present a complete list of controls, displays, and LED indicators on the front panels. All panel indicators are reliable, bright LEDs.

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. Depressing the TRANSMIT/STANDBY key initiates the BOS (Beam On Sequence). At the successful conclusion of BOS, the unit is in the TRANSMIT state (high voltage is on). Alternatively, the operator may depress the TRANSMIT/STANDBY key during HTD causing the TX SELECT lamp to illuminate. In this case, the BOS is initiated automatically at the completion of HTD. In the interest of promoting long life of the TWT, the heater voltage is reduced by 10 percent whenever the CMPA 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 TRANSMIT, the FAULT LED will light and the unit will switch from TRANSMIT to FAULT. Two scenarios are possible. The first scenario occurs when a fault lasts less than four seconds (a transient fault) or when fewer than three transient faults occur within twenty seconds. In this case, the unit will recycle back to TRANSMIT.Each transient fault will generate a recycle. Each recycle from FAULT to TRANSMIT will be delayed by one second. After the unit successfully recycles to TRANSMIT, the RECYCLED FAULT LED will flash until the user presses RESET. Each fault causes a detail fault LED to illuminate behind the front panel access door. This LED will remain lit until the RESET button is pressed or power is cycled.

The second scenario occurs when a fault lasts longer than four seconds or 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 RESET. If the fault was successfully cleared, the FAULT LED will extinguish and the unit will be in STANDBY. Press TRANSMIT/STANDBY to resume transmitting.

In either case, the pertinent fault remains displayed on the detail fault display inside the front panel access door until hitting the RESET button. This allows the user or technician the ability to identify individual faults to a specific module or subassembly.

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/recycle circuit protects the TWT against excessive reflected power due to abnormal waveguide or antenna conditions. Additionally, the forward power metering circuit measures both continuous wave (CW) and peak RF signals. Also included is a forward power low RF alarm circuit, which compares the output power with a user-settable low RF set point and triggers an alarm, should output power fall below this level.

Mechanical Design

General

The VZU-6994 is packaged in a standard rack mounted drawer measuring 19" wide by 5.25" high and 24" deep (plus connectors, fan and air duct adapters). The unit is cooled via a forced-air cooling system consisting of two axial fans, an air filter and an exhaust duct. Allowances are made for 0.10" H_20 drop due to customer ducting losses.

LRU Philosophy

The CMPA utilizes a modular design approach incorporating LRUs for ease of maintainability in the field. The maintenance concept employed in the VZU-6994 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 CMPA to the depot for servicing. The philosophy is to configure the CMPA 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 CPI VZU-6994 Series TWTA unless otherwise specified.

Electrical

Frequency	VZU-6994-AC, -AD	13.75 - 14.50 GHz
	VZU-6994-AB	12.75 to 14.50 GHz
	VZU-6994-AP	14.7 to 15.2 GHz
Output Power		
•TWT	VZU-6994-AC,-AB,-AP	55.44 dBm min. (350 watts)
	VZU-6994-AD	56.02 dBm min. (400 watts)
•flange	VZU-6994-AC,-AB,-AP	54.39 dBm min. (275 watts)
	VZU-6994-AD	55.31 dBm min. (340 watts)
Bandwidth	VZU-6994-AC,-AD	750 MHz
	VZU-6994-AB	1750 MHz
	VZU-6994-AP	500 MHz
Gain		
•at rated power		73 dB min. (88 dB max.)
•small signal		78 dB min. (90 dB max.)
RF Level Adjust Range		0 to 20 dB
Output Power Setability		±0.2 dB
Gain Stability		
•at constant drive & temperature		±0.25 dB/24 hr max.(after 30 min. warm-up)
•over temperature, constant drive (any frequency)		±1.0 dB over oper. temp. range
Small Signal Gain Slope	VZU-6994-AC,-AD	0.015 dB/MHz max.
	VZU-6994-AB,-AP	0.02 dB/MHz max.
Small Signal Gain Variation		
•across any 80 MHz band		1.0 dB pk-pk max.
•across the 500 MHz band		2.5 dB pk-pk max.
•across the 750 MHz band		2.5 dB pk-pk max.
•across the 1750 MHz band		2.5 dB pk-pk max.
Input VSWR		1.3:1 max.

Electrical, continued

Output VSWR		1.3:1 max.
Load VSWR		
•full spec compliance		1.5 max.
•operation without damage		any value
•continuous operation		2.0:1 max.
Residual AM		
•below 10 kHz		-50 dBc
•10 to 500 kHz		-20 [(1.3+log F (kHz)] dBc
•above 500 kHz		-85 dBc
Phase Noise		
•IESS phase noise profile		-6 dB
•AC fundamental		-36 dBc
•Sum of all spurs		-47 dBc
AM/PM Conversion	VZU-6994-AC	2°/dB max. for a single carrier at 8 dB below rated power
	VZU-6994-AB,-AP,-AD	2.5°/dB max. for a single carrier at 8 dB below rated power
Harmonic Output		-60 dBc at rated power, second and third harmonics
Noise and Spurious (at rated gain)		
	VZU-6994-AC,-AD,-AP	<-150 dBW/4 kHz, 10.9 to 12.7 GHz
	VZU-6994-AB	<-130 dBW/4 kHz, 10.9 to 11.7 GHz
	VZU-6994-AC,-AP	<-115 dBw/4 kHz, 11.7 to 12.2 GHz
	ALL	<-65 dBw/4 kHz, xmit band to 18 GHz
	ALL	<-105 dBw/4 kHz, 18.0 to 26.0 GHz
	ALL	<-125 dBw/4 kHz, 26.0 to 40.0 GHz
Intermodulation		-24 dBc or better with two equal carriers at total power level 7 dB below rated single carrier output (at 4 dB with optional integral linearizer)
Group Delay (in any 40 MHz band)		0.01 ns/MHz linear 0.001 ns/MHz^2 parabolic max. 0.5 ns pk-pk ripple max.
Primary Power		110-240 ±10%, single phase 47-63 Hz

Electrical, continued

Power Factor		0.95 min. (meets requirements of EN61000-3-2, total harmonic distortion)
Power Consumption	VZU-6994-AB,-AC,-AP	1.3 kVA (typical)
	VZU-6994-AD	1.35 kVA (typical)
	VZU-6994-AB,-AC,-AP	1.4 kVA (max.)
	VZU-6994-AD	1.5 kVA (max.)
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	40,000 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 blowers. Rear air intake and exhaust. Maximum external pressure loss allowable: 0.10 inches water column.
RF Input Connection	Type N Female
RF Output Connection	WR-75 waveguide flange, grooved, threaded UNC 2B 6-32
RF Output Monitor	Type N Female
Dimensions, (W x H x D)	19 x 5.25 x 24 in. (483 x 133 x 610 mm)
Weight	60 lbs (27.3 kg) max.

Heat and Acoustic

Heat Dissipation	1100 watts max.
Acoustic Noise	65 dBA (as measured at 3 ft.)

MONITORS AND CONTROLS

Control Functions	Main Power On/Off TX (Transmit) Select Transmit/Standby (Beam on/off) RF Drive Adjust (manual standard) Local/Remote/Computer (CIF) Select Indicator Test Fault Reset
Monitoring	RF Output Power Attenuator Setting RF Output Sample Port (-40 dBm nominal, Type N) RF Reflected Power (W) Helix Current (mA) Helix Voltage (kV)
Control/ Status Display	Power On Heater Time Delay (HTD) TX (Transmit) Select Standby Transmit (Beam on) Local/Remote/CIF Meter Select
Fault/Alarm Display	Recycled Fault Fault Low RF High Reflected RF Interlocks Open (power supply temp. or amplifier cover) Helix Over-current Helix Voltage Power Supply Arc DC Buss Fault TWT Over-temperature

REMOTE CONTROL INTERFACE

Control Functions	Transmit/Standby (Beam on/off) Fault Reset RF Drive Adjust
Monitoring	RF Output Power RF Reflected Power Helix Current Helix Voltage Attenuator Setting
Control/ Status	Power On/Off TX Select (Transmit Select) Heater Time Delay (HTD) Standby Transmit (Beam on) Local/Remote/Computer I/F Meter Select
Fault/Alarm Displays	Recycled Fault Fault

OPTIONS AND FEATURES

Options & Compatibility	Integral linearizer External receive band reject filter (increases loss by a minimum of 75 dB, up to 12.75 GHz for standard band; and by a minimum of 50 dB up to 11.7 GHz for extended band) Remote Control Panel Redundant and Power Combined Subsystems 100 VAC Primary Power
Features	PIN Diode Attenuation Standard Forward Power Metering Standard Designed to meet EN60215/EN61000-3-2 Safety/ Harmonic standards as well as 2004/108/EC EMC Standards Filament voltage reduction of 10% in standby RS-232/422/485 (4-wire) computer interface standard

OPTIONS AND FEATURES, continued

Features (cont'd)	Auto Fault Recycle Internal test points for ease of maintenance MTTR < 1 hour Also available in 400 Watt C-Band and 400 W X-Band

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.

ACCESSORIES

Several optional accessory items have been designed for use with CPI Ku-band CMPAs. 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 CMPAs. 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 dummy 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 CMPAs to provide an integrated power-combined CMPA system.

Integral Linearizer

The Integral Linearizer is an input device intended to improve the intermodulation characteristics of the CPI CMPAs. The unit functions predistort the RF input signal to compensate for the amplitude and phase non-linearities inherent in the TWT. In most applications the CMPA can then 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 5.25 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 CMPA. The cable requires 24 conductors plus a shielded pair, and practical wire sizes limit the length to about 1100 feet (335 meters).

Remote control/monitor panels are also available for use with the Switching System and Phase Combiner.

SUPPORT SERVICES

Documentation

CPI Satcom Division provides a standard commercial documentation package for all products. The standard package for satellite communications power amplifiers includes a comprehensive operation and maintenance manual, outline and interface drawings and acceptance test procedure/report (ATP).

The technical 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. Outline and interface drawings provide dimensions and the location and size of mounting holes, duct work, and waveguide, so that site preparation can be accomplished prior to receipt of the equipment.

The ATP outlines the tests performed, circuit and test equipment used, and limits established. Space is provided for recording and certifying the test results, consolidating all related information in one document. The spare parts documentation package consists of a commercial recommended spare parts list to support the equipment for a one-to-two year period of operation.

SUPPORT SERVICES, continued

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 two 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 telephone consultation. When called for, however, 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.

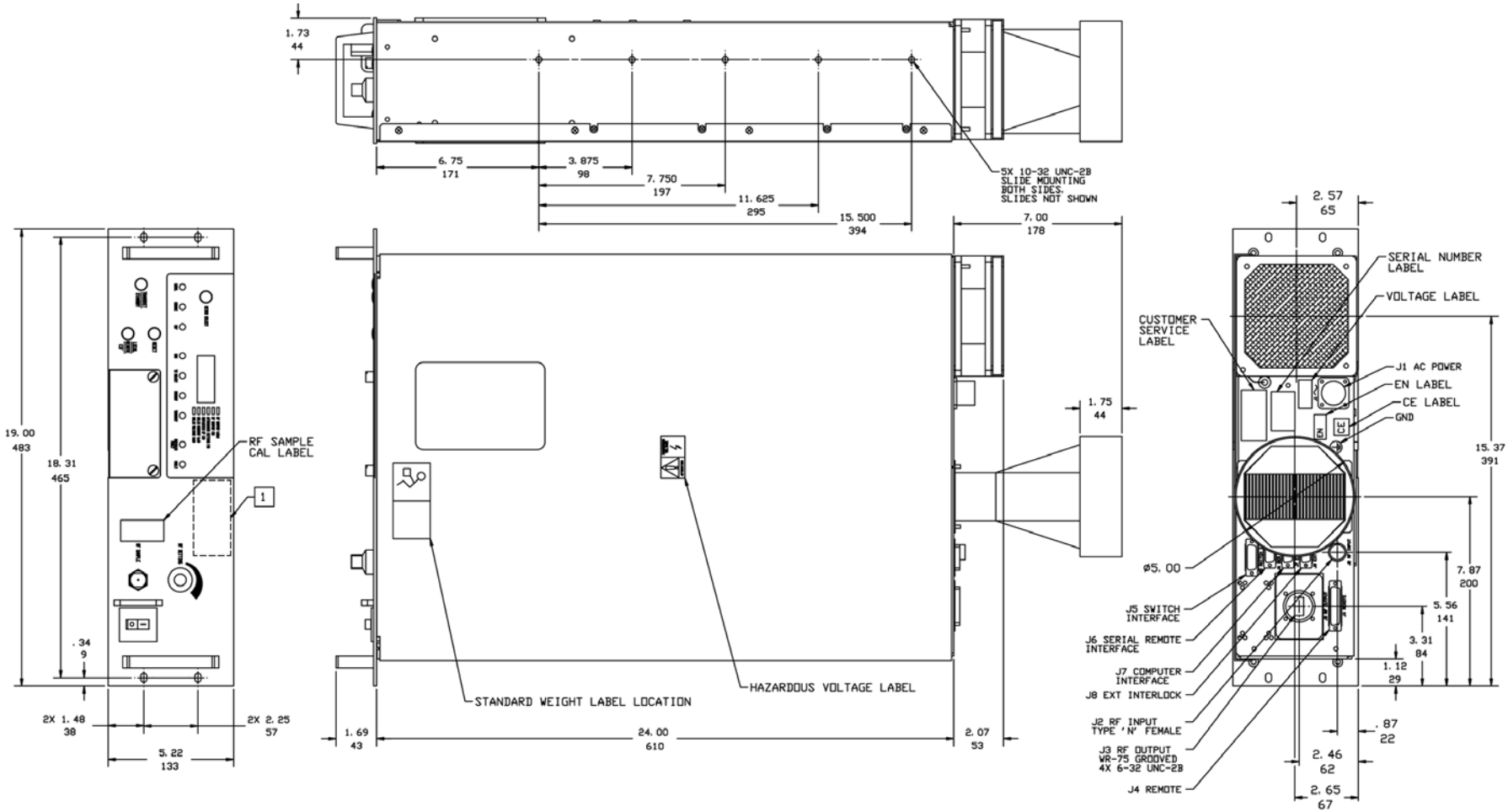


Figure 1. CMPA Outline Drawing (ref. 01018602 rev A dtd 02/06)

Note: Before using this drawing for system design, please check with CPI to ensure that it is the latest revision

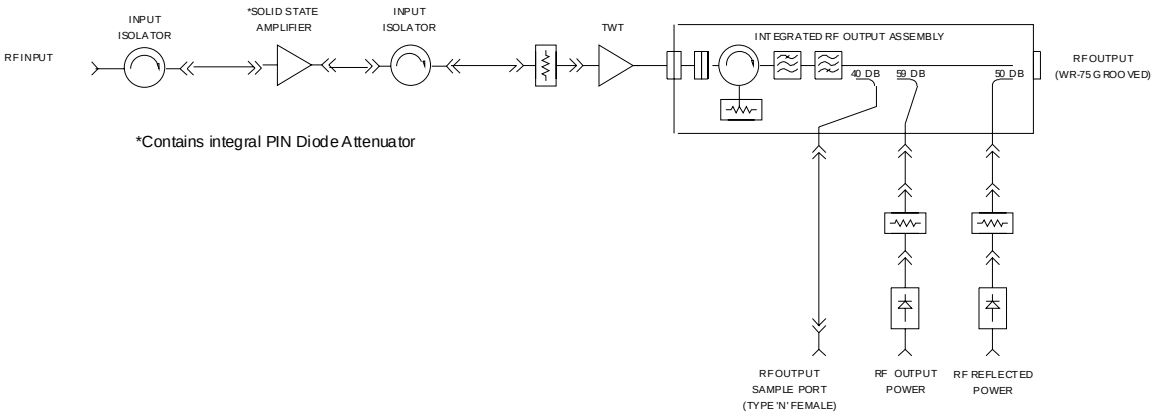


Figure 2. CMPA RF Diagram

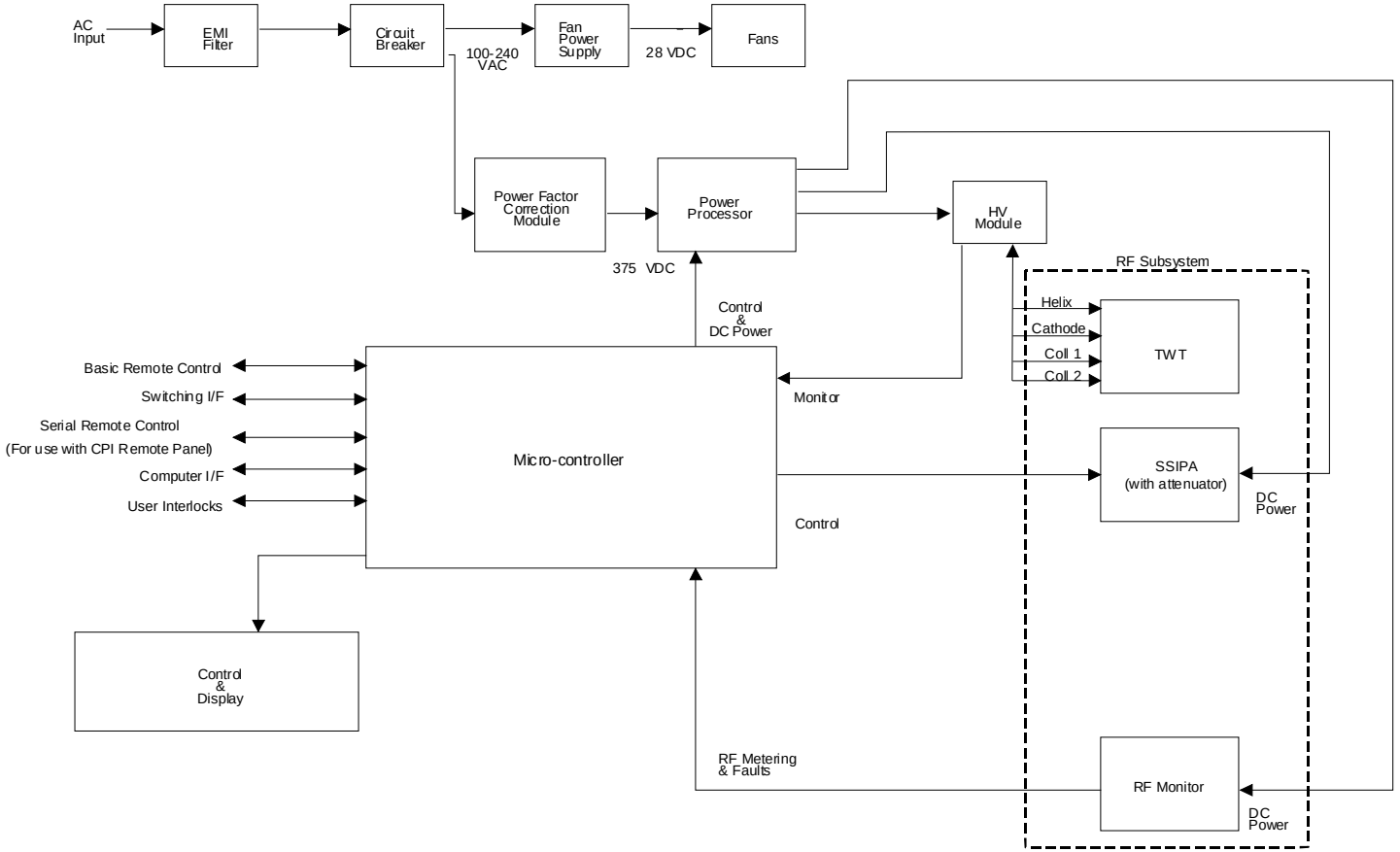


Figure 3 - Power Supply Block Diagram

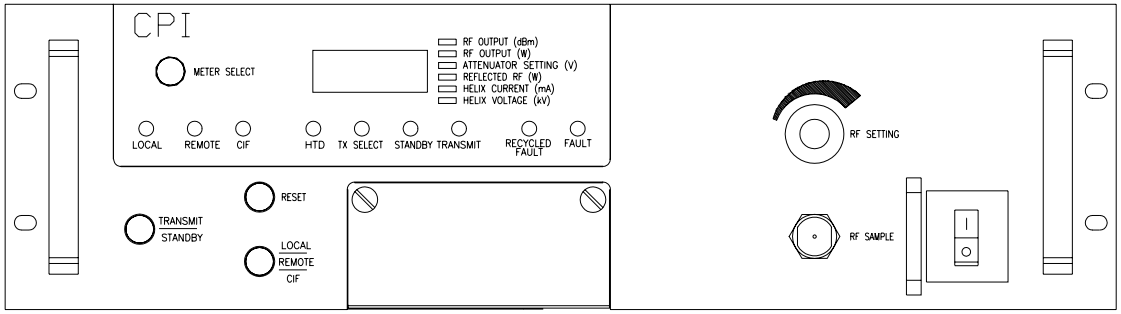


Figure 4. CMPA Front Panel

Communications & Power Industries
satcom division

SPECIFICATION

Cage Code	Sheet 1 of 3	Class	Size	DWG. NO.	Rev
59782		B	A	01027691	D

APPLICATION		REVISIONS				
Next Assembly	Used On	REV	Description	ECO	Date	Approved
	VZU-6994AD	1	PRE-REL		10/27/99	TMH
		1	REL TO ENG.	A00195	10/28/99	BH/
		2	INC E.C.O.	A02083	12/05/01	CLS
		3	INC E.C.O.	A02122	01/10/02	CLS
		A	INC E.C.O. MFG REL/CL A	A02717	5/16/03	CLS/GE
		B	INC. E.C.O.	A03689	2/13/06	ON/FJ
		C	INC. E.C.O.	A03862	6/12/06	ON/FJ
		D	INC. E.C.O.	A04491	3/3/08	FJ

FAMILY CONFIGURATION AND OPTIONS,

400w COMPACT MPA, Ku BAND

CMPA MODEL NO.	OPTION CODES	POWER SUPPLY ASSEMBLY	RF ASSEMBLY
VZU-6994AD-	XXXXXXXXX	01018600-03	01018700-05

EXAMPLE:

VZU-6994AD-00GMTH000 is a Ku Band Compact MPA for 110-240 VAC, with standard front panel, IPA with integral PIN diode attenuator, forward power metering, integral linearizer, CIF port factory pre-set at RS-232, and has no special options.

NOTES:

1. 'O' 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.
2. If unit is being configured with a remote control panel, the Compact MPA must be equipped with PIN diode attenuation option.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER			MATERIAL:	
		DR	TMH	10/28/99	SPEC. NO.	
DEC: 1PL ± .1	2PL ± .02	CHK			FINISH:	
3PL ± .005	FRAC ± 1/64	APPD	TMH	10/28/99	Design Activity Approval	
ANG ± 1 deg	SUR 32	APPD			Customer Approval	

Frequency (Ghz)	CMPA Model Number	Option Codes
13.750 - 14.500	VZU-6994AD	XXXXXXXXX (9 spaces)

Space	Code	Option Description	Option Part Number
1		**Prime Power**	
	0	Single Phase, 110-240 VAC (Standard)	None
2		**Front Panel Assembly**	
	0	Standard	01018626-00
	S	Special Front Panel Assembly	01019455-XX
3		**Attenuator**	
	G	IPA W/Integral Pin Diode (Standard)	None
4		**Forward Power Metering**	
	M	Forward Power Metering (Standard)	None
5		**Integral Linearizer**	
	0	None	None
	T	Include Integral LTI Linearizer	01021338-07
	P	Include LIPA (IPA with Linearizer) option	01040152-00
6		**Computer I/F Port Configuration**	
	0	Factory Pre-set at RS-422/485 (4 wire)	01019702-00
	H	Factory Pre-set at RS-232	01019702-01
	S	Factory Pre-set at RS-422/485 (4 wires w/SA Bus Adapter)	01019702-02
7	0		None
		Remote Control (Previously used for remote control)	
	R	Single Remote Control (VJW-6769A1) **(Do not use, Jan 6, 06**)	01019460-00
	N	Multi-Remote Control (VJW-6769A2) **(Do not use, Jan 16, 06)**	01019460-01
8 & 9	00	None	None
		Special Option Matrix (Only option 00 is available)	
	XX	Special from matrix selected	See Page 3

Space	Code	Option Description	Option Part Number
8 & 9	01	Short Exhaust Duct **(See accessories)**	01020747-00
	02	Receive Filter, External **(See accessories)**	01020654-00
	03	High Altitude Heatsink **(See accessories)**	01027598-00
	05	8 inch dia Intake Duct **(See accessories)**	01033309-00
	06	13 inch long duct kit **(See accessories)**	01030901-00

Accessories:

Remote Control

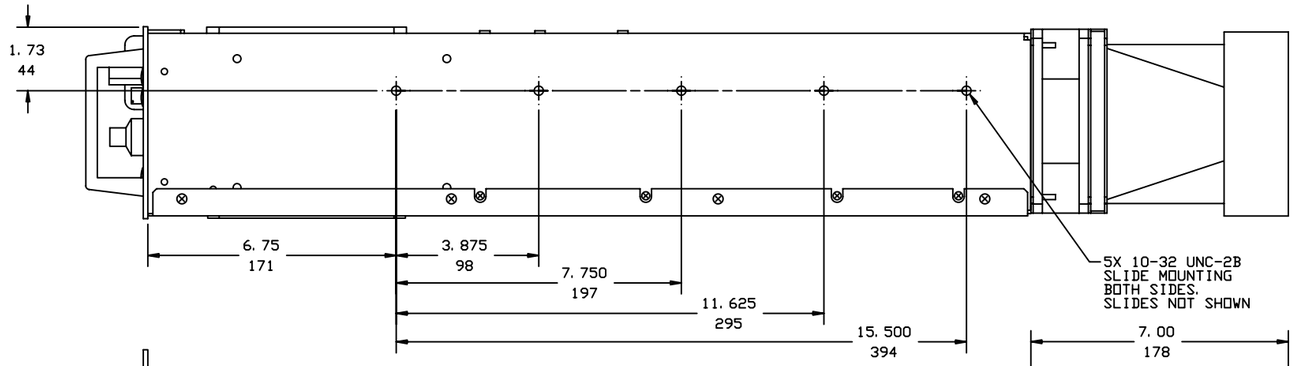
1 RU Remote	01032300-00
1 RU Remote Interconnect Cable	01032346-XX
1 RU Remote Connector	51308773-00

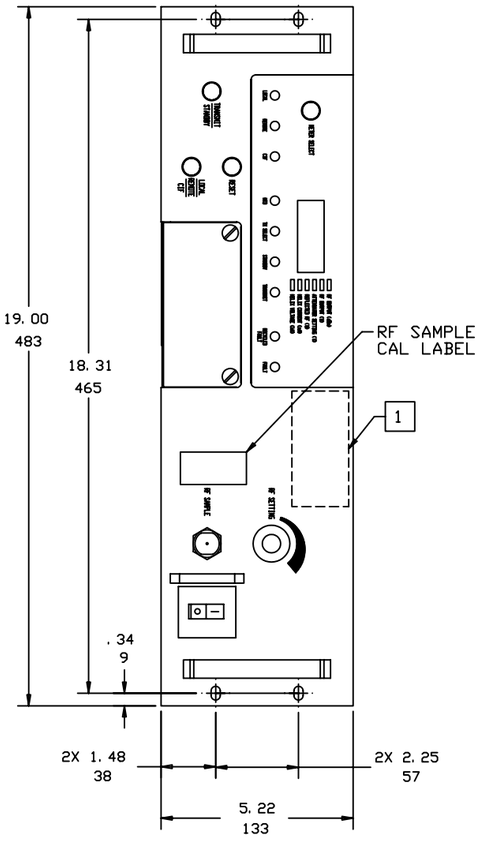
Single Remote Control(VJW-6769A1)	01019460-00
Multi-Remote Control(VJW-6769A2)	01019460-01
Interconnect Cable	01018231-XX

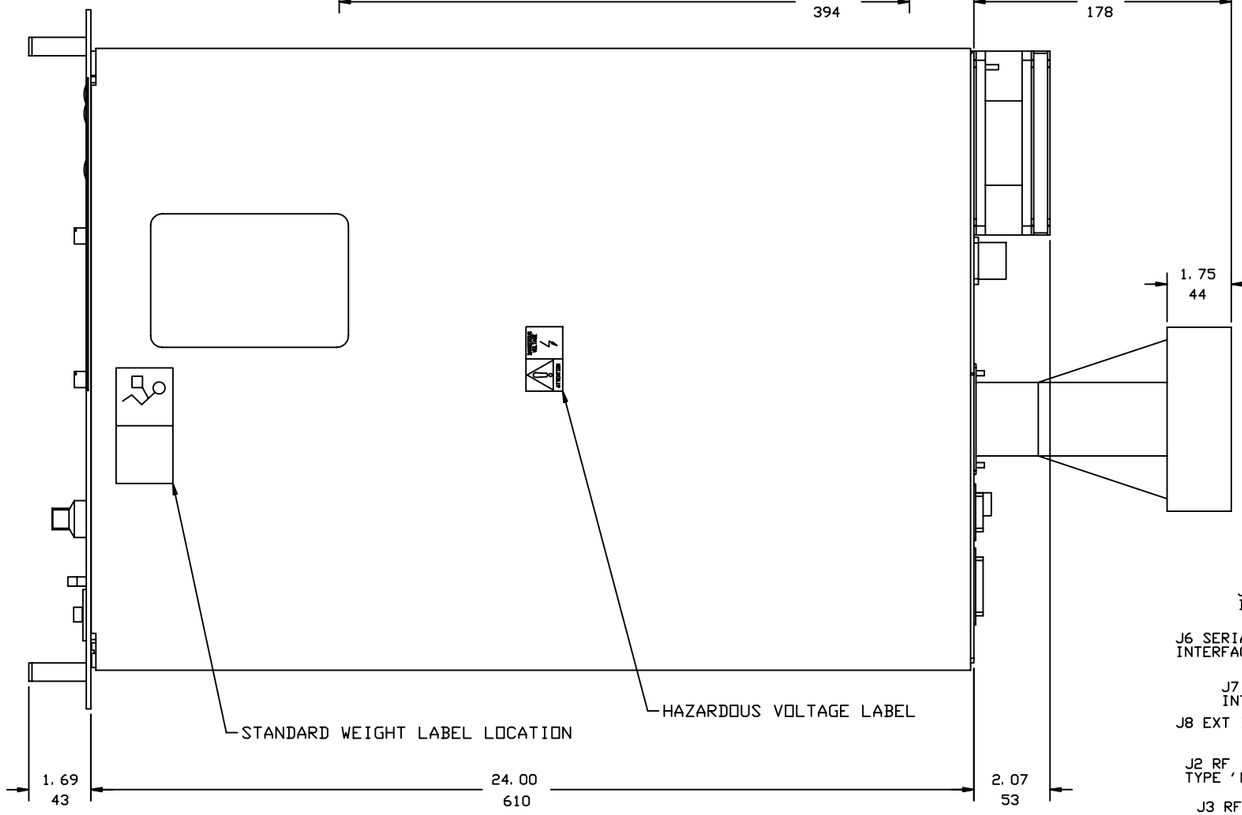
XX=Length in feet. Example 10 feet= 10; 50 feet= 50; etc.

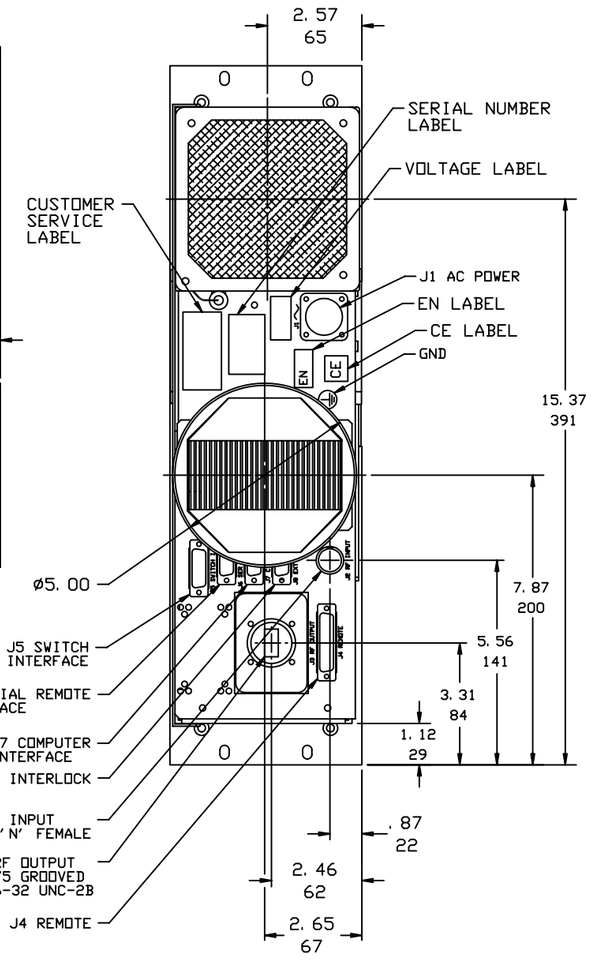
Receive Band Filter	01020654-00
8 inch dia Intake Duct	01033309-00
Short Exhaust Duct	01020747-00
13 inch dia Intake Duct	01030901-00

REVISIONS					
ZONE	REV	DESCRIPTION	ECO	DATE	APPROVED
	1	PRE-RELEASE		10/26/93	
	2	REVISED AND REDRAWN		01/12/94	
	3	MOVED AC PWR & INPUT ISOLATOR		01/18/94	
	4	ADDED AIR DUCTS		02/18/94	
	5	ADDED SIDE VIEW		03/26/94	
	6	REDESIGNED		07/18/94	
	7	ADDED FAN FILTER		08/29/94	
	-	ENG RELEASE		08/29/94	BP
	8	INC ECO	D2173	11/17/96	JD/
	9	INC ECO	D5553	8/27/99	DN/
	A	INC ECO	A03060	2/17/06	GE/BP









1 WEIGHT LABEL LOCATION FOR B.T. UNITS.

NOTES

PROJECTION

INCH
MM

01022097	VZU-6992E2	
01018599	VZU-6994A3	
NEXT ASSEMBLY	USED ON	
APPLICATION		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DEC: 1PL ±.1 2PL ±.02
3PL±.005 FRAC± 1/64
ANG± 1° SURFACE FINISH ✓
MATERIAL
SPEC NO.

QTY	IDENTIFYING NUMBER	DESCRIPTION	CODE IDENT	ITEM

LIST OF MATERIALS

DR	D. COTE	10/26/93
CHK		
APPD		
APPD		
DESIGN ACTIVITY APPROVAL		
CUSTOMER APPROVAL		

Communications & Power Industries
SATCOM DIVISION

OUTLINE, Ku BAND COMPACT MPA/LPA

SIZE	FSCM NO.		
D	59782	01018602	A
SCALE: 1/2	CLASS B	SHEET 1 OF 1	

D 01018602

CAD= cmpa->01018602.asc