⚠ INSTRUCTIONS FOR SAFE OPERATION

BEFORE APPLYING POWER

Review this manual and become familiar with all safety markings and instructions.

Verify that the equipment line voltage selection is compatible with the main power source.

Protection provided by the equipment may be impaired if used in a manner not specified by Amplifier Research.

INTENDED PURPOSES

This equipment is intended for general laboratory use in a wide variety of industrial and scientific applications. It is designed to be used in the process of generating, controlling and measuring high levels of electromagnetic Radio Frequency (RF) energy. Therefore the output of the amplifier must be connected to an appropriate load such as an antenna or field generating device. It is the responsibility of the user to assure that the device is operated in a location which will control the radiated energy such that it will not cause injury and will not violate regulatory levels of electromagnetic interference.

HAZARDOUS RF VOLTAGES

The RF voltages on the center pin of the RF output connector can be hazardous. The RF output connector should be connected to a load before AC power is applied to the amplifier. Do not come into contact with the center pin of the RF output connector or accessories connected to it. Place the equipment in a non-operating condition before disconnecting or connecting the load to the RF output connector.

SAFETY GROUND

This equipment is provided with a protective earth terminal. The main power source to the equipment must supply an uninterrupted safety ground of sufficient size to the input wiring terminals, power cord, or supplied power cord set. The equipment **MUST NOT BE USED** if this protection is impaired.

PHYSICAL DAMAGE

The RF amplifier should not be operated if there is physical damage, missing hardware or missing panels.

MAINTENANCE CAUTION

Adjustment, maintenance, or repair of the equipment must be performed only by qualified personnel. Hazardous energy may be present while protective covers are removed from the equipment even if disconnected from the power source. Contact may result in personal injury. Replacement fuses are required to be of specific type and current rating.

INSTRUCTIONS FOR SAFE OPERATION (continued)

SAFETY SYMBOLS

This symbol is marked on the equipment when it is necessary for the user to refer to the manual for important safety information. This symbol is indicated in the Table of Contents to assist in locating pertinent information.

Dangerous voltages are present. Use extreme care.

CAUTION: The caution symbol denotes a potential hazard. Attention must be given to the statement to prevent damage, destruction or harm.

Indicates protective earth terminal.

RANGE OF ENVIRONMENTAL CONDITIONS

This equipment is designed to be safe under the following environmental conditions:

Indoor use

Altitude up to 2000M

Temperature of 5°C to 40°C

Maximum relative humidity 80% for temperatures up to 31°C. Decreasing linearly to 50% at 40°C.

Mains supply voltage fluctuations not to exceed ± 10% of the nominal voltage or minimum and maximum autoranging values.

Pollution degree 2: Normally non-conductive with occasional condensation

While the equipment will not cause hazardous condition over this environmental range, performance may vary.

COOLING AIR

Care should be exercised not to block the cooling air inlets or outlets. Cooling air blockage can result in damage to the RF amplifier or intermittent shut downs.

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SECTION I

DESCRIPTION AND SPECIFICATIONS

This manual provides operating, interfacing and selected service information pertinent to Amplifier Research Model 500T1G2 Broadband Microwave Amplifier. The Model 500T1G2 is a 500 watt L band traveling-wave tube amplifier (TWTA).

1.1 TWTA DESCRIPTION

The amplifier uses a broadband traveling-wavetube (TWT) to provide 500 watts minimum output over the TWT amplifier's full bandwidth. The amplifier is well suited for susceptibility and general laboratory testing where instantaneous bandwidth and high gain are required.

The amplifier is completely self-contained and packaged for standard 19-inch rack mounting or bench top use. The front panel of the rack mountable amplifier is 8.75 inches high, and the overall chassis is 29.13 inches deep, excluding the rear-panel projections and connectors.

Primary power is 208±10% volt, 50/60 Hz., three phase with neutral (five-wire). An efficient switching power supply design minimizes AC power consumption. In addition, the dual collector TWT is designed to reduce TWT collector dissipation at low RF output levels. A fast regulation control loop and a high degree of filtering ensure performance within specifications over a wide range of operating conditions. The amplifier is fully enclosed, and the upper and lower panels of the enclosure are interlocked to reduce the likelihood of accidental contact with high voltage.

1.2 SUGGESTED APPLICATIONS

RF Susceptibility testing

Antenna and component testing

Equipment calibration

General laboratory instrumentation

1.3 SPECIFICATIONS

Refer to the Amplifier Research Data Sheet on the following pages for detailed specifications.

1.4 ACCESSORIES

Amplifier Research offers a number of accessories for use with this amplifier including:

- Directional coupler
- Antenna
- Flexible transmission line

Refer to a current Amplifier Research catalogue for Microwave Accessories.

1.5 TEST DATA SHEET

A Test Data Sheet for a specific unit is prepared at the time of manufacture and is included with the unit's copy of this manual.

SECTION II
THEORY OF OPERATION

2.1 DESIGN OF THE AMPLIFIER

The model 500T1G2 TWT amplifier consists of four principal subsystems. Two of these subsystems, the microwave power assembly (A27680) and the TWT power supply (A27825) are discussed in sections 2.2 and 2.3, respectively.

The other two subsystems are the microprocessor control system and the TWTA packaging. These both consist of a number of subassemblies. See the build tree in section 5.1 for further information about how the parts lists are structured.

The heart of the microprocessor control system is the control head assembly (A27509-300), which consists of the CPU board (A25450) and the data link board (A22488-001). The microprocessor control system supervises the power supply, provides metering display, processes operator front panel inputs, and enables communication with a host computer over the IEEE-488 interface. The front panel display and controls are carried by the HPA display board (A22700).

The control head is provided with its own power supply and, other than thru the IEEE-488 interface bus, is electrically isolated from the amplifier. Communication with the amplifier is via fiberoptic links to the HPA interface assembly (A25444).

The TWTA packaging consists of cabinet assembly (A27677). The cooling system utilizes two 400 Hz. high-speed tubeaxial blowers.

2.2 DESCRIPTION OF THE RF CIRCUIT

The TWTA consists of two stages of RF amplification: a solid state preamp assembly (E20287) and a traveling-wave tube amplifier (E08032). A voltage-controlled variable attenuator (E20325) permits control of the amplifier's overall gain.

The type N RF input connector is located on the rear panel. The RF input is fed to the variable attenuator and from there to the input connector on the solid state preamp. The solid state preamp's output passes thru an equalizer and drives the RF input of the TWT assembly. The RF output of the TWT is a type S-C coaxial connector. The output is directed through a short cable to a -30/-30 dB dual directional coupler.

The reflected port on the directional coupler is connected to a detector diode whose output is used for VSWR protection by the power supply logic board, for VSWR measurement in the leveling loop, and for reflected power measurement on the HPA interface board.

The forward port output is split by a -3 dB two-way splitter. One of the output ports is connected to a detector diode via an attenuator. The output of the detector diode is used on the HPA interface board to measure forward power. The other output port of the splitter is connected to the type N forward power sample port on the rear panel, again via an attenuator.

2.2 DESCRIPTION OF THE RF CIRCUIT *(continued)*

Amplifier gain is determined by the variable attenuator which has a voltage-controlled loss. Gain adjustment is made by front panel control or over the remote interface. In either case, the control head sets the output of a digital-to-analog converter (DAC) on the HPA interface board. The output of the DAC provides the control voltage for the attenuator. The emergency bypass board (A24830-001) is mounted behind the front panel. It is provided with a circuit that increases the attenuation so that reflected power is limited to a level that can be safely sustained without damage to the amplifier (on the order of 100 watts). The function of the foldback circuit is to permit the amplifier to tolerate high VSWR at the output without shutting down due to over reflected power. In emergency bypass operation (see section 3.7) the gain control signal is provided locally by means of a potentiometer on the emergency bypass board. The foldback circuit remains on line in emergency bypass operation.

2.3 DESCRIPTION OF THE POWER SUPPLY (A27825)

The TWT power supply is of modular construction. Low voltage power for logic and control of the entire power supply assembly is provided by the Low Voltage Power Supply module (A16495). In addition this module provides DC power for the HPA interface and Emergency Bypass Board. Control logic and TWT protection circuits are contained in the HPA logic and Control Assembly (A23050).

The Heater Power Supply Module (A27824) powers the TWT DC heater. Grid bias and pulse top are provided by the Grid Modulator Module (A27832).

The high voltage power supply consists of the following: the three-phase power input module (A23065) converts line voltage to DC for the high voltage switching supply. Switching transistors are on the Power Inverter Module (A27815), and switching is controlled by Regulation Board (A21440). The resonant tank inductor is housed in the Tank Module (A27818). The high voltage transformer and rectifiers are contained in the High Voltage Rectifier Assembly (A27826). The high voltage DC is filtered in the HV Filter Assembly (A27821).

Low voltage interconnects between the power supply modules are through a motherboard. It is installed in the motherboard plate at right angles to the finned power supply heat sink. The heat sink is cooled by the incoming cabinet air. The Motherboard assembly is A27816.

SECTION III
OPERATION

3.1 WARNINGS AND CAUTIONS

Throughout this manual, the symbol

WARNING!

indicates that a hazard exists that may result in personal injury or loss of life.

The symbol

CAUTION

indicates that failure to follow procedures may result in damage to the equipment.

DANGER - HIGH VOLTAGE PRESENT
WARNING!

Electrical equipment in this TWTA generates and stores high-voltage energy that can result in fatal electrocution. Do not operate the TWTA with covers or the front panel removed.

Service work must be performed only by technicians thoroughly familiar with the high-voltages present in microwave tube amplifiers in general, and with this equipment in particular.

Never handle the TWT leads or the high-voltage connectors unless the unit has been unplugged and it has been positively established that the high-voltage filter capacitors have been discharged to a *known* safe level.

SAFETY GROUND
WARNING!

Improper grounding of this equipment can result in electric shock. The TWTA must be operated only with a line cord with a safety ground wire. It is the user's responsibility to ascertain that the power connector is properly wired and that the power outlet is grounded.

EXPLOSIVE ATMOSPHERE
WARNING!

To avoid explosion, never operate this TWTA in an explosive atmosphere. This equipment is not certified for operation in an explosive atmosphere.

3.2 INSTALLATION

3.2.1 Unpacking

Upon receiving the TWTA, unpack the unit and inspect it for obvious signs of external damage. If damage is observed, notify the carrier and contact an authorized service representative.

Save and store the shipping container in case the unit needs to be returned in the future for calibration or repair.

3.2.2 Mounting and removing

The TWTA may be operated as a standalone benchtop unit, or it may be installed in a 19" rack.

If rack mounting of models provided with lifting handles is desired, one or more of the lifting handles may need to be removed to clear the rack's front mounting rails. Optional slide rails for rack mounting are available from Amplifier Research.

NOTE: DUE TO THE WEIGHT OF THE UNIT, THE INSTALLATION OR REMOVAL OF THE AMPLIFIER IS A TWO PERSON OPERATION.

Before removing the amplifier from rack or benchtop cabinet, disconnect power, RF, and any other interface connectors. On the rear of the unit, remove any screws used to connect brackets to amplifier. On the front of the unit, remove the four screws holding the front panel to the cabinet. Carefully slide the amplifier out of the front of the cabinet.

CAUTION

NEVER RACK MOUNT THE TWTA USING THE FRONT PANEL ALONE. THE CHASSIS IS LIKELY TO BE DAMAGED UNLESS ITS WEIGHT IS SUPPORTED. BOTTOM SUPPORT RAILS OR SIDE SLIDE RAILS MUST BE USED IN A RACK MOUNT CONFIGURATION.

See Figure 3-1 (below) for the locations of threaded holes which may be used for supplementary support of the rear of the TWTA.

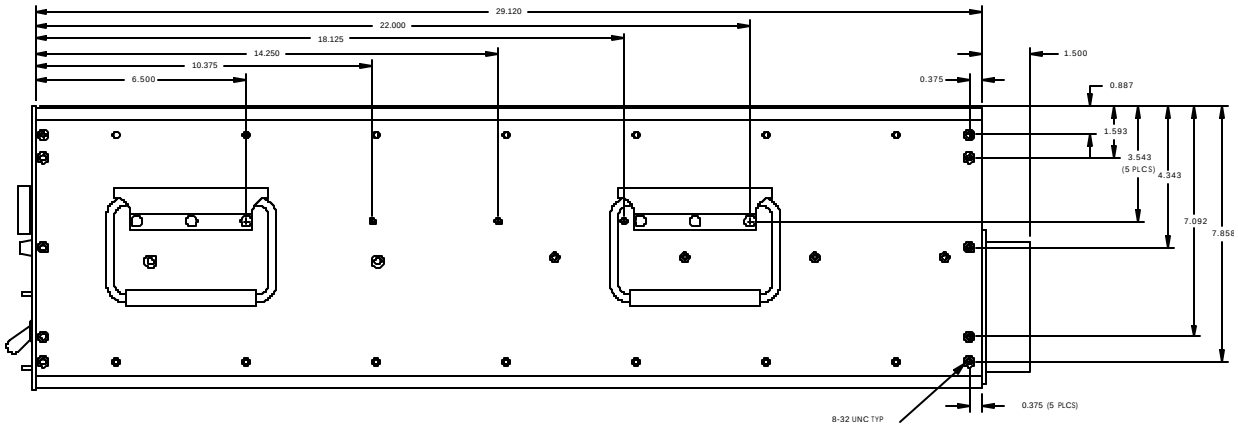

Figure 3-1
Side View of TWTA Showing Threaded Holes

If bottom supports are used for rack mount installation of multiple units, the amplifiers should be separated vertically by at least 1 3/4 inches. This will allow room for necessary support rails and facilitate installation and removal of the units.

The use of chassis slides greatly simplifies rack mounting of multiple units. Figure 3-1 also shows the location of holes used in mounting optional slide rails to the TWTA chassis.

3.2.3 Cooling Requirements

The TWTA is provided with cooling fans. It is important that air movement around the rear of the unit be unobstructed.

CAUTION

FOR EITHER BENCH OR RACK MOUNTING, DO NOT POSITION THE TWTA IN SUCH A WAY THAT THE AIR INTAKE OR OUTLET ARE BLOCKED, OR THAT THE EXHAUST FLOW IS DIRECTED INTO THE INTAKE. SEE PARAGRAPH 3.5 FOR LOCATION OF AIR INTAKE AND AIR OUTLET. IF THE UNIT IS RACK MOUNTED, MAKE SURE THAT THE INTAKE AIR IS 45°C OR BELOW. IF NECESSARY, FABRICATE A SHORT DUCT TO DIRECT THE HOT EXHAUST AIR OUT OF THE RACK ENCLOSURE. GREAT CARE MUST BE TAKEN TO MINIMIZE ANY FLOW RESTRICTIONS. AVOID MOUNTING HEAT-PRODUCING EQUIPMENT IN THE SAME RACK, ESPECIALLY BELOW THE TWTA. FAILURE TO PROVIDE ADEQUATE COOLING CAN RESULT IN THE UNIT'S SHUTTING DOWN FROM OVERTEMPERATURE CONDITIONS.

The TWTA dissipates approximately 2900 watts when in the operate mode without RF drive.

3.2.4 AC Line Power Connections

AC line power connection to the TWTA is made on a terminal block inside the amplifier enclosure. Access to the terminal block screws is by removal of the amplifier bottom panel. Strain relief for a 0.70 dia cable is provided on the rear panel. The power cord must be five-wire, with conductors of 14 gauge or heavier. For use in North America, the following color codes for the power cable should be observed:

Green	Ground
White	Neutral
Red	Phase
Black	Phase
Orange	Phase

The amplifier is insensitive to phase rotation. Some amplifiers for the North American market may be provided with a suitably terminated power cord.

3.2.5 RF Output Connections

The RF output coaxial connector is type 7-16 DIN female.

CAUTION

NEVER OPERATE THE TWTA WITHOUT A MATCHED OUTPUT LOAD RATED FOR AT LEAST 1000 WATTS, CONTINUOUS. THE TWTA IS NOT PROVIDED WITH AN OUTPUT ISOLATOR. FULL REFLECTED POWER MAY IRREPARABLY DAMAGE THE TWT. EVEN WITH NO DRIVE, "LOOPING" OSCILLATION CAN RESULT IN RF OUTPUT HIGH ENOUGH TO DAMAGE THE TUBE IF IT IS OPERATED WITHOUT A LOAD. THE VSWR DETECTION AND FOLDBACK CIRCUIT IS PROVIDED TO PROTECT THE TUBE FROM *PROGRESSIVE* FAILURE OR MISMATCH OF THE OUTPUT LOAD; IT SHOULD NOT BE RELIED ON FOR PROTECTION FROM THE ABSENCE OF A LOAD.

3.2.5 RF Output Connections *(continued)*

If an external isolator is installed at the output of the TWTA, either the isolator should have a load capable of dissipating the full output of the TWTA or the isolator load should be provided with a temperature sensing switch. The temperature switch should be normally closed, self-resetting, and with a temperature rating such that there is no possibility of damaging the load by overheating before the switch opens. The TWTA may be interlocked with the switch by connecting it between pins 10 and 11 of the external interlock connector (J2). If no external isolator is used, retain the jumpers between pins 3 and 4 and between pins 10 and 11 in the mating connector for J2. See section 3.2.6, External Interlock Connector, below.

If an external absorptive filter is installed at the output of the TWTA, either the absorptive filter should be capable of dissipating the full output of the TWTA or it should be provided with a temperature sensing switch as described above.

3.2.6 External interlock connector

The TWTA is provided with an external interlock capability via a 15-pin female D-sub connector, J2. To enable the high voltage power supply, it is necessary to provide continuity between J2 pins 3 and 4. If the amplifier shuts down because the interlock was opened, it will be necessary to reset the system to return to standby (see *System shutdown screen* in Section 3.4). Users may adopt this interlock feature to turn off the high voltage power supply either for equipment protection or as a backup for personnel protection.

CAUTION

THE TWTA'S INTERLOCKS ARE NOT FAIL-SAFE CIRCUITS. DO NOT RELY ON THE EXTERNAL INTERLOCK FOR PERSONNEL PROTECTION. THE INTENT OF THE EXTERNAL INTERLOCK FEATURE IS TO DISABLE THE RF OUTPUT FOR EQUIPMENT PROTECTION. USE PROPER OPERATING AND SAFETY PROCEDURES TO INSURE THAT POWER IS REMOVED FOR PERSONNEL SAFETY.

In addition, the interlock is provided with an external inhibit function. To enable the TWT grid on, it is necessary to provide continuity between pins 10 and 11 of J2. Breaking continuity drives the grid to the bias condition, shutting off the tube and thereby disabling the RF output. As soon as continuity is restored, the tube will again be turned on; no reset is required.

There is an internal jumper between J2 pins 1 and 2; a continuity check through these pins can be used to verify the presence of the amplifier in the instrumentation system.

3.3 FRONT PANEL FEATURES (REFER TO FIGURE 3-2 BELOW)

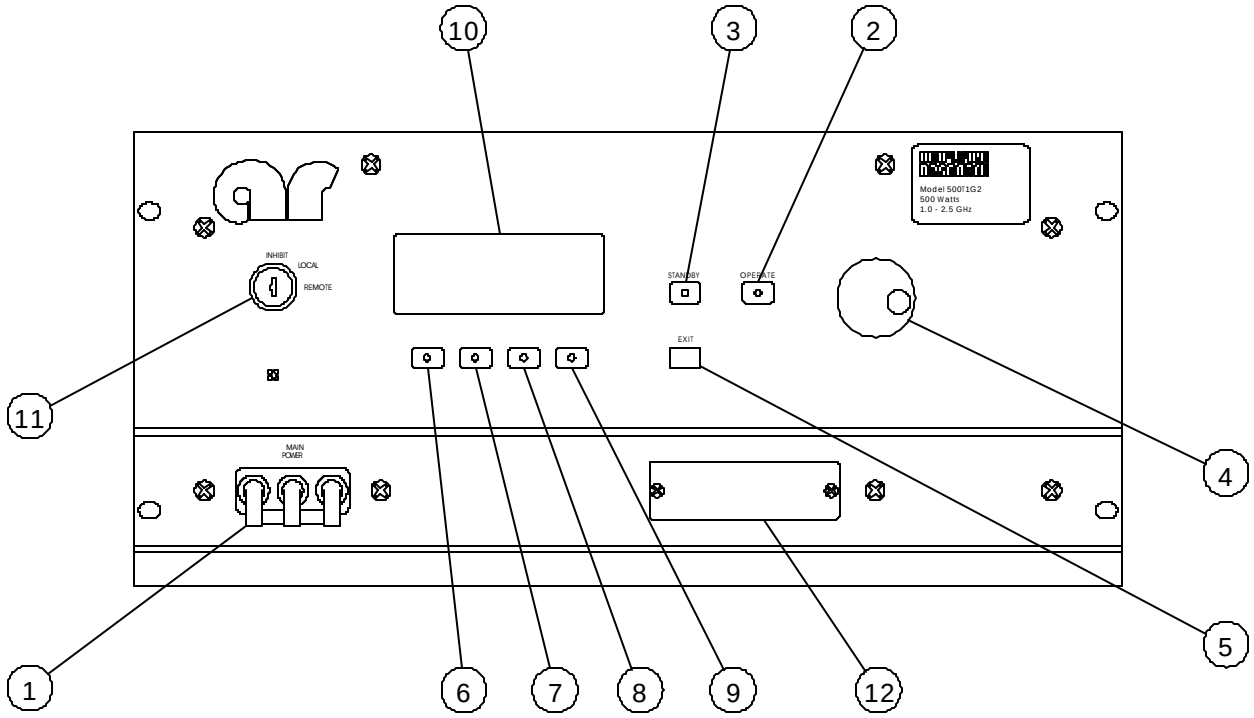

Figure 3-2
Front Panel Features

TABLE 1
FRONT PANEL FEATURES

Item	*Title*	*Function*
1	MAIN POWER	Switchable 15 A. circuit breaker; connects primary power to power supplies.
2	OPERATE	Push-button; turns on high voltage when all faults and heater delay are cleared.
3	STANDBY	Push-button; biases grid off and turns off high voltage.
4	ADJUST	Rotary knob used as an input device to change values of a variety of parameters.
5	EXIT	Push-button; terminates various menu selection routines and returns to the previous menu level.
6-9	S1...S4	"Soft Key" push-buttons; various menu selection functions.
10	Display	Displays numerous parameter values and fault messages.
11	Keylock Switch	Allows operator to inhibit the TWTA, to enable front panel control, or to enable computer control.
12	Emergency switch cover	Provides access to emergency bypass switches, which permit manual control of the amplifier.

3.4 FRONT PANEL DISPLAY AND SOFT KEYS

The purpose of the front panel display is to permit the operator to access extensive information about the condition and operation of the TWTA. To accomplish this, a number of informational screens are programmed. It is important for the operator to be able to select the screen with the required information. Screen selection is accomplished by pressing an appropriate soft key or by pressing the EXIT key. When a soft key is active, its function is displayed on the bottom line of the display. Figure 3-3 provides a "roadmap" for navigating between the screens.

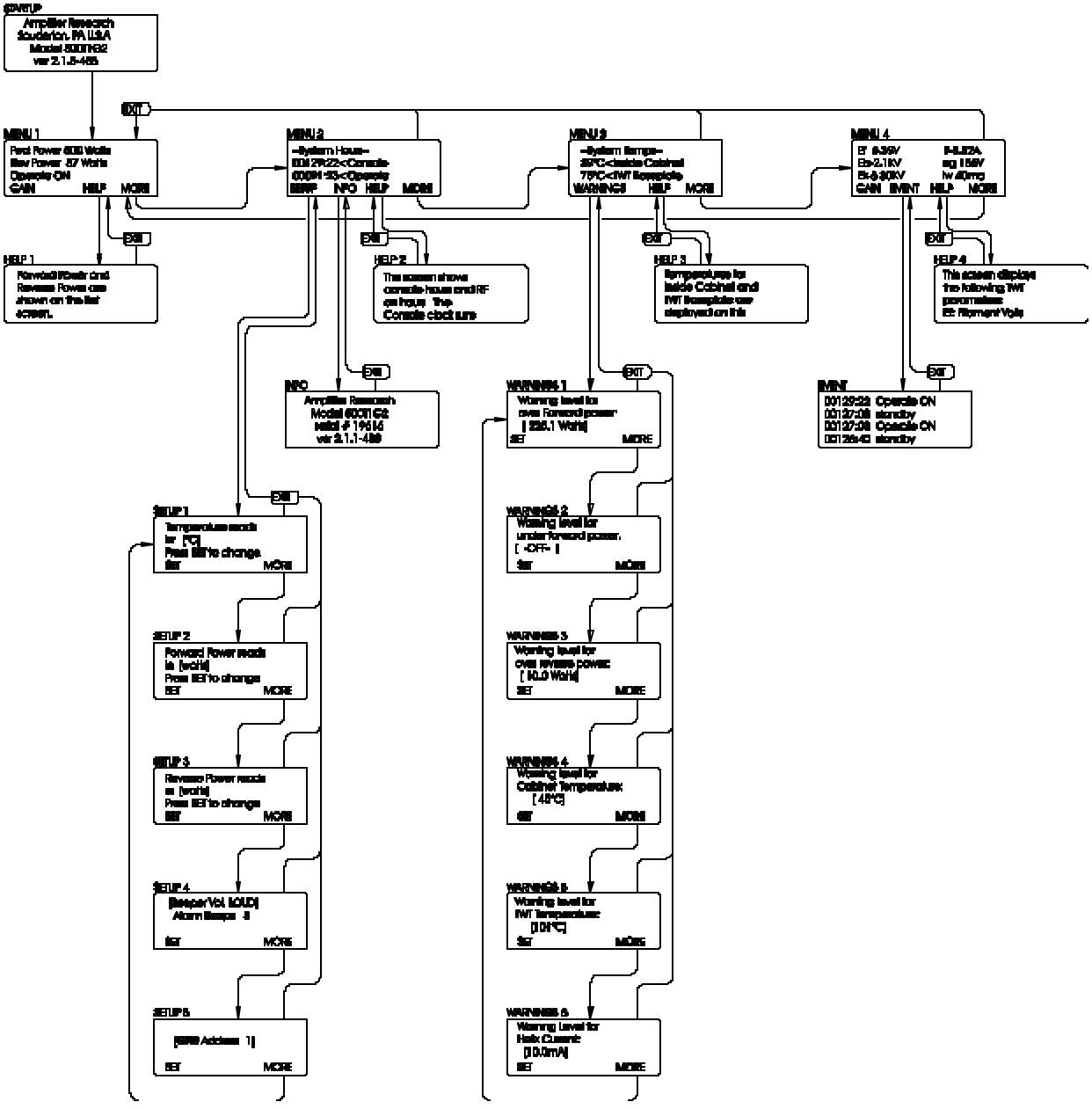

Figure 3-3
Front Panel Display Screens

3.4 FRONT PANEL DISPLAY AND SOFT KEYS *(continued)*

Menu screens - The screens at the highest level are called menu screens. There are four menu screens. At power on, the MENU 1 screen is displayed. Each of the menu screens has the soft key S4 labeled MORE. The MORE key (S4) causes the next menu screen to appear. From MENU 4, MORE causes MENU 1 to reappear. In short, MORE permits scrolling through the menu screens. The EXIT key returns display to MENU 1 from any other menu screen.

The menu screens display system status and parameter levels. They are configured as follows:

MENU 1 Forward power (bar graph, watts, or dB)
Reflected power (watts or dB)
System status (if a latched fault exists, MENU 1 is displayed with the system shutdown message)

MENU 2 Console hours (active when AC power is on)
Operate hours (active when HV is on)

MENU 3 Cabinet temperature (°C or °F)
TWT baseplate temperature (°C or °F)

MENU 4 Heater voltage (Ef)
Heater current (If)
Collector voltage (Eb)
Cathode voltage (Ek)
Helix current (Iw)

Help Screens - On each of the menu screens, soft key S3 is labeled HELP. If S3 is selected, a message describing the functions of that screen will be displayed. Use the ADJUST knob to scroll through the message. The EXIT key will return you to the screen from which the help screen was called.

Setup Screens - From MENU 2, S1 (labeled SETUP) selects the first of five setup screens, SETUP 1. It toggles display of temperature parameters between Fahrenheit and Celsius degrees. Pressing S1 (SET) changes the selection. The setting displayed when the screen is exited will be retained. Pressing MORE again brings up the SETUP 2 screen, which allows a choice of displaying forward power in stripchart form, or in dBm or watts. Pressing MORE a third time brings up SETUP 3, which allows a choice of dBm or watts for displaying reflected power. MORE brings up SETUP 4, which allows entering the desired number of alarm beeps and the desired beep volume. S1 (SET) toggles between parameters, and the adjust knob is used to enter the data. Setup 5 allows the IEEE-488 address to be set. MORE returns you to SETUP 1. EXIT returns you from any of the setup screens to MENU 2.

Warnings Screens - From MENU 3, S1 (labeled WARNINGS) selects WARNINGS 1 which allows the operator to enter the maximum forward power. The existing value is between brackets[]; pressing SET puts arrows >< around the value, indicating that the adjust knob is active. The effect of the warning setpoint is as follows: if the forward power exceeds the setpoint, the audible alarm will sound (if configured in SETUP 3).

This warning will be repeated every thirty seconds until the over forward power condition is cleared. In addition, a warning message will appear on line 3 (the status line) of MENU 1. In the event that the alarm is heard, the operator should go to MENU 1 to determine the cause.

3.4 FRONT PANEL DISPLAY AND SOFT KEYS *(continued)*

Pressing more brings up WARNINGS 2, which allows the under forward power setpoint to be entered. Adjusting this to the minimum value causes -OFF- to be selected, disabling this alarm.

In WARNINGS 3, the maximum reflected power level is set. Note that these are warning levels at which the beep sounds; the actual maximum reflected power level that generates a system fault is set in hardware in the TWT power supply HPA Logic and Control module (A16485).

MORE brings up WARNINGS 4, which allows input of the maximum cabinet temperature. Entering this parameter is performed as above.

MORE brings up WARNINGS 5, identical to the previous screen except that it deals with the maximum TWT collector block temperature. If either parameter exceeds the setpoint, the audible alarm will sound every 30 seconds (if configured), and a warning message will appear on line 3 of MENU 1.

From WARNINGS 5, MORE brings up WARNINGS 6, which permits setting the maximum helix current. Any helix current above this setpoint will result in an audible alarm (if configured), repeated every 30 seconds; and a warning message is displayed on the status line of MENU 1.

Pressing MORE again returns display to WARNINGS 1. As before, pressing EXIT from any of the warnings screens returns display to MENU 3.

Info Screen - From MENU 2, S2 (labeled INFO) selects a screen that displays the RF sample port calibration factors at various frequencies across the band. In addition, this screen displays the model number, serial number and firmware revision information which may be required by a service representative when providing technical assistance. The EXIT key returns the display to MENU 2.

Event Screen - From MENU 4, S2 (labeled EVENT) provides a display of events logged by the control system. These events include AC power-up, heater warm-up, change from standby to operate, faults, and resets. The events are stored in a first-in-first-out (FIFO) software buffer that has room for 100 events; as new events are logged, the older ones are discarded.

System Shutdown Screen - In the event of a system shutdown due to a latched fault (i. e., a fault such as body overcurrent or power low line that requires a reset), the MENU screen is replaced by a screen indicating the nature of the fault. Softkey S4 (labeled OK) is implemented as a reset key; pressing S4 brings back the MENU screens. Line 3 of MENU 1, which normally displays the operational state of the TWTA, is used as a fault display line until the fault is cleared. When the fault clears the system will automatically resume the standby state and high voltage on will be enabled once again.

Factory Service Screens - A number of screens intended for factory service and calibration are behind passwords and are not accessible to the user.

System Malfunction Screens - A number of screens are reserved to display error messages. These messages are not normally seen and indicate a malfunction of the TWTA. System malfunction messages include the following:

Database corrupt
Communication failure
Cannot restore

CU line voltage too low to operate. System shutdown

3.4 FRONT PANEL DISPLAY AND SOFT KEYS *(continued)*

In the event that one of these appears, shut off the TWTA and contact an authorized service representative before proceeding.

CAUTION

ATTEMPTS TO OPERATE THE TWTA DESPITE CONTROL UNIT PROBLEMS MAY RESULT IN LOSS OF THE STATIC RAM DATABASE AND CALIBRATION INFORMATION.

3.5 REAR PANEL FEATURES (SEE FIGURE 3-4 BELOW)

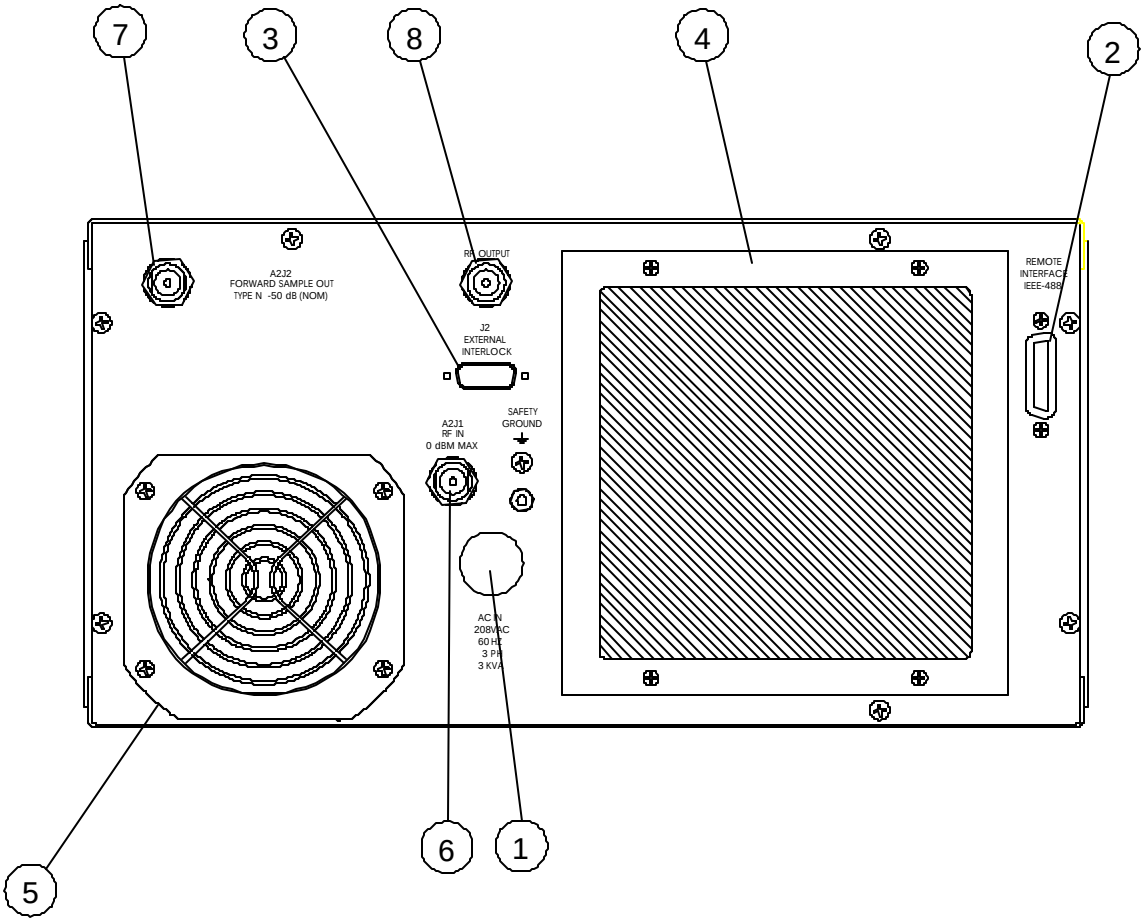

Figure 3-4
Rear panel Features

TABLE 2
TWTA REAR PANEL FEATURES

Item	*Title*	*Function*
1.	AC POWER IN	AC power input strain relief.
2.	IEEE-488	Remote control connector: 24 pin hermaphrodite
3.	EXTERNAL INTERLOCK	Connector for remote interlock and inhibit functions: D-sub 15-pin female
4.	—	Cooling air intake.
5.	—	Cooling air outlet.
6.	RF INPUT	RF input; N female connector
7.	RF FORWARD SAMPLE OUT	RF sample: N female connector
8.	RF OUTPUT	RF output: 7-16 DIN female connector

3.6 INITIAL TURN ON AND WARM-UP PROCEDURE

Install the TWTA as discussed in section 3.2 Provide an RF generator to the RF input Type N connector A1J1. Set RF generator level below -50 dBm and set desired frequency in specified range. Connect a load suitable for 1000 watts continuous operation to the output 7-16 DIN connector. The load VSWR should be less than 2.0:1 A power meter and suitable attenuators may be connected to the RF sample port A1J2. (Refer to RF sample port calibration factors on the rear of the unit or on the *Info* screen in MENU 2). These show the relation between the amplifier output power and the RF sample port power as a function of frequency. When only the power of the fundamental frequency is to be measured and when operating near rated power use filters, a frequency selective receiver, or a spectrum analyzer to reduce the harmonic content of the measured level.

Set keylock to LOCAL.

Switch on the MAIN POWER circuit breaker. The fan will operate. The front panel display will show several identification messages and then the MENU 1 screen. The third line will indicate that the heater time delay is active.

Allow the heater warm-up delay to expire. Line three will indicate OFF/READY.

Push S4 (MORE) three times to go to MENU 4. Verify that the heater voltage and current are near their nominal levels. The values of these parameters at the time the TWTA left the factory are logged on the test data sheet.

Push the OPERATE push-button. You will now see the cathode and the collector voltages rise. Verify that the collector and cathode voltages are near nominal. The helix current should be close to the nominal value for no RF drive. Then push MORE or EXIT to go back to MENU 1.

Set the TWTA gain to maximum. Adjust the RF generator to slowly increase the RF drive toward 0 dBm to reach the desired FWD PWR on the display and power meter (connected to sample port). The forward power bar graph will become active, with maximum length when peak power output is achieved. Best performance is obtained when the input RF drive is set at or just below the level which causes peak power output. Do not set input drive above 0 dBm (Input drive above +20 dBm will damage the unit). The reflected power level should remain below 10% of the forward power, assuming that the load is properly matched.

An alternate procedure is to pre-set the TWTA gain to minimum, set the RF generator to 0 dBm and then slowly increase the TWTA gain to set the desired RF output level.

Observe that the helix current is sensitive to the RF drive level of the TWT. It is at a minimum with no RF drive. The helix currents with no drive and with rated RF output mid-band are logged on the test data sheet. The value of the helix current is a good qualitative indicator of RF drive present.

To shut the system down, turn down the RF generator level below -50 dBm and press STANDBY. Allow the TWTA to cool down until the TWT temperature drops below 70°C, then turn off main power

3.7 EMERGENCY BYPASS OPERATION

For reference, see schematic 10-24830 in section 5.2.

The TWTA is provided with a means of operating the amplifier manually in the event that there is a failure of the control module and it is imperative that the amplifier remain on line.

CAUTION

EMERGENCY BYPASS OPERATION DISABLES ALL MICROPROCESSOR BASED INTERACTIVE FEATURES AND POSSIBLY SOME DIAGNOSTIC FEATURES. FOR THIS REASON, THE EMERGENCY BYPASS MODE OF OPERATION SHOULD BE USED ONLY WHEN THE CONTROL UNIT FAILS AND WHEN IT IS ESSENTIAL TO REMAIN ON LINE.

To access the manual controls, remove the two 4-40 screws securing the emergency switch cover on the front panel. Emergency bypass mode is selected by pushing the left-hand switch (S1) to the left. The center switch (S2) toggles between high voltage on (left) and high voltage off (right). The right-hand switch (S3) selects beam on in the left hand position, and beam off (RF off) in the right-hand position. There is a manual control for the gain adjustment as well. This is a flat, square single-turn potentiometer (R1).

CAUTION

DO NOT ADJUST 20-TURN POT R11; ITS FUNCTION IS TO SET THE REFLECTED RF FOLDBACK LEVEL, AND IT IS CALIBRATED AT THE FACTORY.

3.8 REMOTE IEEE-488 OPERATION

The TWTA is provided with a communication interface that conforms electrically to the IEEE-488 standard. It permits remote emulation of OPERATE, STANDBY, and RESET push-buttons as well as access to parameter measurements, system faults, gain adjustment, and control unit status. The following tables summarize the commands and the return codes.

3.8 REMOTE IEEE-488 OPERATION *(continued)*

TABLE 3
CATALOG OF IEEE-488 COMMANDS

Command	*Function*	*Units*	*Response format*
RDSTAT	Returns status code of processing of previous command (see Table 4)		STATUS=[ ]
RDFLT	Returns system fault code (see Table 5)		flt=[ ]
OPERATE;	Emulates OPERATE push-button		
STANDBY;	Emulate STANDBY push-button		
POWER:OFF;	Emulate STANDBY push-button		
RESET;	Emulates RESET softkey		
RDS/N	Returns serial number		s/n=[ ]
RDCONHR	Returns console hours		ConHr=[ ]
RDRFHR	Returns RF hours		RfHr=[ ]
RDEK	Returns cathode voltage	KV	Ek=[ ]
RDEB	Returns collector voltage	KV	Eb=[ ]
RDEF	Returns heater voltage	V	Ef=[ ]
RDIF	Returns heater current	A	If=[ ]
RDIW	Returns helix current	mA	Iw=[ ]
RDTMPTWTF	Returns TWT temp (°F)	°F	TWTF=[ ]F
RDTMPTWTC	Returns TWT temp (°C)	°C	TWTC=[ ]C
RDTMPPSF	Returns power supply temp (°F)	°F	PSF=[ ]F
RDTMPPSC	Returns power supply temp (°C)	°C	PSC=[ ]C
RDTWTOTF	Returns TWT overtemp warning setpoint (°F)	°F	TWTOTF=[ ]F
STWTOTF	Sets TWT overtemp warning setpoint (°F)	°F	
RDTWTOTC	Returns TWT overtemp warning setpoint (°C)	°C	TWTOTC=[ ]C
STWTOTC	Sets TWT overtemp warning setpoint (°C)	°C	
RDPSOTF	Returns power supply overtemp warning setpoint (°F)	°F	PSOTF=[ ]F
SPSOTF	Sets p. s. overtemp warning setpoint (°F)	°F	
RDPSOTC	Returns p. s. overtemp warning setpoint (°C)	°C	PSOTC=[ ]C
SPSOTC	Sets p. s. overtemp warning setpoint (°C)	°C	
RDIWOC	Returns helix overcurrent warning setpoint	mA	IwOC=[ ]
SIWOC	Sets helix overcurrent warning setpoint	mA	
RDLOGIC	Returns logic state code (see Table 6)		Sys=[ ]
RDA	Returns gain	%	A=[ ]
SA	Sets gain	%	
RDHTDREM	Returns remaining heater time delay	sec.	HTD=[ ]s
RDPOD	Returns forward power out (dBm)	dBm	Po=[ ]dBm
RDPOW	Returns forward power out (W)	watts	Po=[ ]W
RDPRD	Returns reflected power out (dBm)	dBm	Pr=[ ]dBm
RDPRW	Returns reflected power out (W)	watts	Pr=[ ]W
RDPOHID	Returns over forward power warning setpoint (dBm)	dBm	Pohi=[ ]dBm

3.8 REMOTE IEEE-488 OPERATION *(continued)*

TABLE 3)
CATALOG OF IEEE-488 COMMANDS *(continued)*

SPOHID	Sets over forward power warning setpoint (dBm)	dBm	
RDPOLOD	Returns under forward power warning setpoint (dBm)	dBm	Polo=[ ]dBm
SPOLOD	Sets under forward power warning setpoint (dBm)	dBm	
RDPOHIW	Returns over forward power warning setpoint (W)	watts	Pohi=[ ]W
SPOHIW	Sets over forward power warning setpoint (W)	watts	
RDPOLOW	Returns under forward power warning setpoint (W)	watts	Polo=[ ]W
SPOLOW	Sets under forward power warning setpoint (W)	watts	
RDPRHID	Returns over reflected power warning setpoint (dB)	dBm	Prhi=[ ]dBm
SPPRHID	Sets over reflected power warning setpoint (dBm)	dBm	
RDPRHIW	Returns over reflected power warning setpoint (W)	watts	Prhi=[ ]W
SPRHIW	Sets over reflected power warning setpoint (W)	watts	
*IDN?;	Returns the product model number		[ ]
*STA?;	Returns status string (see Table 7)		[ ]
*STB?;	Returns status string (see Table 8)		[ ]

TABLE 4
CATALOG OF STATUS CODES

(The RDSTAT command causes the TWTA to return a string in the form STATUS=[*code*], where [*code*] is an ASCII number whose meaning is given below)

Status Code	*Meaning*
0	No command was given or last command was successful.
2	Last command is in process.
3	Last command failed to complete. Time-out.
10	Last command failed. Invalid command.
11	Last command failed. Data was unparseable.
20	Last set command failed. Data was beyond high limit.
21	Last set command failed. Data was beyond low limit.
22	Last set command failed. Data was out of range
23	Last set command failed. Data was wrong polarity
50	Last command failed. Local system does not have remote enabled.
51	Remote system is not ready to accept commands.
901	Assert error: invalid table argument 1).
902	Assert error: invalid calibration 1).

1). Please call a service representative if you observe this error.

3.8 REMOTE IEEE-488 OPERATION *(continued)*

TABLE 5
CATALOG OF FAULT CODES RETURNED BY RDFLT COMMAND

(The RDFLT command causes the TWTA to return a string in the form flt=[*code*], where [*code*] is an ACSII number whose meaning is given below).

Fault Code	*Meaning*
0	No fault
7	System Fault
8	Heater Fault (Fil not Ready)
9	Low Line
10	Cathode overvoltage
11	Body overcurrent
12	Cathode undervoltage
15	Collector undervoltage
16	Inverter fault
17	Internal interlock open
18	Tube arc
19	TWT (hardware) overtemperature
20	Power supply (hardware) overtemperature
22	External inhibit
23	Over reflected power
26	Panel Open
27	Latched Fault
30	Grid Overvoltage
49	TWT (software) overtemperature
50	Cabinet (software) overtemperature

3.8 REMOTE IEEE-488 OPERATION *(continued)*

TABLE 6
CATALOG OF SYSTEM STATE CODES

(The RDLOGIC command causes the TWTA to return a string in the form Sys=[*code*], where [*code*] consists of 2 bytes encoded as follows)

Bit	*Meaning if high*
0 (LSB)	High voltage on
1	Transmit on
2	Remote mode
3	Fault
4	Heater time delay expired
5	Under forward power warning
6	Foldback active
7	Inhibit mode
8	External inhibit
9	(not used)
10	(not used)
11	(not used)
12	(not used)
13	(not used)
14	(not used)
15 (MSB)	(not used)

TABLE 7
***STA?; RESPONSE CODES**

(The command *STA?; causes the TWTA to send a string indicative of the current system state)

**STA?; response*	*Meaning*
WARM-UP	System is in heater time delay.
STANDBY	System is ready to allow high voltage on
OPERATE	High voltage is on and beam is on
FAULT	High voltage is off and system requires reset

3.8 REMOTE IEEE-488 OPERATION *(continued)*

TABLE 8
***STB?; RESPONSE CODES**

(The command *STB?; causes the TWTA to send a string containing an operational state code consisting of 2 ASCII characters representing hex digits. The response is in the form "STATUS:*[x][y][eol]* " where the hex values of *[x]* and *[y]* are formed as shown below)

x bit	*Meaning*
1	Mode switch; always 1 (reset)
2	Blank switch; always 1 (off)
3	Blank status; always 0 (off)
4	Not used; always 0

y bit	*Meaning*
1	Power status; always 1(power on)
2	Standby status; 0 if not in standby, 1 if in standby
3	Operate status; 0 if not in operate, 1 if in operate
4	Fault status; 0 if no fault, 1 if fault exists

Command syntax is in this form:

<command mnemonic> <parameter> <carriage return>

where;

<command mnemonic> consists of one of any valid command found in Table 3.
<parameter> (as applicable) consists of one ASCII "space" character followed by a number.
<carriage return> consists of an ASCII carriage return.

All commands are case sensitive.

The system will return parameter values, fault codes, and status codes regardless of whether remote is enabled. The parameter value is returned as a string of 20 characters or less, consisting of a label, "=", and a value. For example, outputting the command RDEF to the TWTA would result in the TWTA sending back the string "Ef=6.03" (assuming the heater voltage is 6.03 volts). Units are usually not returned; see table 3 for the units.

If remote is not enabled, set commands and commands to the system logic (i. e., OPERATE; or STANDBY; or RESET;) will not be accepted.

A small sample program that can send commands and receive the strings returned by the TWTA is included in section 5.5. It is written in Hewlett-Packard's "Rocky Mountain" BASIC. The program assumes that the IEEE-488 bus is at address 7 and that the address of the TWTA is 01.

Remote operation of the TWTA is determined by the application (program) running on the system controller (host computer). This application program will aid the user in generating the Command Codes

and displaying/monitoring the Status Codes. Consult the application program users instructions for Remote Operation procedure.

3.8 REMOTE IEEE-488 OPERATION *(continued)*

The following recommendations are provided to guide the software developer in writing host software for the TWTA:

The TWTA does not send SRQ (service request). To determine if there has been a change in the status of the machine (e. g., if a fault has occurred), it is necessary to poll the device regularly using the RDSTAT command.

It is also recommended that the RDSTAT command be used to see whether an execute command was correctly processed. A period of processing time (usually less than 200 milliseconds) should be allowed to pass before reading status with RDSTAT.

The system controller may issue only one string to the TWTA at a time, and must allow the processing time, or the completion of the response message, before issuing the next string

3.9 TWTA GENERAL CONSIDERATIONS

This section is intended to offer some guidelines regarding operation, storage and use of Amplifier Research TWTAs.

Storage: TWTAs, as with other electronic equipment, are best stored in a benign environment at reasonably constant temperature. Service life is not improved by periodic operation.

Availability: For critical missions, and after long periods of storage, it is recommended that TWTA operation be checked sufficiently in advance of the mission to permit repair if required. Though service life is not improved by periodic operation, users experiencing amplifier trip due to body over current may benefit by periodically operating a unit with high voltage and grid on, but no rf drive. Such operation for about one hour on a weekly basis should effectively reduce nuisance tripping. Since the cathode structure has finite life, extended periods of non-functional operation of TWTAs is not recommended. An alternate approach, if periodic trip off has been observed, is to operate the unit without rf input for 1-2 hours before planned functional operation, resetting the unit after occasional trip off.

Cooling during Operate Mode: AR TWTAs have their air outlets and inlets on the rear panels. It is important to prevent the heated air, which is expelled from the TWTA's air outlets, from being recycled into the air inlets. Applications should have a clearance behind the TWTA of at least two feet for single bench top units and at least three feet for the higher power units, or the heated air should be ducted away.

Operation in Standby Mode: Standby mode for TWTAs readies the unit for operation. In this mode the filaments are on but the high voltage is off. TWTAs should not be left in this Standby mode for extended periods. Where practical, operational procedures should limit the time on Standby mode to less than approximately one hour. (See *Explanation of….*, below)

Operate Turn on: When selecting the Operate mode, when high voltage is first turned on, there may be some internal TWT arcing which can cause protective circuits to deselect the Operate mode, thereby returning the unit to the Standby mode. There may be a report of body over-current fault. In either case,

if there is no other contraindication, the Operate mode may be selected again. This procedure may be repeated, if needed up to 25 times, until the Operate mode is actually set. If this condition persists, contact Amplifier Research Service for additional assistance. (See *Explanation of…,* below)

Noise Power Density (NPD): TWTAs produce rf noise over their operating frequency range, as specified by the Noise Power Density (NPD). This noise is significantly higher than the noise produced by typical solid state amplifiers, and is inherent in present TWTAs. The noise may surprise users new to TWTAs when it accumulates and results in a significant indication in a broadband measurement device – such as a power meter or field probe. The error produced by this indication is not significant when operating near rated TWTA power levels, but may cause difficulty when trying to operate high power TWTAs at low output power levels..

For example, consider a hypothetical typical NPD of –76 dBm/Hz, from a 4 GHz bandwidth amplifier. A broadband detector might see the NPD as [-76 dBm/Hz + 10 (log 4 x 10^9) BW factor = -76 + 96=] +20 dBm, or 0.1 watts. This power is insignificant for a user operating at 200 watts (+53 dBm), but may be very noticeable to a user trying to operate below 1 watt (+30 dBm). [One watt is 0.5% of (23dB below) rated power for a 200 watt amplifier.] A field probe user who obtains a 200 V/M field with 200 watts, may see a field as high as [53dBm – 20dBm = 33dB below 200 V/M=] 4.5 V/M due to this hypothetical NPD.

For these applications the use of a lower power amplifier is highly recommended, especially when considering safety issues. Alternatively, additional power loss in the form of an added high power microwave attenuator, or preferably an increased space loss for radiated fields, may be used to lower the noise received by the broadband measurement device.

Explanation of Limiting the Time in Standby mode and of Repeated Operate Selection.

Traveling wave tubes tend to get "gassy" if they are left in a "Standby" mode for extended periods of time. In this "Standby" mode, the heater (filament) is on but there is no high voltage applied to the collector (or high voltage is applied to the collector but the grid is off). This is the normal state after a tube's warm up time, just prior to entering the "Operate" mode.

In this state the cathode end of the TWT is heating up but the electron "Beam" is off. In other words, there is no cathode current. As the cathode heats up, gas trapped in the structure of the tube can be released, thus corrupting the vacuum of the tube. If the tube become too "gassy", arcing may occur when the high voltage is fully applied in the "Operate" mode. Another possible failure mode is a body over-current fault when the beam is turned on and the tube is "gassy".

Occasional arcing is normal for a TWT. The support components are designed to handle this, protecting both the TWT and its support circuitry. However, if the tube arcs two or three times in rapid succession, or worse yet repeatedly, a fault will be sensed that will shut the high voltage off, thus removing the unit from "Operate" status. The remedy usually recommended is to repeat the selection of the "Operate" mode until the unit remains in "Operate". It as been found that most of the faults that can be cleared by this method will be cleared within 25 attempts to enter the Operate mode.

Once the tube is operating normally, gas will continue to evolve at a slow enough rate that the TWTA will not fault. This happens because the gas in the tube will interact with the beam and become ionized. As the electrons in the beam hit the gas molecules they ionize the gas, at which point it is accelerated into the collector structure and "buried" deep enough so that it ceases to be a problem.

To preclude this gassing problem, and thus reduce the need for repeating the "Operate" selection, it is recommended that the time in "Standby" be limited – to about one hour. Extended periods in "Standby" may result in an inability to clear the fault by this method. In this case, service measures may be needed to correct the unit. Thus, users should reduce the likelihood of occurrence of this problem by limiting the amount of time in the "Standby" mode.

The service measures involve pulsing of the tube beam current and gradually increasing the duty of the pulsing until the unit will operate continuously. Note that a similar condition can exist for tubes with grids when the TWTA is in the "Operate" mode (high voltage is on) but gating (control) input is set so that the grid turns off the TWT beam current. Operational procedures should also limit the time in this mode

SECTION IV

MAINTENANCE

The TWTA has minimal maintenance requirements**.** The only moving parts are the elements of switches, relays and the fans. Preventive maintenance recommendations are found in Paragraph 4.3.

Most repairs to the TWTA should be performed by the factory. However, some user service organizations may choose to make feasible repairs in-house. To support this, limited schematic diagrams and parts information is supplied in this manual (see Section V). **Warnings and Cautions should be observed.**

4.1 SAFETY WARNING

WARNING!

Service work must be performed only by technicians thoroughly familiar with the high voltages present in microwave tube amplifiers in general, and with this equipment in particular.

Never handle the TWT leads or the high-voltage connectors unless the unit is unplugged and it has been positively established that the high-voltage filter capacitors have been discharged to a *known* safe level.

CAUTION

A malfunctioning power supply can cause damage to the TWT. If you are troubleshooting the TWTA, remove the TWT and substitute suitable loads to prevent damage to the TWT.

4.2 UNAUTHORIZED REPAIRS

CAUTION

Unauthorized repairs or modification of this product during the warranty period may void the warranty. In the event that the TWTA malfunctions while it is still under warranty, always contact an authorized service representative.

4.3 PREVENTIVE MAINTENANCE

The RF characteristics and power supply voltages and currents of the TWTA should be logged on a regular basis. Maintenance should be performed if significant deviations from the logged values appear. If the unit is under warranty, contact an authorized service representative if impaired performance is suspected.

If there is accumulated dust on the air intake grill, remove it and clean it with dry compressed air.

If significant dust has been noted on the air intake grill, it may be desirable to vacuum the dust and debris from inside the enclosure. To open the enclosure:

1) Remove the amplifier from the cabinet or rack as follows:

NOTE: DUE TO THE WEIGHT OF THE UNIT, THE REMOVAL OF THE AMPLIFIER FROM THE CABINET OR RACK IS A TWO PERSON OPERATION.

4.3 PREVENTIVE MAINTENANCE *(continued)*

Disconnect power, RF, and any other interface connectors. On the rear of the unit, remove any screws used to connect brackets to the amplifier. On the front of the unit, remove the four screws holding the front panel onto the cabinet. Carefully slide the amplifier out of the front of the cabinet.

2) Remove the six screws that secure the lower cover and the six screws that secure the upper cover. Remove the covers to gain access to the interior of the TWTA.

Vacuum dust and debris from inside the enclosure. Clean dust from the TWTA and its flying leads. Remove any dirt from around the three high voltage connectors. While the cover is off, check for loose wires, components or fasteners.

Reassemble in the reverse order.

4.4 TROUBLESHOOTING

Symptom	*Possible cause*
TWT or power supply overtemperature	Air inlet filter dirty Collector heat sink dirty Inadequate clearance behind TWTA High air inlet temperature Defective fan(s) or power supply
Control module display does not come up; unit does not beep when powered up	Shorted or defective control module power supply Control module failure
Control module does not boot	EPROM(s) missing.
Control module “datalink failure” or “Communication Problem” error appears	HPA interface failure. Fiberoptic link failure $\pm$15 VDC supply failure
Heater power supply does not come up	Defective low voltage power supply module Defective heater power supply module
No high voltage	Open external interlock panel switch open Keylock switch on “INHIBIT” or “REMOTE” Defective high voltage power supply.
Voltages normal, but no RF output, helix current low	No RF input Defective remote control board Defective SSA Gain turned down

4.4 TROUBLESHOOTING *(continued)*

After review of the symptoms of the failure, the user may want to check for a loose connector or component especially after rough handling of the unit. Look externally for physical damage and internally for unmated or loose parts.

The service technician should become familiar with the internal mechanical construction to permit correct re-assembly. Limited troubleshooting may be conducted, with caution, based on the failure symptom and an understanding of the logic/schematic diagrams.

4.5 NON-REPAIRABLE MODULES

The Tank Module (A27818), the High Voltage Rectifier (A27826), the High Voltage Filter (A27821), the Grid Modulator Module (A7832), and the Heater Supply (A27824) are encapsulated modules and are generally not field repairable. Contact an authorized service representative if replacement modules are needed.

SECTION V

TECHNICAL DOCUMENTATION

- Note -

The purpose of this technical documentation section is to provide a guide to the TWTA for technician-level servicing. It is intended for use by qualified technical personnel who must troubleshoot and repair the TWTA in the field. Such repairs are typically limited to replacement of modules or major components. For this reason, only documentation pertaining to the highest levels of the system and to system control logic is included.

5.1 TOP LEVEL BUILD TREE

BUILD TREE FOR SERIAL NUMBER
500 W L-BAND TWTA A26900-313

1	A26900-313 500 W L-BAND TWTA
1A1	A27825-000 3KW 5KV POWER SUPPLY FOR 500L
1A1A1	A27824-000 HI,HEATER POWER SUPPLY
1A1A1T1	A09553-000 XFMR,HEATER FEEDBACK
1A1A1L1	A09594-900 MODIFIED INDUCTOR
1A1A1L2	A09595-900 MODIFIED INDUCTOR
1A1A1T2	A09596-900 XFMR,POWER HEATER
1A1A2	A27832-000 GRID MODULATOR FOR 500L
1A1A2A1	A23686-500 MODULATOR'S HV BOARD FOR 500L
1A1A2A1T1	A09227-000 PULSE TOP XFMR (HAND WOUND)
1A1A2A1T2	A09228-000 FEEDBACK XFMR (HAND WOUND)
1A1A2A1T3	A09229-500 BIAS XFMR HAND WOUND
1A1A2A1T4,T5	A09230-000 XFMR,GATE DRIVE (HAND WOUND)
1A1A2A1T6	A09598-500 XFMR TOP SUPPLY
1A1A2A2	A23019-500 GRID MODULATOR'S CONTROL BOARD FOR 500L
1A1A3	A27821-000 5KV 3KW HV FILTER
1A1A4	A27818-000 TANK MODULE
1A1A4A1-2	A09510-000 RESONANT INDUCTOR
1A1A5	A27826-000 HV RECTIFIER
1A1A6	A27815-000 POWER INVERTER MODULE
1A1A6A1	A21449-000 POWER BOARD FOR 3.5KW HPA
1A1A6A1T3 (NOTE 5)	A09527-000 GATE TRANSFORMER
1A1A6A1T2 (NOTE 5)	A09529-000 GATE TRANSFORMER
1A1A6A2	A21440-000 REGULATION BOARD
1A1A8	A16495-000 LOW VOLTAGE POWER SUPPLY MODULE
1A1A8T1	A09511-000 XFMR,15W,50KHZ,15V TO -15V
1A1A9	A23065-000 INPUT FILTER MODULE
1A1A10	A27816-000 MOTHER BOARD
1A1A11	A23050-000 HPA LOGIC AND CONTROL MODULE
1A2	A27680-000 MICROWAVE POWER ASSEMBLY (L-BAND)
1A3	A25444-000 HPA INTERFACE BOARD
1A4	A27509-300 HPA CONTROL CHASSIS ASSY, GPIB/LINK RANSCEIVER BOARD
1A4A2	A25450-000 CPU BOARD W/POWERFAIL
1A4A3	A22488-001 GPIB/LINK TRANSCEIVER BOARD
1A5	A26856-000 HPA SYSTEM CONTROL FRONT PANEL ASSY AR 500T
1A5A1	A22700-000 HPA DISPLAY BOARD
1A5A2	A24830-001 EMERGENCY BYPASS BOARD
1A6	A16483-000 400H INVERTER
1A9	A27682-000 500 L-BAND WIRING KIT
1A10	A27677-000 HPA CABINET AR 500T L-BAND

5.2 SCHEMATICS

HPA LOGIC & CONTROL ASSY	10-A23050
EMERGENCY BYPASS BOARD	10-A24830
HPA INTERFACE BOARD	10-A25444
500 W L-BAND TWTA	10-A26900

5.3 WIRING DIAGRAMS

POWER SUPPLY FOR TWT 5196	20-A27825

5.4 PARTS LISTS

HPA LOGIC EMERGENCY & CONTROL ASSY	61-A23050-000-C
BYPASS BOARD	61-A24830-001-A
HPA INTERFACE BOARD	61-A25444-000-A
500 W L-BAND TWTA	31-A26900-313-A
MICROWAVE POWER ASSEMBLY (L-BAND)	31-A27680-000-D
500 L-BAND WIRING KIT	31-A27682-000-C
3 KW 5 KV POWER SUPPLY FOR 500 L	31-A27825-000-C

5.5 RECOMMENDED SPARE PARTS

A23692-000 400H INVERTER	1 EA	
A16495-000 LOW VOLTAGE POWER SUPPLY MODULE	1 EA	
A23050-000 HPA LOGIC AND CONTROL MODULE		1 EA
A23065-000 INPUT FILTER MODULE	1 EA	
A27815-000 POWER INVERTER MODULE	1 EA	
A27818-000 TANK MODULE	1 EA	
A27821-000 5 KV 3 KW HV FILTER	1 EA	
A27824-000 HEATER POWER SUPPLY	1 EA	
A27826-000 HV RECTIFIER	1 EA	
A27832-000 GRID MODULATOR FOR 500L	1 EA	
N26677-000 FAN, MODIFICATION (Y10038)	2 EA	
W30020-000 CABLE, FIBER OPTIC,	2 EA	

5.6 Sample Program for IEEE-488 Communication

```
1000  ! ********************************************
1010  ! *     IEEE-488 COMMUNICATIONS SOFTWARE       *
1030  ! *     7/24/92  AARON D. McCLURE              *
1040  ! ********************************************
1041  DIM F$[80]
1042  DIM A$[80]
1050  CLEAR SCREEN
1060  INPUT "INPUT COMMAND TO SEND TO POWER SUPPLY.  EXIT TO QUIT.",A$
1070  IF A$="EXIT" THEN 1130
1080  OUTPUT 701;A$
1090  IF A$[1,2]<>"RD" THEN GOTO 1060
1095  IF A$[1,1]="*" THEN GOTO 1100
1100  ENTER 701;F$
1110  PRINT "OUTPUT FROM COMMAND ",A$," IS ",F$
1120  GOTO 1060
1130  CLEAR SCREEN
1140  END
```

HPA LOGIC AND CONTROL MODULE 61-A23050-000-C
Model Number HPA
Last Rev 11/04/97 Control# CORRECTION

REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE
REV B	B23050-000	LOGIC & CONTROL BOARD	1	EA	8M906
C48,C49	C06103-000	CAP,10MF,25V,20%,SOLID TANT,RADIAL,(AVX TAP106M025HSB)	2	EA	
C11	C16333-000	CAP,33MF,25V,AERL, (NICHICON UVX1E330M)	1	EA	
C47	C17104-000	CAP,100MF,50V,AERL, (NICHICON UVX1J101MPA)	1	EA	
C2,C5,C15	C31028-000	CAP,1000PF,200VDC,10%,CER, 1% FAILURE,(KEMET CKR05 SERIES)	3	EA	
C3,C9,C10,C13, C14,C17,C19, C21,C22,C24, C27,C28,C30, C31,C33,C36, C41,C46,	C31032-000	CAP,0.01MF,200VDC,10%,CER, 1% FAILURE,(KEMET CKR06 SERIES)	19	EA	
C1,C4,C6,C7, C16,C18,C25, C26,C32,C34, C37,C38,C39, C40,C43,C44, C45,C50	C31040-000	CAP,1MF,50VDC,10%,CER,1% FAILURE,(KEMET CKR06 SERIES)	18	EA	
D16,D23,D31	D10965-000	ZENER,15V,(DIODES INC 1N965B)	3	EA	
D1,D3-D5,D7-D13,D17-22,D25, D26,D28-D30, D33,D35,D37,D38	D14454-000	DIODE,AXIAL,(MOTOROLA 1N4454)	26	EA	
D36	D14733-000	ZENER,5.1V,1W,10%,AXIAL, (MOTOROLA 1N4733)	1	EA	
D32	D14740-000	ZENER,10V,1W,10%,AXIAL, (MOTOROLA 1N4740)	1	EA	
J2	J10370-000	CONN,37 PIN,D-SUBMINIATURE, PCB RIGHT ANGLE,MALE,(AMP 747252-4)	1	EA	
J7	J12294-000	CONN RIGHT ANGLE MALE 29 PIN,(SAME AS J12291 W/NO MODIF),(HYPERTRONIC KA29/127BPMCO0T)	1	EA	
J4,J5	J18086-000	JACK RECEPTACLE,RIGHT ANGLE PC MOUNT FOR GRID MOD,DIGIKEY	2	EA	
L1	L00200-000	WIDE BAND CHOKE,(VK200 10/3B FERROXCUBE)	1	EA	
	N23061-000	LOGIC CAGE	1	EA	8M906
Q2	Q22907-000	TRANSISTOR,PNP,2N2907A, TO-18	1	EA	

HPA LOGIC AND CONTROL MODULE 61-A23050-000-C

Model Number HPA

Last Rev 11/04/97 Control# CORRECTION

REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE
R1,R9,R19,R37, R44,R50	R00100-000	RES,10 OHM,1/4W,5%,CC,(A/B RC07GF100J)	6	EA	
R4,R20,R27,R29	R01100-000	RES,100 OHM,1/4W,5%,CC, (A/B RC07GF101J)	4	EA	
R23	R01820-000	RES,820 OHM,1/4W,5%,CC, (A/B RC07GF821J)	1	EA	
R5,R7,R17,R18, R28,R34,R45, R49,R53,R59, R71,R72,R87	R02100-000	RES,1K,1/4W,5%,CC,(A/B RC07GF102J)	13	EA	
R6	R02270-000	RES,2.7K,1/4W,5%,CC,(A/B RC07GF272J)	1	EA	
R43	R02330-000	RES,3.3K,1/4W,5%,CC,(A/B RC07GF332J)	1	EA	
R30,R31,R36	R02470-000	RES,4.7K,1/4W,5%,CC,(A/B RC07GF472J)	3	EA	
R35	R05820-000	RES,8.2M,1/4W,5%,CC,(A/B RC07GF825J)	1	EA	
R67	R21402-000	RES,4.02K,1/2W,1%,MF, 100PPM,(DALE RN55D)	1	EA	
R39	R21499-000	RES,4.99K,1/2W,1%,MF, 100PPM,(DALE RN55D)	1	EA	
R38	R21523-000	RES,5.23K,1/2W,1%,MF, 100PPM,(DALE RN55D)	1	EA	
R24	R21649-000	RES,6.49K,1/2W,1%,MF, 100PPM,(DALE RN55D)	1	EA	
R52,R73	R21887-000	RES,8.87K,1/2W,1%,MF, 100PPM,(DALE RN55D)	2	EA	
R75	R21990-000	RES,9.76K,1/2W,1%,MF, 100PPM,(DALE RN55D)	1	EA	
R69,R98	R22105-000	RES,10.5K,1/2W,1%,MF, 100PPM,(DALE RN55D)	2	EA	
R42,R47,R48, R60,R61,R74	R23100-000	RES,100K,1/2W,1%,MF,100PPM, (DALE RN55D)	6	EA	
R54	R23169-000	RES,169K,1W,1%,MF,100PPM, (DALE RN60D)	1	EA	
R40	R23499-000	RES,499K,1/2W,1%,MF,100PPM, (DALE RN55D)	1	EA	
R33,R41,R55	R23698-000	RES,698K,1/2W,1%,MF,100PPM, (DALE RN55D)	3	EA	
R46	R23750-000	RES,750K,1/2W,1%,MF,100PPM, (DALE RN55D)	1	EA	
R21	R23845-000	RES,845K,1/2W,1%,MF,100PPM, (DALE RN55D)	1	EA	
R66	R23953-000	RES,953K,1/2W,1%,MF,100PPM, (DALE RN55D)	1	EA	
R62	R30035-000	RES,10K,1/2W,1%,MF,100PPM, (DALE RN55D)	1	EA	

HPA LOGIC AND CONTROL MODULE 61-A23050-000-C
Model Number HPA
Last Rev 11/04/97 Control# CORRECTION

REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE
R11	R32004-000	TRIMPOT,1K,1/2W,10%,CERMET, 20T,SIDE ADJ,(BECKMAN 67X)	1	EA	
R10,R12,R15,R16	R32020-000	TRIMPOT,10K,1/2W,10%, CERMET,20T,SIDE ADJ, (BECKMAN 67X)	4	EA	
R13,R14	R32049-000	TRIMPOT,5K,1/2W,10%,CERMET, 20T,SIDE ADJ,(BECKMAN 67X)	2	EA	
U4,U5,U6	U02390-000	IC,QUAD COMPARATOR,(NAT LM139J)	3	EA	
U7	U03240-000	IC,LOW POWER OP AMP,(NAT LM324)	1	EA	
U9	U10070-000	IC,PRECISION 10V REFERENCE, (LH0070)	1	EA	
U8	U17805-000	IC,5V REGULATOR,TO-220, (NAT LM340T-5.0)	1	EA	
U1,U2,U3	U20148-000	IC,HEX INVERTER,SCHMIDTT TRIGGER,(74HC14) (SSD)	3	EA	
RP4,RP8	U30106-000	IC,10K PULL-UP RES NETWORK, 6 PIN SIP	2	EA	
RP1-2,RP5-7,RP9	U30410-000	IC,10K FEED-THROUGH 5 NETWORK	6	EA	

NOTES:

1. **J7 pin guide on "F" "3".**

2. **Polarity for C48 and C49:**
   - **Solder C48 (+) facing U1.**
   - **Solder C49 (+) facing U7.**

EMERGENCY BYPASS BOARD 61-A24830-001-A

Model Number 20T

Last Rev 11/06/96 Control# CORRECTION

REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE
REV C	B24830-000	EMERGENCY BYPASS BOARD	1	EA	8M906
C3-C5	C04105-000	CAP,0.1MF,100V,20%,POLY FILM,RADIAL,OIL,[KEMET C331C104M1R5CA]	3	EA	
C2	C31028-000	CAP,1000PF,200VDC,10%,CER, 1% FAILURE,(KEMET CKR05 SERIES)	1	EA	
C1	C31032-000	CAP,0.01MF,200VDC,10%,CER, 1% FAILURE,(KEMET CKR06 SERIES)	1	EA	
D1,D2	D14454-000	DIODE,AXIAL,(MOTOROLA 1N4454)	2	EA	
D3,D4	D14733-000	ZENER,5.1V,1W,10%,AXIAL, (MOTOROLA 1N4733)	2	EA	
I2,I3	I10066-000	LED,RED,HIGH EFFICIENCY, HIGH BRIGHTNESS	2	EA	
I1,I4	I10096-000	LED,GREEN,DIFFUSED,T1-3/4 (XC55G)	2	EA	
TP2	J16212-000	TEST JACK,RED,VERTICAL,(EF JOHNSON 105-0851-001)	1	EA	
TP3	J16213-000	TEST JACK,ORANGE,VERTICAL, (EF JOHNSON 105-0856-001)	1	EA	
J2	J18086-000	JACK RECEPTACLE,RIGHT ANGLE PC MOUNT FOR GRID MOD,DIGIKEY	1	EA	
J1	J18180-000	D-SUB 15-PIN MALE PCB MOUNT STRAIGHT,(POSITRONIC MD15M3000)	1	EA	
Q1-Q3	Q22222-000	TRANSISTOR,NPN,2N2222A, TO-18	3	EA	
Q4,Q5	Q22907-000	TRANSISTOR,PNP,2N2907A, TO-18	2	EA	
R18,R23	R01100-000	RES,100 OHM,1/4W,5%,CC, (A/B RC07GF101J)	2	EA	
R21	R01150-000	RES,150 OHM,1/4W,5%,CC, (A/B RC07GF151J)	1	EA	
R19	R02100-000	RES,1K,1/4W,5%,CC,(A/B RC07GF102J)	1	EA	
R3,R5,R7	R02220-000	RES,2.2K,1/4W,5%,CC,(A/B RC07GF222J)	3	EA	
R22	R02330-000	RES,3.3K,1/4W,5%,CC,(A/B RC07GF332J)	1	EA	
R16,R17	R02470-000	RES,4.7K,1/4W,5%,CC,(A/B RC07GF472J)	2	EA	
R4,R6,R8,R9, R13,R15	R03100-000	RES,10K,1/4W,5%,CC,(A/B RC07GF103J)	6	EA	
R1	R12107-000	TRIMPOT,1K,1/2W,10%,CERMET, 1T,SIDE ADJ,(BECKMAN 72XL)	1	EA	

EMERGENCY BYPASS BOARD 61-A24830-001-A
Model Number 20T
Last Rev 11/06/96 Control# CORRECTION

REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE
R20	R20267-000	RES,267 OHM,1/2W,1%,MF, 100PPM,(DALE RN55D)	1	EA	
R10,R11,R12	R23100-000	RES,100K,1/2W,1%,MF,100PPM, (DALE RN55D)	3	EA	
R2	R30074-000	TRIMPOT,1K,1/2W,10%,CERMET, 100PPM,20T,TOP ADJ, (BECKMAN 66W)	1	EA	
S2,S3	S22004-000	SWITCH,TOGGLE,DPDT,PC MNT, (AUGAT MTA-206N-PC)	2	EA	
S1	S22010-000	SWITCH,TOGGLE,4PDT, ON-NONE-ON,125V @ 6A, (AUGAT MTA-406N-PC)	1	EA	
U2	U11458-000	IC,DUAL OP AMP,(NAT LM1458CN)	1	EA	
U1	U17805-000	IC,5V REGULATOR,TO-220, (NAT LM340T-5.0)	1	EA	

NOTE:

1. **Use REV C board or higher only.**

2. **J1,J2 on solder side.**

HPA INTERFACE BOARD 61-A25444-000-A
Last Rev 03/28/97 Control# CORRECTION

REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE
REV. B	B25444-000		1		8M906
C6,C7,C9,C13, C16,C39,C43,C69	C01104-000	CAP,100PF,50V,CER,(R.G. ALLEN C1C101J1HS2L)	8	EA	
C8	C02109-000	CAP,1000PF,1KV,CER,(RG ALLEN C11B102K3AS6L)	1	EA	
C1-5,C10,C11, C22-26,C28,C30, C33,C35,40-42, 48-51,C62-65, 70,71,73,74,76-79,83,85,87-89, 91,94,96-98, 102,103,105, 107-117	C04105-000	CAP,0.1MF,100V,20%,POLY FILM,RADIAL,OIL,[KEMET C331C104M1R5CA]	62	EA	
C12,C14,C17-C19,C21,C27, C29,C31,C34, C36,C38,C45, C46,C52,C54-C61,C66,C68, C72,C75,82,84, 86,90,92,93,95, 104,106,118-120	C05104-000	CAP,1MF,50V,10%,CER,(AVX SR305C105KAA)	42	EA	
C20,C32,C100	C05153-000	CAP,1.5MF,35V,TANT,RADIAL, (JAMECO TM1.5/35)	3	EA	
C80,C81	C06103-000	CAP,10MF,25V,20%,SOLID TANT,RADIAL,(AVX TAP106M025HSB)	2	EA	
C15	C06220-000	CAP,22MF,6V,SOLID TANT, RADIAL,(AVX TAP226K010SCS)	1	EA	
C44	C06473-000	CAP,47MF,25V,SOLID TANT, RADIAL,(KEMET T356K476K025AS)	1	EA	
C99	C16103-000	CAP,10MF,35V,AERL, (NICHICON UVX1V100)	1	EA	
C101	C17222-000	CAP,220MF,16V,AERL,(ILL CAP 227RAR016A)	1	EA	
C47,C67	C17224-000	CAP,220MF,50V,AERL,(ILL CAP 227RAR050A)	2	EA	
C37	C31040-000	CAP,1MF,50VDC,10%,CER,1% FAILURE,(KEMET CKR06 SERIES)	1	EA	
D8,D10-D16,D18-D19	D14007-000	DIODE,1000V,1A,AXIAL, (MOTOROLA 1N4007)	10	EA	
D1-D7	D14454-000	DIODE,AXIAL,(MOTOROLA 1N4454)	7	EA	
D9,D17	D14733-000	ZENER,5.1V,1W,10%,AXIAL, (MOTOROLA 1N4733)	2	EA	

HPA INTERFACE BOARD 61-A25444-000-A
Last Rev 03/28/97 Control# CORRECTION

REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE
I1	I10074-000	LED,GREEN,ALGAAS, NON-DIFFUSED,(HEWLETT PACKARD HLMP-1540)	1	EA	
J5	J10021-000	RIGHT ANGLE HEADER,2 PIN SERIES 7478,(MOLEX 22-05-3021)	1	EA	
J1	J10371-000	CONN,37 PIN VERTICAL,MALE, P.C.B. MOUNT,(POSITRONICS MD37M3S000)	1	EA	
XU17	J14161-000	SKT,DIP,16 PIN,MACH SLEEVES,(AUGAT 516-AG11D)	1	EA	
XU15	J14281-000	SKT,DIP,28PIN,MACH SLEEVES, (SAMTEC ICA-628-SGT)	1	EA	
XU26	J14320-000	SKT,DIP,32 PIN,MACH SLEEVES,LOW PROFILE, (SAMTECH SS-132-6-2)	1	EA	
TP0	J16210-000	TEST JACK,BLACK,VERTICAL, (EF JOHNSON 105-0853-001)	1	EA	
TP1	J16211-000	TEST JACK,BROWN,VERTICAL, (EF JOHNSON 105-0858-001)	1	EA	
TP2	J16212-000	TEST JACK,RED,VERTICAL,(EF JOHNSON 105-0851-001)	1	EA	
TP3	J16213-000	TEST JACK,ORANGE,VERTICAL, (EF JOHNSON 105-0856-001)	1	EA	
TP4	J16214-000	TEST JACK,YELLOW,VERTICAL, (EF JOHNSON 105-0857-001)	1	EA	
TP5	J16215-000	TEST JACK,GREEN,VERTICAL, (EF JOHNSON 105-0854-001)	1	EA	
TP6	J16216-000	TEST JACK,BLUE,VERTICAL, (EF JOHNSON 105-0860-001)	1	EA	
J4	J18167-000	CONN,37 PIN D-SUB,FEMALE RT ANGLE,PCB,(AMP 745784-4)	1	EA	
J3	J18180-000	D-SUB 15-PIN MALE PCB MOUNT STRAIGHT,(POSITRONIC MD15M3000)	1	EA	
J2	J31013-000	D-SUB CONNECTOR RT ANGLE 25 POS MALE,(747238-4)	1	EA	
XJ1-XJ4	J31014-000	SPRING LATCH KIT,D-SUB, (AMPHENOL 17-529)	4	EA	
K1-K6	K02009-000	RELAY,MINI,5V,DPDT,(OMRON G6H-2-DC5)	6	EA	
L1-L4	L00200-000	WIDE BAND CHOKE,(VK200 10/3B FERROXCUBE)	4	EA	
R6,R8	R01100-000	RES,100 OHM,1/4W,5%,CC, (A/B RC07GF101J)	2	EA	
R2,R41	R01220-000	RES,220 OHM,1/4W,5%,CC, (A/B RC07GF221J)	2	EA	
R4,R7	R05820-000	RES,8.2M,1/4W,5%,CC,(A/B RC07GF825J)	2	EA	

HPA INTERFACE BOARD 61-A25444-000-A
Last Rev 03/28/97 Control# CORRECTION

REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE
R11	R20243-000	RES,243 OHM,1/2W,1%,MF, 100PPM,(DALE RN55D)	1	EA	
R16	R20845-000	RES,845 OHM,1/2W,1%,MF, 100PPM,(DALE RN55D)	1	EA	
R3,R5	R30071-000	TRIMPOT,10K,1/2W,10%, CERMET,100PPM,20T,TOP ADJ, (BECKMAN 67W)	2	EA	
R9,R10,R12,R15, R22,R30,R35, R36,R40,R44,R45	R30103-000	RES,10K,1/8W,1%,MF,100PPM, (DALE CT50)	11	EA	
R17,R19-R21, R23,R25,R28, R31,R42,R43,R46	R30140-000	RES,1K,1/8W,1%,MF,50PPM, (DALE RN50C)	11	EA	
R1,R13,R14,R18, R24,R26,R27, R29,R32,R37-R39	R31164-000	RES,100K,1/20W,1%,FILM, AXIAL,100PPM,MIL,(DALE RN50C1003F)	13	EA	
U26	U00071-000	IC,16 BIT ANALOG TO DIGITAL CONVERTER,(BURR BROWN ADC-71) (SSD)	1	EA	
U17	U00524-000	IC,INSTRUMENTATION AMP, (ANALOG DEVICES AD524A) (SSD)	1	EA	
U15	U00725-000	IC,DUAL 16 BIT DIGITAL TO ANALOG CONVERTER, (BURR-BROWN DAC-725) (SSD)	1	EA	
U7,U8	U03100-000	IC,VOLTAGE FOLLOWER,(NAT LM310)	2	EA	
U1	U03171-000	IC,ADJUSTABLE VOLTAGE REGULATOR,TO-220,(NAT LM317T)	1	EA	
U9,U10,U18	U04090-000	IC,4CH ANALOG MULTIPLEXER, (DATEL MXD-409)	3	EA	
DP2,DP4,DP5, DP8,DP9	U08010-000	IC,8 COMMON CATHODE CLAMPIMG DIODES,9 PIN SIP, (ROHM DAN801)	5	EA	
DP1,DP3,DP6, DP7,DP10	U08011-000	IC,8 COMMON ANODE CLAMPING DIODES,9PIN SIP,(ROHM DAP801)	5	EA	
U27	U11165-000	IC,6.5536MHZ CLOCK OSCILLATOR,1/2 SIZE, (ECLIPTEK EC1100HS-6.5536MHZ) (SSD)	1	EA	
U40	U11521-000	IC,VERSALINK FIBER OPTIC XMITTER,HORIZONTAL,(HP HFBR-1521)	1	EA	
U16,U29	U12222-000	IC,QUAD NPN TRANSISTOR PACK,(2N2222)	2	EA	
U54	U12521-000	IC,VERSALINK FIBER OPTIC RECEIVER,HORIZONTAL,(HP HFBR-2521) (SSD)	1	EA	

HPA INTERFACE BOARD 61-A25444-000-A
Last Rev 03/28/97 Control# CORRECTION

REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE
U6,U19,U34,U39	U20148-000	IC,HEX INVERTER,SCHMIDTT TRIGGER,(74HC14) (SSD)	4	EA	
U42	U20730-000	IC,DUAL J-K FLIP FLOP W/RESET,(7473) (SSD)	1	EA	
U51	U21328-000	IC,QUAD 2 INPUT NAND, SCHMIDTT TRIGGER,(74HC132) (SSD)	1	EA	
U52	U21388-000	IC,3 TO 8 DECODER/DEMULTIPLEXER, INVERTING,(74HC138) (SSD)	1	EA	
U32	U21536-000	IC,DUAL 4 INPUT DIGTAL MULTIPLEXER,(74F153) (SSD)	1	EA	
U35	U22598-000	IC,8 BIT ADDRESSABLE LATCH W/RESET,(74HC259) (SSD)	1	EA	
U36	U23610-000	IC,DUAL INVERTING CLOCK DRIVER,(DS75361) (SSD)	1	EA	
U47	U23909-000	IC,DUAL 4 BIT BINARY/BIQUINARY COUNTER, (74HCT390 OR 74HC390) (SSD)	1	EA	
U41,U48	U24018-000	IC,JOHNSON DECADE COUNTER W/10 DECODED OUTPUTS, (74HC4017) (SSD)	2	EA	
U45	U24138-000	IC,8 BIT BINARY DOWN COUNTER,(74HC40103) (SSD)	1	EA	
U43	U26889-000	IC,8 BIT MAGNITONE COMPARATOR,(74HCT688) (SSD)	1	EA	
U22,U24	U28008-000	IC,QUAD 2 INPUT AND, (74HC08) (SSD)	2	EA	
U4,U49	U28032-000	IC,QUAD 2 INPUT OR, (74HC32) (SSD)	2	EA	
U44,U46	U28040-000	IC,12 BIT DECADE COUNTER, (74HCT4040) (SSD)	2	EA	
U5,U11,U13,U14, U20,U21,U23, U25,U30,U33,U50	U28074-000	IC,DUAL D FLIP FLOP W/RESET,(74HC74) (SSD)	11	EA	
U2	U28123-000	IC,DUAL RETRIGGERABLE 1-SHOT,(74HC123) (SSD)	1	EA	
U31,U53	U28164-000	IC,8 BIT SERIAL IN PARALLEL OUT SHIFT REGISTER,(74HC164) (SSD)	2	EA	
U3,U12,U28,U37, U38	U28165-000	IC,8 BIT PARALLEL IN SERIAL OUT SHIFT REGISTER, (74HC165) (SSD)	5	EA	
RP6	U32001-000	IC,1K FEED-THROUGH RES NETWORK,16 PIN DIP,(A/B 316B102)	1	EA	
RP1-RP5	U32103-000	IC,10K FEED-THROUGH RES NETWORK,16 PIN DIP,(A/B 316B103)	5	EA	

HPA INTERFACE BOARD 61-A25444-000-A
Last Rev 03/28/97 Control# CORRECTION

REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE

NOTES:

1. **Install the four D-sub connectors (J1-J4) with 4-40 hardware prior to soldering.**
2. **Install spring latches J31014 on J1-J4.**
3. **Install dead lead in R33, R34.**
4. **Apply conformal coating-after QC.**

500 W L-BAND TWTA 31-A26900-313-D
Last Rev 02/20/98 Control# CORRECTION

REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE
A6,A7	A16483-000	400H INVERTER	2	EA	8M906
A3	A25444-000	HPA INTERFACE BOARD	1	EA	8M906
A5	A26856-000	HPA SYSTEM CONTROL FRONT PANEL ASSY AR 500T	1	EA	8M906
A4	A27509-300	HPA CONTROL CHASSIS ASSY, GPIB/LINK TRANSCEIVER BOARD	1	EA	8M906
A10	A27677-000	HPA CABINET AR 500T L-BAND	1	EA	8M906
A2	A27680-000	MICROWAVE POWER ASSEMBLY (L-BAND)	1	EA	8M906
A9	A27682-000	500 L-BAND WIRING KIT	1	EA	8M906
A1	A27825-000	3KW 5KV POWER SUPPLY FOR 500L	1	EA	8M906

MICROWAVE POWER ASSEMBLY (L-BAND) 31-A27680-000-D

Last Rev 02/20/98 Control# CORRECTION

REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE
	E01009-000	HIGH POWER COAXIAL CABLE, 14.1" LONG, SC-SP/N-SP, [MALIK CABLE DEVICES N. A. -SCPS]	1	EA	
A2	E08032-000	TWT,1-2.5 GHZ,CW,535 W,TWT ASSY (TELEDYNE MEC-5203)	1	EA	
A3	E20192-000	DUAL HIGH POWER, COUPLER-30DB 8-2.8 GHZ, (MAC TECHNOLOGY CA1123-30A)	1	EA	
A5	E20193-000	2-WAY SPLITTER 0.8-2.8 GHZ, SMA,(MAC TECHNOLOGY PA8224-2H)	1	EA	
A1	E20287-000	AMPLIFIER, 0.7-4.2 GHZ , 28DBM,[MINI CIRCUITS ZHL-42]	1	EA	
A4	E20325-000	PIN DIODE ATTENUATOR, -8DB/V, 0.8-2.8 GHZ,[GT MICROWAVE AOC-38N-OAB]	1	EA	
A6	E20339-000	L-BAND EQUALIZER FOR MEC-5203,[ASGARD CUSTOM]	1	EA	

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REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE
A11	E10011-000	THREE PHASE PI FILTER,15A, LOW PROFILE,FLANGE MT, (FILTER CONCEPTS 3L15LF)	1	EA	
	H10066-000	CABLE TIE MOUNT #8 SCREW (PANDUIT TA1S8-C)	25	EA	
	H10067-000	FLAT CABLE MOUNT,2"WIDE (PANDUIT FCM2-S6-C14)	2	EA	
XZ1	H14001-000	FUSEHOLDER,125V,20A,PNL MNT,CLEAR,(LITTELFUSE 344.125)	1	EA	
	H17039-000	SERIAL NUMBER STICKER FOR AR PRODUCTS,(AR NA)	1	EA	
	H17040-000	MADE IN USA STICKER FOR AR PRODUCTS,(AR NA)	1	EA	
	H32339-000	STRAIN RELIEF WITH FLEXIBLE SUPPORT FOR 0.51-0.71DIA CORDAGE,(MCMASTER 69915K65)	1	EA	
P15,P25	J00020-000	CONN,PIN & SOCKET,2 PIN, FEM,(MOLEX 03-09-1021)	2	EA	
P10	J00021-000	CONN,FEMALE 2 PIN .063, (MOLEX 03-06-1023)	1	EA	
P17,P18	J00023-000	CONN,HOUSING,FEMALE,02 PIN, (MOLEX 5197-N 10-01-3026)	2	EA	
P11	J00033-000	CONN,FEMALE 3 PIN,.063, (MOLEX 03-06-1032)	1	EA	
P19,P20	J00034-000	CONN,HOUSING,FEMALE,03 PIN, (MOLEX 5197-N 10-01-3036)	2	EA	
P13,P14	J00035-000	CONN,HOUSING,FEMALE,3 PIN, 0.1"SPACING,7880 SERIES, (MOLEX 10-11-2033)	2	EA	
P28,P29	J00046-000	CONN,HOUSING,FEMALE,4 PIN, 0.1"SPACING,7880 SERIES, (MOLEX 10-11-2043)	2	EA	
P12	J01031-000	CONN,MALE 3 PIN,.063, (MOLEX 03-06-20332)	1	EA	
P16,P26	J01040-000	CONN,PIN & SOCKET,4 PIN, MALE,STR,(MOLEX 03-09-2041)	2	EA	
P30,P31	J01040-000	CONN,PIN & SOCKET,4 PIN, MALE,STR,(MOLEX 03-09-2041)	2	EA	
XP11,XP12	J03013-000	CONN,PIN MALE,.063,(MOLEX 002-06-2103)	5	EA	
XP10,XP13	J04013-000	CONN,PIN FEMALE .063, (MOLEX 002-06-1103)	5	EA	
J4	J11240-000	CONN,RIBBON,24 PIN,FEMALE, 1A CONTACTS,BLUE,(T&B ANSLEY 609-24F)	1	EA	
P5,P6	J11370-000	CONN,D-SUBINIATURE,37 PIN, FEMALE,RIBBON,(THOMAS & BETTS 609-375-M)	2	EA	

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REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE
P1	J12052-000	CONN,TYPE D RECT,5S,HI POWER	1	EA	
P27	J12091-000	CONN,D-SUBMINIATURE,9 PIN, FEM,(ITT CANNON DEU-9S)	2	EA	
P2	J12250-000	CONN,PLUG,D-SUB,25-PIN,FEM, CRIMP (DBU-25S)	1	EA	
	J17250-000	BULKHEAD MT N-JACK TO SMA JACK ADAPTOR,(OMNI-SPECTRA 2684-2240-00)	3	EA	
	J18012-000	CONN,FIBER OPTIC,GRAY, W/CRIMP RING,(HP HFBR-4501)	2	EA	
	J18013-000	CONN,FIBER OPTIC,BLUE, W/CRIMP RING,(HP HFBR-4511)	2	EA	
	J18035-000	CONNECTOR, MALE, 208 VAC, 5-WIRE (HUBBELL 2511)	1	EA	
XP1	J18054-000	CONTACT,FEMALE,HI POWER PIN,20 AMP	3	EA	
	J18075-000	MALE SCREW LOCK,FOR D SUBMIN CONN,(AMP 205817-1)	2	EA	
P21-P24	J18124-000	CONN,SMA MALE SOLDER ATTACHMENT FOR 188, (PASTERNACK PE4036)	10	EA	
J1	J18162-000	POWER INLET IEC-320 16A, (PANEL COMPONENTS 83011340)	1	EA	
XJ3	J18184-000	D-SUB 15 PIN MALE,CRIMP TYPE,(ITT/CANNON DAV15P)	1	EA	
P4	J31011-000	CONN,37 PIN,MALE,D-SUB,5A, 20 AWG,MAX-55C TO+120 C, (CANNON DCC-37P)	1	EA	
P7,P8	J31012-000	CONN,15 PIN,FEMALE,D-SUB, RIBBON CABLE,1A MAX PLASTIC CASE,(CROSS REF : J31004) (AMP, 841-17-DAFR-B15S) (ALTERNATE: FRY'S IDLC15S-CN1)	2	EA	
	J31014-000	SPRING LATCH KIT,D-SUB, (AMPHENOL 17-529)	8	EA	
	N24373-000	CONNECTOR COVER	1	EA	8M906
B1	N26677-000	FAN,MODIFICATION (Y10038)	1	EA	8M906
S2,S3	S25002-000	SWITCH,PUSHBUTTON,SPDT, SAFETY DOOR INTERLOCK, DEFEATABLE,(MICROSWITCH 3AC5-D8)	2	EA	
S1	S36017-000	C/B,3 POLE,250VAC,15A, 50/60HZ,18.8A TRIP (AIRPAX IEGH-666-1-61-15.0-21-V)	1	EA	
U1,U2	U00350-000	IC,CENTIGRADE TEMPERATURE SENSOR,(NAT LM35DP)	2	EA	

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REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE
	W01880-000	WIRE,26 AWG,COAXIAL, RG-188A/U,900V (BELDEN 83269)	4	FT	
	W11400-000	WIRE,14AWG,BLUE,(ALPHA 5859)	4	FT	
	W11600-000	WIRE,16AWG,BLUE,(BELDEN 83010)	2	FT	
	W11800-000	WIRE,18AWG,BLUE,(BELDEN 83009)	3	FT	
	W12000-000	WIRE,20AWG,BLUE,(BELDEN 83007)	4	FT	
	W12200-000	WIRE,22AWG,BLUE,(BELDEN 83006)	5	FT	
	W21201-000	POWER CORD,12 AWG,5 COND, NEOPRENE COVERED, [ROYAL ELECTRIC 4A-1205]	10	FT	
	W22210-000	WIRE,22AWG,3 COND SHIELD, (BELDEN 8771)	3	FT	
W1-W5	W30020-000	CABLE,FIBER OPTIC,(HP HFBR-3504)	10	FT	
Z1	Z20045-000	FUSE,4A,SB,3AG,250V, (LITTELFUSE 313 004)	1	EA	

3KW 5KV POWER SUPPLY FOR 500L 31-A27825-000-A

Model Number 500L

Last Rev 02/05/98 Control# CORRECTION

REF. DESIG.	ETM P/N	DESCRIPTION	QTY	U/M	CAGE
A8	A16495-000	LOW VOLTAGE POWER SUPPLY MODULE	1	EA	8M906
A11	A23050-000	HPA LOGIC AND CONTROL MODULE	1	EA	8M906
A9	A23065-000	INPUT FILTER MODULE	1	EA	8M906
A6	A27815-000	POWER INVERTER MODULE	1	EA	8M906
A10	A27816-000	MOTHER BOARD	1	EA	8M906
A4	A27818-000	TANK MODULE	1	EA	8M906
A3	A27821-000	5KV 3KW HV FILTER	1	EA	8M906
A1	A27824-000	HI,HEATER POWER SUPPLY	1	EA	8M906
A5	A27826-000	HV RECTIFIER	1	EA	8M906
A2	A27832-000	GRID MODULATOR FOR 500L	1	EA	8M906