

# AMERITRON ALS-1306

1200 WATT 160-6 Meter NO TUNE  
TMOS-FET AMPLIFIER

## INSTRUCTION MANUAL



# AMERITRON

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# Quick Start

Thank you for purchasing this amplifier system. The ALS1306 is a 1200-watt nominal PEP output amplifier and power supply system. This amplifier covers 160-6 meters. Nominal drive power is 100 watts or less. This system will not and does not operate on the CB band.

The ALS1306 interfaces with most modern amateur radio transceivers, including band data information. Band data connection will require purchasing an Ameritron interface cable for your radio.

Carefully unpack this amplifier and power supply. Cabinets and controls can be broken, bent, or dented with rough handling. Please inspect everything for physical shipping damage; this includes cabinets and chassis. Ameritron does *not* package dented or damaged units. If your unit is damaged or dented, including broken knobs or switches, it is always from handling somewhere between Ameritron and the end user. In the event of cabinet damage or broken controls, please retain all packing materials and containers so damage claims can be resolved.

## Installation and Operation

### Placement

**WARNING: Do not block ventilation holes. Do not expose to water or external heat.**

This unit is two units, a power supply and an amplifier section. The power supply, within limits of cable length, can be placed out of the way. The amplifier section should be in a convenient location within arm's reach of the operating position.

### Wiring

#### Power Mains

- 1.) This amplifier requires a 200-260 Vac, 50-400 Hz, 15-ampere or larger mains supply. This range includes all typical power lines worldwide, including USA 240-volt systems (sometimes incorrectly referred to as "220 volt").
- 2.) The plug is a NEMA 6-15P, 250 maximum Vac at 15 amperes. This is a standard USA 250V plug with a safety ground pin
- 3.) The amplifier's power supply system contains two 30-ampere 50-volt supplies, one for HV1 and the other for HV2. The supply can be damaged by operation with voltages below 200 volts or above 260 volts.
- 4.) Larger power wiring will not help performance or power unless amplifier high voltage is unstable.
- 5.) While *not* recommended, the power supply can be rewired for 100-130 Vac operation. The increase in power line current with reduced power line voltage will limit amplifier power.
- 6.) The ALS-1306 power supply system is voltage regulated. You should see very little change in HV1 and HV2 with amplifier power. Less than 3 volts change from the 50Vdc nominal voltage is normal.

- 7.) The ALS-1306 has two power supply boards in the power supply. Exceeding safe power supply current on any supply line will force the overloaded supply into shutdown. Shutdown is reset by turning the main power switch off for a brief time. If the power supply has a permanent overload or the supply has failed, it will not reset.

### Radio and Antenna Connections

**WARNING:** Forcing connector engagement can result in permanent connector damage. Solder on the outside of center pins or bent pins are primary causes of female connector damage. External solder or bent center pins will permanently damage the female.

Do not use Line Isolators on amplifier RF cables. The chassis of the amplifier should be at the same RF potential as all other desk equipment. Shield isolators allow equipment to float to different RF chassis potentials. Different chassis potentials are exactly what we do **not** want, and isolators on desk coaxial cables encourage different potentials. It is better to cure RF problems outside the operating position whenever possible.

- 1.) RF connections are through standard UHF female connectors. Use good cables with quality UHF male (PL259) connectors. The output cable must safely handle at least 1200 watts.
- 2.) Look at the connectors. The amplifier's female connectors have notches on the outer thread edge. The cable males should have protruding tabs on the inner shell beyond the center pin insulator. These tabs and notches prevent unwanted connector rotation. The male's tab or tabs must be aligned with the female's notches. This interlocking prevents connector rotation.
- 3.) With a firm handgrip, gradually tighten RF connectors while making sure the male tab interlocks with the amplifier's female connector notch. Do not use excessive force on connectors. Check for proper tightness and seating by wiggling and flexing the cables near the connector and watching for any indications of abnormal male connector movement, and by wiggling the cable while hand tightening the male shell. If done properly, the connector will be solidly locked without need for pliers or other tools
- 4.) ALC and Relay (keying) connectors are phono females. The phono males from external cables should push directly in with a snug fit.
- 5.) The Relay line has low-voltage (<12V) low current (<20 mA). Transmit is enabled by pulling the Relay line to ground with a relay contact or transistor. Read your radio manual. Unless you have a very unusual radio, your radio will directly key the amplifier.
- 6.) The remote and radio band data connectors are specialized connections. They are for use with Ameritron supplied cables *only*.

## Operation

This amplifier has alert codes. SWR, PA, TX, and band switch lamps indicate operational faults. Operational faults reset by placing the amplifier in standby momentarily. The following table applies to faults:

Warning light Steady	Warning light Flash	Fault	Cause or Cure
SWR	TX	Antenna Reflected Power	High antenna SWR or intermittent antenna or feed line connection
SWR, PA	Band	Wrong filter	Exciter or amplifier on incompatible band, filter failure
PA	TX	PA FET too hot	Excessive power for duty cycle or SWR, lack of proper airflow
	PA	Combiner unbalance	
	10M, PA, TX	Illegal 11 meter	Excessive 27 MHz signal level
	REM, PA	No or wrong band when on remote	Defective or improper remote cable, or bad radio band data information

Before attempting operation:

- 1.) This amplifier is optimized for a 50-ohm load. Be sure your antenna system 50-ohm SWR is as low as possible. As SWR increases from 1:1, either heat or distortion will increase.
- 2.) Be sure your antenna system, including any lightning protection devices, will safely handle high power.
- 3.) Connectors, cables, and antennas must not have loose connections or insulation issues.
- 4.) Your exciter must be less than 100 watts output.
- 5.) Power mains should be capable of 15 amperes, reasonably stable, and 200-260 volts.
- 6.) The low pass filters cut off just above traditional primary bands. This means primary filters are used on WARC bands. Some radios do not supply enough band data to know the exact band, so with some radios the amplifier band data displays the **next higher** primary band above a WARC band. Do not be alarmed if, for example, 15 meters illuminates when 17 meters is selected on some radios.
- 7.) The amplifier will automatically attempt to reduce power if it appears thermal limits will be reached.
- 8.) The amplifier will shut off if an incorrect band is selected, if antenna SWR is too high (even for an instant), if thermal limits are reached, or if there is a catastrophic failure.
- 9.) The alert codes are in a table above on page 10.
- 10.) The ALS-1306 metering reads peak envelope power on all RF power functions.

With proper installation, basic operation is straightforward:

- 1.) Set the bandswitch to the desired band. This happens automatically in the REM position with a suitable radio interface cable
- 2.) Set the exciter or transceiver to the desired power below 100-watts.
- 3.) Place the standby switch in the operate position
- 4.) Transmit, and watching Forward Power metering, be sure power does not exceed 1200-watts on peaks.
- 5.) For high duty cycle modes and long transmissions, reduce power. The amplifier will attempt to reduce power if the FETs approach safe limits.

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## Amplifier Features

This amplifier provides the following standard features:

- 160- through 6-meter operation, full-power on six meters
- Eight conservative linear-service rated, 50-volt MOSFET transistors
- New push-pull stripline PA layout with exceptional VHF performance
- Energy-efficient solid-state design greatly reduces heat, <100-watts power line draw on receive
- Exceptional harmonic suppression
- Operational in a few seconds, no long filament warm-up time
- Clean layout with easy-to-service modular construction
- Quiet variable-speed forced-air cooling system
- Power module current and voltage meters with LED illumination
- Accurate PEP Forward and PEP Reflected output power metering
- Power module balance metering with PA unbalance protection
- Reflected power protection
- Thermal overload protection
- Bandswitch error protection
- Easy to understand front panel LED indicators for rapid fault-error diagnosis
- Standard negative-going ALC output with front panel adjustment
- ALC metering and ALC LED indicator
- Fully-regulated external power supply
- Compact size 17.5" deep x 7" high x 10.5" wide
- Weight amplifier section 23 pounds

## Introduction

The Ameritron ALS-1306 is 1200-watt nominal output, 160 through 6-meter amateur radio band, solid-state amplifier. The ALS-1306 uses eight 50-volt, conservatively rated, linear RF MOSFETs. These MOSFETs are specifically designed for linear power amplifier applications, not class C or pulse service. They provide exceptionally low SSB distortion when compared to other solid-state devices. Fan speed is regulated by temperature sensors; assuring conservative cooling with minimal noise.

Nominal driving power is 100-watts for 1200-watts output (approximately 11 dB gain) on most bands. The compact 10" wide by 6-1/2" high amplifier package (depth only 18") fits nearly any station configuration. The attractive desktop amplifier unit weighs only 24 pounds.



An external 50-volt 50-ampere regulated power supply powers the ALS-1306. The supply is wired for 240 VAC (200-260 VAC, 50-60 Hz, 15 amperes), but can be rewired for 120 VAC operation for lighter duty operation.

## Power Supply

The external power supply for the ALS-1306 is a voltage-regulated current-limited switching supply. It contains 14-volt positive and negative supplies, as well as dual 50-volt 25-ampere continuous (30-ampere peak) fully current-limited supplies. Each PA (power amplifier) module in the ALS-1306 operates from independent 50-volt modules, giving a total dc supply rating of 2500 watts average power and 3000 watts peak power to the power amplifier modules.

Power supply to amplifier interconnections are through a heavy-duty cable using a large Cinch Jones connector.

## Power Line Requirements

This amplifier ships wired for a nominal mains voltage of 230 Vac. Maximum average power-line current at full power output is 12 amperes at 240 volts. Two 250-volt 15-ampere fuses fuse the power line. The switching power supply automatically adapts to any mains voltage between 200 Vac and 260 Vac, and does not require adjustments or tap changes within that range.

**Note:** 120-volt power mains operation is possible with a reduction in CW or RTTY power. Because average power is very low, SSB operation is unaffected by 120-volt operation. 120-V fuse size is 25-amperes maximum.

## Power Supply Features

- Efficient operation from 200-260 volts ac (12 amperes typical at full output power).
- Low standby and receive power drain, typically less than 100-watts.
- Generator and inverter friendly with acceptable power line frequency range 40 to 400 Hz.
- Fully regulated current-limited outputs.
- Step-start to limit stress on power supply components.
- Exceptional filtering and RFI suppression eliminates receiver birdies common to most SMPS.
- Compact light weight design.

## Power Supply Location

Locate the power supply in a convenient ventilated area near the amplifier location. Avoid placing the power supply next to sensitive equipment, such as audio processors, transceivers, or microphones. For safety, ground the wing nut stud on the supply rear to the station ground buss. The station ground buss should comply with National Electrical Codes. NEC and fire protection codes mandate directly bonding of station grounds to the power-line entrance ground. If station ground rods are not bonded to the utility entrance ground, likelihood of equipment or property damage and personal risk increases.

# General Information

## Alert Codes

The SWR, PA, TX lamps, and band switch lamps indicate operational faults. Operational faults reset by placing the amplifier in standby. The following table applies to faults:

Warning light Steady	Warning light Flash	Fault	Cause or Cure
SWR	TX	Antenna Reflected Power	High antenna SWR or intermittent antenna or feed line connection
SWR, PA	Band	Wrong filter	Exciter or amplifier on incompatible band, filter failure
PA	TX	PA FET too hot	Excessive power for duty cycle or SWR, lack of proper airflow
	PA	Combiner unbalance	
	10M, PA, TX	Illegal 11 meter	Excessive 27 MHz signal level
	REM, PA	No or wrong band when on remote	Defective or improper remote cable, or bad radio band data information

## Amplifier Overview

The Ameritron ALS-1306 is a solid-state, 1200-watt nominal RF output power, 1.8-54 MHz amplifier. The ALS-1306 meets or exceeds all FCC requirements governing amateur radio external power amplifiers.

The ALS-1306 uses four pairs of exceptionally low distortion, push-pull MRF-150 (or equivalent) SSB RF power transistors. The characteristics of linear high-voltage FETs are very much like those of triode vacuum tubes. While this amplifier will run more than 1200 watts PEP output, linearity might suffer. Ameritron recommends running 1200 watts or less peak power for maximum linearity. If these instructions are followed this amplifier will have comparable IM performance to the best vacuum tube linear amplifiers.

Temperature sensors on each PA (power amplifier) module monitor heat. Bias and fan speed track FET temperature. The ALS-1306 protection circuitry reduces power as transistors approach conservative thermal limits, and disables the amplifier before transistor exceed safe operating temperature limits.

Harmonic suppression comes from push-pull operation of linear devices, followed by high-quality 5-pole low-pass filters. Many amplifiers use inexpensive ceramic disc or mica capacitors. Lead inductance of mica or disc capacitors reduces high-order harmonic suppression. This amplifier uses quality multi-layer high voltage chip capacitors.

This amplifier greatly exceeds FCC harmonic requirements. HF harmonic suppression typically 10-15 times better than FCC mandated suppression levels. Harmonics are practically immeasurable on all television channels. An external low-pass filter has minimal effect with this amplifier.

Antenna switching is through a pair of sequenced miniature relays on a plug-in module. This facilitates relay servicing or maintenance. Relay switching time is approximately five

milliseconds. The T/R “Relay” control jack is well within the range of almost any transceiver or radio. The “Relay” jack has an open circuit voltage of 13-volts, and closed circuit current less than 20 mA. Virtually any modern amateur radio will directly key this amplifier.

This amplifier includes full metering using large easy-to-read conventional panel meters. The meters read all critical parameters including forward and reflected peak envelope RF power.

## Installation

Please look your amplifier and power supply over carefully. Observe the air inlet and outlet ventilation holes. Facing the amplifier front panel, the cooling air inlets are on the top left and lower right side, including the right bottom. The warm air outlet is on the lower left side of the cabinet as viewed from the normal operating position (front view). While outlet air will not be particularly warm, it is never a good idea to have warm air blow into heat sensitive equipment, such as transceivers or other power amplifiers. Have the same consideration for your new amplifier and power supply. Be sure the air inlet temperature is not substantially above normal room temperature. Ideally, the air inlet temperatures should be below 32° C or 90° F, although temperatures up to 41° C or 106° F are permissible. If ambient temperatures exceed these limits it might become necessary to reduce duty cycle or power.

***Warning: Do not block cooling air inlets and outlets!  
Never expose the amplifier to water or mist.***

## Installation Clearances

The amplifier must have a clear area to the bottom, both sides, and top for proper airflow, and to the rear for interconnection wiring. It is especially important to avoid obstructions that block the air inlet on the top left, as well as both lower sides. Two inches clearance is normally adequate for full ventilation. Keep any papers or loose objects that might impede airflow away from the air inlets and outlets.

Locate the amplifier and power supply away from sensitive equipment such as microphones, audio processing equipment, or low level audio or radio frequency amplifiers. Generally, the best location for the power supply is below the operating desk and away from antenna feed lines. This will keep fan noise and any RF coupling to a minimum.

The power supply has an air inlet at the rear, and air outlets on the top. The highly efficient power supply produces very little heat, but the inlet and outlet must remain open to normal room temperature air.

## Installation Warnings

### Accessory Equipment and Devices

One of the most common causes of amplifier failures or erratic fault protection alarms is installation of antenna switches, lightning protection devices, or baluns with lightning spark gaps in high SWR lines. If your antenna system has an SWR high enough to require an antenna tuner, do not use 50-ohm lightning protection devices after the tuner.

## Installation, Wiring, and Connections

The power supply is factory wired for 200-260 Vac. It uses a standard NEMA-6-15P 15-ampere 240-volt plug. The round center pin is the safety ground. Do not remove the safety ground.

**CAUTION!** *Before* connecting the power supply to an electrical outlet, always be sure you have completed the following four steps:

1. Insert the 15-ampere 250V fuses into the two black fuse caps.
2. Insert the fuse and cap assemblies into the power supply's fuse holders. The fuses lock in place with a slight turn.
3. Connect the power supply to the amplifier.
4. Be sure the amplifier power switch is *off*.

**Caution!** *Fuses have both voltage and current ratings. Use only 250V rated fuses in this device. The voltage rating is generally marked on fuses. DO NOT use automotive-type low voltage fuses in any power line application. For 240-volt operation, 15-ampere fast blow fuses are required.*

**Warning:** *Never insert the power supply cord into the outlet until you have completed the four steps above!*

Position the amplifier at or near the desired location on your operating desk so you have access to the rear panel, and connect the rear panel cables. Do not connect the power mains at this time!

### **Station Ground**

Common rumor is that a station equipment ground reduces RFI (radio frequency interference), reduces lightning damage, or improves signal levels. Generally, changes in RFI or signal quality, with the addition or removal of a station ground, indicate an antenna or feed line installation problem. Typical problems causing desktop RF problems include the following:

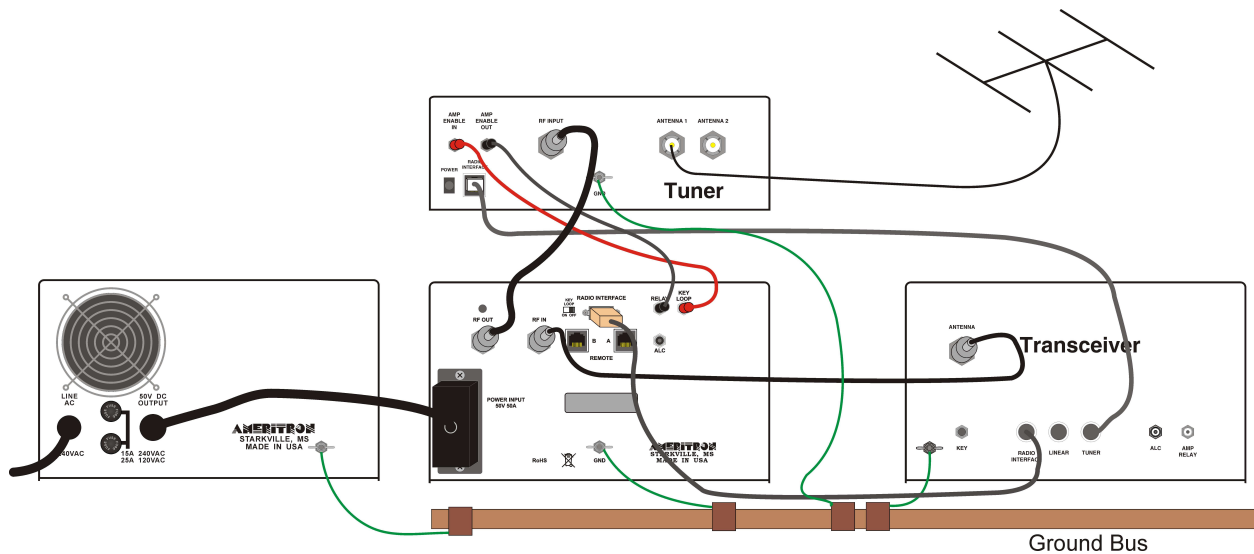
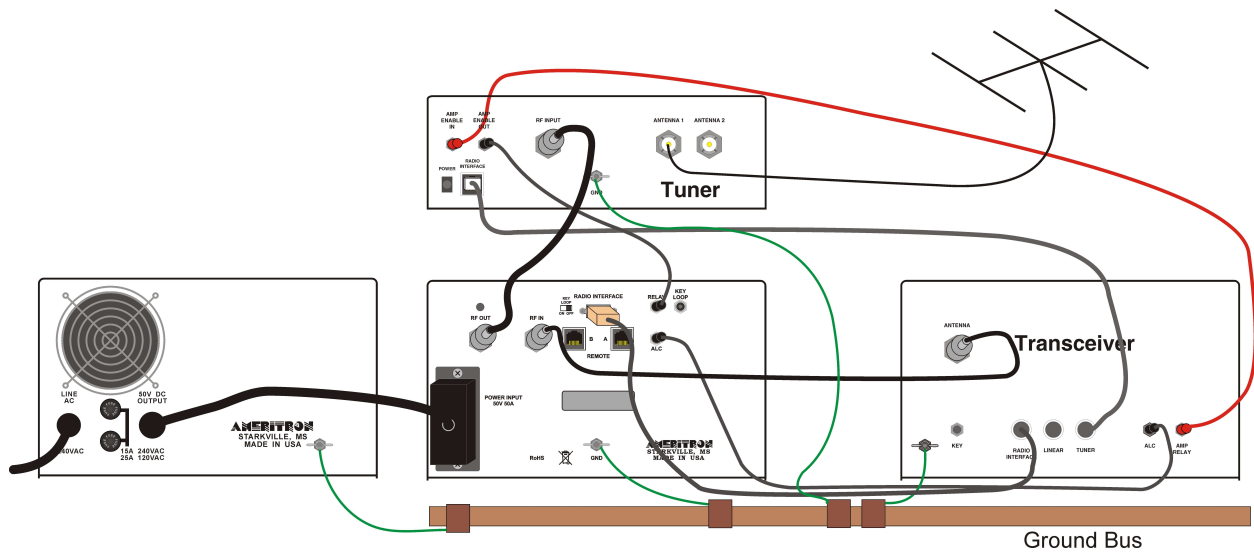
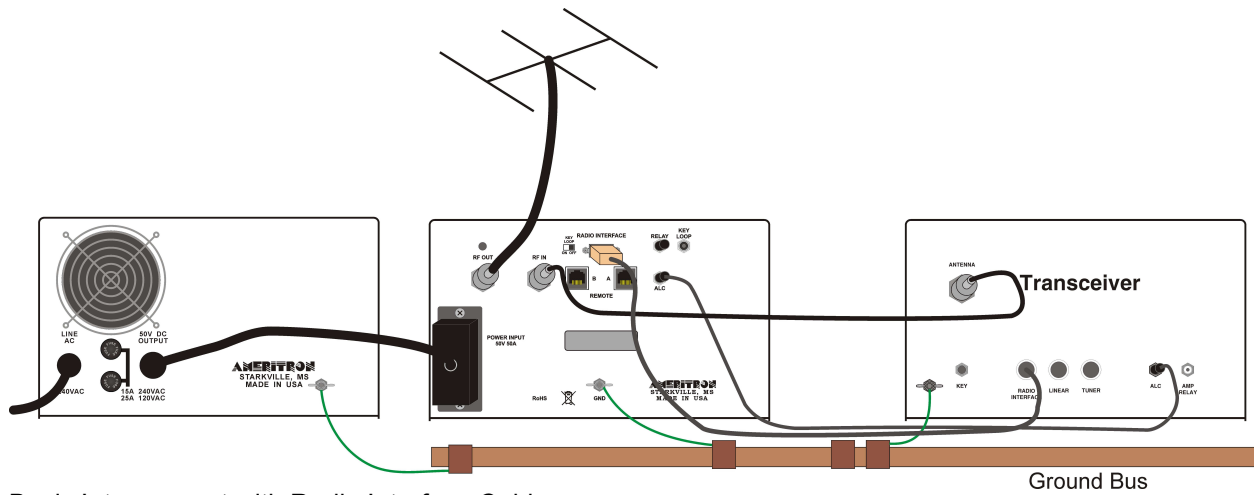
1. Lack of suitable baluns
2. Improper feed line routing near antennas, or improperly designed antennas
3. Antennas too close to the operating position
4. Poor equipment cabinet design, such as non-bonded or grounded equipment covers or panels
5. Poorly designed low-level audio line shield entrances, such as shields allowed to enter cabinets instead of grounding at the enclosure entrance
6. Improper antenna feed line building entrance, lacking a properly grounded entrance panel

Rather than patching a system problem at the desk, it is much better to correct defects at the source.

### **Coaxial Line Isolators**

Never install coaxial line isolators between desktop radio equipment. The goal of every operating position is to maintain all equipment cabinets and housings at the same RF potential. Isolators on or near the desk are contrary to this goal, and actually promote or encourage cabinet or chassis RF potential differences. If an RF problem appears at the operating position; correction, repair, or replacement of defective equipment is in order.





Interconnections Figure 1

## Amplifier Rear Panel

<b>50VDC</b>	The power supply should be unplugged before installing or removing this connector. This connector is indexed by a slight vertical offset in the two round index pins. Mate the round pins and holes. Seat the male plug fully onto the amplifier rear panel male connector pins. After seating, the power supply can be plugged into the AC mains outlet.
<b>ALC</b>	Optional connection. Connects to radio ALC input.
<b>RELAY</b>	Connect to radio amplifier keying line. Radio must pull this line below 2 volts to transmit.
<b>KEY LOOP</b>	Output for remote tuner use.
<b>KEY LOOP Switch</b>	Switch to turn on and off the KEY LOOP function.
<b>GND</b>	Connect to station ground buss, if available. This connection is primarily for extra safety.
<b>RF IN</b>	Connect through good 50-ohm coaxial cable of any reasonable length to radio's antenna output connector. This can be a smaller cable, such as RG-58/U.
<b>RF OUT</b>	To 50-ohm antenna, antenna tuner, power meter. This is the high power output. 50-ohm coaxial cable and system beyond must safely handle at least 1200-watts.
<b>RADIO INTERFACE</b>	This connector is for use with <i>Ameritron</i> radio interface cables. It allows automatic band selection (following the radio). It also provides amplifier actuation in transmit mode with some radios.
<b>REMOTE</b>	These RJ45 connectors are for an Ameritron remote control head, or remote operation with an interface box. It provides access to controls, including most metering functions.

- 1.) If you use a desktop grounding buss system, connect the station ground buss to the amplifier rear panel wing nut. National safety codes require the station ground electrically bond to the power mains safety ground at the building entrance. Do not connect the amplifier to its own isolated ground rod or ground system.
- 2.) Connect the power supply to the amplifier.
- 3.) Connect the RELAY line to the transceiver's amplifier control port. This port is usually described or defined in the amplifier interfacing section of the radio or transceiver manual. This port must pull low for transmit, and be open circuit when receiving. Relay control voltage from the ALS-1306 is 12 volts positive with only 15 mA current. You should always check your transceiver's manual, but almost any standard transceiver directly interfaces with this amplifier.
- 4.) Connect the RF **OUT** (output) port to the appropriate point in your station. This is the high power RF output cable. This connection would go to your 1500-watt rated Power/SWR meter, antenna, or antenna matching device. Good quality Mini-8 or RG-8X cables are acceptable for anything but RTTY use, although larger RG-8 style cables are normally preferred. *Your antenna matching system, or antenna tuner, must connect to this port.*

- 5.) Connect the IN connector to your transceiver. Do not install any active antenna matching devices on this port. In general, the shortest and most direct cable connection is best, although high quality cables can be very long without adverse effect on performance. RG-58/U or Mini-8 (RG-8X) style cables are acceptable. ***You should never use a tuner of any type on the amplifier input, nor should you drive this amplifier with over 100 watts peak envelope power. Never use a non-FCC accepted device with this amplifier.***
- 6.) The ALC line is optional. In general, transceiver internal ALC is all that is necessary. The ALC monitors the RF output power and reflected power supplied by the ALS-1306 to the load.
- 7.) Operate the bandswitch manually during initial testing. Do not connect band decoders, band data lines, or computer interfaces until initial tests are completed and the amplifier is functioning normally.
- 8.) When using an automatic antenna tuner that has the capability to inhibit the amplifier from operating either during tuning or when conditions are outside of the tuner's capability; and when the radio interface has the Amplifier Relay line included (not using the RELAY jack); the KEY LINE can be used. The KEY LOOP Switch is used to route the key signal from the interface to the amp directly or out the KEY LOOP jack.
  - a. If the KEY LOOP is not used set the KEY LOOP Switch to OFF so the Radio Interface Cable can key the amplifier.
  - b. If the KEY LOOP is used with an automatic antenna tuner switch the KEY LOOP Switch to ON, run a cable from the KEY LOOP connector on the amp to the AMP ENABLE IN connector on the tuner, and run a cable from the AMP ENABLE OUT connector to the RELAY connector on the amp.

## Optional Radio Interface Cables

ALS-1306/RCS-12 Radio Interface Cables available from Ameritron.

Model No.	Description	Notes
DB-13D	ICOM with ACC, 13-Pin DIN	
DB-7DI	ICOM with ACC 2, 7-Pin DIN	
DB-DB7DK	Kenwood with DB9 (except TS-480)	<b>SET Baud RATE 9600</b> <b>590</b> menu 53 (HF) 54 (50 MHz) #2, <b>570</b> menu 39 (HF) and 40 (50 MHz)#2 <b>990</b> s menu 11 (HF) and menu 12 (50 MHz) set to 3= active high+relay+delay <b>2000</b> menu 28A #2
DB-DB8MK	Kenwood TS-480	Baud rate 9600, menu 28 (HF) channel 2 and 29 (50 MHz) channel 2
DB-8MY2	Yaesu FT-897/857/817/840/890/990/100	
DB-8DY	Yaesu with standard 8-Pin DIN Band Data	
DB-10MY	Yaesu FT-450/950/1200	
DB-DB15Y	Yaesu FT-DX3000	
DB-DB15HE	Elecraft	



## Front Panel



Amplifier Front Figure 2

The front panel contains the following indicators and controls. To prevent damage, become familiar with the front panel *before* operating the amplifier.

- 1 FET module current meters
- 2 Forward Power meter and Multimeter (reflected power, module RF balance, ALC, and Module supply voltages) selected by knob 7.
- 3 Band or REMote selector knob.
- 4 Backlit Band or REMote LED indicators.
- 5 ALC limit adjustment.
- 6 Backlit Function and Fault Warning LED indicators.
- 7 Meter 2 multimeter scale function selector knob.
- 8 Operate and Standby switch, also resets fault warnings.
- 9 Main Power, also resets power supply overload.

Note: The right-hand meter's left scale-arc (fig.2 ref 2A) continuously indicates forward peak envelope power (PEP) output directly in kilowatts. It is 100 watts, or 0.1 kW, per meter scale picket. PEP has no fixed relationship to long-term average power except, for constant amplitude carriers like a steady CW carrier, when PEP and average powers are equal. PEP is the highest average power during one (or more) radio frequency cycle(s) at the modulation envelope crest.

The right-hand meter's rightmost scale-arc is used for PEP reflected power in watts and combiner imbalance on the upper scale numbers and pickets. Notice power meter calibrations are not evenly spaced. Lower scale numbers and pickets are evenly spaced, and are for other functions. The lower right scale is used for relative ALC setting and power amplifier modules HV (0-70 volts).

## Operation

This amplifier covers all Amateur Radio frequencies below 54 MHz, as restricted by FCC or your local governing authority. Once you have established proper connections, please set the amplifier (Fig. 2, ref 3) to one of the following bands:

Band	Frequency Range	Notes
160	1.8 - <b>2.1</b> MHz	
80	3.2 - <b>4.2</b> MHz	
40	6.0 - <b>7.5</b> MHz	
30	7.5 - <b>14.5</b> MHz	USA 30-meter power limit currently 200-watts
20	7.5 - <b>14.5</b> MHz	
17	14.5 - <b>22.0</b> MHz	
15	14.5 - <b>22.0</b> MHz	
12	22.0 - <b>30.0</b> MHz	Amplifier automatically disables above 25 MHz
10	22.0 - <b>30.0</b> MHz	Amplifier automatically disables below 28 MHz
6	50.0 - <b>54.0</b> MHz	

Frequency Limits Table 1

**Caution:** This amplifier has an FCC mandated automatic disconnect and other features preventing 27-MHz operation. There is no available circuitry or control provision to circumvent this lockout.

## MARS or CAP Operation

For licensed amateur radio operators participating in Military Affiliate Radio Systems or CAP, this amplifier is suitable for use on all frequencies between 1.8 and 54 MHz with some precautions. The upper frequency limits are in bold type in the table above. Do not operate above the bold-type frequency limits in the table above or PA (power amplifier) or filter damage may occur.

Ameritron guarantees to exceed FCC part 97.307 harmonic suppression standards, as of January 2013, inside *amateur bands* listed in the table above. Ameritron does not guarantee harmonic suppression or operation outside amateur bands. Most commercial services prohibit use of non-commercial radio equipment.

This amplifier is *inoperable* between 25 and 28 MHz. Modifications allowing operation in the 25-28 MHz range is not available, irrespective of licensing or end-use.

## Warning Lights

The ALS-1306 has three primary warning lights in the center of the front panel. It also uses other standard LED's as warnings, flashing them in a certain code that indicates problems. These lights serve the following functions:

ALC: The yellow ALC light indicates ALC output. Flashing is normal when using ALC. A steady intense light indicates a problem.

Operational faults reset by placing the amplifier in standby. The following table applies to faults:

Warning light Steady	Warning light Flash	Fault	Cause or Cure
SWR	TX	Antenna Reflected Power	High antenna SWR or intermittent antenna or feed line connection
SWR, PA	Band	Wrong filter	Exciter or amplifier on incompatible band, filter failure
PA	TX	PA FET too hot	Excessive power for duty cycle or SWR, lack of proper airflow
	PA	Combiner unbalance	
	10M, PA, TX	Illegal 11 meter	Excessive 27 MHz signal level
	REM, PA	No or wrong band when on remote	Defective or improper remote cable, or bad radio band data information

## Initial Operation

For your personal and equipment safety, double-check all wiring and connections (fig. 1) before turning power on. After you have verified amplifier connections, follow the procedures below. The following steps are necessary during initial checks:

1. Place the **MULTIMETER** switch (fig.2 ref 5) in the **HV2** position. Place the **ALC SET** control (fig.2 ref 4) full clockwise (10 on knob scale). The multimeter is the right-side scale on the rightmost panel meter (fig.2 ref 5).
2. With the **STANDBY/OPERATE** switch (fig.2 ref 7) on **STANDBY**, turn the power switch (ref 8) **ON**.
3. There will be a slightly delayed “click” from the power supply. **HV2** (fig.2, ref 2) should immediately rise to near full scale, and after a slight delay, you should hear another “click”. The meters and the appropriate **BAND LED** (fig.2, ref 3) should illuminate.
4. The multimeter **HV2 scale** (fig.2, ref 2, bottom right scale) should read between 45 and 55 volts.
5. Change the meter switch (fig.2 ref 6) to **HV1**. The voltage should be the same as in step 4.
6. Rotate the **BAND** switch (fig.2 ref 3) through all positions. The appropriate **BAND LED** will illuminate, and you should hear band-filter relays switch between 160-80, 80-40, 40-30, 20-17, 15-12, and 10-6 selector position changes.
7. Set the **BAND** switch (fig.2 ref 3) to a band where you have a good 50-ohm high-power load connected.
8. Change the meter switch (ref 6) to **REF**. In this position, the multimeter indicates reflected power.
9. With no modulation in the FM, AM, RTTY, or CW mode, and the amplifier still on standby, adjust your exciter power to about ten watts. This is to have a steady unmodulated carrier. Verify you have very low power, ideally around 10-watts carrier (not critical), and that VSWR of *the antenna system* is low. You should see almost no deflection on the reflected power scale (fig.1 ref 2) with the **MULTIMETER** switch in

the **REF** position. If you see reflected power deflection, check your RF cables. **Reminder: You cannot use a tuner in your radio, or between your radio and this amplifier, to match the antenna system. Any antenna matching must be between the amplifier and the antenna, and the antenna tuner and beyond the amplifier must be conservatively able to handle over 1200 watts of carrier or peak envelope power.**

10. Place the amplifier in **OPERATE** position (fig.2 ref 8). Be sure the **BAND** on the amplifier matches the band selected on the transceiver.
11. Place the transmitter or transceiver into transmit in FM, AM, RTTY, or CW modes. The green **TX** LED (fig.2 ref 6) should light. The forward power (fig.2 ref 2) should increase to approximately ten times the initial exciter power reading. Reflected power should remain very low, and the PA current should increase slightly on both scales of the current meter (fig.2 ref 1). No other LED's should illuminate.
12. Briefly, increase exciter power until the amplifier reaches 1200-watts output, *or* increase exciter reaches maximum power without exceeding 1200-watts amplifier power.
13. After you have verified all of this, the amplifier is ready to operate.

With 100-watts PEP, this amplifier should show approximately 1200-watts of output power. This can vary slightly from band-to-band.

## **ALC Adjustment**

Radio manufacturers do not have standardized interfaces. Because of this, ALC requires some initial adjustment. If the ALC voltage is too low, the ALC will not provide good control of power levels. If the ALC voltage is too high, the ALC will cause a power surge and bounce while power slowly settles at the desired steady threshold. This overshoot, dip, and recovery is caused by slow radio ALC response time, which is aggravated by excessive ALC loop gain.

ALC attack bounce shows on a steady carrier (such as RTTY, CW, or FM) as a high initial peak power reading followed by a deep null. The deep null is followed by a slow settling to the desired power level. On SSB, it will show as a slow warble or modulation of power levels, especially at the very start of voice transmissions.

If you observe ALC attack bounce, the ALS-1306 will require ALC gain adjustment. The ALS-1306 has a small blade screwdriver adjustment for setting ALC gain. This adjustment on the left cabinet side behind the front panel, near the panel meters.

## ALS-1306 Functional Overview

The ALS-1306 is an amateur radio multiband radio frequency linear power amplifier. This device complies with technical standards of CFR Title 47 part 97.317(a) and (b).

### General Operation

This linear amplifier covers the 160, 80, 40, 30, 20, 17, 15, 12, 10, and 6-meter amateur bands. Up to 100 watts exciter power is applied to relay RLY1 on circuit board RLY. When power is on and the standby switch is in the operate position, and when the rear panel RELAY control line is held low (below 1 volt), exciter power is routed through RLY1 to the PD8 power divider board.

### Power Division

The PD8 power divider board splits the signal path equally between two 600-watt power amplifier modules. The PD8 circuit board consists of a conventional magic-T power divider, components T2 and R7. This T splits drive power into two equal power signals. Each signal path has a 5 dB attenuator consisting of high power resistors R1 through R6. The 5 dB attenuators on each output port terminate the T in 50-ohms and provide an additional 10 dB of input port isolation between the two PA modules. With a 50-ohm source, in excess of 30 dB port-to-port isolation occurs between PA module inputs. A minimum of 16 dB isolation occurs regardless of input port termination. The attenuators also work in concert with the magic-T to provide a 50-ohm input termination for each PA module. The 50-ohm termination and input port isolation results in unconditionally stable PA modules.

### PA Amplifiers

Power amplification comes from two 600-watt power amplifier modules. Each PA module (PAM-606) uses four MFR-150 field effect transistors. Each MFR-150 has between 100 mA to 300 mA quiescent current. Transistor conduction angle is slightly over 180-degrees, providing linear class-AB operation. Normal dc drain operating voltage is approximately 50-volts.

Unlike standard Motorola based modules, the PAM-606 modules use two diametrically opposed push-pull pairs. The push-pull pairs drive balanced striplines. The balanced striplines combine at a matching transformer. The linear RF power FETs mount on a forced-air-cooled aluminum heatsink.

Two dc fans cool each PAM-606 module. Two thermistors (PAM-606 R2) sense the power amplifier transistor temperature. Transistor temperature thermistor R2 regulates bias voltage, reducing bias voltage as transistor temperature increases. This bias feedback system keeps transistor quiescent current stable independent of transistor junction temperatures. PAM-606 thermistors R2 also feed a comparator that removes drive when transistor temperatures approach unsafe levels.

A second set of thermistors (PAM-606 R1) monitor heatsink temperatures. Voltages from thermistors R1 regulate fan speed, increasing fan speed and airflow as the heat sink warms.

Bias for the PAM-606 modules comes from the CB-2 control board assembly. Each transistor has an individual bias adjustment, with minimum bias counter-clockwise from the top view. This is opposite the control function in CB1 assemblies. The PAM-606 modules employ significant negative feedback to reduce gain, improve gain flatness, improve linearity, and ensure stability. The FETs have direct resistive voltage feedback across each individual transistor from drain-to-gate, as well as push-pull transformer (T2) coupled feedback common to the push-pull circuit.

Push-pull operation, negative feedback, and linear biasing of FETs provide significant pre-filter harmonic suppression.

## **2KWF6 Lowpass Filter Assembly**

Each PAM-606 module connects directly to the 2KWF6 circuit board assembly through 50-ohm cables. Each PA module feeds a 50-ohm high power combiner. This combiner isolates the two PAM-606 inputs while maintaining 50-ohm impedance. Two 25-watt 200-ohm power resistors, R7 and R8, dissipate power level or phase errors between the PA module inputs. Voltage step-down transformer T1 senses voltage across combiner dump resistors, R7 and R8. *T1 is located on the 2KWF6 lowpass filter board.* This voltage, representing PA combiner unbalance, appears on the front panel multimeter as a “PAB” (power amplifier balance) indication. PA unbalance reference voltage also feeds a comparator on the CB2 control board. This comparator disables the PA in the event the power amplifiers become significantly unbalanced, and illuminates the PA front panel light.

The output of the high-power combiner enters the filter section through a directional coupler consisting of current transformer T2, capacitors C36-38, C40-42, and resistors R4, 5 and 6. This directional coupler detects the power amplifier termination errors. These errors include filter band errors. A comparator on the CB2 control board monitors directional coupler termination errors. Any significant filter or antenna reflected power error disables the amplifier. Such errors normally come from selecting the wrong filter for the exciter’s operating band, or having a poor load SWR on the amplifier.

The output of the filter board directional coupler routes through one of seven 5-pole lowpass filter groups. Relays, controlled by CB2 control board logic, select the appropriate lowpass filter components.

## **Control and Protection Logic**

The CB2 control board contains all protection comparators (U7) and control logic latches (U1). In the event of an operational fault, U1 locks out the amplifier and illuminates the proper front panel warning light sequence. CB2 also contains bias, relay sequencing, and fan speed controls.

The CB2 board contains band-decoding systems, and automatically disables operation between 25 and 28 MHz in all ALS-1306 amplifiers regardless of band selection mode. This embedded logic function cannot be disabled or changed.

## **SWR**

The SWR board is a standard 50-ohm directional coupler. The SWR board samples line current and line voltage, vector summing line voltage and current before conversion to a dc output voltage. The resulting voltages represent forward and reflected power, or mismatch from an ideal 50-ohm load.

## Circuit Boards

There are ten basic circuit boards plus two power amplifier modules in the ALS-1306. The text below gives a brief description of each board's function.

### 2KWF6

The 2KWF6 is a high-power low-pass filter. It is the very large topmost board with several large toroids and air wound inductors. This board contains filter SWR fault detection, power amplifier imbalance detection, and multiple high-power low-pass 5-pole filters. Additionally, the antenna relay board **RLY** attaches directly to the 2KWF6 board.

### BS2

The BS2 is located behind the **BAND** switch. It provides all band selection functions, as well as band indicators.

### CB2

The CB2 is located near the front of the amplifier just behind the meters. The CB2 control board provides most control functions. This includes bias, fan speed, overload and wrong-band protection, and transmit-receive relay sequencing. It is the hub for nearly all functions, including external interfaces, power metering and 12-volt busses.

### MB1

The MB1 is located behind the front panel below the meters. It contains peak-envelope-power detection circuits, multi-meter switching, fault indicators, and ALC circuitry. There are four power meter adjustments on this board; forward power, reflected power, forward peak hold time, and reflected peak hold time. Shunts on a header located on the board's upper edge adjust panel meter brightness.

### PA Boards

PA boards are located on top of the heatsinks under the filter board shield panel. The PA boards, along with heatsinks, are integral units of the PA modules. There are no user adjustments on these boards, and the FETs and assemblies are gain matched at the factory. The PA modules are serviced by removing the bottom panel.

### PD8

The PD8 is located on the right side of the amplifier just above the panel containing the cooling fans. It contains a power splitter and two 5 dB attenuator pads. The splitter and attenuator pads isolate the two power amplifiers from each other, and terminate the PA inputs in 50 ohms over a wide range of frequencies. This is necessary to stabilize the PA modules. Do not modify, remove, or bypass the attenuators.

### RJ45

The RJ45 board mounts on the rear panel. It contains two RJ-45 jacks for remote control interface.

### RLY

The RLY board contains two transmit and receive relays, one for RF output switching and the other for RF input switching. T/R relays activate with a low on terminals K (key) J1-3 and RJ1-7. The **CB2** board contains the relay timing controls.

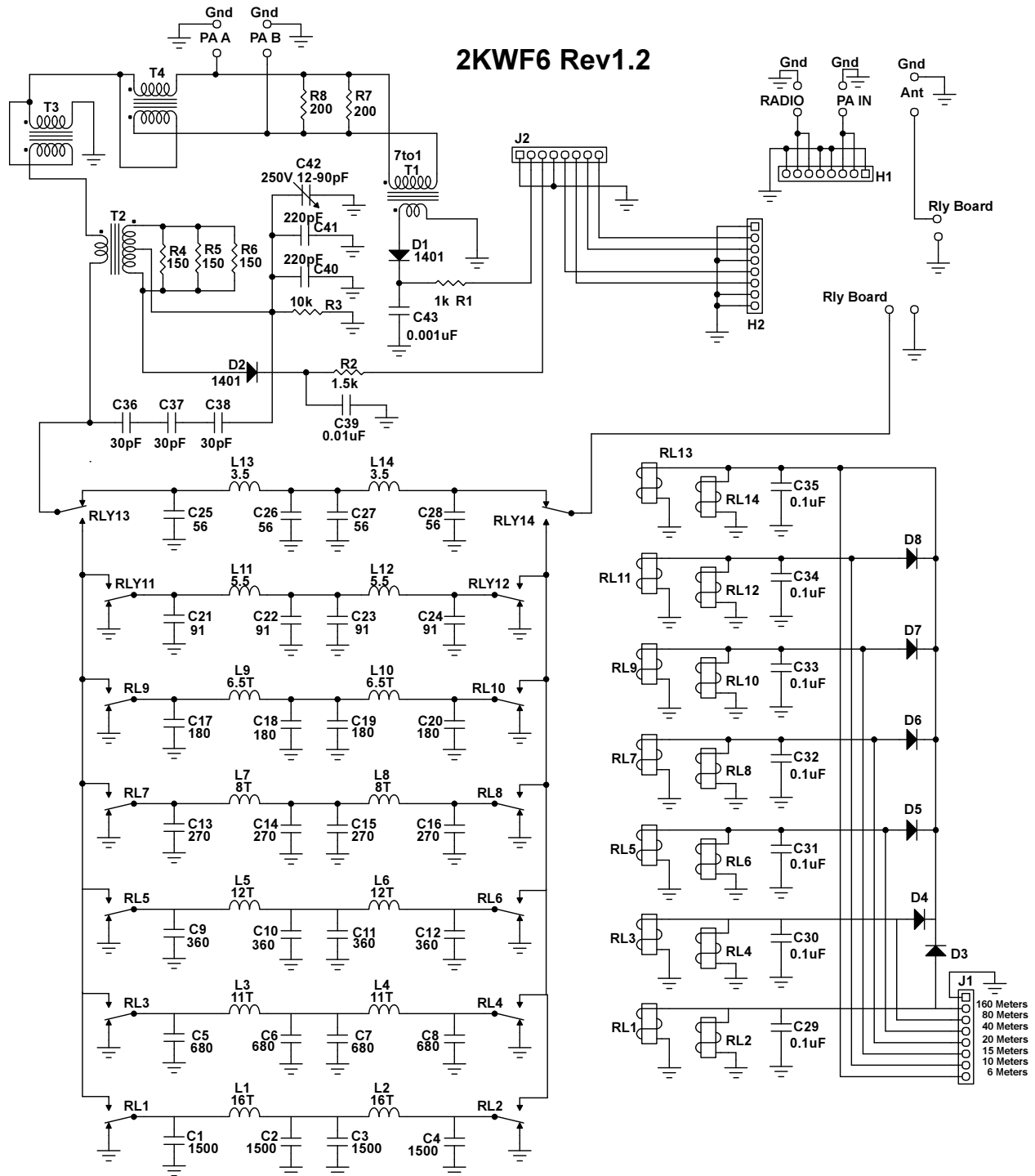
## **SWR**

The SWR board is on the rear panel in front of the RF output connector. It is a traditional 50-ohm directional coupler. The null adjustment is accessible through a rear panel hole.



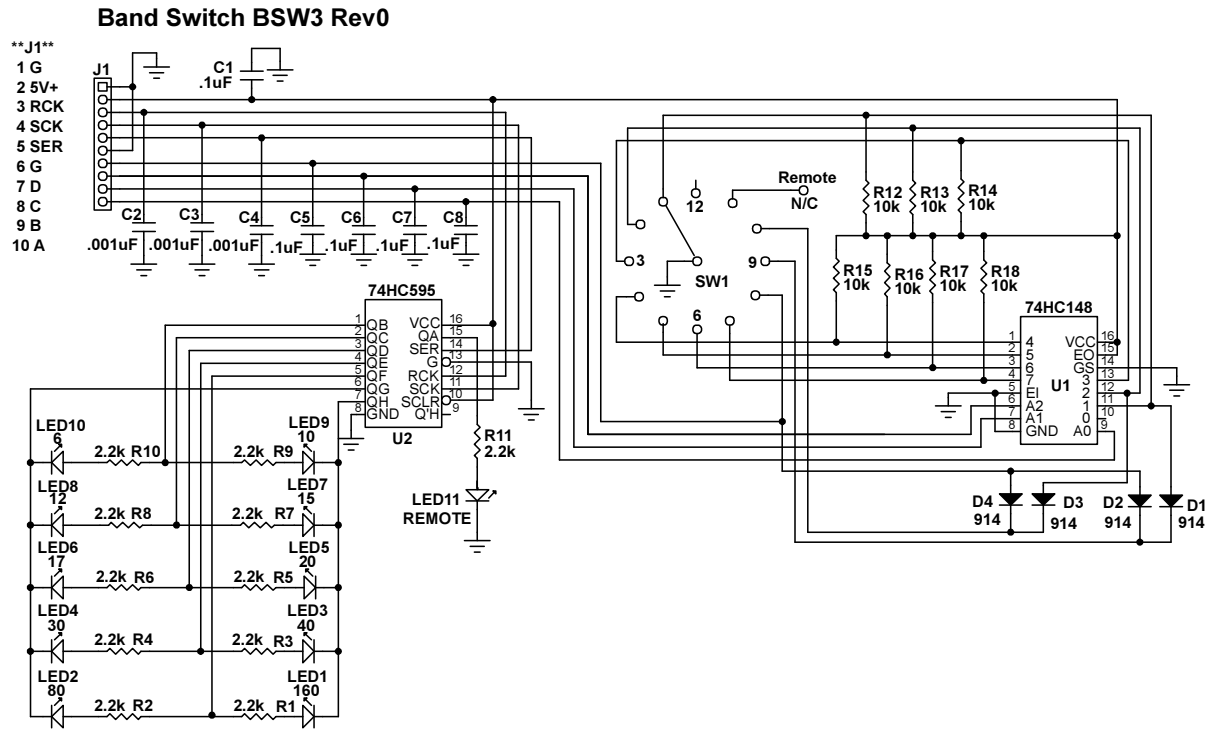
# Schematics

## Filter 2KWF6



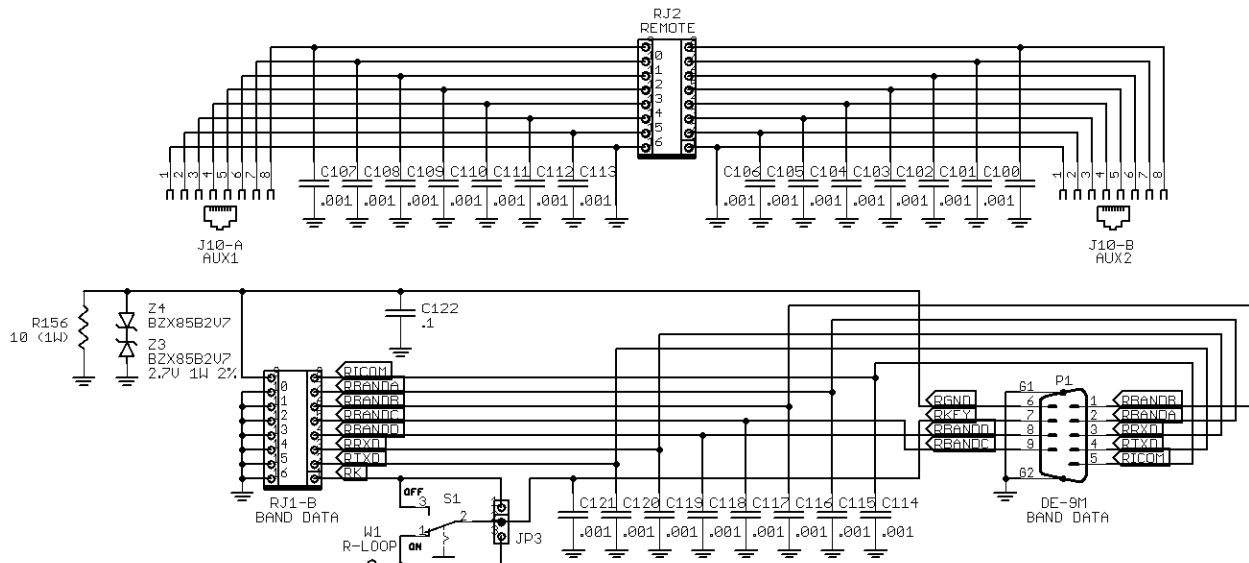
2KWF6 output filter Figure 3

# Bandswitch BSW3



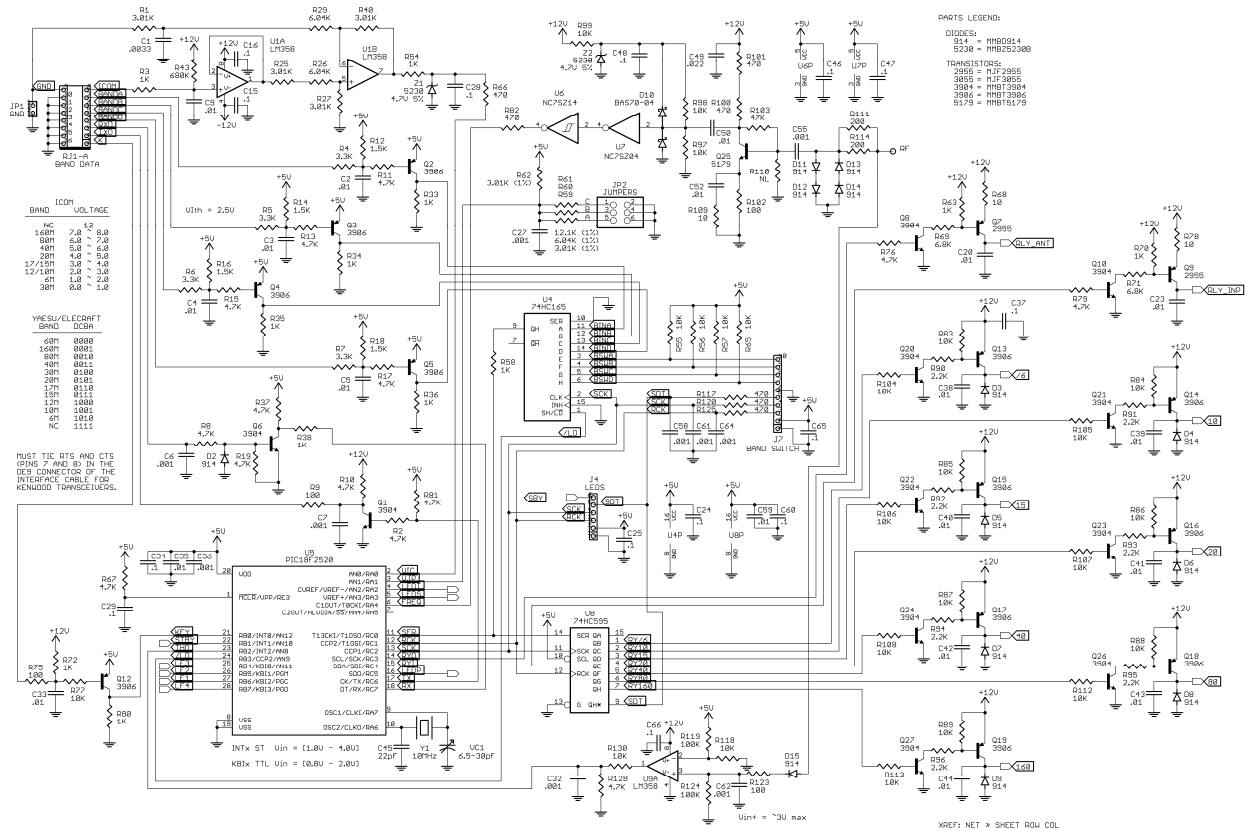
BSW3 bandswitch figure 4

# Interface Connections RJ45



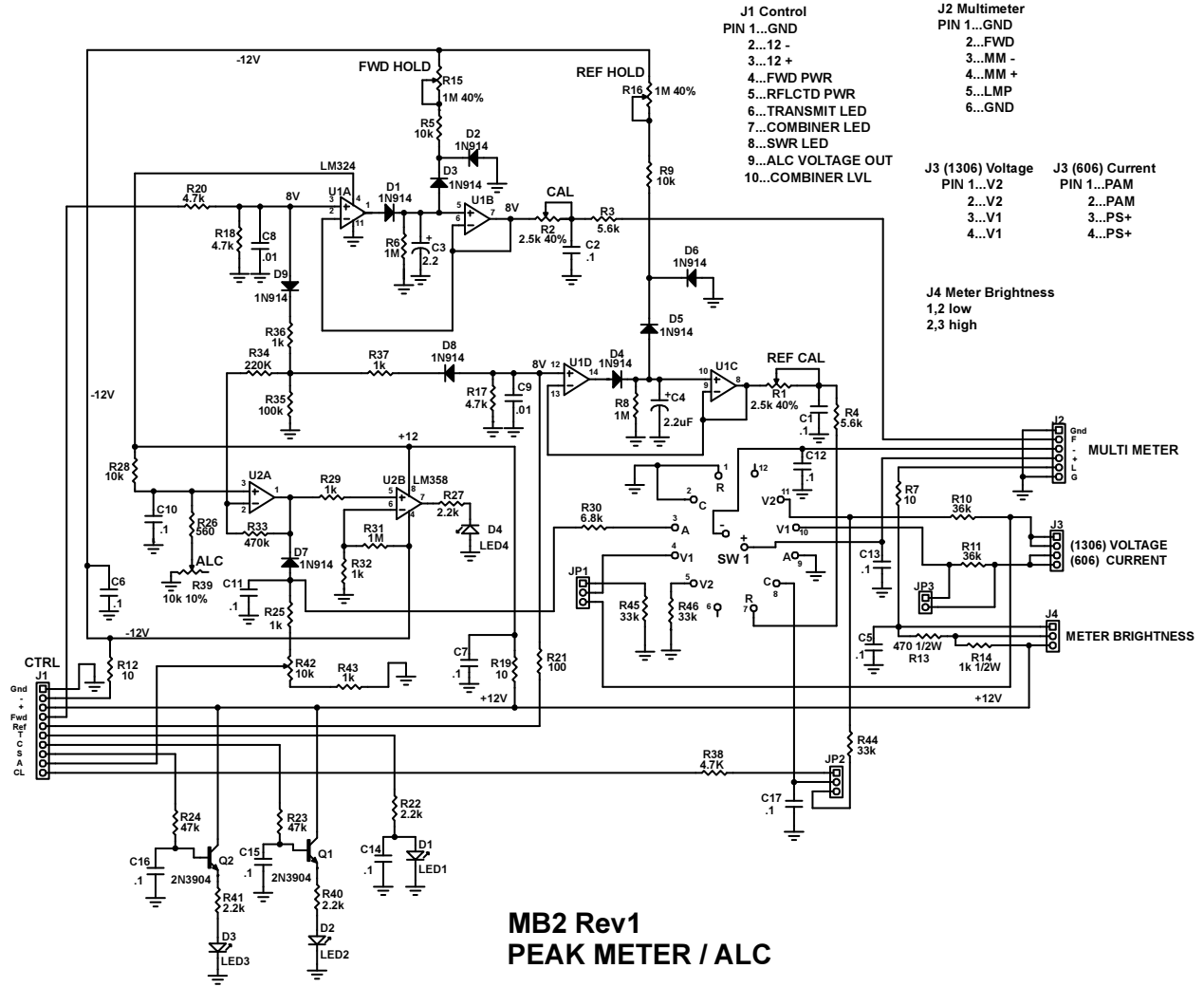
RJ45 Interface Board Figure 5

# Control Board CB2





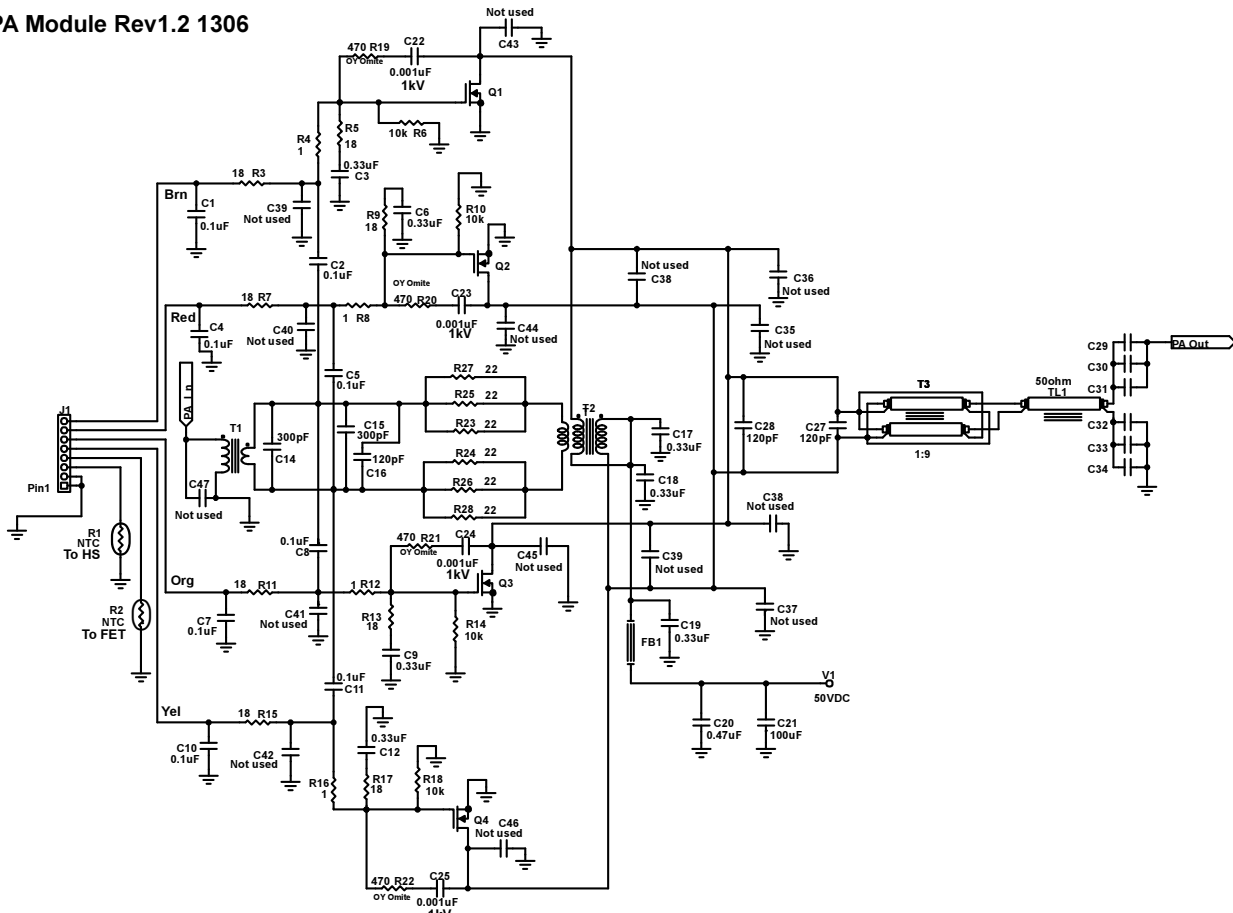
# Metering Board MB2



MB2 ALC/Metering board Figure 9

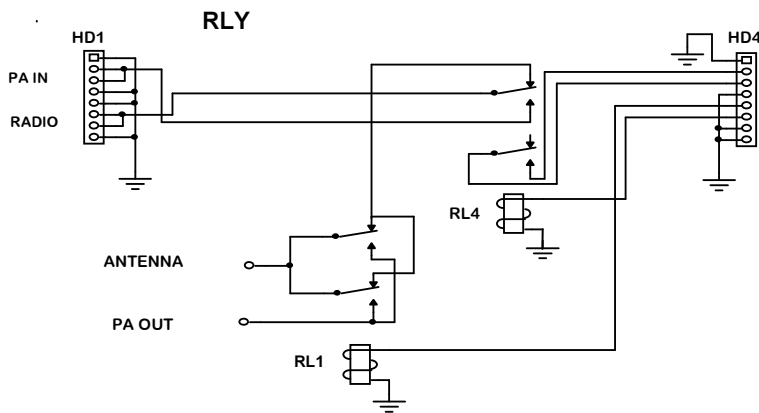
# PA Module

PA Module Rev1.2 1306



PA Power Amplifier Module Figure 10

# RLY Relay Board



RLY antenna relay Figure 11

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## DISCLAIMER

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Customers using this manual should report errors or omissions, recommendations for improvements, or other comments to Ameritron 116 Willow Road, Starkville, MS 39759. Phone: (662) 323-8211; FAX: (662) 323-6551. Business hours: M-F 8-4:30 CST.

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To obtain such warranty service, the original purchaser must:

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- (2) Notify Ameritron or its nearest authorized service facility, as soon as possible after discovery of a possible defect, of:
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  - (b) The identity of the seller and the approximate date of purchase;
  - (c) A detailed description of the problem, including details on the equipment.
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