MLA 400

HF Broadband 1.8—30 MHz Linear Amplifier

The MLA400 is a 13.6VDC HF broadband linear amplifier suitable for use in the range from 1.8 to 30 MHz with a maximum output of 400W, (Av. power), requiring a maximum input drive of 35W, it has been designed to be used with transceivers with 100W outputs but can be used equally well with any transceiver capable of producing 1 to 35W output. It uses 4 RF power transistors in two parallel push pull circuits biased in class AB. There are 6 Low Pass Filters with cut-off frequencies of 3,4,5,8,15,22 and 31MHz that greatly reduce unwanted harmonic output to acceptable levels that may be selected manually or automatically. It features a microprocessor that controls all of the functions of the amplifier and its protection circuits. Protection is provided for excessive input power, excessive output power, excessive load VSWR, out of band operation and excessive temperature. The amplifier may be used either in a mobile / portable or fixed station installation.

Specifications:

Operation Frequency:	1.8—30 MHz (160m to 10m bands)
Modulation Types:	SSB,CW,AM, FM, DATA (All narrowband modes)
Transistor:	4x RM1607 / 2SC2879 / MRF421
Power Supply:	13.6VDC+/- 1V 70A
Input Fuse (Internal):	4x15A (Auto)
Input RF Power:	1-35Wmax (All modes)
Output RF Power:	400Wmax
Maximum bypass power (Amplifier off):	50W
Input VSWR:	1.1—1.5:1
Output VSWR Maximum:	2.5:1

WARNING: Before using this product please read carefully all of the information in this manual or at least the quick start guide!!! To avoid damage or incorrect operation this is extremely important!!!

Quick Start Guide:

A more complete guide to the installation is featured later

1. **Connect the input RTX connector to transceiver with 50 Ohm patch cable**

2. **Connect the ANT Output of the Amplifier to SWR Bridge / ATU (If required), and then the Antenna**

3. **Connect the Amplifier DC power Cables to a suitable 13.6VDC (± 1V) Power Supply or Auto Battery**

4. **Connect PTT cable if required to the transceivers PTT OUTPUT, (The Amplifier may be used without this connected. PTT is Active Low)**

5. **Set front panel filter if desired or let amplifier select the band**

6. **Make sure that the Amplifier is switched off**

7. **Adjust the Transceivers output RF power to 10W (35W max) if it is capable of more than 35W output**

8. **If the antenna requires tuning this must be done before the Amplifier is switched on!!**

9. **Switch on the Amplifier and start operating**

10. **Check that the antenna VSWR is acceptable with the amplifier in use. Any large increase in VSWR indicates that the Antenna or ATU is not suitable for the power being used. Operation should be halted immediately to avoid damage to the Amplifier / Radio / ATU etc.**

****** The amplifier must not be used whilst the antenna is being tuned by either a manual or Automatic ATU *******

******* Automatic ATU's must be placed in standby after the antenna has been tuned such that they cannot start another tuning cycle whilst the amplifier is in use*******

Front and Rear Panel Description

1. ON / OFF button. Press and hold to switch ON / OFF.
2. Manual filter selector, left or right press to change current filter.
3. Displays currently selected band filter.
4. Output power display.
5. Antenna VSWR display.
6. TX LED, Illuminates red when amp is in transmission.
7. SSB delay switch (Use when no PTT is connected in SSB mode).
8. Protection alarm LED.
9. RTX input SO239 connector connected to transceiver.
10. PTT input (Phono / RCA) (Active Low).
11. DC input connector.
12. Antenna output SO239 connector, connected to ATU/ Antenna.

Installation:

Unpack the amplifier from it's shipping carton and inspect for any signs of damage. The amplifier should be installed (either fixed or mobile installation), in a place that allows good ventilation and provides a suitable base to support it. Failure to allow for reasonable ventilation will cause the amplifier to overheat and shutdown prematurely. A short 50 Ohm patch lead should be used to connect the amplifiers RTX input connector to the output, (Antenna Socket) of the Transceiver. The length of this cable is not critical but should be of good quality and be kept as short as practically possible. The ANT output of the amplifier should then be connected to the antenna being used. (Usually there will be a VSWR / Power meter immediately after the output on the amplifier followed by an antenna tuner if a non resonant antenna is being used. This order of connection is very important. (if the drive radio has a built in antenna tuner this should be set to OFF / Bypass or Through mode as it can no longer be used to tune the antenna as it is only looking at the input circuit of the amplifier. If a non resonant antenna is being used then an external ATU is required connected on the output of the amplifier before the antenna. Check also that both the ATU and Antenna are suitably rated for the power output levels. (Antenna VSWR should not change much from low to high power) (ATU's usually have a power rating and most often this is the power handling under tuned conditions **NOT** to be confused with the power handling whilst being tuned. All antenna tuning should be completed at low power with the amplifier switched OFF! Not only does this allow for the drive radio, amplifier, ATU to not be damaged but it also causes less interference, 'QRM', on the bands).

The amplifier has a PTT input located on the rear panel. This may or may not be connected. If left unconnected the amplifier will still function as it contains a RF sense (similar to VOX), circuit that will automatically switch the amplifier to TX when it detects RF on the input. The PTT input is configured as active low which means that shorting it's terminal to ground will trigger the amplifier to enter transmit. This is the way nearly all modern transceiver PTT outputs are configured either open collector / drain or relay and may be connected directly to the PTT input on the amplifier with a suitable cable. The PTT input socket requires a Phono or RCA type plug and should be made with a screened cable.

If the PTT is connected to the radio it must be connected to the PTT output on the radio. On modern transceivers this is usually embedded in one of the multiway connectors on the rear panel. See the radios operating manual for further details. SSB delay on the front panel should be set to OFF as the PTT output from the radio will control this.

The amplifier must be connected to a suitable power supply of the correct voltage output and sufficient current rating. The output should be 13.6 or 13.8V DC but the amplifier may be connected to a supply from 12V to 16V DC without damage. The current rating of the power supply must be at least 70A continuous. Be aware that the current rating must be greater still if the drive radio is also connected to the same power supply.

The voltage output and current rating are very important for low voltage (12V) RF transistors as voltage sag, (poor load regulation) or insufficient current capability can drastically reduce the output power or cause distortion.

The cross sectional area of the cables used to connect the amplifier to the PSU should not be less than 6mm² or 10 AWG. They should also be kept as short as practicably possible to avoid voltage drop due to ohmic losses. This is less of a problem in a fixed installation where the power supply may be placed close to the amplifier.

For a mobile installation the leads should not exceed a length of 3m and they should be connected directly to the Auto battery. An additional fuse may also be connected inline to provide protection in case of cable short circuit to chassis ground from the amplifier to the battery.

The installation location must also provide a suitable ground system both for RF and the AC line supply. This is very important safety requirement for any radio transmission equipment but as power increases becomes increasingly important. A good RF ground will also help to prevent any returned RF from causing problems with the equipment. Usually erratic operation of equipment when in transmission may be attributed to RF being present or poor RF grounding. Installations where a good RF ground is not possible like operation above the ground floor may require alternative solutions such as artificial earths or the connection of 1/4 wave counterpoises to the operating equipment. for the bands being used . Correct RF earthing techniques are however beyond the scope of this manual.

Operation:

Before using the amplifier the user must be familiar with all of the controls and be sure that it has been connected correctly.

Important!!

Before the amplifier is switched on the power output of the drive radio should be adjusted correctly if it is capable of outputting a power greater than 35W. This may be done with the amplifier connected but switched off. 35W is the maximum permissible input power to the amplifier, but the input power should always be adjusted so that the amplifier is not being over-driven. This will change slightly from band to band.

The amplifier features protection against excessive input power and will sound an error tone, 1 single beep, repeated continuously when the input power exceeds approximately 35W. The input power should be reduced to an acceptable level and then to restore operation the amplifier must be reset by cycling the DC input power with the ON / Off switch. The amplifier is also protected for excessive output power. When the amplifier exceeds 400W output in a constant carrier mode the amplifier will signal an alarm, with a sequence of 6 beeps repeated, until the amplifier is reset. The input power should be reduced until the output power reduces below 400W. In SSB where short speech peaks may exceed 400W this does not trigger this error unless the period exceeds about 0.5s.

The protection circuit for excessive input power should not be regarded as a 100% protection for all levels of input power. Up to about 50W the circuit will work very effectively and will save the amplifier from damage, above 50W for example accidental 100W or more applied to the input the protection circuit can not be expected to provide complete protection. In most cases the protection will act sufficiently quickly to protect the transistors from damage but this condition is not guaranteed!!! For this reason when using the amplifier with a 100W capable radio, caution should be used as not to accidentally switch on the amplifier before the power has been reduced to below 35W.

Switch on the power supply to the amplifier followed by the amplifier, a long press of the ON/OFF switch on the front panel. After switch on there is a short delay whilst the amplifier carries out a quick self test procedure. During this time the LED's on the display will illuminate briefly. When the test is finished the low pass filter selected will be set to 10/12m bands. SSB delay set to OFF. The correct low pass filter can be now selected manually, or, on the first transmission the amplifier will automatically select the correct filter.

Filter selection maybe be made manually but for most operation, if changing bands frequently, the filter selection can be left to the amplifier to select the correct filter. as when there is RF present the frequency is calculated and the correct filter latched in circuit. The filter will remain selected until either another frequency (band) is used outside of the filters range or the amplifier is switched off. The default filter after switch on is the 10-12m filter.

If the wrong filter is manually set before transmitting the amplifier will automatically set the correct filter if the frequency measured is outside of the currently selected band. No error or alarm will occur.

Export / FCC versions: Out of band TX

The MLA400 is available in two versions,

Export, that has all band transmit from 1.6 to 30MHz, with suitable Low Pass Filters for the 9 main Ham bands.

FCC version that has the same series of Low Pass Filters however is band blocked from 25 to 27.995 MHz. Transmitting in this band will signal an alarm and the amplifier will sound a sequence of 3 beeps repeatedly until reset.

Both amplifiers will signal an alarm if the transmission frequency is below 1.6MHz and above 30MHz with 3 beeps repeated until reset.

Warning: ATU / Non resonant Antennas

Non resonant Antennas and ATU's (Antenna Tuning Unit). Before transmission you must make sure that there is a suitable load connected to the antenna output of the amplifier. Transistor amplifiers should not be operated into mismatched loads, (high VSWR) An acceptable level

should be less than 1.5:1. Less than 2.0:1 is acceptable but some reduction in power may be seen and the amplifier will work less efficiently and generate more heat. At about 2.5:1 the amplifier will signal an alarm and enter protection it will sound a sequence of 2 beeps continuously until the amplifier is rest. The amplifier should not be used again until the VSWR has been reduced.

The antenna should be tuned so that the load is as close to 1.1:1 as possible, see above. This should also be carried out with the amplifier switched off and the drive radio at low power, 10W should be sufficient for most tuners to carry out the matching process. If an Automatic ATU is used it should, once it has found a suitable match, be disabled such that it may not carry out another tuning cycle until instructed to do so.

Depending on the type of antenna and ATU being used it may be possible to generate very high and low impedance loads that can look to the amplifier almost like open or short circuits, operating the amplifier at full output whilst trying to tune a non resonant antenna with a tuner either manual or Automatic can be catastrophic for the transistors due to the load mismatch. The protection circuit will in most instances cut in at a VSWR of 2.5:1 but if the amplifier is being used at full power whilst tuning the antenna it is possible that the transistors may sustain damage due to the load mismatch. You have been warned!!

Now that the input power has been adjusted correctly, the antenna tuned, (If required), operation can continue. Input power can be adjusted to give the required output power or the amplifier may be run at it's full output.

If using a resonant antenna and having the amplifier set to AUTO (Filter selection), band changes can be as fast as the time it takes to change the band on the drive radio. However changing band on a non resonant antenna always requires the amplifier to be switched off whilst the antenna is re-tuned to an acceptable VSWR.

MODE:

The MLA400 may be used for all of the common narrow band transmission modes such as SSB, CW,AM,FM, SSTV and data modes etc.

Warning: Transmit Time.

High Duty cycle modes such as FM and Data modes etc. operate the amplifier at full power all of the time unlike modes like SSB and CW that are either intermittent or only reach peak output for very short times, these high duty cycle modes will run the amplifier much harder and generate more heat in the same amount of time. It should be noted that the amplifier although capable of being used with these modes should not be operated continuously. A transmission time of more than a minute or two should be avoided to avoid excessive transistor junction temperature. The exact time for transmission in these modes will depend on numerous factors such as is the amplifier fitted with the cooling fans, How good the ventilation is around the amplifier and is there sufficient space for freely flowing air to circulate, etc. If the ambient temperature is high this will reduce the total time in transmission. Common sense should be exercised if the heat sink is becoming too hot to touch then sufficient time should be allowed to let it cool down before reuse. The amplifier is protected against high temperature that will block the operation of the amplifier if too high a temperature is reached and automatically returning back operation when the temperature has reduced. It will trigger an alarm and sound a sequence of 5 beeps repeatedly until the temperature drops to a reasonable level. If the amplifier is reset manually but the temperature remains above the limit it will signal an error for over temperature until the temperature drops to an acceptable level.

Protection:

When the alarm LED illuminates a number of beeps are emitted in a repeated sequence until the amplifier is reset by the user. This is carried out by switching the amplifier off and then back on. In the case of excessive temperature the alarm will reset by itself when the temperature drops.

Number of Beeps:

1:Excessive Input Power
2:Excessive Antenna VSWR
3:Out of Band Transmission <1.600MHz, >30.000MHz Including FCC Band Block no TX 25-27.995MHz
5:Excessive Temperature
6:Excessive Output Power

All error events are recorded by internal memory that can be reviewed should the amplifier need to be serviced.

Input drive and power output:

The amplifier is rated at maximum 400W and requires between 25 and 35W input to achieve this, depending on the band being used. On the lower bands 160/80/40m the gain is higher and requires less input power to achieve maximum output power. On the higher bands 15/17/12 and 10m more input is required. The amplifier is protected for both excessive input power and excessive output power.

Maximum output power considerations:

All amplifiers have a maximum output and this occurs shortly after gain compression where by Pin no longer produces a proportional increase in power output . The amplifier should always be operated at a point below its saturated output. Trying to extract every last watt by overdriving the amplifier will not actually help your signal to be stronger, you will in fact cause higher levels of distortion which will make your signal less intelligible at the distant receiver station.
Running the amplifier a little under max output will also allow the amplifier to run cooler and make it more reliable for many years of use.

As an example consider the following situation.
1 ‘S’ point on a receiver is usually approximately calibrated at 6dB so for example the difference between S5 and S7 2 ‘S’ points is 12dB.

The difference between 35W and 400W is about 10.6dB, a healthy increase to your signal strength, almost 2 ‘S’ points, difficult to achieve by with an antenna alone for most ham operators especially if space is limited. Now lets say for example you run the amplifier at a moderate 350W output by slightly reducing the input power, the difference between 400W and 350W is only 0.5dB which when you compare this to 6 dB per S point is actually very little and as the amplifier is running not at its absolute maximum will give a cleaner output with less distortion that will actually make a difference at the distant receiver for the better!!

FCC ID: …….

Warranty:

This product is covered by a 24 month warranty commencing from the date of purchase. The original purchase receipt will be required for any claim. This warranty does not cover aesthetic damage or damage to the RF power transistors from incorrect use.

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