70cmcm LDMOS Driver board
Assembly notes

This kit contains the components required to build a G4BAO 70cms driver amplifier

This document is correct for the new device AFT05MS004N on the issue 1.0 PCB. Note that Fig 1 shows the Issue 1.1 PCB but the layout applies to issue 1.0 with the new device

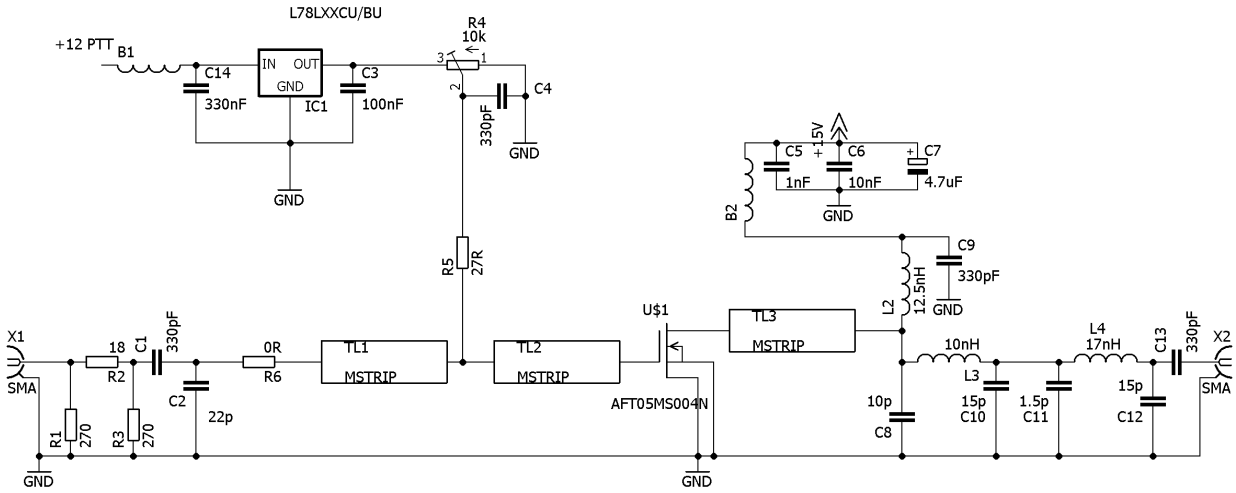


Figure 1 Circuit diagram

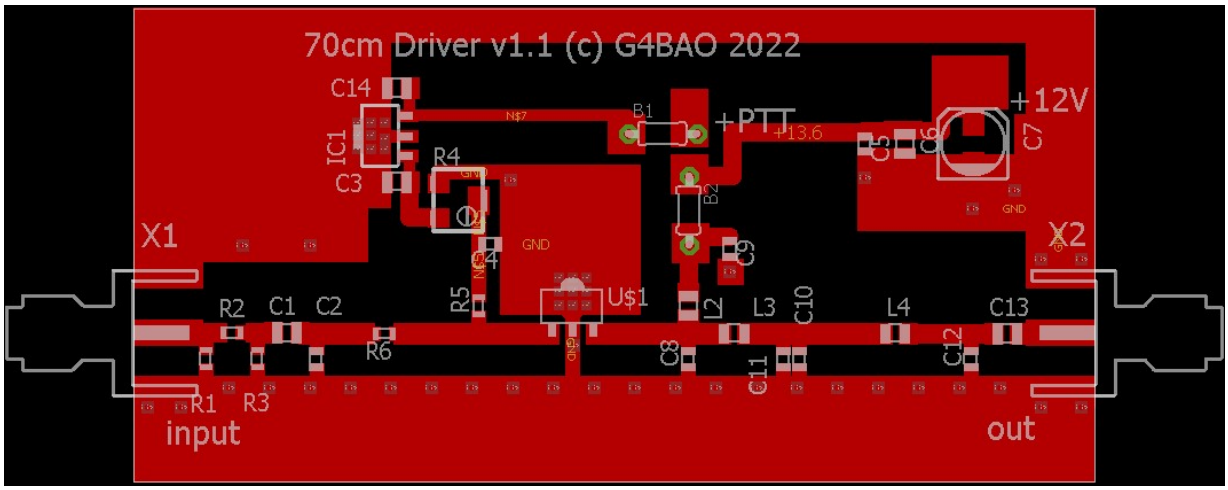


Figure 2 PCB layout

Antistatic precautions

Note that the LDMOS power FET device is susceptible to static damage until the board has been assembled. Do not remove from the packaging without wearing an antistatic wrist strap or at minimum before having first touched something grounded.

Component list

Component	Value	Type	Colour code
R1,R3	270R	SMD 0603	Green/Black card (R bag)
R2	18R	SMD 0603	Pink/Yellow card
R4	10k	SMD preset	Trimmer in clear plastic
R5	27R	SMD 0603	Yellow / Blue card
R6	0R	SMD 0603	White card
C1, C13, C4, C9	330pF	ceramic 0603	Yellow card (C bag)
C2	22pF	ceramic 00603	Pink card
C3	100nF	ceramic 0805	Black/yellow card
C5	1nF	ceramic 0603	Orange card
C6	10nF	ceramic 0805	Black plastic
C7	4.7 uF 35V	SMD electrolytic	Round metal can
C8	10pF	ceramic 0603	Black/Green card
C10, C12	15pF	ceramic 0603	Green card
C11	1p5	ceramic 0603	Purple card
C14	330nF	ceramic 0805	Clear plastic
L2	12nH	Coilcraft 0805HQ-12NX_E	No colour plastic
L3	10nH	Coilcraft air core 0807SQ-10NG	Purple plastic
L4	17nH	Coilcraft air core 0807SQ-17NG	Green plastic
B1, B2	Dual ferrite bead	Panasonic EXCELDRC35 or 25	Obvious!
IC1	5V regulator	L7805CU/BU SOT-89 package	Black plastic Marked “8J HK”
U$1	LDMOS FET	AFT05MS004N SOT-89 package	Black Plastic Marked “ATF504”

Check that all the components and the PCB are present in the kit, and email john@g4bao.com immediately if there is anything missing.

Tools

Use a small (1mm bit or smaller) temperature controlled, earthed soldering iron, and thin (28swg) solder.
A pair of small sharp side cutters
Small SMD tweezers

Assembly

This kit contains very small 0603 components that all look the same or similar. The packaging is colour coded as above. BE VERY CAREFUL not to "ping" them across your bench when removing them from the packaging, as I will not support the kits if replacement components are fitted that are not supplied by me. Never remove a component from the packaging until you are about to fit it so as not to mix them up. Take great care when selecting the semiconductor device as the voltage regulator and the LDMOS FET are in the same package with different markings. Refer to the component list above to get the right part.
To fit the board in a recommended standard Schuberth box (not supplied) small notches need to be taken out of two corners with a small file to allow the overlap of the tinplate. Do this before assembly.

1. Fit the four resistors R1-3 and R6. ***Do not fit R5 yet***

2. Fit the ten 0603 ceramic capacitors C1,C2,C4,C5, C8-13
3. Fit the three 0805 ceramic capacitors C3,C6,C14
4. Fit C7. Observe polarity. The black end is ground This fits OVER the pads provided so solder it in with care.
5. Fit the inductors L2 -L4.
6. Fit the Preset R2
7. Fit the voltage regulator IC1
8. Fit the ferrite beds B1 and B2 soldered under the board. Take care as the gap from the pad to the ground plane is VERY small

DO NOT FIT THE LDMOS DEVICE U$1 YET

Initial check

RE-CHECK THAT YOU HAVE NOT FITTED THE DEVICE or R5 YET.
If you have, remove R5 and place it to one side until after the initial voltage checks, when you can replace it!

Make sure that the cut leads of the beads do not short to ground.

Check for shorts to ground on the +13.6V rail

Rotate R4 fully ANTICLOCKWISE and using a thin wire, apply a regulated +13.6 volts to the +PTT connection, and ground to the ground plane.
Measure the voltage at the junction of R4 and C3. It should be 5 volts +/- 0.2
Measure the voltage at the junction of R5 (not fitted yet) and C4. It should be 0V
Rotate R4 fully clockwise. The voltage should rise to 5.0V+/- 0.2. Rotate R4 fully anticlockwise and the voltage should return to 0V.

Leave the preset at this setting and remove the 13.6-volt supply.

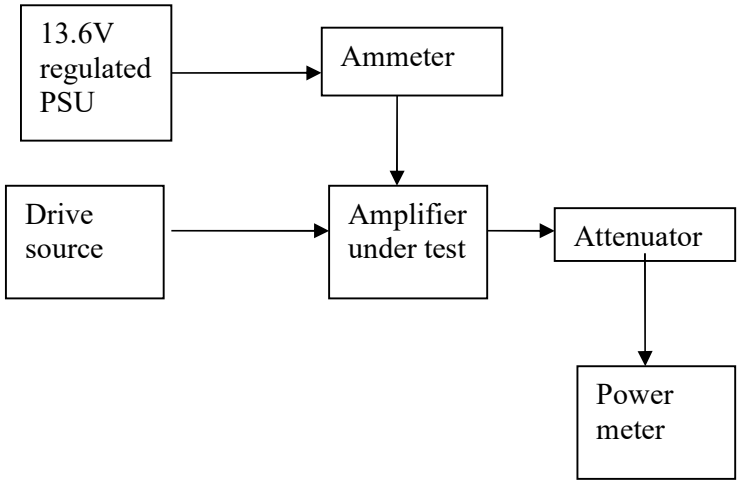
Fitting the LDMOS device U$1

Note carefully the position of the device in Fig 2 and place it carefully and solder the centre pin.
Check again that the device is square on the board and the Tab covers all the small plated through holes.
Solder the other two leads.
Solder the tab making sure that the solder flows under and round it and turn the board over and make sure that solder has gone down the tiny plated through holes but not excessively as this area needs to be flat to fit the stick-on heatsink. If solder has gone through use solder wick to remove it.
Fit the stick on heatsink, Fit R5

Recommended Test equipment

Equipment	Example
Digital Multimeter	Any DMM that can measure up to 15 Volts and 1 Ampere
10mW Drive source with adjustable power	Signal Generator or Low power transverter

13.6V regulated power supply	Any
432MHz Power meter	HP 435A, HP436 plus 30 dB attenuator. Bird Thruline or Diamond SX1000 5Watt dummy load.



Alignment

No RF alignment is required, you just need to set the DC bias on the device to give a drain current of 100mA without drive
Connect the input from your 432MHz 50mW source transmitter to the amplifier input. Connect the amplifier output to a power meter/ dummy load capable of dissipating at least 5 Watts. If you are using “flying coax leads” to connect rather than a box and connectors, there should be NO braid tail, not even 1mm. Use thin PTFE coax so that the inner does not melt and solder the braid directly to the convenient ground point close to the input and output pads.

DO NOT CONNECT ANY DRIVE POWER YET
Be careful with R2, it’s possible to increase the bias enough to destroy the device
Turning the pot clockwise INCREASES the Bias current/voltage.
Connect the 13.6-volt supply via an ammeter to both the 13.6V supply and the PTT connection, on a low range such as 100mA. Starting with R2 set fully clockwise with minimum volts on the gate, VERY carefully increase the gate voltage until the device begins to take drain current. This onset is very sharp, so be very careful, as the drain current can easily swing up to many Amperes if you are heavy handed on the pot. Set the drain current to 120mA +/-1mA. This may rise by some 10-20mA as the device warms up, this is normal. Switch off the supplies and then switch the ammeter to the 1 Amp range. Switch back on.
Check all your connections, take a deep breath and apply the 10mW drive. You should see around 3 Watts out with around 400mA of drain current. Increasing the drive any further will just cause the device to saturate with no further output increase.

Fault finding

There are only few components on the board, so there is little to go wrong, and fault finding is relatively easy. If you fail to achieve something close to the values in the previous paragraph, carefully inspect all your solder joints, and check that you have

not cracked or damaged any of the surface mount components or the FET. If you can get access to a microscope to do this, all the better! Recheck the bias current with no drive (standing current) It should not have changed by more than about 10-20mA. Measure the gate voltage without drive and it should be around 3.6 volts.