Bias Supply/ Control Board for Harris Amplifiers

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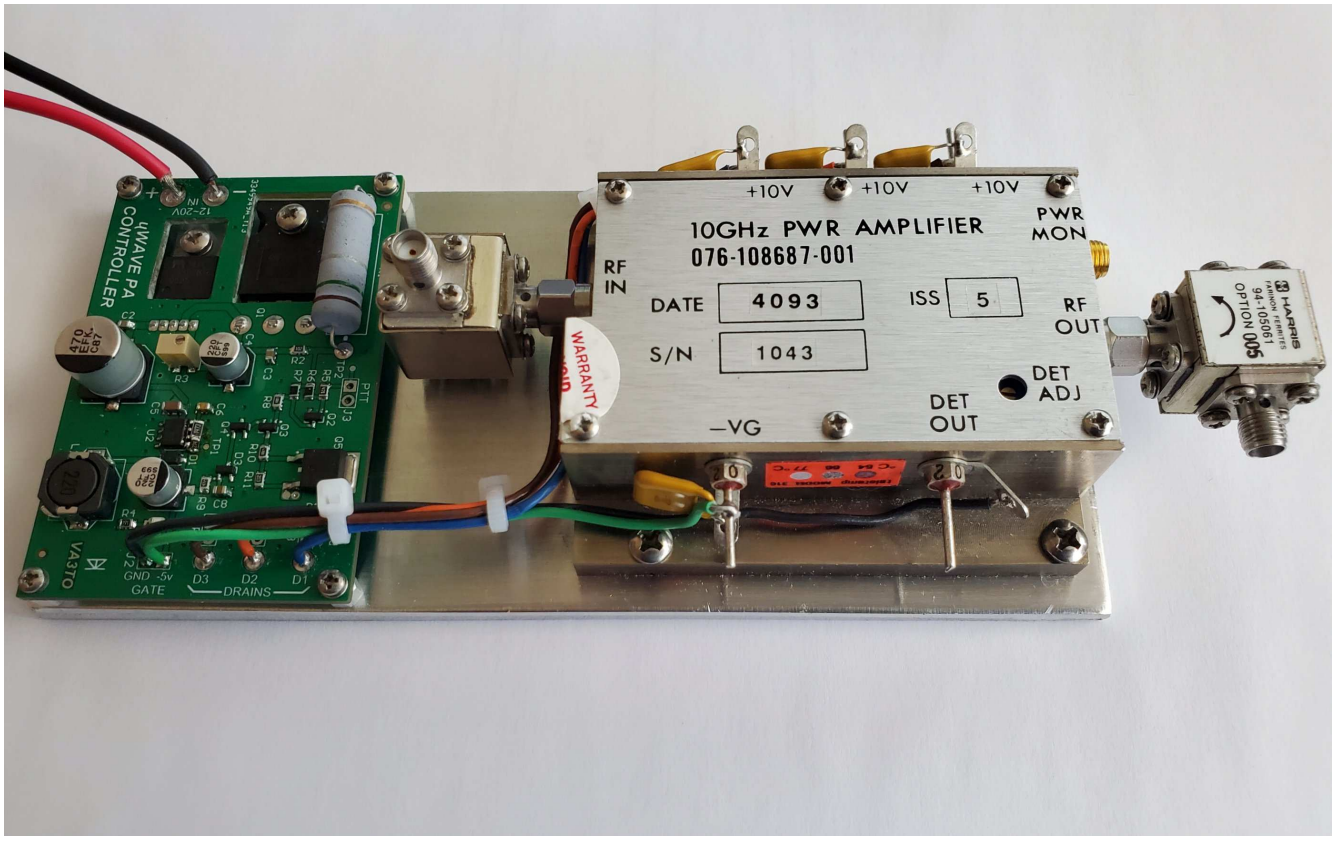
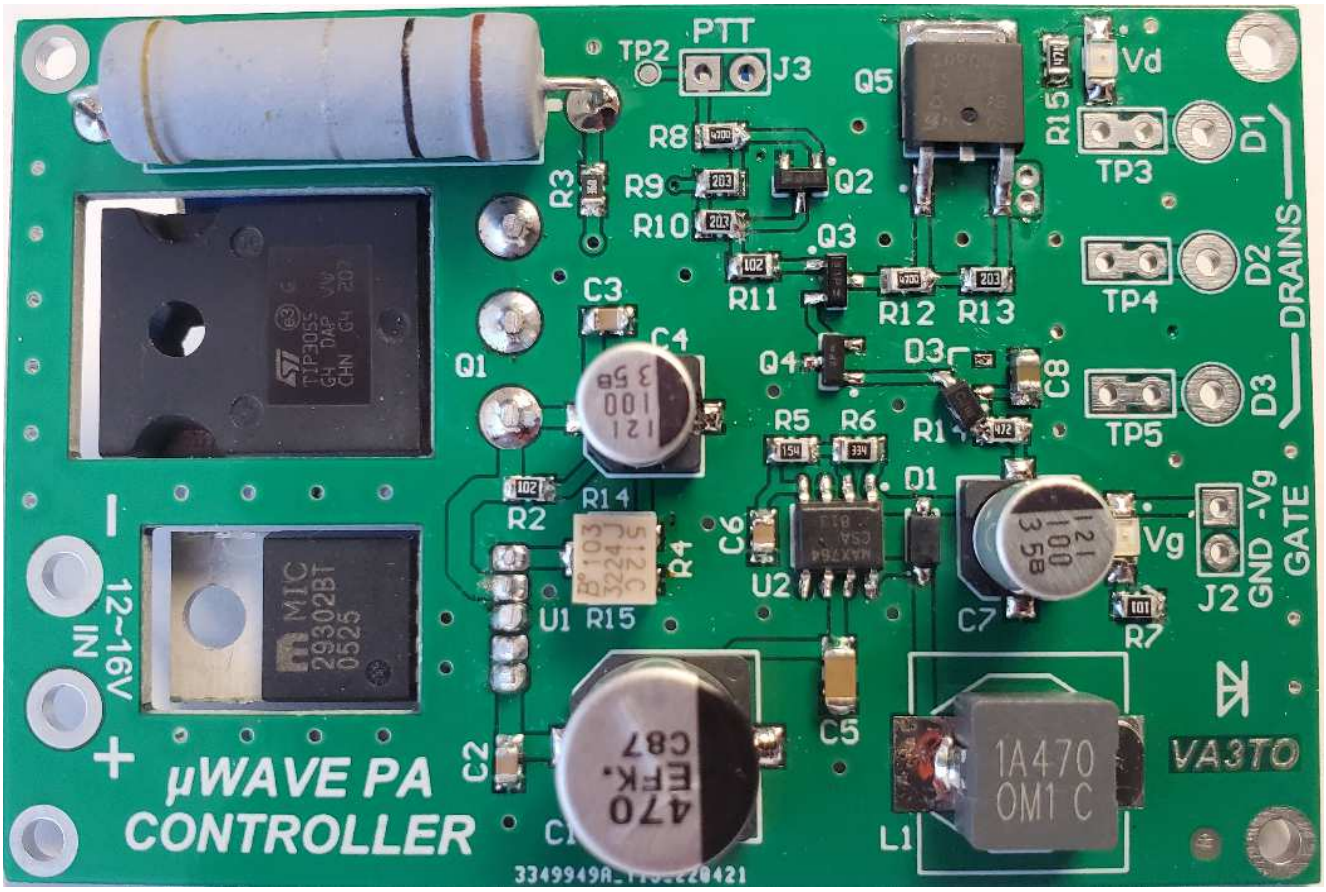
This board was designed to provide the necessary sequenced Drain and Gate voltages for surplus Harris model 076-108687-001 X-band amplifiers.

It can be used with other PAs that require 10V or less on the Drain and between -1 to -5V on the gate, for up to 3 devices.

It could also be used with PAs that require higher Drain current/voltage by isolating the switching FET Source and supplying it with the required power, along with appropriate resistor value changes. The P-channel FET is good to 100V.





- Board dimensions: 3" x 2", mostly SMD components.

- Onboard regulator brings the input voltage (+12 ~ +15V) down to +10V @ up to 5A for the Drain. This can be adjusted to lower voltages for other devices.

- Uses a MAX764 I.C. to generate the negative Gate voltage at current up to 250mA. Voltage can be set between -1 to -5V by changing two resistors. Current build configured for -3.3V.

- Switched Drain supply is split for up to 3 devices with test points that can be broken out to facilitate individual Id measurements.

- Drain interlock circuit sequences the drain voltage only after the -Vg supply & PTT (active Low) are present.

- Mounts to a suitable heatsink using 4x 2-56 screws + 2x 4-40 screws for the reg. & pass transistor.

* **Note** - Pass transistor Q1 tab must be isolated from ground. Use a silpad or mica insulator between the collector and heatsink, and a nylon shoulder insulator for the screw (where necessary). Verify that the collector is not shorted to ground using an ohmeter.

ADJUSTMENTS

Perform the following adjustments and tests before wiring the board to the amplifer:

- Apply 12 ~ 15V to the DC input on the board.
- Measure the Gate supply output at J2. The voltage should be around -3.3V.
- Adjust R4 for +10V at the Source of switching FET Q5. Ground the PTT line and re-adjust R4 for +10V at the Drain (TP3, 4 or 5). Remove power to the board.

- Wire the board to the amplifier.
- Remove the top cover of the amplifier.
- Connect a suitable load to the RF output of the amplifier.
- Apply 12 to 15V to the DC input of the board.
- Ground the PTT line on the board and measure the Drain voltage. Re-adjust R4 for +10V.
- With PTT grounded and no RF on the input, adjust the 3 internal pots for a quiescent current of 1A on each of the first two driver devices and 1.2A on the final device. The links between the pads of TP3,4 & 5 can be cut to faciliate Drain current measurement. After measurement and adjustment restore the connections by soldering a link of buss wire between the pads where the links were cut.
- Replace the top cover.
- The amplifier is now ready for use.

Notes:

The negative Gate supply is set up for -3.3V as built. The Harris amplifiers have internal pots to further adjust the device gate voltages necessary to generate the required Id for each device.
For reference, after adjusting for the required current (D1 = 1A, D2 = 1A, D3 = 1.2A). I measured the following voltages directly on the gates of the amplifier after the adjustment pots:

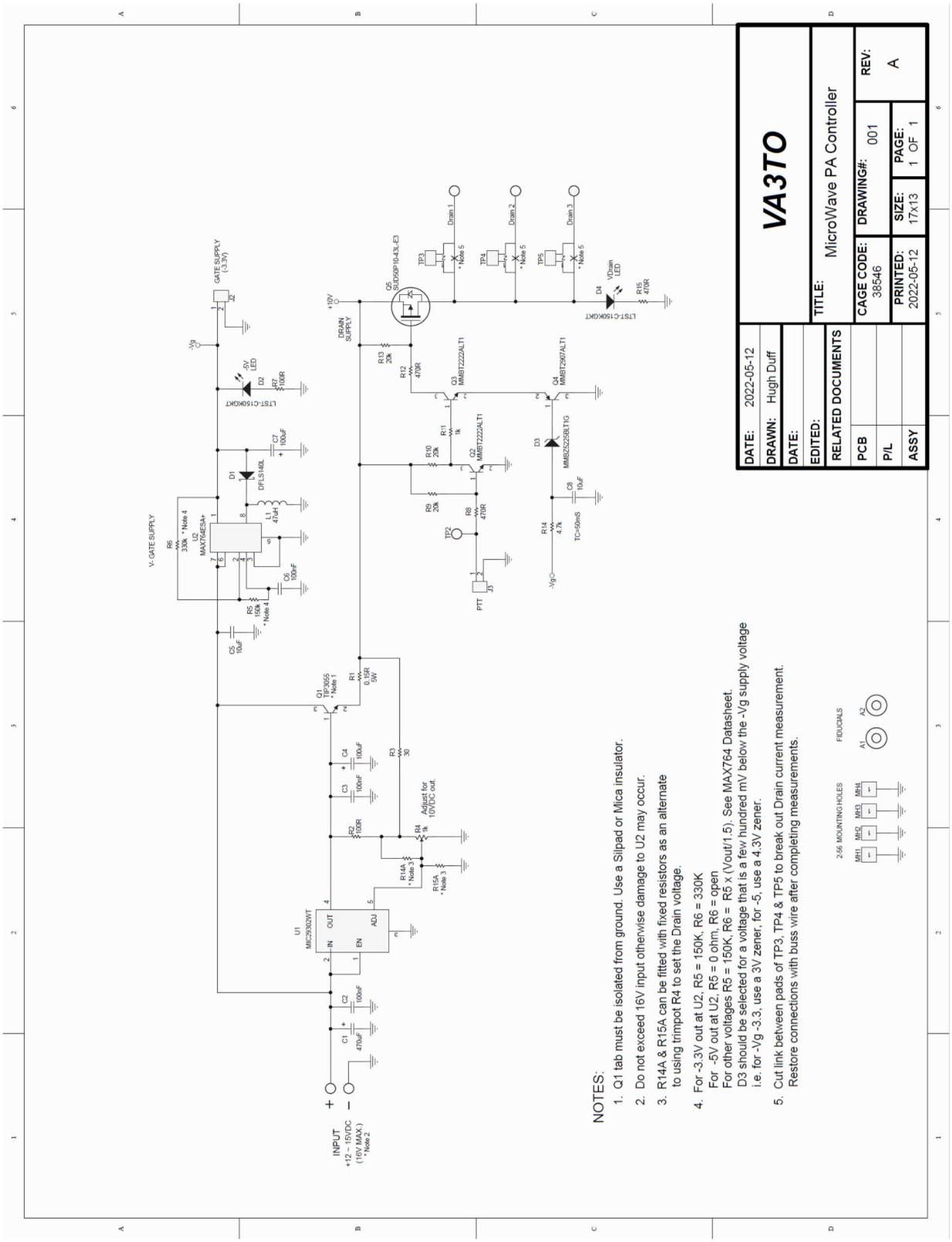
G1 = -1.729V
G2 = -1.665V
G3 = -1.428V

If a different negative voltage from U2 is desired for use with other amplifers then calculate the required resistor values at R5 & R6 as follows:
Assuming R5 is kept at 150K, R6 = R5 x (Vout/1.5) . See MAX764 Datasheet for more details.
Ideally you want to set the negative supply to a more negative voltage to achieve pinch-off for the device(s) used, then use indidual pots to adjust the specified Id for each device, like the Harris PA does.
Zener Diode D3 should be selected to the next lower voltage below the -Vg voltage. For example, if -Vg is set to -3.3V use a 3V Zener, if -Vg is set to -5V use a 4.3V zener. This sets the -Vg power-good trip point of the Drain interlock circuit.

PARTS LIST

Quantity	Designator	Description	Part Number
1	C1	Cap, Aluminum, 470uF, 25V, 20%,10x12mm	EEEFK1E471GP
3	C2, C3, C6	Cap, 100n, 50V, 5%, X7R, 0805	08055C104JAT2A
2	C4, C7	Cap, Aluminum, 100uF, 35V, 20%, 6.3x8mm, NIC	NACK101M35V6.3X8
1	C5	Cap, 10u, 25V, 10%, X7R, 1206	12063C106KAT2A
1	C8	Cap, 10u, 16V, 10%, X5R, 0805	0805YD106KAT2A
1	D1	Diode, Schottky, 150mA, 100V, 150mW, SOD-123	BAT46W-E3-08
2	D2, D4	LED Green Clear 1206 SMD	LTST-C281KRKT
1	D3	Diode, Zener, 3.0V, Single, SOT23, On Semi	MMBZ5225BLT1G
1	L1	Inductor, 47uH, 1.8A, SMD	HCM1A0805-470-R
1	Q1	Transistor, NPN, 60V, 15A, 90W, TO-247	TIP3055
2	Q2, Q3	Transistor, NPN, 40V, 600mA, 225mW, SOT-23-3	MMBT2222ALT1
1	Q4	Transistor, PNP, 60V, 600mA, SOT23, ON Semi	MMBT2907ALT1
1	Q5	MosFet, P-Chan, 100V, 9.2A, DPak, Vishay	SUD50P10-43L-E3
1	R1	Res 0.15 Ohm 10% 5W	MR5JT15L0 (or equiv.)
2	R2, R7	Res, 100R, 5%, 125mW, Thick Film, 0805	CRCW0805100RJNEA
3	R3, R11, R14A	Res, 1K, 1%, 125mW, Thick Film, 0805	CRCW08051K00FKEA
1	R4	Pot, 1K, 10%,SMT, Bourns	3224W-1-102E
1	R5	Res, 150K, 5%, 125mW, Thick Film, 0805	CRCW0805150KJNEA
1	R6	Res, 200K, 5%, 125mW, Thick Film, 0805	CRCW0805200KJNEA
3	R8, R12, R15	Res, 470R, 5%, 125mW, Thick Film, 0805	CRCW0805470RJNEA
3	R9, R10, R13	Res, 10K, 1%, 125mW, Thick Film, 0805	CRCW080510K0FKEA
1	R14	Res, 4.7K, 1%, 125mW, Thick Film, 0805	CRCW08054K70FKEA
1	R14A	R4 ALT – As Required	
1	R15A	R4 ALT – As Required	
1	U1	IC Reg Linear ADJ Low Dropout 3A TO220-5	MIC29302WT
1	U2	Inverting Switching Regulator, -5V, 250mA, 8 SOIC	MAX764CSA+

SCHEMATIC


VA3TO
MicroWave PA Controller
DATE: 2022-05-12
DRAWN: Hugh Duff
CAGE CODE: 38546
DRAWING#: 001
REV: A
PRINTED: 2022-05-12
SIZE: 17x13
PAGE: 1 OF 1
INPUT +12 ~ 15VDC (16V MAX.) *Note 2
V- GATE SUPPLY
DRAIN SUPPLY
GATE SUPPLY (-3.3V)
Adjust for 10VDC out
PTT
VDrain LED
NOTES:
1. Q1 tab must be isolated from ground. Use a Silpad or Mica insulator.
2. Do not exceed 16V input otherwise damage to U2 may occur.
3. R14A & R15A can be fitted with fixed resistors as an alternate to using trimpot R4 to set the Drain voltage.
4. For -3.3V out at U2, R5 = 150K, R6 = 330K
For -5V out at U2, R5 = 0 ohm, R6 = open
For other voltages R5 = 150K, R6 = R5 x (Vout/1.5). See MAX764 Datasheet.
D3 should be selected for a voltage that is a few hundred mV below the -Vg supply voltage i.e. for -Vg -3.3, use a 3V zener, for -5, use a 4.3V zener.
5. Cut link between pads of TP3, TP4 & TP5 to break out Drain current measurement. Restore connections with buss wire after completing measurements.
2-56 MOUNTING HOLES
FIDUCIALS