

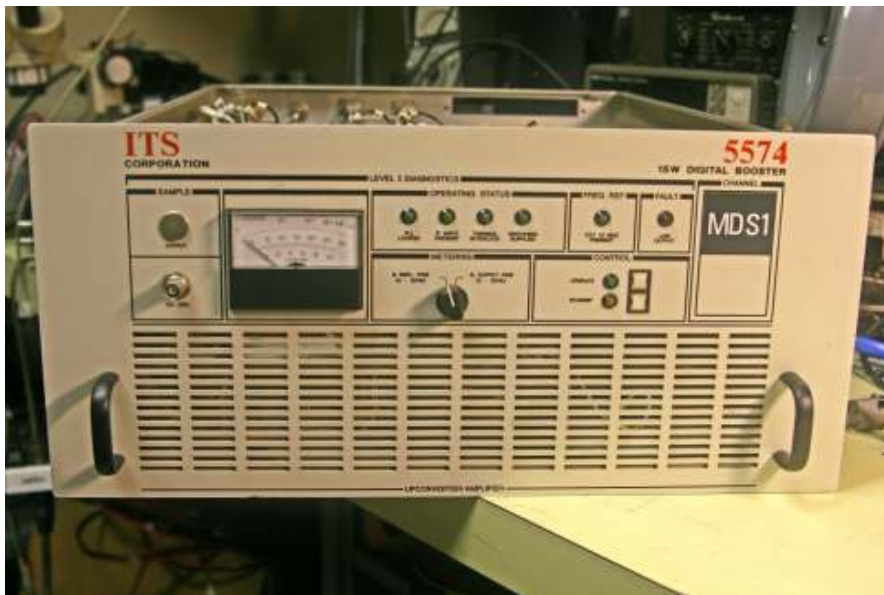
# Using MMDS Surplus Amplifiers For 2304

MMDS Amplifiers re-tuned to 2034  
And  
Control Circuit Ideas

Gary  
WA2OMY

# Two Types of Surplus MMDS Transmitters

ITS Transmitter



EMCEE Transmitter  
Exciter



# ITS TRANSMITTERS

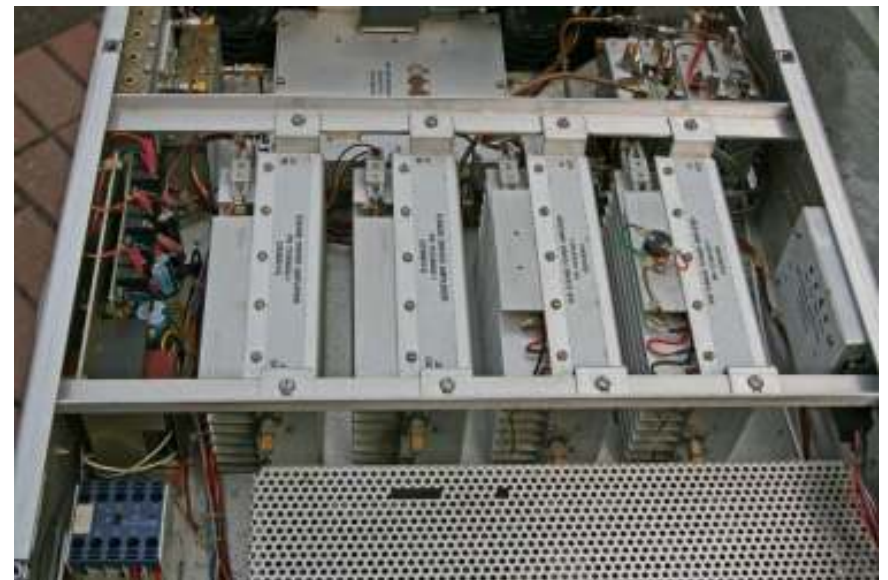
- ITS Transmitter driver - spare 12 W amplifier
- Used in Feedforward amp design, not needed for xmit amp after conversion.
- Requires:
  - 5V Bias @ 130 mA
  - 10V Drain Supply @ 5.2 A
  - (12V w/ 2 diode drop)



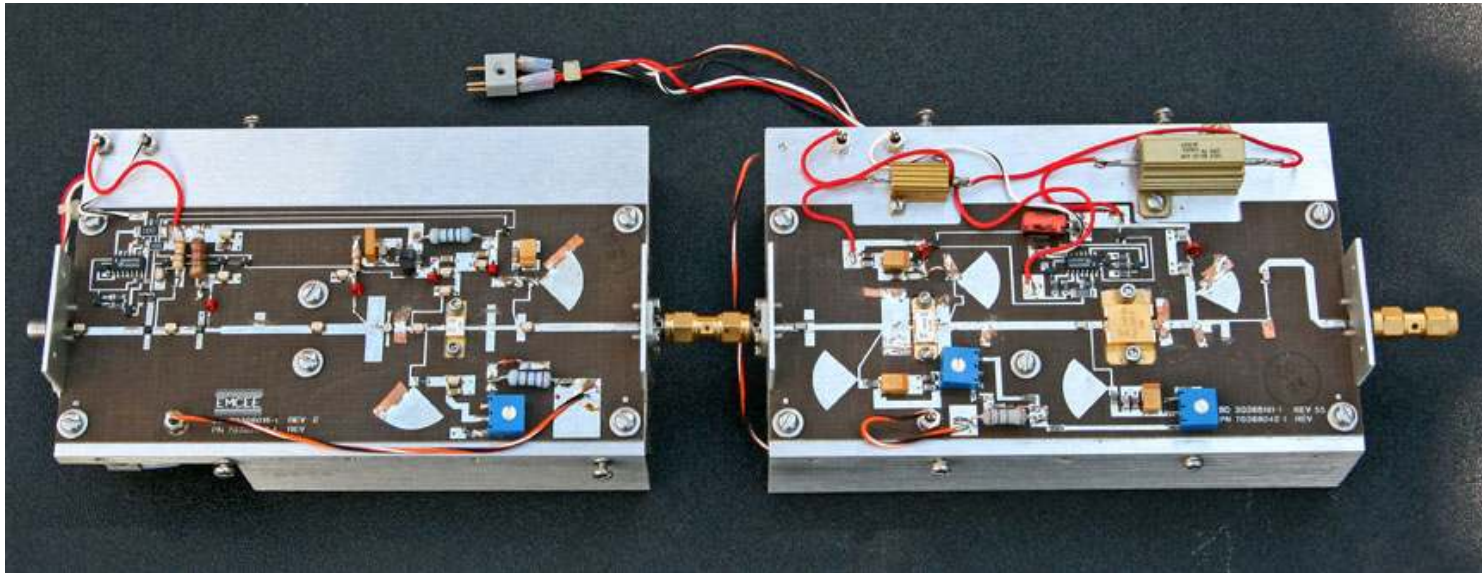
# EMCEE Transmitters

Driver amplifier- 2 stages  
4 amps in ea. chassis

- 2- driver
- 2- 10 W stage
- 2 Complete amplifiers if 2 stages used.
- Requires -
  - 15 V Bias w/ on-board
  - 5 V zener
  - +12V w/ on-board series resistor for
  - drain supply of 10V.



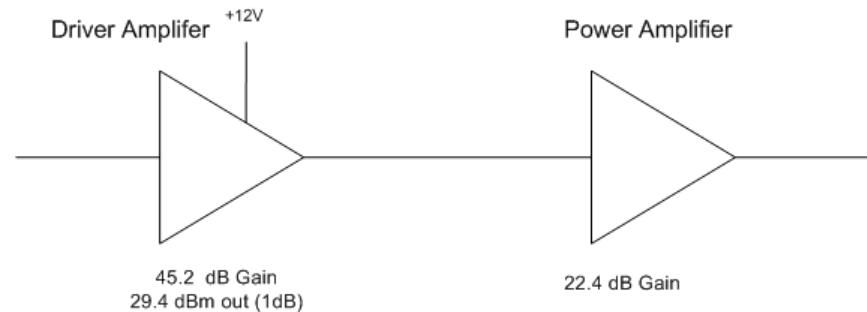
# EMCEE Amplifiers Retuned 2304



Enough gain for 11 W from mixer-filter

- 1<sup>st</sup> 2 stages of driver MMIC design.
- Remove one for less gain

2304 Cascade Amplifiers



Both amplifiers together 67.4 dB Gain  
+40.4 dBm (1 dB) 11 Watts



# All Amplifiers based on Fujitsu FLL200 -3 GaAs FET

## **FLL200IB-1, FLL200IB-2, FLL200IB-3**

**L-Band Medium & High Power GaAs FET**

### FEATURES

- High Output Power:  $P_{1dB} = 42.5\text{dBm}$  (Typ.)
- High Gain:  $G_{1dB} = 13.0\text{dB}$  (Typ.)@1.8GHz (FLL200IB-1)
- High PAE:  $\eta_{add} = 34\%$  (Typ.)
- Proven Reliability
- Hermetically Sealed Package

### DESCRIPTION

The FLL200IB-1, FLL200IB-2, FLL200IB-3 are Power GaAs FETs that are specifically designed to provide high power at L-Band frequencies with gain, linearity and efficiency superior to that of silicon devices. The performance in multitone environments for Class AB operation make them ideally suited for base station applications.

Fujitsu's stringent Quality Assurance Program assures the highest reliability and consistent performance.



### ABSOLUTE MAXIMUM RATING (Ambient Temperature $T_a=25^\circ\text{C}$ )

| Item                    | Symbol    | Condition                | Rating      | Unit             |
|-------------------------|-----------|--------------------------|-------------|------------------|
| Drain-Source Voltage    | $V_{DS}$  |                          | 15          | V                |
| Gate-Source Voltage     | $V_{GS}$  |                          | -5          | V                |
| Total Power Dissipation | $P_T$     | $T_C = 25^\circ\text{C}$ | 83.3        | W                |
| Storage Temperature     | $T_{stg}$ |                          | -65 to +175 | $^\circ\text{C}$ |
| Channel Temperature     | $T_{ch}$  |                          | 175         | $^\circ\text{C}$ |

Fujitsu recommends the following conditions for the reliable operation of GaAs FETs:

1. The drain-source operating voltage ( $V_{DS}$ ) should not exceed 10 volts.
2. The forward and reverse gate currents should not exceed 53.6 and -11.6 mA respectively with gate resistance of  $25\Omega$ .
3. The operating channel temperature ( $T_{ch}$ ) should not exceed  $145^\circ\text{C}$ .

### ELECTRICAL CHARACTERISTICS (Ambient Temperature $T_a=25^\circ\text{C}$ )

| Item                          | Symbol          | Test Conditions   | Limit |      |      | Unit               |
|-------------------------------|-----------------|---|-------|------|------|--------------------|
|                               |                 |   | Min.  | Typ. | Max. |                    |
| Saturated Drain Current       | $I_{DSS}$       | $V_{DS} = 5\text{V}, V_{GS} = 0\text{V}$                    | -     | 8    | 12   | A                  |
| Transconductance              | $g_m$           | $V_{DS} = 5\text{V}, I_{DS} = 4800\text{mA}$                | -     | 4000 | -    | mS                 |
| Pinch-off Voltage             | $V_p$           | $V_{DS} = 5\text{V}, I_{DS} = 480\text{mA}$                 | -1.0  | -2.0 | -3.5 | V                  |
| Gate Source Breakdown Voltage | $V_{GSO}$       | $I_{GS} = -480\mu\text{A}$                                  | -5    | -    | -    | V                  |
| Output Power at 1dB G.C.P.    | FLL200IB-1      | $V_{DS} = 10\text{V}$<br>$I_{DS} = 0.6 I_{DSS}$ (Typ.)      | 41.5  | 42.5 | -    | dBm                |
|                               | FLL200IB-2      |   |       |      |      |                    |
|                               | FLL200IB-3      |   |       |      |      |                    |
| Power Gain at 1dB G.C.P.      | FLL200IB-1      | $f=1.5\text{GHz}$<br>$f=2.3\text{GHz}$<br>$f=2.6\text{GHz}$ | 12.0  | 13.0 | -    | dB                 |
|                               | FLL200IB-2      |   |       |      |      |                    |
|                               | FLL200IB-3      |   |       |      |      |                    |
| Drain Current                 | $I_{dsr}$       | $V_{DS} = 10\text{V}$                                       | -     | 4.8  | 6.0  | A                  |
| Power added Efficiency        | $\eta_{add}$    | $I_{DS} = 0.6 I_{DSS}$ (Typ.)                               | -     | 34   | -    | %                  |
| Thermal Resistance            | $R_{th}$        | Channel to Case   | -     | 1.6  | 1.8  | $^\circ\text{C/W}$ |
| Channel Temperature Rise      | $\Delta T_{ch}$ | $10\text{V} \times I_{dsr} \times R_{th}$                   | -     | -    | 80   | $^\circ\text{C}$   |

CASE STYLE: IB

G.C.P.: Gain Compression Point

**FUJITSU**

# 2304 Amplifiers



# What do we need for easy amateur use?

- Built in -5 V supply
- TR Switch control
- Bias protection
- Drain Current monitor (Nice to have)



# Negative Bias supply

Linear Tech - LT1931 Inverting DC-DC converter  
Low noise- Low ripple – 1 MHz switching Frequency  
Easy to use

Linear Tech suggested application schematic. (Just what we need)

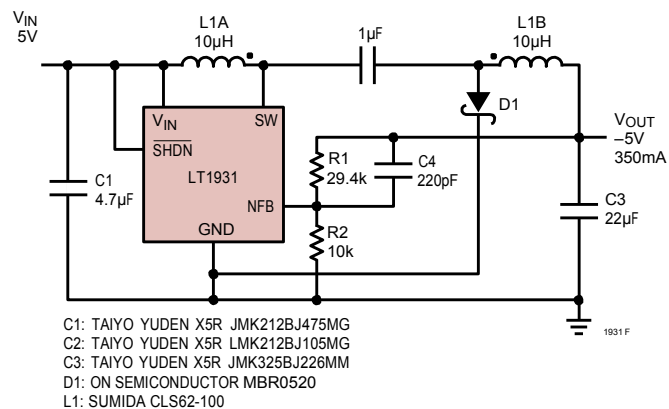


Figure 1. 5V to -5V, 350mA Inverting DC/DC Converter

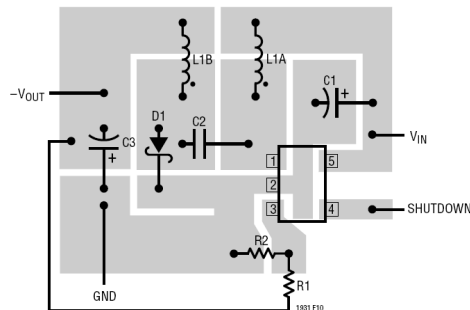
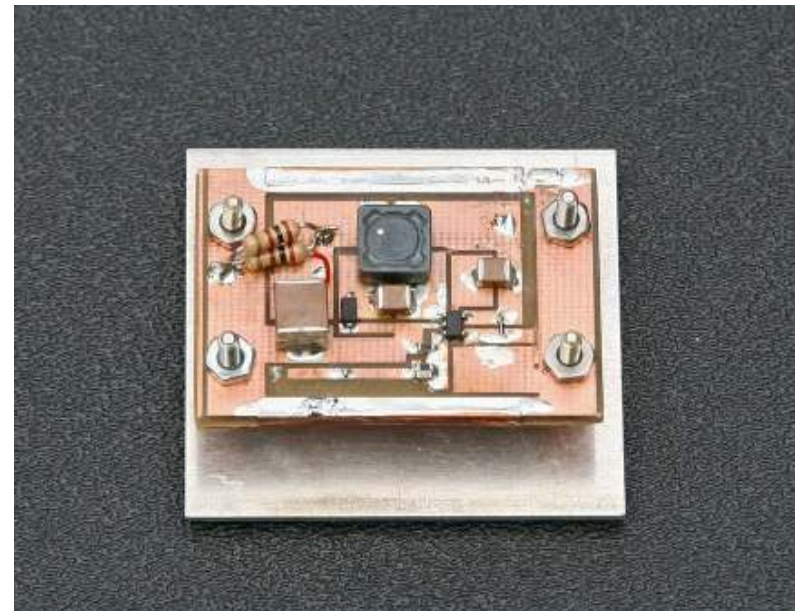


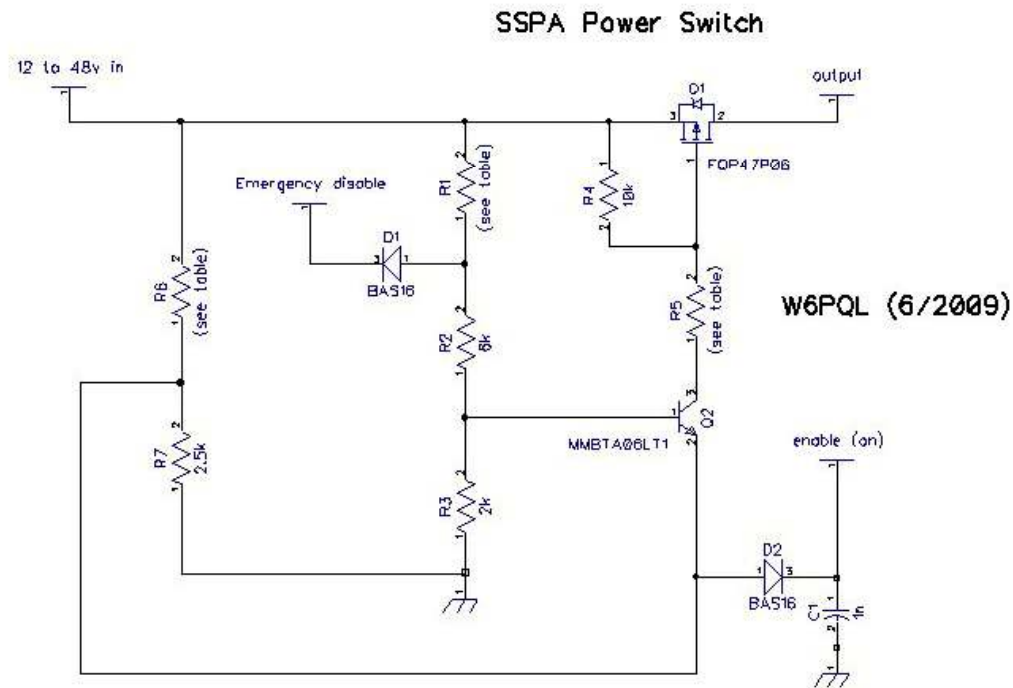
Figure 10. Suggested Component Placement.

1<sup>st</sup> – Breadboard of – V switching supply



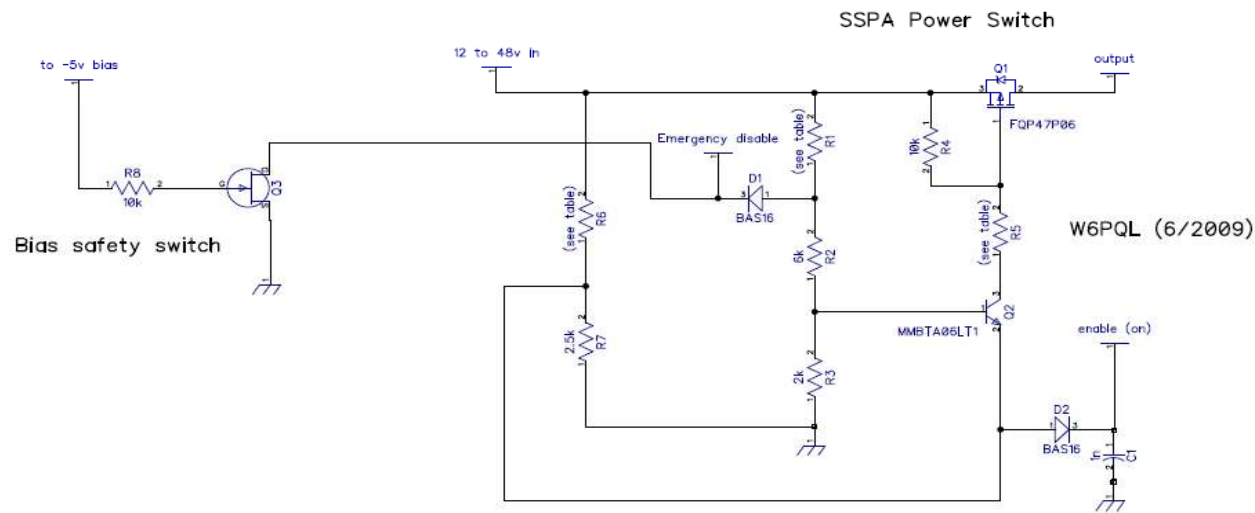
# TR Control

- W6PQL – High Current DC Fet Switch



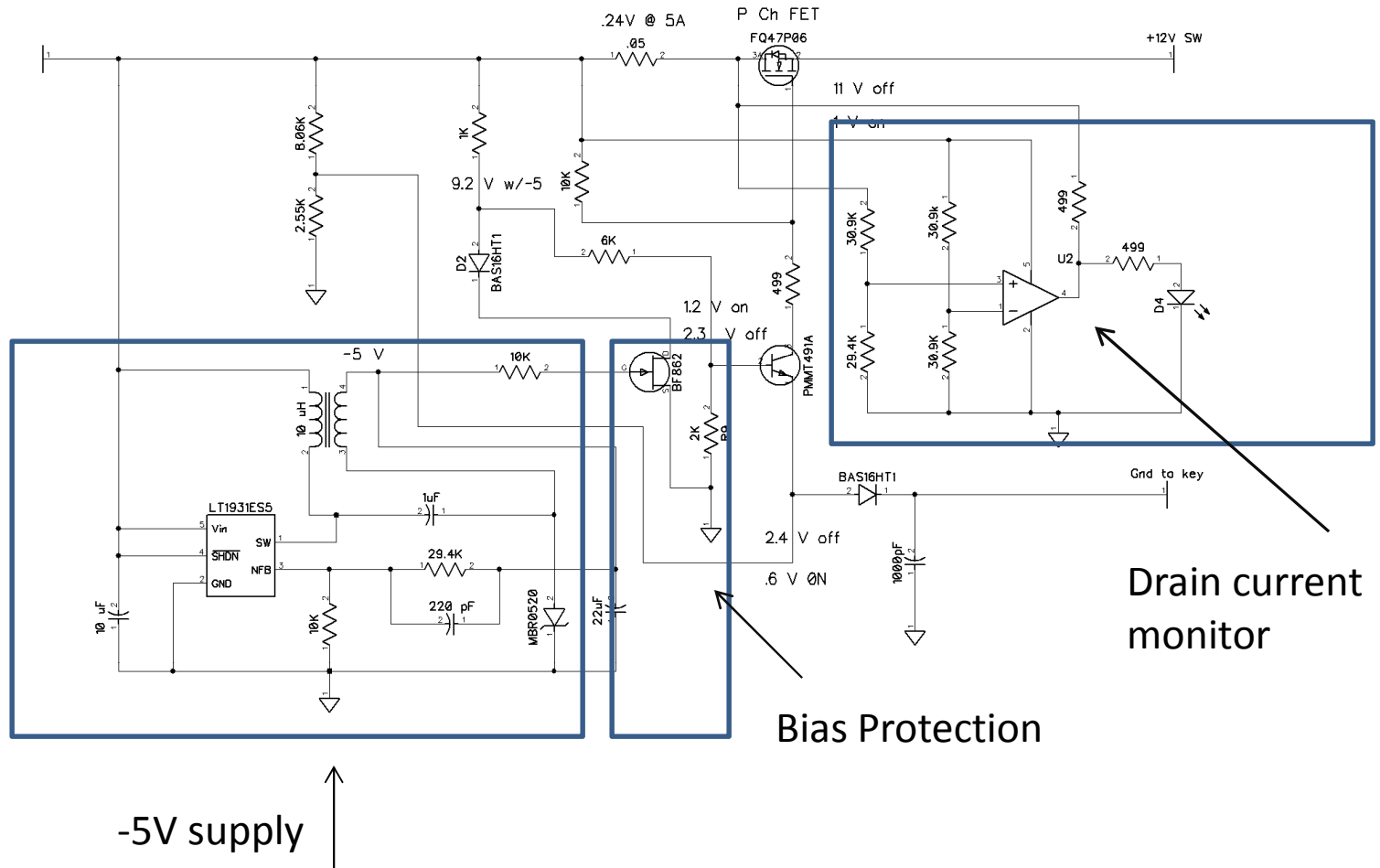
# Bias Protection

- Modify W6PQL FET Switch
  - Add FET for bias protection

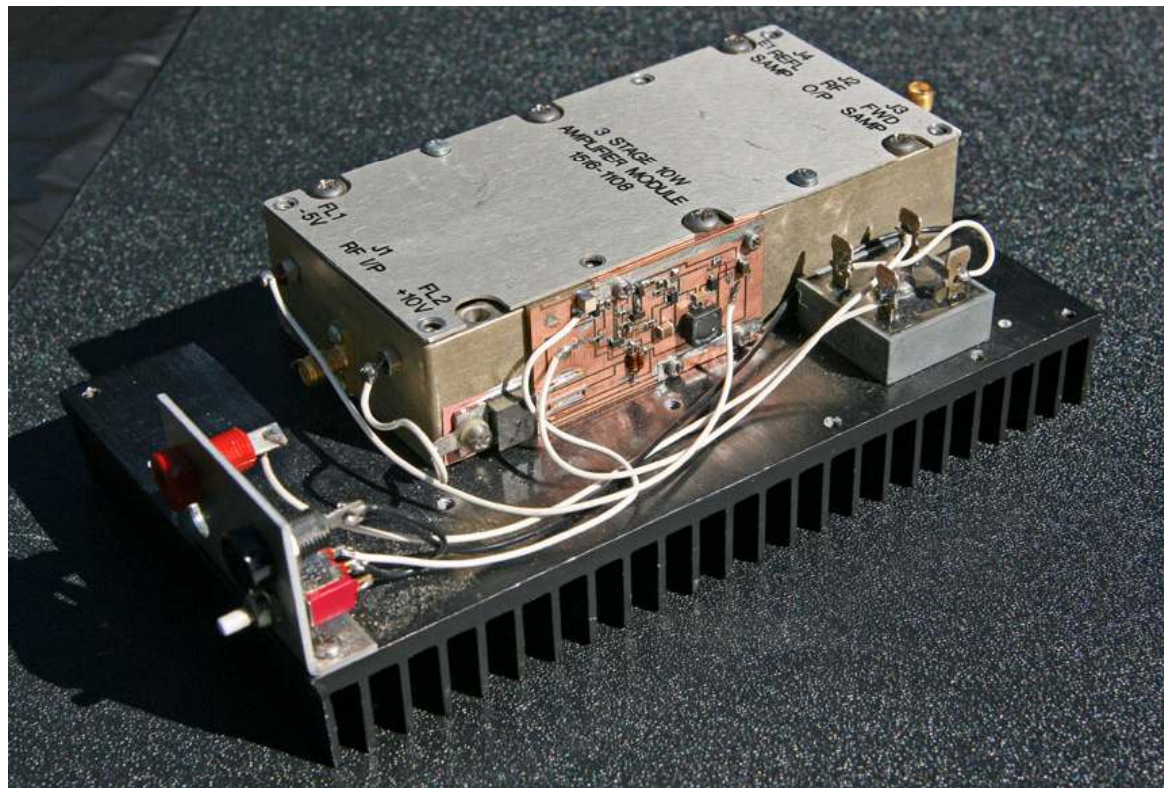


| Operating Voltage | R1  | R5       | R6  |
|-------------------|-----|----------|-----|
| 13.8v             | 1k  | 500 Ohms | 8k  |
| 28v               | 10k | 3.3k     | 20k |
| 48v               | 22k | 6k       | 33k |

-5V Supply, W6PQL FET SW, Drain Current monitor

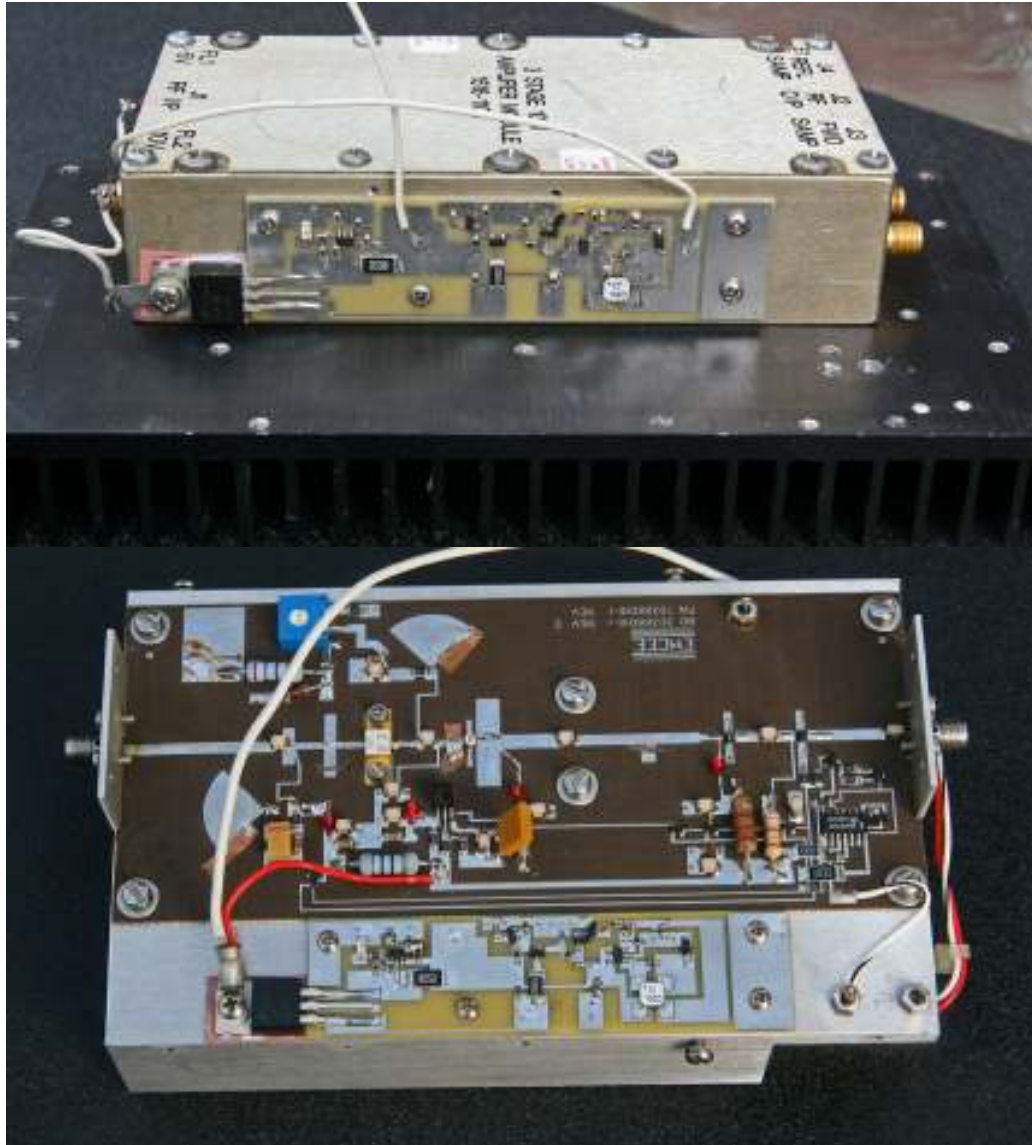


- Prototype of complete 14W amplifier from ITS Chassis
- 12 V IN
- Gnd to turn on amplifier (Pushbutton- for test)





# PCB 123 Boards



# PWB in Sunstone Circuits

- Schematic and PL in PCB123
  - (Sunstone Circuits)
- Amplifiers available
- Boards – kits available- depending on interest

# Next steps

- Make controller for high power stages
- ITS Transmitters 50W
- EMCEE transmitters 2- 30 W amplifiers.