

# TETRODE BOARD

## Calculation of R1, R12, R14

This spreadsheet follows the method in Application Note 3  
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**Modification for F1FRV board, with power MOSFET or IGBT and R1 at DC ground**

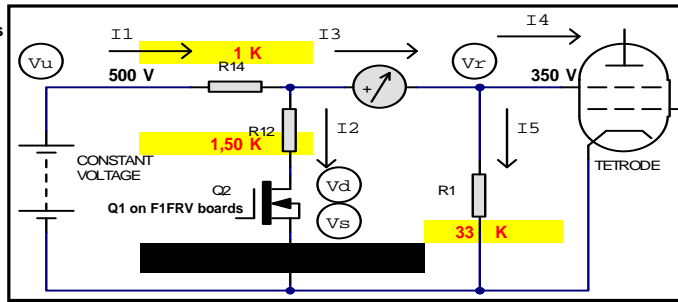
[http://f1frv.free.fr/main1a\\_Tetrode\\_Linear\\_Amp.html](http://f1frv.free.fr/main1a_Tetrode_Linear_Amp.html)

Rev 1e June 2021

by F1FRV added Q2 VDS

& Safe Operation Area examples

Application Note 3, Figure 2 (modified)



Input cells are **Black** Results are **Red**



Step

1 Enter unregulated input voltage: **Vu = 500** V at load ~ **150** mA

2 Enter regulated output voltage: **Vr = 350** V

3 Resistor R1: Use next standard value below **35,0** k

Enter value used for R1: **R1 = 33** k

Power dissipation of R1 **4** W

4 Enter maximum positive screen current: **I4 = + 100** mA

Minimum value of I2 (keep-alive current for Q2) = **10** mA

Resistor R14: Use next standard value below **1,24** k

5 Enter value used for R14: **R14 = 1** k

Power dissipation of R14 **23** W

6 Enter maximum negative screen current: **I4 = - 100** mA

Resistor R12: Use next standard value below **1,53** k

7 Enter value used for R12: **R12 = 1,50** k

Maximum power dissipation of R12 = **60** W @ I2 = 228,8 mA

VDS voltage of Q2 @ Max dissipation = **89** V

MAXIMUM current of Q2 = **229** mA

MAXIMUM power dissipation of Q2 = **20** W

MAXIMUM VDS voltage of Q2 @ Min dissipation = **275** V

Tube:  
**GU-78b or 43b**

Values in Figure 2

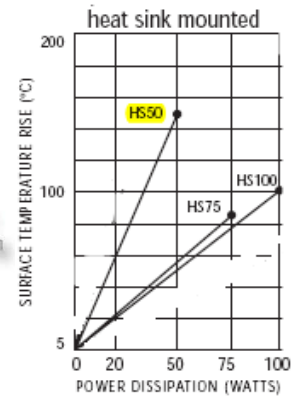
I5 = 10,6 mA

I3 Pos = 110,6 mA

**I1 = 150,0 mA**

I3 Neg = -89,4 mA

I2 = 228,8 mA



**SELECT RESISTORS MAX DISSIPATION AT LEAST 2 OR 3 x USED POWER DISSIPATION. SEE TEMP VS POWER CURVE, RESISTORS CAN BE PARALLELED TO OBTAIN THE DESIRED VALUE ( EG. 3 x 3,3 K 50 W in // TO HAVE 1,1 K 150 W ) RESISTORS CAN BE SERIALIZED TO OBTAIN THE DESIRED VALUE ( EG. 2 x 470 50 W in SERIE TO HAVE 0,94 K 100 W )**

### DESIGN CHECK

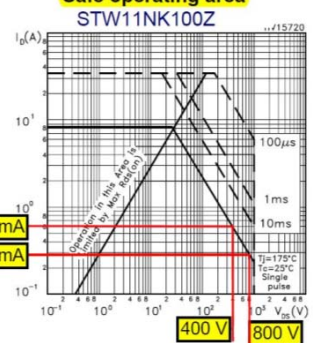
Go back to **Step 1** now, and try a 5% lower value for Vu. In cell D25, enter **475** V

**Do you see any red error messages?**

If you see any red error messages, your present resistor values are marginal!

You should reduce the indicated resistor values, and/or increase the transformer voltage, until **no** error messages appear when you decrease Vu by 5% from your expected minimum value at maximum current. EXCEPT IF YOU ARE SURE OF INPUT VOLTAGE STABILITY AT I1 CURRENT, AND NETWORK MINIMUM VOLTAGE,

**MOSFET**  
**Safe operating area**



Version 1.0 7 March 2003 by GM3SEK **Modified by F1FRV october 2010**

### MOSFET

Fig. 11. Forward-Bias Safe Operating Area @ Tc = 25°C

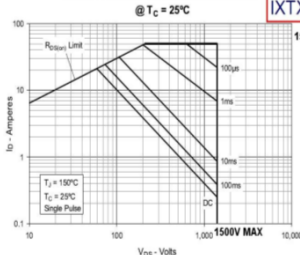
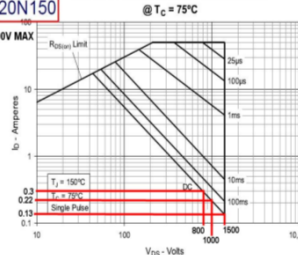


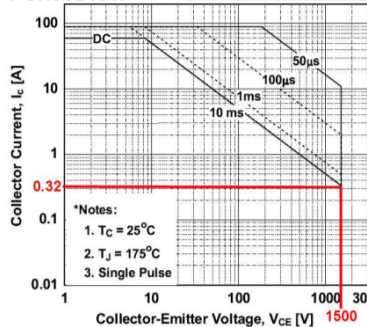
Fig. 12. Forward-Bias Safe Operating Area @ Tc = 75°C



**AS HIGH VOLTAGE MOSFETs FOR G2 > 800 V ARE DIFFICULT TO FIND, USE IGBTs, LESS EXPENSIVES & MORE EASY TO APPROVE.**

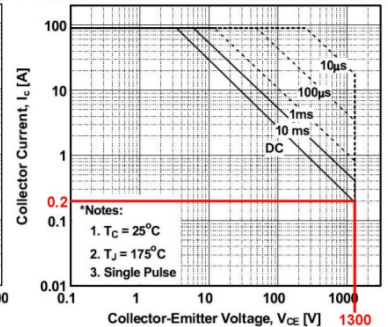
### IGBT

FGH30S150P SOA Characteristics



### IGBT

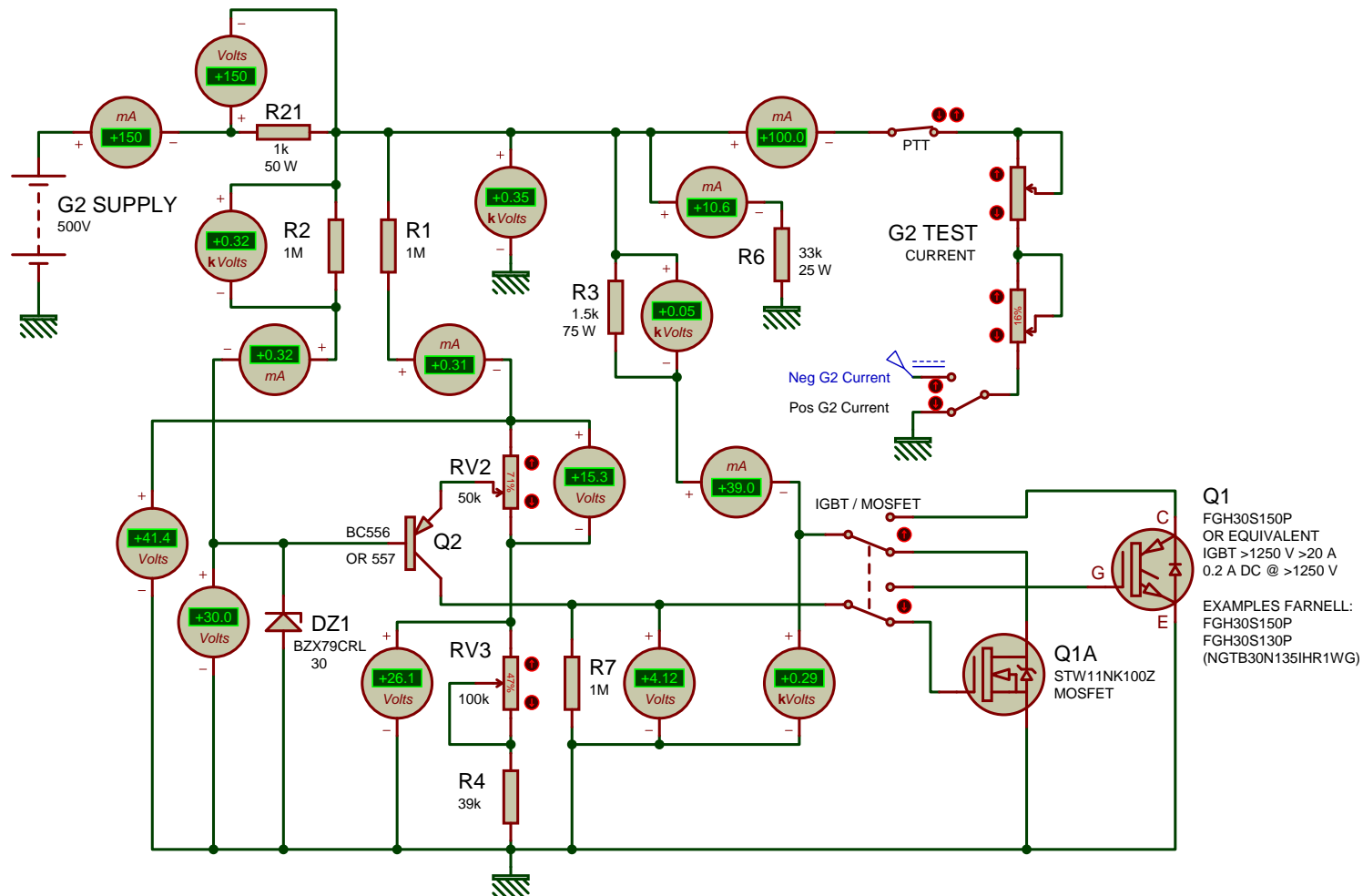
FGH30S130P SOA Characteristics





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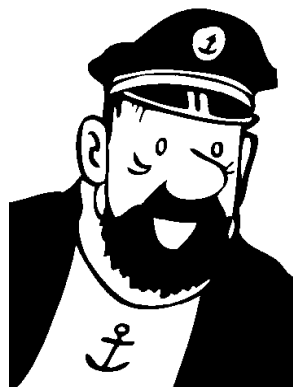
**NOTES** If the simulation aborts with "timestep too small" then set :  
**RELTOL=0.005** (up to 0.01) , **ITL4=300** (up to 500) , **ITL1=300**  
 And in extreme cases (in order of importance) :  
**GMIN=1e-09** , **ABSTOL=1e-08** , **VNTOL=1e-05** (up to 1e-03) only if required **TMAX=10 t**



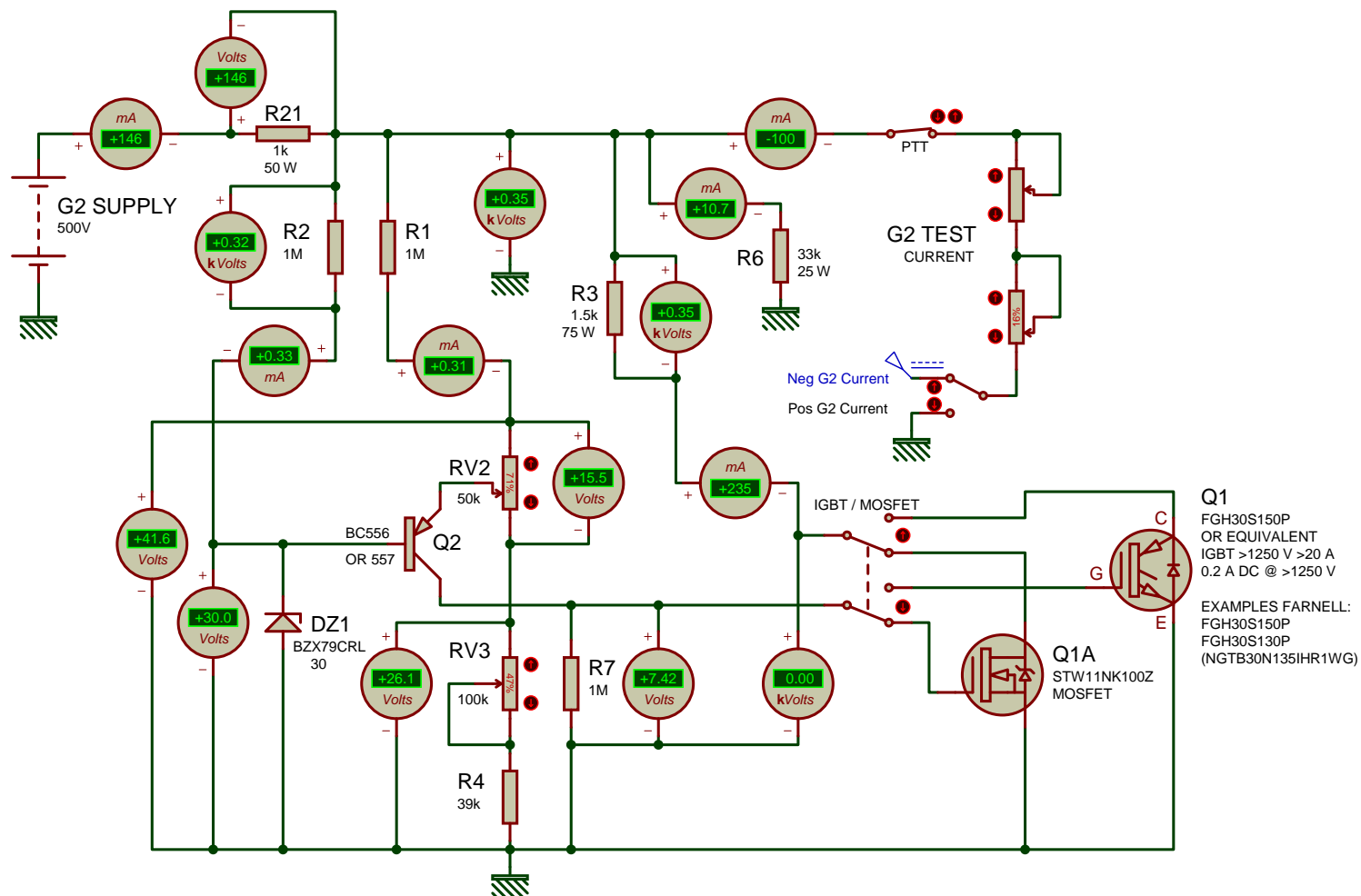
**350 V 100 mA MAX With MOSFET or IGBT**

**TETRODE AMPLIFIER DESIGN SUITE**  
**SIMULATION G2 SHUNT SUPPLY CONTROL**

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**350 V 100 mA MAX With MOSFET or IGBT**

TETRODE AMPLIFIER DESIGN SUITE  
 SIMULATION G2 SHUNT SUPPLY CONTROL

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