

TETRODE BOARD GRID 2 SHUNT REGULATED SUPPLY

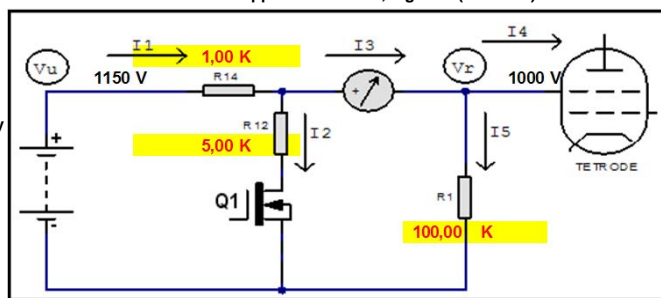
Calculation of R1, R12, R14

This spreadsheet follows the method described in Application Note 3 © 2003 IFW Technical Services Version 1.0 7 March 2003 by GM3SEK

Modification for F1FRV board, with power MOSFET or IGBT and Q1 & R1 at DC ground

http://f1frv.free.fr/main1a_Tetrode_Linear_Amp.html

Application Note 3, Figure 2 (modified)



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



Rev 2 January 2022

New modified schematic
Added Q1 VDS min / max display
Safe Operation Area examples
for MOSFETs & IGBTs

Step

1 Enter unregulated input voltage: **Vu = 1150 V** at load ~ **150 mA**
Estimated transformer voltage before rectifiers & filter: **852 V AC**

2 Enter regulated output voltage: **Vr = 1000 V**

3 Resistor R1: Use next standard value below **100,00 k**
Enter value used for R1: **R1 = 100,00 k**
Power dissipation of R1 **10 W**

4 Enter maximum positive screen current: **I4 = + 100 mA**
Minimum value of I2 (keep-alive current for Q1) = **10 mA**

5 Resistor R14: Use next standard value below **1,25 k**
Enter value used for R14: **R14 = 1,00 k**
Power dissipation of R14 **23 W**

6 Enter maximum negative screen current: **I4 = - 50 mA**

7 Resistor R12: Use next standard value below **5,56 k**
Enter value used for R12: **R12 = 5,00 k**
Maximum power dissipation of R12 = **131 W** @ I2 = **180 mA**

(for Q1 selection) VDS voltage @ Max dissipation = **278 V** @ I2 = **180 mA**
(for Q1 selection) MAXIMUM current = **180 mA** @ VDS = **278 V**
(for Q1 selection) MAXIMUM power dissipation = **50 W** @ I2 = **50 mA**
(for Q1 selection) MAXIMUM VDS voltage @ Min dissipation = **875 V** @ I2 = **100 mA**

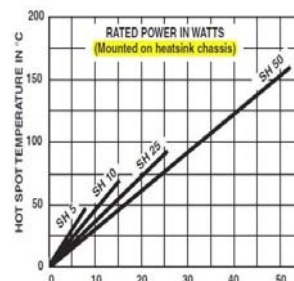
Q1 reference (see datasheet) **FGH30S130P** Q1 Power **500 W** @ 25°C
Q1 MAXIMUM Power @ Junction Temperature **317 W** Q1 Derating **3,33 W / °C**

Tube:
4CX-10 000 D



R1, R12 & R14

100 kOhms	R1
25 W	
Values in Figure 2	
I5 = 10 mA	
I3 Pos = 110 mA	
I1 = 150 mA	
I3 Neg = -40 mA	
I2 = 180 mA	
1 kOhms	R14
50 W	



Heatsink thermal resistance **0,5 °C/W**
Q1 Junction to Case **0,30 °C/W** (see datasheet)
Insulating pad Rth **0,20 °C/W**
Ambient temperature: **30 °C**
Q1 Junction Temperature: **80 °C**

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 SERIALISED 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 D24, enter **1092,5 V**

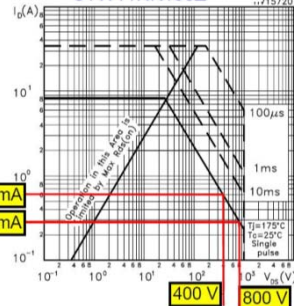
Do you see any red error messages?

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,

Version 1.0 7 March 2003 by GM3SEK **First modification by F1FRV october 2010**

MOSFET
Safe operating area
STW11NK100Z



MOSFET

Fig. 11. Forward-Bias Safe Operating Area

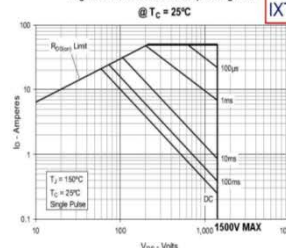
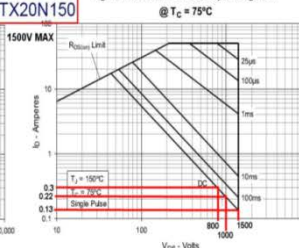


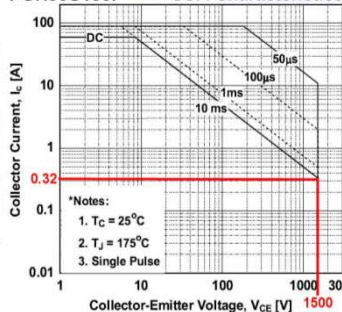
Fig. 12. Forward-Bias Safe Operating Area



IGBT

FGH30S150P

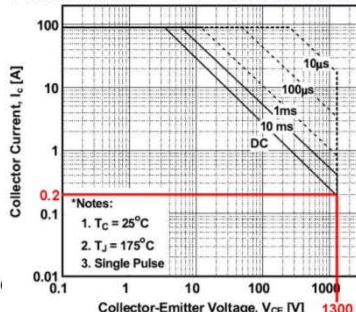
SOA Characteristics



IGBT

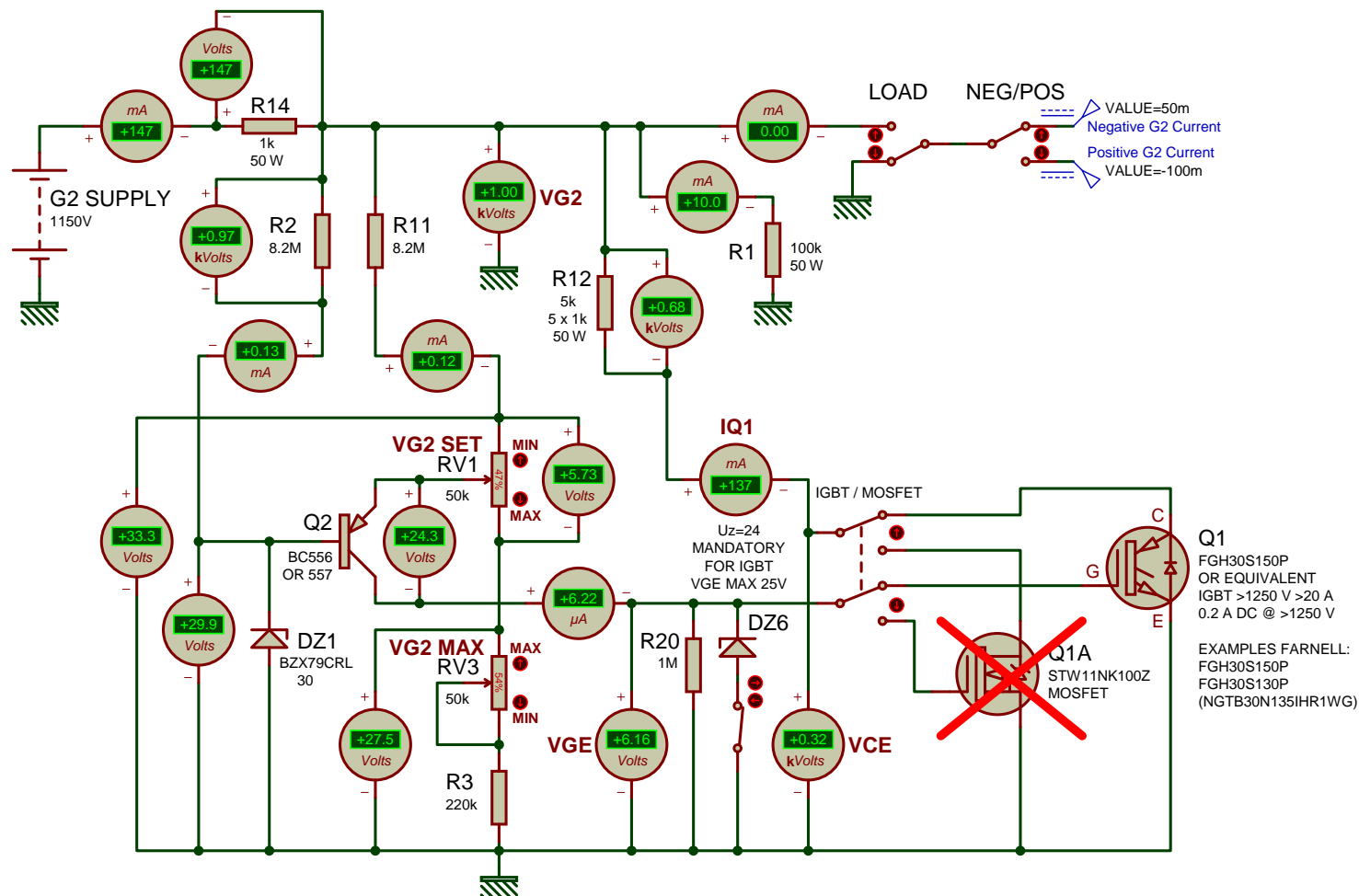
FGH30S130P

SOA Characteristics



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

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



FOR R12 & R14 VALUES, USE EXCEL SHEET: Grid2_G3SEK_an-3-v1.0_Mod_F1FRV

Simulation files are in "PROTEUS" format. To help you in your design, If you have PROTEUS & want receive simulation files, request by e-mail.

EXAMPLE FOR 4CX-10 000 CLASS AB1 WITH G2 : 1000 V

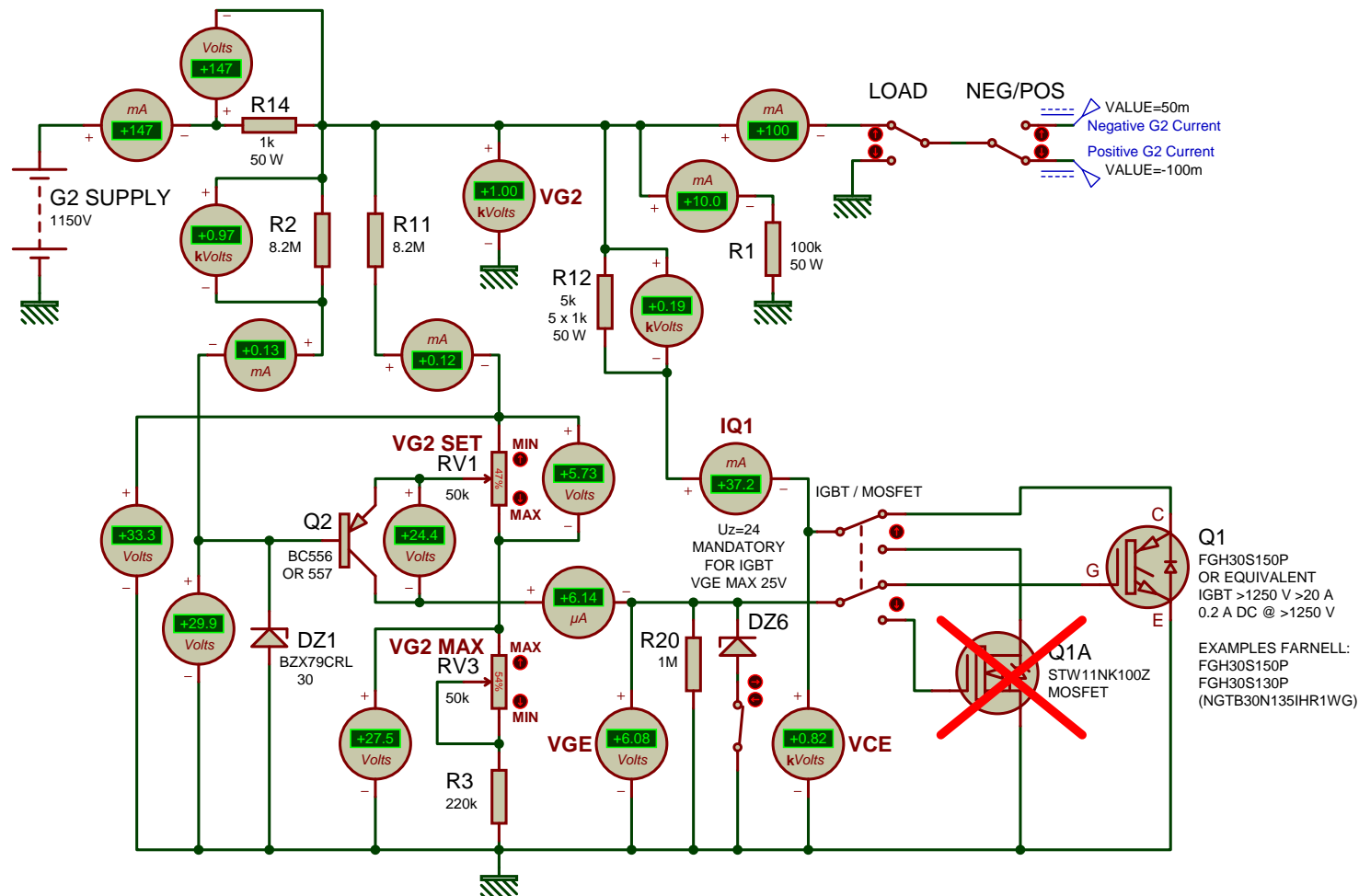
V G2 1000 V (950 V-1100 V) +100 / -50 mA MAX With IGBT (MANDATORY)

TETRODE AMPLIFIER DESIGN SUITE
 SIMULATION G2 SHUNT SUPPLY CONTROL

DOC N°: Amateur Radio
 BY: f1frv@sfr.fr
 DATE: 26/01/22 REV: 7 PAGE: 1/1



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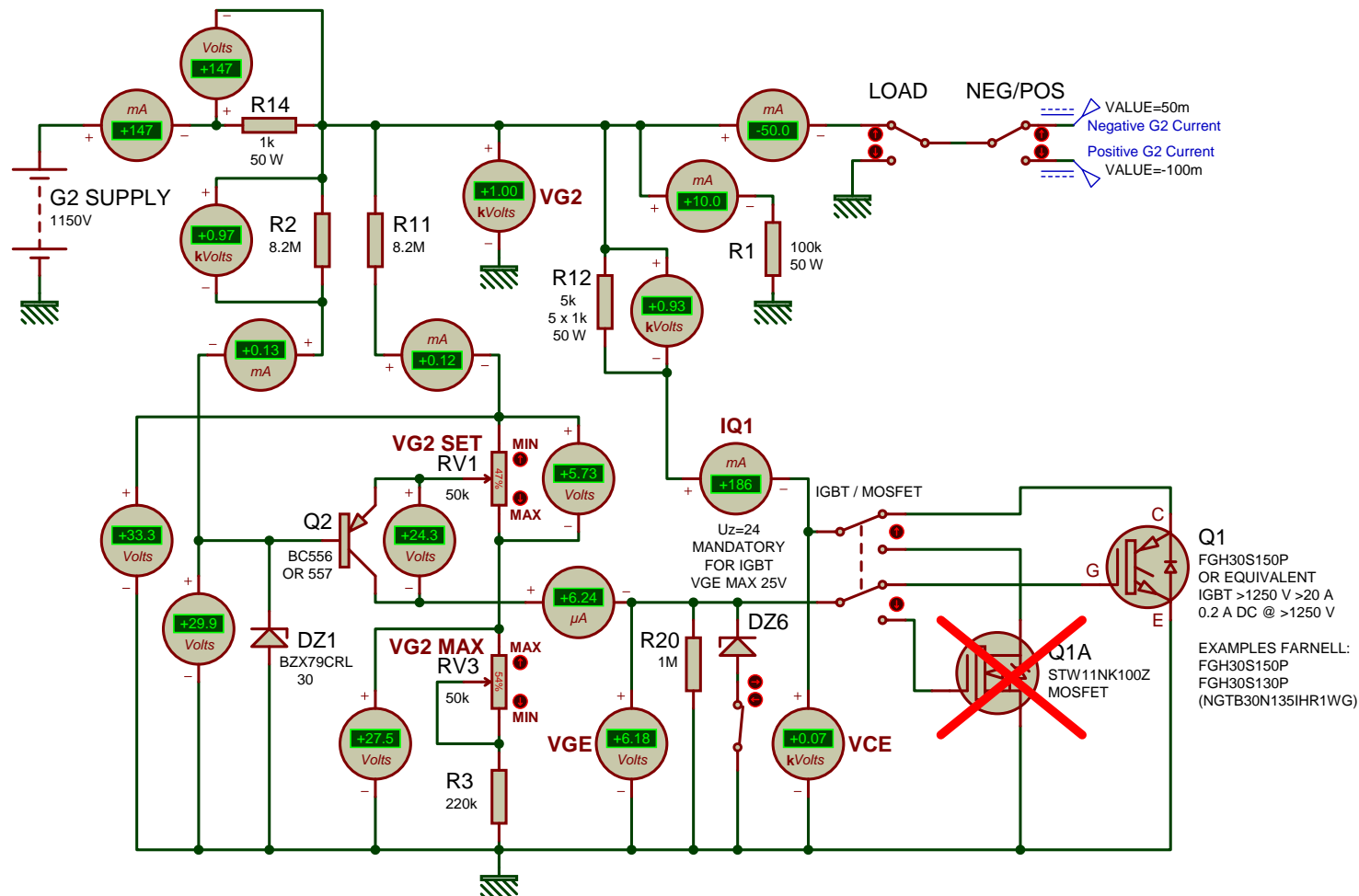
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