

# TETRODE BOARD GRID 1 SHUNT REGULATED SUPPLY

## Calculation of R12, R18 & blocking voltage Zeners current

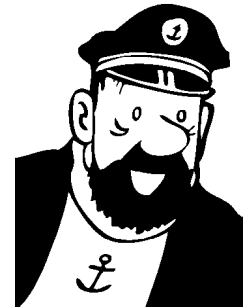
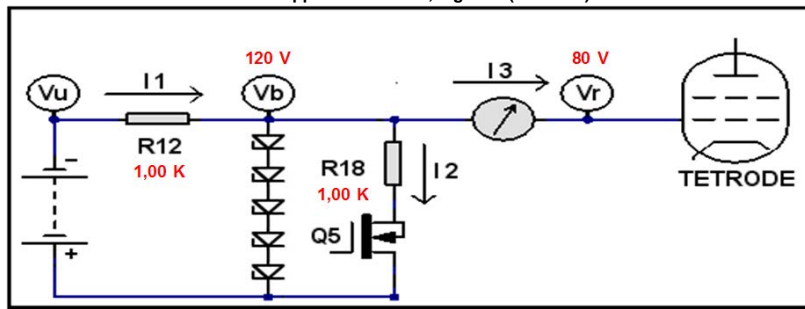
This spreadsheet follows the method described in Application Note 3 © 2003 IFW Technical Services Version 1.0 7 March 2003 by GM3SEK

**Modification for F1FRV G1 board Revision 7, with power P MOSFET and Zeners for G1 blocking voltage**

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

Application Note 3, Figure 2 (modified)

Rev 0 January 2022



Step

1 Enter unregulated input voltage: **Vu = - 155 V** at load ~ **75 mA**  
Estimated transformer voltage before rectifiers & filter: **115 V AC**

2 Enter G1 BLOCKING voltage: **Vb = - 120 V** **24 V** for each Zener  
Blocking voltage Vb Zeners current: - **35 mA**

3 Enter regulated output voltage: **Vr = - 80 V**

4 Enter maximum grid current: **I3 = - 25 mA**

Resistor R12: Use next standard value below **1,60 k**

5 Enter value used for R12: **R12 = 1,00 k**  
Power dissipation of R12 **6 W @ I1 = - 75 mA**

Resistor R18: Use next standard value below **1,07 k**

6 Enter value used for R18: **R18 = 1,00 k**  
Maximum power dissipation of R18 = **6 W @ I2 = - 75 mA**

**MAXIMUM VDS voltage of Q5 (for Q5 selection) = - 30 V @ I2 = - 50 mA**

**MAXIMUM current of Q5 (for Q5 selection) = - 75 mA @ VDS - 9 V**

**MAXIMUM power dissipation of Q5 (for Q5 selection) = 2 W**

Q5 reference (see datasheet) **FQP3P20** Q5 Power **52 W @ 25°C**

Q5 **MAXIMUM** Power @ Junction Temperature **41,75 W** Q5 Derating **0,42 W / °C**

Tube:  
**GU-78B OR GU-43B**



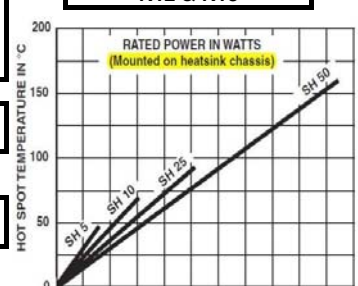
Values in Figure 2

I1 = 75 mA

I2 = 75 mA

I3 = 25 mA

R12 & R18



Heatsink thermal resistance **7,10 °C/W**  
Q5 Junction to Case **2,40 °C/W** (see datasheet)  
Insulating pad Rth **0,20 °C/W**  
Ambient Temperature: **30 °C**  
Q5 Junction Temperature: **49 °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

**EXCEPT IF YOU ARE SURE OF INPUT VOLTAGE STABILITY AT I1 CURRENT, AND NETWORK MINIMUM VOLTAGE.**

Go back to **Step 2** now, and try a 5% lower value for Vb. In cell E26, enter **114 V**

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

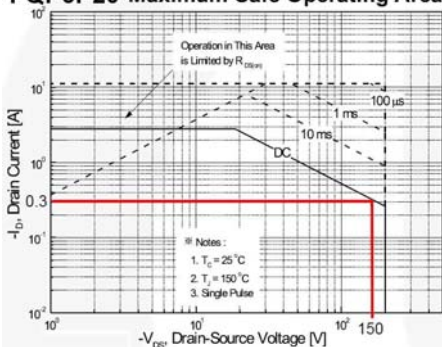
If you see any red error messages, your present resistors values are marginal !

You should reduce the indicated resistor values, and / or increase the transformer voltage, until **NO** error messages appear when you decrease Vb 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.**

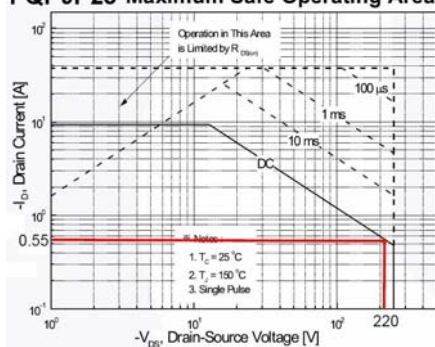
### ZENERS 5 WATTS 1N53xxB

**16 V MAX CURRENT 295 mA**  
**24 V MAX CURRENT 198 mA**  
**27 V MAX CURRENT 176 mA**  
**36 V MAX CURRENT 132 mA**  
**43 V MAX CURRENT 110 mA**  
**47 V MAX CURRENT 100 mA**  
**51 V MAX CURRENT 93 mA**  
**75 V MAX CURRENT 63 mA**  
**91 V MAX CURRENT 52 mA**  
**100 V MAX CURRENT 47 mA**  
**150 V MAX CURRENT 31 mA**  
**200 V MAX CURRENT 23 mA**

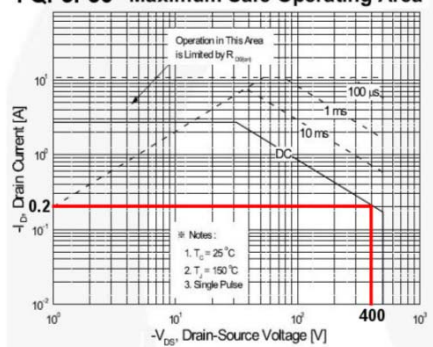
### FQP3P20 Maximum Safe Operating Area



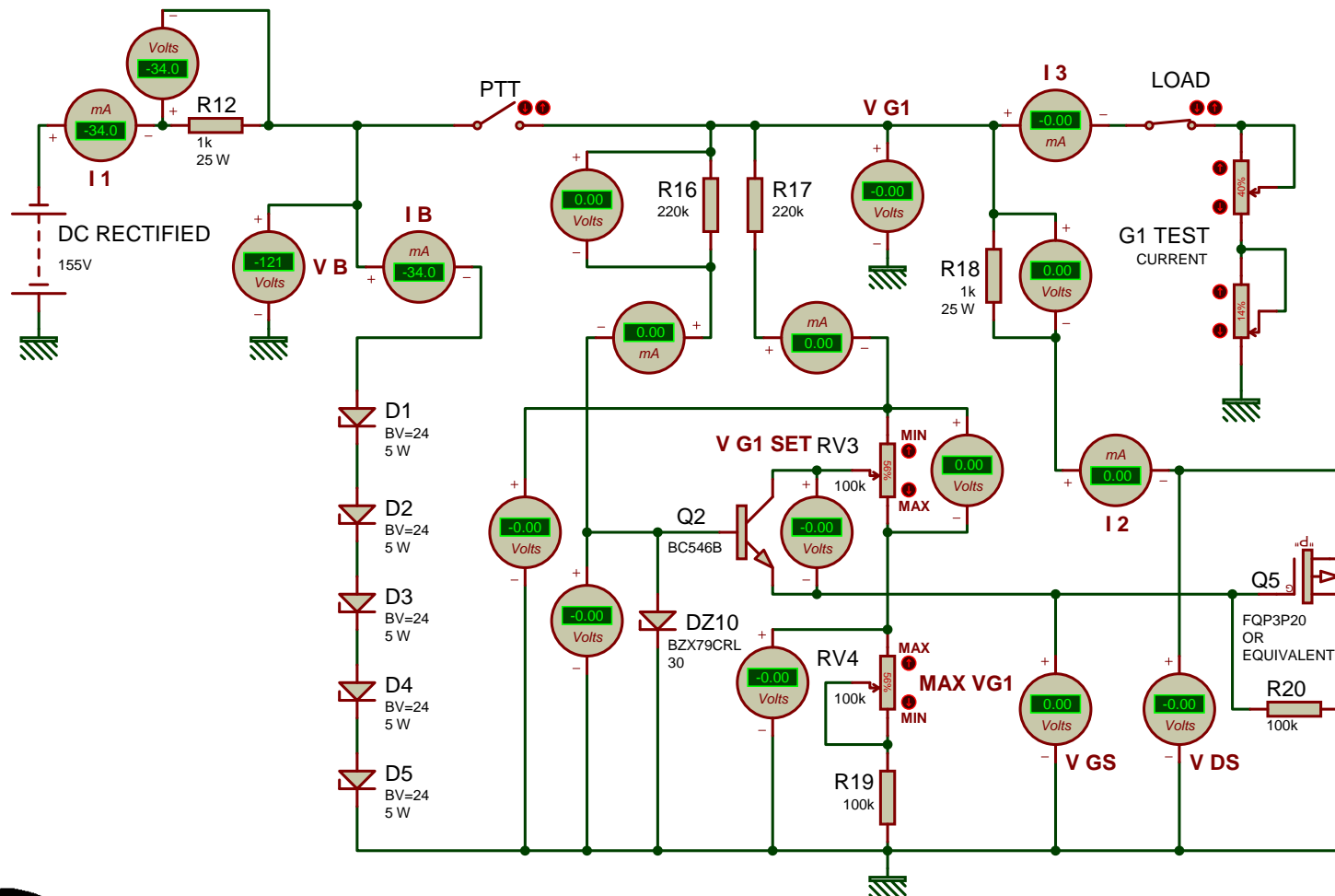
### FQP9P25 Maximum Safe Operating Area



### FQP3P50 Maximum Safe Operating Area



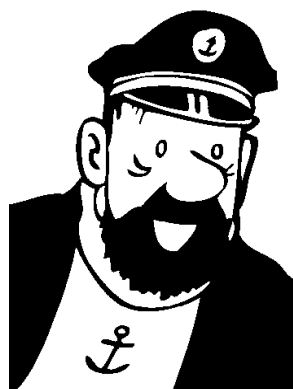
**NOTES** If the simulation aborts with "timestep too small" then set : RELTOL=0.005 (up to 0.01) , ITL4=300 (up to 500) , ITL1=300  
And in extreme cases (in order of importance) : GMIN=1e-09 , ABSTOL=1e-08 , VNTOL=1e-05 (up to 1e-03) only if required TMAX=10 t



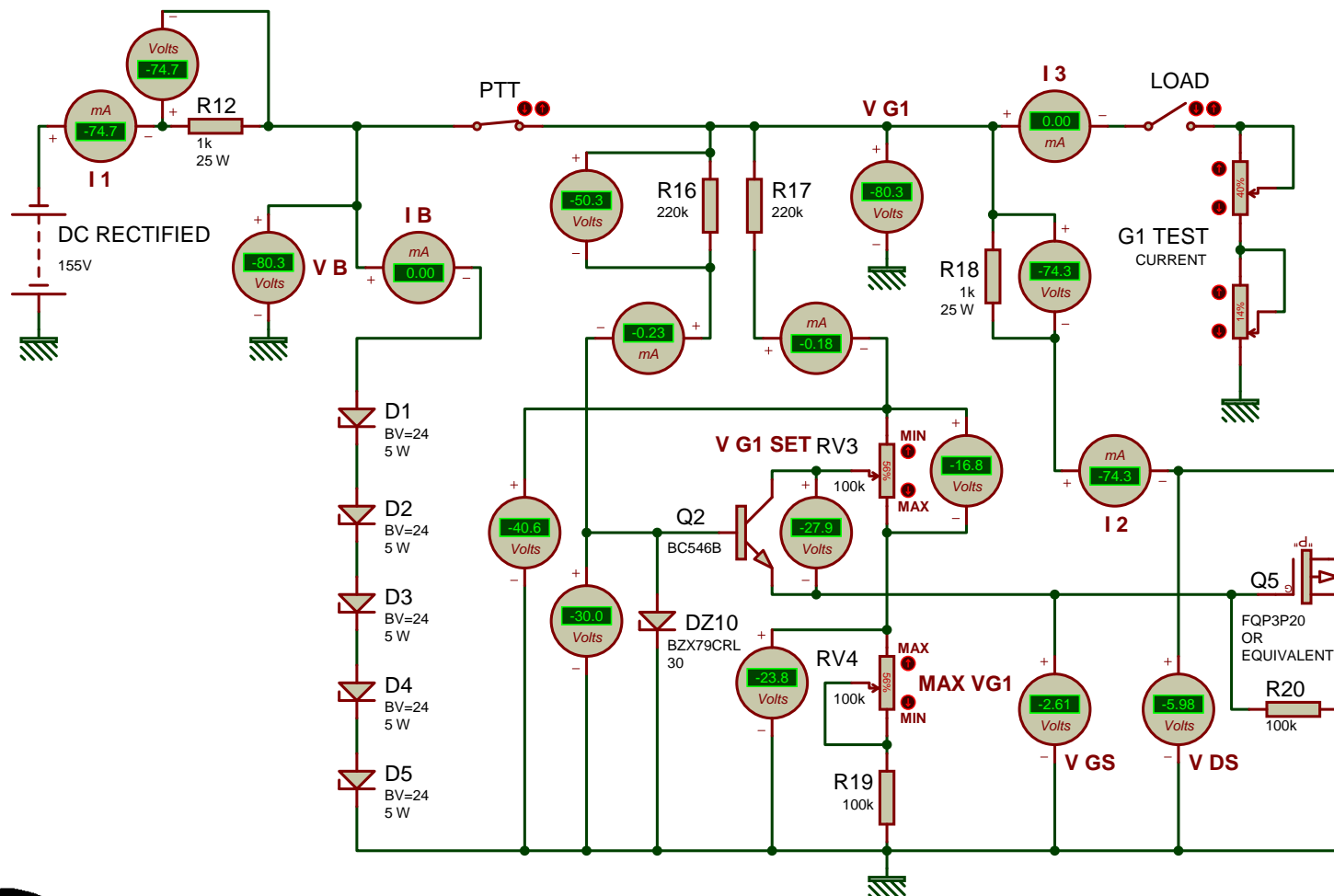
**FOR R12 & R18 VALUES, USE EXCEL SHEET: Grid1\_Shunt\_Supply\_Calculator\_F1FRV**  
**Simulation files are in "PROTEUS" format. To help you in your design,**  
**If you have PROTEUS & want receive simulation files, request by e-mail.**  
**EXAMPLE FOR GU-78B WITH G2 : 300 V**  
**GU-78B V G1 120 V / -80 V (-60V-100V) 25 mA MAX**

**TETRODE AMPLIFIER DESIGN SUITE**  
**SIMULATION G1 SHUNT SUPPLY CONTROL**

DOC N°: Amateur Radio  
BY: f1frv@sfr.fr  
DATE: 28/01/22 REV: 7 PAGE: 1/1



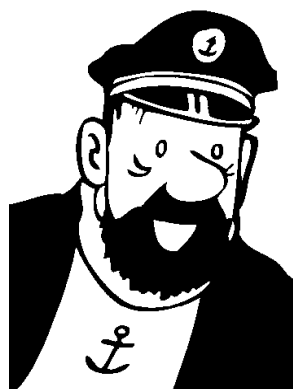
**NOTES** If the simulation aborts with "timestep too small" then set : RELTOL=0.005 (up to 0.01) , ITL4=300 (up to 500) , ITL1=300  
And in extreme cases (in order of importance) : GMIN=1e-09 , ABSTOL=1e-08 , VNTOL=1e-05 (up to 1e-03) only if required TMAX=10 t



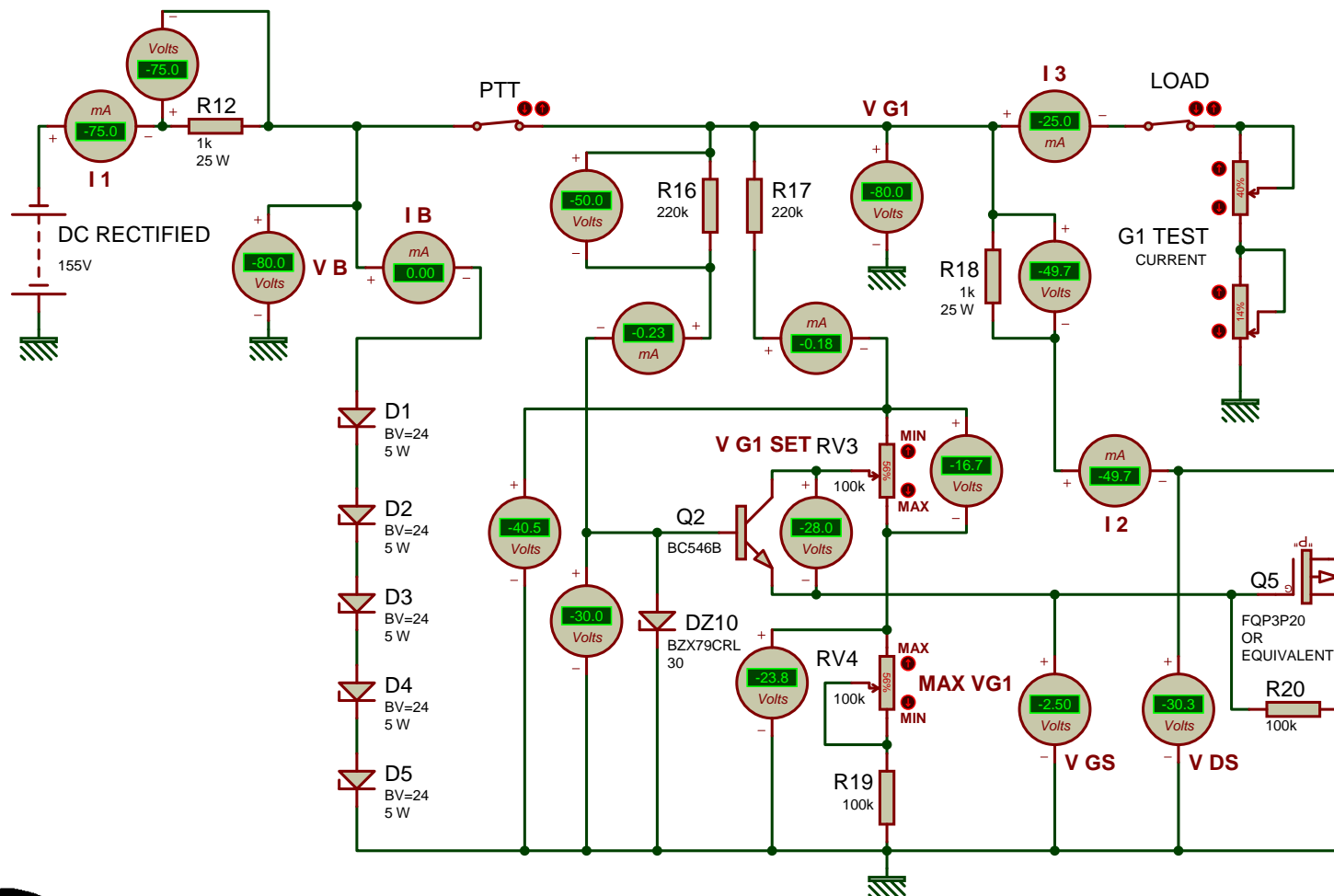
**FOR R12 & R18 VALUES, USE EXCEL SHEET: Grid1\_Shunt\_Supply\_Calculator\_F1FRV**  
**Simulation files are in "PROTEUS" format. To help you in your design,**  
**If you have PROTEUS & want receive simulation files, request by e-mail.**  
**EXAMPLE FOR GU-78B WITH G2 : 300 V**  
**GU-78B V G1 120 V / -80 V (-60V-100V) 25 mA MAX**

**TETRODE AMPLIFIER DESIGN SUITE**  
**SIMULATION G1 SHUNT SUPPLY CONTROL**

DOC N°: Amateur Radio  
BY: f1frv@sfr.fr  
DATE: 28/01/22 REV: 7 PAGE: 1/1



**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

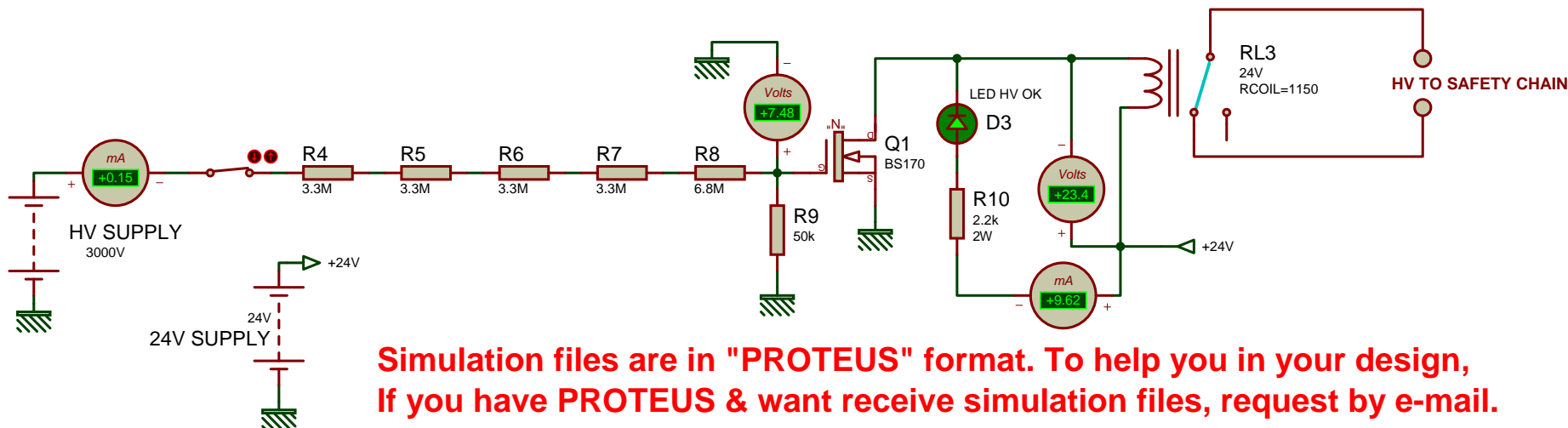


**FOR R12 & R18 VALUES, USE EXCEL SHEET: Grid1\_Shunt\_Supply\_Calculator\_F1FRV**  
**Simulation files are in "PROTEUS" format. To help you in your design,**  
**If you have PROTEUS & want receive simulation files, request by e-mail.**  
**EXAMPLE FOR GU-78B WITH G2 : 300 V**  
**GU-78B V G1 120 V / -80 V (-60V-100V) 25 mA MAX**

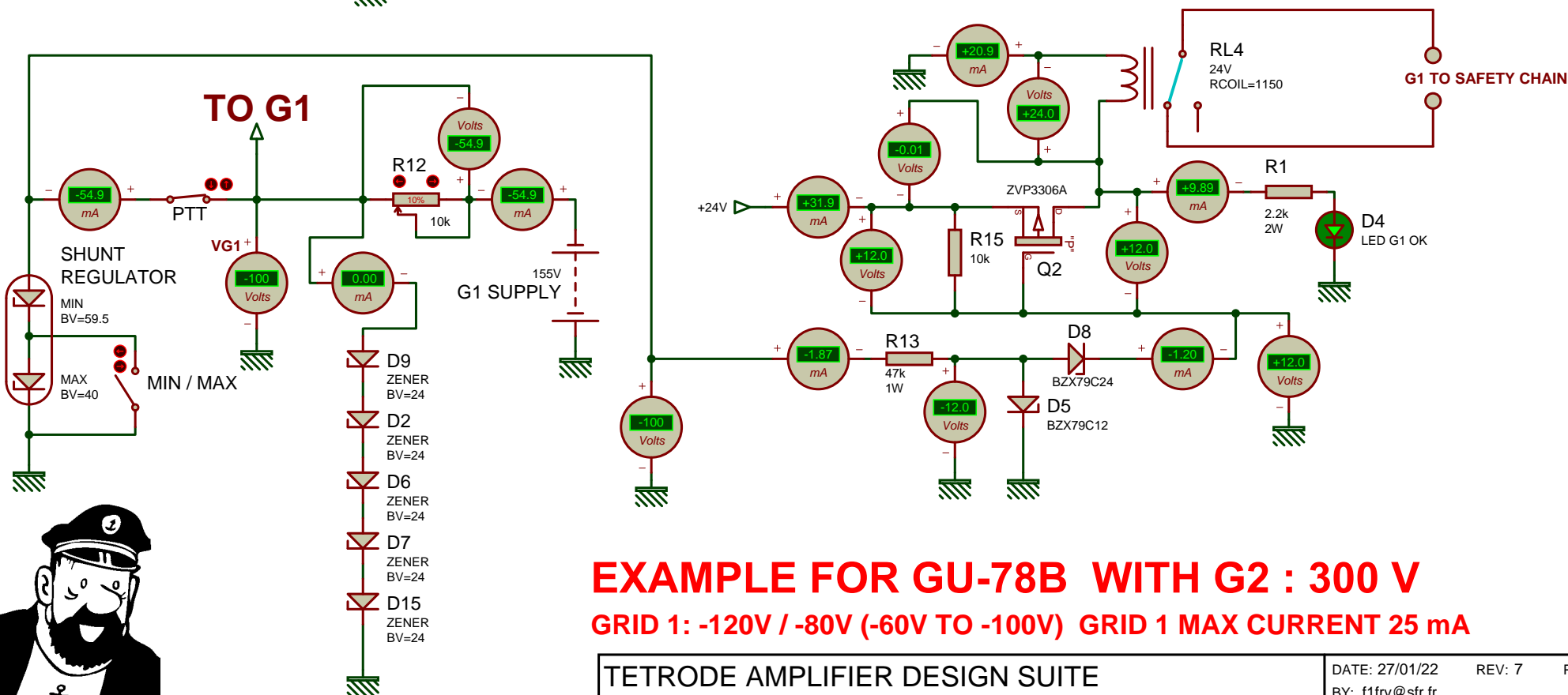
TETRODE AMPLIFIER DESIGN SUITE  
 SIMULATION G1 SHUNT SUPPLY CONTROL

DOC N°: Amateur Radio  
 BY: f1frv@sfr.fr  
 DATE: 28/01/22 REV: 7 PAGE: 1/1





**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 GU-78B WITH G2 : 300 V**  
**GRID 1: -120V / -80V (-60V TO -100V) GRID 1 MAX CURRENT 25 mA**

TETRODE AMPLIFIER DESIGN SUITE  
 SUPPLIES DETECTIONS SIMULATION

DATE: 27/01/22 REV: 7 PAGE: 1/1  
 BY: f1frv@sfr.fr  
 DOC N°: Amateur Radio



