Hifisonix
Speaker Protection Board

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www.hifisonix.com

Important: This project is strictly for DIY/personal use only. If you wish to use this design, or aspects of this design, for commercial applications and/or resale, kindly contact me via the hifisonix website or at bonsai(at)hifisonix.com

Click here for Double sided, silk screened PCB's for the speaker Protection Board

This project uses all through hole components

Specifications – Hifisonix Speaker Protection board

Protection IC: Unisonic UPA1237

Protection functions: Switch on mute, switch off mute, DC offset protection; overcurrent trip input facility

DC Offset detect speaker disengage time: < 20ms for Vdc = 50V; 100ms for Vdc = 10V; 3~5 seconds for Vdc = 2V

Current Overload disengage time: ~5ms

Usable Supply Voltage: 25 to 75V (requires resistor changes - see table on slide 6)

Options: latching/non-latching operation by means of link

Speaker Relay: TO-220 high power mosfets configured as bi-directional solid state relay

ON resistance: dependent upon mosfets used (see Table 1) but typically <20 milli-Ohms and as low as 3 milli-Ohms

Application: Can be used with single supply or slit supply rail amplifiers

PCB Dimensions: 80mm x 50mm

Attention: the values shown in the circuit diagram on slide 4 are for amplifier +ve supply voltages of > 45V. For other supply voltages, see slide 6

Brief Description

This speaker protection board uses the popular UPC1237 IC to provide DC offset protection, AC power detection, DC detection and overcurrent protection (see notes later in this document), facilitating comprehensive speaker protection with just a few extra components

The original µPC1237 was created by NEC Japan, but discontinued many years ago. Taiwanese semiconductor company Unisonic now supply a pin for pin replacement, the UPC1237 available from numerous suppliers in the US and Europe (UK builders can get them from Cricklewood Electronics in London via their website).

There are a lot of low cost speaker protection boards based on the UPC1237 available on eBay and AliExpress. Most use cheap relays to connect the amplifier to the speakers and ***will fail*** if there is a catastrophic DC offset, as is the case if one of the output devices on the amplifier go short – see this thread on diyAudio for example – or if the amplifier output is shorted to 0V. The relays used by the complainant in this case were industrial grade Tyco 16A devices in which the contacts welded short, putting 75V DC onto the B&W 703 bass loudspeakers on one of the channels, cooking them in about 3 seconds. The repair bill was close to US$400.

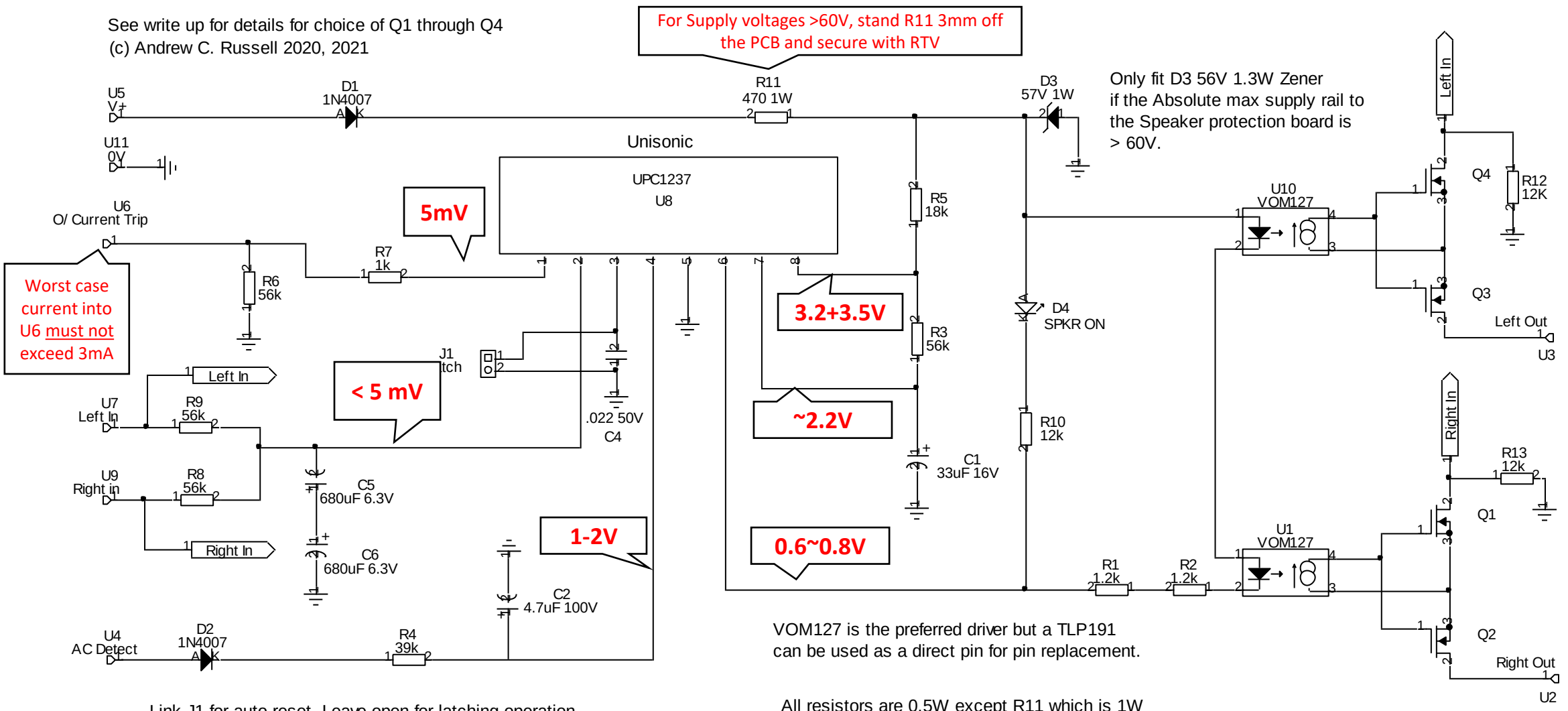
Relays are a VERY BAD solution when dealing with high voltage, high current switching, or with inductive loads.

Instead of using relays between the amplifier output and the speaker, the hifisonix speaker protection board uses power mosfets. These offer lower on resistances than relays, easily switch 10x the currents a good quality relay can, suffer no contact degradation over time, handle inductive loads and switch DC just as well as AC.

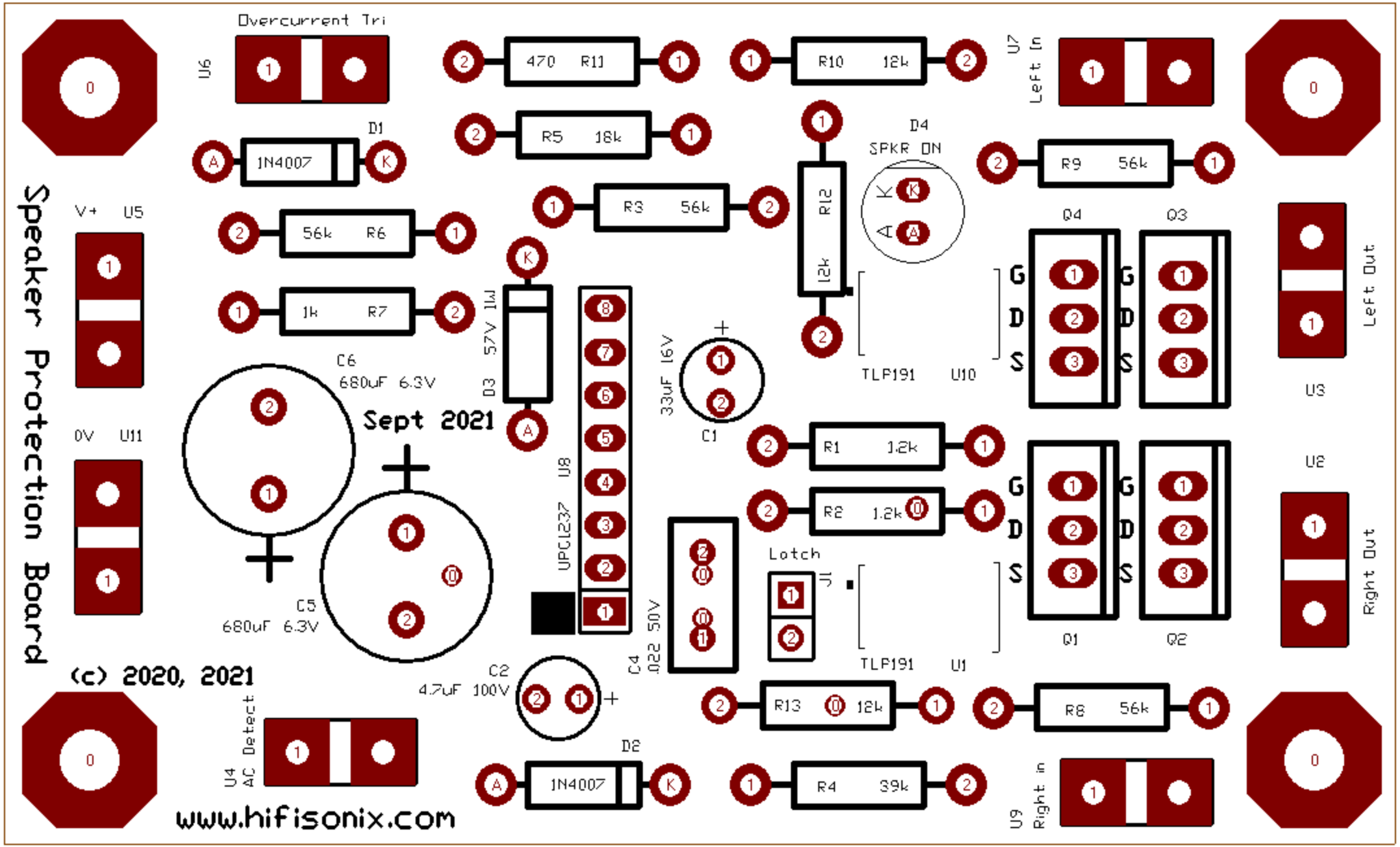
The standard UPC1237 device will work to 60V. On the hifisonix board, a simple zener voltage limiter extends the maximum operating voltage allowing use with high power amplifiers with supply voltages of up to +-75V (using suitable mosfets of course – see table later in this document)

Hifisonix Speaker Protection Board Schematic

The voltages in red were measured with a +55V supply and the AC Detect input connected to the V+ input terminal U5 and the SPKR ON LED illuminated



Attention: the values shown in the circuit are for amplifier +ve supply voltages of ≥60V. See slide 6 for other supply voltages


Speaker Protection Board
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Sept 2021
Overcurrent Tri
U6
D1
1N4007
470 R11
R5 18k
R3 56k
56k R6
1k R7
R10 12k
R12 12k
D4
SPKR ON
R9 56k
U7
Left In
V+ U5
0V U11
C6
680uF 6.3V
C5
680uF 6.3V
D3 57V 1W
U8
UPC1237
33uF 16V
C1
R1 1.2k
R2 1.2k
Latch
J1
TLP191 U10
Q4
Q3
Q1
Q2
TLP191 U1
U3
Left Out
U2
Right Out
C4 .022 50V
C2
4.7uF 100V
D2
1N4007
R13 12k
R4 39k
R8 56k
U4 AC Detect
U9 Right in

Resistor values for selected supply voltages

Vs is the supply voltage at connector U5

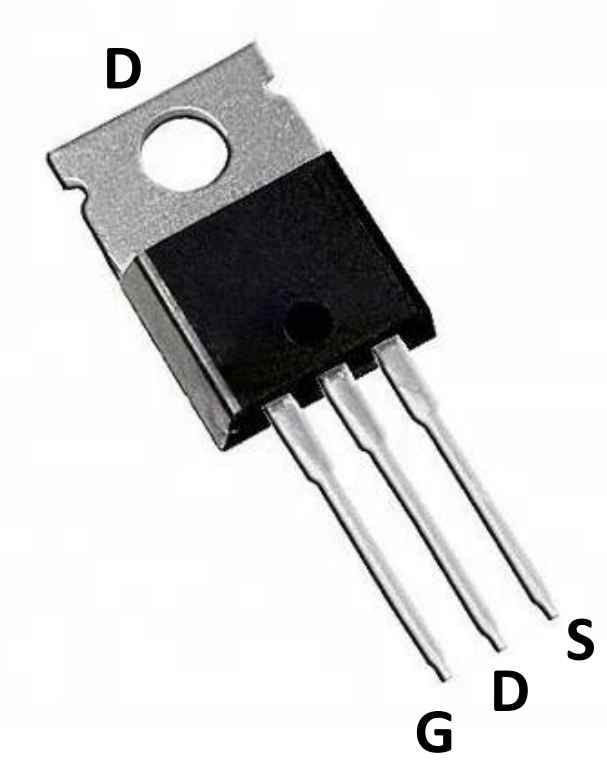
Vs	R1	R2	R4	R5	R10
25	330	330	15k	8.2k	4700
30	390	390	18k	10k	5600
35	560	560	22k	10k	6800
40	680	680	27k	12k	6800
45	820	820	27k	15k	8200
50	1k	1k	33k	15k	10k
55	1k	1k	33k	18k	10k
60	1.2k	1.2k	39k	18k	12k
65	1.2k	1.2k	39k	18k	12k
70	1.5k	1.5k	39k	18k	12k
75	1.5k	1.5k	39k	18k	15k

Note: Above 57V, a simple zener regulator (D3) limits the supply voltage to 57V. See the circuit diagram for details.

Table 1 – Mosfet Selection. Note: All mosfet types are TO-220.

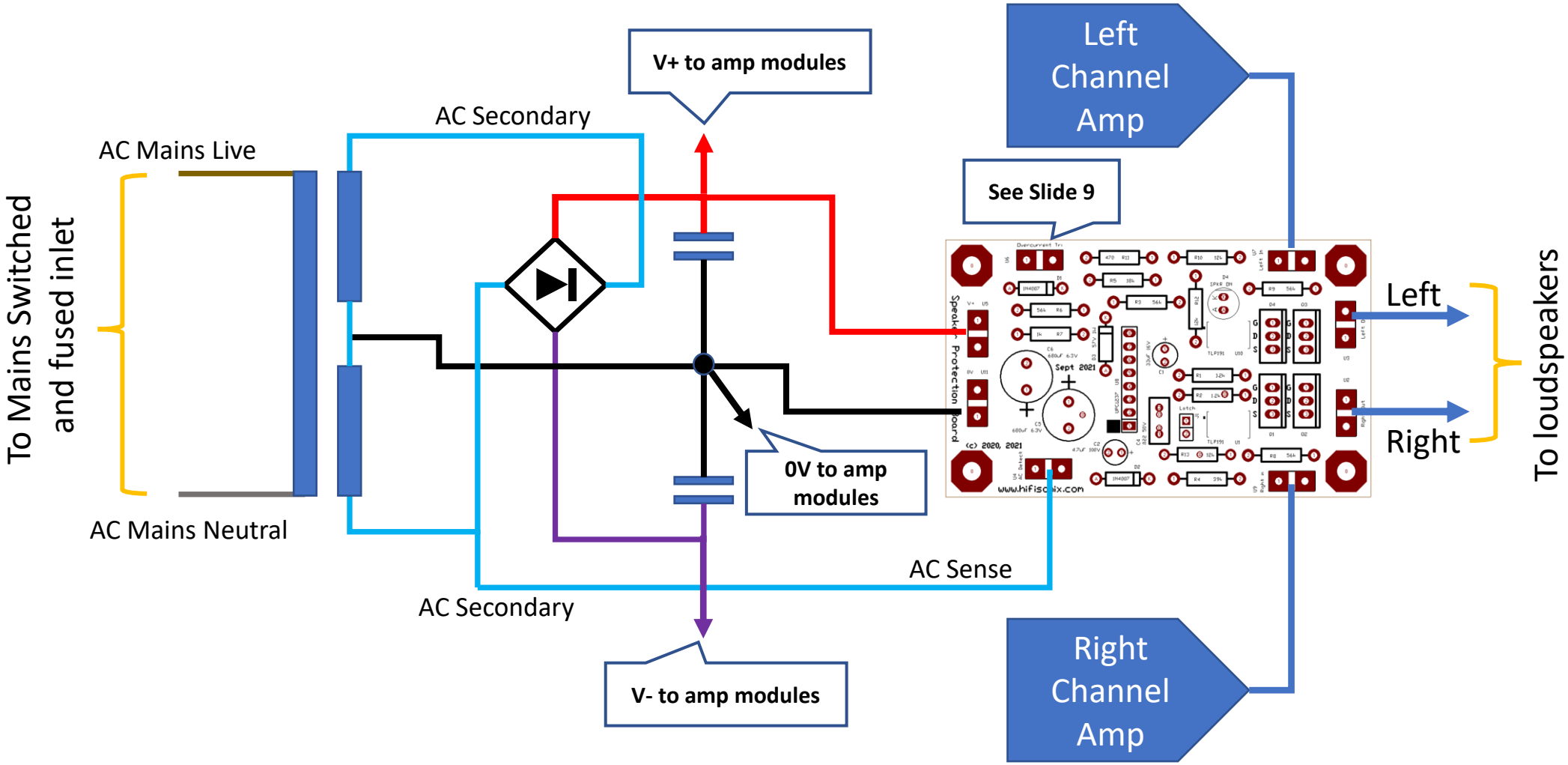
Amplifier Absolute Max Supply Voltage	Suggested Mosfets
<= +-30V	IRLB8748PBF, IPP042N03L G, PSMN2R7-30PL,127, IRLB8743PBF, STP200N3LL
+-40V	PSMN2R1-40PL, PSMN1R9-40PL, IRF40B207, TK3R1A04PL,S4X, IPA041N04NGXKSA1, PSMN8R0-40PS,127, IPP80N04S404AKSA1, PSMN4R5-40PS,127
+-50V ~ +-60V	BUK954R8-60E, PSMN2R5-60PL, PSMN3R3-60PLQ, PSMN4R2-60PL, IXTP120N075T2, STP220N6F7
>+-60V ~ +-75V	PSMN3R5-80PS, PSMN4R4-80PS, PSMN4R3-80PS, FDP4D5N10C, TK5R3E08QM,S1X, FDP053N08B-F102, IRF1407PBF, DMTH10H005LCT, SQP120N10-09_GE3, PSMN3R3-80PS,127

Device Pinout



The table above is a list of indicative power mosfets that can be used with the speaker protection board. In general, logic level types with lower gate charge (‘Qdg’) are preferred.

How to wire in the Protection Board to your Amp



Using the Current Overload Detection Input (terminal U6) – Some Ideas