APN 004
Tuning in amplifier input stages - Protection

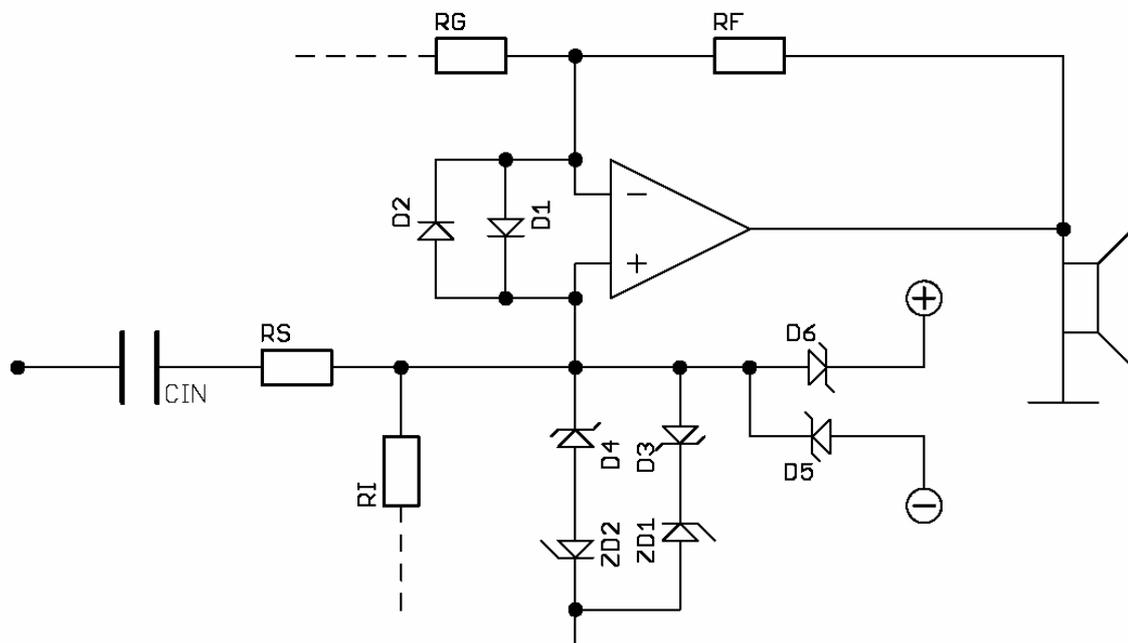# The protected amplifier input

fig. 1

fig. 1 shows a protected input stage with lowest Distortion introduced by protection.
D1 and D2 limit the differential voltage between + and – input, e.g. needed if
feedback is corrupted or output is clipping (in case of output clipping, the + input is
higher/lower than the – input. This would destroy the input stage if not protected)
ZD1 and ZD2 clamp the + input voltage at a level, which would not destroy it. See the
amplifiers datasheet for this values. D3 and D4 are introduced because of reducing
capacitance. Diodes, especially Z-diodes have a voltage dependent capacitance. For
Z-diodes it can be high as 500pF. By using the shottky diodes, the capacitances are
connected in series which makes the total cap. lower than the smallest of both.
(see also next chapter)
D5 and D6 are in use if the Power supply is not up, but there is signal on the input.
They clamp the input voltage to the Power supply rails. If supply is up, they have so
low capacitance that they don't affect the circuit.

Rs must be calculated so that at maximum input voltage (peak) the diodes would
draw it's maximum allowable current (or less).

Sometime, D1 and D2 are intrinsic in the amplifier (check datasheet !!)

Diodes

Typical capacitances of common diodes:

LL4148:   4pF (0V)   < 1pF (Vr > 1V, typ)   Vf = 750mV @ 10mA
BAT41:   5pF (0V)   < 1pF (Vr > 20V, typ)   Vf = 650mV @ 10 mA
BAT48:   20pF (0V)   < 4pF (Vr > 20V, typ)   Vf = 300mV @ 10 mA
BZX85C4V7:   400pF (0V)   150pF (Vr =4.7 V, typ)

Vr =   Reverse Voltage
Vf =   Forward Voltage

Another possibility is to replace the diodes by transistors. But this is only useful in case of high voltages (clamping on power supply)

fig. 2

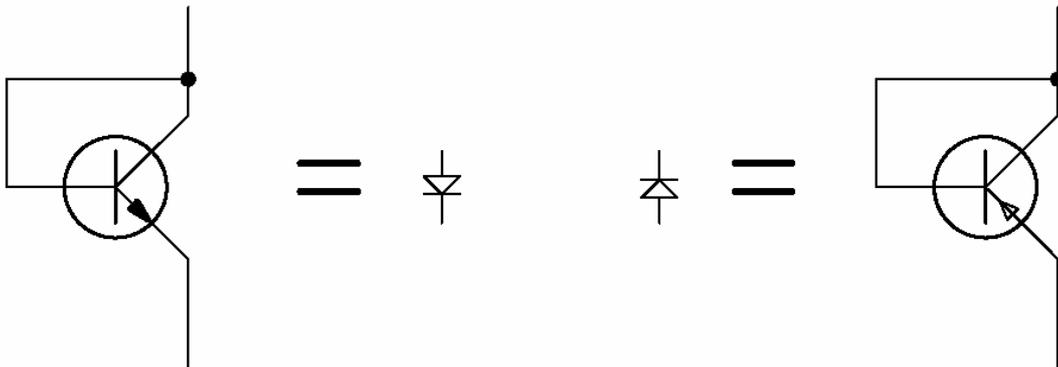BC546/550:   11pF (Vr = 0V)   1.5pF (Vr = 10V)   (NPN)
BC560:   7pF (Vr = 0V)   <2pF (Vr = 10V)   (PNP)
2SA970:   10pF (Vr = 0V)   5pF   (Vr = 10V)   (PNP)
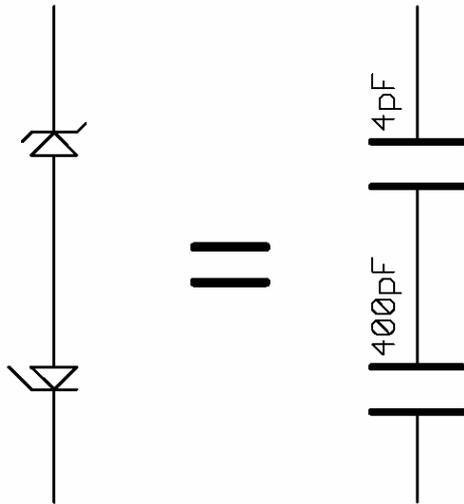
Forward Voltage is in the range 600-800mV in all cases.

fig. 3

fig. 3 shows the benefits of using 2 diodes. The total capacitance is C1 // C2. In the e.g. this would result in 3.9 pF in contrast to the 400pF of the Z-diode only.