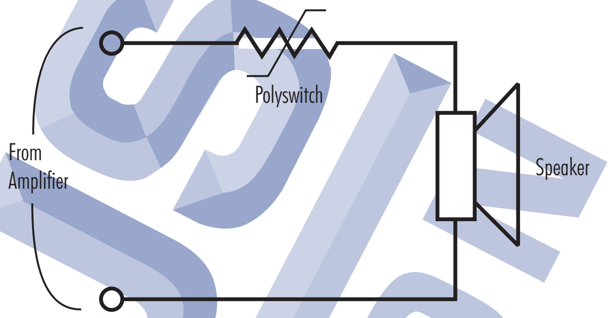
POLYSWITCHES:

Low Cost Overcurrent Protection

Polyswitches are a special type of *positive temperature coefficient* (PTC) resistor, made from a conductive polymer mixture. At normal ambient temperatures, the conductive particles in the polymer form densely packed low-resistance chains, and allow current to flow very easily. However if the current flowing through the device causes the internal temperature to reach a critical level, the polymer's crystalline structure suddenly changes into an expanded amorphous state, producing a dramatic increase in resistance and a sharp reduction in current. The critical current level at which this happens is known as the 'trip' current.

If the voltage level present at tripping is maintained, enough 'holding' current can generally flow to keep the polyswitch internal temperature high, and it will stay in the tripped state. It will only reset if the voltage is reduced to a level where it can cool. When this happens, the polymer particles rapidly return to their original structure and the resistance drops again.

As you can see, a polyswitch acts very much like a self-resetting solid state circuit breaker, and this means they're very suitable for providing low cost over-current protection for speakers, motors, power supplies, battery packs and so on. A very handy device!



Cat No.	Part No.	Trip current (A)	Maximum voltage	Nominal R (Ω)	Tripping power level (watts)		
					4Ω	6Ω	8Ω
RN-3460	RXE075	1.13	60V	0.39	5.1	7.7	10.2
RN-3462	RXE090	1.35	60V	0.34	7.3	10.9	14.6
RN-3464	RXE110	1.65	50V	0.21	10.9	16.3	21.8
RN-3466	RXE160	2.40	50V	0.14	23.0	34.6	46.1
RN-3468	RXE185	2.80	50V	0.12	31.4	47.0	62.7
RN-3470	RXE250	3.75	50V	0.08	56.3	84.4	112.5

At present, protecting speakers from electrical overload damage is probably the most common use for polyswitches. Here the polyswitch is simply connected in series with the speaker to be protected, but you need to choose a polyswitch with the correct trip current level, to match the power level that the speaker can safely handle.

Working out the right trip current level is simply a matter of using the expression:

$$I = \sqrt{(P/R)}$$

In other words, divide the speaker's power level in watts (P) by its nominal impedance in ohms (R), and then take the square root of the result. This will give you the speaker's maximum rated current level (I), so you can choose the polyswitch with the closest trip current level. To provide even higher protection, choose one with a *lower* current level if you wish — as long as you don't mind having to turn down the volume when it trips occasionally on loud music peaks. Much better than having to replace a speaker!

To make it even easier to choose a polyswitch for speaker protection, our Table shows the power levels for 4Ω, 6Ω and 8Ω speakers which correspond to the trip current levels for the polyswitches stocked by Electus. The table also shows the nominal 'cold' resistance of each polyswitch (i.e., below tripping level), its rated maximum voltage and the maximum current level it can interrupt without being permanently damaged itself.

Note that a polyswitch can only protect a speaker from overcurrent/overheating damage. It can't protect against physical damage, or mechanical overload due to inadequate cabinet design.

VARISTORS (MOVs):

Low Cost Overvoltage Protection

As the name suggests, **metal oxide varistors** or 'MOVs' rely for their operation on the electrical behaviour of a metal oxide — usually zinc oxide. A varistor made from particles of this material is essentially an insulator at low voltages, but 'breaks down' once a certain high voltage is reached. When it does break down, the varistor suddenly conducts current.

A MOV therefore behaves very much like two high-voltage zener diodes, connected in series back-to-back (so they're not polarised). This makes MOVs very suitable for high voltage clamping, and for absorption of over-voltage transients or 'spikes'. They're very suited for absorbing transients, because the energy is simply dissipated as heat.

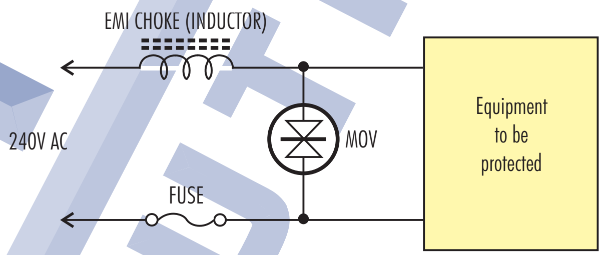
MOVs are often found in the power supplies of computers and other sensitive equipment, and also in mains filters and stabilisers, to prevent damage from mains-borne transients due to switching or lightning.

A MOV is usually connected directly across the mains input of the equipment it's protecting, with a series filter inductor and/or fuse to protect the MOV itself. MOVs are made with various clamping voltage and peak current ratings, and also a maximum **energy** rating — reflecting the fact that a MOV can absorb a very large amount of power for a very brief time, but smaller amounts over a longer time. This rating is therefore given in **joules** (J), where one joule is effectively a **watt-second**. So a MOV rated at 60J can absorb 60 watts for one second, or 600W for 0.1 seconds, or 6kW for 10ms, or 60kW for 1ms, and so on.

The MOVs stocked by Electus are selected for use on either 120V or 240V AC, with their clamping voltage ratings comfortably above the peak value of these RMS voltages. That's why their 'operating voltage' is shown as 130V and 275V respectively.

Three different 275V devices are available, with increasing peak current and maximum energy ratings. The type with the lowest current/energy ratings is suitable for circuits where there's a series inductor to help limit transients, while those with the higher ratings are more suited to applications where they have to provide all of the protection themselves.

Note that MOVs are not indestructible; they can occasionally be destroyed by very long, high energy transients. However in most such cases they still protect the rest of the equipment from serious damage, by absorbing the bulk of the transient energy. Since MOVs themselves are quite low in cost and relatively easy to replace, it's a small price to pay for such effective protection.



Cat. No.	Diameter	Operating volts (RMS)	Clamping voltage	Peak current	Maximum Energy
RN-3408	14mm	130V AC	340V	4500A	57J
RN-3406	10mm	275V AC	710V	2500A	60J
RN-3400	14mm	275V AC	710V	4500A	115J
RN-3404	20mm	275V AC	710V	6500A	190J