Siemens Matsushita Components

PTC thermistors for degaussing

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Large screens in TV sets and PC monitors must present pictures of high color purity and definition. Degaussing circuits equipped with PTC thermistors from Siemens Matsushita Components ensure perfect picture quality.

Picture tubes are shielded against external influences, especially magnetic effects, which can interfere with cathode rays. This shielding and the shadow mask can be magnetized by the earth's magnetic field and by other magnetic fields, e.g. from transformers, lamps and power cables. This interference results in chromatic aberrations (**Fig. 1**) and blurred edges. These effects can be compensated

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by degaussing with a magnetic field powerful enough to cancel the alignment of the magnetic dipoles. Such an alternating magnetic field must neutralize the external field in all relevant areas of the shielding and shadow mask. This is achieved by fitting a degaussing coil at the rear of the CRT.

However, a strong continuous magnetic field would prevent correct imaging. So the field has to be turned off after degaussing in accordance with the following requirements.

A sharp switching characteristic must be avoided. In the case of sudden decay, the magnetic field would align the particles according to the polarity of the last half wave before damping. The following half waves would then lack the energy to neutralize sufficient particles and fail to achieve the necessary statistical equilibrium of alignment of the magnetic dipoles after degaussing. The decay characteristic of the degaussing field is specified by the CRT manufacturer and is essential for correct degaussing.

A very low residual magnetic field strength is required to prevent the picture from "trembling" with the frequency of the AC power supply.

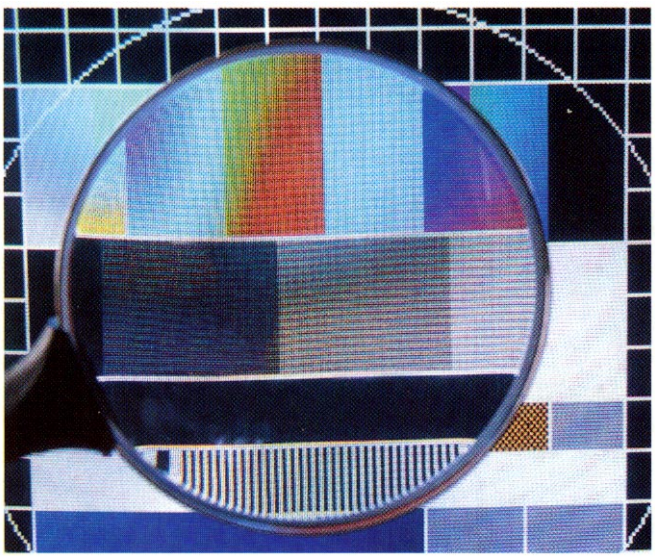
Correct degaussing with PTC thermistors

Thanks to PTC thermistor technology, degaussing functions can be implemented as follows in a single component:

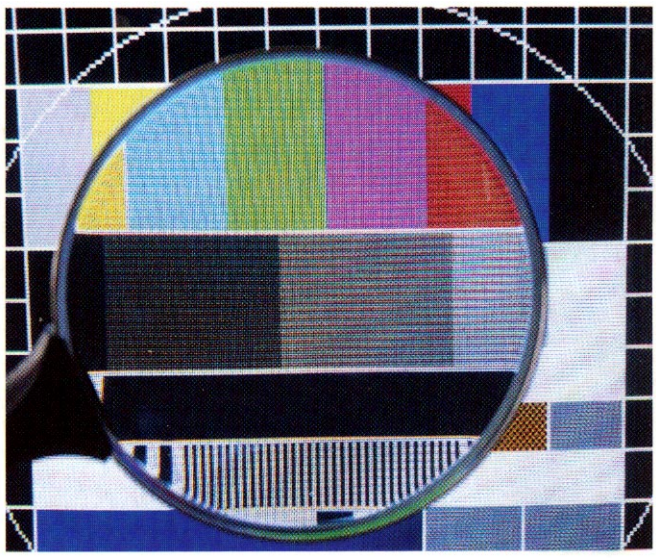
- When voltage is applied, the component has a low resistance. A high initial current can thus flow through the degaussing coil, which is connected in series with the PTC switching thermistor. This current and the number of windings determine the strength of the magnetic field.
- The current heats up the thermistor, whose resistance then rises in accordance with its positive temperature characteristic. This effect leads to controlled

Fig. 1 Interference from magnetic fields causes chromatic aberrations (a), which are compensated by a degaussing circuit (b)

a



b



reduction of the degaussing current and thus optimum damping of the magnetic field. The correct damping characteristic is achieved by the design parameters of the PTC thermistor (reference temperature, disk size, thermodynamic properties, etc.).

- Application of a continuous voltage during operation leads to thermodynamic equilibrium of the PTC thermistor, whose resistance remains high as a result of self-heating. The residual current is limited to the required value as long as the resistor is connected to the supply voltage. The magnetic effects on the picture then remain within the specified limits as long as the CRT is switched on.

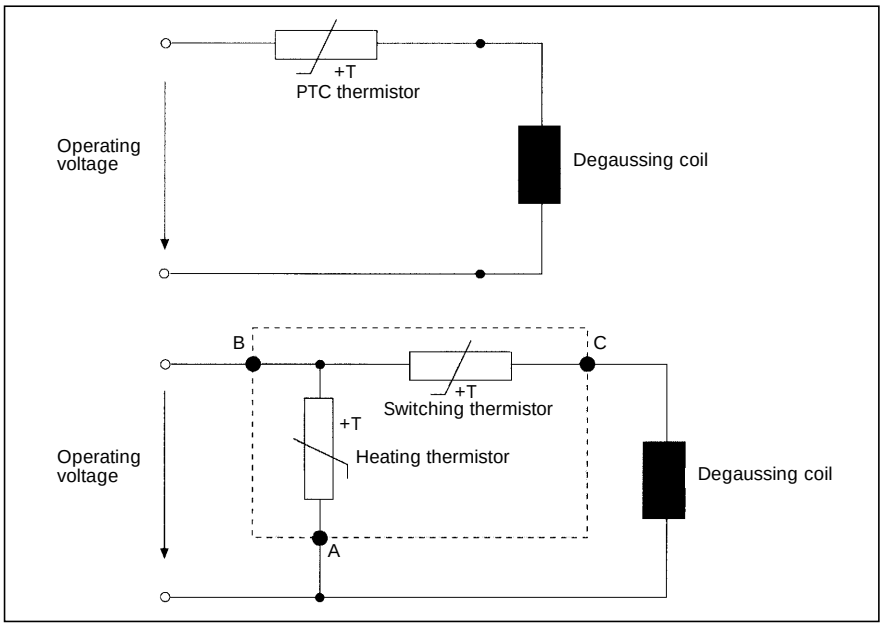


Fig. 2 A degaussing module consists of a degaussing coil with single-disk (a) or double-disk (b) PTC thermistors

The cost of degaussing

The cost of the degaussing modules is largely determined by the costs of the coil and PTC thermistor. Coil costs depend on the wire diameter, number of windings and coil material (usually copper). The current required is obtained by selecting a PTC thermistor with an appropriate rated resistance RN and a coil of cost-optimized design. The cost of the PTC thermistor depends on its design, i.e. wired or cased, single or double-disk type, etc.

Costs can be reduced further by using PTC thermistors with a low resistance. Coils of higher resistance can thus be used and the diameter of the coil wire reduced. This means lower material costs for the same current ratings

The specifications of many monitors and TV sets with small screen sizes can be satisfied by a degaussing circuit with a single-disk PTC thermistor (**Fig. 2a**). This provides a low-cost solution for applications with high performance and safety requirements.

In contrast to the single-thermistor circuit, a degaussing circuit with a double disk PTC thermistor (**Fig. 2b**) offers extra advantages for the large screens of high-end applications, e.g. graphics and medical systems:

- Very low residual current

New high-quality CRTs require extreme suppression of image distortions caused by the frequency of the AC power supply. In normal operation, the residual current must therefore be very low (less than 4 mA), with conditions stable after about 180 s. This can be achieved with a PTC thermistor of type T250. Such low residual currents call for a second PTC thermistor for heating. This heating thermistor heats up the switching thermistor so that the latter's resistance increases after stabilization (**Fig. 3**). The residual current is thus reduced to the low value required.

- Exact control of degaussing current

Many high-quality picture tubes require high inrush currents, combined with minimum residual currents and special damping characteristics. Control of the degaussing process can be adapted with PTC thermistors of double-disk design. Precision production of degaussing thermistors in cases of matching design guarantees correct setting of the electrical and thermal parameters of switching and heating thermistors for controlled decay.

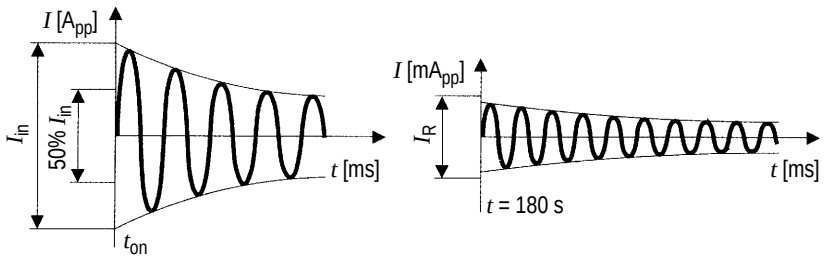
Selecting the right PTC thermistor for degaussing

The following characteristics are important for selection of a suitable PTC thermistor for degaussing:

- V_{max}: maximum operating voltage for which the PTC thermistor is designed
- R_N: rated resistance of the degaussing thermistor at 25 °C
- R_C: resistance of the coil; the current characteristics specified refers to the total resistance $R_N + R_C$
- I_{in} inrush current of the coil, responsible for complete degaussing during turn-on, specified at 25 °C and rated voltage
- I_R residual current, specified for the same conditions as I_{in} and measured after 180 s

All currents are peak-to-peak values

The inrush current (left) and the residual current (right) are key parameters of PTC thermistors used for degaussing



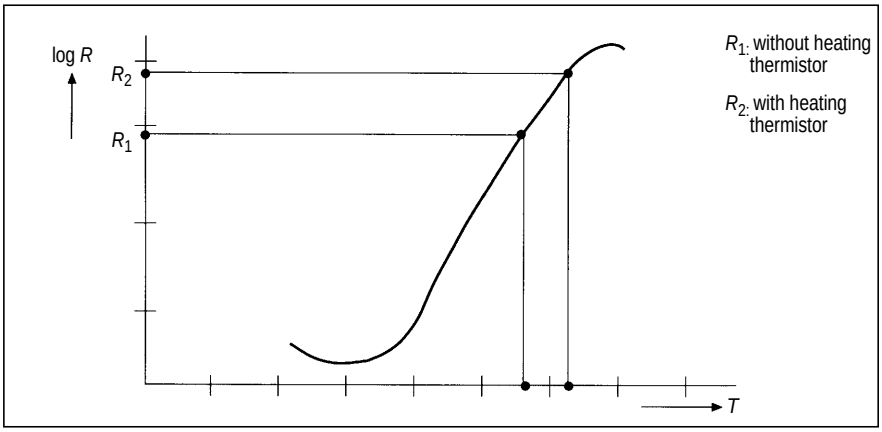


Fig. 3 If double-disk PTC thermistors are used for degaussing, the heating thermistor increases the temperature and thus the resistance of the switching thermistor after stabilization

Smooth damping independent of ambient temperature

Switching thermistors with low reference temperatures have a steep switching characteristic, i.e. the inrush current declines rapidly. In contrast, PTC thermistors from Siemens Matsushita Components have a high reference temperature of 80 °C and a smooth damping characteristic. The long decay characteristic results from the high reference temperature and other design features (thermistor disk volume, contact configuration, etc.).

The decay performance of degaussing thermistors with low reference temperatures can be impaired by the ambient temperature. The switching time within which the PTC thermistor switches from a low to a high ohmic state is reduced when the ambient temperature approaches the reference temperature. The ambient temperature can likewise affect damping behavior. The reference temperature of 80 °C is essential for reliable operation at ambient temperatures up to 65 °C.

Designed for long-term stability

The clamping elements of cased PTC thermistors also contribute to their long-term stability (mechanical attachment of the PTC thermistor to the case, electrical contact between thermistor and terminals). The springs holding the PTC thermistor disks in the correct position are fixed at both ends. The position of the electrical contacts and of the PTC thermistor disks in the case are defined to narrow tolerances. Special clamping elements made from stainless steel-springs provide excellent electrical contact.

Advantages of degaussing with PTC thermistors from Siemens Matsushita Components

- Double-disk versions are approved to CECC44000/DIN EN 144000 from 1995, CECC 44 003 / EN 144 003 from 1995, and CECC 44 003 - 001 from December 1996. This simplifies certification of end products (VDE/CECC approvals).
- PTC thermistors are available for all standard AC supply voltages throughout the world.
- Cased versions are available with standard lead spacings.
- Special case design ensures compact dimensions and good sealing under normal production conditions against fluids and other substances from soldering that could impair thermistor operation and reliability.
- A PTC thermistor design (type T 209) with low ohmic resistance leads to noticeable reduction of material costs because wires of smaller diameter can be used for the degaussing coil.

In terms of electrical, thermal and mechanical design, PTC degaussing thermistors developed by Siemens Matsushita Components perfectly match the degaussing requirements of advanced computer monitors and color TV screens. I

Table 1 PTC thermistors for degaussing from Siemens Matsushita Components match the latest trends in computer monitor and color TV technology

Type	I_{in} A_{pp}	I_R (180 s) mA_{pp}	R_C Ω	R_N Ω	Ordering code
Single-disk, wired PTC thermistors					
C1250	≥ 11	≤ 22.5	25	25	B59259-C1080-B70
C1450	≥ 20	≤ 30	18	12	B59459-C1080-B70
Single-disk, cased PTC thermistors					
J104	≥ 25	≤ 30	10	14	B59104-J80-A10
Further types under development					
Double-disk PTC thermistors					
T100	20 to 30*	≤ 15	≥ 10	29	B59100-T80-A10
T104	25 to 35*	≤ 25	≥ 10	14	B59104-T80-B10
T108	20 to 30*	≤ 15	≥ 10	18	B59108-T80-B10
T170	20 to 30*	≤ 4	≥ 17	≤ 23	B59170-T80-A10
T209	18 to 28*	≤ 7	≥ 20	9	B59209-T80-A10
T250	10 to 20*	≤ 4	≥ 25	≤ 35	B59250-T80-A10
*) Measured at 230 V					