MK/116 Ed. 1

BRIMISTORS

Standard Telephones and Cables Limited

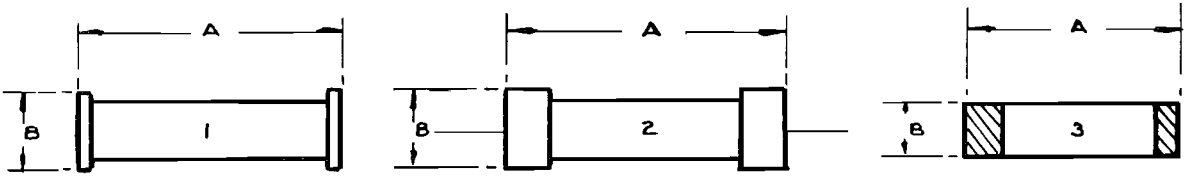


Fig. 1

Summary of Characteristics

Type	Outline	Dimension "A"	Dimension "B"	Initial Resistance Ohms 0°C	Initial Resistance Ohms 20°C	Initial Resistance Ohms 50°C	Max. Voltage Factor "k"	$E_{max.}$ Volts 20°C	Max. Operating Current Amp.	Resistance* at Max. Operating Current Ohms	Max. Instantaneous Current Amp.
CZ1 CZ1A	1 2	1¼″ 1¼″	5/16″ 5/16″	8300	3800	1400	2.36	25	0.3	44	0.6
CZ2	1	7/8″	¼″	12500	5500	1850	2.47	30	0.3	38	0.4
CZ3	1	5/16″	3/16″	3500	1500	560	2.9	13.5	0.2	35	0.3
CZ4 C4 CZ4A	1 3 2	1½″	7/16″	1700	800	320	1.92	14.7	1.25	5.5	2.0
CZ6	1	1¼″	⅜″	6000	3000	1120	2.4	23	0.45	27	0.7
CZ8A	2	¾″	5/16″	3700	1600	620	2.48	15.6	0.3	30	0.6
CZ9A	2	¾″	5/16″	800	350	130	2.53	7.8	1.0	3.7	1.3
CZ10	1	5/16″	3/32″	26000	11000	4000	5.4	19.5	0.075	148	0.150
CZ11	1	1¼″	⅜″	280	140	65	2.04	5.8	1.5	2.5	2.5
CZ12 CZ12A	1 2	1½″	7/16″	240	120	53	1.71	6.4	2.5	1.5	4.0

* In an ambient of 20°C. At higher ambients, this figure will be somewhat lower.

Characteristics and Operation of Brimistors

Brimistors are unpolarised resistive elements of thermistor material, and are peculiarly suitable for surge suppression and resistance variation compensation of other components in radio, television, telecommunication and projection equipment. The resistance of a Brimistor decreases with rising temperature, and so does its temperature coefficient. Thus a rise of about 20°C above room temperature will halve its resistance, but at 250°C an increase of 50°C is necessary to halve the resistance value.

Other Characteristics

Voltage-Current

The current through a Brimistor increases with the voltage across it until that voltage reaches a certain maximum ($E_{max.}$). Thereafter the Brimistor displays a negative voltage characteristic, current increasing rapidly with a decrease of voltage across the Brimistor.

The value of $E_{max.}$, which depends upon the ambient temperature and the type of Brimistor, is given approximately by:—

$$E_{max.} = \frac{R_T}{k}$$

where R_T = resistance of Brimistor at zero input and ambient temperature.

k = maximum voltage factor for the type of Brimistor concerned.

Initial Resistance

The resistance at zero power input of any type of Brimistor is entirely dependent, within normal manufacturing tolerances, upon the ambient temperature, as shown in the table opposite.

Thermal Characteristics

The rate of heating and consequent change of resistance of a Brimistor depends upon its mass, how it is mounted, and the circuit conditions in which it is employed; and the rate of cooling upon its mass and the difference between operating and ambient temperatures.

To choose the most suitable type of Brimistor for a specific application, consider the characteristics and ratings of the various types.

Typical Brimistor Applications

1. Surge Suppression in AC/DC Receivers

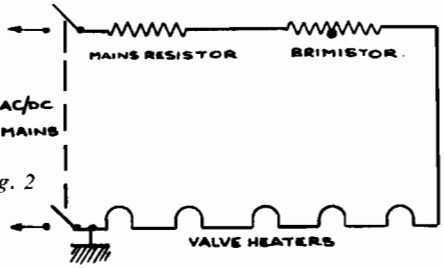


Fig. 2

To combat the surge which flows at switch-on because of the low cold resistance of a series chain of valves, a Brimistor may be connected between the mains resistor and rectifier valve heater. In a typical 0.3A chain, the surge can be reduced to 0.6A by a CZ1, to 0.45A by a CZ6 or to 0.38A by a CZ4. In some equipment, especially television receivers, using a number of different types of valve, it is necessary to shunt the Brimistor, delaying its resistance drop to prevent excessive voltage surges occurring across these valves having relatively small filaments.

For industrial applications, a CZ1 with 5-600Ω 5W shunting resistor can completely eliminate the surge.

Typical Chain	Current Amps.	Supply Voltage	Recommended Brimistor
4+1	0.3	200–240	CZ1 or CZ1A
4+1	0.15	200–240	CZ2
4+1	0.3	110	CZ1 or CZ1A
4+1	0.15	110	CZ1 or CZ1A
4+1	0.2	200–240	CZ1 or CZ2
4+1	0.1	200–240	CZ1 or CZ1A
TV Receiver	0.3	200–240	CZ1A or CZ1 shunted (preferred) or CZ4 or CZ6

2. Time Delay of Relays

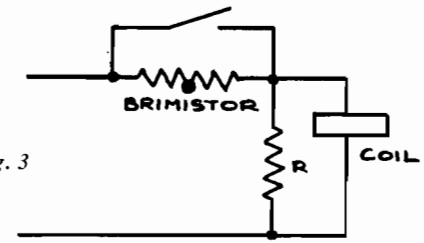


Fig. 3

A large range of time delays can be obtained by suitable selection of Brimistor and shunt. The circuit must be so arranged that $E_{max.}$ is exceeded at switch-on resulting in self-heating. Delay time increases with the size of shunt resistance, and further with the use of a series resistance. For small tolerance in delay time, the Brimistor should operate at high temperature, to reduce the effect of ambient variations. Short circuiting the Brimistor when the relay closes allows it to cool and permits a fresh delay immediately after the relay reopens.

3. Efficient Operation of Dial Lamps

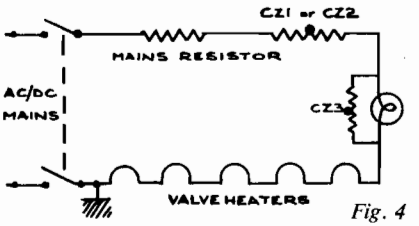


Fig. 4

Fitting a Brimistor for surge suppression obviates having to under-run dial lamps, which is otherwise necessary because of their heating time. The shunt resistor across the lamp may be replaced by a CZ3 Brimistor which, should the lamp fail, will quickly warm up, permitting the set to function at full efficiency provided heater current does not exceed 0.2A. For 0.3A heater chains, a CZ8A is suitable.

4. Protection of Rectifier Valves and Reservoir Condensers

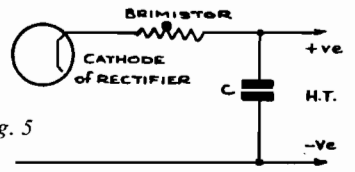


Fig. 5

The large switch-on current surge obtained with the large reservoir condensers of condenser input filters may be reduced by connecting a Brimistor between rectifier cathode and HT+ side of the reservoir condenser. The circuit shown is equally suitable for silicon or thermionic rectifiers.

Recommended types are:

Direct Current up to	75 mA	— CZ10
,, ,,	,, ,, 100 mA	— CZ1 or CZ1A
,, ,,	of 100 to 200 mA	— CZ6
,, ,,	over 200 mA	— CZ4

5. Delay of HT Voltage from Directly Heated Rectifiers

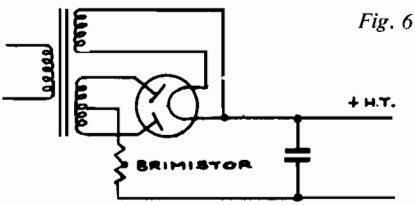


Fig. 6

The application of the full HT voltage to equipment, when a directly heated full wave rectifier is used may be delayed by connecting a Brimistor in the centre tap of the mains transformer. In selecting the correct Brimistor, the R.M.S. current value must be used. R.M.S. current in the centre tap will be 1.6 times the DC output current of the rectifier.

6. Compensation for Increase in Resistance of Focus Coils

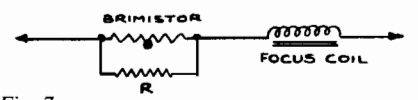
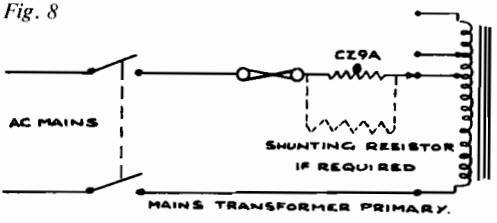


Fig. 7

The increase of resistance of a focus coil, owing to its temperature rise while operating, may be compensated by connecting a Brimistor in series with and in close proximity to the coil. For exact compensation, a shunt resistance also may be needed. According to the current involved, Brimistor types CZ2 or CZ3 are normally suitable.

7. Protection from Switch-on Surges in Mains Transformers

Fig. 8



By using a Brimistor to limit the switch-on surge in the primary of mains transformers of TV and radio receivers, the rating of the fuse or other protective device in the primary circuit may be reduced, thus giving more efficient protection against overload from component breakdown.

Type CZ9A is suitable but may require a shunting resistance to avoid peak surge current exceeding the Brimistor rating. A shunt of 200Ω, ½ to 1W should be suitable.

8. Protection against Filament Burn-Out in Mains/Battery Receivers

A Brimistor is effective in preventing the filament burn-out which may occur in mains/battery receivers if the HT voltage appears across the filament chain when a valve is removed or its filament becomes open-circuit. A CZ10, which is suitable for 25mA or 50mA filament chains, connected in parallel with the chain, will maintain the voltage at a safe value.

9. Protection of Projector Lamps

For this purpose special Brimistors have been developed with resistance and mass chosen to give adequate surge suppression with negligible loss of light output. They provide about ¼ sec. delay which is ample for the lamp filament to warm-up.

For recurrent operation the Brimistor must be allowed to cool before reswitching on. Some surge suppression is achieved if cooling is incomplete but for maximum protection the full cooling time indicated in this table is required:

Lamp Wattage	Supply Voltage	Cooling Time	Brimistor
500 Watts	200–250 V.	12 Mins.	CZ12
300 or 250 Watts	200–250 V.	10 Mins.	CZ11
150 Watts	200–250 V.	6 Mins.	CZ9A

Precautions In Use

Refer to the table for maximum ratings.

Current rating

The maximum *operating* current is a design centre rating which allows for normal supply voltage variation and an ambient temperature of 50°C.

The maximum *instantaneous* current cannot be exceeded without risking destruction of the Brimistor. Should a surge of this magnitude

be likely (e.g. on switching on certain valve heater circuits) a suitable resistor must be shunted across the Brimistor to ensure a slower, steady rate of current rise during the warm-up period.

Voltage rating

The voltage applied to a Brimistor must not exceed $E_{max.}$, when its source resistance is less than $^1/_{80}$ of the Brimistor's cold resistance. Even when this condition is fulfilled, care must still be taken that the maximum instantaneous current rating is not exceeded.

Installation

In mounting, half an inch of wire must be left free for soldering " CZ " type Brimistors. Type " C " Brimistors have silvered ends for insertion in clips, and " CZ–A " have axial wires and end caps.

In positioning a Brimistor, remember that its body temperature may reach 250°C and thus affect other components. Similarly a Brimistor operating in a confined or thermally insulated space may cause damage to itself, and forced air cooling is not advisable, as cracking may occur due to a thermal gradient being set up within the Brimistor.

Use of Shunts

In circuits of low total resistance, it may be necessary to increase the heating time of the Brimistor by shunting some of the current through a resistor. Constant current during the warm-up period may be obtained by choice of a suitable shunt resistor, but its value must not be such as to prevent $E_{max.}$ being reached owing to insufficient voltage being developed initially across the Brimistor.

Not to be used in parallel

Brimistors may not be used in parallel because differences in cold resistance, within manufacturing tolerance, result in unequal current flow which, being cumulative, will end by destroying one unit. They may in certain circumstances be connected in series.

Humidity

Brimistors are not specially sealed against moisture, and on first use after prolonged storage in high humidity there may be some increase of initial resistance, but once used, the Brimistor will return to its original cold resistance value.

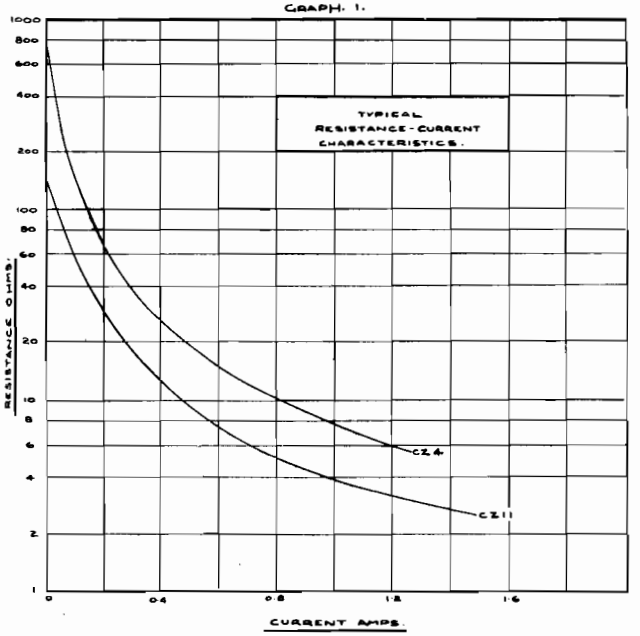
Mechanical Shock

The material of which Brimistors are made may fracture under excessive mechanical stress or shock.

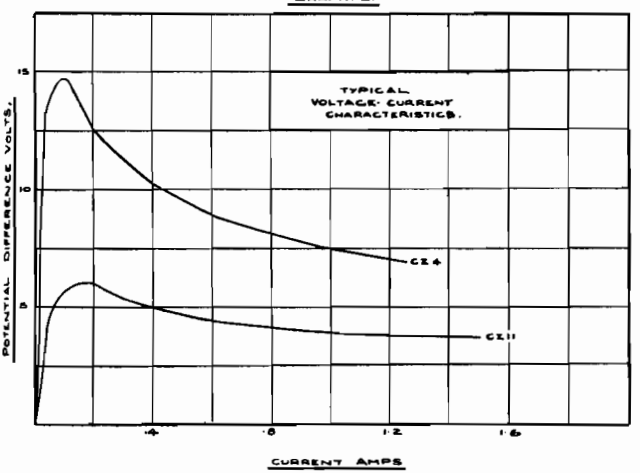
Tolerance

It must be realised that Brimistors are manufactured to normal mass-production tolerances and are not suitable for use in precision measurements.

GRAPH. 1.



GRAPH. 2.



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