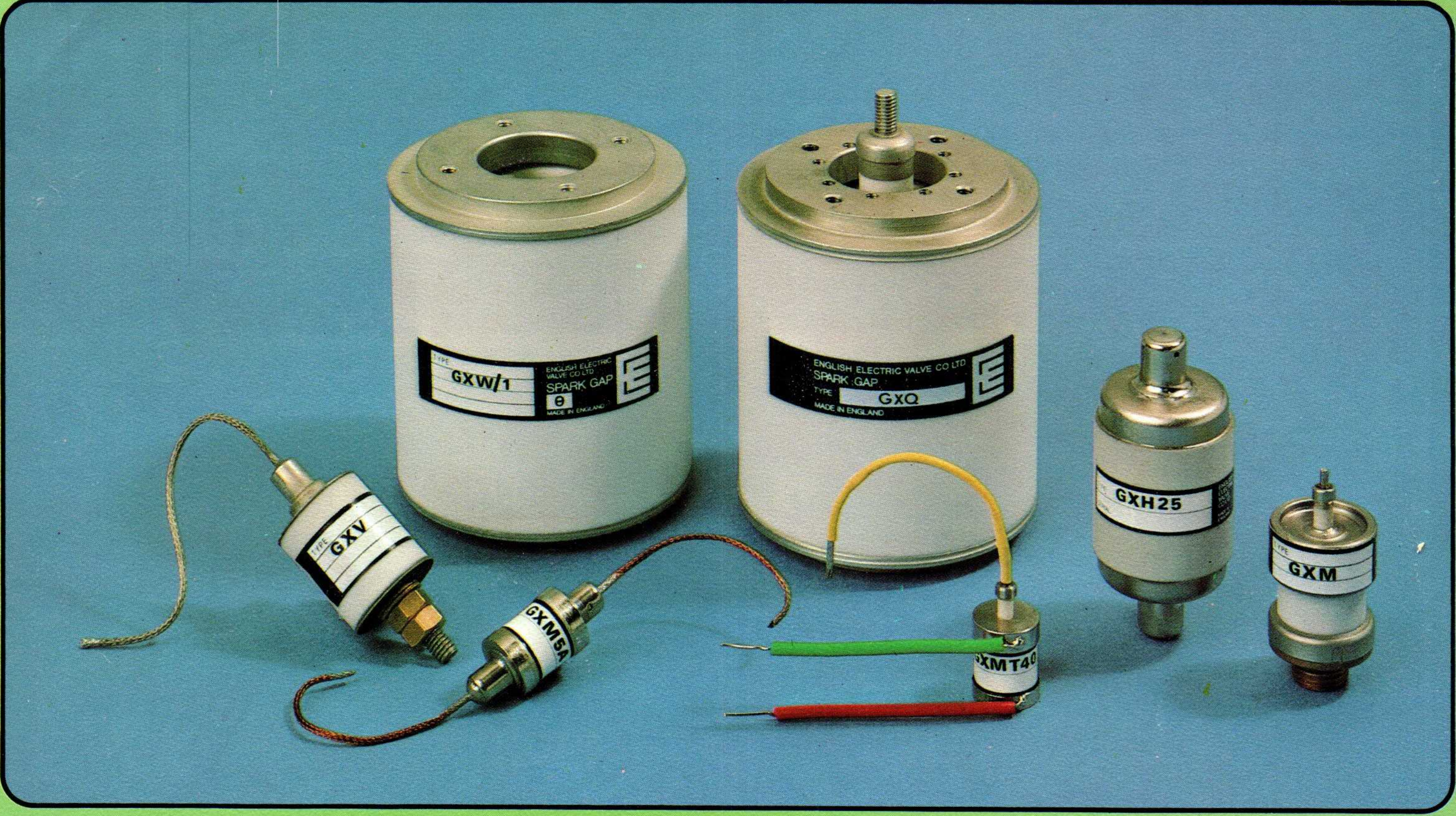
THE PROTECTORS



EEV Ceramic Spark Gaps

ALL ELECTRONIC CIRCUITS are subject to voltage transients. Since circuit components may be destroyed by these transients, some means of protection must be provided. The simplest and most effective means of providing this protection is by using EEV ceramic gas filled spark gaps. These spark gaps will react more quickly to a voltage transient than will an electro-mechanical device or solid state component, thereby giving greater protection.

Features

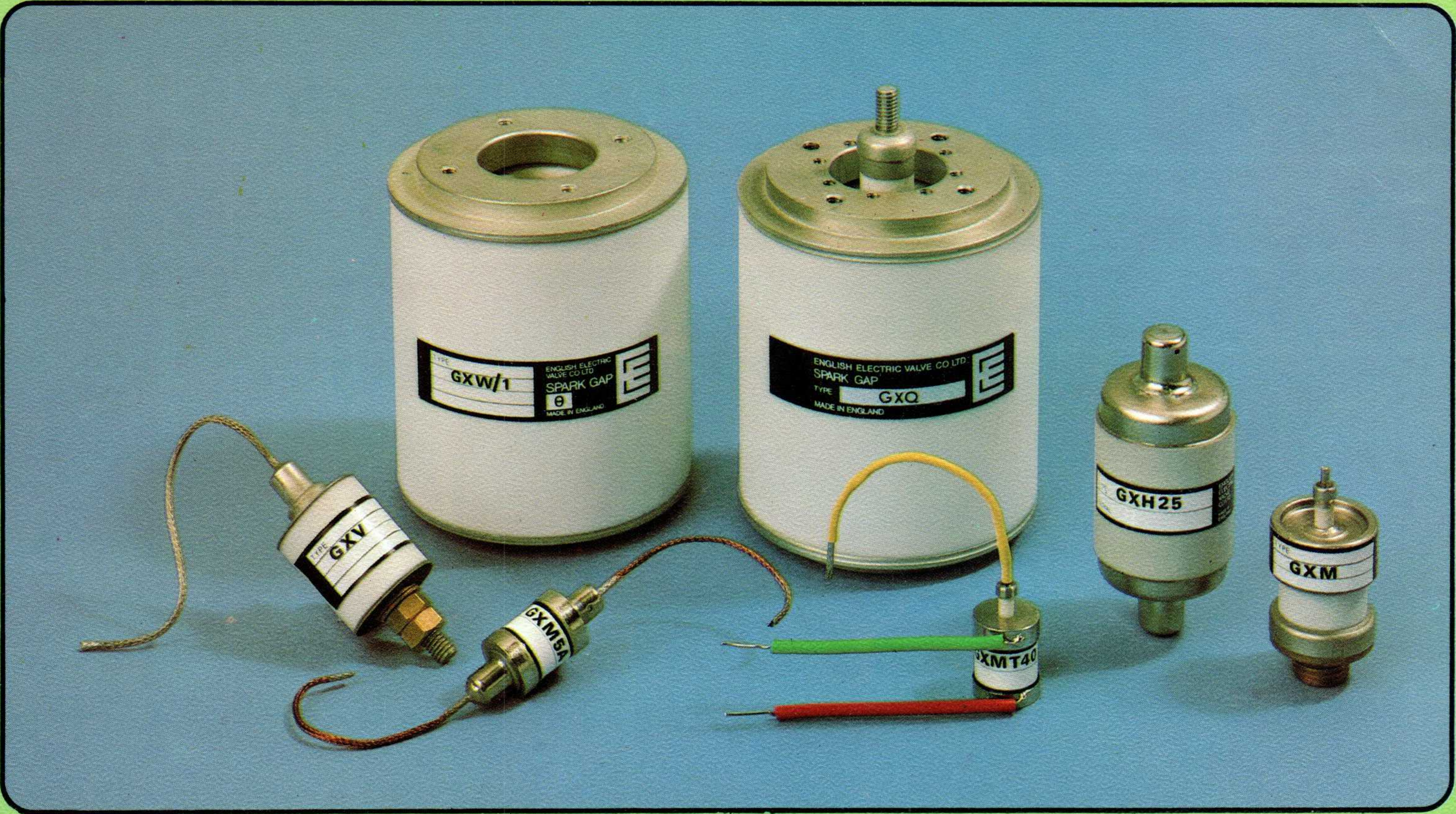
- Wide range, 500-40kV
- Rugged construction
- No stand-by power consumption
- High current capability
- Low inductance
- Universal mounting position
- Wide temperature range
- Low energy triggering

FOR FURTHER DETAILS CONTACT YOUR LOCAL AGENT OR EEV AT THE ADDRESS BELOW:

ENGLISH ELECTRIC VALVE CO LTD

Chelmsford, Essex, CM1 2QU, England
Telephone: 0245 61777
Telex: 99103 Cables: Enelectico Chelmsford

FAST SWITCHERS



EEV Ceramic Spark Gaps

PRECISE HIGH ENERGY SWITCHING is required in many applications, including ignition circuits, short pulse generators, laser pumping, Marx generating switch and EBW circuits. This can be accurately achieved by using EEV ceramic gas filled spark gaps.

Features

- Wide range, 500 - 40kV
- Rugged construction
- No stand-by power consumption
- High current capability
- Low inductance
- Universal mounting position
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SPARK GAPS

Introduction

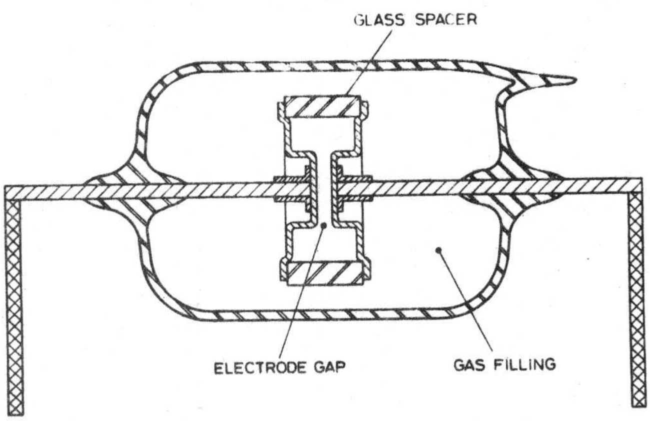
What is a spark gap?

The spark gaps manufactured by English Electric Valve Company are sealed gas filled switches and contain two or more electrodes which present a near infinite impedence to a circuit while unfired and a near short when fired.

Principles of operation

A simple two electrode spark gap is shown in figure 1.

Figure 1

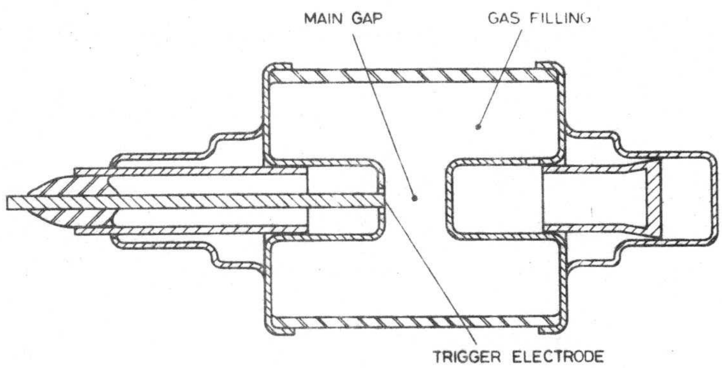


At low voltages the gap is a good insulator with a very low leakage current. As the voltage to the spark gap increases an avalanche effect is created until a point is reached where the gas filling forming the insulation is broken down and an arc discharging is formed between the electrodes which allows the passage of very high currents at a voltage of some 10 - 20 volts.

The arc persists until the current falls to a value insufficient to maintain arc conditions. The current flow then ceases and the ionization of the gas decays until the gap has returned to its original state.

The addition of the third electrode (see figure 2) makes

Figure 2



it possible to establish an arc at gap voltages below the breakdown value. Over a wide range of gap voltage a low-energy pulse applied to the third trigger electrode produces a small arc which transfers rapidly to the main gap. The device then reacts in the same manner as a two electrode spark gap.

Applications

Spark gaps are devices used for two basic functions:

1 As a protection device; and

2 As an energy switch.

If we deal with the first function, that of voltage surges and transient protection, the question will be asked - What needs protecting? The following is a list of equipments effected or damaged by external voltage surges:

Telephone lines

CATV lines

Power lines

Oil and gas pipelines

Antenna systems, radio, TV and microwave

These transients may be caused by the following:

Electrostatic fields ie charged clouds

Lightening

Shorting or interruption of currents in power lines

Auroras

Electromagnetic effects due to near-by nuclear explosions

Protection is also required against voltage surges and spikes. Delicate equipment may be damaged due to intentional or unintentional switching processes. Examples are listed below:

Amplifiers

Digital volt meters

Control circuits

Radios

Communications equipment

These surges or transients may be caused by the operation or switching of:

Inductors

Meters

Generators

Relays

Arcing of CRT's, power tubes and TWT's

Magnetron missing pulses

Sparkover on switch contacts

Figure 3 shows some typical protection applications.

Moving on to the second function of spark gaps, that of energy transfer switches, these are illustrated on the Applications Chart (figure 4). All these switching duties can be achieved by using EEV spark gaps.

Under the heading Pulse Generators and Relaxation Oscillators, here spark gaps can be used for the ignition of natural gas via a suitable ignitor, for the starting of jet engines and gas turbines. This is where the spark gap is used to discharge a high power capacitor into a ceramic or rare earth ignitor located in the flame chamber. EEV spark gaps are also used for igniting flare stacks on off-shore oil rigs and igniting flammable gases in the petro-chemical industry. Spark gaps are also to be found as simple Relaxation Oscillator switches in such things as electric fences.

EEV Spark Gaps Typical Applications

Figure 3

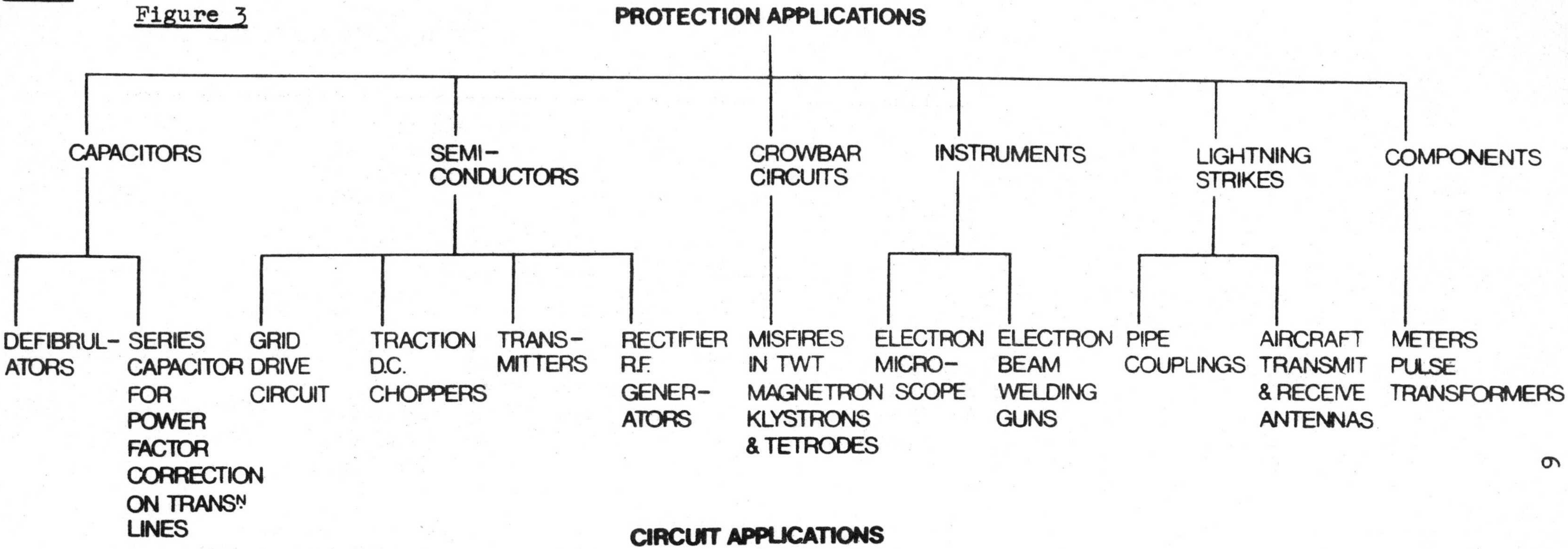
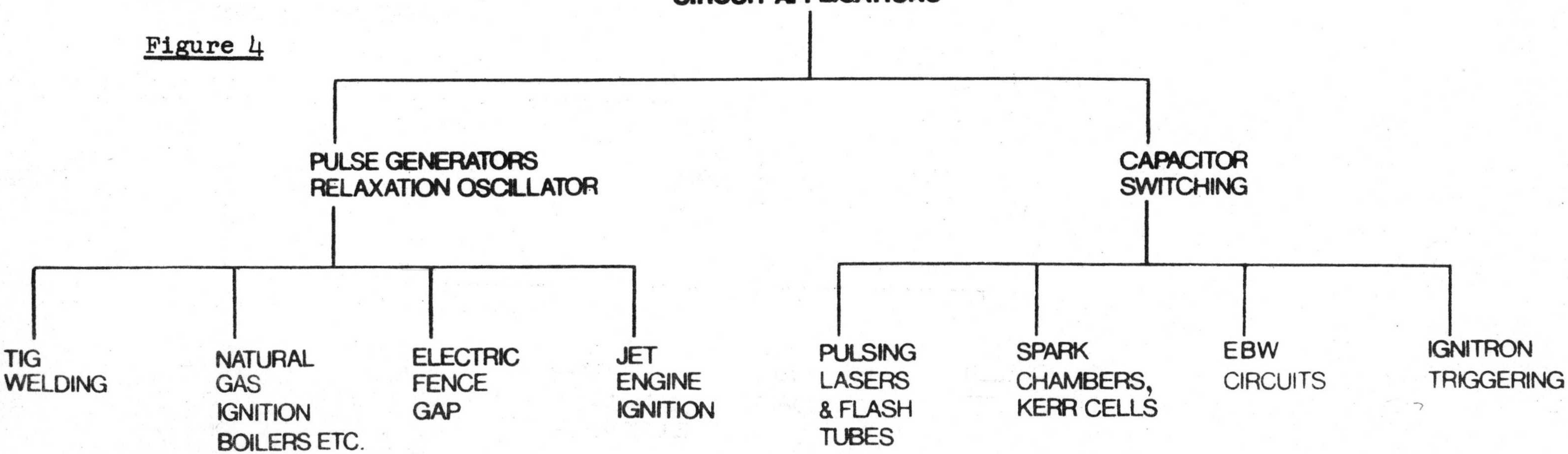


Figure 4



English Electric Valve Company Limited Waterhouse Lane, Chelmsford, Essex, England, CM1 2QU Telephone: Chelmsford (0245) 61777

Moving on to capacitor switching, EEV spark gaps are currently being used for:

- Pulsing lasers and flash tubes
- Switching spark chambers and kerr cells
- Switching exploding bridge wire circuits used in the detonation of nuclear explosions, war heads, close proximity shells, etc

Spark gaps are also used for ignitron triggering where they are used in nuclear fusion experiments by Physics Laboratories and Atomic Energy Authorities.

Competitive devices

For protection:	For energy switching:
Thyrites	Ignitrons
Varistors	Thyratrons
Capacitors	Thyristors
Selenium Rectifiers	Krytrons
Metrocils	Fast mechanical switches

Most of these competitive devices can be replaced by EEV spark gaps due to their high technology features listed as follows:

High current capability

Rugged construction

None-moving parts

Reliable hold-off voltage

Low inductance

Low capacitance

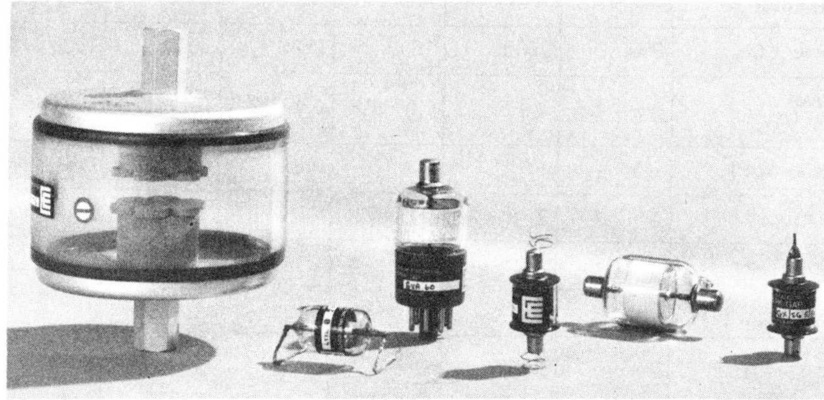
Low energy triggering (three electrode)

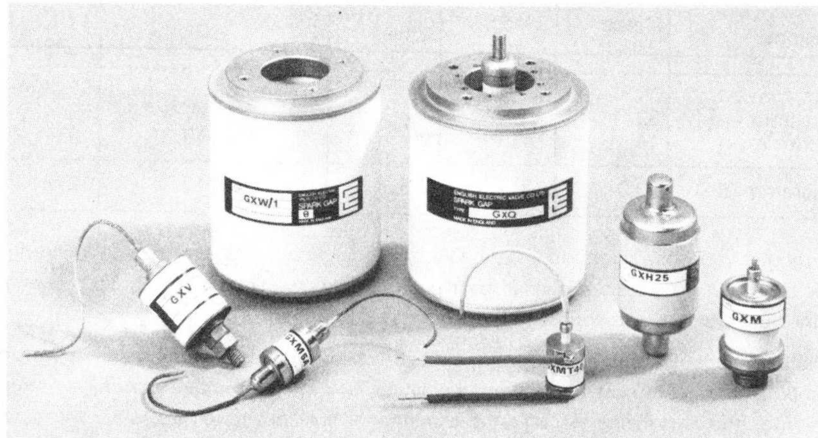
Very wide temperature range

Fast acting

No stand-by power consumption

Glass and Ceramic Envelope Spark Gaps





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Telex: 99103

Type	GXM5A	GXMT40	GXE	GXP	GXK	GXL	GXM70	GXA	GXB	GXC	GXN	GXR	GXV	GXH	GXQ	GXW	GXF
Cumulative charge (coulombs)	30	30	30	50	50	50	50	100	100	100	400	400	400	600	1000	1000	20 000
Max. discharge energy (joules)	10	10	10	10	10	10	10	10	10	10	75	75	75	100	2000	2000	5000
Max. current (A)	2500	2500	1500	2500	2500	2500	2500	3000	3000	3000	4000	4000	4000	10 000	75 000	75 000	80 000
Breakdown voltage (kV)	0.5 – 1.5	2 – 5	0.5 – 3.0	0.4 –12	0.4 –12	0.4 –12	3 –7	5 – 16 pulsed	5 – 16 pulsed	5 – 16	0.4 – 12	0.4 – 12	0.4 – 12	0.5 – 6	10 – 40	0.4 – 20	0.25 – 15
Capacitance (pF)	1.5	1.5	0.6	0.6	0.6	0.6	0.5	0.6	0.6	0.6	0.4	0.4	1.3	0.5	2	2	2
Impulse ratio †	6 – 2.7	–	6 – 1.7	7.5 – 1.7	7.5 – 1.7	–	–	–	–	–	7.5 – 1.7	7.5 – 1.7	7.5 – 1.7	6 – 1.8	–	7.5 – 1.5	12 – 1.6
Minimum trigger voltage (open circuit) (kV)	–	3	–	–	–	1	4	–	–	–	–	–	–	–	5	–	–
Number of electrodes	2	3	2	2	2	3	3	2	2	2	2	2	2	2	3	2	2
Construction G = glass C = ceramic	C	C	G	G	G	G	C	G	G	G	G	G	C	G	C	C	G
Terminations	2 caps 2 leads	2 leads 1 wire	2 flex	1 cap 1 stud	2 caps	1 wire 2 caps	2 leads 1 wire	1 cap octal	2 caps	2 leads	2 caps	1 cap 1 stud	1 cap 1 stud	1 cap 1 screw	screw mounted	screw mounted	2 studs
Overall dimensions height (mm max) dia. (mm max)	33 14	35 14	45 20	47 19	45 19	53 19	48 21	70 35	69 30	75 40	52 19	40 19	53 21	47 28	78 63	78 63	127 104
Weight (grammes)	13.5	10	7.5	15	12	12.5	40	35	27.5	138	18	20	29	37	465	450	900

† The impulse ratio of a spark gap is defined as the breakdown voltage of the device measured under an impulse condition, divided by the d.c. breakdown voltage. The values given are obtained using a 15 kV/μs voltage impulse.

The value of impulse ratio depends on the d.c. breakdown voltage to which the gap is made; the impulse ratio is highest for low voltage gaps. Two values of impulse ratio are given for each type, the first being typical of the minimum breakdown voltage while the second value refers to a gap made to the maximum breakdown voltage.

September 1979 Printed in England


TYPE GXW
ENGLISH ELECTRIC VALVE CO LTD
SPARK GAP
MADE IN ENGLAND
TYPE GXQ 350L
ENGLISH ELECTRIC VALVE CO LTD
SPARK GAP
MADE IN ENGLAND
TYPE GXF
ENGLISH ELECTRIC VALVE CO LTD
SPARK GAP
MADE IN ENGLAND
GXA
ENGLISH ELECTRIC VALVE CO LTD
SPARK-GAP
GXB
TYPE GXH
GXP
GXV
GXE
GXM70
GXMT40
GXN
GXK
GXL
GXK 47
7749 40
TVG 1A
GXM5A