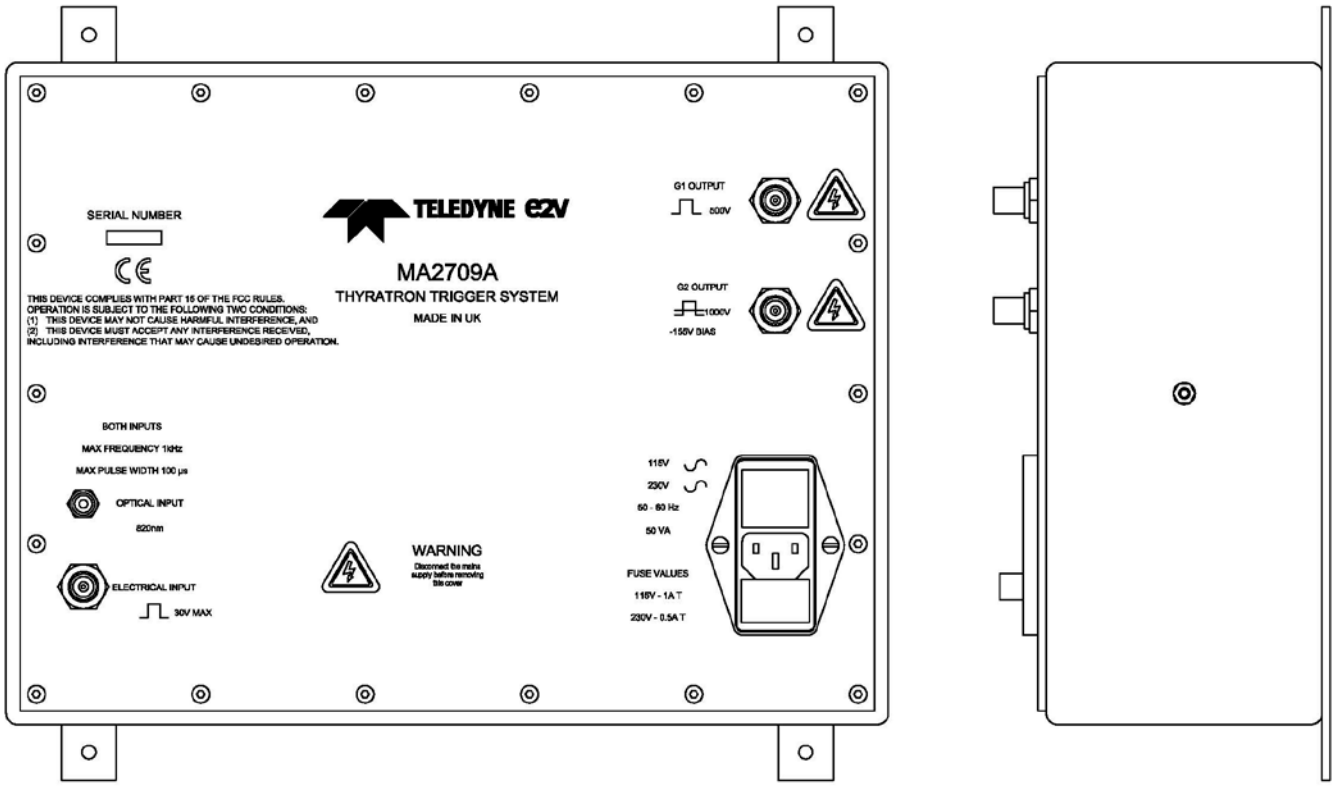


- Suitable for triggering most medium and high power thyratrons.
- Triggered by either optical or low–level electrical trigger input signal.

OVERVIEW

The MA2709A is designed as a trigger generator for most medium and high power thyratrons. It can be triggered by either a low-level electrical signal into the BNC connector or via an optical signal into the FSMA connector. The maximum working frequency is 1 kHz.

The MA2709A can provide a maximum grid 1 pre-ionising current pulse of 45 A (determined by the external grid 1 drive resistor) from a nominal 500 V drive voltage, together with a nominal 1 kV grid 2 trigger pulse (with -150 V bias) from an 80 Ω source, delayed from the grid 1 pulse by 0.5 µs. Grid 1 and grid 2 outputs are via SHV BNC connectors.

The unit has Transient Voltage Suppressors (TVSs) fitted internally but it is important that additional TVS protection, as described on page 2, is fitted close to the thyratron being triggered, and that the mains input is filtered and protected from voltage spikes. The earthing of the unit should follow good practice.

With the additional external TVS protection, the unit has been shown to withstand 20 kV, 100 ns spikes at the grid 1 and grid 2 outputs without damage.

Teledyne e2v (UK) Limited, Waterhouse Lane, Chelmsford, Essex CM1 2QU United Kingdom Teledyne e2v (UK) Ltd. is a Teledyne Technologies company.
Telephone: +44 (0)1245 493493 Facsimile: +44 (0)1245 492492
Contact Teledyne e2v by e-mail: Enquiries@Teledyne-e2v.com or visit www.teledyne-e2v.com for global sales and operations centres.

GENERAL DATA

Electrical

Input voltage (AC rms) (see note 1)	-	115 ± 10% v max or 230 ± 10% V
Input power	-	50 VA

Mechanical (See Fig.3)

Length	320 mm
Width: including feet without feet	 280 mm 240 mm
Height (including 4 mm feet and terminals)	123 mm
Net weight	3.8 kg
Mounting position (see note 2	any

Enviromental

Operating temperature range	+ 10 to+40 °C
Storage temperature	- 10 to+50 °C
Shock and vibration	see note 3
Cooling	see note 4

RATINGS AND CHARACTERISTICS

Input	Min	Max	
Input voltage (see note 1)	95	253	V ac
Input frequency	47	63	Hz
Power consumption		50	Va
Trigger input: electrical (see note 5) optical (See Fig 4 and note 6)	5	30	V
Trigger input impedance	450		Ω
Trigger input frequency (see note 7)		1	kHZ
Trigger input pulse duration		100	µs

Output	Min	Max	
Grid 1 output voltage (see notes 8 and 9)	500		V
Grid 1 output current (peak) (see note 10)		45	A
Grid 1 output impedance (includes 5 Ω fitted internally)	6.0	7.0	Ω
Grid 1 output pulse duration (see note 11)	0.5	0.8	µs
Grid 2 output voltage (see notes 8 and 9)	1000		V
Grid 2 output current (peak)		10	A
Grid 2 output impedance (includes 47 Ω fitted internally)	75	85	Ω
Grid 2 output pulse duration (see note 11)	0.40	0.55	µs
Grid 2 output rate of rise of voltage (see note 12)	5		- kV/µs
Grid 2 bias voltage (see note 13)	-90	-155	V
Grid 2 bias current (see note 13)		20	mA
Input to grid 1 pulse delay	0.2	0.4	µs
Input to grid 2 pulse delay	0.7	1.0	µs
Grid 1 to grid 2 pulse delay	0.5	0.6	µs
Time delay drift over full temperature range		25	ns
Input to grid 2 jitter		2	ns

NOTES

1. The MA2709A has a filtered changeover socket to allow operation with either 115 ± 10% or 230 ± 10% V ac mains input. The filter connects the mains earth to the box via a 400 11H inductor
2. The unit can be fitted in any position. Two metal strips are supplied with the unit; these can be bolted to the back of the case to provide four fixing feet with clearance holes for M5 bolts (see Fig. 3). The operating manual supplied with the unit has full details of methods of fitting.
3. The unit has not been tested to known levels of shock and vibration, but is of generally rugged construction. It should not be subjected to undue shock and vibration.
4. The ambient temperature close to the unit must be kept within the limits specified. No forced-air or other external cooling is required, but when operating near the maximum temperature, the unit should be positioned so that heat can flow away from the unit by convection or conduction.
5. The trigger level should be within the limits quoted; if they are exceeded then possible damage could occur to the unit
6. The optical input pulse is via the 9 mm FSMA style connector - receiver type HFBR -2404. Transmitter type HFBR -1404 is used for driving and testing. To achieve the best performance, the rise time of the input pulse should be as short as possible; a suitable driver is shown in Fig. 4.
7. Operating the trigger system at frequencies higher than 1 KHz may cause internal damage and overheating.
8. This is the open circuit voltage.
9. Outputs are via SHV BNC sockets. In order to meet the EMC emission requirements, the SHV BNC plugs must be wired with double-screened cable.
10. The grid 1 resistor must be set so that the grid 1 current does not exceed the maximum specified for the particular thyratron being triggered. If this is not done, the thyratron may be triggered detrimentally by the grid 1 pre-pulse instead of the grid 2 pulse. Typical resistor values and resulting grid 1 pulse currents are as follows:

G1 Resistor (Ω)	G1 Pulse Current (A)
4.7	35+
6.8	28
10	26
15	23
22	18
33	14
50	10

* Exact value will depend on circuit inductance.

11. Measured at 50% pulse amplitude.
12. Measured between 10% and 90% amplitude with no load connected.
13. The average current drawn from the negative bias supply depends on the operating frequency and the thyratron type. The negative bias supply is generated from a capacitor driven bridge circuit and therefore as the bias current increases, the negative bias voltage falls linearly at 2.5 V / mA

FAULT AND GRID SPIKE PROTECTION

Protection features of the MA2709A:

- Transient Voltage Suppressors (TVSs) fitted internally, together with more TVSs fitted externally close to the thyratron (see above), will protect the MA2709A from thyratron grid spikes. With the external TVS protection circuits fitted, the MA2709A has been shown to withstand a 20 kV, 100 ns long, 20 ns rise time spike at the grid 1 and grid 2 of a thyratron

- Earthing of the MA2709A is via the coaxial SHV BNC outer braids. The outer terminal of the trigger input BNC socket is also connected to the box and it may be necessary to use a ferrite core to minimise earth currents flowing along the input coaxial cable. See Figs. 1 and 2 for practical earthing considerations when fitting the MA2709A into a circuit.

- The MA2709A will operate continuously into an open circuit. The MA2709A will continue to operate if the outputs are short-circuited, but it is not designed to run continuously at full power into a short circuit. The limiting factor is the power rating of the internal grid 1 and grid 2 output resistors.

- The grid 2 negative bias falls to zero if the grid 2 output operates into a short circuit; no internal fuse blows.

- There are three protective fuses: one in the mains input socket to protect against failure of the primary power supply components and one in each of the supply rails to the grid 1 and grid 2 trigger circuits. The latter will blow only if their FET switch fails short-circuit.

- If the input frequency exceeds 1 kHz the output will stop. This prevents the MA2709A being operated in excess of its designed output power level.

HEALTH AND SAFETY HAZARDS

Teledyne e2v electronic devices are safe to handle and operate provided that the relevant precautions stated herein are observed. Teledyne e2v does not accept responsibility for damage or injury resulting from the use of electronic devices it produces. Equipment manufacturers and users must ensure that adequate precautions are taken. Appropriate warning labels and notices must be provided on equipment incorporating Teledyne e2v devices and in operating manuals.

High Voltage

Equipment must be designed so that personnel cannot come into contact with high voltage circuits. All high voltage circuits and terminals must be enclosed and fail-safe interlock switches must be fitted to disconnect the primary power supply and discharge all high voltage capacitors and other stored charges before allowing access. Interlock switches must not be bypassed to allow operation with access doors open

STATUTORY AND REGULATORY COMPLIANCE

Low Voltage Directive

This product complies with the requirements of the Low Voltage Directive 73123IEEC as amended by Directive 931681 EEC

Electromagnetic Compatibility

This product complies with the requirements of the Electromagnetic Compatibility Directive 8913361EEC as amended by Directives 9112631EEC, 92131/EEC, 931681EEC, 93197I EEC and 951541EEC.

This device complies to Federal Communications Commission (FCC) Rules & Regulations for Title 47 (CFR 47), Part 15, Class B.
Operation is subject to the following two conditions:
(1) These device may not cause harmful interference and
(2) This device must accept any interference received, including interference that may cause undesired operation.

CONNECTION SCHEMATIC

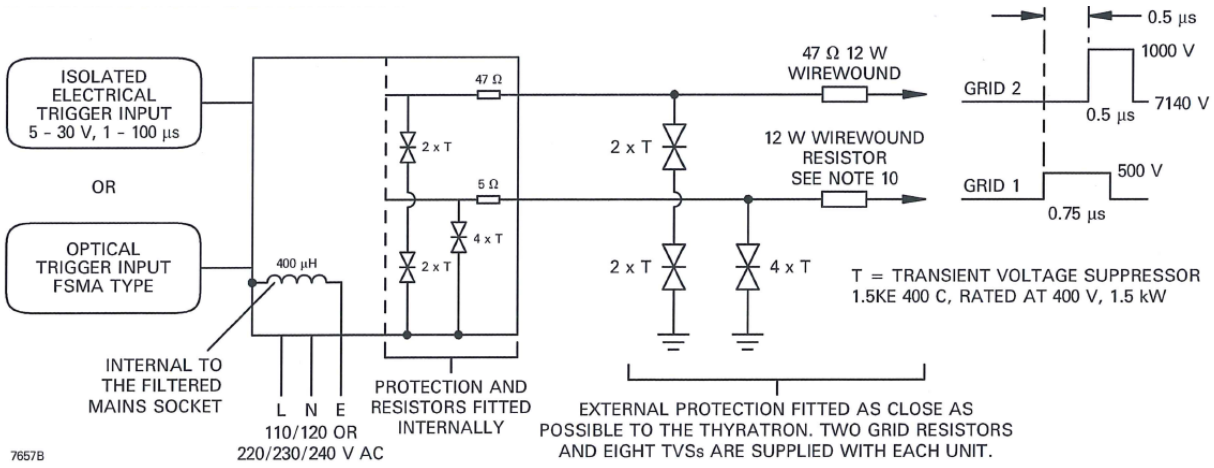


Fig.1 MA2709A remote from the thyratron discharge circuit

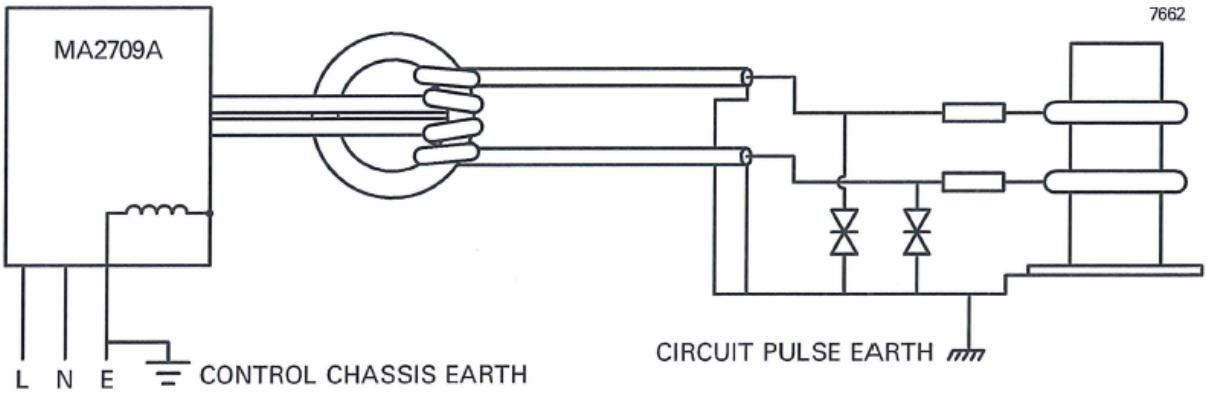


Fig.2 MA2709A mounted close to the thyratron discharge circuit

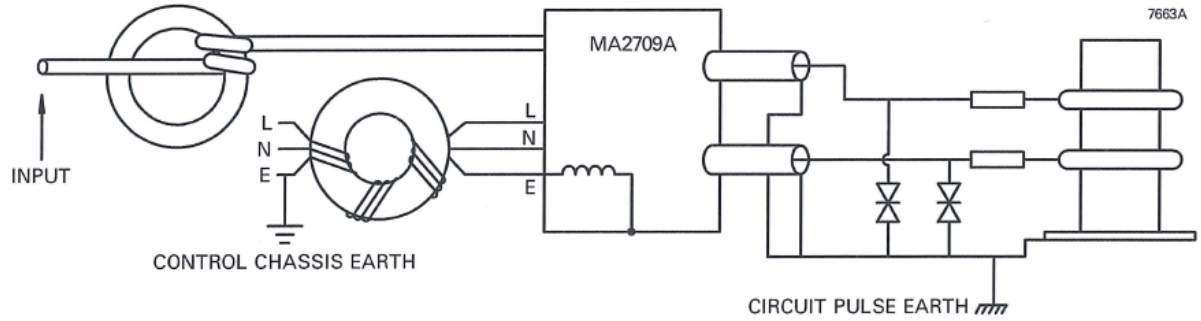
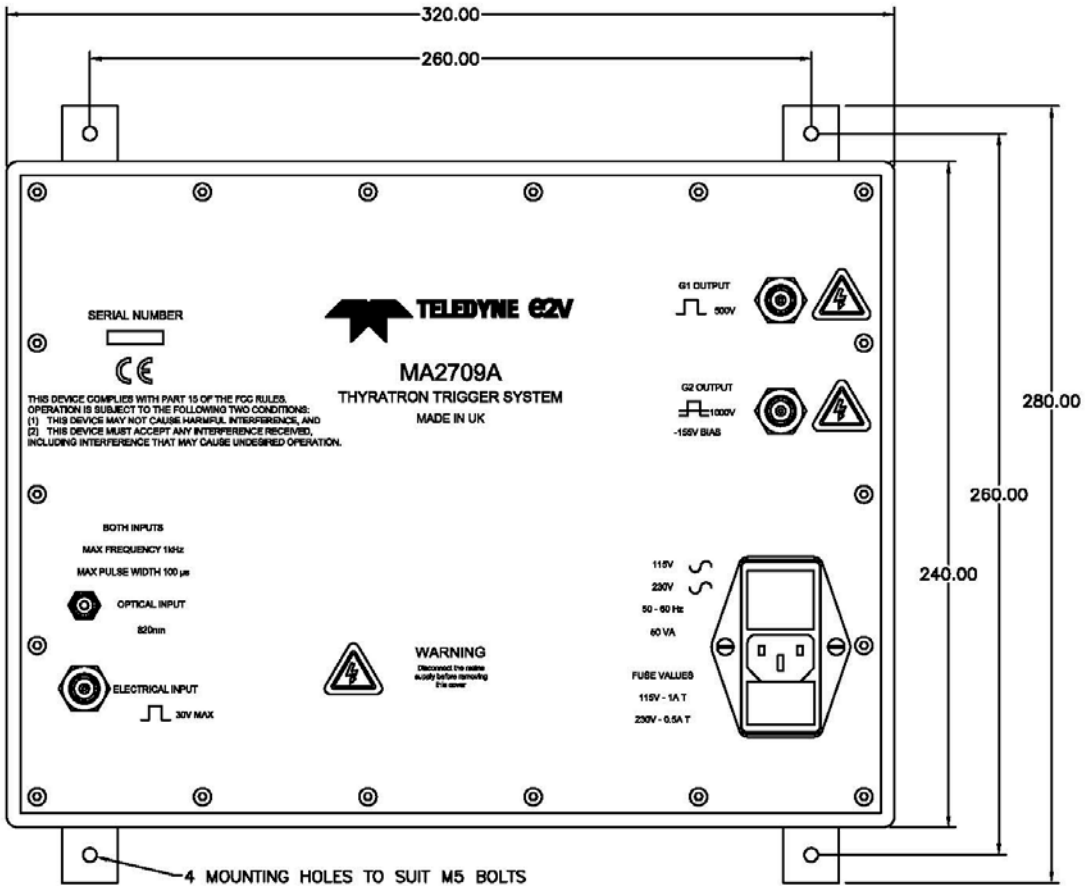
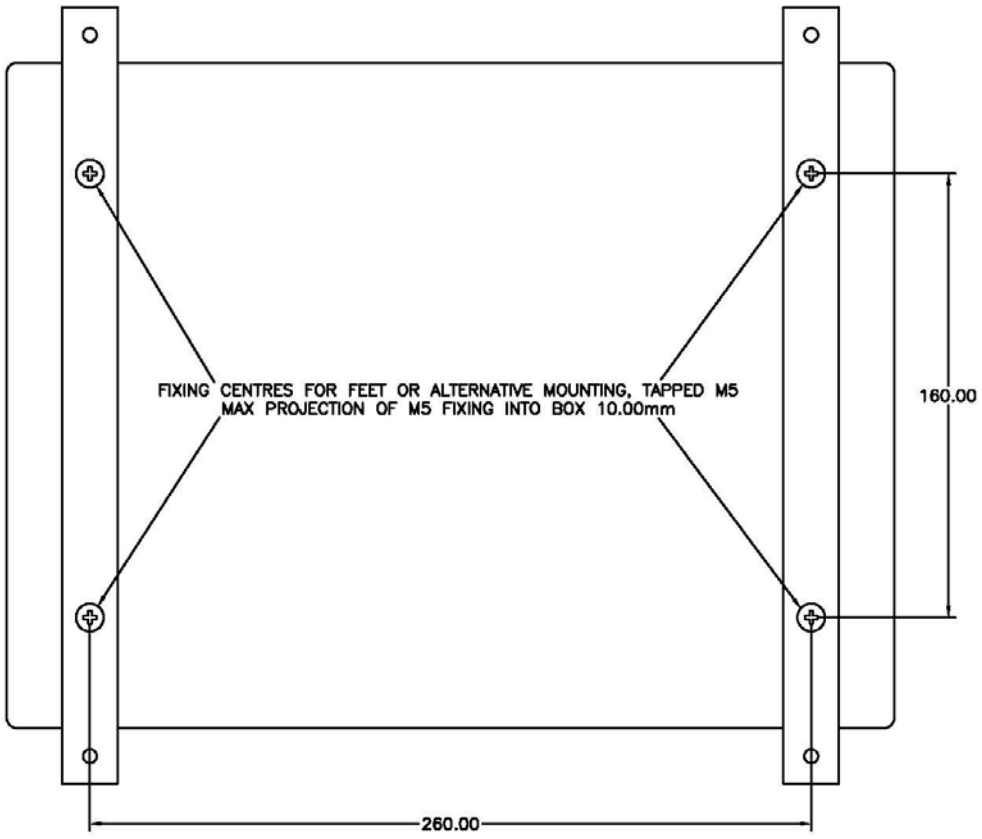


Fig.3 Box Layout and mounting (All dimensions nominal and in mm)





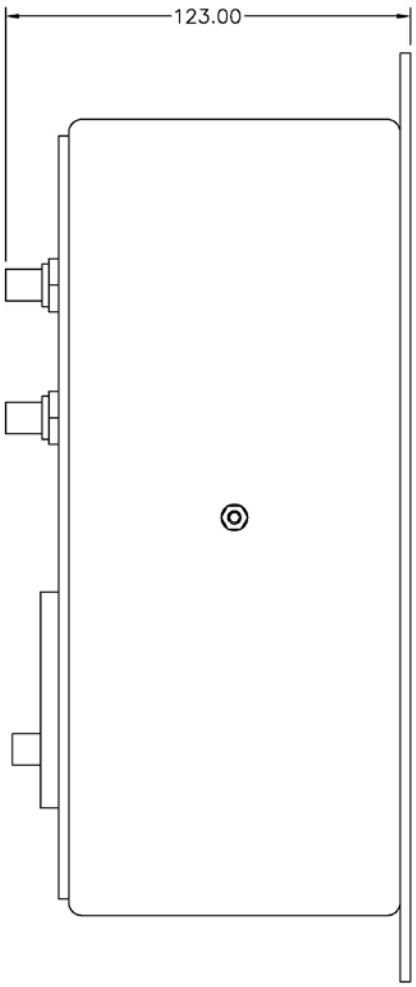


Fig.4 Suitable drive circuit for optic transmitter