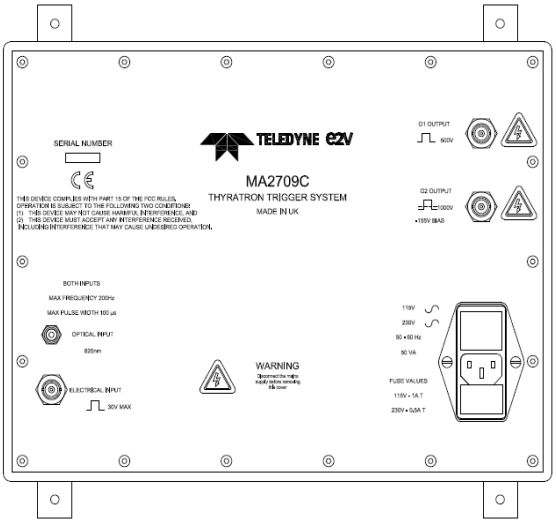
MA2709C
Thyratron Trigger System

FEATURES

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



DESCRIPTION

The MA2709C 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 200 Hz.

The MA2709C 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.

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 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.

GENERAL DATA

Electrical

Input voltage (AC rms) (see note 1)	-	115 + 10% V Or 230 + 10%V
Input power	-	50 VA

Mechanical

Length	-	320 mm
Width:		
Including feet	-	280 mm
Without feet	-	240 mm
Height (including 4 mm feet)	-	123 mm
Net weight	-	3.8 kg
Mounting position (see note 2)	-	Any

Environmental

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

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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 Optical	. .	5 See note 6	30	V
Trigger input impedance	.	450	-	Ω
Trigger input frequency (see note 7)	.	-	200	Hz
Trigger input pulse duration	.	1	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)	.	2.0	3.0	µs
Grid 2 output voltage (see note 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)	.	0.8	1.2	µs
Grid 2 output rate of rise 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	.	200	400	ns
Input to grid 2 pulse delay	.	2200	3400	ns
Grid 1 to grid 2 pulse delay	.	2.0	3.0	µs
Time delay drift; Full temperature range	.	-	25	ns
Input to grid 2 jitter	.	-	2	ns

NOTES

1. The MA2709C 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 µH 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. 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 should be used.
7. Operating the trigger system at frequencies higher than 200Hz 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 MA2709C:

- Transient Voltage Suppressors (TVSs) fitted internally, together with more TVSs fitted externally close to the thyratron (see above), will protect the MA2709C from thyratron grid spikes. With the external TVS protection circuits fitted, the MA2709C 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 MA2709C 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 MA2709C into a circuit.
- The MA2709C will operate continuously into an open circuit.
- The MA2709C 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.
- Operating the trigger system at frequencies higher than 200Hz may cause internal damage and overheating.

EARTHING

It is important to ensure that good electrical practice is followed for earthing the MA2709C so that it is protected from unnecessary earth currents and any resulting voltage spikes.
The filtered mains input socket connects the mains earth to the MA2709C metal case via a 400 µH inductor. Ferrite beads or cores or strip-wound cores can be used to provide effective pulse isolation as indicated in Figs. 1 and 2.

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 technologies 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 door open.

STATUTORY AND REGULATORY COMPLIANCE

Low Voltage Directive

This product complies with the requirements of the Low Voltage Directive 2014/35/EU.

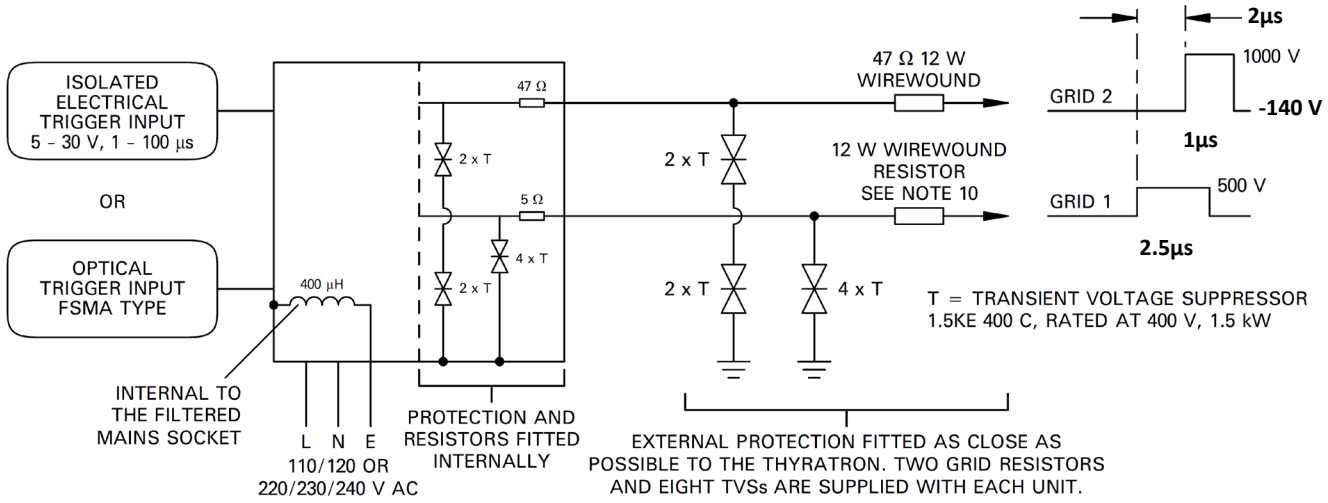
Electromagnetic Compatibility

This product complies with the requirements of the Electromagnetic Compatibility Directive 2014/30/EU.

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) This device may not cause harmful interference and
(2) This device must accept any interference received, including interference that may cause undesired operation.

CONNECTION SCHEMATIC



EARTHING CONSIDERATIONS

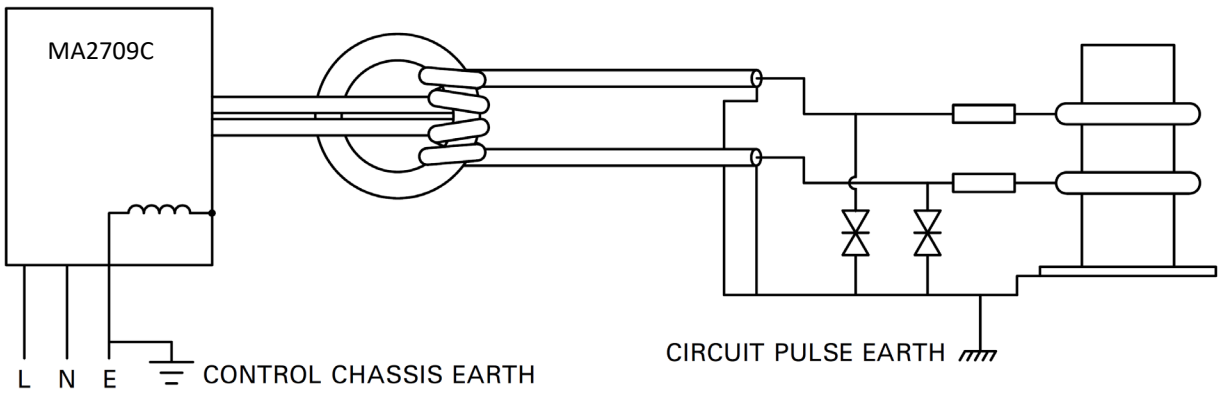


Fig. 1 MA2709C remote from the Thyratron discharge circuit.

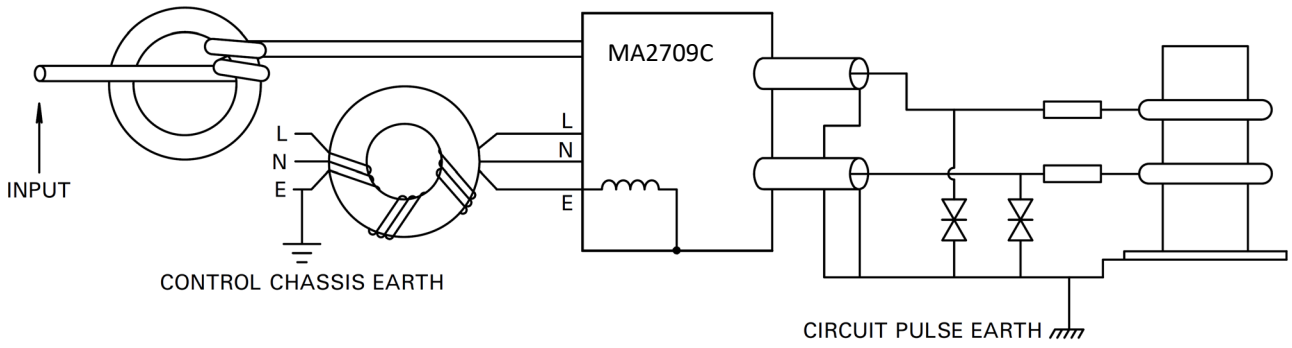
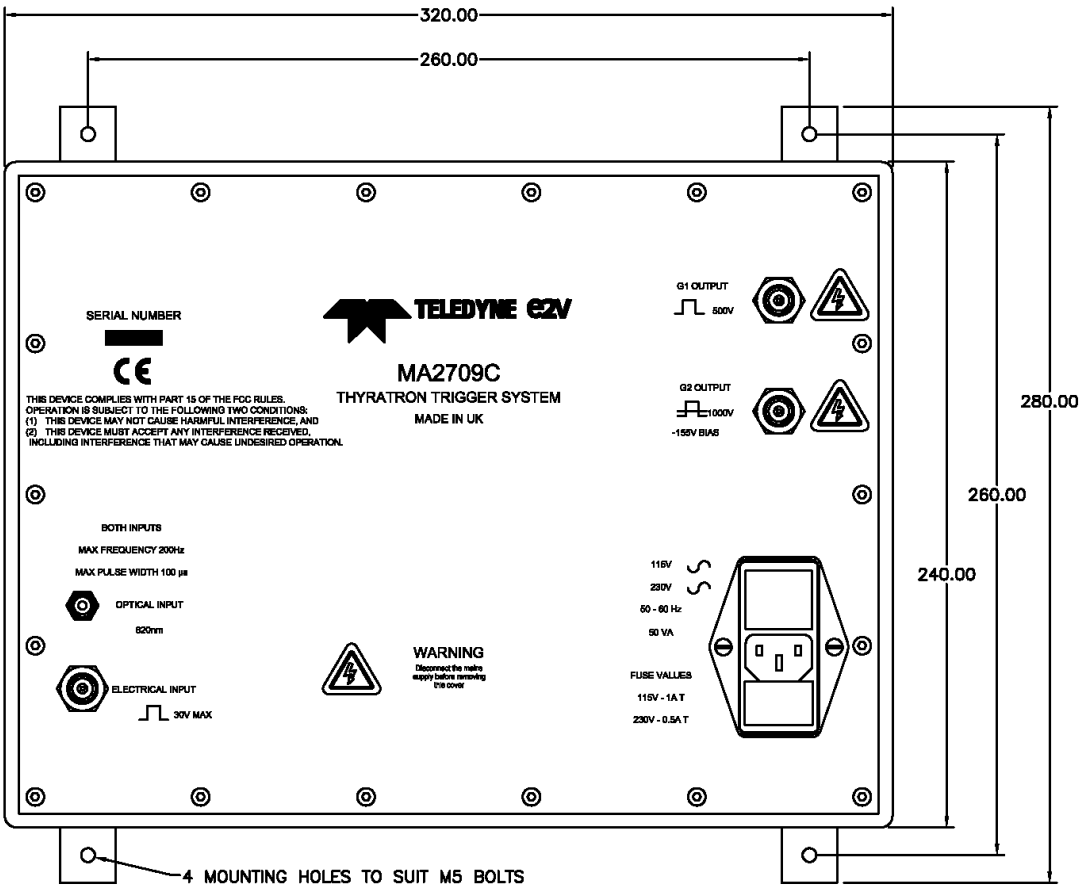
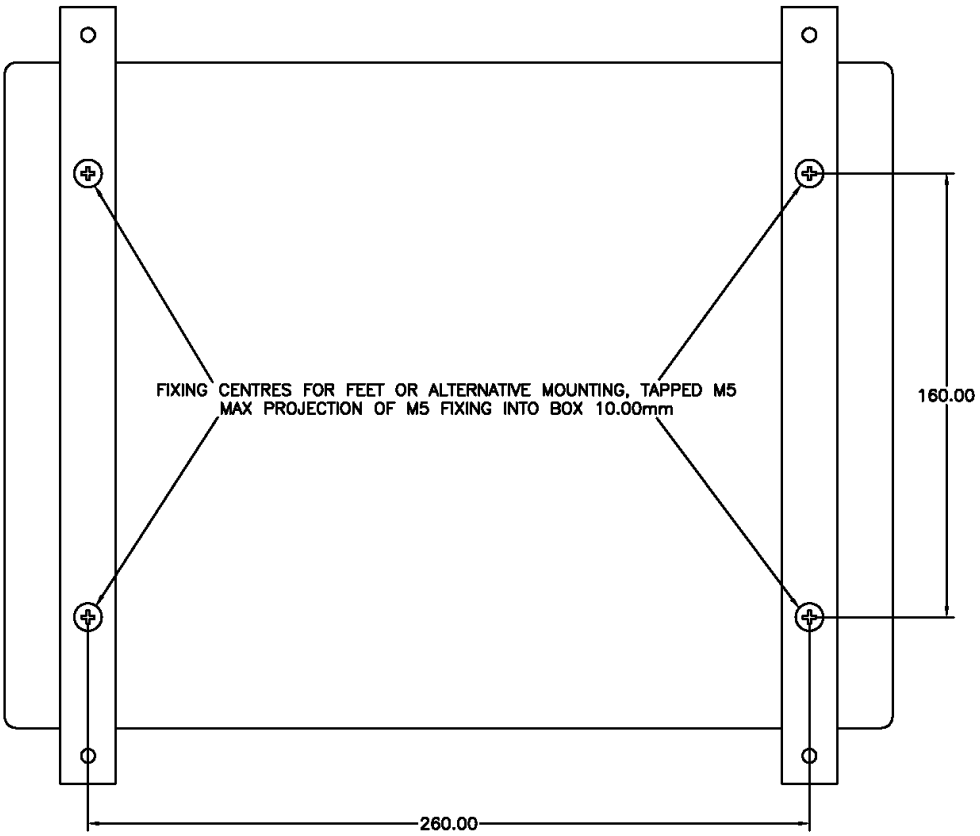


Fig. 2 MA2709C mounted close to the thyratron discharge circuit.

BOX LAYOUT AND MOUNTING





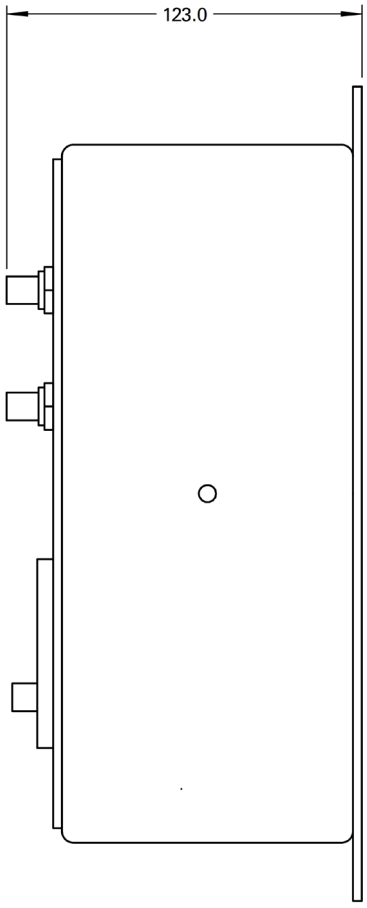


Fig. 3 Box layout and mounting (All dimensions nominal and in millimetres)

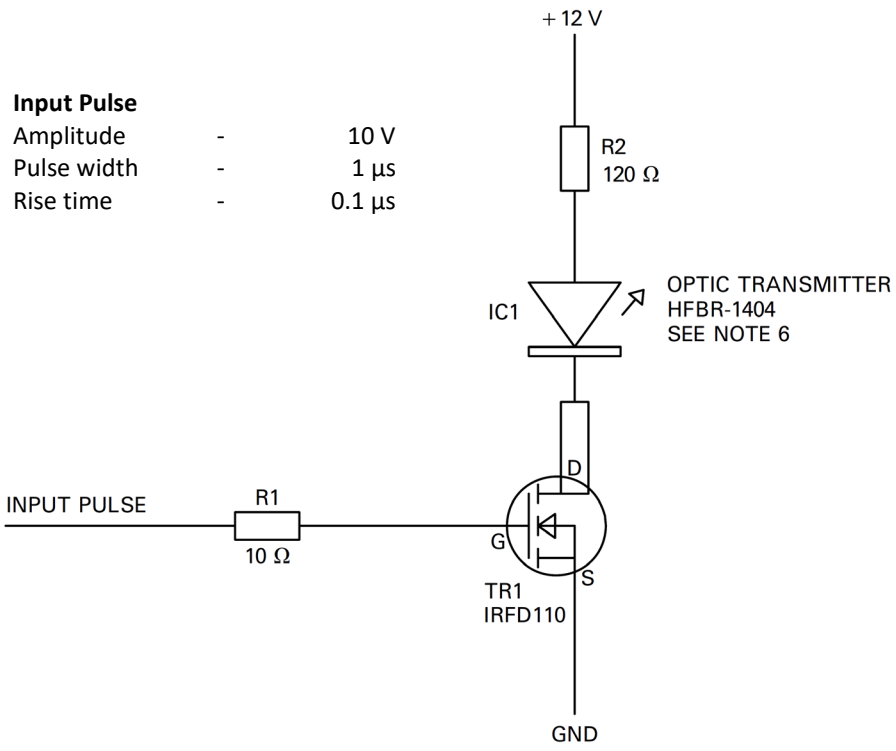


Fig. 4 Suitable drive circuit for optic transmitter