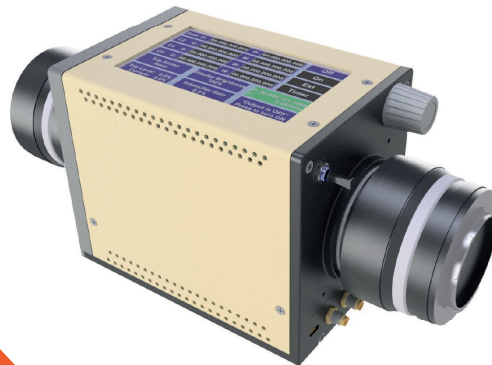


Power Supplies and Gate Electronics

for Image Intensifiers, Demagnifiers, Image Photon Detectors
and Magentic Focus Tubes



- > DETECT
- > CAPTURE
- > INNOVATE

Photek Ltd. manufactures a complete line of power supplies, gate modules and gating controllers for vacuum based photon detectors and imagers.

Designed to seamlessly work with Photek's broad range of Image Intensifiers, Demagnifiers, Image Photon Detectors and Magnetic Focus Tubes, the products presented here are guaranteed to provide optimal performance for your photon detection requirements. Photek specializes in designing complete solutions tailored to your application. Contact a Photek technical consultant for more information.

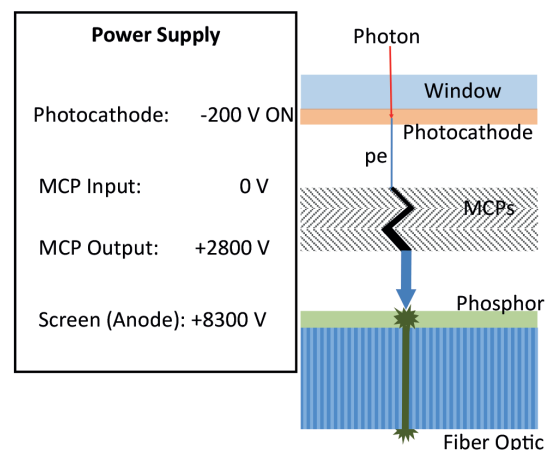
Image Intensifier Power Supplies

Image Intensifiers (II) convert light into electrons in the photocathode, a thin film semiconductor deposited on the input window. A -200 V bias is applied between the photocathode and the Micro-Channel Plate (MCP), accelerating the photo-electrons into the MCP where they are amplified. Anywhere from one to three MCPs can be used for amplification, requiring up to $+1000\text{ V}$ per MCP for operation. The amplified electrons exit the MCP and are accelerated into a phosphor screen anode with a typical voltage up to $+6000\text{ V}$. The amplified and accelerated electrons form an intensified copy of the input image which can be sensed by a CCD or directly by the human eye. The power supplies used to generate these biases are specially designed to provide appropriate voltages for each stage. The MCP voltage is used to control the gain of the II. The screen voltage also affects gain.

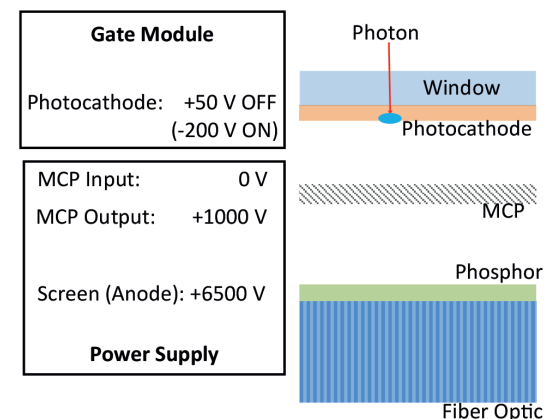
It is often required to turn an image intensifier on and off, called gating, in response to measurements being made. For example, an intensifier may be gated OFF during the bright pulse of a laser and then gated ON to measure weak, delayed signals emitted from a sample being tested. To accomplish this the photocathode is Gated ON to a nominal -200 V during the measurement window, and Gated OFF by reverse biasing the photocathode to a nominal $+50\text{ V}$ with respect to the MCP, effectively cutting off the flow of photoelectrons from the photocathode to the MCP as shown. Special Gate Modules provide fast, 250 V pulses to accomplish this, with Gating times varying from 3 to 50 ns and longer, depending on the application.

- > Image Intensifiers
- > Imaging Photon Detectors
- > Magnetic Focus Tubes
- > Demagnifiers

Triple MCP Image Intensifier Non-Gate



Single MCP Image Intensifier Gated OFF



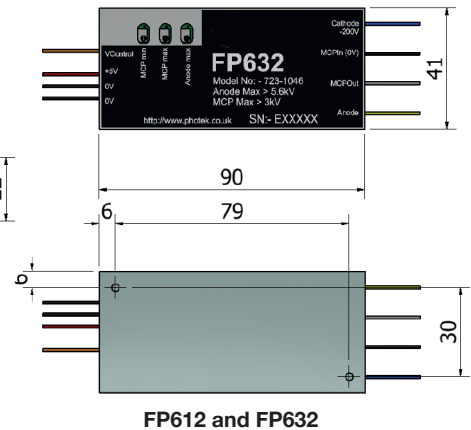
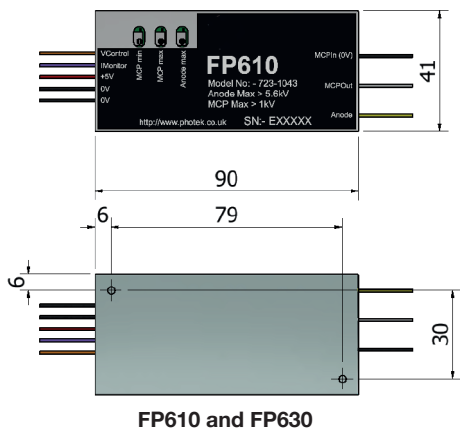
Flat-Pack

Image Intensifier Power Supplies

This family of flat-pack power supplies are specifically designed for Image Intensifiers providing all necessary voltages for operation. MCP voltage can be remotely adjusted using a separate 0 to 5V input.

Adjustment pots are provided to set the minimum and maximum MCP voltages and to adjust the Anode voltage to a fixed value over its 1000V to 6000V range. The **FP61X** variants support Image Intensifiers with a single MCP while the **FP63X** variants can be used for Intensifiers with up to 3 MCPs. For gated applications the **FP6X0** variants require a separate photocathode voltage, typically provided by one of Photek's Gate Modules. If no gating is require a fixed -200 V photocathode voltage is supplied by the **FP6X2** variants. Contact Photek for additional voltages and customised solutions.

Specifications	FP610	FP612	FP630	FP632
MCPs	1	1	2 - 3	2 - 3
Cathode Voltage	n/a	-200 V	n/a	-200 V
Cathode Impedance	n/a	2 GΩ	n/a	2 GΩ
MCP In Voltage	0 V	0 V	0 V	0 V
MCP Out Voltage	100 - 1000 V	100 - 1000 V	100 - 2800 V	100 - 2800 V
MCP Load (min)	10 MΩ	10 MΩ	50 MΩ	50 MΩ
Anode Voltage	1000 - 6000 V	1000 - 6000 V	1000 - 6000 V	1000 - 6000 V
Anode Current (max)	1 μA	1 μA	1 μA	1 μA
Current Monitor Output	Yes	Yes	No	No
Supply Current	5V DC ±5%	5V DC ±5%	5V DC ±5%	5V DC ±5%
Length x Height x Width	90 x 40 x 20 mm	90 x 40 x 20 mm	90 x 40 x 20 mm	90 x 40 x 20 mm
Weight	< 90 g	< 90 g	< 90 g	< 90 g
Operating Temperature Range	0°C - 50°C	0°C - 50°C	0°C - 50°C	0°C - 50°C



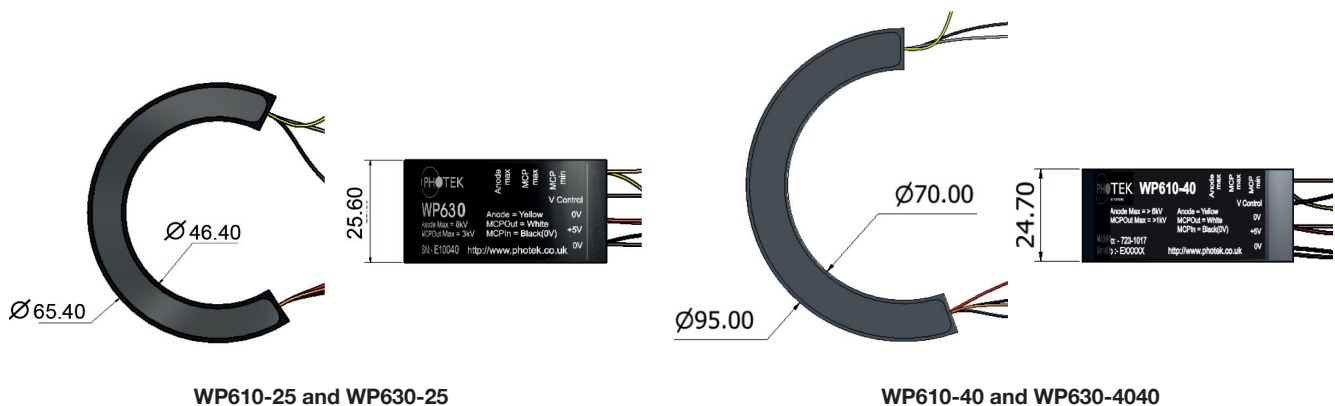
Wrap-Around

Image Intensifier Power Supplies

This family of wrap-around power supplies are ideal for Image Intensifier applications requiring a compact, all-in-one packaging solution.

Only MCP and Anode voltages are supplied in a case that conforms to the outside diameter of the image intensifier, 25mm and 40mm options. The MCP voltage can be remotely adjusted using a separate 0 to 5V input. Adjustment pots are provided to set the minimum and maximum MCP voltages and to adjust the Anode voltage to a fixed value over its 1000V to 6000V range. The **WP610** variants support Image Intensifiers with a single MCP while the **WP630** variants can be used for Intensifiers with up to 3 MCPs. The cathode voltage is supplied by one of Photek's Gate modules. Additional voltage options are available upon request. All wrap-around power supplies are designed to be potted around the intensifier. Contact Photek for these and other customised solutions.

Specifications	WP610-25	WP610-40	WP630-25	WP630-40
MCPs	1	1	2 - 3	2 - 3
MCP In Voltage	0 V	0 V	0 V	0 V
MCP Out Voltage	100 - 1000 V	100 - 1000 V	100 - 2800 V	100 - 2800 V
MCP Load (min)	10 MΩ	10 MΩ	50 MΩ	50 MΩ
Anode Voltage	1000 - 6000 V	1000 - 6000 V	1000 - 6000 V	1000 - 6000 V
Anode Current (max)	1 μA	1 μA	1 μA	1 μA
Supply Voltage	5V DC ±5%	5V DC ±5%	5V DC ±5%	5V DC ±5%
Supply Current	300 mA	300 mA	300 mA	300 mA
Weight	< 90 g	< 90 g	< 90 g	< 90 g
Operating Temperature Range	0°C - 50°C	0°C - 50°C	0°C - 50°C	0°C - 50°C



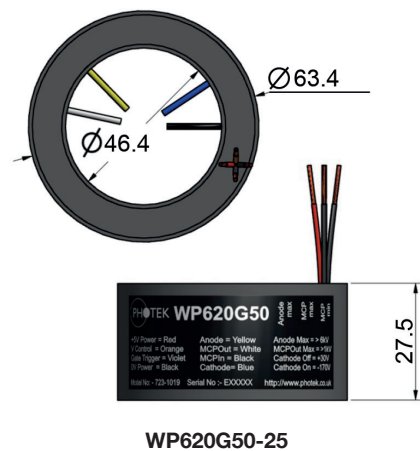
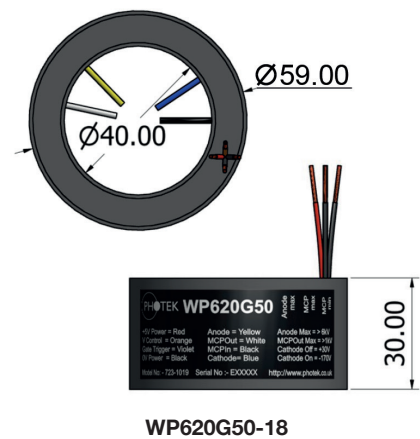
Wrap-Around Gated

Image Intensifier Power Supplies

This family of wrap around gated power supplies are ideal for Image Intensifier applications requiring a compact, all-in-one packaging solution with modest gating capabilities.

All necessary voltages for operation including the high voltage gate pulse are provided in a supply that conforms to the outside diameter of the image intensifier. The MCP voltage can be remotely adjusted using a separate 0 to 5V input and can accommodate up to two MCPs. Trim pots are provided to set the minimum and maximum MCP voltages and to adjust the Anode voltage to a fixed value over its 1000V to 6000V range. Gating is accomplished by simply providing a TTL gate trigger with duration equal to the required gate-on time. Or a fixed TTL level can be provided for non-gated operation. Variants are available for 18 mm and 25 mm image intensifiers. Contact Photek for additional voltages, 40 mm options or customised solutions.

Specifications	WP620G50-18	WP620G50-25
MCPs	2	2
Cathode-On Voltage	-170 V	-170 V
Cathode-Off Voltage	+30 V	+30 V
Gate Width	50 ns to DC	50 ns to DC
Maximum Gate Frequency	10 kHz	10 kHz
Maximum Gate Load	100 pf	100 pf
Gate Trigger Input	TTL	TTL
MCP In Voltage	0 V	0 V
MCP Out Voltage	100 - 2000 V	100 - 2000 V
MCP Load (min)	20 MΩ	20 MΩ
Anode Voltage	1000 - 6000 V	1000 - 6000 V
Anode Current (max)	1 μA	1 μA
Supply Voltage	5V DC ±5%	5V DC ±5%
Supply Current	300 mA	300 mA
Weight	~ 60 g	~ 80 g
Operating Temperature Range	0°C - 50°C	0°C - 50°C



Bench Top

Power Supplies

Photek's bench-top power supplies come with one to four outputs.

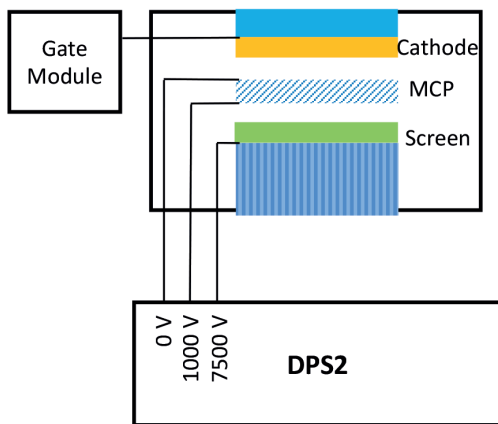
The **DPS1** is designed for detectors that use an integral voltage divider network to provide individual bias voltages and have electronic anodes rather than phosphor screens. The **DPS2**, **DPS3** and **DPS4** are designed for use with phosphor screen image intensifiers having either a single or multiple MCPs respectively. The **DPS4-DEZ2** is specifically designed to operate Demagnifier Image Intensifiers and includes 4 default magnification settings as well as manual control of magnification. The **BPS1-25P** can be used for Magnetic Focus Image Intensifiers. All of the bench top supplies are fully compatible with Photek's family of gate modules. Contact Photek for power supplies with additional outputs or for alternative voltage configurations.

Applications	DPS1	DPS2	DPS3	DPS4	DPS4-DEZ2	BPS1-25P
MCPs	1 - 3	1	1 - 3	1 - 4	0	0
Image Intensifier	No	Yes	Yes	Yes	No	No
Image Photon Detector	Yes ^{1&2}	No	No	No	No	No
Photo-Multiplier Tube	Yes ^{1&2}	No	No	No	No	No
Demagnifier II	No	No	No	No	Yes	No
Magnetic Focus II	No	No	No	No	No	Yes
Specifications						
Current Monitor	Yes	Yes	Yes	Yes	No	No
Computer Interface	Yes	Yes	Yes	Yes	Yes	No
Output 1: Voltage	Option	Option	Option	Option	+1000 V (UF1)	+25000 V
Output 2: Voltage		Option	Option	Option	+1000 V (UF2)	
Output 3: Voltage			Option	Option	+10000 V (UM)	
Output 4: Voltage				Option	+10000 V (SCR)	
Depth	290 mm	258 mm	258 mm	258 mm	260 mm	340 mm
Width	155 mm	265 mm	265 mm	265 mm	280 mm	260 mm
Height	100 mm	110 mm	110 mm	110 mm	116 mm	120 mm
Weight	2.2 kg	<7 kg	<7 kg	<7 kg	2.5 kg	3 kg
Supply Voltage	90 - 260 VAC 50/60 Hz					

¹ With the use of a Voltage Divider Network to provide proper bias voltages

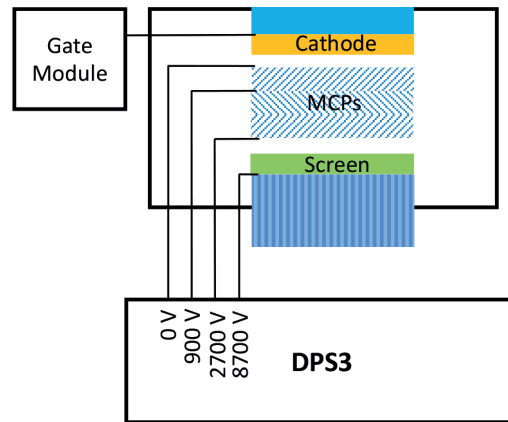
² Anode is at ground to facilitate electronic readout of the signal

Image Intensifier (1 MCP)



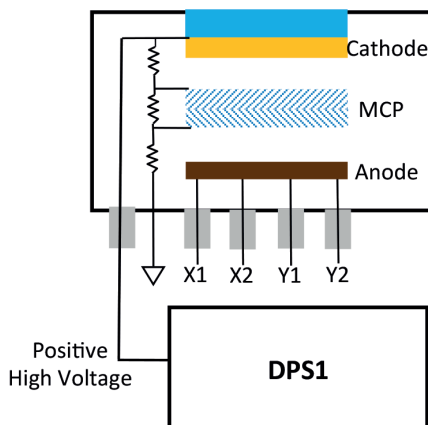
The DPS2 can be used for single MCP Image Intensifiers with an appropriate gate module.

Image Intensifier (2 - 3 MCPs)



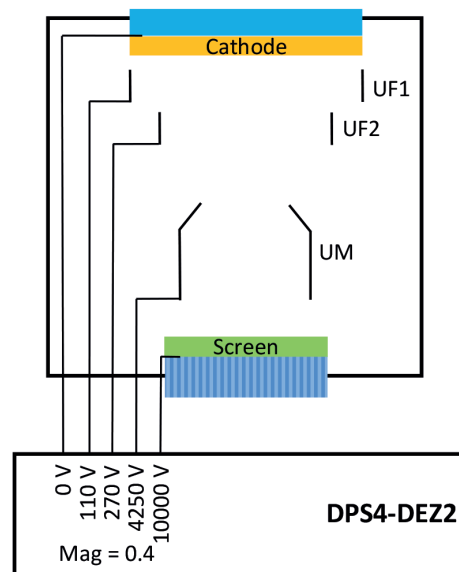
The DPS3 can accommodate image intensifiers with up to 3 MCPs and an appropriate gate module.

Image Photon Detector



The DPS1 is used for all PHOTON Imagers having non-phosphor anodes, including the Image Photon Detector. Typically these anodes are required to operate at or near ground, requiring the use of negative high voltage and a voltage divider network provided with the detector.

Demagnifier



The DPS4 is used for the Photek family of De-magnifying Image Intensifiers. Contact Photek Technical Support for other voltage options and to discuss gating options.

DPS1 Options: The DPS1 may incorporate any of the following modules: -5kV, -2kV, -1kV, +1kV,+2kV, +5kV.

DPS2, DPS3, DPS4 Options: A multiple output power supply may be configured with any combination of the following modules: -10kV, -5kV, -2kV, -1kV, +1kV,+2kV, +5kV. +10kV.

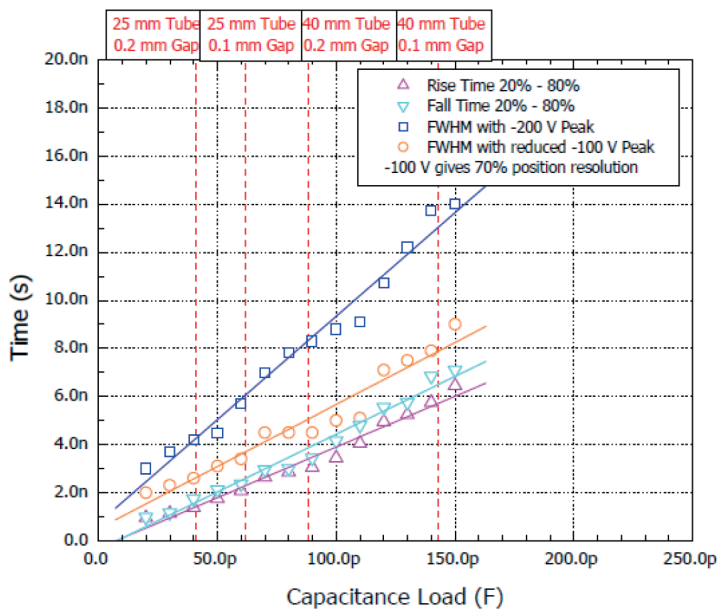
Contact Photek to specify voltage option requirements prior to ordering.

Gate Modules

Image Intensifier Gate Modules

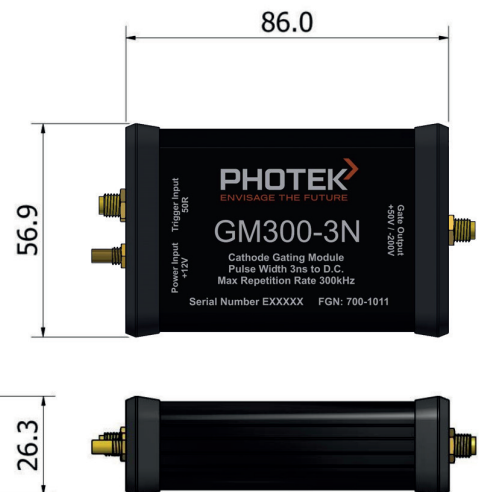
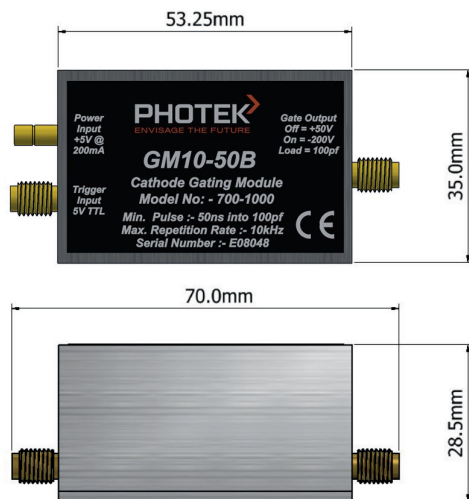
Gate modules are used in conjunction with flat pack, wrap around or bench power supplies whenever gating is required.

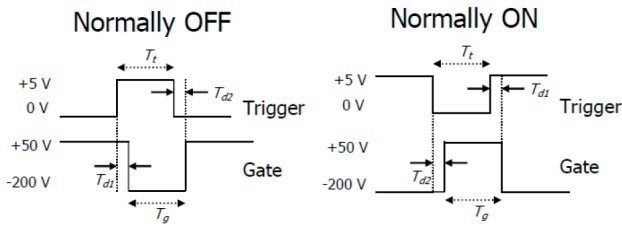
A -200 V photocathode bias voltage is provided by the Gate Module, enabling photoelectrons to flow from the photocathode to the MCP when gated ON. When the gate module is gated OFF, a +50 V bias applied to the photocathode prevents photoelectrons from reaching the MCP, effectively turning off the Image Intensifier. The gating rate and duration is controlled with an external TTL pulse and can be provided by Photek's Gate Controller. Ask Photek about the availability of circuit board versions and customization for your specific requirements.



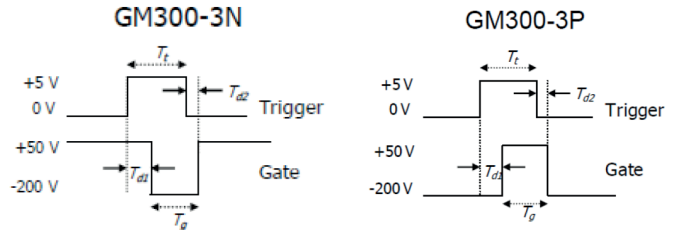
This figure shows the relationship between gate speed and capacitive load for the GM300-3 Gate Module. The gate speed decreases as the area of the tube increases and as the gap between the photocathode and MCP decreases.

Representative configurations of image intensifiers are shown by the red dashed lines. Another strategy to increase gating speed is to reduce the gate voltage, however this can degrade imaging performance. Photek's technical support staff can guide you through the optimization process for your particular application, including the best configuration for the image intensifier as well as the power supply and gate module.





Timing diagram for the GM10-50B Normally OFF gate module and the GM300-8U universal gate module which can be operated in Normally OFF or Normally ON mode.



Timing diagram for the normally OFF GM300-3N and the normally ON GM300-3P gate modules. Either module can be operated in inverted mode with a minimum gate width of 50 ns.

Specifications	GM10-50B	GM300-8U	GM300-3N/P
Normal State	OFF	ON or OFF	N = OFF / P = ON
Input Pulse			
Min Width	60 - 80 ns	8 ns	13 ns
Max Width	DC	DC	DC
Pulse Frequency	10 kHz	300 kHz	300 kHz
Burst Rate	None	2.5 MHz	2.5 MHz
Voltage	5 V TTL (high Z)	5 V TTL (50 Ω)	5 V TTL (50 Ω)
Output Pulse			
Min Width	50 ns FWHM	8 ns FWHM	3ns FWHM
Max Width	DC	DC	DC
Delay	100 - 120 ns	30 - 38 ns	50 ns
Risetime	30 - 50 ns	5 - 13 ns adjustable	1 ns
Falltime	30 - 50 ns	5 - 13 ns adjustable	1 ns
Jitter (RMS)	< 500 ps	40 - 70 ps	30 ps
Voltage			
Off (Nominal)	+50 V	+50 V	+50 V
On (Nominal)	-200 V	-200 V	-200 V
Supply Voltage	+5 V DC	+12 V DC	+12 V DC
Typical Current Max	60 mA	180 mA	180 mA
In-Rush Current Max	500 mA	1 A	1 A
Length	53.25 mm	86 mm	86 mm
Length including connectors	70 mm	106 mm	106 mm
Width	35 mm	56 mm	56 mm
Height	28.5 mm	26 mm	26 mm
Weight	67 g	115 g	115 g
Operating Temperature	0°C to 70°C	0°C to 70°C	0°C to 70°C

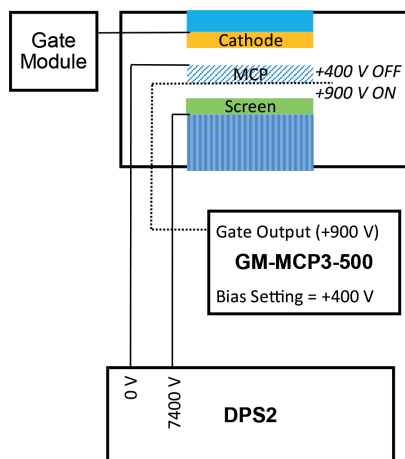
MCP Gate Modules

Microchannel Plate Gate Modules

Microchannel Plate (MCP) Gate Modules are used to gate an MCP ON by coupling a positive high voltage pulse onto the fixed bias of the MCP output electrode.

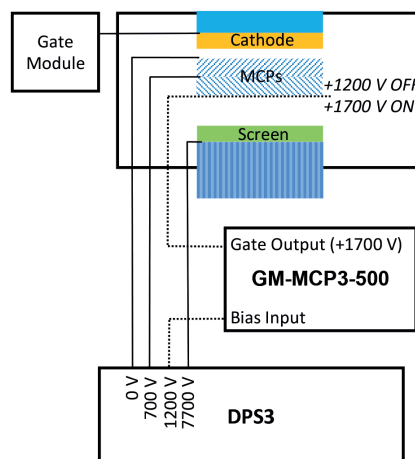
If multiple MCPs are used in a detector, the rear MCP is typically gated ON. In the normal OFF state the MCP bias is set below its working voltage. The MCP is turned ON when the high voltage pulse increases the MCP bias by 500 or 1000 volts. Magnetic Focus Image Intensifiers can also be gated ON using a similar scheme, with the high voltage pulse applied to an internal mesh that effectively reverse biases the photocathode. The GM-MCP3 requires external bias voltages for operation. The GM-MCP3-1000 which outputs a 1000V gate pulse provides the highest level of signal suppression for the most demanding applications. Contact Photek for customised version of these Gate Modules.

Image Intensifier (1 MCP)



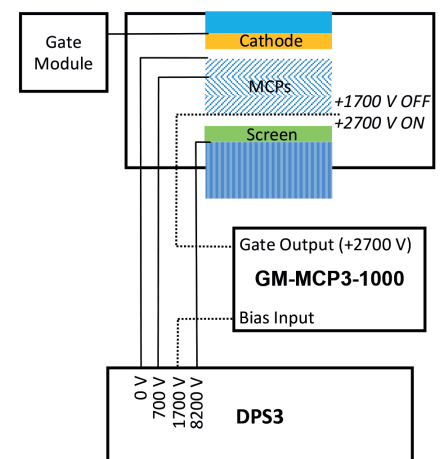
The GM-MCP3-500 is used for single MCP Image Intensifiers with an appropriate gate module to supply the photocathode voltage.

Image Intensifier (2 MCPs)



The GM-MCP3-500 can accommodate image intensifiers with up to 3 MCPs. A cathode gate module can supply the photocathode voltage.

Image Intensifier (3 MCPs)



The GM-MCP3-1000 accommodates image intensifiers with up to 3 MCPs and provides high signal suppression with its +1000 V gate.

Specifications	GM-MCP3-500	GM-MCP3-1000
MCPs	1	2 - 3
Normal State	OFF	OFF
Input Pulse		
Min Width	~ 9 ns	~ 9 ns
Max Width	RC limited	RC limited
Pulse Frequency	1 kHz	1 kHz
Voltage	5 V TTL	5 V TTL
Output Pulse		
Pulse Width Loss	~ 6 ns	~ 6 ns
Min Width	4 ns	4 ns
Max Width	< 10% Duty Cycle	< 10% Duty Cycle
Delay	~ 70 ns	~ 70 ns
Risetime	< 7 ns	< 7 ns
Falltime	1.5 ns	1.5 ns
Jitter (RMS)	< 115 ps	< 115 ps
Voltage		
Off	0 V + Bias	0 V + Bias
On	+500 V + Bias	+1000 V + Bias
Bias (max)	±9000 V (External)	±9000 V (External)
Supply Voltage	+12 V DC	+12 V DC
Supply Current Max	300 mA	300 mA
Length	166 mm	166 mm
Length including connectors	191 mm	191 mm
Width	81.1 mm	81.1 mm
Height	46.1 mm	46.1 mm
Weight	~ 420 g	~ 420 g
Operating Temperature	0°C to 70°C	0°C to 70°C

IGC3 Gate Controller

Fully integrated, programmable gating controller

When combined with a high voltage power supply and gate module, the gate controller provides all functionality required to easily gate any of Photek's Image Intensifiers and Image Photon Detectors.

No additional electronics are required. The IGC3 Gate Controller can be pre-configured by specialists at Photek to provide turn-key operation of your Image Intensifier based on the unique requirements of your application. The IGC3 trigger may be either internally generated or controlled by an external trigger and operates up to 1MHz however this will be limited by the Gate Module utilised. Pulse widths are selectable from 3 ns to 40 ms, and can be set for either Gated ON or Gated OFF modes. Set-up is easy, with all functions available from either the front-panel user interface or via an integral RS232 computer interface. Contact Photek technical support for help in configuring a customized solution.

Specifications	min
Triggering Period	1 ms to 40 ms
Triggering Period Step Size	20 ns
Pulse Width AND Delay < 1 us	
Pulse Width	3 ns to 1 us
Pulse Width Step Size	1 ns
Pulse Delay	160 ns to 1 us
Pulse Delay Step Size	1 ns
Pulse Jitter (RMS)	180 ps
Pulse Width OR Delay > 1 us	
Pulse Width	10 ns to 40 ms
Pulse Width Step Size	5 ns
Pulse Delay	130 ns to 20 ms
Pulse Delay Step Size	5 ns
Pulse Jitter (RMS)	500 ps
Gate Polarity	ON / OFF selectable
Depth	300 mm
Width	270 mm
Height	135 mm
Weight	< 4 kg
Supply Voltage	90 - 260 VAC

Features

- > Two independent Interlock inputs to shut-off high voltage in case of an unsafe condition
- > Front-panel display and pushbutton controls for manual set-up and adjustment
- > Gate Monitor Output provides a TTL indication of the Gate status, factory calibrated when provided with a Gate module
- > Three TTL trigger inputs can be individually enabled to initiate the gate trigger in place of the internal gate source
- > Image Intensifier Gain Control output can be used with power supplies with a gain control
- > ±12 V and +5 V accessory power outputs
- > Power Supply and Gate Module power outputs

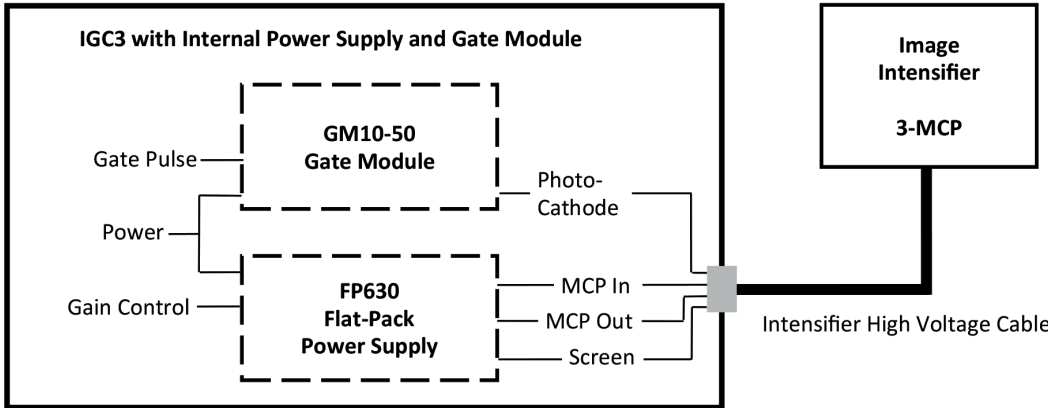


Figure 1: With a built-in Power Supply and Gate Module the IGC3 is the only component needed for full operation of an Image Intensifier, with a single high voltage cable connecting the IGC3 to the Image Intensifier. Control is provided by the front-panel interface or simple to program RS232 interface.



Front Panel Controls and Display



Rear Panel Connectors

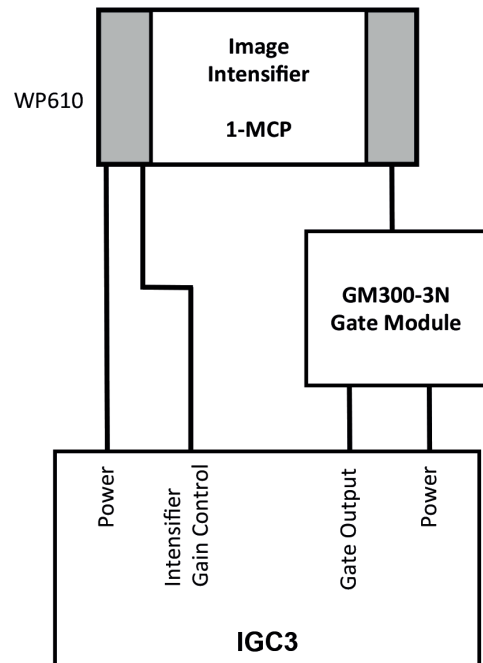


Figure 2: The IGC3 may be used with an external Gate Module and power supply to operate any intensifier combination. The IGC3 has integrated control functions which may be utilized to provide a global control solution.

> ILCI

Intelligent Lens Coupled Intensifier

The ILCI is a fully integrated, programmable gating controller combined with a high voltage power supply, gate module and intensifier with a dual lens system.

The gating controller provides all functionality required to gate the integrated intensifier, no additional electronics are required. The ILCI Gating Controller can be pre-configured by specialists at Photek to provide turn-key operation of your Image Intensifier based on the unique requirements of your application. The ILCI trigger may be either internally generated or controlled by an external trigger and operates up to 100kHz. Pulse widths are selectable from 5 ns to 10 s. Set-up is easy, with all functions available from either the touch screen user interface or via an integrated USB computer interface. Contact Photek technical support for help in configuring a customized solution.

Specifications	range
Pulse Width Range	5 ns to 10 s
Pulse Width Step Size	5 ns
Pulse Delay Range	50 ns to 2 s
Pulse Delay Step Size	5 ns
Frequency Max. (Continuous)	100 kHz
Frequency (Burst mode for 1 ms)	100 MHz
Pulse Jitter (RMS)	180 ps
Depth x Width x Height	267.3 x 96 x 115 mm
Weight	~ 2 kg
Power Supply Requirements	12 V @ 1A



Features

- > Temporal control of gate width, delay and frequency of operation
- > The ILCI may be triggered internally or via one external Trigger Input
- > Three temporally controlled synchronization outputs which can be individually enabled to initiate external timing
- > High frequency operation, 100kHz continuous or 100MHz Burst Mode for 1ms
- > Selectable Positive or Negative Edge triggering from external trigger source input
- > Touchscreen display for manual set-up and adjustment
- > USB Interface for computer control
- > Image Intensifier Gain Control
- > A Screen current monitor function which can disable the gating and high voltage in case of an unsafe condition

> IGC-10F

Intensifier Gating Controller

The IGC-10F is a programmable gating controller combined with a 5ns gate module.

The gating controller provides the cathode gate function for an external intensifier fitted with a high voltage power supply. A Fibre-Optic network interface may be utilized to control the IGC-10F over a network from a webpage with each IGC-10F provided with its own individual IP address therefore multiple units may be utilized on one network. The IGC-10F trigger may be either internally generated or controlled by one (or both) of the two external trigger inputs. The IGC-10F operates up to 10kHz and pulse widths and delays are selectable from 5 ns to 20 s in 5ns steps. Contact Photek technical support for help in configuring a customized solution.

Specifications	range
Pulse Width Range	5 ns to 20 s
Pulse Width Step Size	5 ns
Pulse Delay Range	50 ns to 20 s
Pulse Delay Step Size	5 ns
Frequency Max. (Continuous)	10 kHz
Pulse Jitter Internal Trigger (RMS)	35 ps
Depth x Width x Height	145 x 81 x 46 mm
Weight	~ 2 kg
Power Supply Requirements	12 V @ 1A

Features

- > Integrated High Voltage power supply with Power On/Off and Gain Control functions
- > Temporal control of gate width, delay and frequency of operation
- > The IGC-10F may be triggered internally or via two external trigger inputs
- > Three temporally controlled outputs, Intensifier Cathode Gate, Camera Trigger and a TTL Gate Monitor function
- > 10kHz continuous operating frequency
- > Fibre-Optic Interface for computer control via a webpage
- > Individual IP Address enables multiple units on one network



About Photek

Photek is a specialist manufacturer of vacuum based tubes and camera systems for photon detection.

Our product range includes; Camera Systems, Image Intensifiers, Photomultiplier Tubes, Streak Tubes plus a range of associated electronics.

We are experts in large area and ultra-high speed imaging and advanced photon counting camera systems.

Our continuing success is built upon continuous innovation and product development, and by harnessing and applying knowledge to find solutions for all of our customers' applications.

Photek is accredited to ISO 9001 and ISO 14001.



Contact Us

Our team of specialist engineers and scientists are ready to discuss your application requirements in depth.

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