



IGC3

Intensifier Gating Controller



This document supersedes all previous specifications. Photek accept no responsibility for damage incurred if the customer does not follow the procedures outlined in this manual.

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Issue 1
 12th August 2016

User Manual	UMIGC3
Issue:	1
Date:	12-8-2016
Author:	P Simpson

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1 IGC3 Intensifier Gating Controller

1.1 Description

The IGC3 is a universal A.C. mains powered digital control unit designed to apply gating pulses to an imaging or particle detector system where a specific duration of pulse width and delay are required.

The IGC3 unit incorporates two gating controllers to provide a short and a long gate pulse width generating system. The gating controller selection is automatically performed within the IGC3 to provide the optimum jitter for the selected delay and width values. The 2 gating controllers are: -

1. The NSPG gating controller which has a 250ps incremental pulse width and delay. This controller is capable of pulse widths from 3ns to 1 μ s and delays from 112ns to 1 μ s with a jitter of <1ns.
2. The standard IGC gating controller which has a 10ns incremental pulse width and delay mechanism. This controller is capable of gating pulse widths from 10ns to 40ms and delays from 130ns to 20ms with a jitter of \pm 5ns.

The IGC3 has integrated software to select the appropriate gating controller for the pulse width and delay values that the user inputs.

- If either the delay 'or' pulse width exceeds 1 μ s the IGC3 will use the IGC gating controller.
- If 'both' the pulse width and delay are below 1 μ s the IGC3 will use the NSPG gating controller.

This unit is used in conjunction with gating modules that may be fitted internally into the IGC3 such as Photeks GM10-50, GM300-3, or units that must be externally mounted close to the detector such as Photeks GM-MCP and GM1kV. (The general characteristics of each gating module are detailed in the Gate Module section of this manual.)

The IGC3 may be controlled from a PC using a simple ASCII commands and may be incorporated into the users' software suite as all bi-directional control codes and protocols utilise ASCII characters. These codes and protocols are included later in this manual.

The IGC3 can be controlled from 29 push-button keys and information on the operating conditions is displayed on a 4 line x 20-character alphanumeric liquid crystal display located on the front panel of the unit.

The IGC3 has 2 monitor outputs, a Trigger Output and a TTL gate monitor output. The Trigger Output is a buffered version of the input trigger pulse selected. The TTL gate monitor output is provided as an indication of when and for how long the intensifier is gated on for, this is calibrated with respect to the gate unit and intensifier system supplied with the IGC3 unit. If the unit is supplied without a gate module and intensifier then this pulse will be set to match the TTL gate pulse and set to be delayed by 60ns which is the delay associated with most of Photek's gate modules.

The IGC3 does not provide any image acquisition or image processing functions.

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1.2 Operating Modes

This unit can be used in a variety of modes utilising either an internal clock for triggering or externally generated trigger pulses.

1. Triggering can be taken from either edge of an external TTL logic source or from an internal oscillator operating over the range 1 μ s to 40ms in 20ns steps.
2. Pulse width is selectable from 10ns to 40ms in 10ns steps. *IGC Mode*
Or Pulse width is selectable from 3ns to 1 μ s in 250ps steps. *NSPG Mode*
3. Pulse delay is selectable from 130 ns to 20ms in 10ns steps. *IGC Mode*
Or Pulse delay is selectable from 112 ns to 1 μ s in 250ps steps. *NSPG Mode*
4. The detector may be ‘Gated On’ or ‘Gated Off’ for the duration of the selected pulse width i.e. the polarity of the pulse may be inverted.
5. Trigger 1 can be selected to gate the intensifier directly – Pass Through Mode.
6. Three input trigger connectors may be utilised for independent trigger inputs, however only 1 trigger may be implemented at any particular time.
7. The IGC3 front panel switches may be locked to ensure that modifications of the set-up are carried out exclusively from the PC. There are 2 locking modes, an EDIT LOCK and a LOCK ALL function, both functions are explained later in this manual.

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1.3 *Hardware Installation*

The minimum requirements for operation of this system are for the detector to be connected to the IGC3, and the IGC3 connected to a mains A.C. supply in the range 90V-250V.

In this form the system can function in either an Internal Trigger Mode utilising the internal clock of the IGC3, or in the 'Gated On' (d.c.) mode i.e. no cathode gating.

Connect the system as illustrated in the relevant system interconnection diagram included at the end of this manual.

With the detector in a dark box or suitably darkened environment switch the unit on using the illuminated power switch on the front panel of the IGC3 unit.

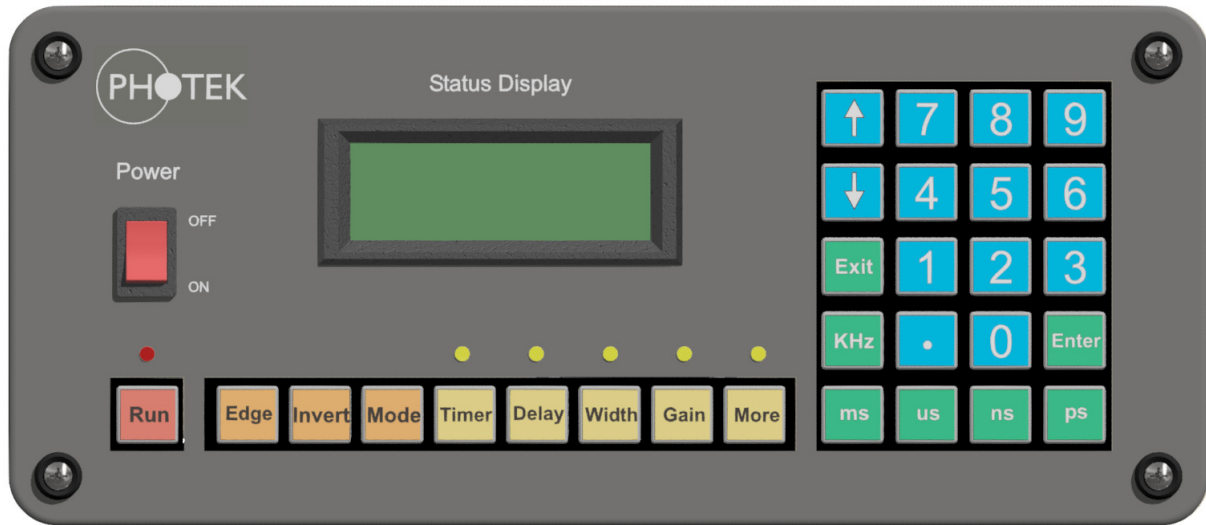
The last delay and width values utilised will be loaded during power up. The high voltage power will be off immediately after power up therefore the gating will be off.

Pressing the "Run" switch to turn on the high voltage and start the last mode of operation. The run switch will illuminate to indicate when the detector is either 'On' or in 'Gating mode'.

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2 Front Panel Description

The front panel of the IGC3 is illustrated below: -



2.1 Power Switch

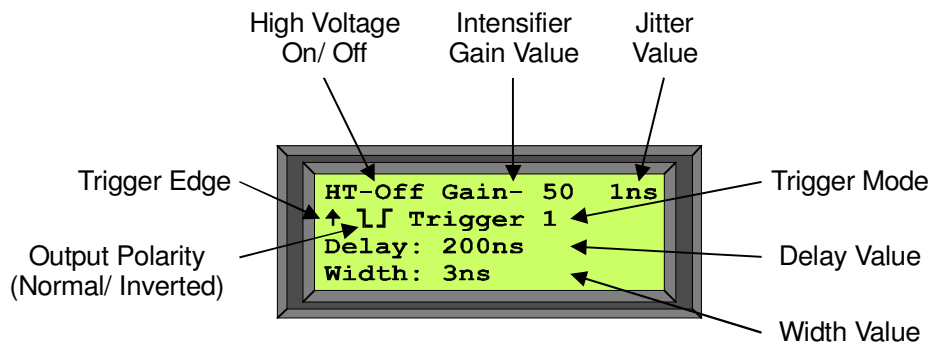
The illuminated power on/off switch will glow ‘Red’ when the unit is switched ‘On’.

2.2 Status Display

The status display is a 4 line by 20-character liquid crystal display. The current operating conditions are displayed here. Manual modification of functions may be carried out using the 29 keys and by monitoring this display.

Any functions downloaded from the PC will be displayed on the unit status display as soon as they are implemented.

Under normal operating conditions the status display will indicate the current values of all relevant functions: Delay, width, gating mode, edge (+ve/-ve), output polarity (normal/inverted), HT status (On/Off), intensifier gain value and output jitter value.



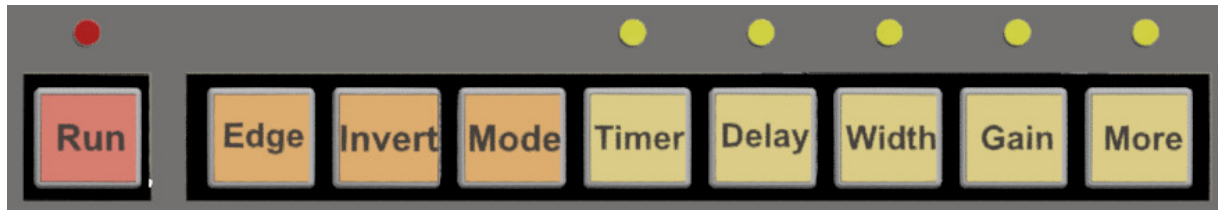
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2.3 Front Panel Keys

The IGC3 may be operated under manual control via the 29 momentary action push-button keys. Each key is annunciated with its function. The keys are colour coded to identify common operating functionality.

2.3.1 Function Switches

There are 9 function keys as illustrated below: -



1. **Red** – Only the ‘Run’ key is colour coded red.

Run - This key is a toggle function for the intensifier HT on/off control i.e. each time this key is pressed the intensifier power will be toggled to the opposite state. There is an LED on this key that will illuminate when the intensifier power is on. There will be a small delay of 0.5s while the High Voltage is stabilising before the gating to the intensifier is enabled. This is also the case when the Intensifier power is turned on via the RS-232 link
2. **Orange** – Three keys are colour coded orange, ‘Mode’, ‘Edge’ and ‘Invert’. These are toggle functions and are non-editable functions.

Mode – This key will cycle through the possible operating modes in the following order: ‘Gated Off’, ‘Gated On’, ‘Pass Through’, ‘Timer’, ‘Trigger 1’, ‘Trigger 2’, ‘Trigger 3’ and then back to ‘Gated Off’.

Edge - This key will toggle between the 2 possible states that trigger the IGC3 unit - ‘positive edge’ (+ve) and ‘negative edge’ (-ve).

Invert - This key will toggle between 2 states ‘Normal’ and ‘Inverted’ output. *Normal output is used to gate the intensifier ‘on’ for the duration of the width value. Inverted output is to gate the intensifier ‘off’ for the duration of the width value.*

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3. **Yellow** – Five keys are colour coded yellow, ‘Timer’, ‘Delay’, ‘Width’, ‘Gain’ and ‘More’. These keys are used to enter the edit functions and utilise the blue keys of the numeric keypad to input values. Once an edit function has been selected and edited a green key must be pressed to end/exit the edit function. Each yellow function key has an LED that is illuminated when the function is being edited.

Timer – This key is only active when ‘Timer’ has been selected as the trigger source for the IGC3. The timer value may be edited in either kHz or as ms/us/ns values. The timer minimum incremental value is 10ns.

Delay – This key is used to edit the delay value. This value may be edited in ms/us/ns/ps values. The minimum incremental value is 250ps for values below 1us and 10ns for values above 1us.

Width – This key is used to edit the width value. This value may be edited in ms/us/ns/ps values. The minimum incremental value is 250ps for values below 1us and 10ns for values above 1us.

Gain – This key is used to edit the intensifier gain value. This value may be edited in between 1 and 100, 1 is minimum gain and 100 the maximum gain.

More – This key is used to enter the 2 extra editable menus, the Special Functions and the Interface Option menus.

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2.3.2 Function Edit Keys

The 20 function edit keys as illustrated below: -



4. **Blue** – There are 13 keys colour coded blue: a 0-9 numeric keypad, decimal point and a pair of Up/Down buttons. These are all the keys required to edit and navigate the menus accessed by the yellow ‘edit’ keys. After editing a function a green ‘end edit’ key must be pressed to exit the edit mode. Editable functions use the numeric keypad to input required values. The Up/Down keys allow navigation of the ‘special function’ and ‘interface options’ menus.
5. **Green** – There are 7 keys colour coded green: ms, us, ns, ps, kHz, Enter and Exit. Each of these keys may be used to finish a relevant edit operation. ‘Exit’ may be used at any time during an edit to cancel the current edit function.

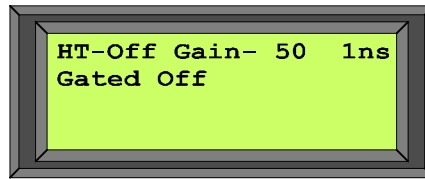
The keys annunciated with kHz, ms, us, ns and ps are for the engineering units kilohertz, milli-second, microsecond, nano-second and pico-second respectively. These are used when a timer, delay or width value are edited (kilohertz is only active in Timer mode). If a sub kilohertz timer value is required then the timer value may be edited and ended by pressing the ‘Enter’ key.

The IGC3 will display the edited value in the form that it is entered i.e. if the user enters 100000ns for the width value it will be displayed as ‘Width: 100000ns’.

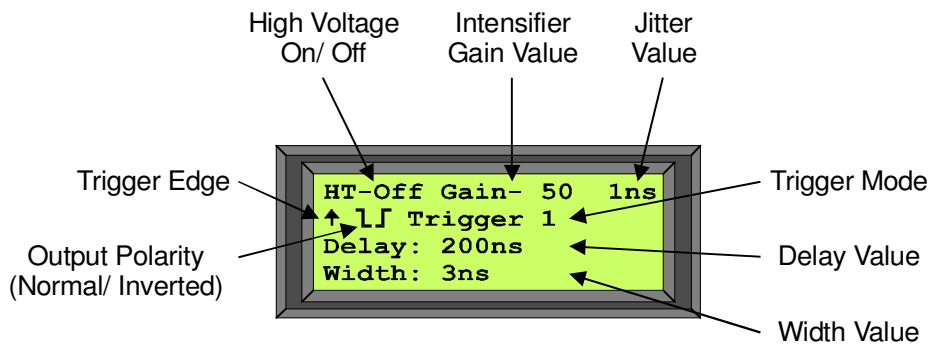
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3 Status Display

At switch on unit status will be displayed similar to the following: -



To enable a gating mode the 'Mode' switch must be pressed successively until the desired trigger mode is reached. The gating mode will cycle through the following sequence 'Gated Off', 'Gated On', 'Pass Through', 'Timer', 'Trigger 1', 'Trigger 2', 'Trigger 3' and then back to 'Gated Off'.



Once a gating mode is selected the screen will change to display the current operating conditions that will be applied. Each of the functions displayed is explained in the following sections.

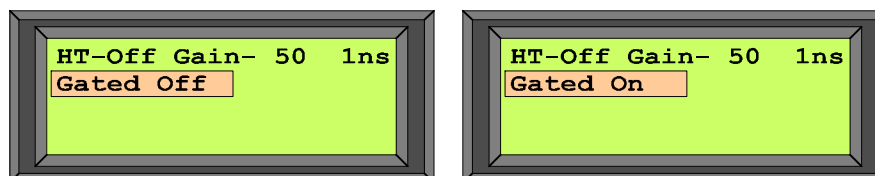
3.1 Gating Mode

The IGC3 has 5 gating trigger modes and dc On/Off operating conditions; successive presses of the 'Mode' switch selects the gating mode.

To activate the selected gating mode the 'Run' switch must be pressed to turn the high voltage on.

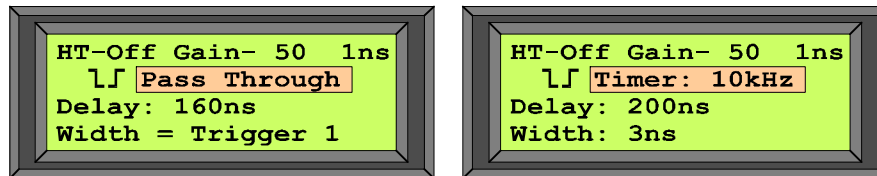
The IGC3 gating modes are listed below: -

1. **Gated Off** – In this gating mode the TTL gate output from the IGC3 is held low (inactive) and the gate module will be in the gated off mode i.e. dc off.
2. **Gated On** – In this gating mode the TTL gate output from the IGC3 is held high (active) and the gate module will be held in the gated on mode i.e. dc on.

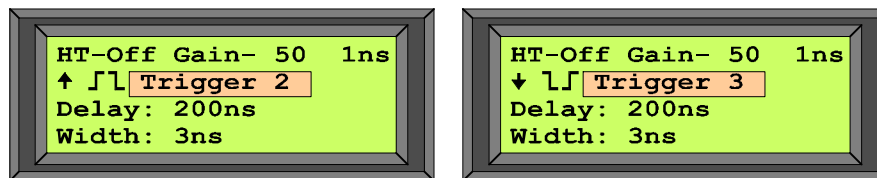


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3. **Pass Through** – In this gating mode the trigger signal active on the Trigger 1 input will be passed directly to the gate module. In Pass Through the trigger edge is fixed on the positive edge, however the polarity can be inverted. The Delay function is not editable but the value is displayed.
4. **Timer** – In this gating mode the 2nd line of the status screen will display an editable timer value. This is generated from an internal clock source and is editable in period or frequency modes - resolution is 20ns or .01Hz. In timer mode either trigger edge of the timer signal may be used, the polarity of the output may be inverted and the full range of width and delay values are available. The Trigger Output signal is directly derived from the Timer signal. The Timer can exceed the specifications of Photeks gate modules; therefore the maximum and minimum values are limited with respect to the gate module utilised. If no gate module is supplied with this system then the timer minimum is 6Hz and the timer maximum is 1MHz (edited on screen as 1000kHz).

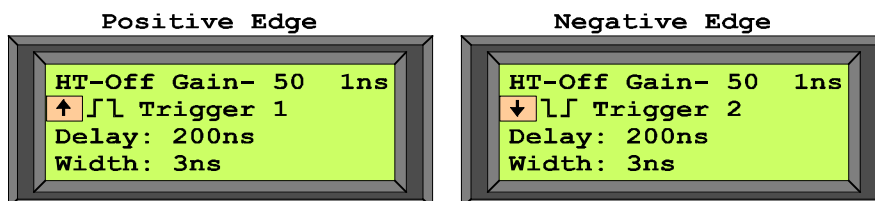


5. **Trigger 1, 2, and 3** – In these gating modes the trigger source selected will be used to enable the delay and width functions programmed into the IGC3 unit. The output may be positive or negative edge triggered and the polarity may be selected normal or inverted.



3.2 Trigger Edge

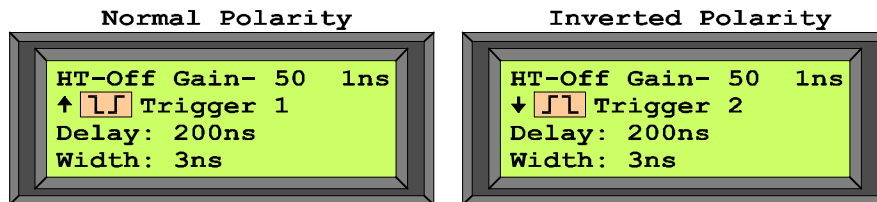
The trigger edge symbol is the arrow at the start of the 2nd line. The trigger edge is selected by pressing the ‘Edge’ button and may be positive edge (arrow pointing up) or negative edge (arrow pointing down). This function is only active for Trigger 1, 2, 3. Both of the trigger edge conditions are illustrated below: -



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3.3 Output Polarity

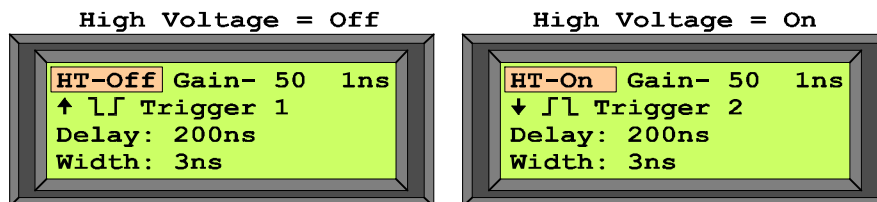
The output polarity symbol is displayed on the 2nd line of the display. The polarity may be selected to be ‘Normal’ which means the gate signal is ‘on’ (active) for the duration of the width variable; or the polarity may be selected to be ‘Inverted’ which means the gate signal is ‘off’ (inactive) for the duration of the width variable. The polarity is selected by pressing the ‘Invert’ switch; the output will toggle between the 2 possible conditions. Both of the polarity symbols/conditions are illustrated below: -



Note 1: - As the cathode of an intensifier is taken negative to turn it on the negative going pulse symbol indicates ‘Normal’ polarity and the positive going pulse symbol indicates ‘Inverted’ polarity. For a GM-MCP which gates positive, normal polarity is required, the graphic displayed will be wrong.

3.4 HT-On/ Off

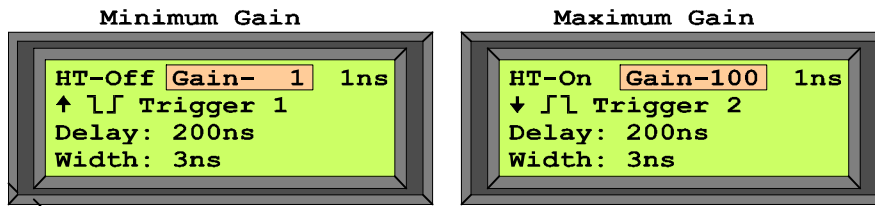
The HT On/Off function is displayed at the start of the top line of the display. This indicates when the power to both the gate module and the high voltage psu for the tube are switched on. The output gating functions are inhibited while the HT is off and enabled when it is turned on. Pressing the ‘Run’ switch turns on the HT. Both of the high voltage conditions are illustrated below: -



3.5 Intensifier Gain

The intensifier gain is displayed in the centre of the top line of the display. This is a numeric value between 0 and 100, this corresponds to the MCP voltage applied to the tube with 0 as the minimum and 100 as the maximum gain. The gain is an editable function accessed by pressing the ‘Gain’ switch and using the numeric keypad and the ‘Enter’ switch to finish editing. The intensifier gain may be dynamically incremented by successive presses of the Up/Down keys, each press will increment the gain variable by 1 digit.

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The intensifier gain function is an analogue voltage derived by a digital to analogue conversion from a 10-bit variable. As the gain control requirement is intensifier specific maximum and minimum limits are programmed into the IGC3 unit and the control variable used is software scaled to provide a 0-100 operating range

The IGC3 controller utilises 0-5V 10-bit digital to analogue converters. With limits set to extreme values and with 0-100 software scaling the incremental voltage is 48.8mV. If the 10-bit limits are reduced the incremental voltage will reduce.

**see miscellaneous status request for further information on intensifier and video gain limits.*

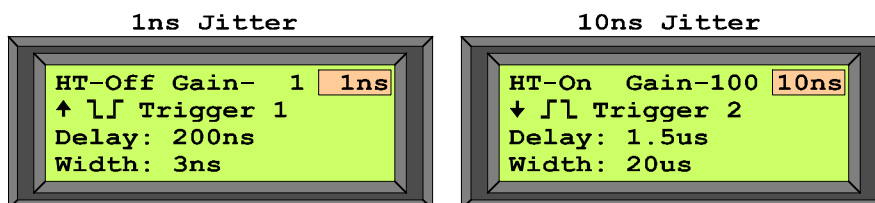
3.6 Jitter Value

The jitter value for the current gating mode is displayed on the top right of the display. This has 2 values that relate to the 2 gating controllers that are embedded in the IGC3: -

1. If both the pulse width and delay are below 1us the IGC3 will use the NSPG gating controller and the jitter value will be $\pm 500\text{ps} \approx 1\text{ns}$ absolute.
2. If either the pulse width or delay are above 1us the IGC3 will use the IGC gating controller and the jitter value will be $\pm 5\text{ns} \approx 10\text{ns}$ absolute.

The IGC3 unit automatically selects the gating controller, and therefore the jitter value. They are not selectable or editable by the user without obeying the conditions that the IGC3 unit uses to select the gating controller utilised. If low jitter is required then both the delay and pulse width values must be below 1us.

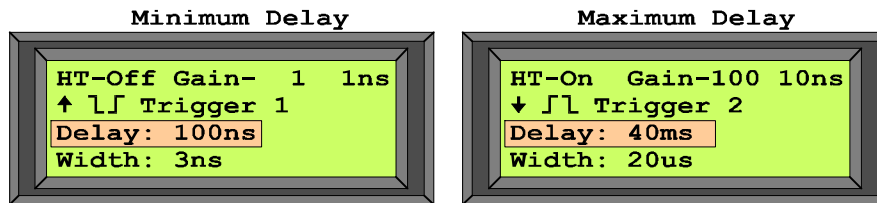
The 2 jitter value displays are illustrated below: -



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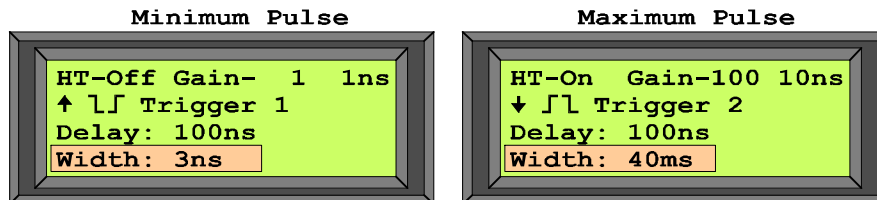
3.7 Delay Variable

The delay variable is displayed along the 3rd line of the display. This value is active and editable in 4 trigger modes, Timer, Trigger 1, 2, 3. To modify the delay value the ‘Delay’ edit switch must be pressed and the desired value input via the numeric keypad, the required engineering unit switch (ms, us, ns, ps) must be pressed for the IGC3 to accept the edit. The delay may be edited in ms, us, ns and ps values however the minimum delay possible is approximately 100ns. The delay value may be edited within the range 100ns to 20ms.



3.8 Width Variable

The width variable is displayed along the 4th line of the display. This value is active and editable in 4 trigger modes, Timer, Trigger 1, 2, 3. To modify the width value the ‘Width’ edit switch must be pressed and the desired value input via the numeric keypad, the required engineering unit switch (ms, us, ns, ps) must be pressed for the IGC3 to accept the edit. The width may be edited in ms, us, ns and ps values however the minimum width possible is 3ns. The width value may be edited within the range 3ns to 40ms.



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4 IGC3 Extra Menus

Successive presses of the ‘More’ switch open several menus that are used to edit additional IGC3 functions. These menus are: -

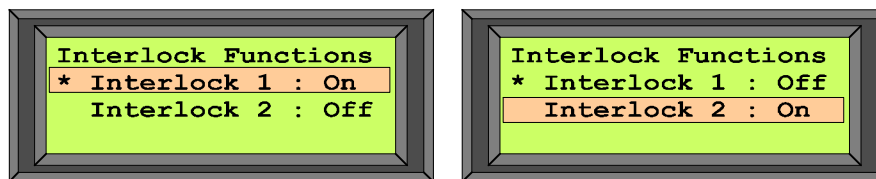
1. Interlock Functions
2. Keyboard Options
3. Gate Unit Selection
4. Intensifier Gain Setup
5. Video Gain Setup

The functions for each of these menus are detailed in the following sections.

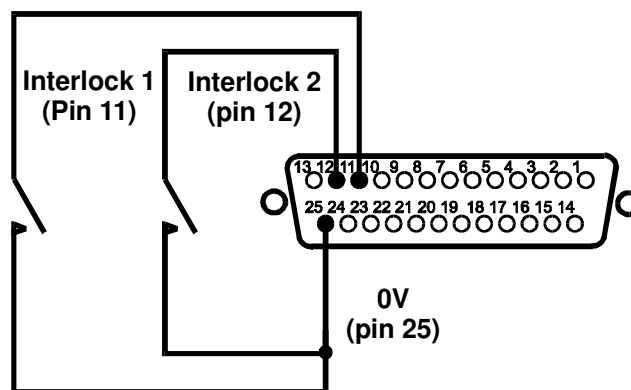
4.1 Interlock Functions

There are 2 interlocks which may be utilised to provide safe operation of the IGC3/ Detector system. In the Interlock Functions menu the 2 interlocks may be turned ‘on’ or ‘off’. The Up/Down buttons are used to navigate through this menu. The interlocks are modified by pressing enter when the asterisk indicates they are selected.

The Interlock Functions menu is illustrated below: -



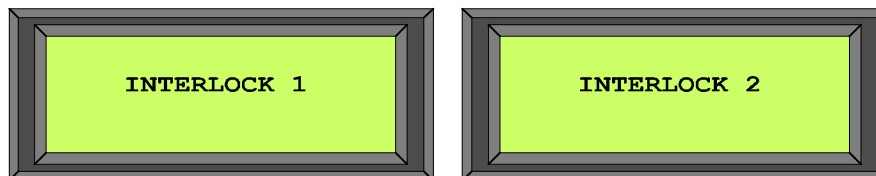
Each interlock requires the related pin on the 25-Way D-Type connector located on the rear panel of the IGC3 to be connected to 0V to be satisfied. This may be done by connecting a micro-switch on a dark box door or microscope lamp between either pin 11 or 12 and pin 25 on the 25-Way D-type .



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If an interlock pin is left open circuit an internal pull-up resistor within the IGC3 unit will activate the interlock and disable the high voltage power on/off function accessed by the ‘run’ switch. If the high voltage power is on when an interlock is activated it will be immediately powered off and the display will indicate that an interlock has occurred.

Both interlocks may be enabled to provide a dual safety mechanism and in this case both would need to be satisfied before the IGC3 would allow the high voltage to be enabled.



Note: - Control of BPS units is not performed by the IGC3 interlocks.

4.2 Keyboard Options

The Keyboard Options menu allows the user to select the locking mode for the IGC3 unit and assign a 3-digit number as the switch locking code.

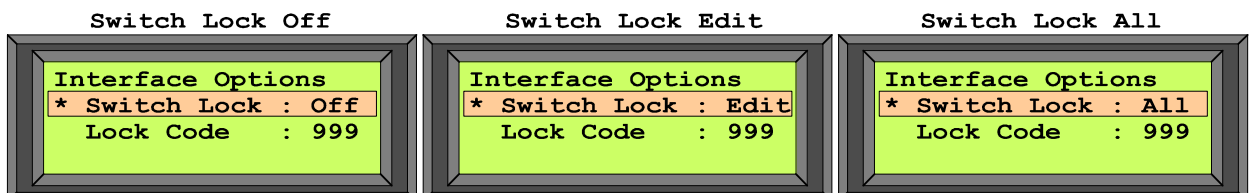
4.2.1 Lock Mode

There are 3 switch-locking modes implemented on the IGC3: -

1. OFF: - This disables the locking function.

2. EDIT LOCK: - This allows the intensifier to be activated from the front panel ‘Run’ switch but none of the operating conditions can be modified. All switches are disabled, if any of these buttons are pressed the display will flash up the “Keyboard Locked” before returning to the Status Display Screen. The 3-digit lock code must be entered to manually lock/unlock the switches.

3. LOCK ALL: - This feature locks all front panel switches, this may be used when the unit is under PC control and manual editing is undesirable. If any button is pressed the display will flash up the message “Keyboard Locked” before returning to the Operating Mode Screen.



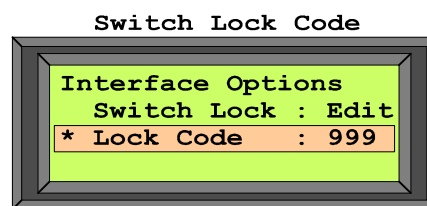
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All switch-locking functions can be enabled/disabled from either the PC or the IGC3 unit. The lock mode may be modified when the asterisk indicates it is selected: -

1. Press ‘Enter’ once to access the lock mode.
2. Use the up/down switches to select between ‘off’, ‘edit’ and ‘all’
3. Press ‘Enter’ again to exit and enable the new lock mode.

4.2.2 Lock Code

The switch locking code sets the 3 key sequence that may be used to lock the IGC3 manual control interface, it is a user definable number which may be edited to any 3-digit number the user desires. Once set the new code will be implemented immediately and will enable/ disable the switches according to the locking function selected i.e Off, Edit or All.



The lock code can be edited when the asterisk indicates it is selected.

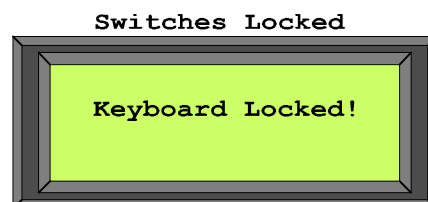
1. Press enter once to access the edit function.
2. Type in the new 3 digit code
3. Press enter again to exit and enable the new code.

The IGC3 Unit will be supplied with a default switch locking code of: - 999

To Lock The Switches: -

While the status is displayed the IGC3 may be locked. Key in the correct 3-digit (numeric) switch locking code. This will toggle the IGC3 between switches locked and unlocked in the switch locking function selected.

If the user attempts to modify the IGC3 settings while the switches are locked the display will indicate that the switches are locked and then return to the status screen.



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4.3 Gate Unit Selection

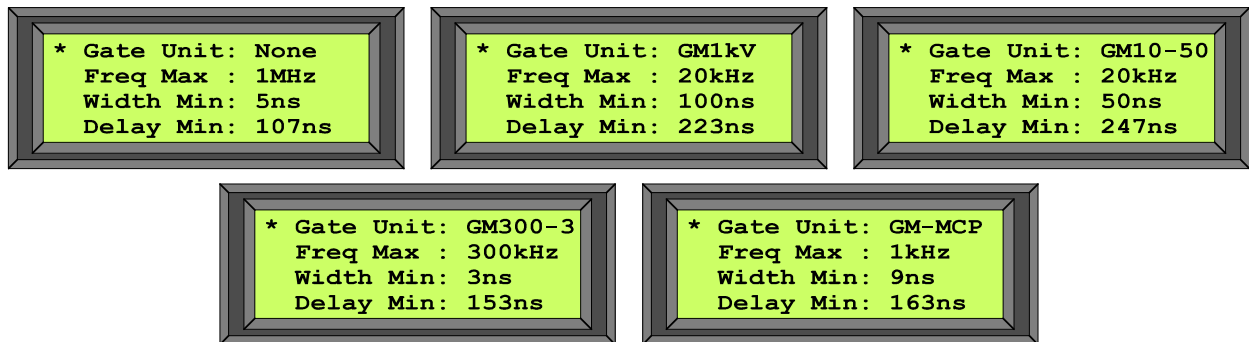
The Gate Unit selection menu allows the user to choose between 5 pre-programmed gate unit options that Photek offer. Each gate unit has specific limits to their operating characteristics and the IGC3 has been programmed to set these limits depending on the gate unit selected.

The 5 Gate Unit options and their respective limits are illustrated below: -

Gate Unit	Maximum Frequency	Minimum Pulse Width	Gate Unit Propagation Delay	Gate Unit Pulse Width Loss
No Gate Module	1MHz	5ns	0ns	-
GM1kV	20kHz	100ns	116ns	30ns
GM10-50	20kHz	50ns	130ns	30ns
GM300-3	300kHz	3ns	50ns	10ns
GM-MCP	1kHz	9ns	70ns	5ns

Three of the characteristics specific to the selected gate unit are displayed on the gate unit selection screen, Maximum Frequency, Minimum Pulse Width and Minimum Propagation Delay.

The Gate Module Selection Screen is illustrated below: -

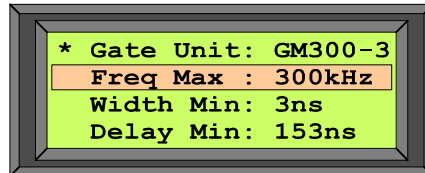


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4.3.1 Maximum Timer Frequency

The maximum Timer Frequency that may be edited by the user is set when the Gate Unit to be used with the IGC3 is selected. The IGC3 does not provide any input trigger limitation to the operating frequency and so in Pass Through and Trigger1, 2, 3 modes the maximum frequency limits of the gate unit being utilised must be observed.

The maximum frequency is displayed on the second line of the Gate unit selection Screen as illustrated below: -

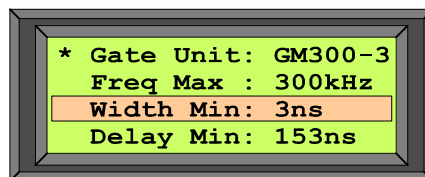


4.3.2 Minimum Pulse Width

This is the minimum pulse width that may be edited by the user with respect to the gate unit selected. This Pulse Width Minimum implements a pulse width modifier to offset inherent pulse width loss on the Gate Units.

If the user uses Pass Through mode the pulse width modification and pulse width minimum modifier functions are not implemented. In this mode of operation the user should be aware of the maximum/ minimum characteristics of the gate unit being used.

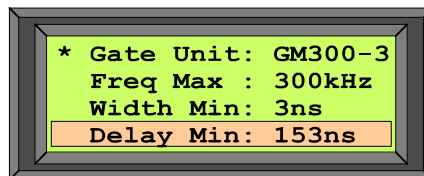
The minimum pulse width is displayed on the third line of the Gate unit selection Screen as illustrated below: -



4.3.3 Minimum Propagation Delay

The minimum propagation delay displayed on this screen is related to both the Gate Unit selected and the mode of operation that the IGC3 is currently operating in. Each mode of operation has specific characteristics and the IGC3 is pre-programmed to adjust for these. The IGC3 has 3 distinct gating modes, 2 gating controllers (1ns /10ns jitter) and 5 possible gate unit selections, each of these modes has a different minimum propagation delay.

The minimum delay for the current mode of operation is displayed on the fourth line of the Gate unit selection Screen as illustrated below: -



Note: - The user may view this variable if they are unsure of the minimum delay for the current mode of operation.

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4.4 Intensifier Gain Setup

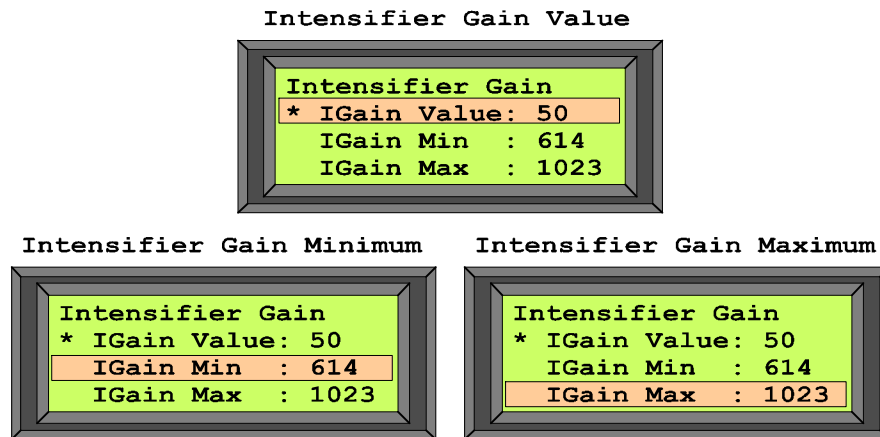
The intensifier gain setup screen allows the maximum and minimum limits of the MCP control voltage and the intensifier gain value to be edited. For Photek supplied systems the maximum and minimum limits of this function will be set related to the specific Intensifier and High Voltage Module supplied, the user should not modify these functions.

If the IGC3 is supplied as a standalone unit the intensifier gain output may be used as a 0-5V control voltage.

The intensifier gain output from the IGC3 controller utilises 0-5V 10-bit digital to analogue converters with decimal limits of 0 and 1023. With limits set to extreme values and with 0-100 software scaling the incremental voltage is approximately 50mV. If the 10-bit limits are reduced the incremental voltage will reduce.

The intensifier gain limits may be set to a reduced output voltage span and the software scaling to set a 0-100 range will automatically adjust to provide a new fixed incremental output voltage.

The intensifier gain setup menu is illustrated below: -



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4.5 Video Gain Setup

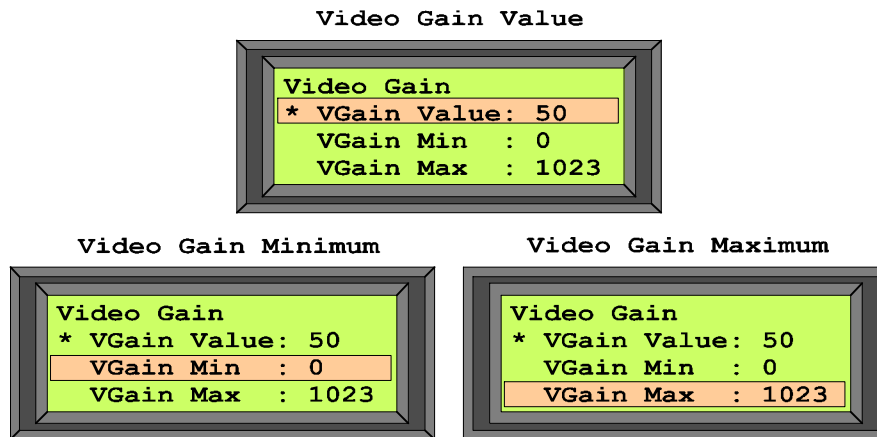
The video gain setup screen allows the maximum and minimum limits of the MCP control voltage and the intensifier gain value to be edited. For Photek supplied systems the maximum and minimum limits of this function will be set related to the specific CCD Camera supplied, the user should not modify these functions.

If the IGC3 is supplied as a standalone unit the video gain output may be used as a 0-5V control voltage.

The video gain output from the IGC3 controller utilises 0-5V 10-bit digital to analogue converters with decimal limits of 0 and 1023. With limits set to extreme values and with 0-100 software scaling the incremental voltage is approximately 50mV. If the 10-bit limits are reduced the incremental voltage will reduce.

The video gain limits may be set to a reduced output voltage span and the software scaling to set a 0-100 range will automatically adjust to provide a new fixed incremental output voltage.

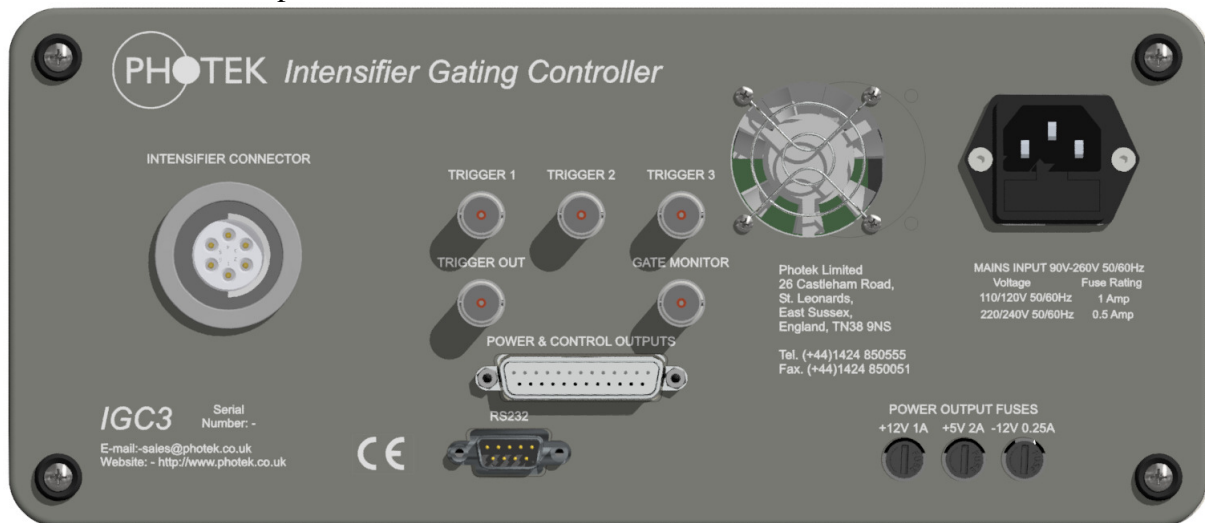
The video gain setup menu is illustrated below: -



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5 Rear Panel Description

The IGC3-Basic rear panel is illustrated below: -



Note: - For units that do not incorporate high voltage or gate modules inside the IGC3, the Intensifier Connector will not be fitted.

5.1 IEC Mains Inlet

The mains input for this unit is via a fused IEC inlet. This unit accepts any A.C. mains voltage between 90V and 250V, either 50Hz or 60Hz.

For voltages of 90V - 120V A.C. a 1A fuse should be fitted and for voltages of 220V - 240V A.C. or higher a 0.5A fuse should be fitted. The Fuse compartment has the capacity to store 1 spare fuse.

5.2 Fan Outlet

The fan outlet and the underside of the unit should be left uncovered to allow for air circulation within and around this unit.

The air intake is via slots located on the bottom of the unit and air is expelled from the Fan outlet mounted on the rear panel.

5.3 Trigger Input - 1, 2 & 3

The trigger-input connectors are 50Ω BNC connectors that accept TTL (+5V) compatible trigger pulse inputs.

Each trigger input can be selected as the trigger for the cathode gate module either manually from the front panel or by PC control via the RS-232 link.

All three trigger inputs have an input impedance of 4.7kΩ. And propagation delays between any trigger input and the output gate pulses are identical (See Propagation Delays Section).

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5.3.1 Trigger Input 1 Pass Through: -

Trigger Input 1 can be enabled as a pass through trigger pulse which will be directed to the intensifier cathode gate unit without passing through the pulse width and delay circuitry. This will produce a pulse on the cathode equal to the Trigger 1 Input Pulse minus the gate module pulse width loss.

5.4 Trigger Out BNC

The trigger out is a buffered TTL output of the signal used to trigger the delay and width functions of the IGC3 unit. The duration of this pulse is the duration of the selected trigger signal. This output is 50 Ω compatible.

5.5 TTL Gate Monitor

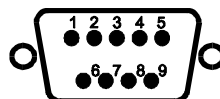
The TTL gate monitor output is a low voltage version of the gate pulse applied to the detector. This pulse is delayed internally within the IGC3 so that it matches the propagation delay through the system. The pulse width output is equivalent to the gate module pulse width output +10ns. This output is 50 Ω compatible.

5.6 RS-232 Connector

This is an asynchronous serial communication port operating at a fixed baud rate of 19200. This enables the IGC3 to be controlled from a standard PC by means of ASCII control characters and codes.

The IGC3 RS-232 uses a 2 wire system (transmit and receive), handshaking is implemented in software for confirmation of valid control codes.

A full listing of codes and protocols are listed in the software interface section of this manual. The RS-232 connector is a 9-Way D-Type Plug. Pin-out functions are listed below: -



(View as seen looking at the rear panel)

9 Way D-type plug	
Pin No.	Function
Pin 2	Transmit data
Pin 3	Receive data
Pin 5	Ground/ 0V

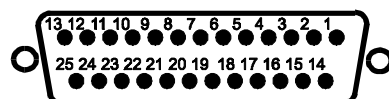
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5.7 Power And Control Outputs Connector

This 25-Way D-Type Socket contains all of the low voltage power and control signals for operation of gated image intensifiers.

Note: - For units supplied with HT Psu Modules and Gating Modules fitted inside the IGC Unit the HT control and gating output functions of this connector are redundant. This connector may be utilised for low voltage d.c. power.

The Functions of this connector are indicated below: -



(View as seen looking at the rear panel)

25-Way D-Type Socket	
Pin No.	Function
14	+12V @ 1A Power Output (See Note)
15	+5V @ 1A Power Output (See Note)
1, 2, 3, 7, 8, 9, 10, 17, 18, 23, 24, 25	0V
16	-12V @ 250mA Power Output (See Note)
4	TTL Gate Monitor
5	Trigger Output
6	Gate Output
11	Interlock 1
12	Interlock 2
13	Not Used
19	Video Gain Output
20	Switched Gate Module Power (Default= +12V)
21	Intensifier Gain Output
22	Switched HT Module Power (Default = +5V)

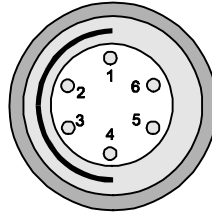
Note: - Each power output is fitted with a fuse internal to the IGC3 unit, each fuse is a 5x20mm anti-surge (T) rated at the output current maximum.

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5.8 Intensifier High Voltage Connector

This is a 6-Way 12kV rated WWFischer D106A013 panel mounted socket; it is fitted to the IGC3 when a flatpack high voltage power supply is fitted internal to the IGC3 unit. The mating connector (S106A013) is fitted onto 1.5m of cable connected to the Image Intensifier supplied with this system.

The High Voltage connector supplies all of the voltages to the image intensifier as follows: -



(View as seen looking at the rear panel)

Pin Number	Function	Output Voltage
1	Cathode	+50V to -200V
2	MCP In	0V
3	MCP Out	400V to 1000V
5	Screen	5.9kV to 6.5kV
4 & 6	Not connected	-

Note: - All Voltages indicated here are general, for exact voltages for the image intensifier supplied with this system please refer to the intensifier test summary.

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6 RS-232 Serial Interface

6.1 Serial Link Configuration

The RS-232 utilised by the IGC3 is a 3-wire interface for asynchronous transmission and reception of data. The interface utilises TD (Transmit Data), RD (Receive Data) and Gnd from the RS-232 protocol.

The Baud rate for communication is fixed at 19200; this is programmed into the IGC3 and cannot be modified.

The Data format is No Parity, 8 Data bits and 1 stop bit.

All data transmitted to or from the IGC3 is in ASCII format. Commands take the form of letters and variables are ASCII numbers.

6.1.1 Configuration Summary:-

Baud Rate	=	19200
Parity	=	No
Data Bits	=	8
Stop Bits	=	1

6.2 IGC3 Serial Commands

The IGC3 serial control commands are listed below: -

a	8bit	EEPROM address
b	8bit	EEPROM data byte
d	32bit	Delay value
i1	0,1	Interlock 1 Enable / Disable
i2	0,1	Interlock 2 Enable / Disable
ig	16bit	Intensifier Gain value
ip	0,1	Intensifier Power Off, On
l	0-5	Switch Lock status (Off, U Edit, U All, L Edit, L All)
me	0,1	Edge Mode
mm	0-8	Gating Mode
mp	0,1	Inversion Mode
q	0	test link
s		EEPROM save
t	32bit	Timer value
vg	16bit	Video Gain value
w	32bit	Width value

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6.3 IGC3 Status Request Commands

The IGC3 status request commands are listed below: -

zd	delay status request
zg	intensifier gain/ video gain status request
zm	mode status request
zt	timer status request
zw	width status request
zx	miscellaneous status request
zy	delay minima status request

6.4 Command Acknowledgement

When a serial command is received it is acknowledged with either 'ok', 'OK' or '! E'.

1. ok – command accepted, NSPG gating controller active.
2. OK – command accepted, IGC gating controller active.
3. !E – IGC3 unit is being edited by the front panel switches.
4. !1, !2 – Interlock 1 or Interlock 2 occurred.

6.5 Command & Data Format

6.5.1 Unit Identification

The unit identification may be requested from the IGC3 by using the 'id' command. The returned data will be the unit type 'IGC3' and the IGC3 software issue number i.e. 'V3.05'. each data element will be de-limited by a comma, an ok will follow the returned data string.

The format of this command function is illustrated below: -

Command Function	ASCII Command Letter	ASCII Integer Data String	Returned Data
Request Unit Identification	id	- (no data string)	IGC3,V3.05,ok

6.5.2 Pulse Width and Delay

The Pulse Width and Delay ASCII command characters can all be followed by 12 ASCII characters. The desired engineering unit for the function must be the last character sent, m or ms for milliseconds, u or us for microseconds, n or ns for nanoseconds and p or ps for picoseconds. OK is returned on receipt of a valid command.

The IGC has a maximum resolution of 0.25ns; that is the least significant digit that can be edited equates to a 250ps increment. The IGC3 incorporates leading zero suppression so that the data may be transmitted in the shortest string form that will edit all the values required.

The command characters coded to these functions are illustrated below: -

Command Function	ASCII Command Letter	Maximum/ Minimum ASCII Integer Data String	Command String Transmitted	Instruction Equivalence
Modify Pulse Width	w	40m	w40m	Width = 40ms
		3n	w3n	Width = 3ns
Modify Delay	d	20m	D20m	Delay = 20ms
		120n	d120n	Delay = 120n

6.5.3 Timer

The timer may be edited in either frequency or period mode. The Timer ASCII command characters can be followed by 8 ASCII characters. The desired engineering unit for the timer function must be the last character sent m or ms for milliseconds, u or us for microseconds, n or ns for nanoseconds and p or ps for picoseconds, k, kH or kHz for kiloHertz and if a carriage return is sent the IGC3 assumes integer values in Hertz. OK is returned on receipt of a valid command.

The IGC timer has a maximum resolution of 20ns; that is the least significant digit that can be edited equates to a 20ns increment.

The IGC3 incorporates leading zero suppression so that the data may be transmitted in the shortest string form that will edit all the values required.

The command character coded to this function is illustrated below: -

Command Function	ASCII Command Letter	Maximum/ Minimum ASCII Integer Data String	Command String Transmitted	Instruction Equivalence
Modify Timer	t	1000k	t1000k	Timer = 1Mhz
		6	t6 (CR)	Timer = 6Hz

6.5.4 Gating Mode/ Trigger, Trigger Edge, Output Mode/ Polarity, Locking Mode

The Gating Mode, Trigger Edge and Output polarity commands are one or two ASCII command letters followed by a single ASCII integer. OK is returned on receipt of a valid command.

The command characters coded to these functions are illustrated below: -

Command Function	ASCII Command Letter	Valid ASCII Integer Data	Equivalent IGC3 Function
Modify Gating Mode	mm	0	Intensifier Off
		1	Intensifier On (dc)
		2	Pass Through
		3	Internal Timer
		4	Trigger Input 1
		5	Trigger Input 2
		6	Trigger Input 3
Modify Trigger Edge	me	0	+ve Trigger Edge
		1	-ve Trigger Edge
Modify Output Polarity (Not available on the IGC3-WA-4 and IGC3-WA-4)	mp	0	Output Normal
		1	Output Inverted
Modify Locking Mode	l	0	Off
		1	Unlocked Edit
		2	Unlocked All
		3	Locked Edit
		4	Locked All

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6.5.5 Intensifier Gain (Video Gain)

The intensifier Gain command is two ASCII command letters followed by upto 3 ASCII integers. This is equivalent to a gain range of 0-100. OK is returned on receipt of a valid command.

The IGC3 will accept 1, 2 or 3 integers with the last received integer equivalent to the number of units.

The command character coded to this function is illustrated below: -

Command Function	ASCII Command Letter	ASCII Integer Data String	Equivalent IGC3 Gain Value
Modify Intensifier Gain	ig	1	1
		10	10
		100	100
Modify Video Gain	vg	1	1
		10	10
		100	100

6.5.6 Status Request

The Status commands are the only PC control function that will stream data other than 'ok', 'OK' or "!E" back to the PC.

The data transmitted is all the operational parameters that the IGC3 is currently using (these will also be the values stored in the non-volatile memory of the IGC3).

The data transmitted to PC as a string of ASCII integer characters with a comma de-limiter between successive data variable strings.

Status requests can be made for various functions as detailed below, the data is streamed back to the PC in the order illustrated below: -

6.5.6.1 Delay, Width and Timer Status Requests

Each of these requests returns a single 32-bit variable that indicates the current value of these functions. The commands are as follows: -

Command	Function	Data Returned
zd	Request Delay Status	Delay (32-bit)
zw	Request Width Status	Width (32-bit)
zt	Request Timer Status	Timer (32-bit)

6.5.6.2 Intensifier and Video Gain Status Request

The intensifier and video gain status request returns a pair of 16-bit variables that indicate the current value of these functions. The command is as follows: -

Command	Function	Data Returned
zg	Request Gain Status	Intensifier Gain (16-bit)
		Video Gain (16-bit)

6.5.6.3 Mode Status Request

The mode status request streams the general operating conditions active on the IGC3 unit at present, the data returned is listed below: -

Command	Function	Data Returned
zm	Request Mode Status	Power On/ Off
		Gating Mode
		Trigger Edge
		Output Polarity
		Interlock 1 Enabled/Disabled
		Interlock 2 Enabled/Disabled
		Gate Counter - <i>not used</i>
		Switches Locked
		Switch Locking Mode
		Lock code 1 – <i>ASCII number</i>
		Lock code 2 – <i>ASCII number</i>
		Lock code 3 – <i>ASCII number</i>

6.5.6.4 Miscellaneous Status Request

The miscellaneous status request streams the software version number and the upper and lower limits for the intensifier and video gain functions, and the maximum and minimum timer values that may be set.

6.5.6.4.1 Intensifier/ Video Gain Limits

Intensifier and video gain outputs are analogue functions derived by a digital to analogue conversion from 10-bit variables. The limits for these functions are factory set at optimum values and the control functions are software scaled to provide a control range between 0 and 100. The gain variables limits stored within the IGC3 are the 10-bit values that set the maximum and minimum voltages for the functions.

The IGC3 controller utilises 0-5V 10-bit digital to analogue converters. With limits set to extreme values and with 0-100 software scaling the incremental voltage is 48.8mV. If the 10-bit limits are reduced the incremental voltage will reduce.

If the IGC3 is supplied without a camera the video gain limits will be set to their extreme values and will output 0-5V. This may be utilised as a 0-5V control function.

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6.5.6.4.2 Timer Limits

The timer maximum and minimum values are gate unit dependant and will be set according to which gate module is selected in the interface options menu.

The data returned by the miscellaneous status request is listed below: -

Command	Function	Data Returned
zx	Request Miscellaneous Status	Version Number
		Intensifier Gain Min
		Intensifier Gain Max
		Video Gain Min
		Video Gain Max
		Timer Min (Hz)
		Timer Max (x250ps)

6.5.6.5 Delay Minima Status Request

The delay minima status request streams the minimum propagation delay possible for each mode of operation. As there are 2 gating controllers and the circuitry utilised to perform each gating function has its own specific propagation delay, the minimum delay for each mode of operation is programmed into the IGC3 unit. The IGC3 will not accept delay values below the minimum value for its current mode of operation.

The data returned by delay minima status request is listed below: -

Command	Function	Data Returned
zy	Request Delay Minima Status	Pass Through
		Trig 1,2,3 NSPG +ve edge
		Trig 1,2,3 NSPG -ve edge
		Trig 1,2,3 IGC +ve edge
		Trig 1,2,3 IGC -ve edge
		Internal Timer NSPG +ve edge
		Internal Timer NSPG -ve edge
		Internal Timer IGC +ve edge
		Internal Timer IGC -ve edge

The delay minima are held as 8-bit numbers, the value is the number of 1ns units.

7 IGC3 Options

The IGC3 may be supplied with image intensifiers, intensified camera systems, photo-multiplier devices and positive ion or electron detection systems. Photek have developed a range of gating modules and power supply components for this variety of applications.

The IGC3 may be supplied in several configurations: -

1. As a standalone system incorporating high voltage power and gating module.
2. As a remote control unit for gate modules fitted near or within the intensifier housing.
3. As a low voltage pulse generator with no high voltage or gating module, but with all of the control functions fully functional and accessed by the 25-Way D socket on the rear of the unit i.e. intensifier gain, high voltage On/Off control etc.
4. As a gating controller in user defined camera systems as the IGC3 has a configurable video gain output, and multiple output low voltage power supply.

7.1 IGC3 High Voltage Options: -

The IGC3 has 4 High Voltage options dependent on the system and application: -

1. A flatpack HT module may be fitted internal to the IGC3 unit and interface to the intensifier via a 6-Way 10kV rated high voltage socket. The intensifier will be hard-wired with the mating plug with 1.5m of cable.

Note: - This option is for situations where the available space for the intensifier housing is limited.

2. A wrap-around HT module may be fitted internal to the intensifier housing. The IGC3 unit will interface to the intensifier via a 25-Way D-type socket. The intensifier will be hard wired with all low voltage connections required.

Note: - This is the preferred option for gated intensifier systems because only low voltage signals are being transmitted i.e. all high voltage is local to the intensifier.

3. For Photo-Multiplier systems an external DPS1-5N unit may be supplied. This is a single output -5kV HT module. A DPS unit is a digitally controlled high voltage power supply and may be controlled via a PC fitted with an RS232 interface.
4. For Vacuum Interface Detectors an external DPS2/DPS3 unit may be supplied. This is a dual/triple output High Voltage PSU which supplies both the MCP and screen voltages for the detector. A DPS unit is a digitally controlled high voltage power supply and may be controlled via a PC fitted with an RS232 interface.

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7.2 IGC3 Gating Options: -

The IGC3 may be supplied with any of the Photek gate modules, the current module options are outlined below: -

Gate Module	Output Gate Voltage Amplitude	Minimum Output Pulse Width	Maximum Operating Frequency	Gate On Voltage	Gate Off Voltage	Internal High Voltage Isolation
Dual GM1kV	±400V *	100ns	20kHz	Application Specific		Yes >2kV
GM10-50B	250V	50ns	20kHz	-200V	+50V	No
GM300-3N	250V	3ns	300kHz	-200V	+50V	No
GM-MCP	500V	9ns	1kHz	+500V	0V	No

Gate modules may be customised for specific applications, contact sales@photek.co.uk if your application requires a module not listed in the above table.

Photeks gate modules are not all suited to fit within the IGC3 unit.

The Dual GM1kV unit is a large module that requires an external high voltage bias to introduce a high voltage offset on the internal circuitry. This unit must be fitted close to the detector.

The GM10-50 is a small module that may be fitted internally within the IGC3 unit, or fitted in its own case and mounted close to the intensifier.

The GM300-3 may be fitted internally within the IGC3 unit or fitted in its own case and mounted near the intensifier/ detector.

The GM-MCP unit is an MCP gate module that requires short connections between it and the channel plate it is gating. For this reason the GM-MCP is always supplied as a module which may be fitted close to the VID.

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8 Gate Modules

Photek produce several gate modules that may be controlled by the IGC3

1. The cathode of an Image Intensifier may be gated for direct imaging applications*
2. The MCPIn or MCPOut electrodes may be gated on Vacuum Interface Detectors for particle detection

**If a suitable scintillator is placed in front of the cathode then x-ray imaging is possible.*

The cathode of an image intensifier may be gated using any one of the following gate modules; GM10-50, GM300-3.

The MCPOut electrode of a VCD electron detector* may be gated by a GM1kVA and the MCPIn electrode of a VCD positive ion detector* may be driven by a GM1kVB. Both of these applications may be performed on one system by using both a GM1kVA and a GM1kVB constructed as a single unit, the Dual GM1kV.

The MCPOut electrode of a VCD electron detector* may also be gated using a GM-MCP unit.

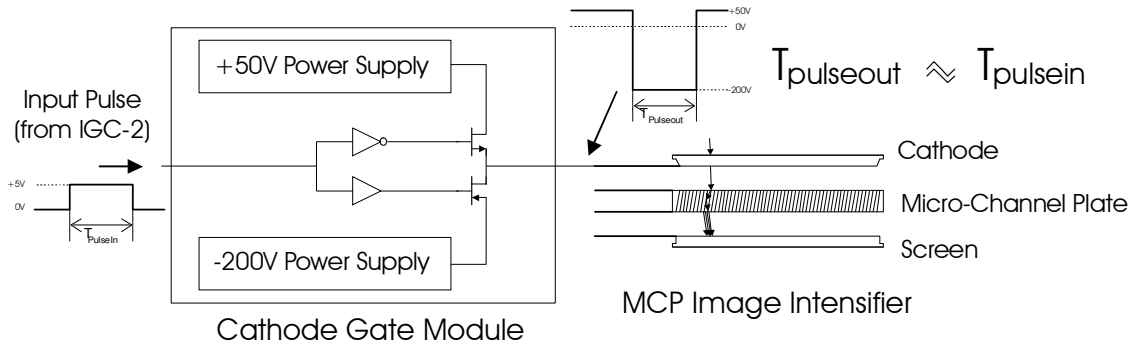
**Both of these detectors are manufactured as vacuum interface detectors and do not have a cathode.*

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8.1 Intensifier Cathode Gate Module: -

Gating of the intensifier cathode is achieved by switching the voltage on the cathode from +50V (biased off) to -200V (biased on).

The functional schematic of an intensifier cathode gate module is illustrated below: -



8.1.1 Gated Off Mode: -

The Micro-Channel Plate input for the intensifier is connected to 0V, when the gate module output is at +50V this creates a positive bias on the Cathode with respect to the MCP In electrode, this is called the ‘Gated Off’ mode.

8.1.2 Gated On Mode: -

When the gate module switches ‘on’ its output changes from +50V to -200V. The bias voltage on the Cathode is now -200V with respect to the MCP In electrode and electrons liberated from the cathode are attracted to the MCP. This is the ‘Gated On’ mode.

8.1.3 Image Intensifier Compatible Gate Modules: -

The following gate modules may be used to gate image intensifiers: -

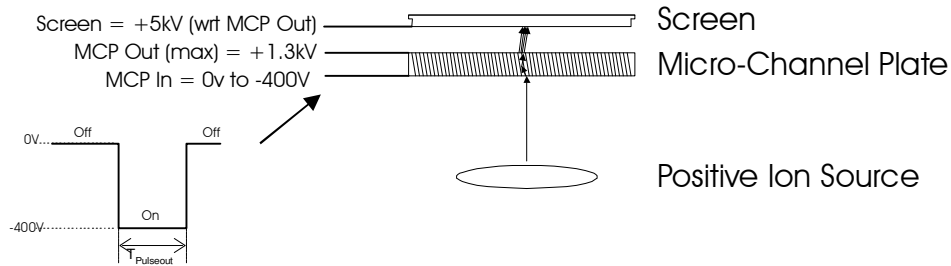
- GM10-50
- GM300-3

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8.2 MCPIn Gate Module: -

Gating of the MCPIn electrode allows a Vacuum Interface Detector (VCD) to be used as a positive ion detector. The detector must be fitted into a vacuum chamber with a pressure of 10^{-6} or lower and an external high voltage power supply is required to provide MCPOut and Screen electrode voltages.

Positive Ion Detection Functional Schematic



The functional schematic of a dual MCP VCD positive ion detector is illustrated below: -

8.2.1 Gated Off Mode: -

The Micro-Channel Plate input for the intensifier is connected to 0V. The voltage across the channel plate holds the gain of the detector at a very low level. This is called the ‘Gated Off’ mode.

8.2.2 Gated On Mode: -

When the gate module switches ‘on’ its output changes from 0V to -400V. This change in voltage produces a negative bias which attracts positively charged ions and the increased channel plate voltage increases the gain of the detector by a factor >250. This is the ‘Gated On’ mode.

8.2.3 MCPIn Compatible Gate Modules: -

The following gate modules may be used to gate MCPIn electrodes: -

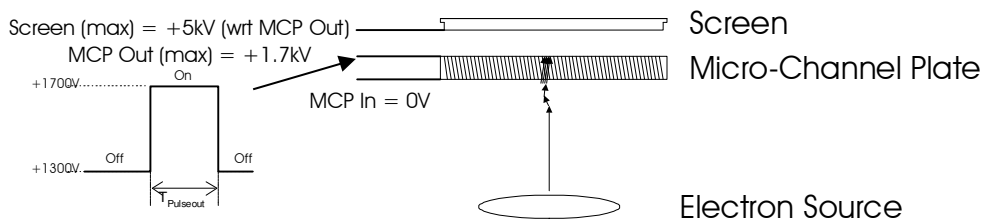
- GM1kVA
- Dual GM1kV
- GM-MCP

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8.3 MCPOut Gate Module: -

Gating of the MCPOut electrode allows a Vacuum Interface Detector (VCD) to be used as an electron detector. The detector must be fitted into a vacuum chamber with a pressure of 10^{-6} or lower and an external high voltage power supply is required to provide MCPOut bias and Screen electrode voltages.

Electron Detection Functional Schematic



The functional schematic of a dual MCP VCD electron detector is illustrated below: -

8.3.1 Gated Off Mode: -

The Micro-Channel Plate output for the detector is connected to +1200V. The voltage across the channel plate holds the gain of the detector at a very low level. This is called the ‘Gated Off’ mode.

8.3.2 Gated On Mode: -

When the gate module switches ‘on’ its output changes from +1200V to +1600V. This change in voltage across the channel plate increases the gain of the detector by a factor >250. This is the ‘Gated On’ mode.

8.3.3 MCPOut Compatible Gate Modules: -

The following gate modules may be used to gate MCPOut electrodes: -

- GM1kVB
- Dual GM1kV
- GM-MCP

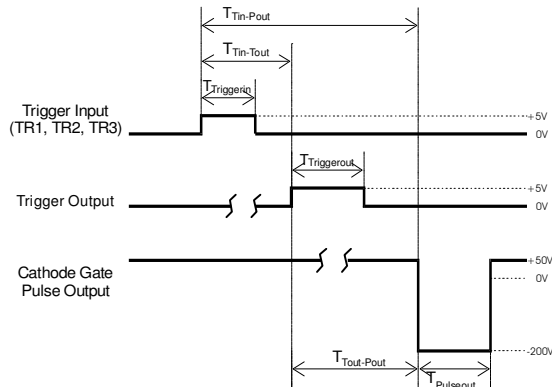
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9 Timing Information

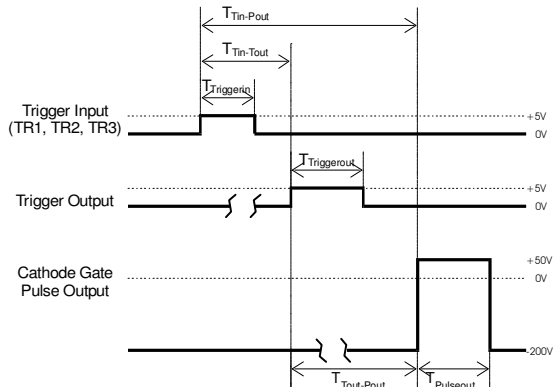
The IGC3 has several modes of operation and due to this has varying delays associated with different operating modes that may be implemented.

The triggering mode used to gate the intensifier will determine when the intensifier will gate on with respect to the input trigger pulse. Positive/ Negative Triggering is used to select the edge of the trigger signal that will initiate the delay and gate pulse settings of the IGC3. Normal/Inverted polarity is used to either gate the intensifier ‘on’ or ‘off’.

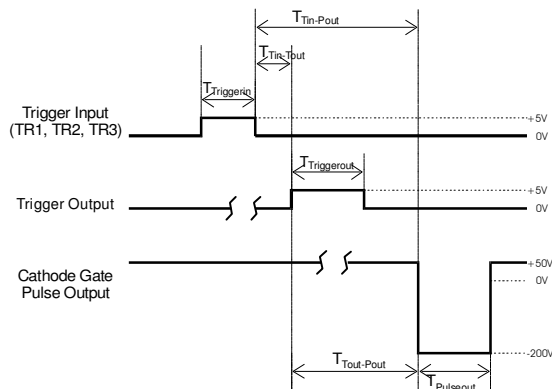
Positive Trigger Normal Output



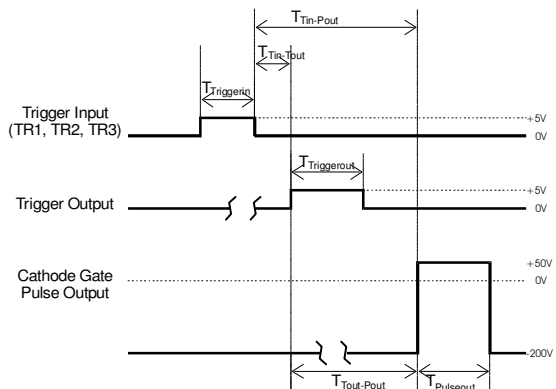
Positive Trigger Inverted Output



Negative Trigger Normal Output



Negative Trigger Inverted Output



$T_{Triggerin}$ = trigger pulse width duration

$T_{Tin-Tout}$ = time between trigger in active edge and trigger out

$T_{Tin-Pout}$ = time between trigger in active edge and gate pulse out

$T_{Triggerout}$ = trigger pulse width output duration

$T_{Tout-Pout}$ = time between trigger out positive edge and gate pulse out leading edge

$T_{Pulseout}$ = intensifier gate pulse output time

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9.1 System Delay Minimums

The IGC (10ns jitter) and NSPG (1ns jitter) gating controllers are different gating controllers. The propagation delays that will be incurred are not just specific to the mode of operation, but also to the gating controller that the IGC3 unit has selected to implement the required delay and pulse width values.

Each controller may be used in Positive/ Negative edge triggering, this equates to 4 possible timing values for each mode of operation. Inclusion of a gate module adds more delay which is specific to the model of gate module used with the IGC3. The polarity of the output does not affect the propagation delays through the system.

Trigger sources and timing functions are listed down the leftmost column, refer to the timing diagram on the previous page for an illustration of the functions. Cells that have been merged indicate common timing parameters across the merged operating parameters.

Each IGC3 is calibrated individually to program all of the Trigger to Output Pulse delays into the unit as minimum delay values that may be set by either the IGC3 or the windows software supplied with the system. The absolute accuracy of the delays is $\pm 5\text{ns}$ for the IGC controller mode and $\pm 2\text{ns}$ for the NSPG controller.

If a Photek Gate Module is supplied with the IGC3 unit the measured values for the total system will be individually programmed into the IGC3 unit.

Each system will have specific minimum delay times related to the gate module supplied with the system. The following tables indicate typical values obtained from IGC3 gating systems utilising Photek gate modules.

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9.1.1 IGC3-Basic : Typical Delays

This is an IGC3 gating controller supplied without a gate module. The delays programmed into this unit are to the low voltage outputs from the IGC3 unit.

The user gate module propagation delay must be taken into consideration as these will add to the delay that is edited into the IGC3 unit.

Gating Controller				
		IGC – 10ns Jitter		NSPG – 1ns Jitter
Trigger Source	+ve Trigger	-ve Trigger	+ve Trigger	-ve Trigger
Pass Through				
$T_{Triggerin}$	$\approx 10ns$ (min)	The Pass Through mode of operation is only functional in IGC Controller Mode and Positive Trigger.		
$T_{Tin-Pout}$	50 – 60ns			
$T_{Tin-Tout}$	15 – 25ns			
$T_{Triggerout}$	$\approx TriggerIn$			
$T_{Tout-Pout}$	$T_{Tin-Pout} - T_{Tin-Tout}$			
$T_{Pulseout}$	$\approx TriggerIn$			
TR1, 2, 3				
$T_{Triggerin}$	10ns (min)			
$T_{Tin-Pout}$	$\approx 102ns$	$\approx 101ns$	$\approx 109ns$	$\approx 108ns$
$T_{Tin-Tout}$	15 – 25ns			
$T_{Triggerout}$	= TriggerIn			
$T_{Tout-Pout}$	$T_{Tin-Pout} - T_{Tin-Tout}$			
$T_{Pulseout}$	= Pulse Width Setting			
Timer				
$T_{Triggerin}, T_{Tin-Pout}, T_{Tin-Tout}$	For Internal Timer Mode, Trigger In is a redundant function. Therefore any timing related to Trigger In is also redundant.			
$T_{Triggerout}$	= 0.5 x Timer Period			
$T_{Tout-Pout}$	76ns	77ns	86ns	87ns
$T_{Pulseout}$	= Pulse Width Setting			

All NSPG values are $\pm 2ns$ and all IGC values are $\pm 5ns$.

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9.1.2 IGC3 and GM10-50 Typical System Delays

This is an IGC3 gating controller supplied with GM10-50 gate module.

The delays programmed into this unit are to the high voltage output from the gate module to the the cathode.

GM10-50 typical propagation delay is 130ns and pulse width loss is approximately 30ns.

GM10-50	IGC3 Gating Controller With GM10-50 Gate Module			
	IGC – 10ns Jitter		NSPG – 1ns Jitter	
Trigger Source	+ve Trigger	-ve Trigger	+ve Trigger	-ve Trigger
Pass Through				
$T_{Triggerin}$	≈80ns (min)	The Pass Through mode of operation is only functional in IGC Controller Mode and Positive Trigger.		
$T_{Tin-Pout}$	164ns			
$T_{Tin-Tout}$	15 – 25ns			
$T_{Triggerout}$	≈TriggerIn			
$T_{Tout-Pout}$	$T_{Tin-Pout} - T_{Tin-Tout}$			
$T_{Pulseout}$	≈TriggerIn – 30ns			
TR1, 2, 3				
$T_{Triggerin}$	10ns (min)			
$T_{Tin-Pout}$	225ns	225ns	230ns	230ns
$T_{Tin-Tout}$	15 – 25ns			
$T_{Triggerout}$	= TriggerIn			
$T_{Tout-Pout}$	$T_{Tin-Pout} - T_{Tin-Tout}$			
$T_{Pulseout}$	= Pulse Width Setting			
Timer				
$T_{Triggerin}, T_{Tin-Pout}, T_{Tin-Tout}$	For Internal Timer Mode, Trigger In is a redundant function. Therefore any timing related to Trigger In is also redundant.			
$T_{Triggerout}$	= 0.5 x Timer Period			
$T_{Tout-Pout}$	220ns	220ns	220ns	220ns
$T_{Pulseout}$	= Pulse Width Setting			

All NSPG values are ±2ns and all IGC values are ±5ns

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9.1.3 IGC3 and GM300-3 Typical System Delays

This is an IGC3 gating controller supplied with GM300-3 gate module.

The delays programmed into this unit are to the high voltage output from the gate module to the cathode.

GM300-3 typical propagation delay is 65ns and pulse width loss is approximately 7ns.

GM300-3	IGC3 Gating Controller With GM300-3 Gate Module			
	IGC – 10ns Jitter		NSPG – 1ns Jitter	
Trigger Source	+ve Trigger	-ve Trigger	+ve Trigger	-ve Trigger
Pass Through				
$T_{Triggerin}$	≈25ns (min)	The Pass Through mode of operation is only functional in IGC Controller Mode and Positive Trigger.		
$T_{Tin-Pout}$	103ns			
$T_{Tin-Tout}$	15 – 25ns			
$T_{Triggerout}$	≈TriggerIn			
$T_{Tout-Pout}$	$T_{Tin-Pout} - T_{Tin-Tout}$			
$T_{Pulseout}$	≈TriggerIn – 7ns			
TR1, 2, 3				
$T_{Triggerin}$	10ns (min)			
$T_{Tin-Pout}$	144ns	169ns	178ns	178ns
$T_{Tin-Tout}$	15 – 25ns			
$T_{Triggerout}$	= TriggerIn			
$T_{Tout-Pout}$	$T_{Tin-Pout} - T_{Tin-Tout}$			
$T_{Pulseout}$	= Pulse Width Setting			
Timer				
$T_{Triggerin}, T_{Tin-Pout}, T_{Tin-Tout}$	For Internal Timer Mode, Trigger In is a redundant function. Therefore any timing related to Trigger In is also redundant.			
$T_{Triggerout}$	= 0.5 x Timer Period			
$T_{Tout-Pout}$	115ns	119ns	146ns	133ns
$T_{Pulseout}$	= Pulse Width Setting			

All NSPG values are ±2ns and all IGC values are ±5ns.

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9.1.4 IGC3 and GM-MCP Typical System Delays

This is an IGC3 gating controller supplied with GM-MCP gate module.

The delays programmed into this unit are to the high voltage output from the gate module to the MCP.

GM-MCP typical propagation delay is 70ns and pulse width loss is approximately 5ns.

GM-MCP	IGC3 Gating Controller With GM-MCP Gate Module			
	IGC – 10ns Jitter		NSPG – 1ns Jitter	
Trigger Source	+ve Trigger	-ve Trigger	+ve Trigger	-ve Trigger
Pass Through				
$T_{Triggerin}$	≈10ns (min)	The Pass Through mode of operation is only functional in IGC Controller Mode and Positive Trigger.		
$T_{Tin-Pout}$	50 – 60ns			
$T_{Tin-Tout}$	15 – 25ns			
$T_{Triggerout}$	≈TriggerIn			
$T_{Tout-Pout}$	$T_{Tin-Pout} - T_{Tin-Tout}$			
$T_{Pulseout}$	≈TriggerIn – 5ns			
TR1, 2, 3				
$T_{Triggerin}$	10ns (min)			
$T_{Tin-Pout}$	165ns	165ns	177ns	177ns
$T_{Tin-Tout}$	15 – 25ns			
$T_{Triggerout}$	= TriggerIn			
$T_{Tout-Pout}$	$T_{Tin-Pout} - T_{Tin-Tout}$			
$T_{Pulseout}$	= Pulse Width Setting			
Timer				
$T_{Triggerin}, T_{Tin-Pout}, T_{Tin-Tout}$	For Internal Timer Mode, Trigger In is a redundant function. Therefore any timing related to Trigger In is also redundant.			
$T_{Triggerout}$	= 0.5 x Timer Period			
$T_{Tout-Pout}$	150ns	150ns	160ns	160ns
$T_{Pulseout}$	= Pulse Width Setting			

All NSPG values are ±2ns and all IGC values are ±5ns

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10 IGC3 Specifications

10.1 Mechanical:

IGC3 Size:	300 x 270 x 135mm (Maximum Extents)
IGC3 Weight:	<4Kg
Panel Colour:	Umbra Grey (RAL7022)
Case Colour:	Pebble Grey (RAL7032)
Bezel Colour:	Stone Grey (RAL7030)

10.2 Mains Supply

Supply Voltage:	Universal 90-260V 50/60Hz
Fuse Rating Required:	110V/120V 1Amp 220V/240V 0.5Amp

10.3 Output Pulse Characteristics

	GM1kV	GM10-50	GM300-3	GM-MCP
Output Pulse characteristics A	+400V	+50V/-200V	+50V/-200V	0V/+500V
B	-400V	--	--	--
Dual	±400V	--	--	--
Minimum Pulse Width	100ns	50ns	3ns	9ns
Minimum Pulse Propagation Delay	100ns	120ns	50ns	70ns
Maximum Repetition Rate	20kHz	20kHz	300kHz	1kHz

10.4 High Voltage Outputs

If the IGC3 is fitted with an internal flatpack the high voltage module D.C. output voltages will be present on the WWFischer S106A013 high voltage socket when the 'Run' switch is illuminated.

Screen Voltage Output	upto 6.5kV
MCPOut Voltage	upto 1000V
MCPIn Voltage	0V
Cathode Voltage	+50V or -200V

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