



Synchrocam

Intensified Camera & Multi-Channel NanoSecond 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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1 SynchroCam - Intensified Camera & Multi-Channel NanoSecond Gating Controller

1.1 Description

The SynchroCam is a temperature stabilised multi-channel triggered intensified camera system with 20ns minimum exposure. It incorporates low jitter temporal control of both the duration and synchronisation of the camera exposure. The multiple channels allow the SynchroCam to be the timing generator for a triggered capture system.

The trigger function for the camera may be provided from an external TTL trigger source (upto 50Hz) or by an internal programmable clock.

The SynchroCam has 5 programmable timing channels, 1 is used to trigger the intensifier, 1 is used to trigger the internal CCD camera, with 3 outputs available on the rear panel to trigger external equipment being used in conjunction with the SynchroCam.

There is an external trigger input to allow the system to be used in an externally triggered system.

A TTL gate monitor output is also provided to allow the user to confirm when the intensifier gate is actually fired.

The gating limits of the SynchroCam are 20ns minimum exposure with 1ns increments and 200ns minimum delay between an external trigger pulse and frame capture with less than 1ns jitter. When both frame width and delay are below 1 μ s the SynchroCam has 1ns minimum incremental resolution on both frame width and delay functions. With either frame width or delay are above 1 μ s the SynchroCam has 5ns resolution on both frame width and delay functions.

The SynchroCam is software controlled by a microcontroller embedded within the camera. This controls the temporal adjustments of the unit, PC command interpretation, the high voltage module On-Off and Intensifier Gain functions. Communication between the camera and computer is via an RS232 link.

The Temperature stabilisation of the SynchroCam is achieved using a pair of fans and an array of resistive heaters. All calibration has been performed when the camera is at a stable 35°C. The power on indicator will flash if the temperature is out of range. The SynchroCam requires approximately 10 minutes to stabilise after power on.

The power supply required for the SynchroCam unit is 19V at 2A.

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2 SynchroCam Component Parts

The SynchroCam comprises a number of subsystems that have been integrated to a fast frame image capture system that may be remotely controlled from a PC.

The SynchroCam subsystems are detailed below: -

2.1 18mm Image Intensifier: -

The camera utilises a single MCP plate 18mm image intensifier as a fast optical switch. The Intensifier utilises a Quartz input window with S20 photoCathode which provides spectral sensitivity in the range 200nm to 800nm. The Phosphor Screen is constructed with P43 phosphor and has a decay time of approximately 1ms. The radiant gain of the intensifier is controlled within the range 40 and 10,000 Watts /Watt. A C-Mount lens adapter is incorporated into the Intensifier housing so that an application specific lens may be mounted.

2.2 High Voltage Power Supply: -

A special high voltage power supply is required to operate the image intensifier. This is encapsulated into the Intensifier housing. This unit is controlled by the SynchroCam microcontroller. RS232 serial commands provide power supply on/off functions and gain control.

2.3 Triggered CCD module: -

The CCD camera provided is a Basler acA780-75gm GIGE Camera, which provides a 780x580 pixel image at a maximum of 75Hz frame rate. This camera is coupled to the image intensifier using an 18mm fibre-optic taper. The camera uses a GIGE network interface.

2.4 GM1-20 Gate Module: -

This is a high voltage pulse amplifier which applies a 250V pulse to the cathode of the image intensifier to turn the cathode on for the duration of the pulse. When the output of this unit is +50V the cathode is biased off, when the output switches to -200V the cathode of the intensifier is “gated on”. The minimum programmable on time for the intensifier cathode is 20ns and the maximum frequency of operation is 1kHz.

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2.5 Gating Controller

The gating controller is the centralised controller for all temporal channels of the SynchroCam. There are 5 channels of temporal control within the SynchroCam, one for the Intensifier Cathode Gating, one for the CCD and three are output via the rear panel for synchronising external equipment.

Each channel incorporates 2 gating controllers in order to provide a <1ns jitter short frame width and delay gating control (NSPG) and a 5ns jitter long frame width and delay gating control (IGC). Selection of the gating controller utilised is performed automatically by the SynchroCam microcontroller, the criterion for gating controller selection is: -

1. If **“EITHER”** the frame width or delay for a channel are greater than 1us the IGC will be utilised for that channel.
2. If **“BOTH”** the frame width and delay for a channel are below 1us the NSPG controller will be utilised for that channel.

2.5.1 Nano Second Pulse Generator (NSPG)

This is a low jitter programmable pulse generator which is used to generate output pulses for frame width and delay functions below 1us.

This unit is constructed around silicon delay lines and therefore has inherently low jitter. There are 2 stages to the NSPG module, a programmable delay unit which may provide upto 1us delay and programmable pulse generator which utilises TTL logic to derive a pulse from 2 identical signals with 1 temporally delayed. The temporal difference between the pulses is the frame width that will be applied to the cathode.

If the programmed delay and width are short the jitter can be as low as 600ps, however as the delay or frame width increases and more silicon delay line elements are added the jitter increases and at 1us frame width and delay settings the jitter can be as much as 3ns.

2.5.2 Intensifier Gating Controller (IGC)

This programmable pulse generator which is used to generate frame widths and delays above 1us and may be programmed with delays and widths totalling upto 20s, i.e. a pulse width of 11 seconds could be used with a delay of 10 seconds and not exceed the IGC module.

This unit is constructed around 32-bit counters running from a 200MHz clock. The 32-bit counters are programmed with a start time and a stop time, this creates a delay and a width function. The sum of Delay + Width may not exceed 20 seconds.

The minimum increment of this gating controller is 5ns and the jitter is fixed at ± 2.5 ns (1 clock cycle).

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3 SynchroCam Rear Panel

The rear panel of the SynchroCam camera has 7 connectors, 3 indicator lights and 2 fan outlets for cooling of the camera. These components are detailed below: -



3.1 Indicator Lights

The SynchroCam has 3 indicators as follows: -

1. Power On

The “Power On” indicator, this will illuminate when the unit is powered on.

This indicator will flash on for 10% of the time after the power is turned on.

It will flash on for 50% when the “pw1” command has been sent and the Heaters, Delay Lines and CCD are all powered.

When the SynchroCam has temperature stabilised itself to 35°C the indicator will flash on for 90% of the time.

Only when the intensifier is powered will the power on Light be permanently on.

2. Armed

The “Armed” indicator will illuminate every time the SynchroCam is ready to trigger, it will extinguish when the camera “Fires” however if the unit is being use in a free-running mode with a repeat trigger function the Armed light will re-enable after the camera has fired.

3. Fired

The “Fired” indicator will illuminate when the camera has fired. If the camera is being used in single shot mode this light will stay on until the gating is re-enabled. If the camera is in free-running mode this indicator will extinguish when the camera re-arms itself ready for the next trigger.

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3.2 Fan Outlet

There are 2 fan outlets on the rear panel of the SynchroCam camera, both of which should be left uncovered to allow warm air to be expelled from this unit.

The air intake is via holes located on the side panels of the SynchroCam camera. These fans are speed controlled to temperature stabilise the SynchroCam. If the temperature rises above 35°C the speed of the fans will be increased to bring the temperature back to 35°C. If the temperature is too low the Heaters will be enabled to bring the camera to 35°C as quickly as possible.

3.3 Power and Control Inputs

This 9-Way D-Type Plug contains low voltage power and control signals for operation of the SynchroCam camera.

The Functions of this connector are indicated below: -



(View as seen looking at the rear panel)

9-Way D-Type Plug	
1 & 2	19V D.C. Input
3, 4, 5, 6 & 9	0V
7	RS232 Receive
8	RS232 Transmit

3.4 CCD Link

This is a 8-Way RJ45 connector which provides a Gigabit Ethernet connection to the camera. Pin assignments and pin numbering adhere to the Ethernet standard and IEEE 802.3af.

This camera may be run over a network with full imaging of the ccd down the Ethernet link.

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3.5 Channel 1,2,3

These are 3 TTL outputs for temporally controlling the triggering of external equipment. Each channel has the combination of short width and delay high precision NanoSecond Pulse Generator (NSPG), and also the long width and delay Intensifier Gating Controller (IGC).

The selection of gating controller utilized for each channel is related to the pulse width and delay values, if “both” the Pulse Width and Delay are below 1us then the NSPG will be utilized, however if “either” the Pulse Width or Delay are above 1us then the IGC will be utilized.

Each output is capable of driving a 50Ω load however the outputs are limited to 5V and the voltage does not change in relation to the load, however if a load below 50Ω is connected the output may drop in voltage.

Notes: -

1. Channel 4 is utilized for the CCD camera trigger.
2. Channel 5 is the Cathode Gate, the limits on this channel are that the Pulse Width + Delay must be below 1.1us. If the combination of both pulse width and delay are above 1.1us then the IGC gating controller will be used.

For Example: -

If the settings are 500ns Delay and 500ns Width the NSPG will be used,

If the settings are 600ns Delay and 600ns Width the IGC will be used.

For settings of Delay = 900ns and Width = 200ns or Width = 900ns and Delay = 200ns the NSPG will be used.

3.6 Trigger Input

This input allows an external source to be used to synchronize the system. This could be an experiment that is used as a trigger rather than being triggered by the SynchroCam system. When an external input is used as the trigger the minimum programmed delay possible is 200ns, this is due to internal propagation delays within the SynchroCam system.

The minimum delay possible between the channels is effectively zero as they can all be programmed with the same delay value, this would make them co-incident and therefore operating with zero delay.

3.7 Monitor Output

This is a panel mounted SMA socket which allows monitoring of the frame width of the SynchroCam camera. It is a low voltage TTL version of the intensifier cathode gate pulse. The monitor output is a positive going TTL pulse.

In NSPG mode the monitor output occurs approximately 7ns earlier than the cathode pulse and the duration is +3ns of the actual cathode gate output when measured electrically.

In IGC mode the monitor output may be considered to be co-incident with the cathode pulse.

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4 Intensifier Gain

The intensifier gain function is controlled by software using a 10-bit DtoA converter to apply a voltage control input to the intensifier power supply.

The gain of the intensifier doubles for an increase of 50 ADU's with the minimum gain of 40 at an ADU value of 600.

Any value below 600 will be rejected as the gain is too low for safe operation of the intensifier.

A chart of ADU values verses gain is illustrated below: -

ADU Value	Intensifier Gain
600	40
650	80
700	160
750	320
800	640
850	1,280
900	2,500
950	5,000
1000	10,000

5 Intensifier Spectral Response

The spectral response measurements for the cathode are tabulated below: -

WaveLength (nm)	Quantum Efficiency (%)
254	20.4
300	20.0
350	14.0
400	15.0
450	15.2
500	12.3
550	9.3
600	7.4
650	5.5
700	4.3

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6 RS-232 Serial Interface

6.1 Serial Link Configuration

The RS-232 utilised by the SynchroCam camera system 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 57600 this is programmed into the SynchroCam and cannot be modified.

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

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

6.1.1 Configuration Summary:-

Baud Rate = 57600
 Parity = No
 Data Bits = 8
 Stop Bits = 1

6.1.2 Command Acknowledgement

When a serial command is received it may be acknowledged or the acknowledgement can be suppressed if the user wishes by enabling the “vb” or “verbose” command.

To suppress command acknowledgement send a “vb1” or “vb0” command and the synchrocam will accept commands but not acknowledge them. To re-enable command acknowledgement send a “vb2” command.

The following is a list of command acknowledgements and error codes that may be received by the user.

Response	Description Of Response
ok	command accepted and executed
err 1 command not recognised	characters entered are not a valid command
err 2 parameter missing	valid parameter required
err 301 number out of range	command not accepted as the value is out of the range of the function being updated
err 302 chn may only be 1 or higher	The channel number is set to “0” which addresses all channels when the command is specific to an individual channel

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6.2 Serial Commands

The commands for the SynchroCam have been enabled in 2 ways, short commands for quick control by the user typing the commands and also as long commands (words) that may be used in software code to make it more readable/understandable. The SynchroCam user commands are listed below: -

Short Command	Long Command	Description
cmds	commands	Command Table Request
c	channel	Channel Select
d	delay	Delay value
f	setfreq	Timer Value in Hertz
id	version	Unit Name & Software Version Request
ig	igain	Intensifier Gain value
ip	intensifierpower	Intensifier Power Off, On
lo	lockout	Lockout Enable/Disable
mm	mode	Mode Selection
ps	powerstatus	Request Power Status Information
snr	serial	Request Camera Serial Number
pw	power	Camera, Heater and Gating Controller On/Off
rt	readtemp	Heater status and Temperature measurement variables
t	settime	Timer Value in seconds
ts	tempstat	Request "At Temperature" Flag
vb	verbose	SynchroCam Response Selection
w	width	Width Value
zco	statusallchannels	Request all Channel Settings
zcal	statusreq	Status Request

Note: - Commands are not case sensitive.

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6.3 Command & Data Format

6.3.1 Command List Request

The command list request command allows the user to see a list of all user commands available for the SynchroCam.

The format of this command function is illustrated below: -

Command Function	ASCII Command Letter	ASCII Integer Data String	Notes
Command List Request	cmds (commands)	-	

6.3.2 Channel Select

The channel command character/s must be followed by 1 ASCII number in the range 0-5. This command allows the user to select all channels using “c0” or individual channels e.g. “c1” selects channel 1. Once a channel has been selected all delay and width values entered will be programmed into the selected channel.

If the “c0” command is used the following delay and width values will be applied to all channels.

The format of this command function is illustrated below: -

Command Function	ASCII Command Letter	ASCII Integer Data String	Notes
Channel Select	c (channel)	0	all channels
		1	channel 1
		2	channel 2
		3	channel 3
		4	channel 4
		5	channel 5

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6.3.3 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 for milliseconds, u for microseconds, n for nanoseconds and p for picoseconds. OK is returned on receipt of a valid command.

The SynchroCam has a maximum resolution of 0.25ns; that is the least significant digit that can be edited equates to a 250ps increment.

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

The format of this command function is 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
	(width)	3n	w3n	Width = 3ns
Modify Delay	d	20m	d20m	Delay = 20ms
	(delay)	120n	d120n	Delay = 120ns

6.3.4 Unit Identification

The unit identification may be requested from the SynchroCam by using the 'id' command. The returned data will be the unit type 'SynchroCam' and the firmware issue number i.e. 'V1.00'. 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 (version)	- (no data string)	SynchroCam,v1.00, ok

6.3.5 Gating Mode/ Trigger

The Gating Mode commands are two ASCII command letters followed by a single ASCII integer. OK is returned on receipt of a valid command.

The format of this command function is illustrated below: -

Command Function	ASCII Command Letter	Valid ASCII Integer Data	Equivalent Function
Modify Gating Mode	mm (mode)	0	Intensifier Off
		1	Intensifier On (dc)
		2	Internal Timer
		3	Trigger Input

6.3.6 Intensifier Gain

The intensifier Gain command is two ASCII command letters followed by upto 4 ASCII integers. The intensifier gain minimum has been set to 600 which is where the intensifier starts to work in low gain mode, a digital gain setting of 600 is equivalent to an intensifier gain of 40. So the gain range of this system is 600-1023 which is equivalent to a gain range of 40 to 10,000. Ok is returned on receipt of a valid command.

The format of this command function is illustrated below: -

Command Function	ASCII Command Letter	ASCII Integer Data String	Equivalent Gain Value
Modify Intensifier Gain	ig (intensifiergain)	600	600
		1023	1023

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6.3.7 LockOut Function

The lockout function allows the camera to be set into a single or multiple trigger mode. As default the unit is in free-running trigger mode where the output will pulse for every trigger input, however if a single shot camera is required the unit may be enabled to trigger just once on receipt of an external trigger pulse.

The format of this command function is illustrated below: -

Command Function	ASCII Command Letter	ASCII Integer Data String	Notes
Disable LockOut (Default Condition)	lo (lockout)	0	Multiple Triggers Accepted.
Enable LockOut	lo (lockout)	1	Single Shot Mode

6.3.8 Verbose

The verbose command allows the user to specify the level of command acknowledgement required from the SynchroCam. The “vb” command is followed by either a 0, 1 or 2.

0 indicates no responses required, 1 enables just error responses, 2 enables all responses.

The default state for verbose is all acknowledgements are enabled.

The format of this command function is illustrated below: -

Command Function	ASCII Command Letter	ASCII Integer Data String	Notes
Set Command Acknowledgement	vb (verbose)	0	No Acknowledgements
		1	Only Errors are Acknowledged
		2	Enables all acknowledgements

6.3.9 Serial Number Request

The serial number request command returns the serial number for the SynchroCam.

The format of this command function is illustrated below: -

Command Function	ASCII Command Letter	ASCII Integer Data String	Notes
Serial Number Request	snr (serial)	-	

6.3.10 Temperature Measurement Request

The heater status request command allows the user poll the SynchroCam for the current heater state, on or off, and the actual temperature of the camera.

The returned values are 0 or 1 for the heater status (on or off) followed by a number that indicates the current camera temperature.

The format of this command function is illustrated below: -

Command Function	ASCII Command Letter	ASCII Integer Data String	Notes
Temperature Request	rt (readtemp)	-	

6.3.11 Temperature Flag Status Request

The temperature flag status request command allows the user to check that the camera is at its calibrated temperature. This command returns either a 0 or 1, a 1 indicates that the camera is within 1°C of its calibrated temperature of 35°C, i.e. between 34°C and 36°C.

The format of this command function is illustrated below: -

Command Function	ASCII Command Letter	ASCII Integer Data String	Notes
Temperature Status Request	ts (tempstat)	-	

6.3.12 Timer Command

The timer command allows the SynchroCam operating period to be programmed.

The shortest period is 1ms (equivalent to 1kHz) and the longest period is 60 seconds.

The format of this command function is illustrated below: -

Command Function	ASCII Command Letter	Maximum/ Minimum ASCII Integer Data String	Command String Transmitted	Instruction Equivalence
Modify Timer Value	t	1m	t1m	timer = 1ms
	(settime)	60	t60	timer = 60s

6.3.13 Frequency Command

The frequency command allows the SynchroCam operating frequency to be programmed.

The highest frequency allowed is 1kHz (Period = 1ms) and the lowest frequency is .0166Hz (Period = 60s).

The format of this command function is illustrated below: -

Command Function	ASCII Command Letter	Maximum/ Minimum ASCII Integer Data String	Command String Transmitted	Instruction Equivalence
Modify Frequency	f	1000	f1000	Frequency = 1kHz
	(setfreq)	50	f50	Frequency = 50Hz

6.3.14 Power Command

The power command allows all of the peripheral functions of the camera to be powered off while the camera is still running. This command enables or disables the camera heaters, the ccd power and the gating controller power. The intensifier power is not linked into this function and must be powered by an “ip” command.

The format of this command function is illustrated below: -

Command Function	ASCII Command Letter	ASCII Integer Data String	Notes
Power Command	pw	0	Power Off
	(power)	1	Power On

6.3.15 Intensifier Power Command

The intensifier power command provides an on/off function for the Intensifier Gate Module and the High Voltage PSU.

When the intensifier power is enabled the “Power On” illuminator will be permanently on, at all other times the power on indicator will flash between 10% on and 90% on depending on what is powered up. The format of this command function is illustrated below: -

Command Function	ASCII Command Letter	Maximum/Minimum ASCII Integer Data String	Command String Transmitted	Instruction Equivalence
Intensifier Power	ip (intensifierpower)	1 0	ip1 ip0	Intensifier Power On Intensifier Power Off

6.3.16 Power Status Request

The power status request command may be used to determine the status of the power within the camera. There are 4 individually powered sections of the synchrocam whose statuses are each linked to 1 bit of a 8-bit binary number. Bit 4 is used to determine whether the camera within its calibrated operating temperature range.

The power status is returned as a decimal number and it must be interpreted to determine its meaning, bit 0 \equiv intensifier, bit 1 \equiv ccd, bit 2 \equiv delay lines, bit 3 \equiv heaters and bit 4 is the at temperature flag. The format of this command function is illustrated below: -

Command Function	ASCII Command Letter	Returned Data	Notes
Power Status Request	ps (powerstatus)	0	All power Off
		14	Heater, Camera and Delay Lines all On
		15	Heater Camera, Delay Lines and Intensifier all On
		30	Heater, Camera and Delay Lines all On and the SynchroCam is at temperature.
		31	Heater Camera, Delay Lines and Intensifier all On and the SynchroCam is at temperature.

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6.3.17 Status Request

The Status commands are the only PC control function that will stream data to the PC other than the acknowledgements previously specified.

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

Each status function may be individually requested using the “zcal” function followed by the relevant number.

Command Function	ASCII Command	Valid ASCII Integer Data	Equivalent Function
Status Request	zcal (statusreq)	1	Trigger Input NSPG Delay min
		2	Trigger Input IGC Delay min
		3	Internal Timer NSPG Delay min
		4	Internal Timer IGC Delay min
		5	NSPG Width Loss
		6	IGC Width Loss
		7	250ps Delay Line Percentage Error Correction
		8	5ns Delay Line Percentage Error Correction
		9	Minimum Width Setting
		10	Maximum Width Setting
		11	Minimum Delay Setting
		12	Maximum Delay Setting
		13	GainFactor
		14	Gain Maximum
		15	Voltage Maximum
		16	Trigger Source
		17	Intensifier Gain
		18	Delay Value
		19	Width Value
		20	Width Switch
		21	Timer Value in seconds

The previous table includes all functions for completeness but the user should only concern themselves with the status variables 9, 10, 11, 12, 16, 17, 18, 19 and 21.

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6.3.18 Channel Status Request

The channel status command will stream data to the PC.

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

The “zco” command requests the operating parameters of all the channels as illustrated below: -

Command Function	ASCII Command	Returned Data
Status Request	zco (statusallchannels)	Channel Delay Width C1 200.000n 1.000m C2 200.000n 1.000m C3 200.000n 1.000m C4 200.000n 1.000m C5 200.000n 50.000m Mode : 0 Single shot : 1 Current Channel : 5 Intensifier Gain : 700 Frame Rate : 10.000 Camera Power : 1 Intensifier Power : 0 Temperature : 35.1

The data returned includes: -

1. The delay and width of each channel C1 to C5.
2. Operating Mode
3. Lockout status (Single or Multiple shot status)
4. Current Selected Channel
5. Intensifier Gain Digital Value
6. Frame Rate (Frequency of Timer)
7. Camera Power status#
8. Intenisifer Power status
9. Temperature Measurement Value.

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7 Programming Sequence

Example programming sequences are included below as a quick start guide to running the camera in any of its 3 operating modes dc On, Internally triggered and Externally triggered.

7.1 DC On (mm1)

Warning: -

The camera should only be used in this mode of operation when the intensifier cathode is in the dark or in a light controlled environment where the light source is extremely dim.

The sequence required to operate the camera in DC On mode is as follows: -

Software Command	Camera Function Implemented
mm0	Mode off, gated off.
pw1	Power On, Delay Lines, CCD and Heaters.
ip1	Intensifier Power On
mm1	DC On mode.

The camera should be functioning in DC mode, i.e. the cathode of the intensifier is permanently turned on.

7.2 Turning the Gating Off

For all operating conditions the camera may be powered down safely by using just 3 commands as illustrated below: -

Software Command	Camera Function Implemented
mm0	Mode off, gated off.
ip0	Intensifier Power Off
pw0	Power Off, Delay Lines, CCD and Heaters.

The camera should now be safe and the mains power may be turned off.

7.3 Internal Trigger (mm2)

In internal trigger mode the SynchroCam does not require any external trigger source. It will generate its own trigger at a frequency selected by the user. The frequency may be between 1kHz and 1/60 of a Hertz.

The sequence required to operate the camera in Internal trigger mode is as follows: -

Software Command	Camera Function Implemented
mm0	Mode off, gated off.
pw1	Power On, Delay Lines, CCD and Heaters.
lo0 (or lo1)	Repeat Triggering (or single shot trigger)
c4	Select channel 4 – CCD Trigger
d200n	CCD delay value
w100u	CCD width value
c5	Select channel 5 – Intensifier Cathode
dxxx	Cathode delay value
wxxx	Cathode width value
igxxx	Intensifier Gain value
ip1	Intensifier Power On
mm2	Select Internal Trigger Mode.

The SynchroCam may now be used as a programmable delay and width frame capture system with all delays and widths editable with all timing referenced to the *internal* trigger source.

Notes : -

1. The CCD camera must be programmed to respond to external trigger.
2. The CCD exposure time should be set to the C5 delay + C5 width + 2ms.

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External Trigger (mm3)

For external trigger mode the SynchroCam requires an external trigger source applied to the trigger input SMA connector. The trigger frequency selected by the user must be below 1kHz which is the maximum operating frequency of the cathode gate circuit.

The sequence required to operate the camera in External trigger mode is as follows: -

Software Command	Camera Function Implemented
mm0	Mode off, gated off.
pw1	Power On, Delay Lines, CCD and Heaters.
lo0 (or lo1)	Repeat Triggering (or single shot trigger)
c4	Select channel 4 – CCD Trigger
d200n	CCD delay value
w100u	CCD width value
c5	Select channel 5 – Intensifier Cathode
dxxx	Cathode delay value
wxxx	Cathode width value
igxxx	Intensifier Gain value
ip1	Intensifier Power On
mm3	Select Internal Trigger Mode.

The SynchroCam may now be used as a programmable delay and width frame capture system with all delays and widths editable with all timing referenced to the *external* trigger source.

Notes : -

1. The CCD camera must be programmed to respond to external trigger.
2. The CCD exposure time should be set to the C5 delay + C5 width + 2ms.

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SynchroCam Specifications

7.4 Mechanical:

SynchroCam Size:	250 x 90 x 90mm (Maximum Extents)
SynchroCam Weight:	≈1.8Kg
Panel Colour:	Black

7.5 Electrical:

7.5.1 SynchroCam PSU Mains Supply

Supply Voltage:	Universal 100-240V 50/60Hz
Fuse Rating Required:	2Amp

7.5.2 Cathode Pulse Characteristics

	GM1-20
Output Pulse characteristics A	+50V/-200V
Minimum Cathode Pulse Width	20ns
Minimum Pulse Propagation Delay	100ns
Maximum Repetition Rate	1kHz

7.5.3 Intensifier High Voltage

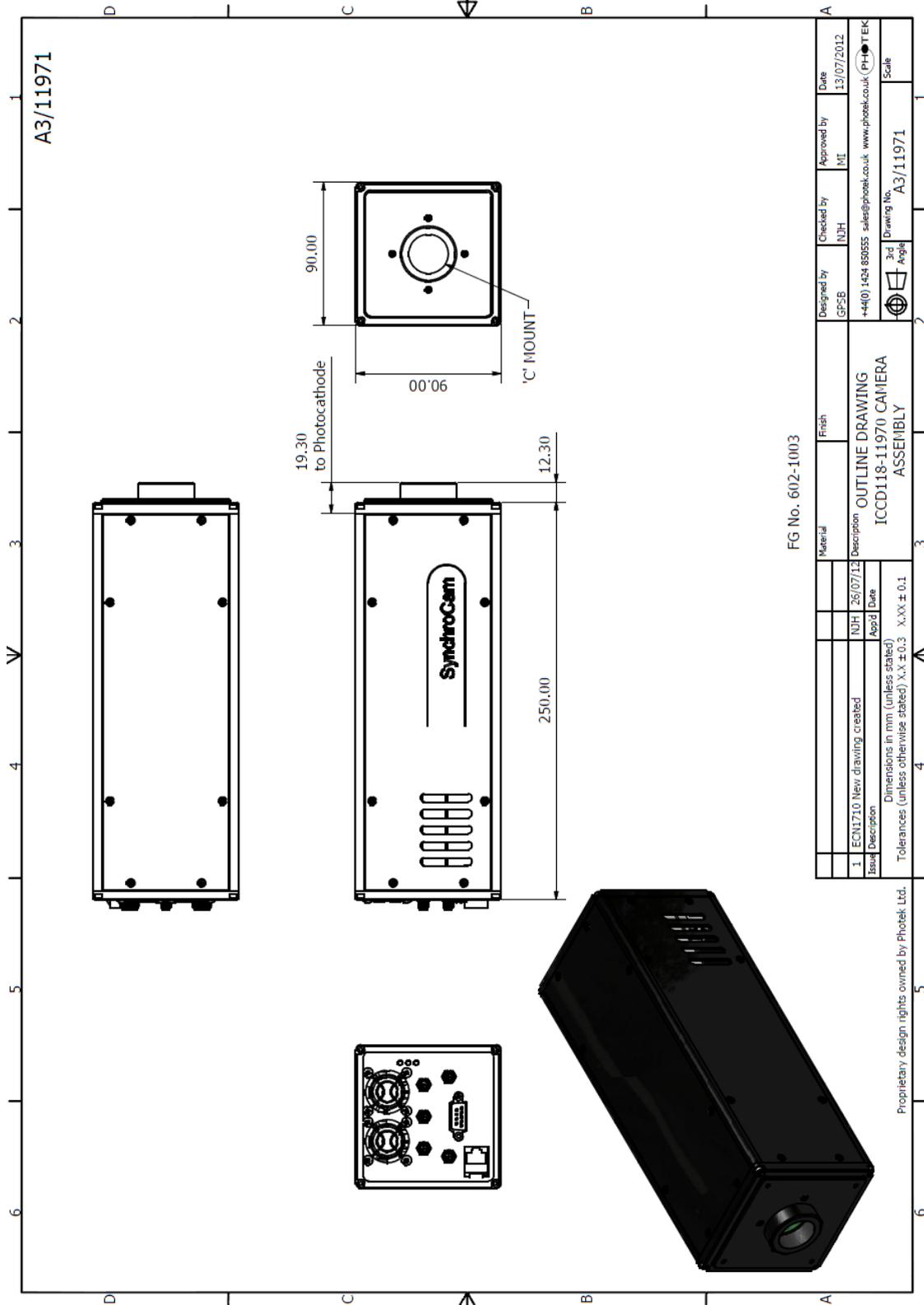
The SynchroCam is fitted with an internal wrap-around high voltage module with general output voltages as detailed below. These voltages are only present when the Intensifier Power has been enabled down the RS232 link (ip1 command).

Screen Voltage Output	upto 7kV
MCPOut Voltage	upto 1000V
MCPIIn Voltage	0V
Cathode Voltage	+50V/-200V

Note: - The Cathode and Intensifier High Voltages are contained within the camera and do not appear on any connectors accessible from the outside of the camera.

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8 Camera Outline Drawing



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9 Component Part Identification Numbers

The identification numbers of the components incorporated into this Camera are as follows: -

- | | |
|-----------------------------|--------------|
| 1. MCP118\Q\S20\P43 | SN: G1121005 |
| 2. Basler acA780-75gm | SN: 21277941 |
| 3. SynchroCam Dely PCB | ED436 |
| 4. SynchroCam Control PCB | ED437 |
| 5. Intensifier PSU Assembly | ED441 |
| 6. Cathode Gate Assembly | ED442 |

10 Items Supplied

The following Items comprise an SynchroCam system:-

Item No.	Description	Quantity
1	SynchroCam Camera Module : Model Number 602-1003 SN:E12128	1
2	ED501 - SynchroCam PSU & RS232 Lead (RS232 section = 4.5m)	1
3	ED508- SMA to BNC Cable (2m)	3
4	IEC Mains Lead with Moulded UK Plug (2m)	1
5	RJ45 to RJ45 Network Cable (5m)	1
6	UMICSC1 - SynchroCam User Manual (this document)	1

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Any unauthorised adjustment or modification to this unit will void all warranties and will only be supported at Photeks discretion.

Photek reserves the right to amend general information contained in this manual without prior notice.

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