SPECIFICATIONS	VHS-2151A2	12/12/2011
HiCATT18 (D/S, F) – Intensifying high-speed camera attachment, with Gen2/Gen3 Hybrid Intensifier, fast gating and relay optics for use in combination with high speed cameras.		

Specification HiCATT 18

Intensifying high-speed camera attachment, with Gen2/Gen3 Hybrid Intensifier

Description

The **HiCATT 18** is an intensifying camera attachment specially designed for use in combination with high-speed cameras. The HiCATT 18 amplifies low-light-signals to a level that is up to 10.000 times higher. This way the sensitivity of the attached high-speed camera is increased and high-speed, low-light-level imaging is possible. The hybrid Image Intensifier of the **HiCATT 18** consists of 2 stages. The first stage, a 18mm Gen2/Gen3 proximity focused MCP intensifier, offers a very high, adjustable gain. The second stage, a 18mm proximity focussed Gen1 booster, produces the extra high output brightness that is required for high speed imaging. In gating mode the first stage functions as a fast electro optical shutter with shutter times down to nanoseconds.

The intensifier stages and their high voltage power supplies, including gate unit, are mounted in a metal housing. At the output of the intensifier a relay objective is mounted having a magnification that matches the output size of the intensifier to the sensor format. The gate unit provides gate pulses to the photocathode of the image intensifier. The pulse width is variable and follows a TTL input pulse over the range from 40ns to DC at a repetition rate up to 100kHz.

The **HiCATT 18 S** is similar to the HiCATT 18 but is supplied with an additional Intensifier interface unit, including a Windows Control program for controlling the gating and gain setting of the image intensifier by PC.

The **HiCATT 18 D Low Jitter** is similar to the HiCATT 18 but is supplied with a low jitter digital delay generator unit. This unit delivers very precise timed pulses and offers multiple programmable sync output signals. A Windows Control program is supplied for controlling the gating and gain setting of the image intensifier.

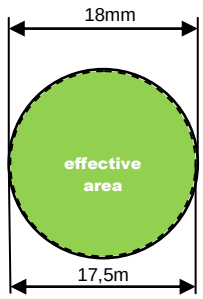
The **HiCATT 18 F** offers fast gating down to 3 ns (5 ns Gen 3 intensifier) with an integrated control unit. Gain and gating are controlled via USB connection by a Windows Control program. The maximum repetition rate is 200 kHz.

SPECIFICATIONS	VHS-2151A2	12/12/2011
HiCATT18 (D/S, F) – Intensifying high-speed camera attachment, with Gen2/Gen3 Hybrid Intensifier, fast gating and relay optics for use in combination with high speed cameras.		

Gen2 hybrid image intensifier.

Specifications at 20$^{\pm 2}$ °C:	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**
Photocathode Gen2 Intensifier		**S20**			**Super S25**	
Input window		Quartz			Borosilicate Glass	
Input window thickness (mm)		5.5				
Input / output diameter (mm)		18 / 18				
maximal response at (nm)		270 to 450			500 to 850	
Typical spectral response		See curve on the last page				
@270nm	30	55		-		
@400nm	38	65		-		
@800nm	5			40	65	
@850nm	-			32	55	
Luminous sensitivity (µA/lm)		200		500	700	
Peak Quantum efficiency (%)		22			15	
Luminous Gain Gen2 intensifier	1600 (cd/m^2/lx)	2500 (cd/m^2/lx)		2000 (cd/m^2/lx)	4000 (cd/m^2/lx)	
Photon gain Gen1 booster (ph/ph)	6	11		6	11	
EBI gen2 (µlx)		0.1	0.25		0.1	0.25
Resolution on output (lp/mm)	25	29		25	31	
Phosphor P46 decay time to 10% (µs)	P46 (P20, P43 on request) 0.2-0.4					
Gating time (FWHM) (ns)	40ns – ∞ (3ns for HiCATT 18 F)					
Gate repetition freq. (kHz)	D.C to 100kHz (200kHz for HiCATT 18 F)					
Gate pulse synchronisation	Follow External TTL-signal					
Effective area	17.5 mm					

Uniformity, Spots



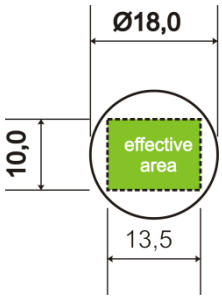
The number of spots exceeding a contrast with their surrounding area of 30% is less or equal to the number indicated in the table below. The size of non-circular spots is determined on the basis of equal area to circular spots. When the distance between two spots is less than the maximum dimension of either spot, the two spots are considered to be one spot.

Size of Spots	Max. number of spots within useful area		
	-Ø6	Ø6 – Ø15	Ø15 – Ø18
> 300 µm	0	0	0
225 – 300 µm	0	0	1
150 – 225 µm	0	1	2
75 – 150 µm	1	2	3
< 75 µm	Minimal	Minimal	minimal

SPECIFICATIONS	VHS-2151A2	12/12/2011
HiCATT18 (D/S, F) – Intensifying high-speed camera attachment, with Gen2/Gen3 Hybrid Intensifier, fast gating and relay optics for use in combination with high speed cameras.		

Gen3 hybrid image intensifier.

Specifications at 20$^{\pm 2}$ °C:	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**
Photocathode Gen3 intensifier	**GaAsP**			**GaAs**		
Input window	Borosilicate Glass					
Input window thickness (mm)	5.5					
Input / output diameter (mm)	18 / 18					
maximal response at (nm)	450 to 550			550 to 750		
Typical spectral response	See curve on the last page					
Luminous sensitivity (µA/lm)	400	700		1000	1200	
Peak Quantum efficiency (%)	38	50			27	
Luminous Gain Gen3 intensifier ((lm/m²)/lx)	$3.0x10^3$	$6.6x10^3$		$3.6x10^3$	$1.1x10^4$	
Photon gain Gen1 booster (ph/ph)	6	11		6	10	
EBI gen3 (µlx)		0,2	0,5		0,2	0,5
Resolution on output (lp/mm)	20	26		23	28	
Phosphor P46 decay time to 10% (µs)	P46 (P20, P43 on request) 0.2-0.4					
Gating time (FWHM) (ns)	40ns – ∞ (5ns for HiCATT 18 F)					
Gate repetition freq. (kHz)	D.C to 100kHz (200kHz for HiCATT 18 F)					
Gate pulse synchronisation	Follow External TTL-signal					
Effective area	13.5 x 10 mm in the center					
Uniformity, Spots	The dark and white spots which exceed a contrast of 30% of their surrounding area should not exceed the following values over the guarantee area:					



Size of Spots	Max. number of spots within effective area	
	Dark Spots	White Spots
> 150 µm	0	0
100 – 150 µm	2	0
75 – 100 µm	8	4
50 – 75 µm	minimal	6
< 75 µm	minimal	minimal

Note 1: The Gen2/Gen3 image intensifier of the **HiCATT 18** is standard equipped with a single MCP. Dual MCP image intensifiers are available on request. Please contact Lambert Instruments for details.

Note 2: The HiCATT 18 is standard equipped with a hybrid image intensifier (gen2/gen3 + gen1 booster). The Gen1 booster can be omitted to increase the resolution of the HiCATT 18 (at the cost of a lower value for the maximal output brightness). Please contact Lambert Instruments for details.

Note 3: The HiCATT 18 is standard equipped with a 18mm hybrid image intensifier. It is also possible to supply the unit with a 18mm hybrid image intensifier. Please contact Lambert Instruments for details.

SPECIFICATIONS	VHS-2151A2	12/12/2011
HiCATT18 (D/S, F) – Intensifying high-speed camera attachment, with Gen2/Gen3 Hybrid Intensifier, fast gating and relay optics for use in combination with high speed cameras.		

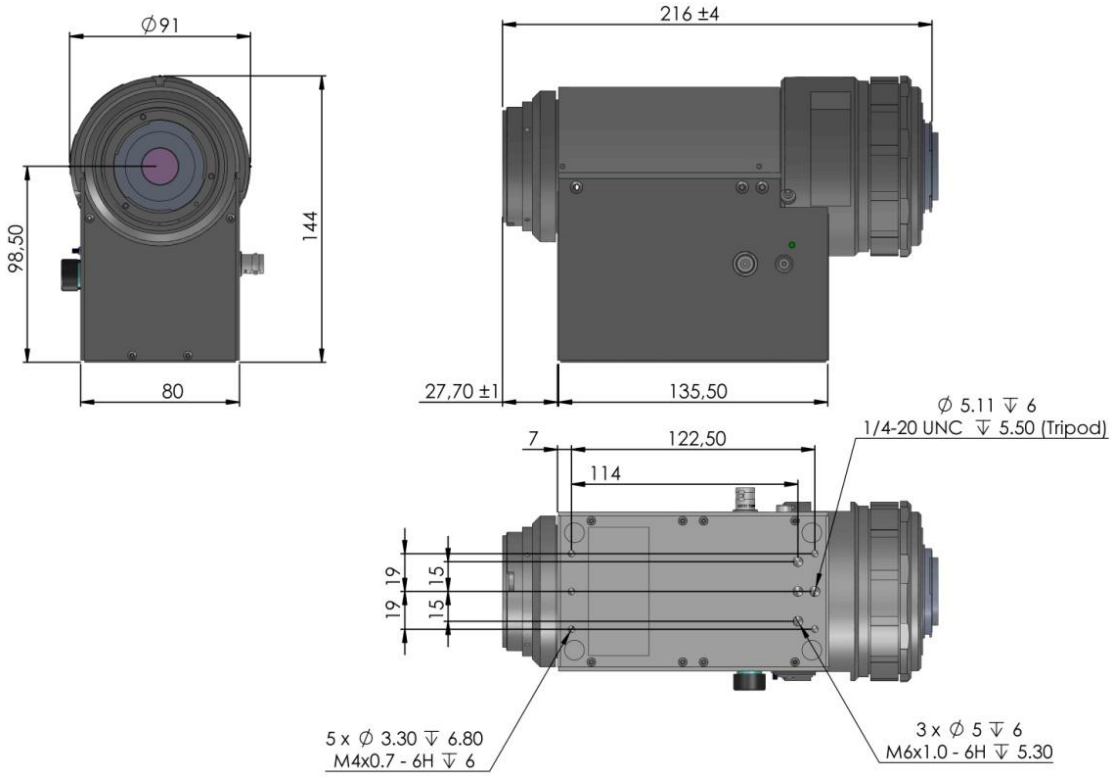
Housing and relay lens

A metal housing contains the image intensifier, high voltage power supply with gating and relay lens. The relay lens images the output of the image intensifier onto the image sensor of the attached camera. The HiCATT 18 can be equipped with a 18:18 relay lens.

Optical parameters:

	18:18 relay lens
Input image diameter	18mm
Output image diameter	18mm
Input lens mount	F-mount (C-mount on request)
Output lens mount to camera	F-mount (C-mount on request)

Dimensions:



High voltage power supply and gate unit.
The high voltage power supply for the image intensifiers is mounted inside the intensifier housing and provides a fixed high voltage to the anode and a variable MCP voltage. The built-in gate unit supplies a fixed voltage for continuous operation or a pulsed voltage for gated operation to the cathode of the intensifier. The HiCATT 18 intensifier has a manual gain control by means of a variable MCP voltage that is controlled by a potentiometer. (Digital gain control via USB is provided in de **HiCATT 18S/D**. See below for details). The gating is controlled by following an external TTL signal and can be varied from 40ns to DC. The unit is powered by 12VDC.

	Minimum	Typical	Maximum
Gate pulse frequency Continuous (kHz)			100
Gate pulse synchronisation		Follow External TTL-signal	
Gate pulse width (ns)	40		DC
Rise and fall time, 10-90% (ns)		15	20
Propagation delay (ns)		80	
Power supply (VDC)		12	

Gating
The dynamic range of the intensifier can be further expanded by the use of gating. The effective integration time of the camera can be lowered by decreasing the gate pulse width of the intensifier. A shorter gate pulse shortens the duty cycle of the intensifier and allows it to be used at higher light levels. Also a shorter gate pulse results in reduction of the motion blur caused by moving objects or dynamic events. Applying shorter gating will require higher gain to prevent loss of intrascene dynamic as the same number of photons have to be delivered within a shorter time. An external TTL signal defines the pulse width and pulse frequency when gating the intensifier. Any pulse width from DC down to 40ns can be applied (faster gating down to 3ns can be provided on request). On the unit a switch is provided to have the gate open continuously without the need of a TTL signal.

Digital interface (HiCATT 18S only):
With this interface unit the gain and gating properties of the Lambert Intensifier HiCATT 18S can be controlled by software. The unit provides the gate pulses for the image intensifier. The pulse width and delay can be set by software. An external TTL signal determines the gate frequency (can be up to 30kHz). By connecting a synchronisation signal from the camera for example EXP, SHUTTER OUT or WEN) the gating of the intensifier can be synchronised with the exposure time of the camera by selecting the external trigger or follow external mode.

The unit also supplies the DC voltages for the intensifier and the gating electronics. The interface is connected to the computer via an USB port (optional RS232). A Windows interface program is supplied to change all the settings like gain, gating mode, gate pulse width and delay. The unit can also be controlled by a set of ASCII commands from customer software.

SPECIFICATIONS	VHS-2151A2	12/12/2011
HiCATT18 (D/S, F) – Intensifying high-speed camera attachment, with Gen2/Gen3 Hybrid Intensifier, fast gating and relay optics for use in combination with high speed cameras.		

Gain control	100% - 1% in 4096 steps (logarithmic)
Propagation delay	100ns (typical)
Gating modes	closed continuous open ext. trigger follow external
programmable gate delay in the ext. trigger mode (delay from rising edge trigger input)	up to 5s in 20ns steps (jitter +/- 10ns)
programmable gate pulse width in the ext. trigger mode	up to 5s in 20ns steps (jitter < 250ps)
Output power for intensifier	+12V
Input power	110-230VAC (50-60Hz) , 30W
Interface to PC	Via USB (optional RS-232, contact Lambert Instruments)
Control	Via supplied Windows interface software or ASCII command set
Options	Customer specified re-programming of timing. Extra in- and outputs.

Low Jitter digital signal generator (HiCATT 18D, HiCATT 18 DF):

This pulse generator has 4 independent programmable pulse outputs (including the one that is used for gating) that can provide precise timed TTL pulses with pulse widths down to 5ns (FWHM). A USB interface (optional RS232) allows for easy control of the pulse width, delay, polarity and synchronisation mode by using the supplied Windows interface program, or by sending simple ASCII commands to the virtual COM port.

The unit has a programmable DDS rate synthesizer for setting output pulse repetition frequency. The output pulses can also be synchronised with an external trigger signal.

The Low Jitter digital interface is, among other things, ideally suited for controlling the gating of image intensifiers, like the Lambert HiCATT 18D Low Jitter. The digital control of the image intensifier gain is also possible with this unit. The unit supplies the DC voltages for the intensifier and the gating electronics.

Synchronizing the gating of the image intensifier with the exposure time and frame rate of an attached camera can be done by connecting a trigger signal from the camera (e.g. EXP, Strobe or Shutter out) to the trigger input of the low jitter digital interface.

Specification

Gain control	100% - 1% in 4096 steps (logarithmic)
Intensifier Gate time control	3ns – 10s, 10ps resolution (FWHM) Note: The minimal possible gate time depends on the type of intensifier and gate unit.
Intensifier Gate delay control	0 - 10s, 10ps resolution
Output A/B/C pulse width control	5ns – 10s, 10ps resolution (FWHM)
Output A/B/C delay control	0 - 10s, 10ps resolution
Maximal trigger rate	16Mhz
internal trigger source	DDS rate synthesizer, programmable between 0-16 MHz, 0.02 Hz resolution
Timing accuracy	±400ps ± 10ps/ºC
Jitter delay	Below 50ps RMS (typ. < 40ps RMS) between ext. trigger to any output or between any outputs. For delays > 1ms add 10ps per millisecond of delay
Insertion delay	20ns ± 400ps
Trigger input	TTL, Programmable trigger level between +0.25 to +3.3 volts Programmable trigger slope, Programmable termination, hi-Z or 50 ohm
Output A/B/C/D	TTL (max. output level is 5V), Programmable delay, width and polarity, 50-ohm source impedance (at 50-ohm max. level = 2,5V)
Communication	USB
dimensions	223 x 199 x 72 (lxwxh)
Supply voltage	100-240Vac, 50-60Hz
Deliverables	Low Jitter digital interface, cables, manual and CD with Windows control software

SPECIFICATIONS	VHS-2151A2	12/12/2011
HiCATT18 (D/S, F) – Intensifying high-speed camera attachment, with Gen2/Gen3 Hybrid Intensifier, fast gating and relay optics for use in combination with high speed cameras.		

Spectral response available Photocathodes: