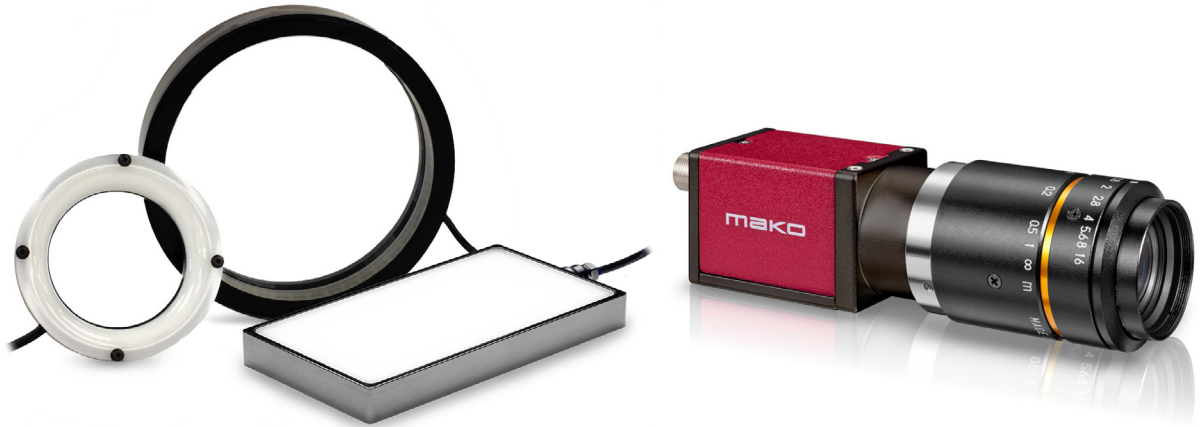


APPLICATION NOTE

Ai Lighting with Mako Cameras

Ai Lighting and Controllers, Equipment Specifications, Connections, SignaTech™, and Lighting Configurability.

V2.1.0
2025-Jul-22



Scope

This document details the compatibility between Advanced illumination controllers and lighting products with Mako cameras. The following information includes Ai lighting controller categories, their differing capabilities, detailed technical specifications, and unique advantages of deploying Ai lights and controllers in conjunction with Mako cameras.

Precautions



NOTICE

Damage to the connected devices

Read the manufacturer documentation before connecting the components.

Lighting with Ai

Ai lights are engineered with high power LEDs for maximum intensity. Each light features LEDs fully characterized with SignaTech™ (Signature Technology), Advanced illumination's proprietary control system that allows Ai lights to operate at maximum output under any operating conditions, all while protecting the light head from damage.



Triggering Ai lights with Mako cameras

To trigger Ai lights with a camera, you can use the DCS-100E controller on page 5 or any other Ai control unit that allows you to achieve the result desired.

Bar Lights

Bar Lights, also known as Linear Array Lights, offer both bright field and dark field illumination, depending on angle of incidence. Because of the variety of lengths available, Bar Lights are useful for large area illumination when used in opposing pairs or in a picture frame mounting orientation.

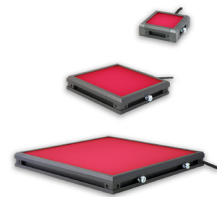
<https://www.advancedillumination.com/products/category/bar-light/>



Backlights

Backlighting provides an area of uniform illumination, oriented behind the object of interest, primarily for creating a part silhouette of instant contrast between dark and light. It is most useful for edge detection, part location/orientation or presence/absence, hole detection, and object gauging.

<https://www.advancedillumination.com/products/category/backlight/>



Dark Field Ring Lights

Dark Field Ring Lights provide illumination that is projected at a shallow angle to the imaging surface, 45 degrees or less. Typical applications include reflective flat surface defect or edge detection, where the majority of the light may reflect away from the camera on the flat, featureless surface, but defects may scatter the light to the camera, creating feature-appropriate contrast.

<https://www.advancedillumination.com/products/category/dark-field-ring-light/>



Bright Field Ring Lights

Bright Field Ring Lights provide illumination directly onto an object, at angles of incidence above 45 degrees horizontal, creating distinct shadows or general purpose illumination, depending on subject features. Highly effective when used on non-specular objects requiring high degrees of contrast.

<https://www.advancedillumination.com/products/category/ring-light-bright-field/>



Spot Lights

Spot Lights are typically characterized as general-purpose illuminators, used to create both bright field and dark field effects, depending on the light angle of incidence.

<https://www.advancedillumination.com/products/category/spot-light/>



Line Lights

Line lights, as opposed to Linear Array Bar Lights, employ a secondary lens to focus the light into a narrow beam, typically for short to intermediate working distances. Line Lights are mostly used in conjunction with line scan cameras and are typically mounted in a medium to high angle bright field orientation.

<https://www.advancedillumination.com/products/category/line-light/>



Coaxial Lights

Coaxial Lights provide a type of diffuse illumination, generated from an internal source. The light is then deflected downward onto the imaging plane via a 50% beamsplitter, which allows light from the object to be collected by the camera above. Ideal for imaging highly reflective objects or where the area of inspection is obscured by shadows from its surroundings.

<https://www.advancedillumination.com/products/category/coaxial-light/>



Diffuse Lights

Diffuse Lights, also known as “cloudy-day illumination” provide non-directional, soft illumination that is free of shadowing. This effect is well suited for inspecting highly specular and curved objects, but at close working distances.

<https://www.advancedillumination.com/products/category/diffuse-light/>



Discrete Control Systems

Discrete Control Systems (DCS) are dedicated external controllers that feature plug-and-play operation using Ai's proprietary SignaTech™ ([Signature Technology](#)). Depending on the configuration, DCS controllers can support built-in pre-programmed sequencing for computational imaging, multi-channel control for RGB lighting, as well as high power pulsing for high-speed imaging analysis. Discrete controllers offer the most versatility for a control category while maintaining simple operation.

<https://www.advancedillumination.com/products/category/controllers/>



Inline Control Systems

Inline Control Systems (ICS) are cable-based controllers that provide steady and optimal power to light head assemblies using hard-coded current limiters that match each light's peak output. ICS controllers have the advantage of being situated outside of the light head, drawing heat generated by the control electronics away from the LEDs, when compared to embedded control systems (ECS). This allows for lower LED junction temperatures, improving light longevity. Inline controllers are available in both overdrive strobe and continuous configurations.

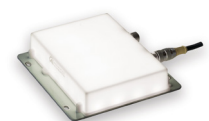
<https://www.advancedillumination.com/products/category/controllers/>



Embedded Control Systems

Embedded Control Systems (ECS) are closely integrated controllers built into each light head assembly. Embedded controllers are limited to a select number of lighting products but offer similar control advantages to Inline Control Systems. Being situated within the light head, ECS controlled lights do not require any additional controller in order to operate in both continuous and overdrive strobe modes.

<https://www.advancedillumination.com/eurobrite/>



Ai Controller Matrix

	24V Light	iCS 2 (iC)	iCS 3 (i3)	iCS 3S (i3S)	EuroBrite	DCS-100E	DCS-103E	DCS-400E	DCS-800E	Pulsar 320E
Embedded Control System (In-light)	N/A	✗	✗	✗	✓	✗	✗	✗	✗	✗
In-line Control System (On-cable)	N/A	✓	✓	✓	✗	✗	✗	✗	✗	✗
Discrete Control System (Detachable)	N/A	✗	✗	✗	✗	✓	✓	✓	✓	✓
Continuous Mode	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗
Overdrive Strobe Mode	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓
TCP/IP Ethernet Connectivity	✗	✗	✗	✗	✗	✓	✓	✓	✓	✓
Analog Light Dimming Circuit	✗	✓	✓	✓	✓	✗	✗	✗	✗	✗
Gating On/Off Trigger Circuit	N/A	✓	✓	✓	✓	✓	✓	✓	✓	✓
Default-On Device Upon Power-Up	✓	✓	✓	✗	✗	N/A	N/A	N/A	N/A	N/A
IP Rating	N/A	67 ²	67 ²	67 ²	67	N/A	N/A	N/A	N/A	N/A

Max Number of Lights Connected/Controlled	1	1	1	1	1-4 ³	1	1-3	1-4	1-8	2
DC Input Voltage (Nominal)	24	24	24	24	24	24	24	24, 48	24, 48	24
Max Current per Output - Continuous (A)	PS Limited	1.25	1.25	1.25	1.25	4.5	1.5	0.5	0.5	N/A
Max Current per Output - Strobe(A)	N/A	N/A	8	8	8	15	5	5/10@ 24v/48v	5/10@ 24v/48v	50

Trigger Delay (µs)	N/A	20 ⁴	20 ⁴	20	20	20	20	20	20	<2
Input Trigger Pulse-Width Pass-Thru	N/A	✓ ⁴	✓ ⁴	✓	✓	✓ ⁵	✓ ⁵	✗	✗	✗
Output Pulse Width Range (µs)	N/A	30 ⁴	30 ⁴	30 ⁺	30 ⁺	30-65k	30-65k	30-3600k	30-3600k	1-100K

RGB Light Control	✗	✗	✗	✗	✗	✓	✗	✓	✓	N/A
Computational Imaging	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗

¹ Separate 5-pin A-coded M12 power/trigger cable required.

² Must be ordered with an IP67+ rated light, otherwise comes IP50 rated as standard.

³ EuroBrite Bar Light, Large Spot Light, and Backlights can be daisy-chained up to 4 units.

⁴ Default-on device - gates light off when triggered to strobe.

⁵ In gated continuous mode only - no overdrive pass-thru.

Triggering Ai Lights

The following diagram shows a typical trigger setup between a Mako camera and an Ai light using a DCS-100E controller as an example. Advanced illumination offers a wide variety of controllers capable of connecting to Mako cameras.

Setup

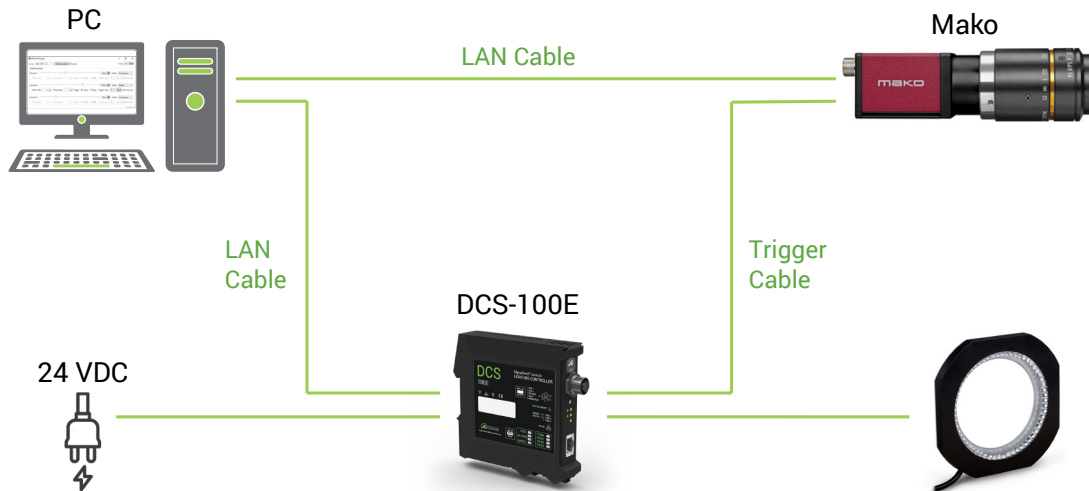


Figure 1: Application setup with Mako triggering Ai Lights

Note: DCS-100E is not PoE enabled.

Required Hardware

Table 1 lists the included components. Bullets show where you can select between various items.

Component	Product	Product Details
Camera	Mako	All models
Camera I/O cable	Hirose 8-pin female to open end	<ul style="list-style-type: none"> K1200196 (2 m) K1200197 (5 m)
Light control unit	Ai control unit	DCS-100E
Lighting system	Ai light	See Ai lighting categories on page 2 and 3.
Extension cable between Ai lights and DCS-100E	Female to male	<ul style="list-style-type: none"> LC1S-C1 (1 m) LC2S-C1 (2 m) LC3S-C1 (3 m) LC5S-C1 (5 m)
I/O cable	User supplied	See DCS wiring specifications on page 6

Table 1: Required hardware

DCS-100E and DCS-103E Specifications

	DCS-100E	DCS-103E
Operating Modes	Pulse (Overdrive Strobe), Gated Continuous, Continuous	
Input Supply Requirements	24 V DC Nominal, 4.5 A Recommended 21 V Min - 30 V Max; Power Inputs Reverse-Polarity Protected	
Output Channels	Number of Outputs: 1 Number of Channels per Output: 3	Number of Outputs: 3 Number of Channels per Output: 1
Output Power	Continuous: 90 W Max Total, 30 W per Channel* Pulsed: 540 W Peak Total, 180 W Peak per Channel*	
Pulse Width Range	30 μ s - 65 ms	
Trigger Frequency Limit	2 KHz	
Trigger Delay	20 μ s	

Table 2: DCS-100E and DCS-103E Specifications

DCS-100E and DCS-103E Pinout Functions

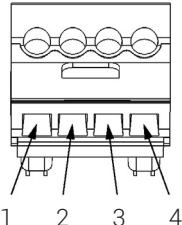
Input Terminal Pinout	Pin	DCS-100E and DCS-103E Functions
	1	Common Ground
	2	Trigger Input 1
	3	Trigger Input 2
	4	Trigger Input 3

Table 3: DCS-100E and DCS-103E Pinout Functions

DCS-100E and DCS-103E I/O CONNECTIONS

Mako Camera

DCS-100E/103E Controller

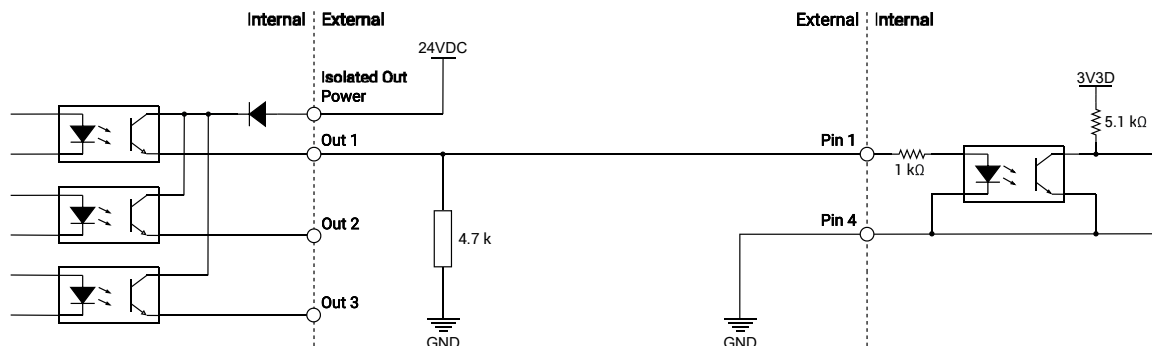


Figure 2: Mako output trigger to DCS-100E and DCS-103E input.

For more technical information on how to operate a DCS-100E and DCS-103E controller, please refer to the following manual: https://www.advancedillumination.com/wp-content/uploads/2019/05/DCS_Series_Manual_V2.pdf

DCS-400E and DCS-800E Specifications

	DCS-400E	DCS-800E
Operating Modes	Sequence, Pulse (Overdrive Strobe), Continuous	
Input Supply Requirements	24 V DC Nominal, 4.5 A Recommended 21 V Min - 48 V Max; Power Inputs Reverse-Polarity Protected	
Output Channels	Number of Outputs: 1 Number of Channels per Output: 4	Number of Outputs: 2 Number of Channels per Output: 4
Output Power	Continuous: 60 W Max Total, 15 W per Channel Pulsed: 480 W Peak Total, 120 W Peak per Channel	Continuous: 120 W Max Total, 30 W per Channel Pulsed: 960 W Peak Total, 120 W Peak per Channel
Pulse Width Range	30 μ s - 3600 ms	
Trigger Frequency Limit	2 KHz	
Trigger Delay	20 μ s	

Table 4: DCS-400E and DCS-800E Specifications

DCS-400E and DCS-800E Pinout Functions

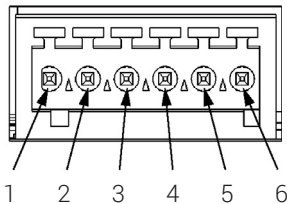
Input Terminal Pinout	Pin	DCS-400E and DCS-800E Functions
	1	Trigger Input 1
	2	Trigger Input 2
	3	Trigger Output 1
	4	Trigger Output 2
	5	Common Ground
	6	Common Ground

Table 5: DCS-400E and DCS-800E Pinout Functions

DCS-400E and DCS-800E I/O Connections

Mako Camera

DCS-400E/800E Controller

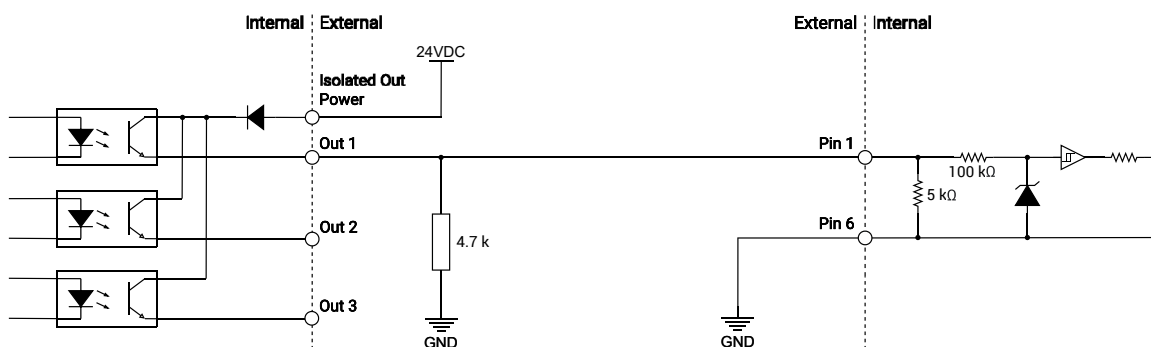


Figure 3: Mako output trigger to DCS-400E and DCS-800E input.

For more technical information on how to operate a DCS-400E and DCS-800E controller, please refer to the manual:
https://www.advancedillumination.com/wp-content/uploads/2019/08/050167_DCS400_800_Manual_v1.1.pdf

Pulsar 320E Specifications

	Pulsar 320E
Operating Modes	Pulse (Overdrive Strobe)
Input Supply Requirements	24 V DC Nominal, 4.0 A Recommended 21 V Min - 30V Max; Power Inputs Reverse-Polarity Protected
Output Channels	Number of Outputs: 2 Number of Channels per Output: 1
Output Power	Pulsed: 5000 W Peak Total, 2500 W Peak per Channel
Pulse Width Range	30 μ s - 100 ms
Trigger Frequency Limit	2 KHz
Trigger Delay	< 2 μ s

Table 6: Pulsar 320E Specifications

Pulsar 320E Pinout Functions

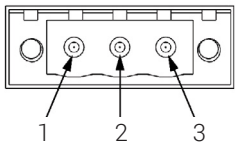
Input Terminal Pinout	Pin	Pulsar 320E Functions
	1	Trigger Input 1
	2	Trigger Input 2
	3	Common Ground

Table 7: Pulsar 320E Pinout Functions

Pulsar 320E I/O Connections

Mako Camera

Pulsar 320E Controller

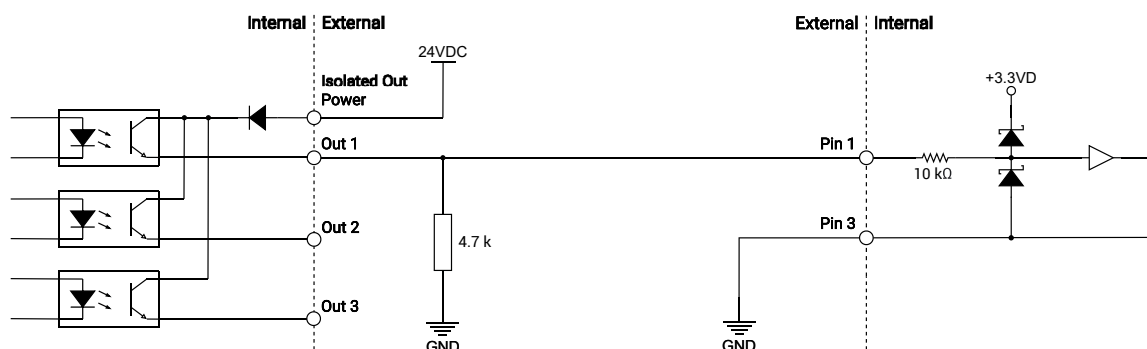


Figure 4: Mako output trigger to Pulsar 320E input.

For more technical information on how to operate a Pulsar 320E controller, please refer to the following manual:
https://www.advancedillumination.com/wp-content/uploads/2018/11/P320_Manual.pdf

IC, I3, and I3S Specifications

	IC	I3 & I3S
Operating Modes	Gated Continuous, Continuous	Pulse (Overdrive Strobe), Gated Continuous, Continuous
Input Supply Requirements	24 V DC Nominal, 1.25 A Recommended 21 V Min - 30 V Max; Power Inputs Reverse-Polarity Protected	
Output Power	Continuous: 25 W Max	Continuous: 25 W Max Pulsed: 125 W Peak Max
Pulse Width Range	30 μ s - ∞	
Trigger Frequency Limit	2 KHz *Requires Duty Cycle \leq 1% beyond 1KHz	
Trigger Delay	20 μ s	
Trigger Interaction	N/A	I3: Default ON Device I3S: Default OFF Device

Table 8: IC, I3 and I3S Specifications

IC, I3 and I3S Pinout Functions

Optional A-coded M12 Pinout	Pin (M12)	Wire Color (Flying Leads)	IC Functions	I3 & I3S Functions
	1	Brown	24 V DC	24 V DC
	2	White	0-10 V Analog Control	Shield
	3	Blue	DC GND	DC GND
	4	Black	GLO	PNP/Active High Trigger
	5	Gray	N/A	0-10 V Analog Control

Table 9: IC, I3 and I3S Pinout Functions

I3 and I3S I/O Connections

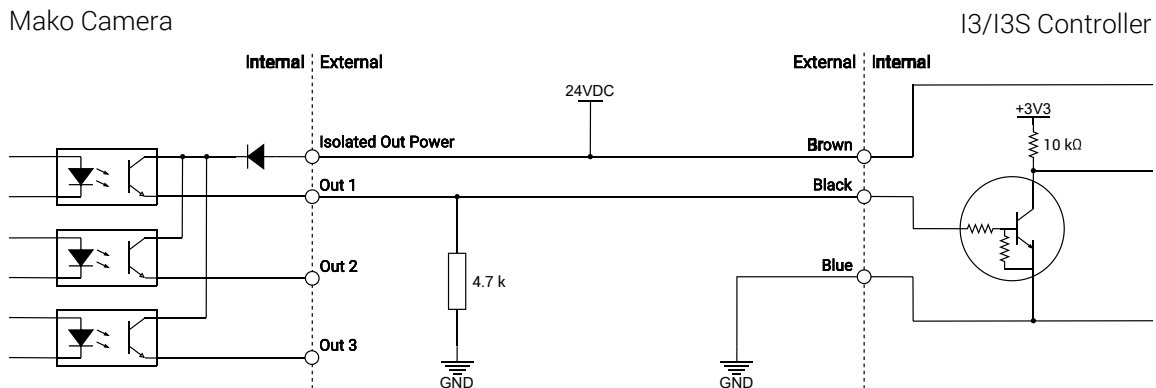


Figure 5: Mako output trigger to I3 and I3S input.

For more technical information on how to operate a IC, I3 or I3S controller, please refer to the following webpages:

IC: <https://www.advancedillumination.com/products/ics-2-0-inline-constant-current-source/>

I3 & I3S: <https://www.advancedillumination.com/products/i3-inline-constant-current-source/>

EuroBrite Control Specifications

	EuroBrite
Operating Modes	Pulse (Overdrive Strobe), Gated Continuous, Continuous
Input Supply Requirements	24 V DC Nominal, 1.25 A Recommended 21 V Min - 30 V Max; Power Inputs Reverse-Polarity Protected
Output Power	Continuous: 25 W Max Pulsed: 125 W Peak Max
Pulse Width Range	30 μ s - ∞
Trigger Frequency Limit	2 KHz *Requires Duty Cycle \leq 1% beyond 1 KHz
Trigger Delay	20 μ s
Trigger Interaction	Default ON device that strobes OFF when triggered

Table 10: EuroBrite Control Specifications

EuroBrite Pinout Functions

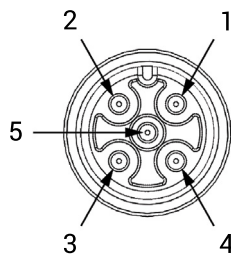
M12 Pinout	Pin	EuroBrite Functions
	1	24 V DC
	2	Shield
	3	DC GND
	4	PNP/Active High Trigger
	5	0-10 V Analog Control

Table 11: EuroBrite Pinout Functions

EuroBrite I/O Connections

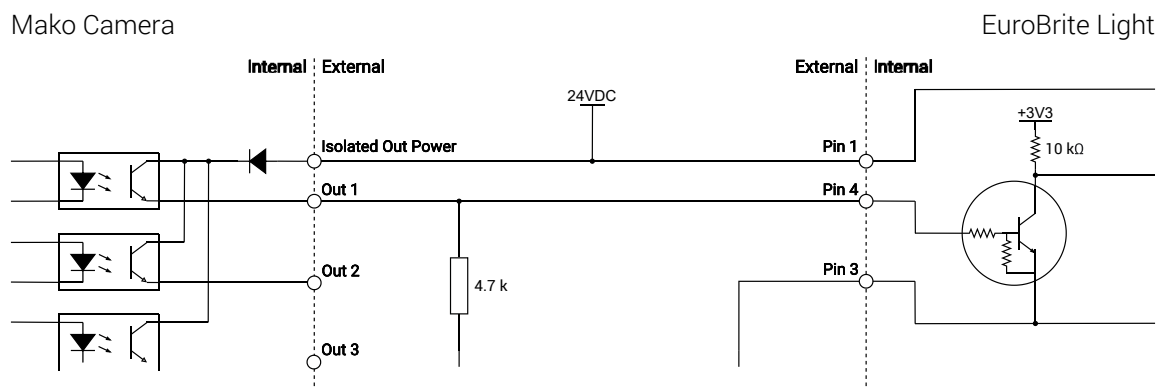


Figure 6: Mako output trigger to EuroBrite input.

For more information on EuroBrite lights, please refer to the following webpage:
<https://www.advancedillumination.com/eurobrite/>

Lighting with EuroBrite

EuroBrite™ lights are engineered to provide high-intensity illumination and advanced technology for unmatched performance at an exceptional value. The built-in controller, with Adaptive Overdrive™ and Adaptive Power™ technologies, drives the lights in both strobed and continuous modes.



Using Ai lights with Mako cameras

EuroBrite lights have embedded controllers, so they can work directly with Allied Vision cameras, no additional light controller is required.

Adaptive Power™

A feature of EuroBrite™ lighting control, Adaptive Power™ utilizes an on-board thermistor to maximize light output in continuous mode. By factoring in the ambient temperature and the heat-sinking potential of the customer's mounting structure, during the learning procedure, the maximum drive current is calculated and locked in.



Figure 7: EuroBrite Bar Light AL-S025300

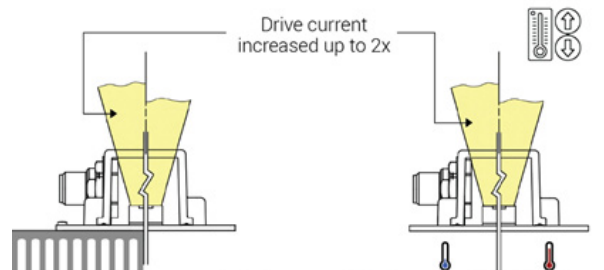


Figure 8: EuroBrite Adaptive Power drive current

Adaptive OverDrive™

Adaptive Overdrive™ provides a maximal output pulse in strobe mode, regardless of exposure period. Upon receiving an external trigger input, a EuroBrite™ light produces a high-power pulse for 5 ms. Should the external trigger pulse width exceed 5 ms, the light output pulse gradually trails off to a sustained, safe level for the remaining exposure period. Traditional fixed duration strobe drivers cannot provide similar performance.

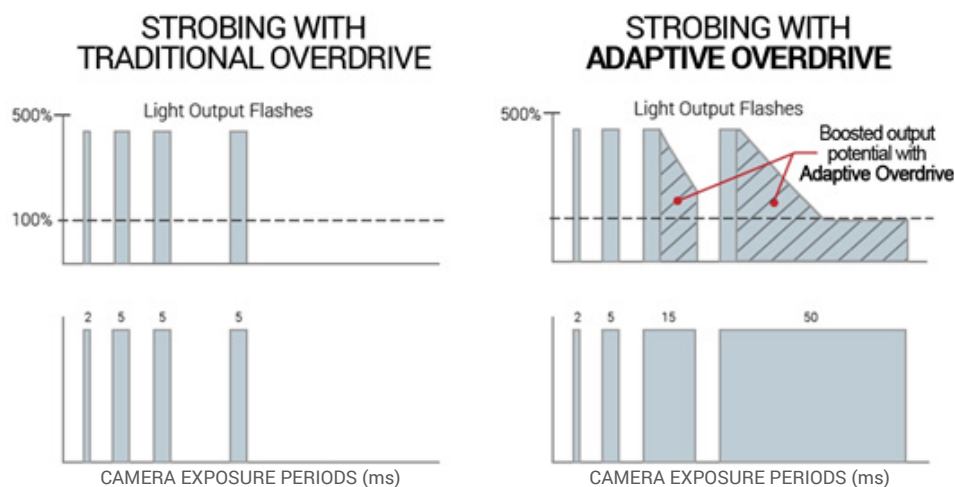


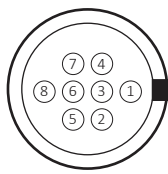
Figure 9: Traditional Overdrive vs. Adaptive Overdrive

Mako Output Description



Mako cameras are not intended to be connected to a DC distribution network. The maximum Length for I/O cables must not exceed 30 meters.

The general purpose I/O port uses a Hirose HR25-7TR-8PA(73) connector on the camera side. The mating cable connector is Hirose HR25-7TP-8S. Table X describes the I/O connector pin assignment, camera side Hirose HR25-7TR-8PA(73).



Pin	Signal	Direction	Level	Description
1	Out 1	Out	Open emitter, maximum 20 mA	Opto-isolated output 1
2	Out 2	Out	Open emitter, maximum 20 mA	Opto-isolated output 2
3	Out 3	Out	Open emitter, maximum 20 mA	Opto-isolated output 3

For input definitions, see the Mako manual.

Table 12: Mako output pin assignment

Mako Feature Configuration

We recommend you to use the following settings.

Light Pulse Width Equal to Exposure Time

Feature group	Feature	Value
Strobe	StrobeDelay	0
	StrobeDuration	0
	StrobeDurationMode	Source
	StrobeSource	Trigger
SyncOut	SyncOutLevels	0
	SyncOutPolarity	Negative
	SyncOutSelector	SyncOut1
	SyncOutSource	Exposing

Table 13: Feature Configuration for Light Pulse Width Equal to Exposure Time

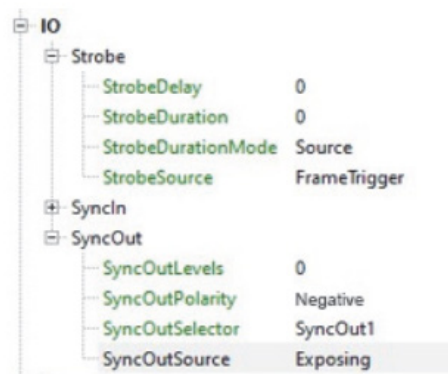


Figure 10: Feature Configuration for Light Pulse Width Equal to Exposure Time

Start of exposure with a timed strobe delay and duration

Feature group	Feature	Value
Strobe	StrobeDelay	10 ¹
	StrobeDuration	100 ¹
	StrobeDurationMode	Controlled
	StrobeSource	Exposing
SyncOut	SyncOutLevels	0
	SyncOutPolarity	Negative
	SyncOutSelector	SyncOut1
	SyncOutSource	Strobe1
¹ Example values		

Table 14: Feature Configuration for Start of Exposure with a Timed Strobe Delay and Duration

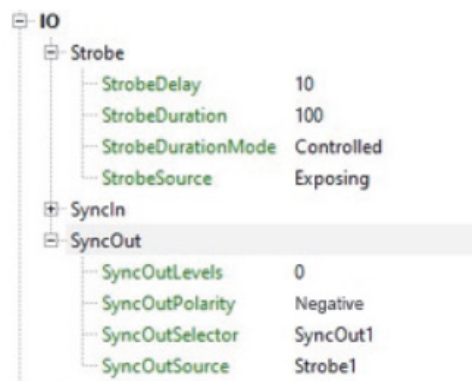


Figure 11: Feature Configuration for Start of Exposure with a Timed Strobe Delay and Duration

Controlling with SignaTech™

SignaTech™ (Signature Technology) is Advanced illumination's proprietary control system that allows Ai LED illuminators in machine vision systems to operate at maximum output under all operating conditions, while protecting the light head from damage.

During the light assembly process, key LED characterization information gets auto-populated into a light head's EEPROM. Microprocessor-based DCS and Pulsar controller software then reads the stored info, sets operating conditions, and manages any GUI and I/O functions.

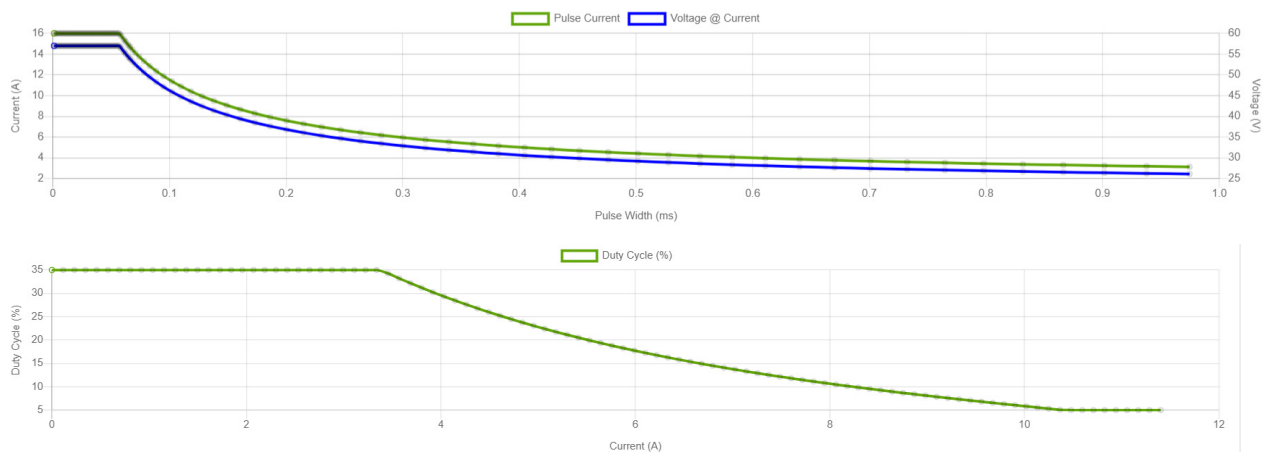


Figure 12: Sample charts from Advanced illumination's proprietary data management software, used in the production of SignaTech™ enabled lights.

The SignaTech™ Control System allows pulsing of certain LEDs up to 50 times overdrive currents while still maintaining the highest flux output and longest LED lifetime.

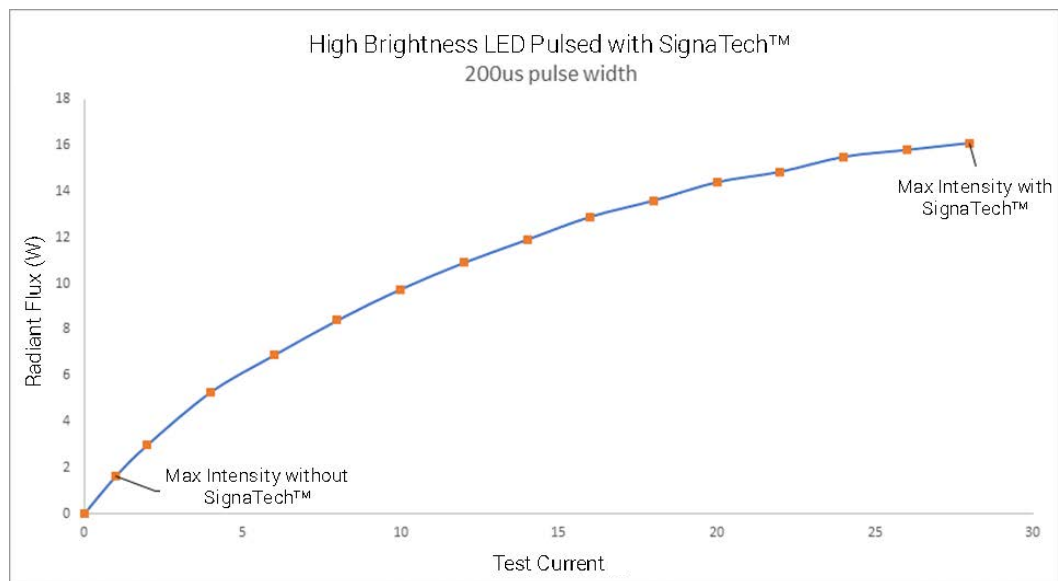


Figure 13: Sample data of an overdrive application, with and without SignaTech™ enabled.

Product customization is a multi-tiered approach.

Fully custom-designed and built products that are engineered, often from the ground up, to fit your exact machine vision needs. Typically offered for OEM applications and volume orders.



<https://www.advancedillumination.com/configurator-products-page/>

















<p>Lens *</p> <p><input type="radio"/> N - Narrow</p> <p><input checked="" type="radio"/> M - Medium (Standard)</p> <p><input type="radio"/> W - Wide</p> <p>Length *</p> <p>18 in</p> <p>Spectral Wavelength *</p> <div style="display: flex; flex-wrap: wrap;"> <div style="width: 33%;">  365nm - Ultra-Violet </div> <div style="width: 33%;">  375nm - Ultra-Violet </div> <div style="width: 33%;">  385nm - Ultra-Violet </div> <div style="width: 33%;">  395nm - Ultra-Violet </div> <div style="width: 33%;">  405nm - Violet </div> <div style="width: 33%;">  455nm - Royal Blue </div> <div style="width: 33%;">  470nm - Blue </div> </div> <div style="display: flex; flex-wrap: wrap;"> <div style="width: 33%;">  525nm - Cyan </div> <div style="width: 33%;">  530nm - Green </div> <div style="width: 33%;">  590nm - Amber </div> <div style="width: 33%;">  625nm - Red Orange </div> <div style="width: 33%;">  660nm - Red </div> <div style="width: 33%;">  730nm - Infra-Red </div> <div style="width: 33%;">  850nm - Infra-Red </div> </div> <div style="display: flex;"> <div style="width: 33%;">  940nm - Infra-Red </div> <div style="width: 33%;">  White - White </div> </div>	<p>LL174</p> <table border="0"> <tr> <td>Lens</td> <td>M - Medium (Standard)</td> </tr> <tr> <td>Length</td> <td>18 in</td> </tr> <tr> <td>Spectral Wavelength</td> <td>660nm - Red</td> </tr> <tr> <td>Power Option</td> <td>C1 - DCS-100/103 Connector</td> </tr> <tr> <td>Heat Sink</td> <td>Yes</td> </tr> <tr> <td>Wash Down</td> <td>No</td> </tr> <tr> <td>Diffuser</td> <td>No</td> </tr> <tr> <td>Polarizer</td> <td>Yes</td> </tr> <tr> <td>Optional Cable Length</td> <td>No</td> </tr> </table>	Lens	M - Medium (Standard)	Length	18 in	Spectral Wavelength	660nm - Red	Power Option	C1 - DCS-100/103 Connector	Heat Sink	Yes	Wash Down	No	Diffuser	No	Polarizer	Yes	Optional Cable Length	No	<p>Product: LL174 - High Intensity Bar Light, Rev A</p> <p>Part Number: LL17418-660C1HP</p> <p>Description: High Intensity Bar Light, 18", Red, C1 Connector, Heat Sink, Polarizer, Rev A</p> <p>Lead Time: 2 wks</p> <p>Weight: 2555g (5.64lb)</p>
Lens	M - Medium (Standard)																			
Length	18 in																			
Spectral Wavelength	660nm - Red																			
Power Option	C1 - DCS-100/103 Connector																			
Heat Sink	Yes																			
Wash Down	No																			
Diffuser	No																			
Polarizer	Yes																			
Optional Cable Length	No																			

Figure 14: Sample image from Advanced illumination's online Configurator.

Technical Data and Ordering

Advanced illumination Products

**Website**<https://www.advancedillumination.com/>**Email**sales@advancedillumination.com**Headquarters**

Advanced illumination, Inc.
440 State Garage Rd.
Rochester, VT 05767
T// +1 802 767 3830
F// +1 802 767 2636

[Contact Us](#)

Allied Vision Products

Website

General

<https://www.alliedvision.com/en/contact>

Distribution Partners

<https://www.alliedvision.com/en/about-us/where-we-are>**Email**

General

info@alliedvision.com

Support

support@alliedvision.com**Sales Offices**

Europe, Middle East, and Africa

T// +49 36428 677-230

North and South America

Toll-free: +1 877 USA 1394

T// +1 978 225 2030

California: +1 408 721 1965

Asia-Pacific

T// +65 6634 9027

China

T// +86 21 64861133

Headquarters

Allied Vision Technologies GmbH
Taschenweg 2a
07646 Stadtroda, Germany
T// +49 36428 677-0
F// +49 36428 677-28

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