



# User Manual

DCS-400E

DCS-800E

Quad Controller Series

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## Version History

Version #	Implemented By	Revision Date	Approval Date	Reason
0.1				Initial Design Definition draft
0.2	JRS	5/20/2019		Updated cad images and wiring diagrams
0.3	RRR	8/2/2019		SW Command List Added
1.0	JRS	8/05/19	8/5/2019	Updated front panel images, readied document for release

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## Hardware Overview

The DCS400 and DCS800 Quad Lighting Controller is a multi-channel controller for Advanced Illumination LED illuminators. With multi-channel control, this controller is ideal for applications such as photometric stereo, high-resolution color and bright-field / dark-field combination lighting.

This controller family is not limited to computational imaging and can be used as a general-purpose controller for a wide range of applications in both **continuous** and **strobe** modes of operation.

### DCS-400E, Quad Controller

- Single Output, 4 Channels
- x2 digital trigger input
- X2 trigger outputs

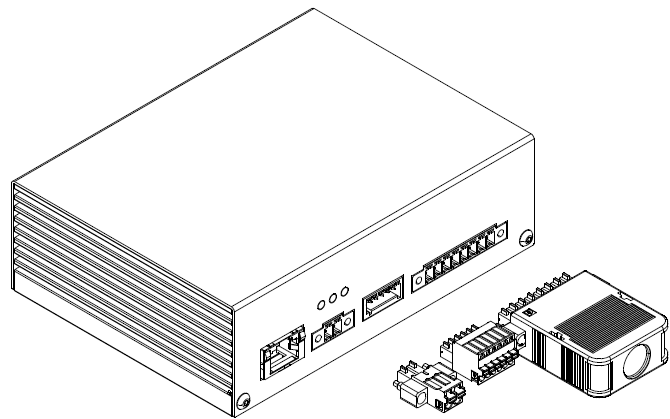


Figure 1

### DCS-800E, Quad Controller x2

- Dual Output, 8 Channel
- x2 digital trigger inputs
- X2 trigger outputs

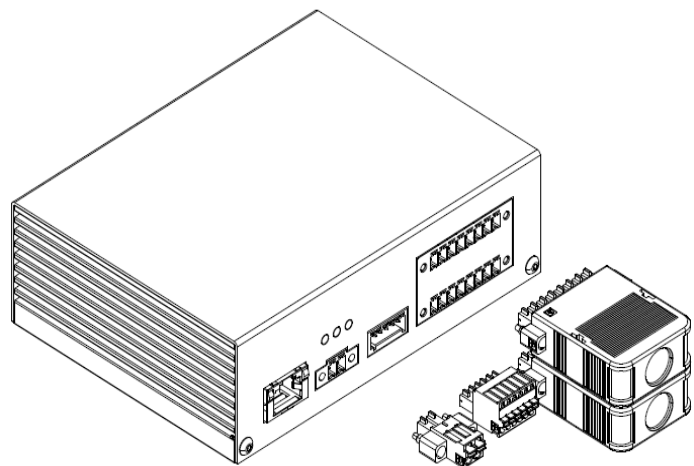


Figure 2

## Installation Model

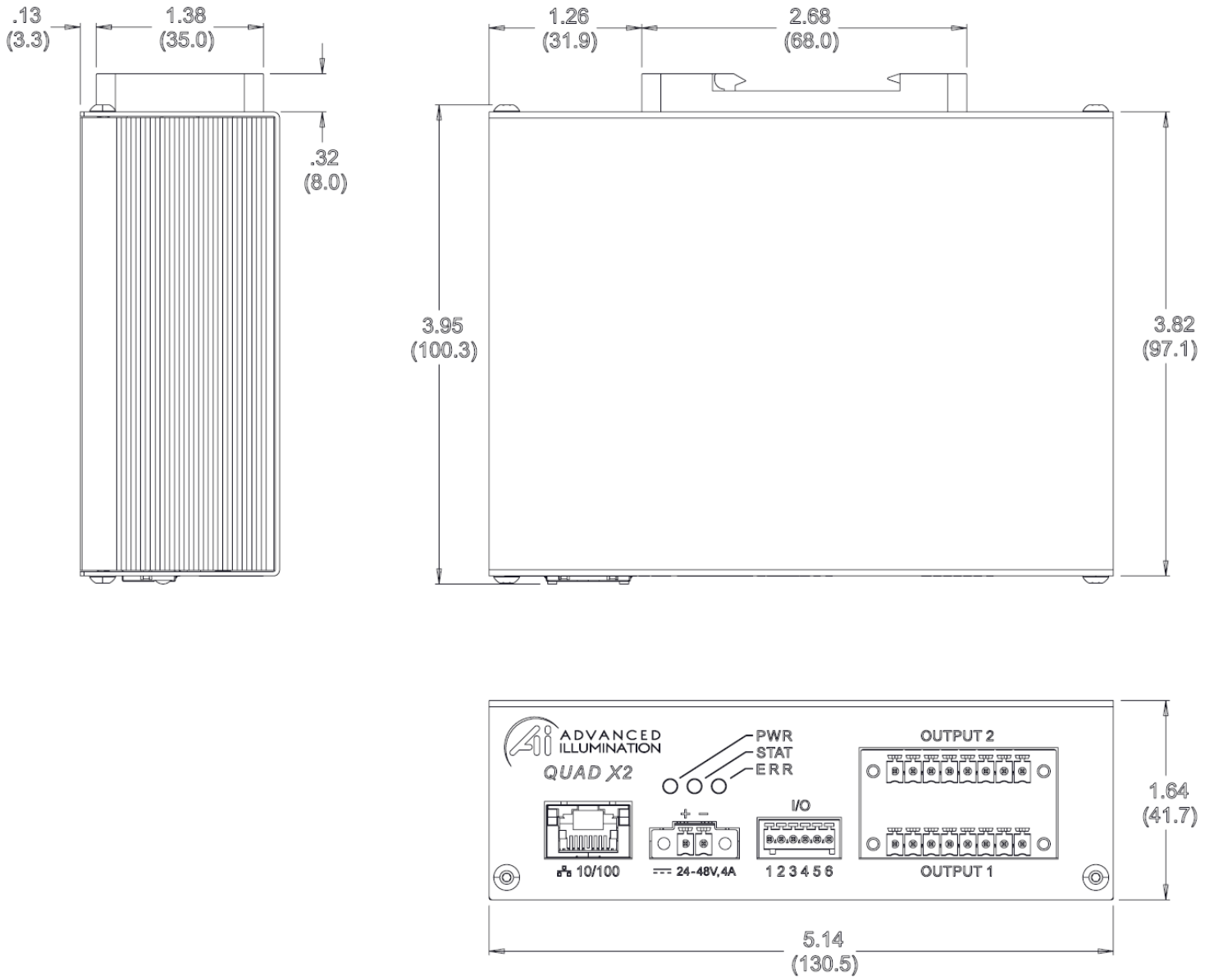


Figure 3

## General Specifications

Specification	DCS-400E (single output)	DCS-800E (dual output)
Power Requirements	24VDC Nominal, 4.5A Vmin = 22VDC Vmax = 48VDC	
Output Power	Up to 100W total 5A Pulsed (24V input) *10A pulsed *(48V input) 1A continuous per channel	
Channel Control	4 Independent Channels, 1 Output	8 Independent Channels, 2 Outputs
Modes	Continuous, Pulsed, or Gated Continuous	
External Trigger Input/Output	5V, TTL Compatible Overvoltage protected, safe up to 30VDC	
Pulse Width Range	30usec to 1 hour	
Trigger-to-Pulse Latency	30 usec delay 2us rise/fall	
Duty Cycle / Frequency	15% duty cycle limit in overdrive/pulsed mode*  *Longer duty cycles possible at "continuous" current ratings	
Operating Temperature Range	0 °C to 60 °C	
Communication / Software	10/100 Ethernet Standard TCP-IP, UDP  .NET library compatible with C#, F# and VB  Windows Software	

## Front Panel Illustrations

### Front Panel Illustration, DCS-400E

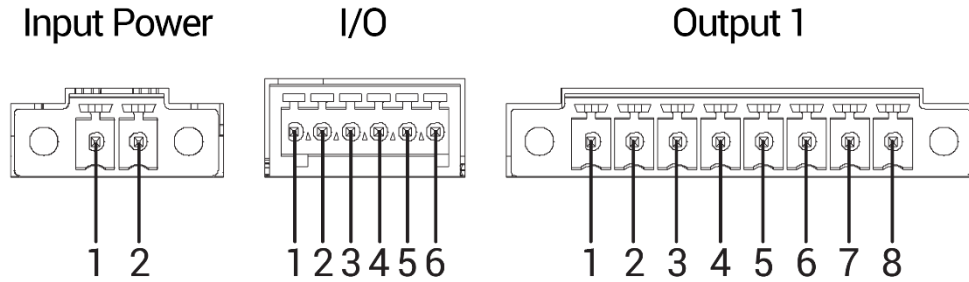


Figure 4

### Front Panel Illustration, DCS-800E

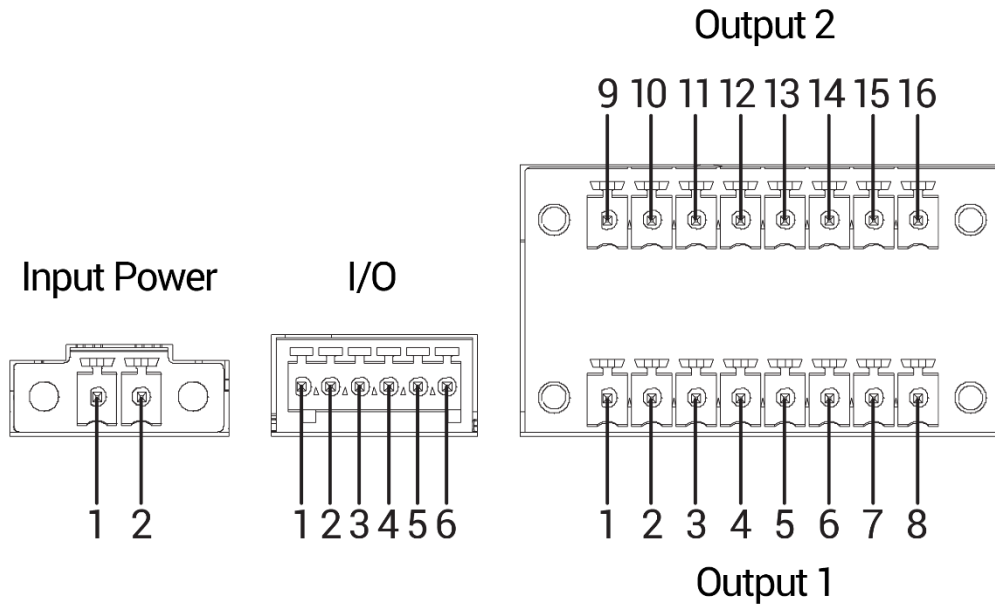


Figure 5

Refer to the tables on the next page for connection info

## Front Panel Descriptions

*Table 1 - Input Power, P1*

Pin	Description	Note
1	24-48VDC	Reverse polarity protected
2	DC GND	

*Table 2 - Indicator LEDs*

	Color	Behavior	Function
LED 1	Green	On	Main Power Indicator
LED 2	Amber	Heartbeat / Blink	Flashes once per second heartbeat while light is connected. Flashes when commands are received.
LED 3	Red	Blink Code	Error code—Long / Medium / Short flashes indicate an error code

*Table 3 – IO Connector, P2*

Pin	Description	Note
1	TRIGGER-IN1	ACTIVE-HIGH – pull high to activate (Channels 1-4)
2	TRIGGER-IN2	ACTIVE-HIGH – pull high to activate (Channels 1-4 for DCS-400E, Channels 5-8 for DCS-800E)
3	TRIGGER-OUT1	Frame Start—output signal, occurs at the beginning of each channel pulse
4	TRIGGER-OUT2	Frame Stop—output signal, occurs at the end of each channel pulse
5	TRIGGER GND	Same as DC ground
6	TRIGGER GND	Same as DC ground



Table 4 – Output Connector P3 & P4

Output 1 (P3)		Output 2 (P4)		Notes
Pin	Description	Pin	Description	
1	SignaTech™ GND	9	SignaTech™ GND	Reserved
2	SignaTech™	10	SignaTech™	SignaTech™ Light Protection – NOT USER SERVICEABLE
3	CH3 & CH4 -	11	CH7 & CH8 -	LED Cathode (common)*
4	CH4 +	12	CH8 +	LED Anode
5	CH3 +	13	CH7 +	LED Anode
6	CH1 & CH2 -	14	CH5 & CH6 -	LED Cathode (common)*
7	CH2 +	15	CH6 +	LED Anode
8	CH1 +	16	CH5 +	LED Anode

### Important Information

\*LED Cathode pins, pin 1 and pin 9 are COMMON and may be tied together.

This controller requires SignaTech to operate correctly. SignaTech is **included** with lights purchased from Advanced Illumination. It is not possible to drive a non-SignaTech protected light source without explicit instruction from Advanced Illumination.

### Output Connector

**Plug:** Phoenix Contact, 1827761

**Strain Relief:** Phoenix Contact, 1834408

## Quick-Start

### General Connection Diagram

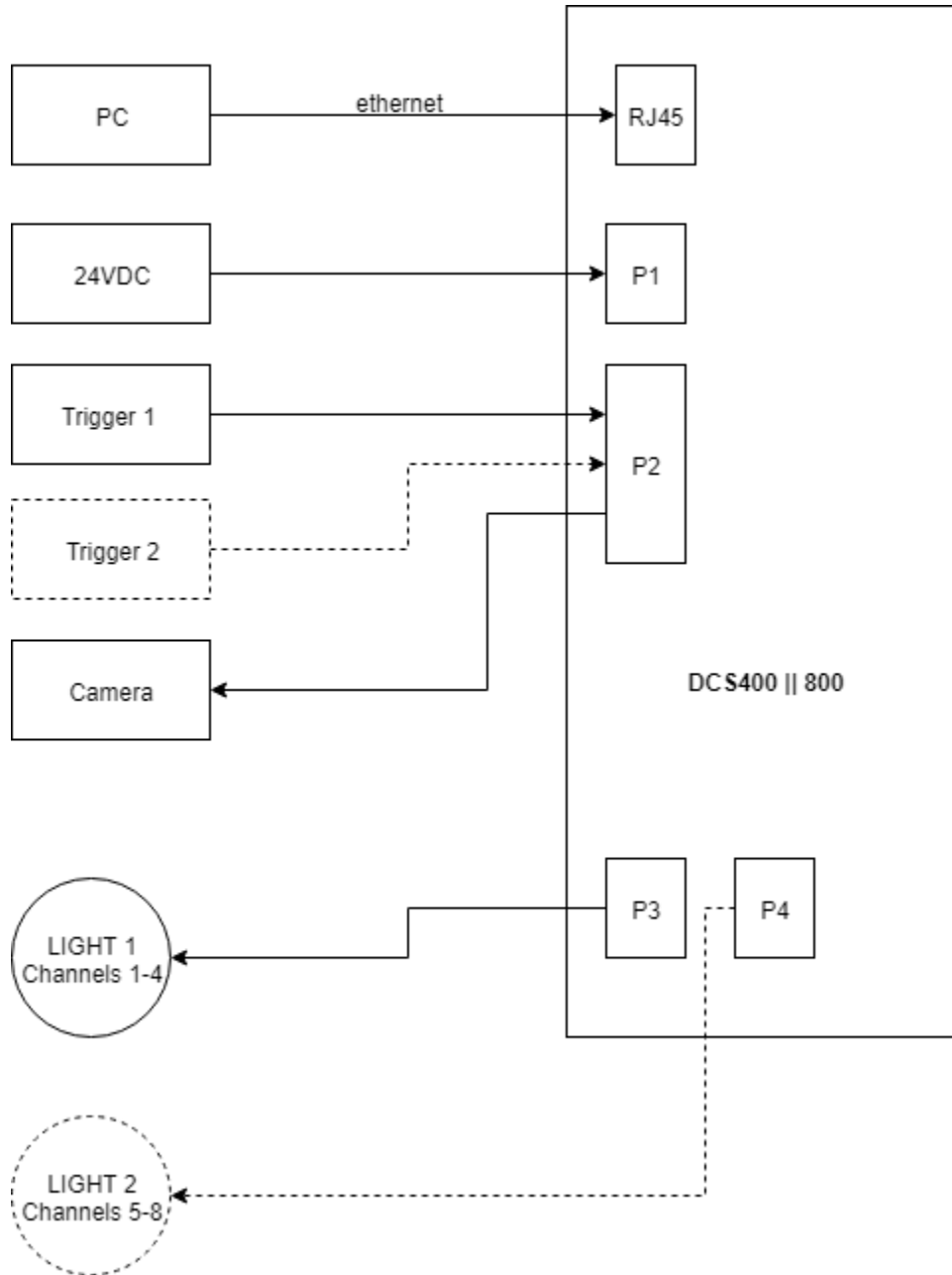


Figure 6 – General Wiring Example

## Modes of Operation

### Continuous

Each channel is capable of up to 1A output in **standard mode**. Continuous mode is not possible in **sequence mode**; in sequence mode, DC can be simulated by using long pulse widths.

Note: Depending on the load and power dissipation, not all channels may operate at 1A simultaneous. The controller must maintain a safe power dissipation, so channel currents may be throttled.

### Pulsed

Pulsed mode illumination is triggered by an external signal.

Pulse widths and delay are available from 10 to 4,290,000,000 microseconds and can be applied independently to any channel.

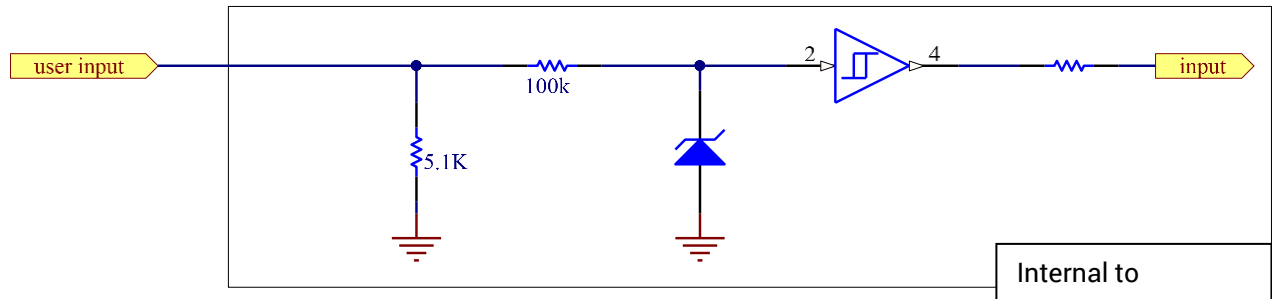
### Sequence

Channels settings are organized into **events**. The event could be considered a pre-set, or recipe, that stores the behavior when a trigger is received.

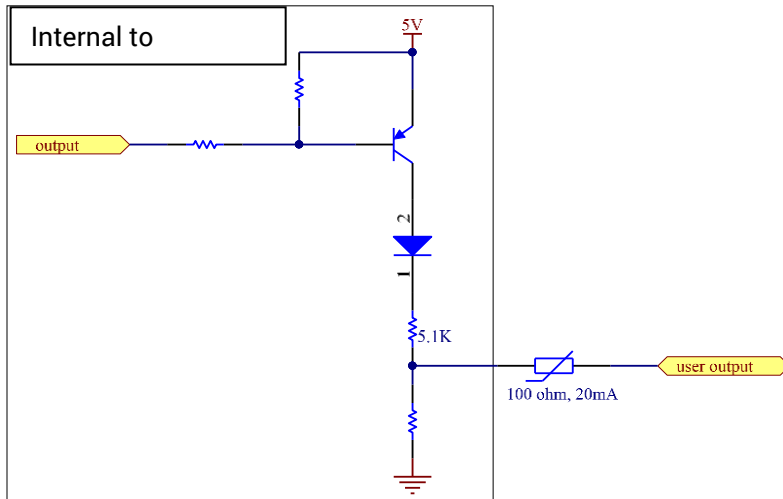
Programming multiple **events** allows the controller to sequence through pre-determined recipes. Each external trigger edge will advance the sequence to the next event.

## Trigger Input & Outputs

### Simplified Input Diagram (P2 pins 1 & 2)



### Outputs – Frame Start/Stop (P2 pins 3 & 4)



**Frame-start** (Pin 3) is an output trigger signal that occurs at the beginning of each channel pulse. This signal can be used to trigger an external device, or camera.

For example: by using the **frame-start** signal, it is possible to synchronize a camera exposure to capture each channel as they flash in a sequence. This is useful in photometric stereo applications where the camera needs to be carefully synchronized to capture multiple flashes

**Frame Stop** (pin 4) -- Similar to **frame-start** except the stop signal begins at the end of each light pulse. This signal can be used to determine when the last channel pulse has ended and is useful for controlling system timing more accurately.

## Software Setup

### Default Ethernet Settings

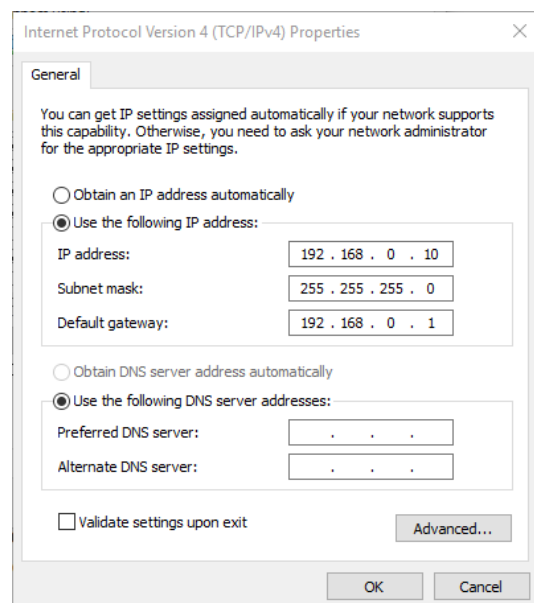
The Controller uses standard Ethernet protocol (TCP-IP and UDP) to communicate. The DCS control user interface can be used to communicate, or other software may be used to send data packets directly from the host to the controller.

Table 5

Setting	Value
Typical Port Settings	UDP, port 7777 TCP, port 777
DHCP	Enabled by default
Default IP Address	192.168.0.5  *Controller will use default IP if DHCP fails upon power up, or if an Ethernet cable is not connected
User Assigned IP Addresses	User can assign a new IP address by sending a command, or entering a new IP address in the “manage devices” window of the GUI.  If a user assigned IP address is used, the controller will not begin using that IP address until the controller power is toggled.

This controller uses DHCP to automatically acquire an IP address. **If directly to a PC Ethernet port, you will need to set up the PC to use a static IP address in the range of 192.168.0.x**

Figure 7 - Example PC settings



## User Interface (GUI)

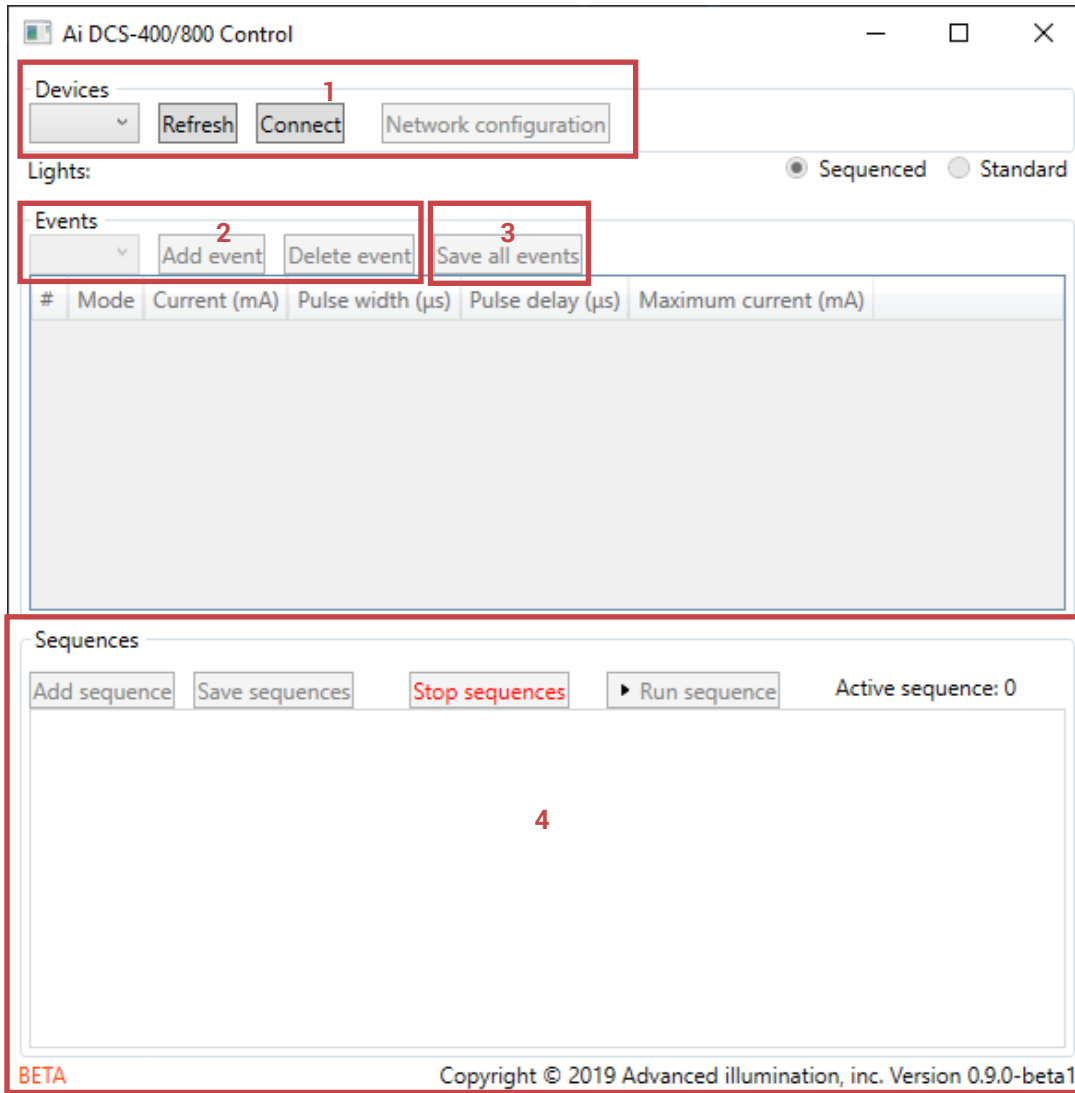


Figure 8

1. This dropdown box will list any discovered devices by IP address. Select the devices you want to connect to here. The refresh button will re-scan for devices on the network, and the connect button will connect to the highlighted IP address.
2. Editing channels exists in a section we call Events. Default startup is Event 1, but additional events can be created to store pre-set configurations.
3. Save Event will store the event in memory, as well as run the event once pressed
4. Sequences can be used to chain different events together. **Note, you should have at least 1 default sequence set up even if only 1 event is running.**

# Software Usage

## Overview

The Ai DCS-400/800 software must connect to a device before it can be used. The Refresh button (see Figure 95) refreshes the list of available DCS-400/800 devices on the local network. Either select a device from the list or type an IP address (in dotted-quad, e.g. “XXX.XXX.XXX.XXX” format) and click connect.

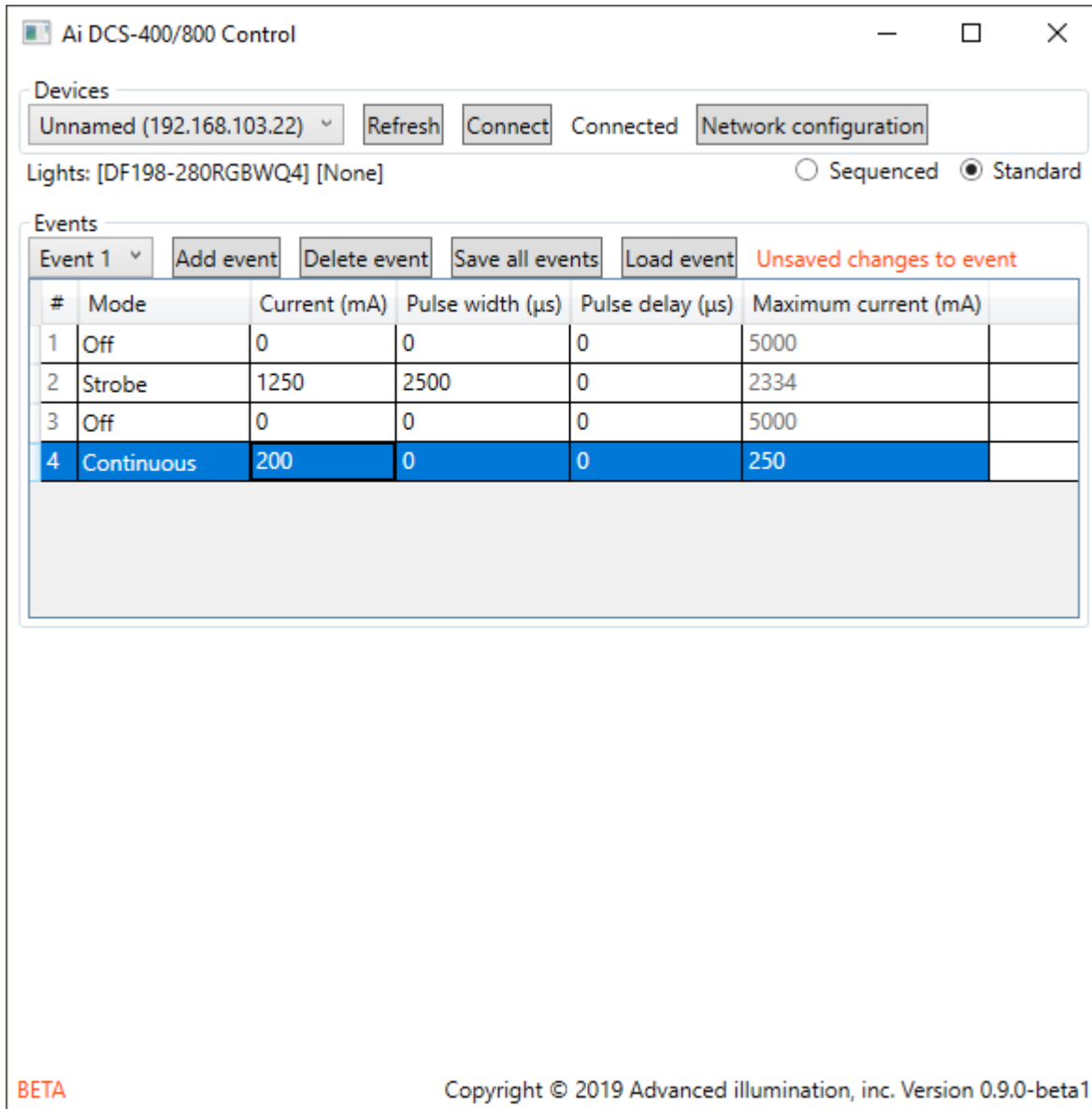


Figure 95: Software main window example

## Modes

### Standard Mode

The standard mode allows using a DCS-400 or DCS-800 like a “normal” 4- or 8-channel controller. Operation in Standard Mode starts by putting the controller in Standard mode and adding an Event (See Figure).

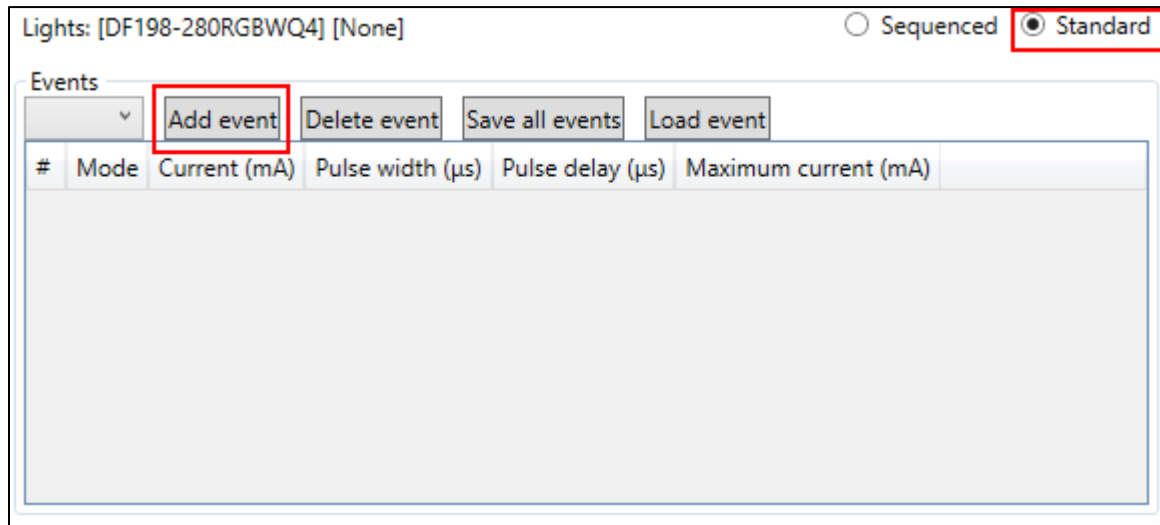
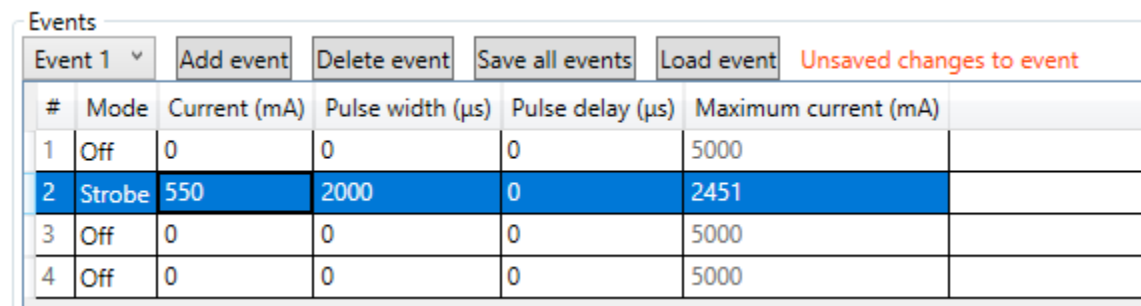


Figure 10: Image of Standard mode and Event add

### Adding an Event

Once an event is added, you can set configurations (current, channel mode, etc.) on each channel and they will be immediately reflected on the controller. Note that the event itself is not auto-saved: if you power down the controller the configuration will be lost unless you click “Save all Events”. The warning shown in Figure 6 will inform you if you have unsaved edits.



The screenshot shows the 'Events' section of the software. It includes a dropdown menu set to 'Event 1', the same four buttons as in Figure 10, and a red warning text 'Unsaved changes to event'. Below is a table with the following data:

#	Mode	Current (mA)	Pulse width (μs)	Pulse delay (μs)	Maximum current (mA)
1	Off	0	0	0	5000
2	Strobe	550	2000	0	2451
3	Off	0	0	0	5000
4	Off	0	0	0	5000

Figure 61: Unsaved event warning

Other events you add must be loaded with the Load Event button to be applied to the device. Loading an Event will set that Event active on the device, and it will be auto-loaded next time the device is powered on. If no Event is loaded when the device is power cycled, it will load the first available saved Event. Saving channel configurations as an Event allows you to easily recall the configurations later, much like the Profiles in Advanced illumination’s DCS-100 and DCS-103 controllers.



## Sequenced Mode

Sequenced mode allows the controller to automatically cycle through a predefined series of Events with a hardware trigger (currently only Trigger Input 1). This allows the controller to, for example, flash alternate sides of a right light with only one continual stream of trigger pulses and no further input from the software/SDK.

### Events

Creating an Event is the same as in Standard Mode, except for two points:

1. Event changes are not immediately updated on the device.
2. An Event cannot be loaded directly while in Sequenced Mode, only Sequences can.

### Sequences

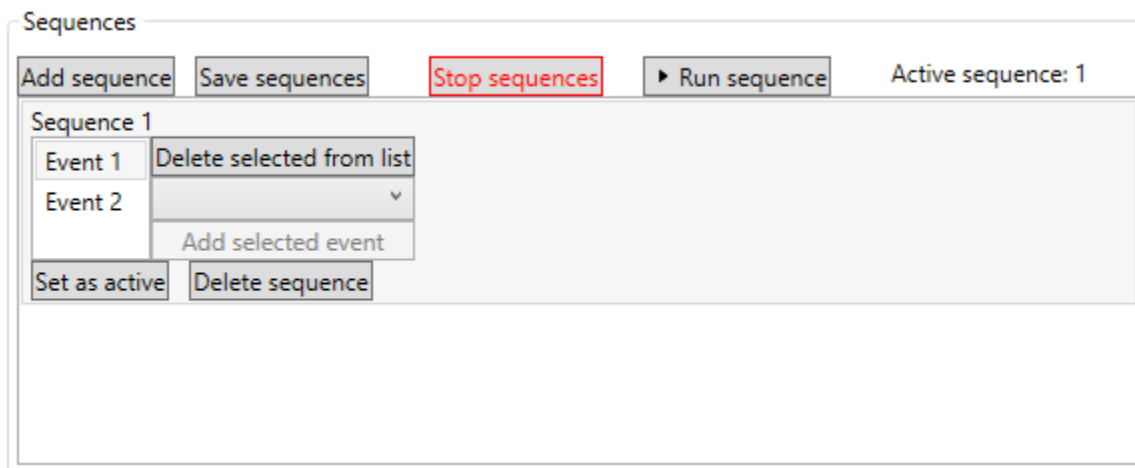


Figure 72: Sequence editing menu

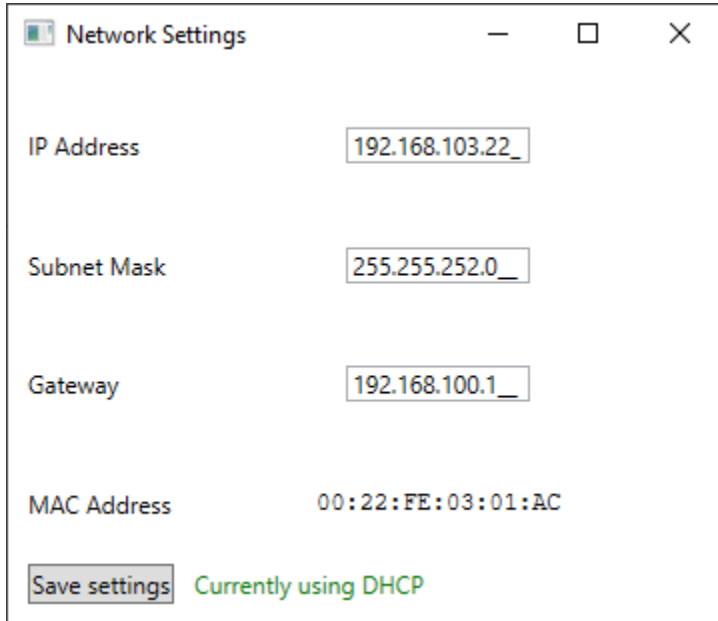
A Sequence is, at its simplest, a list of Events. When a Sequence is loaded, a hardware trigger causes the controller to start the first Event in the list, the next trigger starts the next event, and so on. When the last Event in the Sequence is reached, it starts over from the first Event.

The sequence menu is shown above in Figure 7. Clicking "Add Sequence" adds a new sequence, which appears inline below the other sequences in the list. On any Sequence, you can select an Event from the dropdown in the Sequence and click "Add selected event" to add that event to the Sequence. You can have multiple of the same Event in the Sequence, however you are limited to 10 Events per sequence.

Once you have a Sequence defined, click "Save sequences" to save all defined Sequences to the controller. You can then make load a Sequence on the controller by clicking "Set as active" on a sequence. The "Run sequence" button allows you to simulate a trigger pulse to ensure that sequence is working as intended. Be aware that this button sends an HTTP POST message to the controller, so there will be network delay between the click and the pulse.

## Network Configuration

Network Configurations are viewed by clicking the “Network Configuration” button on the main window when connected to a device. Network Configurations opens in its own window, as shown in Figure 8 below.



The screenshot shows a window titled "Network Settings" with a standard Windows-style title bar (minimize, maximize, close buttons). The window contains the following fields and values:

Field	Value
IP Address	192.168.103.22
Subnet Mask	255.255.252.0
Gateway	192.168.100.1
MAC Address	00:22:FE:03:01:AC

At the bottom of the window, there is a "Save settings" button and a status indicator that reads "Currently using DHCP" in green text.

Figure 83: Network Configuration example in DHCP Mode

### Static IP configuration

A static IP address is set by entering an IP address, subnet mask, and Gateway address in the boxes provided. Note that the window displays the current value of all settings, even if it's using DHCP. Settings are saved by clicking the “Save Settings” button. If settings are saved unchanged from the values displayed from DHCP, then the device is assigned a static IP address configuration matching those values.

### Resetting to DHCP

Network configuration can be reset back to DHCP mode by clicking the red-text “Reset to DHCP” button, which will replace the green DHCP message when the device is using a static address. The device should then be power-cycled for it to use its new settings.

## Software Command and Control Interface

### Command Structure

The DCS400/800 uses an SCPI-like interface where commands are a series of readable strings with parameters separated by commas. The strings must be terminated by a semicolon (;) for proper operation.

Commands can be sent in an ASCII format by specifying the IP Address and correct port number for either TCP/IP or UDP.

#### Commands with a parameter

Commands that require a parameter have it separated by a comma.

Example: "SET:PULSE:WIDTH:CHANNEL1,100;"

Where "SET:PULSE:WIDTH:CHANNEL1," is the command and "100" is the parameter.

#### Commands without a parameter

If the command has no parameter, the command simply ends with a semicolon.

Example: "\*IDN?;"

Commands are case sensitive, and must be entered exactly as shown

## Command Table

Table 6

COMMAND	DESCRIPTION	RETURNS
<b>SET:CURRENT:CHANNELc,nnnn;</b>	Sets the current in milliamps  c = 1 - 8 (channel number) nnnn= 0-8000 (strobe)	
<b>SET:PULSE:WIDTH:CHANNELc,nnnn;</b>	Sets the pulsewidth in usec  c = 1 - 8 (channel number) nnnn = 0 - 4290000000 (us)	INFO: Channel "c" pulse width set to "nnnn" us
<b>SET:PULSE:DELAY:CHANNELc,nnnn;</b>	Sets the pulse delay in usec  c = 1 - 8 (channel number) nnnn = 0- 4290000000 (us)	INFO: Channel "c" pulse delay set to "n" microseconds.
<b>PULSE:CHANNELc;</b>	Software triggers the channel c = 1-8	
<b>*IDN?;</b>	Gets device information: firmware, hardware, etc..	Advanced illumination "DCS-100: (fw version, hw version)"
<b>*CHANNEL:INFO?;</b>	Gets device channel information	
<b>SET:IP:ADDRESS,xxx;</b>	Sets static IP address.  Xxx = IP address in dotted-quad format (XXX.XXX.XXX.XXX)	INFO: Set IP address to XXX.XXX.XXX.XXX. Reboot for it to take effect.

<b>SET : GATEWAY : ADDRESS , xxx ;</b>	Sets gateway IP address.  Xxx = IP address in dotted-quad format (XXX.XXX.XXX.XXX)	INFO: Set Gateway address to XXX.XXX.XXX.XXX. Reboot for it to take effect.
<b>SET : SUBNET : MASK , xxx ;</b>	Sets subnet mask.  Xxx = subnet mask in dotted-quad format (XXX.XXX.XXX.XXX)	INFO: Set subnet mask to XXX.XXX.XXX.XXX
<b>ERASE : SETTINGS ;</b>	Erases device settings.	
<b>STOP : SEQUENCE ;</b>	Stops running sequence. Immediately aborts all long-running pulses and shuts off all channels.	INFO: Running sequence aborted
<b>RUN : SEQUENCE ;</b>	Runs the currently active sequence. Imitates a hardware trigger in sequenced mode.	INFO: Running event X on Sequence X  X is event/sequence number

## Warranty Information

Every Advanced illumination, Inc. (Ai) product is thoroughly inspected and tested before leaving the factory. Products are warranted to be free of defects in workmanship and materials for a period of five years from the original date of purchase. Should a defect develop during this period, please contact Ai Customer Service or your Ai distributor for a Return Merchandise Authorization (RMA), and return the complete product, freight prepaid, to Ai. Please provide a detailed description of the problem if possible. If a defect is found, Ai will - at our discretion - repair or replace the product without charge. Ai claims no liability for any implied warranties, including “merchantability” and “fitness for a specific purpose.”

## Customer Support and Product Information

Standard Product Information: [www.advancedillumination.com](http://www.advancedillumination.com)

Customer Service Inquiries: [customerservice@advancedillumination.com](mailto:customerservice@advancedillumination.com)

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