**Using DLP® LightCrafter™ 4500 Triggers to Synchronize Cameras to Patterns**

**ABSTRACT**

This document describes how to use DLP® LightCrafter™ 4500 with the global trigger function of industrial USB 2, USB 3, FireWire, and GigE CCD cameras from Point Grey Research, The Imaging Source, and others.

**Contents**

1 Introduction ................................................................................................................... 2
2 Connections .................................................................................................................. 3
  2.1 J14 .................................................................................................................... 3
  2.2 J13 and J15 ....................................................................................................... 4
  2.3 J10 and J12 ....................................................................................................... 5
3 DLP LightCrafter 4500 and The Imaging Source Firewire Camera ........................................ 6
4 Conclusion .................................................................................................................. 9
5 Resources .................................................................................................................... 9

**List of Figures**

1 DLP LightCrafter 4500 Controller Board ......................................................................... 2
2 Schematic of J14 – Trigger Out 1 and 2 ........................................................................ 3
3 Schematic of J13 ....................................................................................................... 4
4 Jumper Locations for Setting Voltage Levels on J13 (Trigger 1 Out) and J15 (Trigger 2 Out) ................................................................. 4
5 Jumper Locations for Setting Voltage Levels on J10 (Trigger 1 In) and J12 (Trigger 2 In) ................................................................. 5
6 Example Hook-Up of DLP LightCrafter 4500 and Firewire Camera from The Imaging Source ................................................................. 6
7 DLP LightCrafter 4500 Control Software – Pattern Sequence/Sequence Settings Tab ................................................................................................. 7
8 DLP LightCrafter 4500 Control Software – Pattern Sequence/Trigger Config Tab ................................................................................................. 8
1 Introduction

DLP LightCrafter 4500 features two input and two output triggers for use in synchronizing cameras and other devices with the pattern sequence running on the board. This document focuses only on the output triggers, which are generally used to synchronize cameras with global shutters to allow the capture of each individual frame or pattern in a sequence of frames.

Most cameras with global shutters use opto-isolated trigger inputs in order to provide protection from potentially damaging voltages which may be applied inadvertently. The connector types, exact timing and electrical requirements differ. Please see the manual for a particular camera, or check the manufacturer’s website for application notes about using the trigger.

Figure 1 shows the location of the connectors for Trigger In (J11) and Trigger Out (J14).
2 Connections

2.1 J14

Figure 2 shows the schematic of the Trigger Out connector J14.

![Schematic of J14 – Trigger Out 1 and 2](image)

Opto-isolators require a small amount of current to operate. They are not digital circuits that respond to a voltage level relative to ground. Instead, they isolate two circuits by changing an electrical signal into a light signal, and then back to an electrical signal, all within the opto-isolator. This isolates one circuit from any noise, or ground level differences between the circuits on either side of the opto-isolator.

The trigger outputs of DLP LightCrafter 4500 can be set to the required logic voltage level (1.8 V or 3.3 V) by inserting a jumper across the appropriate pins of the corresponding jumpers. These jumpers are shown in the illustration of DLP LightCrafter 4500 controller board Figure 1. For Trigger 1 Out, the voltage level is set by putting a jumper onto the appropriate pins of header J13. Likewise, the voltage for Trigger 2 Out is set by header J15. The same voltage selection scheme works for Trigger 1 In (J10) and Trigger 2 In (J12). See the schematic of one of the headers, J13, in Figure 3.
2.2 J13 and J15

Figure 3 shows the Trigger Out 1 voltage level select header J13. This is the same for Trigger Out 2 header J15.

J13: The desired voltage level for Trigger 1 Out is selected by insertion of a jumper between the appropriate pair of pins.

Figure 3. Schematic of J13

Figure 4 shows how the jumpers are placed to select the voltage levels on J13 (Trigger 1 Out) and J15 (Trigger 2 Out). This board has the jumpers inserted to select 3.3 V.

In this case, the jumpers are installed for 3.3 V.

Figure 4. Jumper Locations for Setting Voltage Levels on J13 (Trigger 1 Out) and J15 (Trigger 2 Out)
2.3 J10 and J12

Figure 5 shows how the jumpers are placed to select the voltage levels on J10 (Trigger 1 In) and J12 (Trigger 2 In). This board has the jumpers inserted to select 3.3 V.

In this case, the jumpers are installed for 3.3 V.

Figure 5. Jumper Locations for Setting Voltage Levels on J10 (Trigger 1 In) and J12 (Trigger 2 In)
3 DLP LightCrafter 4500 and The Imaging Source Firewire Camera

Figure 6 shows an example hook-up of DLP LightCrafter 4500 and The Imaging Source Firewire camera. The camera is connected to Trigger 1 Out. Trigger 2 Out is not used. There is no cable connected for Trigger In. In addition to the Trigger Out cable, Power supply, USB, and Firewire cables are shown in Figure 6.

Figure 6. Example Hook-Up of DLP LightCrafter 4500 and Firewire Camera from The Imaging Source
Figure 7. DLP LightCrafter 4500 Control Software – Pattern Sequence/Sequence Settings Tab

An example of setting DLP LightCrafter 4500 to trigger a camera on a Pattern Sequence is shown in Figure 7. Note that under Operating Mode the Pattern Sequence button has been selected. This automatically opens the Pattern Sequence/Sequence Settings tab. For this illustration, a pattern sequence has been created and sent to DLP LightCrafter 4500.

Under Individual Pattern Settings the trigger has been set to Internal Trigger. The Internal Trigger (µs) has been set to 33333 µs, which sets the period between successive patterns. This period results in a pattern rate of 30 frames per second.

Important Note: The Pattern Exposure(µs) must be set shorter than the Internal Trigger (µs) by more than 230 µs. If this requirement is not met, the pattern will not run. The control software will indicate an error by lighting the annunciator next to the Period Exposure diff < 230 in the Data Validation area.

The trigger out signal corresponds in time to the Pattern Exposure (µs). That is, the trigger out signal will be active for the length of the exposure within the trigger period.
Figure 8 shows the Pattern Sequence/Trigger Controls tab of DLP LightCrafter 4500 control software. This screen allows for setting the Trigger 1 Out Rising Edge Delay and Trigger 1 Out Falling Edge Delay, and the Trigger 2 Out Rising Edge Delay. On this tab it is also possible to set the Trigger 2 Patterns per Pulse so that Trigger 2 Out sends a pulse every n patterns. This allows for synchronization of a whole pattern sequence consisting of n patterns. The Trigger 2 pulse width is nominally 20 µs, but this can be varied somewhat by setting the Trigger 2 Out Rising Edge Delay. Note the click box Invert Trigger 1 Output which does what it indicates.

Verify that the trigger pulse width is compatible with the requirements of the specific camera which is being used. See the camera data sheet.
4 Conclusion

The trigger features of DLP LightCrafter 4500 offer flexible means of synchronizing cameras or other devices to the pattern sequences projected by the module. Many different voltage level, polarity, and timing requirements can be accommodated by appropriate configuration of DLP LightCrafter 4500 through its control software. Other resources are available for understanding and utilizing these and other features of DLP LightCrafter 4500. Visit www.ti.com/dlp to download data sheets and other supporting documents.

5 Resources

The following hardware is helpful:

- Trigger Connector Housing (connects to J11, J14)
  - Molex part number: 51021-0600
  - Digi-Key part number: WM1724-ND

- Crimp pins (6 each required for the Trigger housing)
  - Molex part number: 50079-8100
  - Digi-Key part number: WM2023-ND

Revision A History

Changes from Original (July 2013) to A Revision

<table>
<thead>
<tr>
<th>Change Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Added section titles and updated image titles</td>
<td>2</td>
</tr>
<tr>
<td>Removed 5.0-V trigger option</td>
<td>3</td>
</tr>
</tbody>
</table>
IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms. No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have not been so designated is solely at the Buyer’s risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

<table>
<thead>
<tr>
<th>Audio</th>
<th><a href="http://www.ti.com/audio">www.ti.com/audio</a></th>
<th>Amplifiers</th>
<th><a href="http://www.amplifier.ti.com">www.amplifier.ti.com</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>DSP</td>
<td>dsp.ti.com</td>
<td>Energy and Lighting</td>
<td><a href="http://www.ti.com/energy">www.ti.com/energy</a></td>
</tr>
<tr>
<td>Interface</td>
<td><a href="http://www.interface.ti.com">www.interface.ti.com</a></td>
<td>Medical</td>
<td><a href="http://www.ti.com/medical">www.ti.com/medical</a></td>
</tr>
<tr>
<td>RFID</td>
<td><a href="http://www.ti-rfid.com">www.ti-rfid.com</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OMAP Applications Processors</td>
<td><a href="http://www.ti.com/omap">www.ti.com/omap</a></td>
<td>TI E2E Community</td>
<td>e2e.ti.com</td>
</tr>
<tr>
<td>Wireless Connectivity</td>
<td><a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2014, Texas Instruments Incorporated