Camera Link™

Appendix D For The Camera Link Specification For The Interface Standard For Digital Cameras And Frame Grabbers

Preliminary Specifications

Revision B

Frank Cuzze, 3M Product Development Engineer, Austin, Texas
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1. Mechanical Interface

1.1 Overview

This section describes the Camera Link™ connector and cable interface required on the display source and display device. General dimensions, tolerances and descriptions of those features which affect the intermateability of the receptacle and plug connectors are described in this section. The pinouts for the receptacle connector are also described in this section.

1.2 Camera Link Connector

The Camera Link connector shall be a two-row shielded ribbon contact connector with contacts on .050” spacing. A 360 degree “delta” shaped metal shell shall enclose the plug and receptacle contacts to provide shielding and proper polarity when mated. The contacts are designed to handle limited power, ground and signals.

1.2.1 Board Mount Connector Pin Assignment

The assignment of signals to the connector pins shall be as shown in Table 1-1. There is no difference between the display source end of the cable and that of the display device. Thus, either end of the cable may be connected to the display source or display device.

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**Table 1-1 Pin Assignment for Shielded Twisted Pair Cabling**

<table>
<thead>
<tr>
<th>Camera Connector</th>
<th>Right Angle Frame Grabber</th>
<th>Channel Link Signal</th>
<th>Cable Name (Reference Only)</th>
<th>Camera Connector</th>
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<th>Channel Link Signal</th>
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<tbody>
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<td>Pair 1-</td>
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<td>Inner shield</td>
</tr>
</tbody>
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**3M™ Cable Assembly and Camera Link Pinouts**

*3M™ Cable v 51.2

*Cable assembly compatible with both Camera Link configurations

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**Camera Link Cable Assembly Wiring Diagram**

*Table 1-1 Pin Assignment for Shielded Twisted Pair Cabling*
1.2.2 Mechanical Drawings

This section depicts the dimensions and mechanical outline of the connector receptacles on the display source, display device and cable assembly. The cable assembly plug used on the display source and display device is shown in Figure 1-1. The panel cutout for the display source and display device is shown in Figure 1-2. The cable assembly is shown in Figure 1-3. The board mount receptacle is shown in Figure 1-4. These figures are for illustrative purposes, only.
1.2.3 Connector Retention
The receptacle on the display source and the plug on the cable assembly shall be retained by two 4-40 screws on each end to ensure the proper mating of the connector reference surfaces. Proper mating is critical to minimizing radiated emissions and electromagnetic interference.

1.2.4 Contact Finish
The contacts of the connector receptacles of the display source and cable assembly shall be plated with a noble metal or noble metal alloy that meets the following minimum requirements 0.76 um gold over 2.0 um nickel.

1.2.5 Shell Finish
The connector shell shall be plated with a minimum of 4 um Electroless nickel.

1.3 Camera Link™ Cabling
A Camera Link cable assembly shall consist of a cable meeting the requirements of Appendix D with a Camera Link plug on each end. Acceptable cables for Camera Link will use shielded twisted pairs. It is up to the manufacturer of the Camera Link equipment to use the gauge and type of cable required to meet applicable regulatory requirements, and the specifications of Appendix D. Adherence to this standard does not guarantee regulatory compliance.

1.3.1 Cable Length
The maximum cable length shall be 10m.

1.3.2 Number of Signal Conductors
The Camera Link cable shall comprise 11 twisted shielded pairs and 4 individual drain conductors.

1.3.3 Wire Gauge
Each conductor in an Camera Link cable shall be tin plated copper stranded wire, 7/36, and no less than 28AWG. The drain wires shall be tin plated copper stranded wire, 7/36, and no less than 28AWG.

1.3.4 Conductor Resistance
The resistance of a single conductor of a Camera Link cable shall not exceed 3 Ohms when the conductor is of the maximum length, 10m, specified in this standard.

1.3.5 Insulation
Each conductor in the cable shall be separately insulated. The minimum insulation resistance shall be 100 meg Ohms.

1.3.6 Shield Requirement
The Camera Link cable shall be encompassed with a single braided shield, and a single foil shield. The foil shield is under the braided shield and both shields surround all conductors in the cable. The overall shield shall provide a minimum of 90% coverage.

For shielded twisted pair cable, each twisted pair shall be shielded individually. Each shield shall provide a minimum of 100% coverage.
1.3.7 Cable Jacket
The outer diameter of the cable shall be 9.0 mm nominal, and will be made out of poly vinyl chloride, PVC.

1.3.8 Single Twisted Pair Transmission Skew (Intra-pair Skew)
The differential time of transmission, single pair transmission skew, of a pulse through a single differential pair in a Camera Link™ cable shall not exceed 50ps/m.

1.3.9 Multiple Twisted Pair Transmission Skew (Inter-pair Skew)
The differential time of transmission, pair to pair transmission skew, of a pulse through any two differential pairs in a Camera Link cable shall not exceed 50ps/m.

2. Testing Requirements
The performance and testing requirements for the Camera Link connector plug, and receptacle are described in this section. Test procedures and requirements from ANSI/EIA/TIA 364 are used, where applicable.

2.1 Environmental Requirements
2.1.1 Temperature Life
The connector plug, and receptacle shall be tested according to ANSI/EIA/TIA 364-17, method A with test condition 3 at +85 degrees C. Test time is run under condition B, Table 3, for 250 hours, using method A, without load, while connectors are mated.

2.1.2 Cyclic Humidity
The connector plug and receptacle shall be tested according to ANSI/EIA/TIA 364-31, Test conditions B, Method III omitting 7B. Contact resistance shall be measured according to ANSI / EIA/TIA 364-23. Contact resistance shall not exceed 35 mil Ohms. Contact resistance for the assembly shall not change by more then 25 mil Ohms from the original resistance measured.

2.1.3 Thermal Shock
The connector plug and receptacle shall be tested according to ANSI/EIA/TIA 364-32, Condition 1 for 5 cycles mated. Contact resistance shall be measured according to ANSI/EIA/TIA 364-23. Contact resistance shall not exceed 35 mil Ohms. Contact resistance shall not change more than 25 mil Ohms from the original resistance measured.

2.1.4 Corrosion Resistance
The connector plug and receptacle shall be tested for 30 cycles mated and unmated. The connector plug and receptacle shall be tested according to JEDA-25-1974, using H₂S + 3 ppm, at 70-80% RH, at 40°C for 96 Hours. Contact resistance shall not exceed 35 mil Ohms. Contact resistance shall not change more than 25 mil Ohms from the original resistance measured.

The procedure for the corrosion test is as follows.

1. Initial low level contact resistance, LLCR, measurement
2. Insertion & Withdrawal / 30 cycle
3. LLCR, measurement
4. H₂S Gas
   H₂S 3 +/- 1ppm, 70 - 80%RH, 40 degrees, 96 hrs
5. LLCR, measurement
2.2 Electrical Requirements

2.2.1 Dielectric Withstanding Voltage
The connector plug and receptacle shall be tested according to ANSI/EIA/TIA 364-20, using a test voltage of 400 VRMS with the connector unmated and unmounted, at a barometric pressure of 15psi. Leakage current should not exceed 10.0 mil amps max between two adjacent contacts.

2.2.2 Insulation Resistance
The connector plug and receptacle shall be tested according to ANSI/EIA/TIA 364-21, using Method C with a test voltage of 100VDC and the connector unmated and unmounted. Minimum insulation resistance shall be 100 Meg Ohms between adjacent contacts and between each contact and the connector shell.

2.2.3 Low Level Contact Resistance
The connector plug and receptacle shall be tested according to ANSI/EIA/TIA 364-23. The resistance shall be no more than 35mil Ohms per mated contact pair initially. Throughout all tests there shall be no more than 25 mil Ohms change from the original resistance measured.

2.2.4 Contact Current Rating
The connector plug and receptacle shall be tested according to ANSI/EIA/TIA 364-70 at a minimum current of 1.0A with a temperature rise of no more than 30 degrees C, with all pins driven.

2.2.5 Impedance of LVDS Differential Signal Lines
The connector, plug and cable shall be tested using a time domain reflectometry method normalized to 500ps rise time, with single-ended 1:1 S:G ratio. The impedance of the source and the impedance of the load shall be 100 Ohms. Only the shell shall be grounded. The impedance of each differential pair shall be 100 Ohms +/-10 Ohms.

2.2.6 Bandwidth of LVDS Differential Signal Lines
The connector, plug and cable shall be tested according to EIA/TIA 364-107, using a 1V signal with 500 ps rise time. Bandwidth testing of the LVDS differential signal lines is shown below in figures 2.1 and 2.2 for two baud rates driving a pseudo random bit pattern over a 3 meter length of cable. The eye opening for the 600 Mbps data rate shall be 40% with a 150 ps jitter.
Figure 2-2

Eye Diagram
V51.0/F26-30/3m
1.2Gbps
### Insertion Loss of Camera Link™ 28 AWG Shielded Twisted Cable Pairs

**Figure 2-3**

<table>
<thead>
<tr>
<th>Conductor O.D.</th>
<th>0.48mm</th>
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<tr>
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<td><strong>AWG28</strong></td>
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2.2.7 Crosstalk of LVDS Differential Signal Lines
   The connector, plug and cable shall be tested according to EIA/TIA 364-90, using a 1V signal with 500 ps rise time. Both the near end crosstalk, NEXT, and far end crosstalk, FEXT, shall be measured, with only the shield grounded. The measured crosstalk shall not exceed 4%.

2.2.8 Skew of LVDS Differential Signal Lines
   The connector, plug and cable shall be tested using a 1V signal with 500ps rise time. Intrapair skew will not exceed 50 ps/m between the conductors within a pair. The interpair skew will not exceed 50 ps/m between pairs.

2.2.9 Insertion Loss of Camera Link™ Cable
   The insertion loss of a 100 Ohm 28 gauge shielded twinax pair shall be between 0.35 dB/m at 100 MHz to 1.40 dB/m at 1000 Mhz.

2.3 Mechanical Requirements

2.3.1 Durability
   The connector plug and receptacle shall be tested according to ANSI/EIA/TIA 364-09, two mated pairs for 30 cycles. The resistance shall be no more than 35mil Ohms per mated contact pair initially. Throughout all tests there shall be no more than 25 mil Ohms change from the original resistance measured.

2.3.2 Mating and Unmating Force
   The connector plug and receptacle shall be tested according to ANSI/EIA/TIA 364-13, inserted and extracted at 25 mm per minute. The mating force shall not exceed 3.9kgf nor be less than 1kgf.

2.3.3 Vibration
   The connector plug and receptacle shall be tested according to ANSI/EIA/TIA 364-28, Condition 1. Continuity shall be measured according to ANSI/EIA/TIA 364-46 for all contacts. No discontinuities shall be longer than 1 us.

3. Camera Link Cabling Information
   The Camera Link interface uses a cable assembly manufactured by 3M, with MDR-26 pin connectors on both ends, and has several options available to the customer.

3.1 Cable Assembly
   The Camera Link cable assembly is available in two shell configurations, and various lengths. Table D-1 describes the specifications for the following options:

3.1.1 Thumbscrew Overmolded Backshell
   The inner IDC assembly is wrapped with a copper foil tape, which connects the outer chassis cable shield to the face of the MDR plug. A final overmolded shell is made from PVC material.

3.1.2 Thumbscrew Shell Kit
   An inner metal shroud connects the chassis ground from the cable to the face of the MDR plug. A plastic “shell boot” is slipped over the metal shrouds, providing the finished shell.

3.1.3 Ordering Information
   Cable assemblies and boardmount receptacles are available from 3M. For more information on 3M products, see the 3M Web site at: http://www.3m.com/us/electronics_mfg/interconnects/
3.1.4 Cable Assembly Catalog Part Numbers

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<th>Part Numbers</th>
<th>Description</th>
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<td>14T26-SZLB-XXX-0LC</td>
<td>Thumbscrew Overmolded Backshell</td>
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XXX = Length Field
100 = 1 meter
200 = 2 meters
300 = 3 meters
450 = 4.5 meters
500 = 5 meters
700 = 7 meters
A00 = 10 meter

3.1.5 Board Mount Receptacle Catalog Part Numbers

The following table lists the 3M™ boardmount receptacle part numbers.

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<th>Part Number</th>
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3M Boardmount Receptacle Part Numbers
Table 3-2

Camera Link is a certification mark of Automated Imaging Association.
Channel Link is a trademark of National Semiconductor.

3M is a registered trademark of 3M Company. All other tradenames referenced are the service marks, trademarks, or registered trademarks of their respective companies.

Electronic Solutions Division
6801 River Place Blvd.
Austin, TX 78726-9000
800/328-1368
www.3M.com/esd