Cable for GigE Vision®

Can Traditional Category Cable Do It All?

The GigE Vision standard released in June 2006 by the Automated Imaging Association (AIA) provides a unique vision system that optimizes networking performance while providing a more cost-effective solution than USB 2.0, 1394b and Camera Link.

With full-resolution camera frame rates up to 200 frames per second (fps), GigE Vision not only breaks the bandwidth barrier of FireWire and approaches the performance of Camera Link, it does so at a lower cost than either low-voltage differential signaling (LVDS) or Camera Link. The standard achieves this by calling for field-installable cable and connectors that are available virtually everywhere.

Depending on the application and installation length, GigE Vision will work with Cat5, Cat5e, Cat6 or Cat6a cable. That's the positive side of the GigE Vision standard. However, these cables, which were primarily produced with solid copper wire using plenum or riser-type construction, were not designed to be used in a factory or other environments with an in-motion apparatus. For that reason, the intrinsically stiff, designed-for-static applications category cables will not meet the requirements when GigE Vision is applied in food processing, medical vision and control industry installations.

What Is the Ideal Cable Design for GigE Vision Applications?

Camera manufacturers and potential users of GigE Vision were interviewed to help define the essential GigE Vision cable attributes. GigE vision cable should ideally:

- Meet signal performance and emission requirements of GigE Vision at lengths up to 100 meters
- Have an O.D. of 6 millimeters or less
- Interface with standard RJ45 and specialty industrial connectors
- Have an industrial flex life of at least 1 million cycles
- Be soft with little or no "memory"
- Have dark-colored matte jacketing that complies with RoHS requirements and is suitable for traditional factory environments
- Incorporate specialty materials capable of withstanding the abuse of moving factory equipment and robots
- Cost similar to Cat5, Cat5e, Cat6 and Cat6a cabling

Can One Type of Cable Meet All Needs?

Inevitably, questions will arise about the “ideal cable”—signal, emissions and physical attributes. Engineers, no doubt, will say there isn’t a single cable that can meet all requirements.

An informal assessment of the potential of GigE Vision indicates that traditional category cable will be inadequate for the often demanding mechanical requirements of real-world applications in the factory, medical facility or food processing plant. All applications incorporating GigE Vision will not be static. Therefore, the success of the specification depends on the ability of the cable to support the standard as it evolves.

Traditional solid-wire category cable will likely not support all future applications such as:

- Mechanical parameters similar to ITC/PLTC exposed-run-rated with an oil and weld slag-resistant jacket
- Equipment in-motion operated by robotics or a human—the ideal use for GigE Vision
- A medical-imaging application that requires soft or crush-resistant cables

For GigE Vision to mature, industry standards must account for unique applications.

Certainly, some applications are ideally suited for conventional category cable and traditional RJ45 connectors. As the standard evolves, applications will occur in which higher demands are placed on the cable and connector. To meet these new requirements, connector manufacturers have designed and put into production industrial Gigabit Ethernet RJ45 interface connectors with thumbscrew and other locking mechanisms. The design of this product presumes that the traditional RJ45 connector will not be sufficiently robust for a number of potentially demanding GigE Vision applications. Using the same presumption, a more adaptable cable or variety of cables will be required to fully meet the needs of this emerging market.

Some currently defined areas of nontraditional cable needs are:

- High-flex cable of 1 million cycles plus
- Continuous flex cable with constant motion requiring at least 10 million cycles
- Cut-resistant jacketing
- Oil- and chemical-resistant jacketing
- Underwater cabling
- High- and/or low-temperature cable
- Crush-resistant cable construction
- Outdoor weather-resistant cable
- Small O.D. cable

Is 100 Meters of “High-flex” Cable Possible?

Design of high-flex cable requires a precise mix of costly high-tensile strength alloys, smaller components and cable O.D., durability, toughness and high flexibility. Any cable design engineer will tell you it is as much art as it is science. The basic properties of flex cable design might form a highly desirable product from a mechanical standpoint but, conversely, these same characteristics could potentially limit the signal performance of the final product.

In flex conductor design, the proper stranding and alloy selection, combined with the proper torsional twist, will produce an effective result but might limit the performance of the finished product when compared with the cable produced with solid wire. Conductor insulation type and thickness play a significant role in the development of high-flex cable but also could create problems with signal performance. Even the shielding and cable jacketing that are ideal for flex cable may not offer the optimal performance parameters found in less “flexible” cable.

What’s the Solution?

The GigE Vision standard must recognize various cable types to meet all potential installation requirements.

- Traditional category cable is perhaps best for long runs, static applications and applications in which field installation and cost are of greater importance than other, sometimes more expensive, mechanical attributes.
- High-flex and continuous-flex cable are appropriate for shorter runs that involve motion. Due to the type of materials and construction methods required, these cables may not function in all applications at 100 meters. (A stranded conductor Ethernet cable is classified by IEEE as a ‘patch cable’ with a defined maximum run length of 10 meters; though some stranded cable designs will function acceptably at longer lengths.)
- The majority of applications that require “flex” cable are estimated to be less than 10 meters.
- Custom cable for specific markets can be made in small runs.
- Soft, flexible and small O.D. cable construction could adversely affect length, but most requirements for this type are expected to be shorter runs.

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