



Connecting the 21st Century Factory

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Finding the right cables and connectors to enable actuators, computer numeric controllers, cameras, programmable logic devices, servo motors and other factory automation equipment to communicate with each other, is a significant challenge where there are many competing industry standards and proprietary interfaces. 3M can help navigate a course through the maze.



Figure 1: 3M™ Shrink Delta Ribbon System meets AIA's Mini Camera Link® standard for machine vision applications enabling space-saving, high-speed digital communications between cameras and frame grabber boards.

It is not easy being an engineer in charge of a modern factory. The engineer worries about how to design and maintain a manufacturing system that produces the highest quality output at the lowest unit cost. Technology is supposed to make life easier, but getting the most out of the component parts from different suppliers when many of these standards-based devices are not inter-operable or even supported in their region of the world, often means connecting the factory is actually a headache. Adding confusion to an already complex puzzle, proprietary interfaces supported by individual manufacturers still abound, a situation which can actually drive up support costs.

3M is very active in the industrial automation space providing solutions to connect both standards-based and proprietary networked devices (fig. 1). Close working relationships with key OEMs worldwide gives 3M access to real world problems in search of practical solutions. Since 1961, 3M has been a supplier of connectors and cables for internal board-to-board and wire-to-board applications. From .100"/2.54mm to .50mm grid spacing, 3M offers equipment designers one of the widest choices of interconnect solutions in the business, drawing on expertise in designing, molding, plating, stamping and assembling of precision metal and plastic parts, as well as technology for terminating discrete wire and ribbon cable.

3M is often approached by our customers to design a better solution. Let's look at a few of these.

Motion Control

In motion control, the 3M™ Mini Delta Ribbon (MDR) and Shielded Compact Ribbon (SCR) platforms connect servo-motors and solenoid valves. 3M has built these platforms upon deep experience and know-how of designing and building products using two proven technologies: the miniaturized ribbon-style contact, which is a robust alternative to fragile pin/socket designs; and insulation displacement contact (IDC) technology, which offers a fast and robust method to terminate wire and cable. These connectors are designed to work with shielded cables to deliver the electrical performance of demanding factory cabling applications and to protect transmitted data from electromagnetic interference. In keeping with 3M's reputation for innovation, the SCR improves on the IEEE 1394 or FireWire connector, adding additional contacts for more signal pairs; and latches to provide a more

secure connection during use and easier disconnection for operators carrying out repairs or maintenance.

Machine Vision

In machine vision (MV), 3M has been a leading proponent of a common physical interface for CCD and CMOS digital cameras used in in-process quality control. For MV applications, the Automated Imaging Association (AIA) created the Camera Link® standard, which is based on the Low Voltage Differential Signaling (LVDS) protocol defined in ANSI/TIA/EIA-644, approved in 1996 and popularized as National Semiconductor's Channel Link™ platform. With LVDS just five pairs of wires can transmit up to 28 bits of data. The low number of wires enabled the AIA to reduce the size of the connector. In collaborating on the development of the Camera Link® standard, 3M Company and National Semiconductor worked very closely to test and define the performance of high speed connectors and cables for LVDS transmission. The AIA chose the 3M's MDR System to be the connector of choice for its original Camera Link® standard. MDR cable assemblies from 3M allow engineers to connect Camera Link® compliant digital cameras and frame grabber boards together from different manufacturers and transmit high quality images in real time.

Building on this influential industry position, 3M has been a key contributor to the Mini Camera Link® (MCL) standard, for which SDR is called out in Appendix D of the latest document (fig. 1); as well as for Power over Camera Link® (PoCL-Lite). At Automate 2011, 3M announced its support for the new Camera Link HS™ (CLHS) standard, and demonstrated how the new 3M Twin Axial Ribbon Cable can be utilized in support of the new standard. 3M Twin Axial Cable is the first known flat, foldable and longitudinally shielded high performance twin axial ribbon cable.

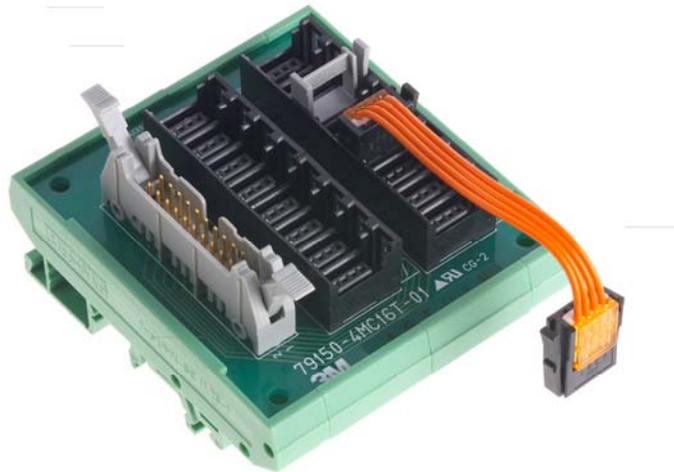


Figure 2: 3M's Mini-Clamp Connector offers a convenient way to manage discrete wires, including integral latches to securely maintain the connection in service in high vibration environments.

Sensing

In sensing, the 3M™ Mini-Clamp System connects computer numeric controls (CNC) and programmable logic controllers (PLC), governing and regulating pressure sensors, position pick-up and switches (fig. 2). The connector – based on 2.00mm x 2.00mm grid spacing – comes in different sizes to accommodate common wire gauges and is color coded to assist the engineer pick the right part. At the heart of the system, Mini-Clamp plugs and sockets use proven IDC technology which does not require special tooling or pre-treatment of cables. To terminate, insert the wire into the cover, take a standard pair of pliers, and just squeeze! That simple assembly process represents significant labor time and cost savings over traditional alternatives. The process also does not create material debris or waste which makes it well suited for clean room environments.

The Mini-Clamp connector family from 3M has been designed to offer an adaptable, flexible and reliable solution. Mini-Clamp connectors are offered in different versions to accept wire diameters ranging from 0.60mm to 2.00mm. Each has a built-in color-coded cover ensuring the assembly operator picks the right connector for the cable. The cover is semi-transparent allowing the operator to inspect wire positions to ensure the wires are correctly seated and properly terminated. Additionally, a wire

retention feature is built in to the cover to lock the wire in place for long term reliability in use. Latches and polarization ensure the connectors are properly mated.

On the PC board side too, Mini-Clamp connector's compact design saves valuable board space. The copper alloy gold-plated pin-contacts are spaced on a true 2.00mm grid and rated up to a maximum of 3 Amps.

Fieldbus and Networking

For real-time distributed control, Fieldbus (standardized as IEC 61158) is the primary network protocol of choice for industrial automation. Yet, it has spawned a multitude of standards for use in different parts of the network hierarchy. They differ in terms of their physical distance, speed of operation, real-time capabilities and other application specific requirements.

CC-Link Advanced Open Field Network is a new network communications protocol adopted by ISO centered on automobile, semiconductor and liquid crystal display manufacturing. More than 1,300 partner companies comprise CC-Link Partner Association's (CLPA), now in its tenth year. In 2010, 3M joined the CLPA on its board of directors. In that role, 3M will provide guidance on standards and specifications for CC-Link-compatible connectors and cables. CLPA is one of the world's leading open control networking organizations promoting CC-link, the predominant factory-automation networking technology in Asia that is also gaining acceptance in North America and Europe in the automobile industry. CC-Link reduces wiring and automation system costs while enabling multiple field devices to communicate to each other and to automation controllers over a single cable.

For this rapidly growing application, 3M has again adapted its renowned IDC technology to create the 3M Link Connector (fig. 3). Fully compliant with the CC-Link/LT specification, the 3M Link Connector can be used for bussing or terminating and is offered with a latching mechanism for both in-line and PC board applications. Based on .100"/2.54mm grid spacing, the 3M connector can be terminated to 18 gauge discrete and flat cable as required by the CC-Link/LT specification. This new product is already helping engineers to expedite build-out of factory communications networks, simplifying installation and reducing the total applied cost.

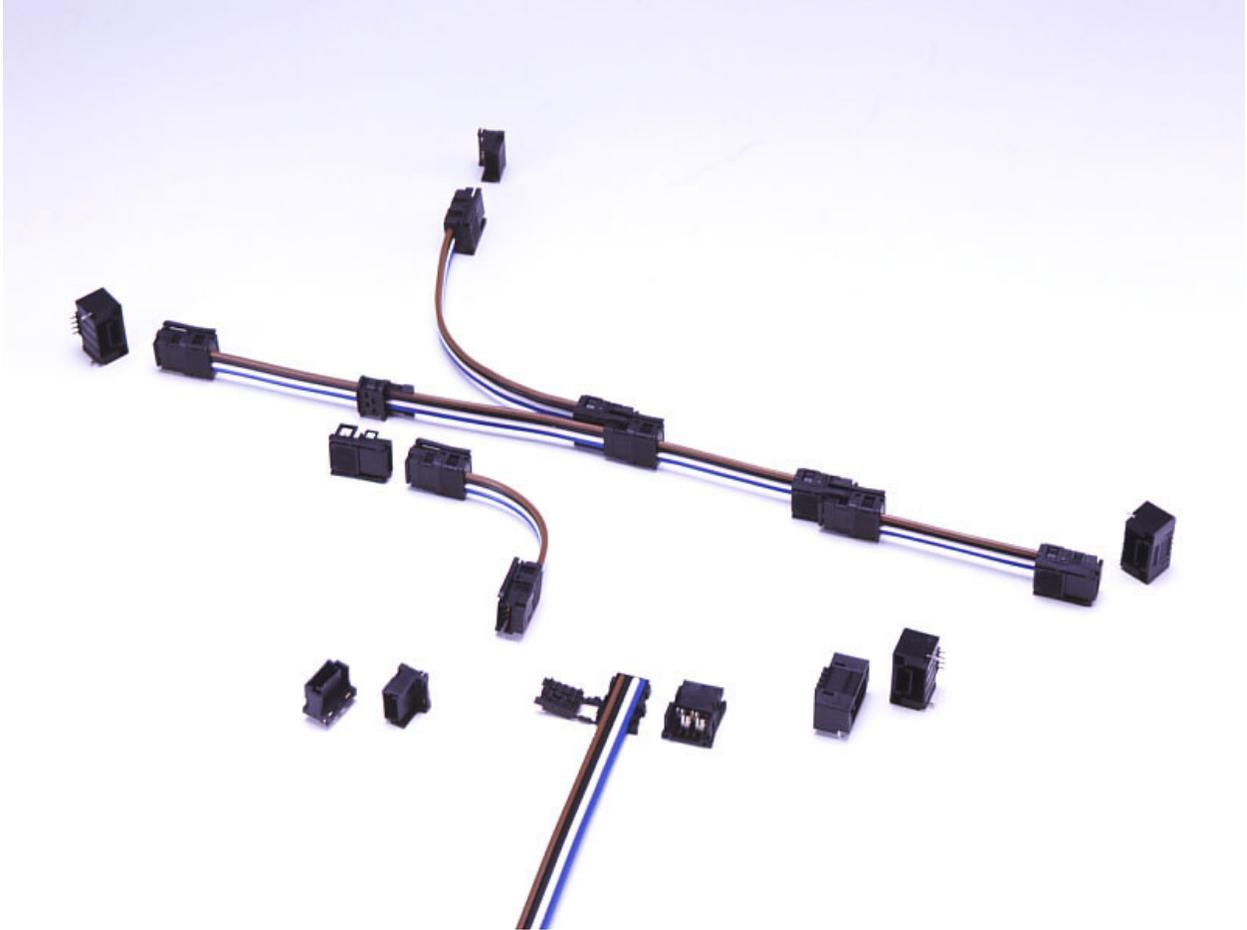


Figure 3: 3M's Link Connector provides a modular solution for networking components in a factory automation system by simply attaching new branches 'daisy-chain'-style to the main trunk cable.

New Power Clamp Connectors and Cables from 3M are also suitable for CLPA's open technology field-level networking applications and protocols. Applications include integration of a wide range of automation devices from numerous suppliers on a single network. The connectors allow for flexibility in constructing production lines using CLPA partner products. The 3M Power Clamp solution is designed to provide outstanding, reliable electrical connections between sensors, power supplies, drives and control units, helping to keep them running at peak performance. 3M Power Clamp products use proven IDC technology from 3M to terminate to both flat ribbon and discrete wire. The wire and cables do not require special preparation like stripping, tinning, and so forth. Simply cut the wires or cable to length

and place the wires into the cover and squeeze the cover into the body with a standard pair of pliers – no special tooling required in order to achieve a quality and reliable termination. The simple installation process does not create material debris or waste, and potentially saves labor relative to traditional interconnect wire termination alternatives. Power Clamp Connectors from 3M are designed with color-coded covers to allow for proper wire usage, wire alignment and retention, enabling proper wire termination. The connectors have an integrated wire guide built into the cover, which provides reliable positioning of the individual wires. Polarizing tabs help ensure proper mating and latching devices help provide a reliable connection, even under difficult conditions, such as mechanical stress and vibration commonly found in industrial environments.

Factory engineers have many, often confusing or incompatible, choices when designing and installing factory automation systems. 3M is actively working in this space to make those choices easier by supporting major industry initiatives in network communications, machine vision, motion control and sensing technologies. By drawing on deep know-how of key enabling technologies, such as IDC, 3M is developing practical, elegant interconnect solutions that bring *real value* to engineers worldwide.

For more information, contact your 3M authorized distributor or go to <http://www.3Mconnectors.com>

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