

MINIATURE INTERCONNECTS FOR VISION & SURVEILLANCE TECHNOLOGIES

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A new breed of cable and connector systems are helping to change tomorrow's camera and surveillance technologies.

Today's charge coupled device, (CCD), technologies and CMOS chips are rapidly improving their higher resolution capabilities. Parallel chip receivers are also extending image capture breadth and resolution. As a result, processing speeds are doubling with larger image frames and the use of increased frame rates from 30 and 60 frames per second to over 100 frames per second. This is driving digital signal data rates from the, (older), 5 Gigabits/second to above 10 gigabits/second. To handle this rush for higher resolution simultaneously with higher speeds, new cable and connector designs are required to deliver quality signals to the image processor and storage systems. We are also including the use of infrared spectrum scanning and mixed light frequency monitoring. Soon we will see more use of hyperspectral imaging being applied in applications from food analysis to security scanning at airports. These multispectral imaging systems actually capture a cube-like structures of many wavelength frequency bands of image data that must be processed after collection. These systems will push the limits of high speed Ethernet processing systems as well as the interconnections serving them.

Our industry has developed families of ruggedized Micro and Nano standard connectors for similar applications in the military and aerospace sector. The standard connector series have been designed to be small, lightweight and meet full specifications such as Military standard 83513 for Micro-size and Military standard 32139 for Nano-size connectors. Manufacturers must include extremely small pin to socket elements that carry the specified current flows as well as retain constant signal integrity during operation.

To do this the pin to socket systems are often made of highly tempered BeCu springs or flex elements that are then carefully nickel plated and subsequently coated with gold. The spring strength must remain through temperature cycles and daily rugged use while the plating on the key elements must retain very low contact resistance through the life of the instrument.

In addition, micro cameras are being designed for use from endoscopes to eyeglasses and onto miniature drones that fly in swarms. Portable surveillance equipment employ imaging methods from the visual and infrared to LIDAR scanners. Surveillance planes and satellites are used to constantly survey and register images of critical areas from afar. Cameras must now be smaller and light weight as well as being rugged enough to withstand shock and vibrations seen during use and or during some of crash landings typically experienced in the drone industry. Miniature surveillance cameras must also increase their resolution and run faster frame rates. Many systems now include wide-field of view to capture images below. Data processing and storage and or remote image transfer is beginning to be included within the camera box. Standard surveillance camera systems are often used but more frequently demand and format needs require customized equipment. Additionally, surveillance for city and street cameras are being installed throughout our big cities. This paper will explore a sampling of various imaging systems and the unique requirements for connector and cables required.



Some of the smallest cameras are custom designed for special use in the medical field. These include optical probes and image sensors such as tracheoesophageal scopes, catheters, and endoscopes. The connectors utilize Nano-sized beryllium/copper spring loaded pins to assure constant contact during the diagnostic process. Wiring is specially designed for strength and flexibility. The wires are insulated in Teflon® jacketing and as small as size (32-36 AWG). Medical scopes are used frequently and must also survive thousands of connecting and disconnecting in their product life cycle. Connector assembly is done in clean rooms including high-level quality inspections to assure reliability. Micro-med connectors use bacteria and bio-growth free materials that are also serializable and or autoclaved between uses.

Nano-sized connectors being used inside data packs for covert surveillance equipment still need connector and cable to route data throughout the module. Nano eye sized cameras offer stealthy performance for mounted viewing as well when employed in portable systems. Micro sized data devices now require ultra-miniature connectors such as the PZN format pictured in the image attached. Surface mount receptacles fit with the size and height of other active components on the p.c. boards. The Nano interconnecting pin to socket method retains signal integrity during active pursuit situations in rugged situations and remain easily plugged and disconnected in discrete environments. Board designers specify the number of pin elements needed to keep size and weight to a minimum.

Interconnections for airborne cameras face their own special challenges. Standard demands include the need for rapid and easy connector mating and de-mating for systems that are recording data into onboard storage modules. As high resolution and increased frame rates, the amount of digital data streaming off the camera to the storage unit increases exponentially. Cables may have to exceed 5 gigabits per second to

When even more severe covert environments are expected the design engineer selects a customized version of the well-established Nano-D connector with its heritage in the military specification number 32135. The nano-d connector offers extreme strength of a metal connector while retains minimum size and weight. These connectors are used throughout military personal packs, on UAVs and aircraft weapon systems with proven reliability and ease of use. Covert and military systems are often used in the dark. In these applications, connectors must not reflect light and be easily operated. Special black plating and thumb indents are designed into the connectors so the user can mate and disconnect the system in total darkness without being detected. Special covert designs often vary in wire count and must always be as small as possible. Fast turn solid modeling systems are used to quickly adjust existing high-reliability Nano-d connectors with exact pin counts needed.



Omnetics' Nano-D Connectors

keep up. At a minimum, one might consider using Fire Wire cable with drain to tame both speed and potential noise during signal transmission. Simultaneously the airborne unit is operating under high vibration that can add electrical noise to the inline cable if not designed carefully. Final landing on many imaging based drones is drastic and connectors must remain intact and survive what we call “intentional crash landing” that can

include high shock impact. The complete system must be low weight and size to fit into drone and helicopter type systems. One advantage of low weight components is that when designed correctly, they withstand much higher shock because continued force is reduced with less weight. Also many on-board electronics use battery supplied power and modern low voltage CCD type camera systems, micro and Nano connectors are used for data transfer in interconnections. Some limited range systems use Bluetooth controls that keeps weight low but may require specialty shielding on the cable links within the system.

Standard connectors vs custom designed ones is often a question of time and cost. Today, however, tailored variations of high reliability customized standards is done quickly and at much lower cost. Most standard connector models are in residence in solid modeling software at the connector supplier's factory. A system designer can call

and work remotely with the connector supplier to adapt and even re-size connectors for new camera and surveillance systems with little effort. The solid works systems can then send data to 3-d modeling or CNC machines to build up the 1st article product. It can then be placed into the new unit to assure form and fit within a very short time. The key is using the same pin to socket mating elements within currently high reliability connectors in the industry.

Camera systems are now benefiting from application specific designed interconnections for their cameras as size and weight goes down and as camera data link speeds go up. Image designers can work directly with connector designers to quickly design and build their new instruments with assurance they will work and survive the many rigors of surveillance systems today.