SMALL INTERCONNECTS OFFER MISSION CRITICAL INTEGRITY

On any given day approximately 2,300 man-made satellites are orbiting the earth’s surface. These satellites are responsible for relaying both analog and digital signals carrying a plethora of voice, video and data-streaming to and from various locations worldwide. Each second, these satellites directly impact everyday luxuries we enjoy, such as cellphones and email, to more mission critical scientific and military communications across the globe.

Space is said to be one of the harshest and most severe environments imaginable, but, just getting there is half the problem. During the launch phase itself, each individual component, whether it is on the aircraft itself or the physical payload is subjected to an intense array of shock and vibrational elements that can damage the electronics including the interconnect system. With this in mind, designers must find manufacturers capable of designing and manufacturing these components to not just meet these requirements, but to exceed them as they relate to shock, vibration and the extreme temperature cycles experienced by satellites both during launch and deployment. Once in position, these satellites range in size from microsatellites, weighing less than 1kg, to larger satellites weighing over 6,500 kg. and although the gap in size is quite large, many design characteristics in relation to the components used are quite similar.

Going Smaller
If the space industry has taught us anything, it is that whenever something is proven on a larger payload, there’s an immediate interest in reducing its size without affecting its overall capabilities and/or purpose. In regards to this industry, affordability has always been the limiting factor. However, as time goes by, organizations such as Universities focused specifically on CubeSat designs are slowly bridging this gap in relation to affordability. These new-aged miniaturized satellite are generally designed for space research in a form factor made up of multiples of 10×10×11.35 cm cubic units.

On average, CubeSats have a mass of no more than 1.33 kilograms per unit, and often tend to utilize small, commercial off-the-shelf (COTS) components, such as standard Micro-D and Nano-D interconnect options. Considering the payload alone on many of these new miniature satellite platforms, the size and weight of all the components involved is vital. Previously, satellite templates allowed designers the ability to design in comfort connectors along the lines of D-Subminiature connectors and 38999’s, however, as satellite technology continues to expand, larger connector options similar to that of D-sub connectors are no longer a viable option.

Meanwhile, Omnetics Connector Corporation has taken this interconnect challenge to the next step. “It’s truly ingenuity at its best”, says Derek Hunt (Regional Sales Director). “We took an existing concept and simply made it better in every way for the user without jeopardizing the performance or overall rugged nature of such a product, oh yeah…. did I mention we ditched the jackscrews without affecting the reliability?”
Continued.....

This new interconnect option offers designers a significant weight savings from previous D-Subminiature footprints. At only 1.27 mm (.050") contact spacing, these connectors are half the size of D-subminiature connectors and are an ideal solution for designers faced with SwaP (Size, Weight and Power). Omnetics Micro-D’s in particular have saved designers on average of $10 per gram on Low Earth Orbit (LEO) Satellite applications and as much as $20 per gram on a Geostationary (GEO) Satellite. This is a cost savings of as much as $30,000 per satellite. Not to be forgotten, Omnetics also offers a Space Grade Nano-D Subminiature solution at .64mm (.025").

Space Grade Connectors
Space grade connectors come in a variety of sizes, shapes and complexities and are a vital part of any mission critical piece of electronics. All of Omnetics connectors encompass a unique flex-pin gold-plated contact, which is polarized and shrouded by a low outgassing insulator material. The pin-to-socket strength makes these connectors capable of more than 2,000 mating cycles. Omnetics has been qualified as mandated by the quality standards set forth by: ESA (European Space Agency), ISRO (Indian Space Research Organization), JAXA (Japan Aerospace Exploration Agency) as well as NASA (National Aeronautics and Space Administration). These Space-grade offerings are readily available in a number of tail terminations and pin counts. Pre-wired connectors are available with 80 micro inches of silver-plated PTFE insulated wire options, whereas, board-mount options include both surface-mount and through-hole variations. If designers are looking to move away from pre-wired assemblies by way of a flex circuit, flex tails are also available for optimal placement. Shell finishes include nickel-plated aluminum, stainless steel, and titanium. Miniature cable to board interconnect systems can be designed concurrently using interactive Solid Models online with the small sat design team. Satellite applications frequently require cable to connector shielding for EMI and potentially Cyber Security controlled lines.

Omnetics shielded backshells and electrically shielded and grounded protection systems add to long-term performance of the system. Small satellite interconnect cabling often must be wound through tightly selected routes in some of the smallest spaces out there. Omnetics interconnects can include highly flexible cable designs with specialty insulation that save space and meet current and voltage levels above the space and vacuum deratings expected by the design team.

A number of Omnetics Micro and Nano-miniature connector wiring systems are currently available that offer the combination of high speed digital data and power. Wire hook-up protocol formats for the signal speed integrity are also available, as are special test modeling.

Dating back to the Hubble Telescope, Omnetics design team has been working daily with space agencies, contractors and commercial space agencies to create the next big thing as it relates to mission critical solutions for both manned and unmanned deep space explorations. Omnetics Connector Corporation offers designers the high-performance solutions necessary for space applications, with an emphasis on low outgassing materials, wide temperature ranges, smaller size and lighter weight which yield longer flight times. Omnetics space grade interconnect solutions offer users the reassurance of NASA’s mission critical screening per EEE-INST-002, with an underlined emphasis on overall quality and reliability as it relates to both their COTS’s offerings and custom designed solutions.

Omnetics Expedited 3D Models with the designers in Mind.....

There are several key benefits of using 3D design and 3D modeling within today's interconnect world. Advantages include simplicity, automation as well as interactive analysis for the designers themselves. Unfortunately for connector makers, often lost in translation is the physical connector itself. Connectors, although vital to the components overall success, are often the last aspect of the design to be rolled out. Connector companies like Omnetics Connector Corporation often find themselves on the hot seats as it relates to new custom, built to order solutions.

How can you design, create and build a custom connector harness in less than 8 weeks? Easy, and it all starts up front with the initial design concept of a 3D model.

Omnetics 3D models are created as STEP Files (.stp) made to be imported into a variety of different CAD programs (ProE, Solidworks, inventor, etc.). By making these models available same day and/or early within design stage, Omnetics quick turn customer service system is able to save engineers an abundance of time and effort on the front end of designs.

Custom 3D models can be created through Omnetics inside sales team, whereas, standard off the shelf parts are always available at: http://www.omnetics.com/Products/cots.asp. Here the STEP files are freely downloadable, therefore designers don’t have to wait for samples and/or sales people to see if a particular connector will fit.

On top of the COTS and expedited custom 3D model program, Omnetics Connector Corporation has in conjunction developed an advanced online modeling tool that enables design engineers to dynamically create virtual 3D connector models, even for designs that have yet to be manufactured. This new online solution allows users to utilize a single interface to search for commercial, industrial, medical, military, aerospace and hi-reliability interconnect products. With the 3D modeling tool, design engineers can select from various output model formats including STEP, ProE, Shrink-wrap, STL and IGES, provided the requested product represents a standard configured item.
Equipment benefiting from miniature shielded wiring harnesses begins with high performance portable systems that are often used in military field operations. Additionally applications range from healthcare electronics to robotics. In the medical industry, handheld surgery tools, dental camera modules, cosmetic lasers and even spinal pain management tools use uniquely designed wiring to support both patient comfort and technical performance. The shielded systems reduce operation-room electronic noise. Application-specific wire-harnesses are also used in military sensor system detectors, processors for mine-detection, portable camera and surveillance modules, and unmanned aerial vehicles. Today’s UAVs, faced with extreme conditions, are demanding minimum-weight miniature electronics to achieve increased payload and flight times with additional cameras, sensors and broadcast equipment.

Cable design, solid model images and information is on Omnetics website at http://www.omnetics.com

By: Bob Stanton
(Omnetics Connector Corporation, Director of Technology)

Design teams are constantly demanding higher density to increase the functions of each part of their instruments. Space available for the internal wiring systems that route signals from one section of the instrument to another is getting smaller and more critical. Designing a cable and connector system specifically for each instrument helps reduce size and weight while improving circuit speed, signal routing and helps matching signal impedance to other circuits in adjoining modules.

Carefully modeled wiring harnesses are designed to fit exact dimensions and routes inside miniature electronic equipment. This allows for compact modules that are small, lightweight and reliable. Micro and Nano-sized connectors with ruggedized spring pin contacts, as small as 13 thousandths of an inch in diameter, provide constant connection thru high vibration and physical shock. These combined cable-connector systems are designed-to-fit the instrument, retain high flexibility, and offer constant performance during use. Wire harness routing from one module to another is kept at the shortest possible length to improve signal quality. Shielded cable is frequently employed to assure signals are not affected by resulting electro-motive interference, and protect from cyber-attack. Teflon® insulated high-strand miniature copper wiring is used to insure flexibility, long life and withstand a wide temperature range often needed in ruggedized portable electronics.

Tool-Free Latching Nano-D’s

Wouldn’t it be great, if you could replace the jackscrews within your current nano related applications without losing any reliability in terms of shock and vibration?

Well, look no further because Omnetics, the leading manufacturer of miniature high-rel connectors, has announced that its Bi-Lobe® connectors are now available with a quick latch system. Moreover, these devices pass the shock and vibration requirements of MIL-DTL-32139 — making them the first latching nano products suitable for use in military and aerospace applications. The latches provide extra security, but are very simple to use and require no tools.
High-Speed Digital Connector Design
(Part XII – Design Requirements for HDMI)

We are in the middle of a series on designing connectors to meet specific standards. In this installment, we will focus on designing to HDMI (High-Definition Multimedia Interface), a common high-speed video standard.

**Specifications, Versions, and Connector Types**

There are two different types of HDMI specifications: The overall HDMI specification and the cable specification. The overall HDMI specification, typically HDMI 1.4 or HDMI 2.0, defines the signal requirements and capabilities.

The cable specification defines two different types of cables: Standard Speed (Category 1) and High Speed (Category 2). Standard Speed cables are qualified for 720p and 1080i video. High Speed cables, which include the vast majority of cables available today, are qualified for 1080p, 4K, and 3D video. It is important to note that the cable requirements are defined by the cable specification (Standard Speed or High Speed), not the overall HDMI specification (1.4 or 2.0).

In addition to the two types of specifications, there are different connector types, which define the mechanical dimensions of the connectors. These connector types impact some of the specifications, so it is important to understand which type is being used. The most common connector type is Type A, which is used by most computers and TVs. The other common connector type, Type C or Mini HDMI, is typically used in small portable electronics.

**Specification Comparison**

Table 2 shows the primary requirements for the two types of cables defined in the cable specification. As shown, the main difference between the two specifications is the maximum allowable loss, which decreases from -8dB to -5dB at 825 MHz, and from -21 dB to -12 dB at 2.475 GHz. The other point of interest is the increased tolerance on the Type C connector when compared to the Type A connector. This provides added margin when designing smaller connectors.

**Applying the Specifications to Cable and Connector Designs**

Simulation and measurement are used to optimize the connectors based on the impedance and loss requirements. The 100Ω impedance specification requires an increase in the pin spacing. This is achieved either through double-spacing the critical pins, or by using a custom insulator designed specifically for HDMI. Designing for impedance requires working to find a balance between manufacturability and electrical performance. There are no explicit length requirements, but cable lengths should generally be limited to about 15 ft (26 AWG), 10 ft (30 AWG), or 6 ft (32 AWG).

**HDMI Solutions**

Omnetics offers multiple solutions for HDMI. Some solutions use standard parts while modifying the pinout for optimal impedance (Figure 1a). Other solutions are custom designs that provide improved electrical performance while maintaining the miniature and rugged mechanical design that Omnetics is known for (Figure 1b).
Latchng Nano-D’s Continued.....

The latching Bi-Lobe connectors utilize Omnetics’ rugged and reliable Flex-Pin contact system spaced on 0.025in (0.635mm) centerlines, and capable of carrying 1A per contact.

Available in pin counts from 9-65, latching Bi-Lobes® can be configured with discrete wires, over-molded cable, panel mount housings, and PCB mount versions.

One of Omnetics recent aerospace customers noted, “When you can ditch the screwdriver that you can barely hold in the first place, and not lose any sleep over shock and vibe, you know you’ve found a good product.”

<table>
<thead>
<tr>
<th>Electrical Mechanical Specifications</th>
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<tbody>
<tr>
<td>Durability: 200 Melting Cycles Min</td>
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<tr>
<td>Temperature: -55°C to 125°C (200°C with HTE)</td>
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<tr>
<td>Current Rating: 1 amp per contact</td>
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<tr>
<td>Voltage Rating (DWR): 250 VAC RMS Sea Level</td>
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<tr>
<td>Insulation Resistance: 5,000 Megohms min</td>
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<tr>
<td>Shock: 100 G’s discontinuity &lt; 10 nanoseconds</td>
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<tr>
<td>Vibration: 20 G’s discontinuity &lt; 10 nanoseconds</td>
</tr>
<tr>
<td>Thermal Vacuum Outgassing: 1.0% max TML, 0.1% max VCM</td>
</tr>
<tr>
<td>Contact Resistance: 71 mv Drop @ 1 amp</td>
</tr>
<tr>
<td>Mating/Unmating Force: 7oz. (16g) max per contact</td>
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</table>

For more info go to: http://www.omnetics.com/products/bilobe-latches/

“When you can ditch the screwdriver that you can barely hold in the first place, and not lose any sleep over shock and vibe, you know you’ve found a good product.”

ON THE ROAD WITH OMNETICS

May 8 - 11: Xponential 2017 - Dallas, TX.
May 15 - 18: SOFIC - Tampa, FL
August 5 - 10: Small Satellite Conference - Ogden, UT

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About Omnetics

Omnetics was founded in 1984 to deliver rugged, reliable interconnect solutions for the most demanding industries. The company has a fully integrated design and manufacturing plant in Minneapolis, Minnesota, USA where it produces Micro and Nano miniature interconnect products featuring: COTS, Standards and Custom connectors for industries such as Medical, Military, Aerospace, Defense and other technology oriented OEMs.

DID YOU KNOW?

There are 3 main groups of satellites.

- Fixed satellite services handle billions of voice, data, and video transmissions.
- Mobile satellite systems used for navigation (GPS) and to connect remote ships, aircraft, etc.
- Scientific research satellites for meteorological data, land survey images, and other scientific research functions.