New PICMG 2.30 Draft Standard for cPCI Can Extend Legacy System Life

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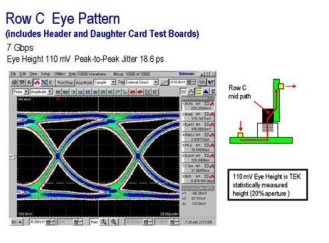
Since its launch, CompactPCI standard has proved to be very popular among modular system designers, installers and users alike. CompactPCI is a standard designed to ensure the interoperability of modular embedded systems, single board computers and backplanes. It is driven by the PCI Industrial Computer Manufacturers Group (PICMG), a consortium of more than 250 companies that collaboratively develops open specifications that adapt PCI technology for use in high-performance communications networking and industrial computing equipment.

To take advantage of advances in high-speed serial data transmission technologies, PICMG is releasing a new option for its popular CompactPCI standard. The new PICMG 2.30 Compact PCI PlusIO standard is based on PICMG 2.30 core specification and defines the migration path from parallel PCI to the serial PCI Express. The draft standard was approved in November 2008 and final approval is expected this summer.

The new draft standard defines the pin assignment and the function of the user pins on the J2 connector for 32-bit system slots. The J2 pinout is consists of 22 rows of six pins set in a 2 mm x 2 mm hard metric grid, where the outer rows are specified as grounds. The current pinout does not provide for high speed signals such as PCI Express, SAS/SATA, USB and Gigabit Ethernet whereas the draft 2.30 standard does. However, the new pin assignment defines by the PICMG 2.30

Putting the UHM to the Test



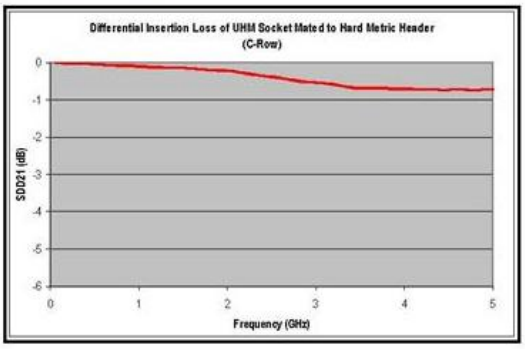
To characterize the signal integrity of a UHM socket connector mated to a standard 2 mm Hard Metric header, 3M designed two test boards – a header board and a socket board to simulate a backplane mated pair. Test signals were injected into and out of this mated pair via these test boards so some of the measurements we will review include the losses from the test board traces where total PCB traces of 127mm are included in the measurement.

An eye pattern is one of the key tests used to characterize

standard makes little difference to system performance with out upgrading the connector as well .Standard unshielded 2 mm Hard Metric (HM) connectors used in current CompactPCI embedded computers can only enable transmission to 1.5 Gbps and cannot support the high density pin-out of high speed differential signals that many new applications demand.

Thus, the new draft PICMG 2.30 standard specifies the Ultra Hard Metric (UHM) Socket Connector from 3M. The UHM socket connector provides the improved signal integrity performance required to transmit multiple high-speed protocols while still designed to mate to a standard 2 mm HM backplane header. The UHM socket connector's patented and patent-pending "virtual coaxial box" shielding technology dramatically reduces the severe crosstalk commonly experienced by 2 mm hard-metric connectors above 1 Gbps speeds and it enables speeds greater than 7 Gbps.

Differential Insertion Loss for Row C
3M™ UHM Right Angle Socket mated to cPCI Vertical Header
(Simulated from Model)



PICMG 2.30 Protects Investment

Concurrently with 2.30, PICMG crafted a new standard for the next generation of Compact PCI Plus boards. The PICMG CPLUS.0 draft standard is a separate specification for new systems. It is based

the differential data rate performance of the UHM socket connector mated to a header. The measurement from a digital sampling scope was used to demonstrate the quality of a 7 Gbps (gigabit per second) eye pattern. Including the losses from board traces – i.e. total length of 127mm of traces – the scope still measured a significant eye opening of approx 110mV for 7Gbps with relatively low jitter. [FIGURE 1]

Characteristic impedance is another signal integrity property that is typically measured to characterize the performance of a connector system. The differential characteristic impedance of the UHM socket connector was designed to match 100 ohm environments, which are typical of high speed serial protocols. When mated to an HM header, the test shows the impedance profile of the UHM socket

on Compact PCI and remains compatible with IEC 1101, but it only supports modern point-to-point connections. PICMG CPLUS.0 defines a new system slot connected to up to eight peripheral slots via a star topology. CPlus.0 specifies the AirMax connector from FCI, which is expected to support data transfer rates of up to 12 Gbps and beyond.

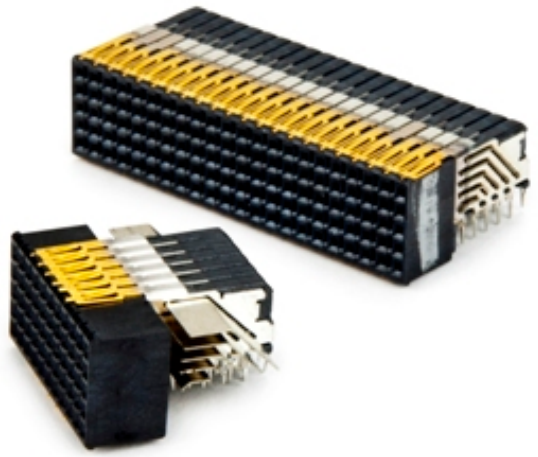
Upgrading to a new CompactPCI Plus system offers a number of advantages in terms of increased performance, but not all users need that much capability. Nor do some want the expense of a forklift overhaul. Indeed, the PICMG 2.0 platform continues to enjoy a healthy market and PICMG has made a commitment to create standards that enable incremental, economical upgrading of legacy CompactPCI systems. That’s why the 2.30 standard was drafted. The PICMG 2.30 standard is currently the only way to achieve high-speed, high-density signals in a PICMG 2.0-based system without sacrificing signal integrity and density.

Because the 2.30 standard is based on the PICMG 2.0 CompactPCI core specification, it enables designers to make modular upgrades to incumbent systems and protect their investment in legacy hardware. To preserve interoperability of modular embedded systems, the standard allows backward compatibility to support investments in legacy PCI bus cards and backplanes fitted with 2 mm HM connectors. The Ultra Hard Metric (UHM) Socket Connector from 3M is completely mechanically compatible to the HM connector for CompactPCI J2 and is designed to drop into the existing footprint of an HM socket.

The PICMG 2.30 standard allows designers to “future proof” CompactPCI systems by creating a way to use legacy cards and “super” cards on the same connector to be approximately 100 ohm including the via of the socket at 33 picosecond rise time.

In addition to eye pattern and impedance measurements, 3M has conducted extensive S Parameter testing and modeling. The plot shown here is the modeled differential insertion loss for the UHM socket connector mated to a standard 2 mm CompactPCI® 5+2 HM Header. The curve indicates very low loss that is less than 1 dB for frequencies of greater than 4GHz.

backplane. The UHM socket connector bridges the older cards and the newer ones as part of a hybrid backplane, allowing for a cost-effective upgrade while extending the life of legacy hardware.



Why a New Connector?

2 mm HM Connectors have been industry work horses for many years, in part because they have been adopted into many popular backplane standards such as PICMG's CompactPCI and VITA's VME 64x. Their popularity stems from the fact that 2 mm connector systems increase signal density over .100-inch systems, they are available in various modular form factors and they are cost effective.

Backplanes are being challenged to move from low-speed parallel bus applications to high-density, high-speed serial point-to-point differential signal transmission, such as SATA/SAS, PCI Express, Gigabit Ethernet and USB. As a result, today's systems require connectors optimized for very high densities of multi-gigabit-per-second differential signals.

Unshielded 2 mm Hard Metric connectors are limited by their susceptibility to crosstalk, especially in applications requiring higher signal densities combined with higher data rates. Severe crosstalk is caused by the lack of isolation between neighboring signals and makes unshielded 2 mm HM connectors unusable in high-speed, high-signal density applications. Consequently, designers have had to sacrifice signal pins and convert them to grounds, thus significantly reducing the number of channels available for signal transmission.

The Ultra Hard Metric (UHM) Socket Connector from 3M, specified by the PICMG draft 2.30 standard, is a “super” HM connector that addresses these signal integrity limitations of unshielded 2 mm HM connectors. They are fully shielded with the lowest crosstalk and highest signal density of any 2 mm HM connector available today. They are designed to be intermateable with standard 2 mm HM vertical backplane headers. They have controlled impedance, and the offer 7 Gbps or higher performance when mated to standard 2 mm HM headers.

Compared to an unshielded 2 mm HM connector, the fully shielded UHM socket connector displays significantly reduced crosstalk. In addition the UHM socket connector shield design provides a controlled impedance path, which minimizes insertion loss and rise-time degradation. By improving the signal isolation, more of the signal pins can now be used for high speed signals. This significantly increases the number of channels available for transmission compared to the unshielded 2 mm HM connector pin-outs – as many as two times more channels can be used for high speed signals.

The key innovation that enables high

signal density at higher speeds is the addition of internal shielding. In the UHM socket connector vertical and horizontal shields are placed between each column and row in order to isolate each signal contact. For differential signals this allows the designer to utilize either row differential or column differential formats as shown in the illustration. This shielding is designed to control the differential impedance as close as possible to 100 Ohms.

In addition to improving signal integrity, the UHM socket connector right angle socket was designed to be mechanically compatible with legacy 2 mm HM designs. This required the connector to be intermateble with 2 mm HM headers designed to IEC 61076-4-101. It also required the connector to be PCB footprint compatible. The UHM socket connector's internal shielding is connected to the same PCB row to which the CompactPCI EMI shields are terminated. This makes it possible to use the UHM socket connector as a 'drop-in' replacement for the existing connector on the daughter card.

For these reasons, PICMG chose the 3M UHM socket connector for its new 2.30 standard. The standard prescribes a direct way to improve the performance of legacy and new systems built in accordance with PICMG 2.0 CompactPCI® standards. The new draft standard's specified J2 connector, the UHM socket connector, provides full shielding, low crosstalk and high signal density, while its controlled impedance characteristics offer performance in excess of 7 Gbps. UHM socket connectors are intermateable with both legacy and new equipment built with connectors meeting IEC 61076-4-101, allowing for a cost-effective upgrades and extending the life of the user's investment.

In order to implement the PICMG 2.30 standard, 3M has agreed to license the UHM socket connector's design to other manufacturers. Reasonable and Non-Discriminatory (RAND) licensing for claims in 3M's patents and patent applications is now available. A copy of the license may be obtained under a Confidential Disclosure Agreement from the 3M Electronic Solutions Division by calling 512-984-6399.

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