Adding MIL-STD-1553 to any platform made easy

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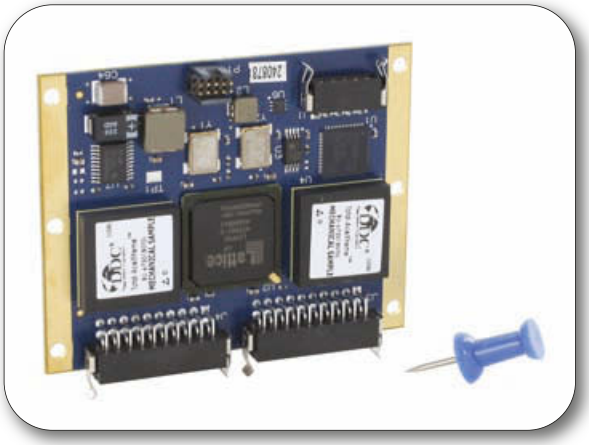
This article highlights that MIL STD 1553 is more and more used for industrial applications as well as military, and there are already a multitude of products to simplify its implementation for these purposes.



BU-67113U small form factor USB board

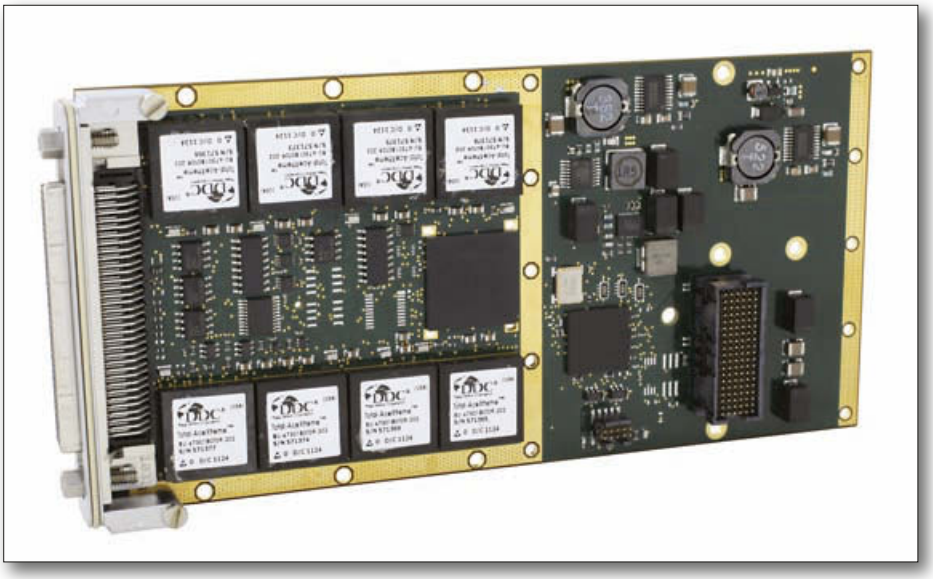
MIL STD 1553 is a protocol standard that defines the electrical and functional characteristics of a serial data bus that has been mainly used in military aircraft. The bus architecture of MIL STD 1553 allows for reduced size and weight of systems and the wiring that interconnects them, is inherently reliable, and incorporates redundancies that make it a safe data bus solution. It has served as the primary command and control interconnect on many different types of military platforms and applications. Traditional embedded 1553 applications involve the use of standard off the shelf board form factors like PMC, XMC, and PC/104 boards, or circuit layout designs utilizing 1553 components. New methods also allow the use of small form factors, which are very tiny cards like mini PCIe, USB, or other form factors, to add I/O capabilities like 1553 to rugged systems.

Many test systems traditionally use standard off the shelf board form factors like PCI, PCIe, cPCI, or PXI boards, while more recent methods involve the use of USB or Ethernet connectivity to the host computer system. Whatever method the system level designer may choose, adding 1553 capabilities has certainly become much easier over the years. PMC (PCI mezzanine cards) can go into VME, VPX, cPCI/PXI, or PCI chassis systems which incorporate large metal card cages. Embedded PCI mezzanine card (PMC) and switched mezzanine card (XMC) board form factors sit inside rugged embedded card cages for adding 1553 to systems. A PMC is a printed circuit board manufactured to the IEEE P1386.1 standard. There is also a part of the VITA standard that defines PMC conduction cooling. A standard size PMC board is 5.87 inches x 2.91 inches (149 mm x 74 mm) and plugs onto a base board such that the two boards are parallel to each other. Mezzanine cards have played an essential role in embedded systems with single board computers and standard backplanes. XMC is the same size as a PMC board but offers the next generation high speed back end interface connection to the host instead of a PCI connection. The most popular type of XMC board is a PCIe back end interface with high density connectors. DDC offers a complete line of standard off the shelf PMC and XMC boards for 1553 applications and typically includes a variety of different types of I/O on board to save space, power, weight and costs, which are critical in embedded platforms that might only have one PMC or XMC site. One example of this is the newest XMC card from DDC that provides up to 8 dual redundant MIL STD 1553 channels on a single XMC board.

The PC/104 Plus and PCI 104 form factor is still a very popular small form factor that has allowed embedded and laboratory system designers to keep development costs low through the use of commercial off the shelf (COTS) products. This form factor is a compact design that is well suited for small embedded applications and rapid prototyping in the lab. The card is only 3.575 inches x 3.775 inches (90 mm x 96 mm) and uses a stacking concept where one card sits on top of the other, which allows you to build a tower of cards. The pins from one card insert into the card below it to provide the bus interface. This stacking concept allows system designers to eliminate backplanes that consist of large metal card cages, making the overall format smaller in size and lower in cost.

PMC, XMC, and PC/104-Plus type of form factors can at times be too large and heavy for some applications. Also the demand for lightweight, low-power, rugged, reliable bus interfaces for smaller platforms such as UAVs has increased the demand for small components or small form factor rugged boards. DDC

BU-67114H small form factor mini-PCIe board



BU-67112Z MIL-STD-1553 XMC board with 8 channels

offers a complete line of MIL-STD-1553 components and rugged small form factor boards for applications with stringent size and weight limitations. To conserve size and weight, system designers can incorporate 1553 functionality on their base board by using an off-the-shelf component. A component has traditionally consisted of 1553 protocol and transceivers integrated into one small package. DDC has recently revolutionized the industry with the introduction of the Total-ACE and Total-AceXtreme components that integrate a complete MIL-STD-1553 solution with transformers inside one tiny package, available in a square plastic BGA package as small as .63 inch x .63 inch (16 mm x 16 mm).

The use of one small device simplifies the design and layout of a 1553 circuit on a base processor circuit card assembly. DDC also offers a complete hardware and software Total-AceXtreme development kit that makes the design and development of 1553 circuitry even easier. Small form factors are becoming very popular in embedded applications and this allows for a reduction in overall size and weight for rugged embedded systems and provides an alternative to designing your own circuit card assembly. This allows system developers to focus on system level design and easily include 1553 functionality as an add-on option when required.

There are a number of small form factor standards being released today, and more are emerging, with the objective of saving space, power, and weight in overall system development. The small form factor special interest group (SFF-SIG) is an independent group that develops, promotes, and supports small form factor circuit board, I/O, and storage specifications. The group embraces the latest technologies, but also has a philosophy of maintaining legacy compatibility and enabling smooth transitions to next-generation interfaces. There are also a number of VITA specifications for small form factors. VITA is an incorporated, non-profit organization of vendors and users having a common market interest in real-time, rugged embedded computing systems. VITA members have worked together to define and develop key computer bus, board, and system specifications such as VME, PMC, VPX, XMC, and others. The community has realized that there is a driving need for electronic systems to get smaller and lighter. This has resulted in three new competing standards: VITA 73, VITA 74, and VITA 75. These specifications are in working group status right now and have not been ratified, but there are major system manufacturers that have already adopted and made products for these technologies.

The BU-67114H small form factor Mini-PCIe board allows up to two dual-redundant MIL-STD-1553 channels to be easily added to any small embedded system, laptop, or tablet computer, to provide a cost-effective, lightweight, small size, rugged, and reliable 1553 bus interface. The board is designed with unique DDC components, based on ASICs, to allow for the smallest size and lowest power. Each 1553 channel can emulate a bus controller (BC), multiple remote terminals (RTs), a bus monitor (MT), BC/MT, or Multi-RT/MT modes independently per 1553 channel. The MIL-STD-1553 interfaces on this board consist of one or two Total-AceXtreme interfaces. Total-AceXtreme is latest generation MIL-STD-1553 component from DDC with unique 1553 protocol and transceiver ASICs inside one component with integrated transformers. The use of this type of technology on the board allows for higher MTBF, lower 1553 power dissipation, higher performance, and the use of less board area. Each channel provides 48-bit/100 nanosecond resolution time stamping of each received message. An integrated DMA engine allows for optimized performance in bus monitor mode to decrease CPU utilization and free up CPU cycles. In addition, Total-AceXtreme features a high performance data streaming engine (DSE). The DSE maximizes the efficiency of data transfers between the host processor and the 1553 interface. Modern processor buses are optimized for burst transfers of data. The DSE maximizes the efficiency of modern processor buses by facilitating block transfers (DMA) of data to and from the 1553 interface with minimal processor overhead. The benefits of this streaming interface are reduced CPU utilization and increased real-time performance for BC and multi-RT modes of operation.

A small form factor USB board (BU-67113U) is also available from Data Device Corporation, and incorporates all the same features and benefits of the mini-PCIe card in a small board that connects to a standard USB 2.0 host interface. The added benefit here is that you can mount this board anywhere in your system and interface to your host computer via a USB 2.0 cable. With this new board you only need an available USB 2.0 port in your system, and there is no longer any need to have a free card slot in order to populate 1553, or for doing any circuit layout design to integrate a component level solution.

DDC provides a complete set of drivers and software support for all major operating systems. The MIL-STD-1553 C software development kit (SDK) includes drivers for VxWorks, Integrity, Linux, and Windows. These SDKs allow you to quickly integrate DDC 1553 products into your C source code applications. A common SDK exists across all operating systems allowing the programmer portability across different platforms. The SDK includes a variety of different samples with full source code along with detailed documentation. The easy-to-use high level functions abstract all low level hardware accesses and memory allocation such that specific hardware knowledge is not required. DDC also offers optional graphical user interfaces that are Windows applications which allow for bus monitoring and simulation for quick and easy setup. These applications also contain an industry-unique feature that allows the end user to program the bus through this application, and then click a button to generate the application C code to reduce risk, ensure success, and shorten the development cycle. The application C code can be compiled for use in any of the supported operating systems. The MIL-STD-1553 software package is called BusTrACEr and is available today. ■