Four-Channel PC/104 MIL-STD-1553 Circuit Board

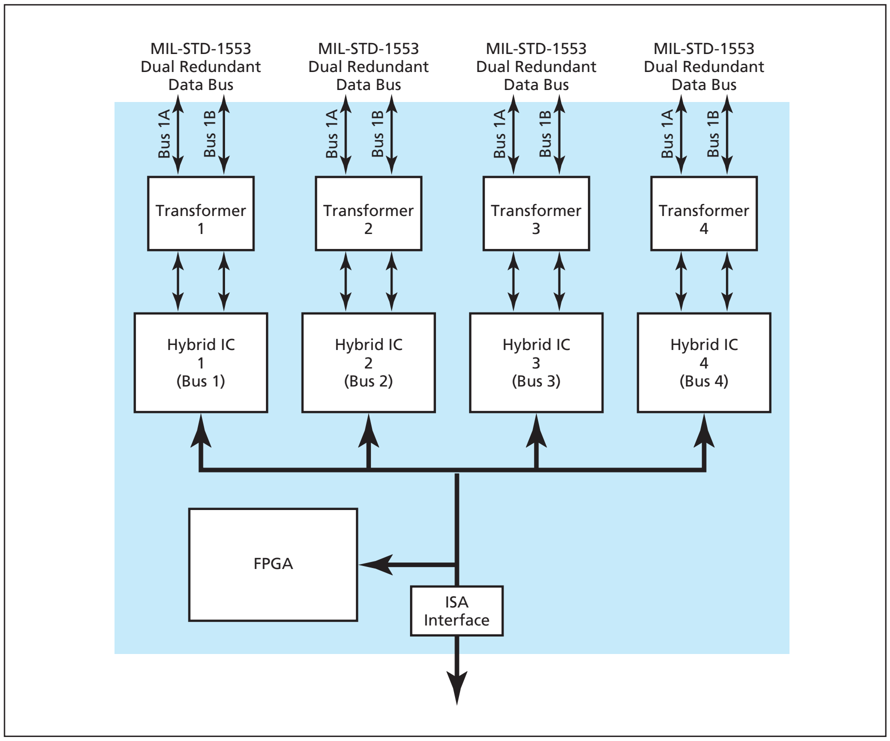
For a given size, weight, and power consumption, greater functionality is obtained.

Lyndon B. Johnson Space Center, Houston, Texas

The mini bus interface card (miniBIC) is the first four-channel electronic circuit board that conforms to MIL-STD-1553 and to the electrical-footprint portion of PC/104. [MIL-STD-1553 is a military standard that encompasses a method of communication and electrical-interface requirements for digital electronic subsystems connected to a data bus. PC/104 is an industry standard for compact, stackable modules that are fully compatible (in architecture, hardware, and software) with personal-computer data- and power-bus circuitry.]

Prior to the development of the miniBIC, only one- and two-channel PC/104 MIL-STD-1553 boards were available. To obtain four channels, it was necessary to include at least two boards in a PC/104 stack. In comparison with such a two-board stack, the miniBIC takes up less space, consumes less power, and is more reliable. In addition, the miniBIC includes 32 digital input/output channels.

The miniBIC (see figure) contains four MIL-STD-1553B hybrid integrated circuits (ICs), four transformers, a field-programmable gate array (FPGA), and an Industry Standard Architecture (ISA) interface. Each hybrid IC includes a MIL-STD-1553 dual transceiver, memory-management circuitry, processor interface logic circuitry, and 64K × 16 bits of shared static random access memory. The memory is used to configure message and data blocks. In addition, 23 16-bit registers are available for (1) configuring the hybrid IC for, and starting it in, various modes of operation; (2) reading the status of the functionality of the hybrid IC; and (3) resetting the hybrid IC to a known state. The miniBIC can operate as a remote terminal, bus controller, or bus monitor.



The **miniBIC** comprises, in effect, four MIL-STD-1553 interfaces that can operate independently or in coordination.

The FPGA provides the chip-select and data-strobe signals needed for operation of the hybrid ICs. The FPGA also receives interruption signals and forwards them to the ISA bus. The ISA interface connects the address, data, and control interfaces of the hybrid ICs to the ISA backplane.

Each channel is, in effect, a MIL-STD-1553 interface that can operate either independently of the others or else as a redundant version of one of the others. The transformer in each channel provides electrical isolation between the rest of the miniBIC circuitry and the bus to which that channel is connected.

This work was done by Gary L. Cox of **Johnson Space Center.** *For further information, contact the Johnson Commercial Technology Office at (281) 483-3809.*
MSC-23216

Improved Method of Locating Defects in Wiring Insulation

The best features of the DWV and TDR methods are combined.

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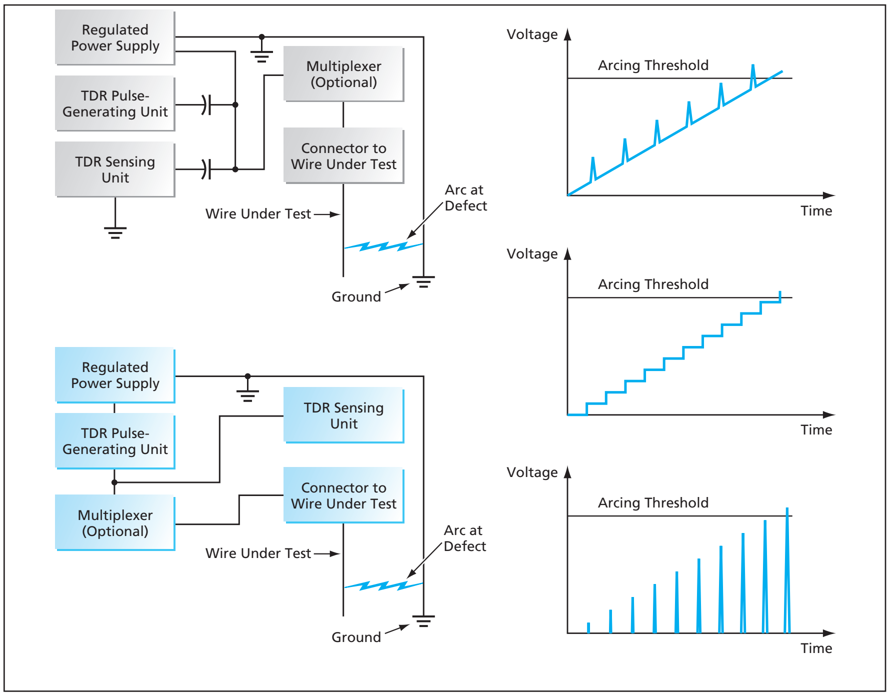
An improved method of locating small breaches in insulation on electrical wires combines aspects of the prior dielectric withstand voltage (DWV) and time-domain reflectometry (TDR) methods. The method was invented to satisfy a need for reliably and quickly locating insulation defects in spacecraft, aircraft, ships, and other complex systems that contain large amounts of wiring, much of it enclosed in structures that make it difficult to inspect.

In the DWV method, one applies a predetermined potential (usually 1.5 kV DC) to the wiring and notes whether the voltage causes any arcing between the



A **Wire Is Tested** by applying a suitable voltage waveform to produce arcing and measuring the time between (1) the pulse or staircase edge that immediately precedes the arcing and (2) the receipt of the arcing signal at the location of application of the waveform. The distance to the defect where the arcing occurs is calculated from the time thus measured.

wiring and ground. The DWV method does not provide an indication of the location of the defect (unless, in an exceptional case, the arc happens to be visible). In addition, if there is no electrically conductive component at ground potential within about 0.010 in. (≈ 0.254 mm) of the wire at the location of an insulation defect, then the DWV method does not provide an indication of the defect. Moreover, one does not have the option to raise the potential in an effort to increase the detectability of such a defect because doing so can harm previously undamaged insulation.

In the TDR method as practiced heretofore, one applies a pulse of electricity having an amplitude of <25 V to a wire and measures the round-trip travel time for the reflection of the pulse from a defect. The distance along the wire from the point of application of the pulse to the defect is then calculated as the product of half the round-trip travel time and the characteristic speed of a propagation of an electromagnetic signal in the wire. While the TDR method as practiced heretofore can be used to locate a short or open circuit, it does not ordinarily enable one to locate a small breach in insulation because the pulse voltage is too low to cause arcing and thus too low to induce an impedance discontinuity large enough to generate a measurable reflection.

The present improved method overcomes the weaknesses of both the prior DWV and the prior TDR method. One prepares the system to be tested by filling all or part of the system with a liquid or gas that does not harm the wiring and that is either electrically conductive or undergoes dielectric breakdown (and thereby becomes electrically conductive) at a relatively low applied electric field. For example, if the system to be tested is an aircraft, one can fill the interior of the aircraft with neon, through which arcs can readily develop between wires and metal grounds. This permits arcing to a ground as far as 1.0 in. (≈25.4 mm) from the conductor.

The figure depicts two typical alternative assemblies of equipment that could be used to implement the present method, along with three typical alternative voltage waveforms that could be used in the method. Once the system to be tested has been prepared as described in the preceding paragraph, one of these waveforms is applied to a wire under test. In the case of the first waveform, one superimposes a conventional TDR signal on a gradually increasing voltage until arcing occurs. To make the arcing occur at the identifiable time of one of the TDR pulses (preventing the somewhat random arcing that might otherwise occur) and thereby make it possible to measure the round-trip travel time, (1) the rate of the interval between the TDR pulses is made long enough to encompass any reflections that might occur and (2) the rate of gradual increase of voltage is made such that highest voltage yet reached occurs at the peak of each superimposed TDR pulse.

The second voltage waveform is a staircase function. In this case, the highest voltage yet reached (and thus arcing) always occurs at a rising edge. The third waveform consists solely of TDR pulses, but unlike in conventional TDR, these are high-voltage pulses. In this case, the amplitude of the pulses is increased gradually until they cause arcing.

This work was done by Owen R. Greulich of **Ames Research Center**. *Further information is contained in a TSP (see page 1).*

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Ames Research Center, (650) 604-5104. Refer to ARC-14612.

Strobe Traffic Lights Warn of Approaching Emergency Vehicles

Simple, intuitive displays indicate directions of approach.

NASA's Jet Propulsion Laboratory, Pasadena, California

Strobe-enhanced traffic signals have been developed to aid in the preemption of road intersections for emergency vehicles. The strobe-enhanced traffic signals can be incorporated into both new and pre-existing traffic-control systems in which the traffic-signal heads are of a relatively new type based on arrays of light-emitting diodes (LEDs). The strobe-enhanced traffic signals offer a less expensive, less complex alternative to a recently developed system of LED-based warning signs placed next to traffic signals. Because of its visual complexity, the combination of traffic signals and