Network Extender for MIL-STD-1553 Bus

Long-distance communications and equipment tests can be effected through a single multicoiled source.

Lyndon B. Johnson Space Center, Houston, Texas

An extender system for MIL-STD-1553 buses transparently couples bus components at multiple developer sites. The bus network extender is a relatively inexpensive system that minimizes the time and cost of integration of avionics systems by providing a convenient mechanism for early testing without the need to transport the usual test equipment and personnel to an integration facility. This bus network extender can thus alleviate overloading of the test facility while enabling the detection of interface problems that can occur during the integration of avionic systems. With this bus extender in place, developers can correct and adjust their own hardware and software before products leave a development site. Currently resident at Johnson Space Center, the bus network extender is used to test the functionality of equipment that, although remotely located, is connected through a MIL-STD-1553 bus. Inasmuch as the standard bus protocol for avionics equipment is that of MIL-STD-1553, companies that supply MIL-STD-1553-compliant equipment to government or industry and that need long-distance communication support might benefit from this network bus extender.

The state of the art does not provide a multicoiler source for this purpose. Instead, the standard used by the military serves merely as an interface between a main computer in some device or aircraft and the subsystems of that device or aircraft — for example, a subsystem that controls wing flaps or ailerons. Unfortunately, the transmission distance of a state-of-the-art MIL-STD-1553 system is limited to 400 ft (122 m). The bus network extender eliminates this distance restriction by enabling the integrated testing of subsystems that are located remotely from each other, without having to physically unite those subsystems. Interlinking by use of the bus network extender is applicable to 90 percent of all required testing for the military; hence, it offers the potential for savings in cost and time. There is also potential for commercial applications in simulation and training and in the development of real-time systems.

The bus network extender enables long-distance communications by use of specified media and compliant equipment, while conforming to all rel-
MMIC HEMT Power Amplifier for 140 to 170 GHz

Circuits like this one could be useful in radiometers for probing the atmosphere.

NASA’s Jet Propulsion Laboratory, Pasadena, California

Figure 1 shows a three-stage monolithic microwave integrated circuit (MMIC) power amplifier that features high-electron-mobility transistors (HEMTs) as gain elements. This amplifier is designed to operate in the frequency range of 140 to 170 GHz, which contains spectral lines of several atmospheric molecular species plus subharmonics of other such spectral lines. Hence, this amplifier could serve as a prototype of amplifiers to be incorporated into heterodyne radiometers used in atmospheric science. The original intended purpose served by this amplifier is to boost the signal generated by a previously developed 164-GHz MMIC HEMT doubler [which was described in “164-GHz MMIC HEMT Frequency Doubler” (NPO-21197), NASA Tech Briefs, Vol. 27, No. 9 (September 2003), page 48.] and drive a 164-to-328-GHz doubler to provide a few milliwatts of power at 328 GHz.

The first two stages of the amplifier contain one HEMT each; the third (output) stage contains two HEMTs to maximize output power. Each HEMT is characterized by gate-periphery dimensions of 4 by 37 µm. Grounded coplanar waveguides are used as impedance-matching input, output, and interstage-coupling transmission lines.

The small-signal S parameters and the output power (for an input power of about 5 dBm) of this amplifier were measured as functions of frequency. For the small-signal gain measurements, the amplifier circuit was biased at a drain potential of 2.5 V, drain current of 240 mA, and gate potential of 0 V. As shown in

such delays result from finite signal-propagation speed and are unavoidable. Notwithstanding such delays, the bus network extender is well suited for protocol and interface integration testing, even on slower links. On faster links, some systems equipped with the extender can cycle MIL-STD-1553 frames at full speed, subject to only inevitable data delays. Some systems equipped with bus network extenders may seem to operate in real time on high-speed links.

The bus network extender is equipped with utility software that, upon command, displays the status of all BCs, remote transmission queues, and RT message queues. The software also provides a configuration file for all connected systems to provide error-free configuration at all locations, a configuration file that contains an entire system interface control document, and an input file that performs extensive error checking. Since slave BCs are configured automatically, remote configuration data are totally eliminated when remote simulations are not required. Should a slave network server be unreachable, the extender attempts to re-establish network connections automatically while maintaining adherence to real-time-response requirements for all MIL-STD-1553 messages.

This work was done by Julius Marcus and T. David Hanson of GeoControl Systems, Inc., for Johnson Space Center. For further information, contact the Johnson Commercial Technology Office at (281) 483-3809. MSC-22741