

dSPACE is addressing the unique and demanding requirements of aircraft and satellite development and testing, through new interface boards. Extra channels and features, and new blocksets, have been added to the interface boards for avionics buses ARINC 429 and MIL-STD-1553. And there is now a new interface board for ARINC 717. These solutions are ideal in modular dSPACE real-time systems for hardware-in-the-loop (HIL) testing and rapid control prototyping (RCP) in the aerospace industry.

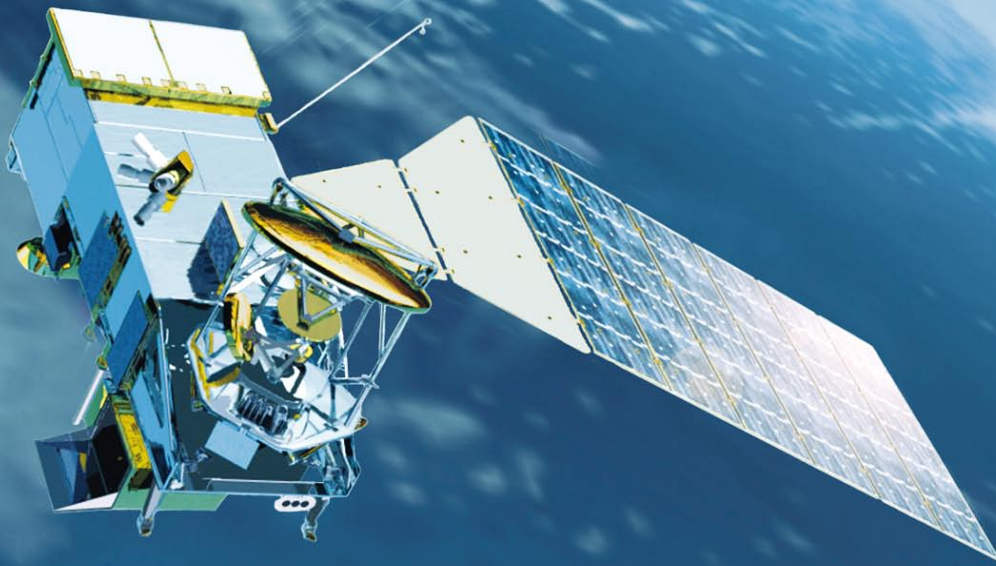
#### Testing Aerospace Buses Flexibly and Easily

To run integration tests of several electronic control units (ECUs) with HIL simulators in aerospace applications, a large number of bus channels are required on one interface board, configuring the bus communication for the tests has to be made as easy as possible, and all the properties of the buses under test must be supported. Component tests with one ECU on an HIL simulator partly have different requirements, because bus nodes that are not available during

the tests have to be simulated additionally. Here too, though, there needs to be an easy way of defining the bus communication. With MIL-STD-1553, the special bus structure also has to be taken into account, as it includes a bus controller, up to 32 remote terminals and a bus monitor. In HIL tests for components, the bus controller has to be simulated, and for integration tests, it is mainly the remote terminals. The new aerospace bus solutions from dSPACE fulfill all these requirements. This is because they were



*The National Polar-orbiting Operational Environmental Satellite System (NPOESS) is collecting, disseminating and processing data about the Earth's weather, atmosphere, oceans, land, and near-space environment. dSPACE tools have been used for subsystem development and integration.*



# Avionics for High Flyers

With the new interface boards, dSPACE systems are well prepared for avionics development.



Photo: Lockheed Martin



Photo: Eurocopter



Photo: Honda Aircraft



### Overview of the New Hardware

Product:	Carrier Board:	Extension Module:
MIL-STD-1553	DS4504 PMC	QPM-1553 from GE Intelligent Platforms
ARINC 429	DS4501 IP	IP-429HD-88P from GE Intelligent Platforms
ARINC 717	DS4501 IP	IP-717-HBP from GE Intelligent Platforms

developed in close cooperation with leading aerospace component and system manufacturers. The new interface boards are being used successfully in the Joint Strike Fighter (F35) program, the NPOESS program (a US environmental satellite), and other projects.

vides special blocksets. These are the interfaces to the real-time model (plant model for HIL tests or controller model for RCP applications) and provide a graphical environment for intuitively configuring communication. It is not necessary to program the interface boards at the deep

Users can conveniently access the entire functionality of the avionics interface boards by using the graphical blocksets.

### Solution for an Integrated Development Process

The new solutions for MIL-STD-1553, ARINC 429 and ARINC 717 are based on industry-proven modules from GE Intelligent Platforms, in PMC and IP form factor. These modules are integrated into the dSPACE Peripheral High-Speed (PHS) bus via dSPACE PMC and IP carrier boards, which are optimized for high-performance real-time operation. This configuration means that developers can utilize the very short latencies of dSPACE's modular hardware with the advantages of industry-proven bus system boards from other providers. This constellation can be employed to set up seamless, traceable development processes running straight through from model-based development to release tests for controllers on an HIL simulator. For easy connection of the bus interfaces, dSPACE pro-

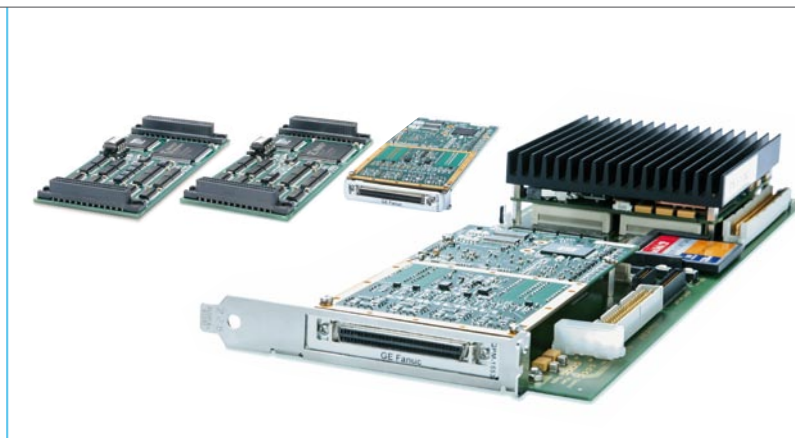
protocol level. Their functionality can be used conveniently for the individual buses with the help of the appropriate Real-Time Interface (RTI) blocksets from dSPACE. One feature that deserves special mention is that configuration files are used to configure bus communication, making it easy to change the parameterization of the models in Simulink®.

### MIL-STD-1553

The new interface board has four doubly redundant channels that comply with the current MIL-STD-1553 A/B Notice II. Each of the four channels can be user-configured independently of the others as one of the terminal devices specified in the standard: bus controller, remote terminal and bus monitor. Thus, the new interface board can be optimally utilized for developing

Examples of aircraft and spacecraft developed using dSPACE tools and interface boards: Lockheed Martin F35, Eurocopter EC145, Honda Jet, ESA METOP (from top to bottom.)

sophisticated components and for testing complex networks. An essential component is the RTI blockset. Newly developed by dSPACE, this contains a library with send and receive blocks for remote terminals. The blocks in it give users complete access to the channels' functional behavior, their physical level, the transmitted messages, and status information. In addition to the message contents, the outputs of the receive blocks also make time stamps, commands, status messages and message counts available in the real-time model. The blocks can be used to simulate up to 32 remote terminals on an MIL-STD-1553 bus and enable users to set subaddresses, the word count, mode codes and broadcast messages for each remote terminal. Both the physical bus level and the transmission behavior can be manipulated to perform error testing. For physical tests, the bus output voltage can be either predefined or fed in from the outside. For tests on the transmission behavior, the times for no-response timeout and late-response timeout can be set. A special feature is that if a channel is configured as a bus monitor,



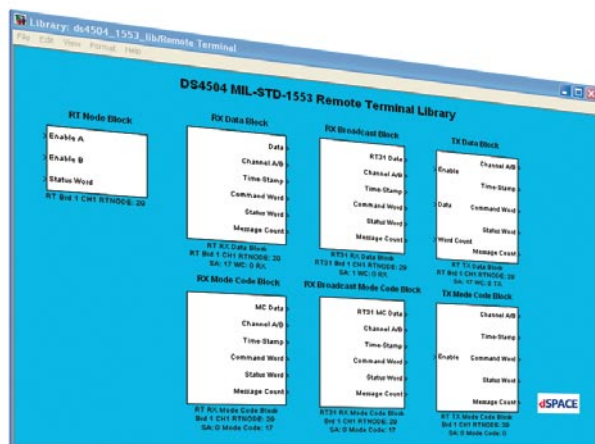
DS4504 PMC Carrier Board with installed QPM-1553 module from GE Intelligent Platforms. Next to it are the QPM-1553, IP-429HD-88P and IP-717-HBP modules (from right to left).

the messages to be monitored are not only available in the real-time model, but can also be sent to a PC via Ethernet.

### ARINC 429 and ARINC 717

dSPACE's new interface board for ARINC 429 is ideal for testing entire avionics networks, including communication between a very large number of bus nodes. With up to 32 send and 32 receive channels, it has twice as many channels as its predecessor. One outstanding feature is the completely redeveloped blockset, which facilitates the configuration of bus channels enormously. The configuration files that are used define all the properties of the ARINC labels: data format, start bit, data length, scaling factor and SDI filter. This makes it very easy

to change the labels. With the data from the configuration files, the ARINC messages are generated automatically in the real-time models by means of Encode and Decode blocks, and payload data can also be extracted from the received ARINC messages. To perform the all-important tests for erroneous bus transmission, errors can be inserted for bit-count, inter-message-gap and parity errors. ARINC 717 buses are another frequent component in network tests with ARINC 429 buses, allowing data transmission between the Digital Flight Data Acquisition Unit (DFDAU) and the Digital Flight Data Recorder (DFDR) to be tested. There is now also a dSPACE interface board for these buses, offering the same advantages as the ARINC 429 interface board. ■



Library of remote terminal blocks for the new DS4504 MIL-STD-1553 interface board as an example of dSPACE's Real-Time Interface

## Summary

The new interface boards for MIL-STD-1553, ARINC 429 and ARINC 717 have graphical user interfaces and work with a database, making communication configuration intuitive and easy. Used in conjunction with dSPACE's fast, modular real-time systems, they are ideal for developing and testing components and systems for aerospace applications. Not surprising, since they were developed in close cooperation with leading aerospace companies.