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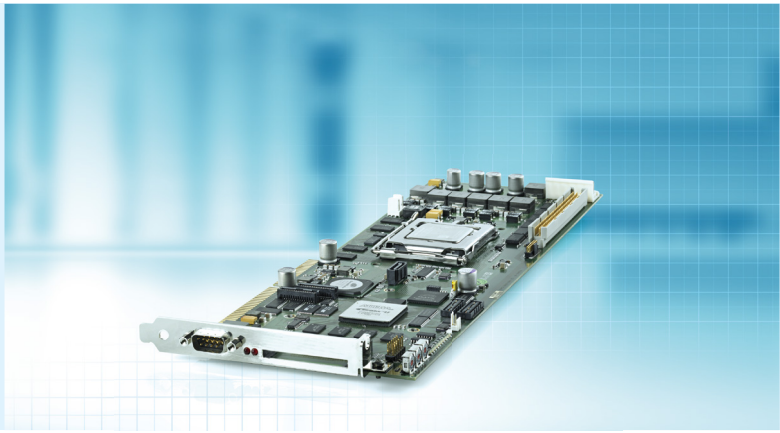
Find the *dSPACE DS1006-07* at our website: ***Click HERE***

DS1006 Processor Board

Computing power for processing-intensive real-time models

Highlights

- x86 processor technology
- Quad-core AMD Opteron™ processor with 2.8 GHz
- Fully programmable from Simulink®
- High-speed connection to all dSPACE I/O boards via PHS bus
- Multiprocessor system of several DS1006 Processor Boards via fiber-optic connection (Gigalinks)



Application Areas

The DS1006 Processor Board is one of the processor boards that form the heart of dSPACE's modular hardware. It is our flagship for very complex, large, computation-intensive models – like the ones found in powertrain and virtual vehicle simulations. In such simulations, the DS1006 provides the computing power for the real-time system and also functions as an interface to the I/O boards and the host PC. It can be directly connected to all dSPACE I/O boards via PHS bus.

Key Benefits

The DS1006 Processor Board is based on an a quad-core AMD Opteron™ x86 processor with 2.8 GHz clock frequency. Thus, it always delivers a high level of processing power, even for large-scale real-time applications. If required, you can add an Ethernet I/O interface for Gigabit data streaming or a flash memory for automatic, host-independent booting of the real-time applications.

Multicore Processor for More Computing Power

You can set up a multiprocessor system by using the individual cores of the multicore processor, and assign the I/O boards easily by graphical programming via RTI-MP (p. 62). With the possibility for parallel computing and a high-performance data exchange between the cores, the DS1006 multicore board speeds up all your applications (p. 371).

Multiprocessor Setup

If you need even more performance, you can build a multiprocessor system by connecting several DS1006 boards via an additional optical interface (DS911 Gigalink Module, p. 373). Synchronization between the boards is guaranteed, since interrupts can be sent to other processor boards via hardware, with minimal latencies.

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Technical Details

Parameter		Specification
Processor		■ Quad-core AMD Opteron™ processor, 2.8 GHz ■ 4 x 64 kB L1 data cache, 4 x 64 kB L1 instruction cache, 4 x 512 kB L2 cache, 6 MB L3 cache
Memory		■ 1 GB DDR2-800 SDRAM local memory for the application and dynamic application data ■ 4 x 128 MB DDR2-267 SDRAM global memory for host data exchange ■ 2 MB onboard boot flash memory for boot firmware ■ Application flash memory on CompactFlash card (accessable via ControlDesk®). The capacity depends on the card.
Timer		■ For each core: 3 general-purpose timers ■ Synchronous time base unit (STBU) for multiprocessor systems
Interrupt controller		■ For each core: one interrupt controller with 18 different interrupt sources ■ The interrupt sources of the connected I/O boards can be handled from each core via internal Gigalinks.
Interfaces	Serial interface	■ RS232 interface with standard UART allowing transfer rates of up to 115.2 Kbaud
	Connection to I/O boards	■ PHS++ bus interface ■ 32-bit I/O bus for modular I/O configuration (p. 366) ■ Peak transfer rate 20 MB/s, up to 30 MB/s for new I/O boards ■ Up to 64 PHS bus interrupts
Host interface		■ One full-size 16-bit ISA slot required ■ Interface via eight 16-bit I/O ports (ISA bus)
Multiprocessor system		■ Building multiprocessor systems with further DS1006 Processor Boards ■ Up to 20 DS1006 Processor Boards ■ Up to 4 high-speed links via one DS911 Gigalink Module on each DS1006 ■ Possible cable length of up to 100 m
Physical characteristics	Physical size	■ 340 x 125 x 15 mm (13.4 x 4.9 x 0.6 in)
	Ambient temperature	■ 0 ... 40 °C (32 ... 104 °F)
	Cooling	■ Active cooling (fan)

	Power supply	■ ISA bus:
		  ■ +5 V ±5%, 2.0 A (without DS911)
		  ■ +5 V ±5%, 3.0 A (with DS911 as of module revision 2.0)
		  ■ +12 V ±5%, 1.5 A
		■ CPU power connector: +5 V ±5%, 20 A

Order Information

Product	Order Number
DS1006 Processor Board	■ DS1006

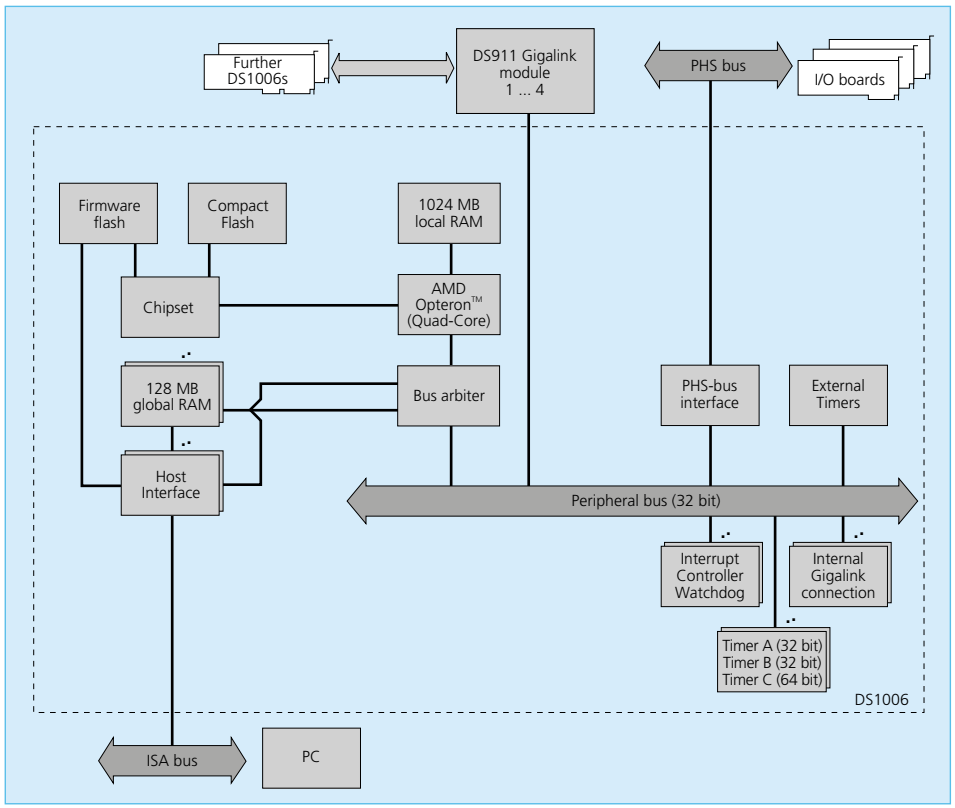
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Relevant Software and Hardware

Software		Order Number
Included	■ C Real-Time Library	–
	■ Experiment and Platform Manager	–
Required	■ Real-Time Interface (p. 56)	■ RTI
	■ GNU C compiler for AMD Opteron™	■ DS1006_COMP
Optional	■ Real-Time Interface for multiprocessor systems extension (p. 62)	■ RTI_MP
	■ DS1006 Ethernet Blockset (p. 80)	–

Hardware		Order Number
Required	■ For safety reasons DS1006 Processor Boards must be used only in PX10 and PX20 Expansion Boxes with hardware revisions certified for DS1006 Processor Boards (may require an Expansion Box update).	For detailed information about Expansion Boxes, please contact dSPACE.
Optional	■ PHS bus cable (with x connectors and terminator)	■ PHS-CABx
	■ DS911 Gigalink Module	■ DS911
	■ DS802 PHS Link Board	■ See p. 367
	■ DS921 (Connector bracket for Ethernet connection)	■ See p. 485

Block Diagram



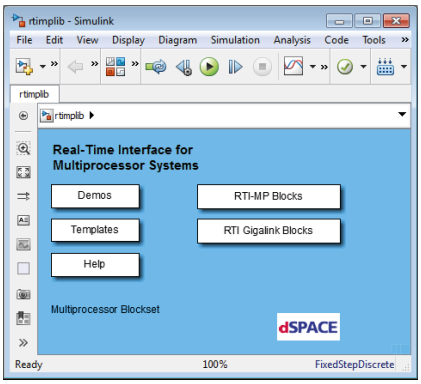
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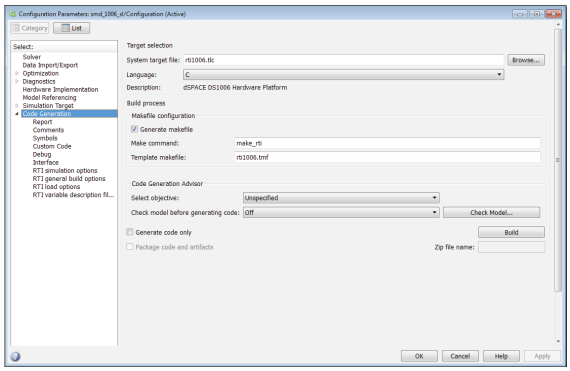
Graphical Programming

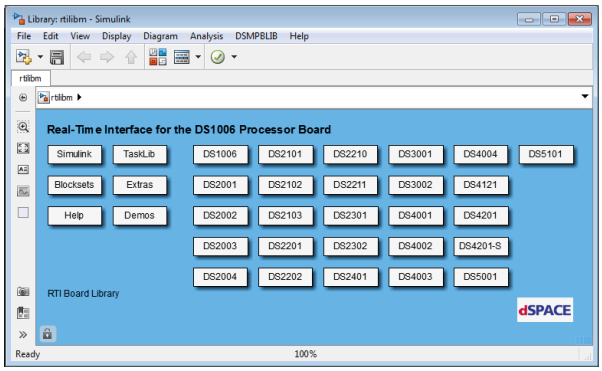
Programming from MATLAB®/Simulink®/Stateflow®

You can easily program the DS1006 Processor Board from Simulink via Real-Time Interface (RTI, p. 56). Simulink blocks provide access to the entire range of dSPACE I/O boards. The setting up of multiprocessor systems as well as the configuration of the data transfer between the processor cores is simple thanks to dedicated RTI blocks (RTI-MP, p. 62).

Dialogs for altering simulation parameters (such as solver options or the simulation time) and for generating C code, are directly accessible from the Simulink environment.







Speed Information

Performance of the DS1006 Processor Board Using One Core

ASM Package (including I/O and CAN Restbus Simulation)	Mean Turnaround Time
ASM Gasoline Engine Basic Simulation Package (p. 253)	0.11 ms
ASM Vehicle Dynamics Simulation Package (including Brake Hydraulics Model) (p. 263)	0.14 ms

Performance of the DS1006 Processor Board Using More Than One Core with Connections via Gigalinks

For this benchmark, ASM Virtual Vehicle with two main model components (Gasoline Engine Basic, Vehicle Dynamics) with I/O and CAN restbus simulation is calculated on different cores with connections to each other via internal Gigalinks; two DS2211 HIL I/O Boards are connected to the PHS bus of one DS1006 Processor Board:

ASM Main Model Component	Mean Turnaround Time
Gasoline Engine Basic	0.16 ms
Vehicle Dynamics	0.20 ms

For comparison: the same model with external Gigalinks and the predecessor DS1006 Processor Board (single-core

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processor with 2.6 GHz). Two DS1006 Processor boards are used with one DS2211 HIL I/O Board connected to each:

ASM Main Model Component	Mean Turnaround Time
Gasoline Engine Basic	0.17 ms
Vehicle Dynamics	0.22 ms

Comparison of both Measurements

Because the I/O communication is split into two PHS buses in the second benchmark, it might be expected to be faster than the first one. But the better performance of the internal Gigalink connections used in the first benchmark outweighs the disadvantage of having only one PHS bus. It might be better to use more than one DS1006 Processor Board in other cases (e.g., with very high I/O communication at each main model component).

Performance of the DS1006 Processor Board Using More Than One Core (Without Connected I/O Boards)

The following benchmark without any connected I/O demonstrates the different performance of external and internal Gigalink connections: ASM Virtual Vehicle with three main model components (Drivetrain, Gasoline Engine, Vehicle Dynamics) is calculated on different cores connected to each other via internal Gigalinks.

ASM Main Model Component (without I/O)	Mean Turnaround Time
Drivetrain	17.2 µs
Gasoline Engine	36.1 µs
Vehicle Dynamics	91.3 µs

For comparison: the same model with external Gigalinks and the predecessor DS1006 Processor Board. ASM – Virtual Vehicle with main model components (Drivetrain, Gasoline Engine, VehicleDynamics) is calculated on different DS1006s (predecessor DS1006 with 2.6 GHz single core processor) connected to each other via external Gigalinks.

ASM Main Model Component (without I/O)	Mean Turnaround Time
Drivetrain	43.7 µs
Gasoline Engine	66.5 µs
Vehicle Dynamics	140.9 µs

These benchmarks are only examples that give an idea of the performance achievable by the DS1006 Processor Board. The turnaround time of an application depends on a large number of factors, such as:

- The application size compared to the cache size of the processor
- The amount of I/O at each PHS bus, because of additional time needed for communication via PHS bus
- The number of signals that have to be sent via Gigalink connections (external or internal)
- The way the model is divided into parts that can be calculated in parallel

For applications with tough requirements on I/O latencies, please note that the DS1006 Processor Board with the Quad-Core processor has to access all connected I/O boards via one PHS bus.

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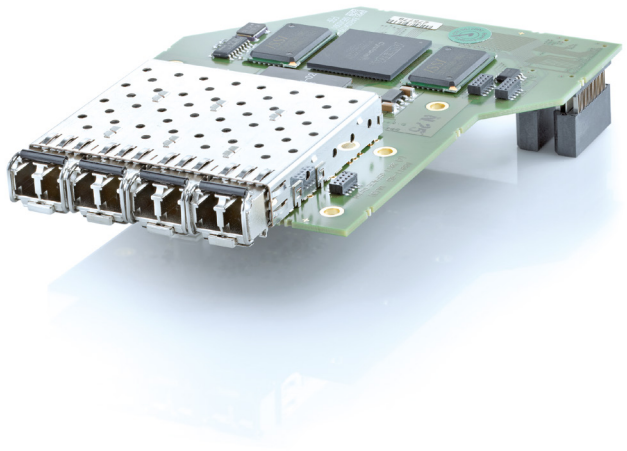
Multiprocessor Setup via DS911 Gigalink Module

Expanding Processor Power

With modular hardware based on the DS1006 Processor Board, you can achieve any performance you need simply by expanding your hardware with further DS1006 boards. Tasks can be shared between the processor boards to attain optimum response times and performance.
What is more, this automatically increases the I/O capacity of your system.

Gigalink Modules

The DS1006 Processor Boards are connected via optional Gigalink modules, which allow high-speed serial data transmission via fiber-optic cable and 1.25 Gbit/s technology. You can connect up to 20 processor boards in a system, and over distances up to 100 meters, in this way.
The fiber-optic connectors of the Gigalink modules are pluggable, making it easy to replace them yourself.



Technical Details – DS911 Gigalink Module

Parameter	Specification
General	■ Hardware extension to DS1006 Processor Board for building multiprocessor systems ■ Requires several DS1006 Processor Boards, each with a DS911 Gigalink Module ■ Gross transfer rate: 1.25 Gbit/s ■ Distance up to 100 m
Hardware details	■ 4 optical, high-speed communication ports (Gigalinks), each providing 16 bidirectional interrupt lines and 16 bidirectional data channels (2 kilowords width on each channel) ■ The fiber-optic connectors are pluggable, making it easy to replace them yourself. Substitute connectors are available only from dSPACE (order number: SFP_TRANS_MOD). ■ I/O access speed of send operations adapted to Gigalink's capabilities: Data is sent directly without a FIFO buffer ■ 32-bit or 64-bit read/write operations allowed: 32-bit access for single 32-bit (or shorter) data words, fast 64-bit access for block transfer functions wherever possible ■ Real-time interrupt dispatching ■ Passive cooling

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