

Teaching with the xPC Target Turnkey System for Education

xPC Target Turnkey for Education consists of Simulink, xPC Target, and other required MathWorks products together with the Education real-time target machine from Speedgoat. It is an integrated solution for studying and teaching design concepts in mechatronics, motion control, power electronics, and signal processing.

xPC Target Turnkey provides a ready-to-use, real-time testing and simulation platform with built-in analog and digital I/O connectivity. It includes all required cables, terminal boards, and adapters (power supply, DVI-I to VGA) to connect the target machine to the hardware under test.

Students can gain insight into a system design by monitoring and tuning the performance of the xPC Target application from Simulink while it is running in real time.

The industrial-grade design of the Education real-time target machine allows students to become familiar with components and design methodologies currently used in industry.

Teach Basic and Advanced Mechatronic Design Concepts

Teach hardware-in-the-loop and rapid control prototyping concepts with a lab that's easy to set up. Let students design models and visualize system behavior in Simulink. At the click of a button they can generate code from the model and execute it in real time on the Education real-time target machine. The xPC Target Turnkey for Education comes with:

- 32 single-ended or 16 differential analog inputs (16-bit resolution)
- 8 single-ended analog outputs

- Parallel digital I/O (8 input lines, 8 output lines)

Teach advanced mechatronics using the optional Motion Control FPGA Package. This package comes with:

- An additional module with a Xilinx Virtex-II FPGA and 64 TTL I/O lines
- Motion control I/O functionality

With the optional Education FPGA Development Kit for xPC Target from Speedgoat, study and teach the complete path of VHDL code development and implementation on a FPGA chip running together with your Simulink design.

Getting Started

Required hardware:

- Education real-time target machine

Required MathWorks products:

- MATLAB
- Simulink
- Simulink Coder
- xPC Target

Required third-party software:

- Visual C++ Express Edition or any other C/C++ compiler supported by xPC Target
- Xilinx ISE WebPACK V. 10.1 (for Motion Control FPGA Package – Type 1)

- Xilinx ISE Design Suite V. 10.X Logic Edition (for Motion Control FPGA Package – Type 2)
- ModelSim Xilinx Edition-III (for custom FPGA implementations)
- Xilinx ISE and ModelSim (for VHDL code generation)

Recommended MathWorks products:

- Stateflow

Online Resources

- Speedgoat real-time target machines for industrial applications:
mathworks.com/products/xpctarget/supported-hardware/index.html
- Teaching Controls with a Remote Laboratory using Simulink and xPC Target:
mathworks.com/academia/articles/jernigan_ieee_may2009.html
- Details about the xPC Target Turnkey System for Education
mathworks.com/academia/xpctarget-turnkey
- Resources for project-based learning with MATLAB and Simulink
mathworks.com/academia/hardware-resources



The Education real-time target machine. The hardware comes with built-in Ethernet support, Intel Celeron M 1 GHz CPU, 1024 MB CompactFlash device (preinstalled with the xPC Target real-time environment), I/O cable, terminal board, DVI-I to VGA adapter, universal power supply, and DVD with Simulink test models and tools and drivers for xPC Target.

Technical Specifications of Target Machine and Available Options

Education real-time target machine

Summary: Complete, assembled, and tested Speedgoat Education real-time target machine including chassis and industrial mainboard, CPU, RAM, onboard Intel Fast Ethernet controller, power supply module, flash device, external USB memory device, and boot environment for xPC Target installed on main drive. Includes 32/16 analog input, 8 analog output, 8 digital TTL input, 8 digital TTL output, and 2 RS232 channels; I/O cable; terminal board; DVI-I to VGA adapter; universal power supply; data disk with Speedgoat xPC Target driver blocks for current release and one release prior; Simulink test models; documentation; and Speedgoat USB kernel transfer utility. Twelve months of free email delivery of Speedgoat tools and drivers software for future releases of MathWorks software are also included.

Chassis

Enclosure	Sheet chassis with EMI protection
Color	Zinc coated, black with blue label
Dimensions (<i>h x d x w</i>)	270 x 241.1 x 111.9 mm
Weight	4.5 kg
Power supply	24 V VDC input power rating, external power supply included
Mounting	Including rear brackets for wall or machine cabinet mounting

Mainboard and CPU

Processor	Intel Celeron M 1 GHz
Chipset	Intel 82855GME (GMCH) with ICH4, 400 MHz front side bus
Bus	PCI, 32-bit/33 MHz
Graphics	Intel Extreme Graphics 2, DVI/SDL, on board
Memory	256 MB DDR RAM standard (1024 MB DDR RAM optional)
BIOS	Phoenix
Ethernet	1 x Intel 82562 10/100 Mb/s, 1 x Intel 82551ER 10/100 Mb/s
Available I/O slots	2

Drives

Main drive	1024 MB IDE flash device
USB drive	1 x USB memory device, 4 GB

Accessible Components

I/O module slots	2 PCI slots: one slot occupied by the included I/O module, one available
Power inlet	24 V DC (+/- 25%), external AC 110/240 V, 50/60 Hz power adaptor included
Power switch	none
Power LED	At front
Drive activity LED	At front
DVI-I connector	DVI-I to VGA connector included
Ethernet	2 x 10/100 Mb/s; for host-target communication and real-time Ethernet I/O
Serial ports	2 x RS232; for general-purpose I/O connectivity
USB	2 x USB 2.0; for xPC Target kernel and file transfer between host and target using the provided USB memory device (recommended) or the external USB 3.5 in. 1.44 MB floppy drive (classic method)
Keyboard and mouse	1 x PS/2, at front

Environment

Temperature	0 to +55 °C, operating
Humidity	10–90%, non-condensing
Shock/vibration	15 g, 11 ms/2–9 Hz: 3.5 mm amplitude/9–200 Hz: 1 g

Software

OS/RTOS	FreeDOS and xPC Target kernel, preinstalled on flash device or hard disk
Host PC	xPC Target driver blocks and Simulink test models for installed I/O module and USB kernel transfer utility

I/O Module (Included)

Form factor	PCI I/O module installed in one of the two available I/O slots
PCI bus	32-bit/33 MHz
Power requirements	2.6 W typical, 3.4 W maximal
Operating temperature	0 to +70 °C
Relative humidity	5–95%, non-condensing
Analog channels	32 single-ended or 16 differential analog inputs, 8 analog outputs, 16-bit
Digital channels	8 digital TTL inputs and 8 digital TTL outputs
A/D sampling and conversion time	15 µs per channel
D/A conversion time	12.375 µs per channel
A/D voltage ranges	-3.3 to +3.3, -5 to +5, -10 to +10, 0 to +5, and 0 to +10 V (selectable)
D/A voltage ranges	-10 to +10 V

Accessories (Included)

VGA	DVI-I to VGA adapter
Power supply	External 50 W power adapter (universal AC input range)
Terminal board	68 terminals arranged in two rows, spring loaded, and SCSI3 female connector with 68 pins DIN rail mounting support Dimensions (<i>h x w x d</i>): 50 x 182 x 90 mm
Cable	6 ft/1.8 m round black cable with SCSI3 male connectors with 68 pins at both ends
Drivers	Driver software for xPC Target and Simulink test models

Options

Motion Control FPGA Package

Summary: Configurable FPGA-based I/O module with 64 TTL I/O lines and Xilinx Virtex-II FPGA chip with 7k or 24k (selectable) logic cells. Includes I/O cable and terminal board, data disk with Speedgoat xPC Target driver blocks for current release and one release prior, Simulink test models, and two selectable pulse train functionality implementations, each providing a fixed set of channels for pulse width modulation (PWM), capture (CAP), quadrature decoding of incremental encoder sensors (QAD), and generic parallel digital I/O (DIO).

I/O Module (Included)

I/O module	32-bit 33 MHz I/O module with 64 digital TTL lines
Pulse train functionality	Fixed set of PWM, capture, quadrature decoding, and generic digital I/O channels (two selectable implementations)
Drivers and test models	Speedgoat tools and drivers for xPC Target and Simulink test models

Accessories (Included)

Terminal board	68 terminals arranged in two rows, spring loaded, and SCSI3 female connector with 68 pins DIN rail mounting support Dimensions (<i>h x w x d</i>): 50 x 182 x 90 mm
Cable	6 ft/1.8 m round black cable with SCSI3 male connectors with 68 pins at both ends
Documentation	Description of I/O module and pulse train driver functionality for PWM, capture (CAP), quadrature decoding (QAD), and generic digital I/O (DIO)

Education FPGA Development Kit for xPC Target

Summary: Step-by-step guide showing how to develop custom FPGA implementations using the optional Motion Control FPGA Package, xPC Target, and Xilinx software tools (not included). Includes VHDL code examples and Simulink blocks for FPGA bitstream-download and FPGA application interaction.

QUESTIONS AND COMMENTS:

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