

Solution Proposal, for Quote Q_0415_104687

Prepared for:

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Project / Application description:

For robotic arm control, a flexible rapid control prototyping solution is required. The system shall run off 24VDC battery supply and offer expandability for possibly EtherCat or FlexRay in the future. Video logging may be required for this project.

The application is intended to run at a target sample rate of >1kHz.

This proposal specifies a Speedgoat real-time target machine that is:

- ✓ fully assembled and tested to meet your needs
- ✓ accompanied with quality services including
 - Hardware warranty
 - Technical support by phone and email
 - Free driver block updates
- ✓ shipped with test models, cables, and terminal boards



Key information provided by this solution proposal includes:

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Information about pricing and delivery lead-time is available in the attached quote Q_0415_104687.



Real-time target machine configuration

For the use in the field we typically recommend to use the low volume and low weight Mobile real-time target machine with an Intel Pentium M 1.4 GHz CPU installed. This target machine comes with no internal cabling and no moving components (fanless) and allows installing up to three I/O modules in the native PMC form factor: www.speedgoat.ch/Products/Real-timetargetmachines-MobileV1.aspx.



For high-volume data logging at high sample rates we recommend an upgraded solid-state drive (SSD) instead of the default 32GB SSD. Data stored on the SSD is accessible to you for example through the Simulink Real-Time Explorer in a very similar way as with the Windows Explorer.

For video acquisition, the onboard USB ports can be used with USB webcams. EtherCat Master can be added with one of our versatile Ethernet modules:

www.speedgoat.ch/Products/IOmodules-Protocols-EtherCATrtUDPRawEthernet/Default.aspx

FlexRay can also be added by adding an IO module:

www.speedgoat.ch/Products/IOmodules-Protocols-FlexRay-IO621.aspx

Warranty and Maintenance Services

Flexible services packages are project based engineering are available to protect your investments and ensure continuous maintenance of your real-time system: www.speedgoat.ch/Services

The 3 year full service package included with this proposal protects your investments by assuring full compatibility with future MathWorks software releases, providing access to latest features and advanced technical support, warranty on hardware and the immediate receipt of loaner components in case anything breaks, to assure minimal application downtime.

You can continue uninterrupted service in subsequent years by renewing your Speedgoat maintenance subscription annually.

The full service package is the optimal complement to your hardware purchase. An extended service package including 5 years warranty is available upon request.

To summarize, we propose the following:

Item ID	Qty	Product Name
105000	1	Mobile real-time target machine
105250	1	Mobile-SSD128GB

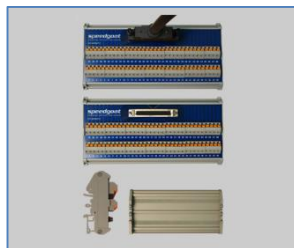
Installed I/O Connectivity

Speedgoat offers a large portfolio of I/O modules, including fixed-functional I/O connectivity, reconfigurable FPGA-based I/O connectivity, and extensive protocol interface support.

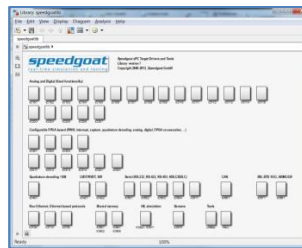
The delivery includes cables and terminal boards for all I/O modules, versatile Simulink Real-Time driver blocks, and a Simulink test model. Additional panel solutions are available upon request.



Cables



Terminal boards



Driver blocks



BNC/XLR panels

Requirements

These are the I/O and protocol requirements necessary for your project. They are used to provide you an appropriate system configuration:

- 1x CANopen

Based on the above I/O requirements list, we propose the following I/O modules:

CAN

I/O requirements

- 1x CANopen

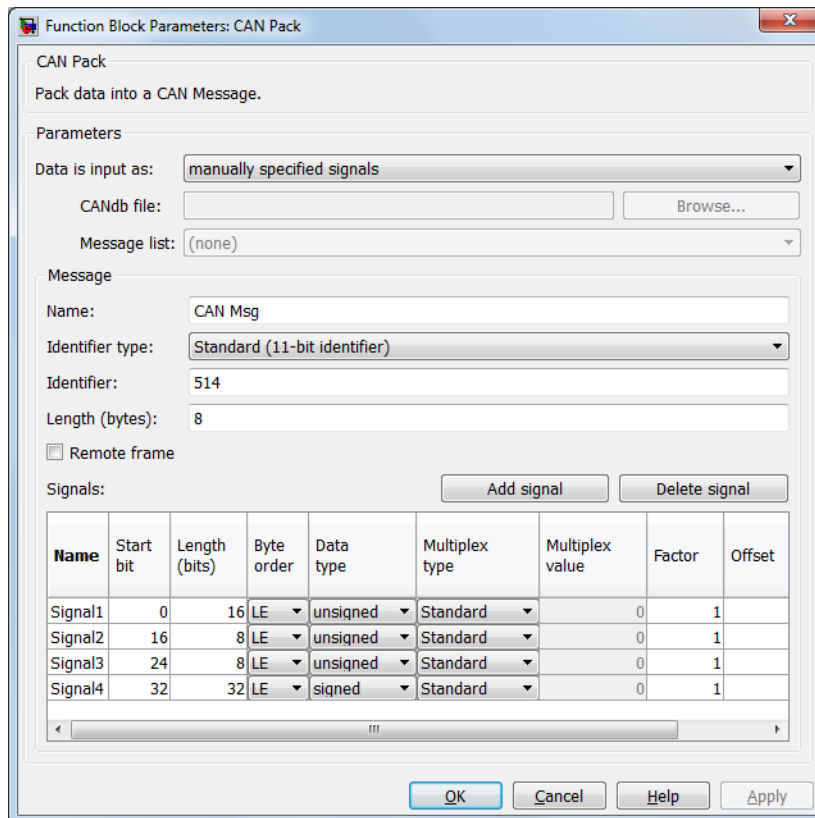
Qty	Item ID	Product Name	Key Functionality Provided
1	20601	IO601	<p>Intelligent CAN I/O module with two galvanic isolated high/low speed 2.0b CAN ports, or one CAN and one LIN port. SAE J1939 driver support is available for both ports. Including loopback test cable.</p> <p>For more information see: www.speedgoat.ch/Products/IOmodules-Protocols-CAN-IO601.aspx </p>

The IO601 I/O module provides two isolated 2.0b CAN ports. One port can also be used for LIN communication.

The IO601 I/O module provides two isolated 2.0b CAN ports. These ports are fully hardware compatible with the CANopen standard.

Please note that Simulink Real-Time currently doesn't provide native support for the CANopen application layer. Nevertheless several of our customers successfully interface with CANopen nodes with the IO601 card.

All CANopen PDO messages can be handled in the same way as ordinary CAN message. The complete 8 bytes can be used for data transmission:



Function Block Parameters: CAN Pack

Pack data into a CAN Message.

Parameters

Data is input as: manually specified signals

CANdb file: Browse...

Message list: (none)

Message

Name: CAN Msg

Identifier type: Standard (11-bit identifier)

Identifier: 514

Length (bytes): 8

☐ Remote frame

Signals:

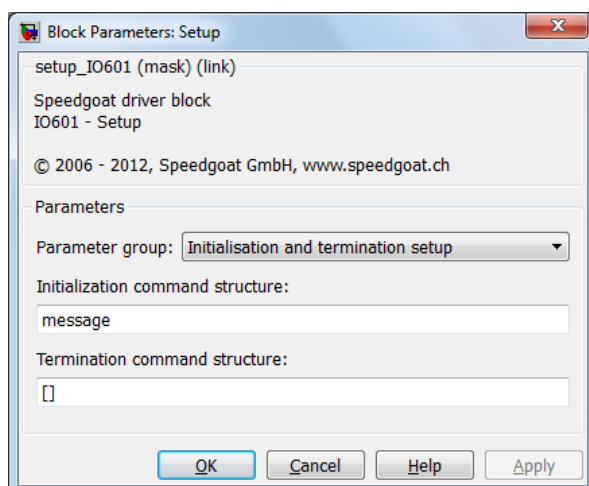
Name	Start bit	Length (bits)	Byte order	Data type	Multiplex type	Multiplex value	Factor	Offset
Signal1	0	16	LE	unsigned	Standard	0	1	
Signal2	16	8	LE	unsigned	Standard	0	1	
Signal3	24	8	LE	unsigned	Standard	0	1	
Signal4	32	32	LE	signed	Standard	0	1	

The CANopen standard defines a set of identifier numbers with four transmit and four receive PDOs. The slave ID is used as the offset to address particular nodes. For example:

Identifier	Function	Computation
385...511	Transmit PDO 1	384 + Slave ID
513...639	Receive PDO 1	512 + Slave ID

You can send to and receive messages from all slaves by using the corresponding identifier number in the "CAN Pack" blocks in your model.

The IO601 Setup block can execute initialization messages at the first model execution step. You can for example change operation mode of slaves by defining corresponding initialization messages:



Block Parameters: Setup

setup_IO601 (mask) (link)

Speedgoat driver block

IO601 - Setup

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Parameters

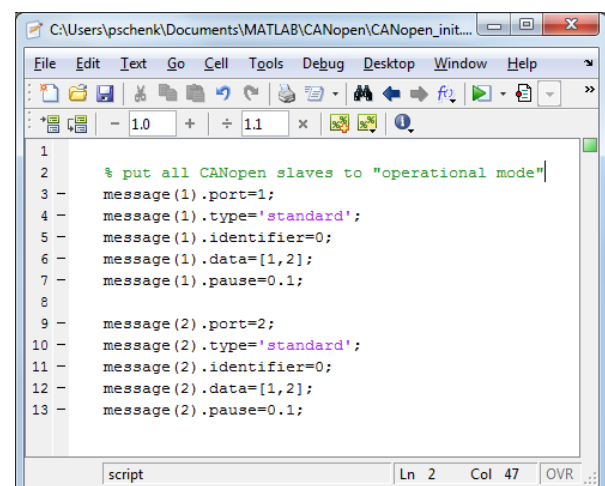
Parameter group: Initialisation and termination setup

Initialization command structure:

message

Termination command structure:

[]



```

1 % put all CANopen slaves to "operational mode"
2 message(1).port=1;
3 message(1).type='standard';
4 message(1).identifier=0;
5 message(1).data=[1,2];
6 message(1).pause=0.1;
7
8
9 message(2).port=2;
10 message(2).type='standard';
11 message(2).identifier=0;
12 message(2).data=[1,2];
13 message(2).pause=0.1;

```

script Ln 2 Col 47 OVR

Minimally achievable sample rates

To calculate achievable sample rates, I/O latencies of the I/O channel count configured in the Simulink driver blocks need to be added to the time required for the algorithmic calculation.

I/O latency calculation

This calculation provides information about the achievable sample rate, in case all I/O is acquired and generated at the same rate. It is possible to reduce latency if fewer I/O channels are used in the Simulink model, or if some channels are configured to run on slower rates.

QTY	I/O Module, functionality	Channel count	Formula [units: us]	Result [us]
			Total I/O latency:	0.0

Protocols are typically not included in the calculation due to the unknown load on the model. According to our experience, CANopen will not add critical latency to the system since it is working at a comparably slow speed.

Time required for the algorithmic calculation

This time depends on model complexity, the algorithmic load introduced, and available CPU performance. For your reference, the below table provides information about the time required for the algorithmic calculation using the default Simulink benchmark model: `xpcbench('this')`.

Target machine	Minimal	F14	F14*5	F14*10	F14*25
Mobile real-time target machine (standard configuration)	8	10	16	21	51

Model complexity (legend)

Minimal = Time required for kernel scheduling, host-target communication, and background tasks
F14 = 62 blocks and 10 continuous states (including minimal of 8 us for kernel scheduling)
F14 *5 = 310 blocks and 50 continuous states (5 x F14, including minimal of 8 us for kernel scheduling)
F14*10 = 620 blocks, 100 continuous states (10 x F14, including minimal of 8 us for kernel scheduling)
F14*25 = 1550 blocks, 250 continuous states (25 x F14, including minimal of 8 us for kernel scheduling)

Physical modeling tools from MathWorks (SimScape, SimPowerSystems, SimMechanics, etc) may introduce rather high latencies to the CPU, significantly higher than in the above benchmark. Based on our experience, up to 100us may be a more realistic assumption in this case.

Effective sample rates can only be proved by running your application on a target machine from Speedgoat. We are happy to benchmark models on request, and to assure confidentiality via NDAs.

Achievable sample time, and sample rates

The achievable sample rate of the complete real-time testing system depends on both, I/O latency and CPU calculation time (assuming a model with fairly high complexity):

I/O latency: 0.0us

Algorithmic calculation: 51us

Total: 51.0us

With the current configuration the estimated maximum model sample rates is: **51.0us/19.6kHz**.

This versatile target machine allows well achieving the required sample rate of >1kHz.

Software and Hardware Prerequisites

Speedgoat real-time target computer hardware together with Simulink Real-Time software from MathWorks forms a turnkey solution for real-time simulation and testing:

- Simulink Real-Time and Speedgoat solutions are designed to work together
- Real-time target machines are custom assembled to work out-of-the-box



MathWorks software

Prior to setting up your target machine, please ensure to have the following minimally required MathWorks software installed on your development computer:

	Current release R2015a – R2014a	R2013b and previous releases
MathWorks Software (minimally required)	MATLAB (32-bit or 64-bit) Simulink MATLAB Coder Simulink Coder Simulink Real-Time	MATLAB (32-bit or 64-bit) Simulink MATLAB Coder Simulink Coder xPC Target

For automatic HDL code generation, you require Simulink HDL Coder and Fixed-Point toolbox.

C Compiler

For C code generation using R2012a and newer, the free Microsoft Windows SDK 7.1, including .NET Framework 4.0 is required, see: www.mathworks.com/support/compilers.

For large and complex models you may take advantage of additional optimizations of the 2010 and 2012 edition professional compilers. Task execution time may decrease by up to 40-50%. Free trial versions are available at this link: <http://www.microsoft.com/en-us/download/details.aspx?id=30682>

HDL synthesizer for algorithm acceleration on FPGAs

For automatic HDL code generation on all IO33X FPGA-based I/O modules, the following additional software is required: Xilinx ISE Design Suite 14.x (part of Xilinx Vivado Design Suite)

For more information visit:

http://www.speedgoat.ch/Resources/Support/TargetMachineSetup/index.html?hdl_coder.htm.

Hardware

To connect your host PC with your target machine, your host PC needs to provide a spare Ethernet port. If not available, a USB-to-Ethernet Adapter can be used.

Besides, the following peripherals might be required:

- PC-compatible monitor with standard VGA or DVI-I connector, to display target scopes
- PS/2 compatible keyboard, to work with target scope commands (not typically required)

Quality Production, Support and Warranty Services

Together we work on products which will make a difference in the future. This is why we believe and are committed to the success of partnerships with you as the customer, and companies around the world as our suppliers.

Quality Production Engineering

Each Real-time target machine, fully assembled to meet your specific needs, goes through extensive burn-in tests to work-out-of-the-box.

Every single target machine is optimized and benchmarked to guarantee best real-time testing performance using Simulink and Simulink Real-Time. Each target machine is accompanied with configuration specific test models, cables, and pre-wired terminal boards to perform loopback tests.

Aftersales Support

Your success is our success: our job is only done, when your system is up and running.

We make sure to maintain your investment over a long period of time. Providing timely technical support is a standard and this independently if it's a simple driver use question or on how to upgrade your current system for your next high-tech project.

Subscription to our Systems Maintenance Service ensures full access to professional technical support by phone an e-mail, and free Speedgoat tools and driver updates compatible with future releases of MathWorks software.

Warranty

Speedgoat undergoes rigorous efforts when selecting and testing components to guarantee highest quality, performance, state-of-the-art functionality, and long term supply.

But even the best engineered product can break. Not a problem: Our Hardware Warranty Service Packages are the optimal complement to your hardware purchase. The Level One Hardware Warranty Service includes 3 years of warranty on hardware, and with our repair and on-stock services included we make sure that your system will be up and running again in the shortest possible amount of time.

Even outside of warranty we take the same complete care of repairing defective systems as we take in delivering new ones.

Long Term Supply

All key components used for our target machines are coming from the vendor's long term embedded programs, and the chassis of most target machines is a Speedgoat specific design produced in Switzerland.

To drive quality and innovation, Speedgoat maintains close ties with the manufacturers. As a result, duplicate systems can be created over a period of many years, and if something should happen to your machine quality repair and warranty services and spare parts are available.

Training and Consulting Services

Together with MathWorks, we provide training and consulting jump start services to our mutual customers all over the world. Do not hesitate to enquire for further information about available training and consulting services.