MicroLabBox

- Compact all-in-one development system for the laboratory
- More than 100 high-performance I/O channels with easy access
- Comprehensive support for electric motor control
- Three connector panel variants available

dSPACE

MicroLabBox

Compact prototyping unit for the laboratory

Highlights

- Compact all-in-one development system for laboratory purposes
- Dual-core real-time processor at 2 GHz
- User-programmable FPGA
- More than 100 channels of high-performance I/O
- Dedicated electric motor control features
- Ethernet and CAN bus interfaces
- Easy I/O access via integrated connector panel

Application Areas

MicroLabBox is a compact development system for the laboratory that combines compact size and cost-effectiveness with high performance and versatility. MicroLabBox lets you set up your control, test or measurement applications quickly and easily, and helps you turn your new control concepts into reality. More than 100 I/O channels of different types make MicroLabBox a versatile system that can be used in mechatronic research and development areas, such as robotics, medical engineering, electric drives control, renewable energy, vehicle engineering, or aerospace.

Key Benefits

High computation power combined with very low I/O latencies provide great real-time performance. A programmable FPGA gives you a high degree of flexibility and lets you run even extremely fast control loops, as required in applications such as electric motor control or active noise and vibration cancellation.

MicroLabBox is supported by a comprehensive dSPACE software package (p. 5), including, e.g., Real-Time Interface (RTI) for Simulink® for model-based I/O integration and the experiment software ControlDesk, which provides access to the real-time application during run time by means of graphical instruments.

Versatility through Connector Panel Variants

MicroLabBox is available in three connector panel variants (p. 3-4), offering different types and/or positions of the I/O connectors. The front panel variant provides Sub-D connectors at the front to access the connectors of the MicroLabBox when it is included in a stack of laboratory equipment or easily switch between wire harnesses. The top panel variant is available with two different connector types and is ideal for desk use.

Equipped with BNC and Sub-D connectors, the top panel MicroLabBox allows easy access to the analog I/O channels via probes that are typically used in laboratories to offer high analog signal quality. Additionally, a top panel variant with spring-cage terminal blocks, which are often used in industrial automation, is available. This means, signal connections can be changed very fast and conveniently by means of a common push-in and release mechanism of the clamp with a standard screwdriver. To make wiring and signal tracing as user-friendly as possible, all panel variants show the pinout information on the unit itself. The pinout information is also displayed in the I/O blocks of the implementation software Real-Time Interface (RTI).

Technical Details

Parameter		Specification		
MicroLabBox		**Front Panel Variant**	**Top Panel Variant with BNC Connectors**	**Top Panel Variant with Spring-Cage Terminal Blocks**
Processor	Real-time processor	■ NXP (Freescale) QorlQ P5020, dual-core, 2 GHz ■ 32 KB L1 data cache per core, 32 KB L1 instruction cache per core, 512 KB L2 cache per core, 2 MB L3 cache total		
	Host communication co-processor	■ NXP (Freescale) QorlQ P1011 800 MHz for communication with host PC		
Memory		■ 1 GB DRAM ■ 128 MB flash memory		
Boot time		■ Autonomous booting of applications from flash (depending on application size), ~5 s for a 5 MB application		
Interfaces	Host interface	■ Integrated Gigabit Ethernet host interface		
	Ethernet real-time I/O interface	■ Integrated low-latency Gigabit Ethernet I/O interface		
	USB interface	■ USB 2.0 interface for data logging ("flight recorder") and booting applications via USB mass storage device (max. 32 GB supported)		
	CAN interface	■ 2 CAN channels (partial networking supported)		
	Serial interface	■ 2 x UART (RS232/422/485) interface		
	LVDS interface	■ 1 x LVDS interface to connect with the Programmable Generic Interface PGI1		
Programmable FPGA[1)]		■ Xilinx® Kintex®-7 XC7K325T FPGA		
Analog input	Resolution and type	■ 8 14-bit channels, 10 Msps, differential; functionality: free running mode ■ 24 16-bit channels, 1 Msps, differential; functionality: single conversion and burst conversion mode with different trigger and interrupt options		
	Input voltage range	■ -10 ... 10 V		
Analog output	Resolution and type	■ 16 16-bit channels, 1 Msps, settling time: 1 µs		
	Output voltage range	■ -10 ... 10 V		
	Output current	■ ± 8 mA		
Digital I/O		■ 48 bidirectional channels, 2.5/3.3/5 V (single-ended); functionality: bit I/O, PWM generation and measurement (10 ns resolution), pulse generation and measurement (10 ns resolution), 4 x SPI Master ■ 12 bidirectional channels (RS422/485 type) to connect sensors with differential interfaces		
Electric motor control I/O functionality	Separate interfaces	■ 2 x Resolver interface		
	Functionality on digital I/O channels	■ 6 x Encoder sensor input ■ 2 x Hall sensor input ■ 2 x EnDat interface ■ 2 x SSI interface ■ Synchronous multi-channel PWM ■ Block commutational PWM		
Sensor supply		■ 1 x 12 V, max. 3 W/250 mA (fixed) ■ 1 x 2 ... 20 V, max. 1 W/200 mA (variable)		
Feedback elements		■ Programmable buzzer ■ Programmable status LEDs		
Theft protection		■ Kensington® lock		
Cooling		■ Active cooling (temperature-controlled fan)		
Physical connections		■ 4 x Sub-D 50 I/O connectors ■ 4 x Sub-D 9 I/O connectors	■ 2 x Sub-D 50 I/O connectors ■ 48 x BNC I/O connectors ■ 4 x Sub-D 9 I/O connectors	■ 2 x Sub-D 9 I/O connectors ■ 27 x spring-cage terminal block connectors with 8 pins each
		■ 3 x RJ45 for Ethernet (host and I/O) ■ USB Type A (for data logging) ■ 2 x 2 banana connectors for sensor supply ■ Power supply		

[1)] *User-programmable via RTI FPGA Programming Blockset. Using the RTI FPGA Programming Blockset requires additional software.*

Parameter		Specification		
MicroLabBox		**Front Panel Variant**	**Top Panel Variant with BNC Connectors**	**Top Panel Variant with Spring-Cage Terminal Blocks**
Physical characteristics	Enclosure size	■ Approx. 310 x 250 x 110 mm (12.2 x 9.8 x 4.3 in)	■ Approx. 310 x 250 x 115 mm (12.2 x 9.8 x 4.5 in)	■ Approx. 310 x 250 x 110 mm (12.2 x 9.8 x 4.3 in)
	Temperature	■ 0 ... 50 °C (ambient temperature)		
	Power supply	■ 100 ... 240 V AC, 50 ... 60 Hz		
	Power consumption	■ 125 W		

Panel Variants

MicroLabBox, front panel variant

MicroLabBox, top panel variant with BNC connectors

MicroLabBox, top panel variant with spring-cage terminal blocks

Order Information

Products	Order Number
MicroLabBox, front panel variant	■ MLBX_1302F
MicroLabBox, top panel variant with BNC Connectors	■ MLBX_1302T
MicroLabBox with spring-cage terminal blocks	■ MLBX_1302S

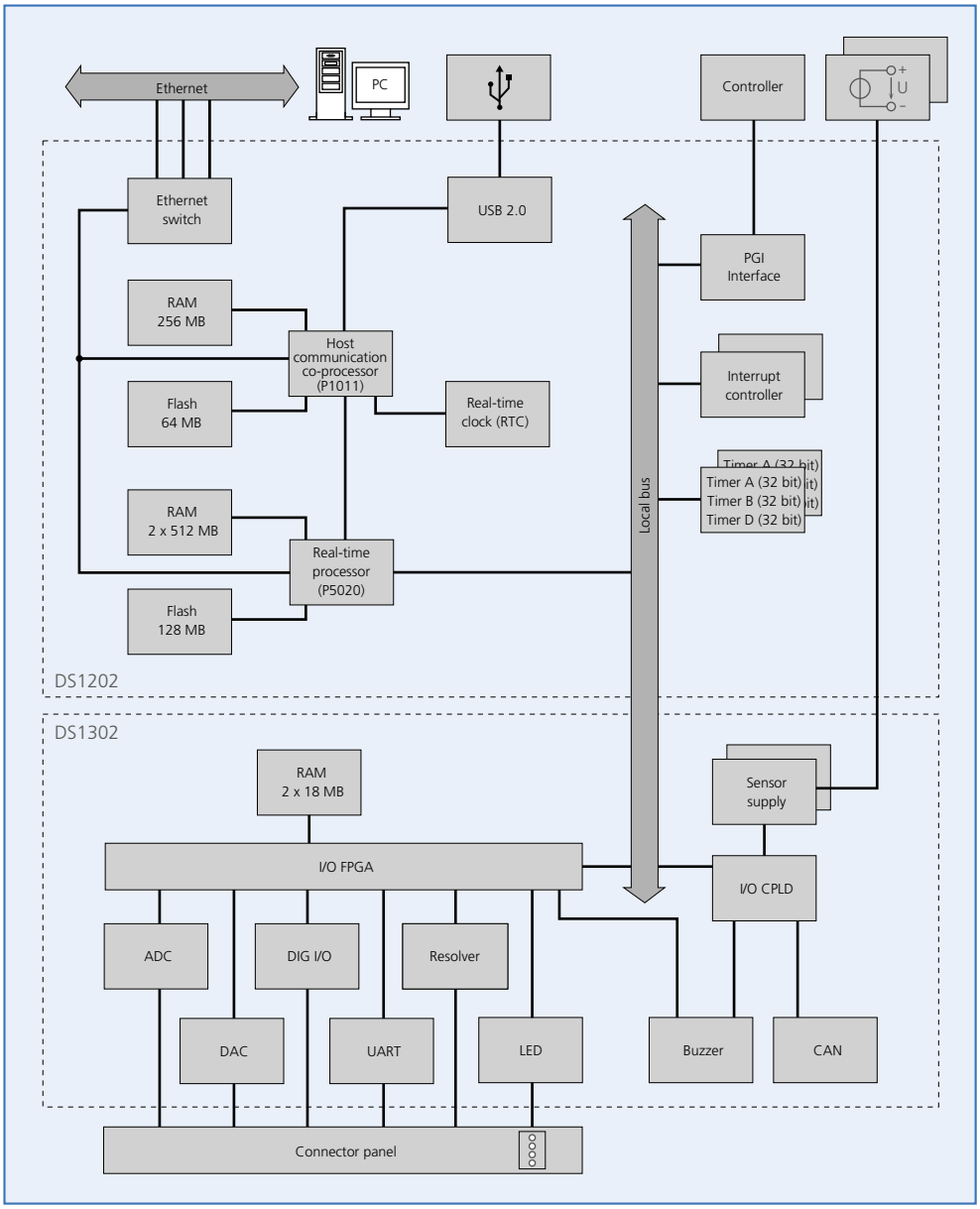
Relevant Software and Hardware

Software		Order Number
Included	■ Data retrieval utility for flight recorder read-out	–
	■ Comprehensive C libraries (e.g., digital I/O support)	–
Required	■ For Simulink®-based use cases: Real-Time Interface (RTI)	■ RTI
	■ GNU C Compiler for Power PC	■ MLBX_COMP
Optional	■ ControlDesk	See relevant product information
	■ For multi-core applications: RTI-MP	■ RTI_MP
	■ RTI CAN Blockset	■ RTICAN_BS
	■ RTI CAN MultiMessage Blockset	■ RTICANMM_BS
	■ RTI Electric Motor Control Blockset (p. 10-11)	■ RTI_EMC_BS
	■ RTI USB Flight Recorder Blockset (part of Real-Time Interface)	■ RTI
	■ RTI Ethernet Blockset	■ RTI_ETHERNET_IO
	■ RTI FPGA Programming Blockset	See relevant product information
	■ Platform API Package	■ PLATFORM_API

Hardware		Order Number
Included	■ Ethernet patch cable (HSL_PATCH) for host connection	–
	■ Power supply cable	–
	■ Set of Sub-D plugs	–
	■ Case for storage and transportation	–
Optional	■ Adapter cable 50-pin Sub-D to WAGO terminal panel	■ MLBX_CAB1
	■ RapidPro SC Unit	See relevant product information
	■ RapidPro Power Unit	See relevant product information

MicroLabBox

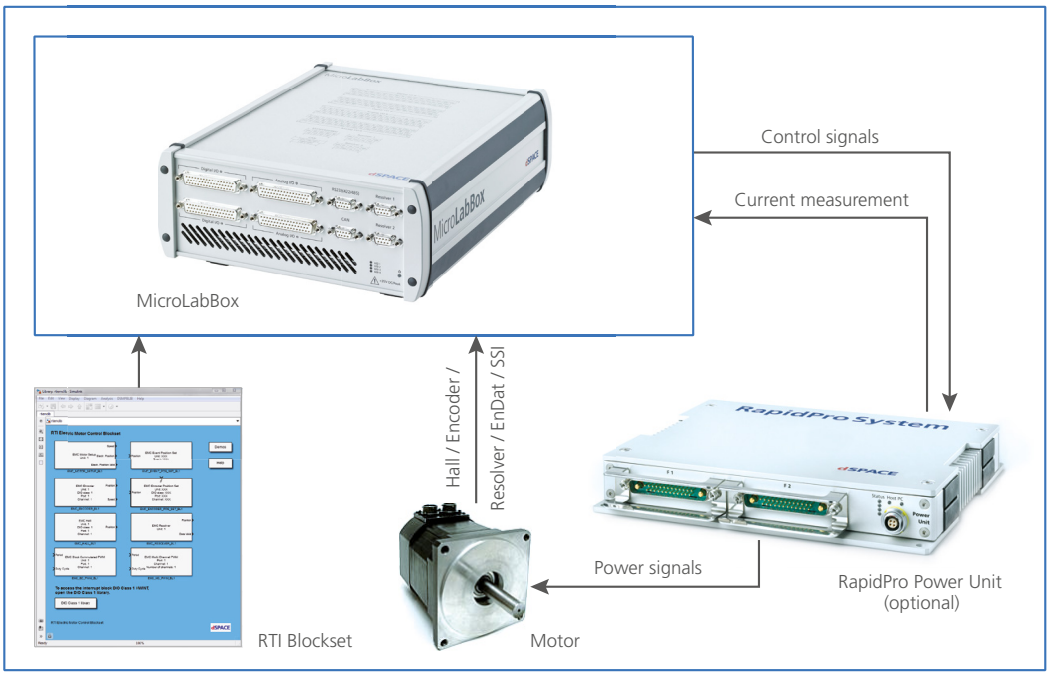
Block Diagram



Use Cases (Examples)

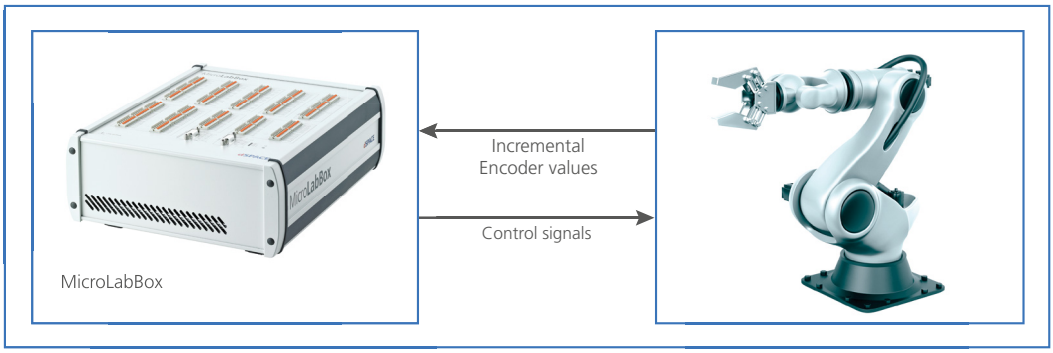
Developing Control Strategies for Electric Motors

MicroLabBox is ideal for developing control functions for many different electric motors, such as asynchronous motors, brushless DC (BLDC) motors, and permanent magnet synchronous motors (PMSM). The RTI blocks for electric motor control (p. 10, RTI Electric Motor Control Blockset) ensure convenient and comprehensive configuration options for the I/O interfaces.



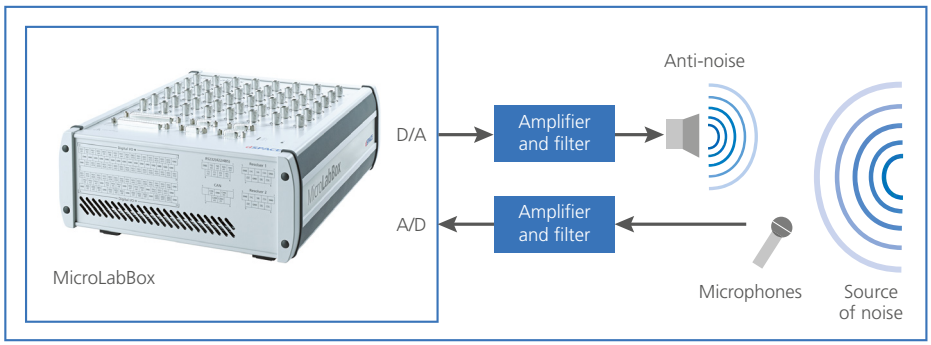
Rapid Control Prototyping in Robotics

Its numerous interfaces make MicroLabBox ideal for many kinds of robotics applications. In this example, MicroLabBox replaces the robot's position controller and receives the robot's incremental encoder signals for determining the current position of the robot. Then, the real-time processor calculates the control algorithm and sends the controller output with position and velocity data back to the robot. Thus, you can implement and test different control algorithms very quickly.



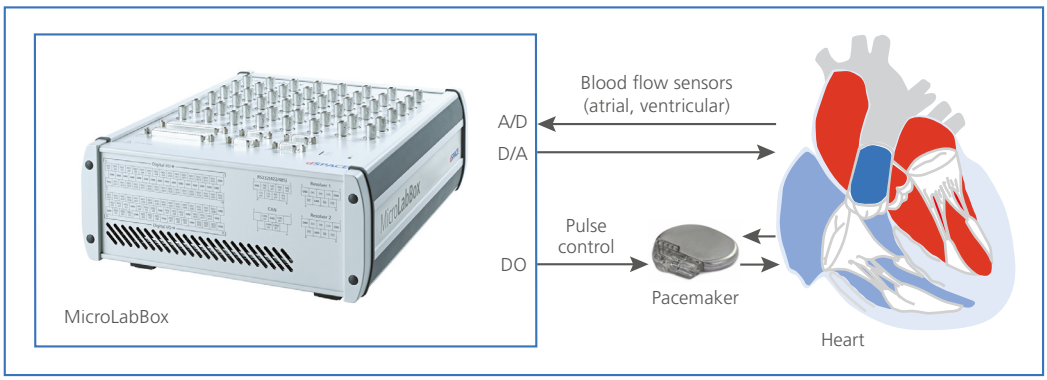
Active Noise Cancellation and Vibration Damping

Applications in active noise cancellation (ANC: e.g., for hi-fi headphones, cell phones or a passenger car cabin) and vibration damping (e.g., for reducing wear and tear or industrial plant noise) pose a particularly great challenge for signal processing. For ANC applications, for example, the anti-noise has to be calculated and generated before the original noise reaches the respective noise cancellation speaker or the point in space designated for noise cancelling. MicroLabBox's fast real-time processor and low-latency I/O access make it the right tool for developing new algorithms for active noise reduction and vibration reduction. MicroLabBox achieves control loops of only a few microseconds. If the requirements are even higher, the algorithms can always be offloaded to the integrated FPGA.



Developing and Testing Medical Devices

Safety and reliability play a crucial role in the development of medical devices. New functions must have an optimal design and undergo extensive testing. In many cases, capturing and preprocessing signals is an integral part of function development. With MicroLabBox, you can outsource extensive and computation-intensive signal preprocessing tasks, such as filtering or signal analysis, to an integrated FPGA. Connecting BNC cables directly to MicroLabBox for processing analog signals minimizes the influence of external errors on the signal and makes it possible to achieve a high signal quality. During or after the development of the medical device, MicroLabBox can also be used as a testing system. With it, you can reproducibly simulate many different environment conditions, e.g., based on test algorithms or existing measurement data. This increases the medical device's maturity, saves time, reduces costs, and minimizes the risks compared to tests on a living organism.

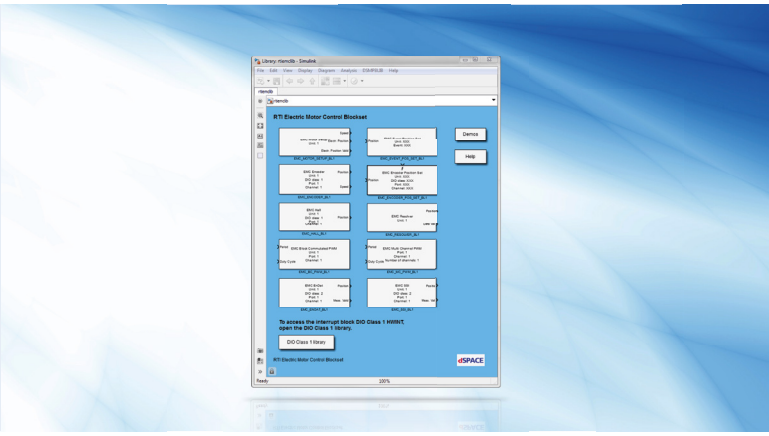


RTI Electric Motor Control Blockset

Configuring electric motor control I/O functions of MicroLabBox

Highlights

- Access to electric motor control specific I/O functionalities of MicroLabBox
- Easy configuration and implementation of Hall sensor inputs, incremental encoder, Resolver, EnDat, and SSI interfaces as well as PWM signal generation
- Automatic calculation and interpolation of the current motor speed, position, and angle, plus generation of asynchronous events



Application Areas

Electric motor controls play an important role in various application fields such as automotive industry, robotics, medical engineering, and many more, e.g., to comply with new, strict emission regulations or to build up more precise machines in industrial environments. Often, the control algorithm for an electric motor is a key point in fulfilling customers' requirements. But the effort of developing, implementing, and validating the required control algorithms in traditional tool chains can be very high, and these tool chains often lack flexibility. The MicroLabBox in combination with the RTI Electric Motor Control Blockset is the ideal system to reduce this effort. Developing and testing new control algorithms takes place in a model-based software environment with a minimum amount of time. The RTI Electric Motor Control Blockset is a user-friendly software interface that provides a link between your real-time hardware platform MicroLabBox and the model-based development software MATLAB®/Simulink®/Stateflow® from Mathworks.

Key Benefits

The RTI Electric Motor Control Blockset provides access to the electric motor control specific I/O functionalities of MicroLabBox and allows you to configure them easily and conveniently. No additional modeling effort is needed to use sensor interfaces commonly applied in electric motor applications such as Hall sensors, incremental encoder, resolver, EnDat, or SSI. In addition, ready-to-use Simulink blocks for generating different synchronous PWM signals are available. The current speed, position and angle of the electric motor are automatically calculated. If sensor interfaces with low resolution such as Hall sensors are used, an automatic interpolation can be enabled to achieve a higher sensor resolution and to improve the quality of the position measurement. When first starting the motor to get the current motor position it is possible to use the Hall sensor interface immediately, and then switch to a sensor with the higher resolution such as the encoder interface after one revolution of the electric motor. With this process, a valid position and the best resolution is always available for the controller. Simulink-based control models can be easily connected with the required I/O interfaces and then be downloaded to the MicroLabBox at the push of a button. The controller can be tested in a real environment with different sensors and actuators, and new motor control strategies can be developed much faster than in traditional tool chains.

Functionality Overview

Functionality	Description

General	■ Accessing and configuring dedicated I/O functions for:
	  ■ Resolver interfaces
	  ■ Encoder sensor inputs
	  ■ Hall sensor inputs
	  ■ EnDat interfaces
	  ■ SSI interfaces
	  ■ Synchronous multi-channel PWMs
	  ■ Block commutational PWMs
	■ For electric motors with up to 6 phases and 16 pole pairs
	■ Controlling 2 or more electric motors at the same time
	■ Combining 2 sensors to extrapolate the position of the motor's rotor
	■ Generating events for algorithm execution triggered by specified motor positions

Order Information

Product	Order Number
RTI Electric Motor Control Blockset	■ RTI_EMC_BS

Relevant Software and Hardware

Software			Order Number
Required	For MicroLabBox	■ Real-Time Interface[1)]	■ RTI

Hardware			Order Number
Required	For MicroLabBox	■ MicroLabBox[2)] with front or top panel	■ See p. 5

1) *For information on standard hardware and software requirements for Real-Time Interface (RTI), please see Real-Time Interface product information.*
2) *A corresponding compiler is required, please see p. 5.*

www.dspace.com

Germany
dSPACE GmbH
Rathenaustraße 26
33102 Paderborn
Tel.: +49 5251 1638-0
Fax: +49 5251 16198-0
info@dspace.de

United Kingdom
dSPACE Ltd.
Unit B7 · Beech House
Melbourn Science Park
Melbourn
Hertfordshire · SG8 6HB
Tel.: +44 1763 269 020
Fax: +44 1763 269 021
info@dspace.co.uk

France
dSPACE SARL
7 Parc Burospace
Route de Gisy
91573 Bièvres Cedex
Tel.: +33 169 355 060
Fax: +33 169 355 061
info@dspace.fr

Croatia
dSPACE Engineering d.o.o.
Ulica grada Vukovara 284
10000 Zagreb
Tel.: +385 1 4400 700
Fax: +385 1 4400 701
info@dspace.hr

China
dSPACE Mechatronic Control
Technology (Shanghai) Co., Ltd.
Unit 01-02,06-09, 19F/L
Middle Xizang Rd. 168
The Headquarters Building
200001 Shanghai
Tel.: +86 21 6391 7666
Fax: +86 21 6391 7445
infochina@dspace.com

Japan
dSPACE Japan K.K.
10F Gotenyama Trust Tower
4-7-35 Kitashinagawa
Shinagawa-ku
Tokyo 140-0001
Tel.: +81 3 5798 5460
Fax: +81 3 5798 5464
info@dspace.jp

USA and Canada
dSPACE Inc.
50131 Pontiac Trail
Wixom · MI 48393-2020
Tel.: +1 248 295 4700
Fax: +1 248 295 2950
info@dspaceinc.com

01/2020