IO691

CAN and CAN FD I/O Module

Hardware Reference Manual

v1.2

speedgoat
real-time simulation and testing

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Document Version History

Version Number	Document Action	Author	Date
1.0	Initial release	SoGr	06 February 2020
1.1	Extended Temperature Version added	SoGr	11 March 2020
1.2	Amended "Number of interfaces" in technical specification table	BeSc	25 January 2021

1 Technical Information

Description

The IO691 I/O module provides an intelligent CAN interface with two galvanically isolated channels supporting flexible data-rate CAN (CAN FD) and high-speed CAN (CAN HS) protocols. Driver blocks for Simulink Real-Time™ are also included.

The IO691 is compatible with CAN 2.0A/B networks and supports SAE J1939 and ASAM XCP for bypassing.

The IO691 is a Single Lane PCIe Mini (mPCIe) module providing CAN FD with up to 5 Mbps and a 64 data-byte payload, as well as CAN with up to 1 Mbps and a 8 data-byte payload. All the signals are accessible through two 9-pin D-sub front CAN connectors. Furthermore, given the "lean" on-board CAN firmware, the receive and transmit driver block latencies are minimal.

Due to the large variety of interface channels, the IO691 is suitable for many demanding applications; for example, test benches and manufacturing plants. This I/O module is also ideal for closed-loop controls, hardware-in-the-loop simulations and restbus simulation using MATLAB® and Simulink.

The IO691 is fully compatible with the Simulink Real-Time workflow. The extensive Simulink Real-Time driver blockset offers comprehensive functionality.

Features

CAN

- Two independent, galvanically isolated CAN channels for CAN FD and CAN HS (ISO 11898-2)
- Supports SAE J1939 and ASAM XCP for bypassing
- CAN FD with up to 8 Mbps and a 64 data-byte payload
- CAN with up to 1 Mbps and a 8 data-byte payload
- Compatible with CAN 2.0A messages (11-bit identifier) and CAN 2.0B messages (29-bit identifier)

2 Technical Specifications

Physical	
Form factor	mPCIe
Power requirements	300 mA max @ +3.3 V DC (0.726 W typical)
Bus	PCI Express x1
Galvanic Isolation	1 kV for 1 second
Weight	15 g
Connectors	2x 9-pin D-sub plug according to CiA 303-1
Environmental	
Operating temperature	-40 °C to +85 °C
Relative humidity	10 to 90 %, non-condensing
CAN	
Number of interfaces	2 interfaces configurable for CAN HS and CAN FD
CAN bus interface	High-speed CAN (according to ISO 11898-2), galvanically isolated
Transceiver	Microchip MCP2561FDE/SN
CAN controller	CAN-IP Core in EP4CGX Altera FPGA
Message Frame format	Base frame format CAN 2.0A (11-bit identifier), Extended Frame format: CAN 2.0B (29-bit identifier)
Buffer	Write buffer for 16 messages, Read buffer for 256 messages

3 Handling and Operating Instructions

3.1. ESD Protection

The module is sensitive to static electricity. Appropriate care must be taken when packing, unpacking and handling the module.

3.2. I/O Interface Installation

Make sure that the power is off. Plug the PCIe/PCI connector into the corresponding slot of the carrier card. Ensure the interface is securely held on the carrier card. Install the carrier card in the computer according to the instructions from the carrier card manufacturer.

Plug the expansion into the corresponding expansion connector. Make sure that the expansion is properly inserted into the socket. The interface automatically detects any installed expansions. If the expansion is not detected automatically, check that it is properly inserted.

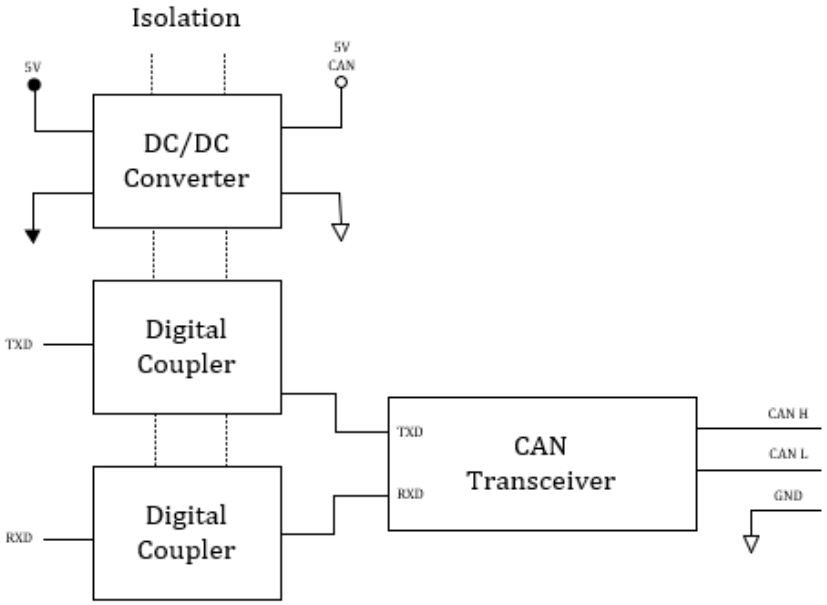
3.3. Assembly Recommendations

When removing the module from the carrier board, ensure mechanical stress is kept as low as possible.

4 Functional Description

4.1. CAN Bus

Each CAN channel offers galvanic isolated interfaces between the CAN transceiver and CAN controller, as shown below. Furthermore, the bus coupling can optionally be galvanically isolated. With galvanic, isolation, the shield of the CAN connector is connected to CAN ground through a 1 MΩ resistor and a 10 nF capacitor. The shields of the CAN connectors are directly connected together.

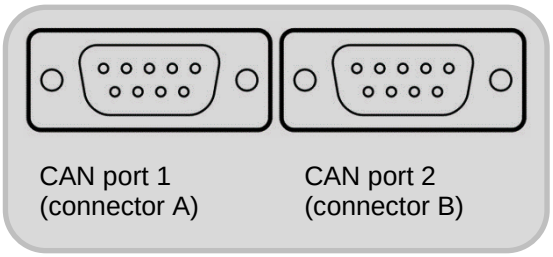


Galvanic isolation

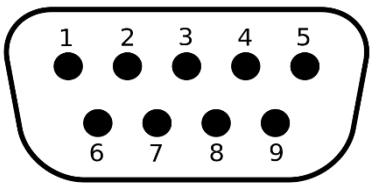
IMPORTANT	
Noise immunity	For the best noise immunity, Speedgoat recommends using shielded CAN cables, like the one delivered with the module.
Termination resistor	The IO691 I/O module features on-board 120 Ω termination resistors, which are disabled by default. For bus termination, a 120 Ω resistor is required between pins 2 and 7.

5 I/O Connector

Pin count:	9 pins
Connector type:	D-sub



5.1. Pin Mapping



9-pin D-Sub (male)

Pin	DB9 Connector A/B, Signal	Pin	Row Connector on PCB, Signal
1	-	**1**	-
2	CAN-Low	**2**	Ground
3	GND	**3**	Ground
4	-	**4**	-
5	-	**-**	-
6	GND	**-**	-
7	CAN-High	**-**	-
8	-	**-**	-
9	-	**-**	-

Note: Both 9-pin D-sub plugs have the same pin mapping.

Note: The IO691 I/O module has no feed-through option. Please use the module's channels as end-points within your bus to ensure optimal performance.

6 Standards and Certifications

This I/O module meets or exceeds the following standards:

EMC Compliance (CE)	This device complies with the Electromagnetic Compatibility Directive.
FCC Compliance	This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: • This device may not cause harmful interference. • This device must accept any interference received, including interference that may cause undesired operation.

7 Legal

As used herein, the term "Seller" shall mean Speedgoat GmbH, and term "Buyer" shall mean the person, firm or corporation executing a purchase order for "goods", sold by Seller (hereinafter "Products").

7.1. Limited Warranty

Seller warrants that the Products delivered hereunder shall be free from defects in workmanship and material under normal use and wear in accordance with Seller's instructions and specifications for a period of twenty-four (24) months from date of delivery to the Buyer, including component parts of Products sold as spare, replacement, maintenance or storage parts, which are also warranted for twenty-four (24) months from date of delivery, provided, however, in either case, that notice of any such defect is provided to Seller within thirty (30) days of its discovery by the Buyer. THE WARRANTY SET FORTH IN THIS SECTION SHALL BE IN LIEU OF ALL OTHER WARRANTIES, AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO WARRANTY OF MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE, AND FITNESS FOR ORDINARY PURPOSE USED OR PURPOSE INTENDED, ARE EXCLUDED. IN NO EVENT SHALL SELLER, ITS EMPLOYEES OR SUPPLIERS BE LIABLE, EITHER DIRECTLY OR BY WAY OF INDEMNIFICATION, TO BUYER OR ANY THIRD PARTY FOR (A) AN AMOUNT EXCEEDING THE PURCHASE PRICE OF THE PRODUCT IN QUESTION AND (B) ANY PUNITIVE, EXEMPLARY, SPECIAL, INDIRECT OR CONSEQUENTIAL LOSSES, DAMAGES OR INJURIES regardless of whether such claim is based upon delays in delivery or payment, breach of warranty, breach of contract, strict liability, negligence, or any theory now known or hereinafter adopted by legislation or by any court. Neither Seller nor its affiliates shall be liable for any damage or loss to exposure of Products and/or their packaging to the elements (including but not limited to rain, snow, sleet, sun, wind, floods, etc.); chemicals, corrosive solvents or soils; unauthorized or improper use, maintenance, storage or repair; due to any failure to follow Seller's manuals, warnings, notices or instructions; or due to any malfeasance, recklessness or negligence by Buyer, any employee or costumer of Buyer or any other third party.

EXCLUSIVE REMEDY: In any event, the Buyer's exclusive remedy hereunder is limited to the furnishing of replacement parts on an exchange basis, or, at the option of Seller, to the repair or replacement of defective Products or replacement parts at one of Seller's locations, but in either case only if the defective Product or part has been submitted to Seller during the period of warranty. The Buyer accepts and acknowledges that the foregoing allocation of risk is reflected in the purchase price.

The parties further agree that if any portion of the foregoing exclusion of damages is held to be voidable or void by reason of public policy or unenforceable for any other reason whatsoever, all remaining portions of the foregoing exclusion shall continue in effect.

THE WARRANTY SET FORTH ABOVE DOES NOT EXTEND TO: Any systems which have been damaged or rendered defective as a result of accident, misuse, or abuse; by the use of parts not manufactured, authorized or sold by Seller; by modification or as a result of service by anyone other than Seller; systems not containing original components or original replacement of components; damage during shipment, unless due to incorrect packaging by Seller; systems which fail or are damaged after delivery due to shipment, handling, storage, operation, use or maintenance in manner or environment not conforming to any published instructions or specifications issued by Seller.

In-warranty repaired or replacement parts or Products are covered by warranty only for the remaining unexpired portion of the original warranty period applicable to the repaired or replaced parts or Products. In other words, repair or replacement of Products or parts under warranty does not extend the original warranty period.

Products that are no longer part of the regular sales offering are considered EOL (end-of-life) and are repaired on a best-effort basis.

7.2. Extended Hardware Warranty Service

Extended Hardware Warranty Service is available as an option and must be purchased at the time the Products are purchased for which the warranty shall be extended.

The **Level One Hardware Warranty Service** extends the standard 24-month warranty period by 12 months resulting in a 36-month warranty period.

The **Level Two Hardware Warranty Service** extends the standard 24-month warranty period by 36 months resulting in a 60-month warranty period.

Hardware warranty terms exceeding the 60-month range are available on request.

7.3. Return

Buyer shall not return any Product without Seller's prior written consent. An R.M.A. (Return Material Authorization) number issued by Seller must accompany all returned material. An RMA number can be obtained by contacting the Seller's support department (support@speedgoat.com).

Within Warranty, Products returned and needing corrective repair are serviced at no-charge in accordance with the terms of Seller's Warranty policy.

Repairs on out of Warranty Products are performed at Buyer's expense.

Please pack the returned Products in their original shipping cartons, or in equivalent strong protective shipping cartons. Shipping costs from Buyer to Seller associated with warranty repairs or replacements shall be borne by the Buyer. Shipping costs for the return of repaired goods from Seller to Buyer shall be borne by Seller.

7.4. Systems Software Maintenance and Support Services

Delivery of Seller systems and hardware/software components by default include 12 months (1 year) of Systems Software Maintenance and Support Services.
Subscription to Systems Software Maintenance and Support Services includes access to Seller tools and driver software compatible with future releases of MathWorks software and professional technical support by phone and e-mail.

Subscription to Systems Software Maintenance and Support Services does not include free updates of existing custom implementations (FPGA bitstreams).

Software Maintenance and Support Renewal
For uninterrupted Systems Software Maintenance and Support Services in subsequent years Buyer may opt to renew its subscription annually to maintain its investment. Reinstatement if elapsed is possible on request, but incurs back maintenance charges of up to 6 months. Staying subscribed is the most cost-effective way to access latest advances and technical support.

7.5. Use of Speedgoat Software Including Tools and Drivers

LEGAL INFORMATION ABOUT THE USE OF SPEEDGOAT TOOLS AND DRIVERS: Speedgoat tools and drivers are optimized for hardware purchased from Seller and may be used only in conjunction with the hardware (serial no.) for which the tools and drivers were purchased for. Access to the Speedgoat tools and drivers is only available if the target machine component has active subscription to Systems Software Maintenance and Support Services.

Terms and Conditions for software components are defined in the Speedgoat End-User License Agreement (EULA).

8 Contact Information

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