



Product Information

CU3-TRIO • *CompactPCI*[®] • Triple Isolated RS-485 I/F

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Preliminary

Short Description

The CU3-TRIO is a peripheral slot card for CompactPCI® systems, equipped with a PCI Express® to UART bridge. Three high speed RS-485 balanced line transceivers with internal 5kV isolation barrier provide for optimum noise and EMC immunity. The front bezel D-Sub connectors withstand up to 250VAC measured against shield.

The 950-style UARTs (aka COM ports) are compatible with any asynchronous serial application. Device drivers are available for Windows® and Linux. The 16Mbps EIA/TIA-485 transceivers can be configured for full-duplex operation (4+1 wire cable) or half-duplex (2+1 wire cable), either point-to-point or multipoint applications.

Feature Summary

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CompactPCI®

- ▶ PICMG® CompactPCI® standard
- ▶ Single size Eurocard 3U 4HP 100x160mm²
- ▶ Suitable for CompactPCI® peripheral slot
- ▶ CompactPCI® backplane connector J1 for PCI® 32-bit 33/66MHz support
- ▶ On-board PCI® to PCI Express® bridge
- ▶ Option +5V only power supply

UART

- ▶ Pericom® PCI Express® quad UART PI7C9X7954
- ▶ High performance 950-class UARTs
- ▶ 16C550 software compatible
- ▶ 128-Byte FIFO for each transmitter/receiver
- ▶ Baud rate up to 15Mbps
- ▶ XON/XOFF in-band flow control
- ▶ CTS/RTS or DSR/DTR out-of-band control
- ▶ Data frame 5, 6, 7, 8 and 9 bits
- ▶ Clock prescaling 4 to 46
- ▶ Windows® & Linux device driver support

Feature Summary

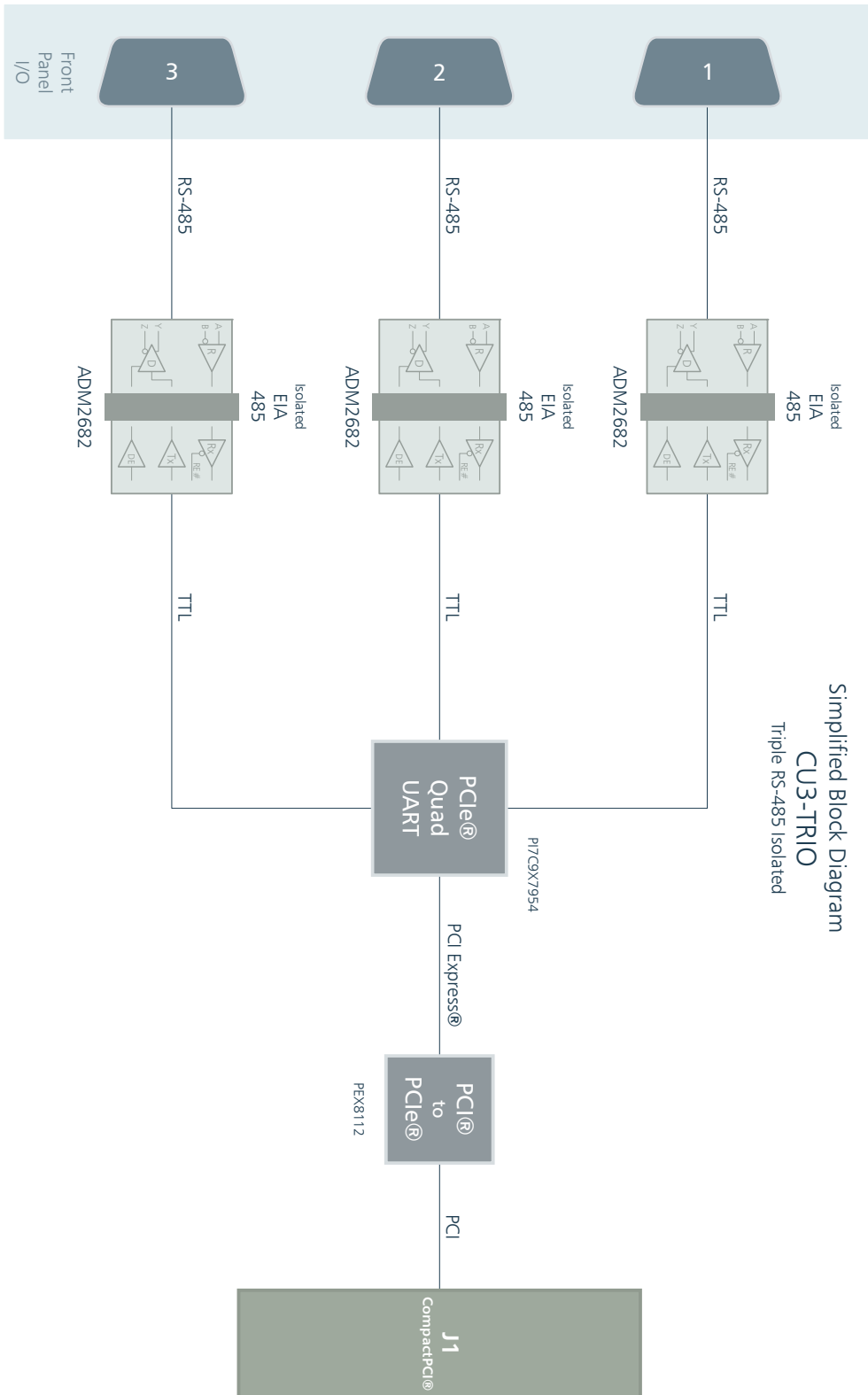
RS-485 Transceivers

- ▶ 5kV rms isolation barrier RS-485/RS-422 transceivers (Analog Devices)
- ▶ Configurable as half or full duplex
- ▶ ± 15 kV ESD protection on RS-485 input/output pins
- ▶ Data rate 16 Mbps
- ▶ Connect up to 256 nodes on one bus (driver enable control via DTR)
- ▶ Open- and short-circuit, fail-safe receiver inputs
- ▶ High common-mode transient immunity > 25 kV/ μ s
- ▶ Thermal shutdown protection
- ▶ 3 x Front panel male 9-pin D-Sub connectors
- ▶ RS-485 ports isolated against each other and board circuitry (limited to 250VAC by D-Sub connector characteristics)
- ▶ On-board DIP-switches for full/half-duplex setting, and line termination on/off

Environment, Regulatory

- ▶ Designed & manufactured in Germany
- ▶ Certified quality management according to ISO 9001
- ▶ Long term availability
- ▶ Rugged solution (coating, sealing, underfilling on request)
- ▶ Custom specific modifications on request
- ▶ RoHS compliant
- ▶ Operation temperature -40°C to $+85^{\circ}\text{C}$ (industrial temperature range)
- ▶ Storage temperature -40°C to $+85^{\circ}\text{C}$, max. gradient $5^{\circ}\text{C}/\text{min}$
- ▶ Humidity 5% ... 95% RH non condensing
- ▶ Altitude -300m ... $+3000\text{m}$
- ▶ Shock 15g 0.33ms, 6g 6ms
- ▶ Vibration 1g 5-2000Hz
- ▶ MTBF tbd years
- ▶ EC Regulations EN55022, EN55024, EN60950-1 (UL60950-1/IEC60950-1)

Block Diagram



Simplified Block Diagram
CU3-TRIO
Triple RS-485 Isolated

www.ekf.com/c/ccom/cu3/img/cu3_blk.pdf

Theory of Operation

The CU3-TRIO is equipped with the Pericom PI7C9X7954 PCI Express® quad UART, which is suitable for asynchronous baud rates up to 15Mbps. According to the RS-485 transmission line standard, only the UART receive and transmit data signals are in use, and in addition DTR as RS-485 driver enable control for half-duplex and multipoint configurations.

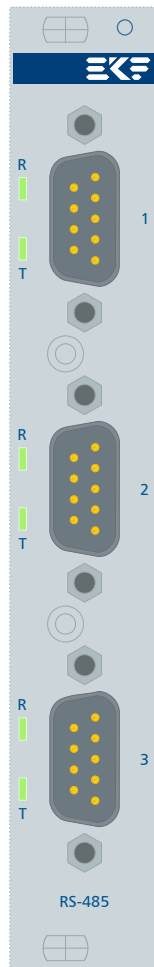
Three ADM2682E transceivers are provided to meet the RS-485 physical layer specifications. The RS-485 signals of both serial ports are isolated from the board circuitry, and also isolated from each other. Due to the D-Sub connector specification, a maximum of 250VAC between the RS-485 signals measured against shield (front bezel) must not be exceeded.

Standards - Specifications

Term	Document	Origin
CompactPCI®	CompactPCI® Specification, PICMG® 2.0 R3.0	www.picmg.org
PCI Express®	PCI Express® Base Specification	www.pcisig.com
RS-485	ANSI/TIA/EIA-485-A Standard Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems	www.tiaonline.org

Component Orientation

Front Panel



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CU3-TRIO
3 x RS-485

www.ekf.com/c/com/cu3/img/cu3_fpl.pdf

D-Sub Connectors

The CU3-TRIO is equipped with male 9-pin D-Sub front bezel connectors. Each connector is wired to an associated ADM2682E isolating RS-485 transceiver, thus achieving insulation of any port from each other and to the CU3-TRIO board GND.

Serial Ports 1 - 3 • Male D-SUB 9		
EKF Part No. 261.02.009.23		
	1	Shield (Frame Ground)
	2	B (Inverting Input)
	3	Isolated Ground
	4	Z (Inverting Output)
	5	Isolated Ground
	6	Isolated Ground
	7	A (Non-Inverting Input)
	8	Isolated Ground
	9	Y (Non-Inverting Output)

RS-485 Half-Duplex vs. Full-Duplex

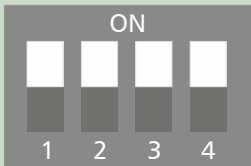
For a full-duplex RS-485 point-to-point or multipoint application, the receiver data lines A/B and the driver signals Y/Z require a twisted-pair wire each, resulting in a 2x2+1 wire network cable. RS-485 requires a common ground, by specification - this is referred to as signal C in the ANSI EIA-485 document. In many cases the additional ground wire can be omitted, if all RS-485 nodes are properly grounded. Sometimes the RS-485 cable shield is used as common ground.

For a half duplex RS-485 point-to-point or multipoint application, the receiver data lines A/B and the driver signals Y/Z must be tied together (A=Y, B=Z). This solution requires a single twisted-pair wire, resulting in a 2+1 wire network cable. The strapping between A/Y and B/Z can be done within the shell of the mating DB9 connectors. As an alternate, the CU3-TRIO provides on-board DIP-switches, which allow to join A/Y and B/Z internally (1=ON 2=ON).

DIP Switches (Each Port)

EKF Part No. 160.15.04.0

160.15.04.0
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1=OFF 2=OFF

Full-Duplex RS-485

1=ON 2=ON

Half-Duplex RS-485

3=ON

A/B Termination Active

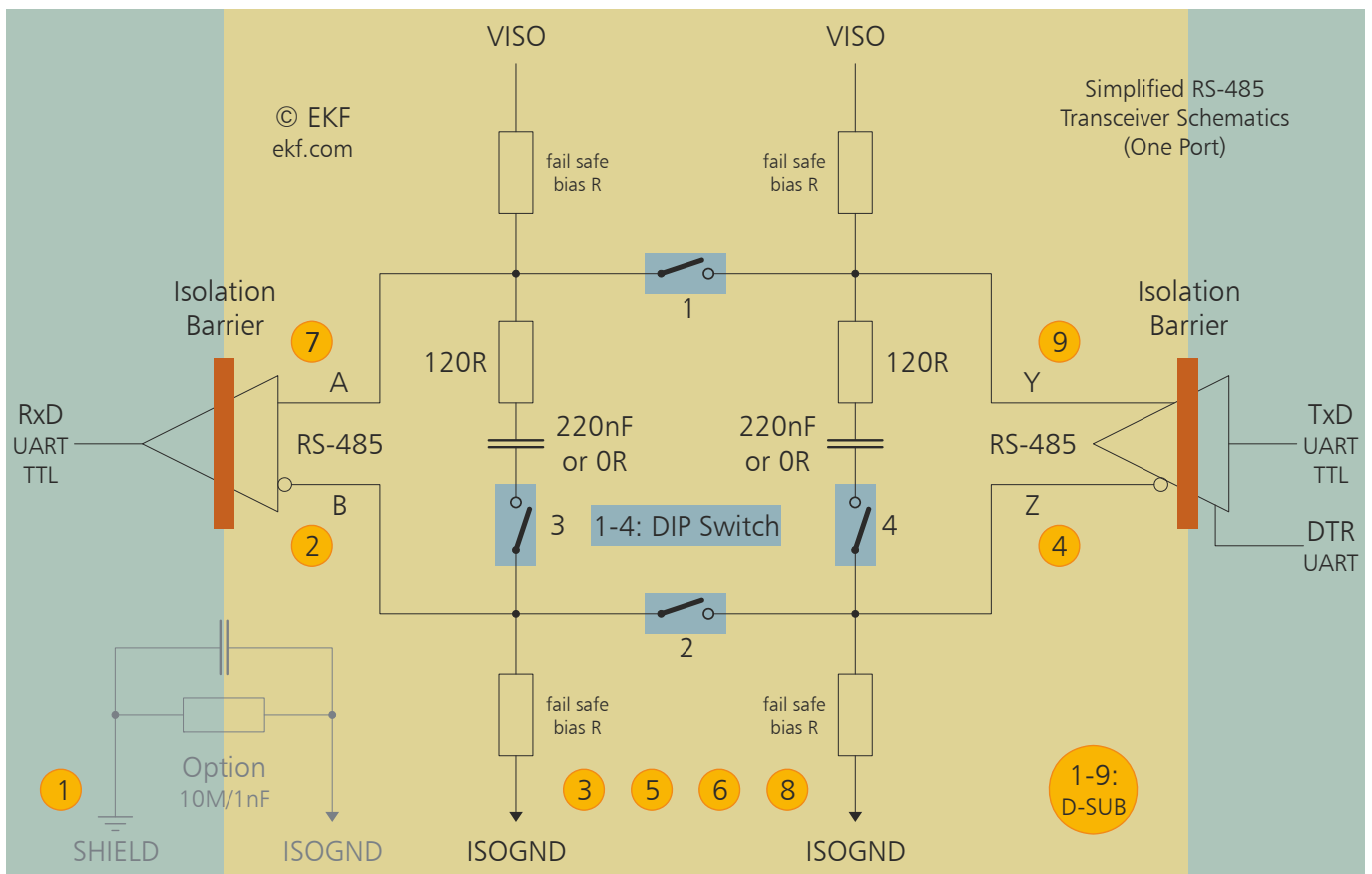
4=ON

Y/Z Termination Active (Full-Duplex Only)

RS-485 Line Termination

For signal integrity, both extreme ends of a RS-485 bus must be terminated, typically 120 Ohm between A/B and also Y/Z (full-duplex only), ideally matching the twisted pair cable impedance. A popular approach is to use external termination, having the resistors located within the shell of the DB9 cable connectors. As an alternate, the CU3-TRIO provides on-board DIP-switches, which can individually activate internal termination resistors on A/B and Y/Z.

By default, the internal termination is achieved by 120 Ohm & 220nF placed in series (AC termination). AC termination is used to reduce the power consumption of idle links as well as to reduce ringing voltages. The negative effect though is a reduction in cable length and bit rate. On request, the CU3-TRIO can be manufactured with DC termination (0-Ohm as a replacement for 220nF), for maximum signal integrity with long cables, at higher power consumption.



www.ekf.com/c/ccom/cu3/img/cu3_termination.pdf

Isolation Voltage

The maximum isolation voltage with respect to the CU3-TRIO depends mainly on the voltage rating specified for the D-Sub connectors (signal pins and isolated ground to frame ground). Several connector manufacturers specify the 'Dielectric Strength' as 1000VAC, and the 'Dielectric Withstanding Voltage' (DWV) as 500VAC rms, for 1 minute in each case. The rated connector voltage can be found as 250VAC (Suyin) or 300VDC (some other manufacturers).

In most cases, the reason for a superimposed voltage would be a ground loop, electromagnetic interference and/or electrostatic charging due to a long RS-485 cable. Whenever suitable, tie together externally (e.g. within the mating cable connector) isolated ground and shield, or couple loosely by 10M Ω /1nF 500VAC in parallel. On request, the CU3-TRIO can be manufactured with these components populated on-board, for each port individually.

Is RS-485 a Two-Wire Connection?

Is RS-485 a two-wire or a three-wire system? It is most definitely a three wire system (four plus one wire with respect to full-duplex operation). The TIA standard (ANSI/TIA/EIA-485-A, page 15, A.4.1) requires the presence of a common return path between all circuit grounds along the balanced line for proper operation.

The TIA standard defines a maximum common mode voltage range from -7V to +12V on the signal lines A and B, measured against C (common ground). A TIA/EIA-485 system however with only two wires A and B (C generator and C receiver commons not connected) can result in an unpredictable common mode voltage superimposed on the interface lines A and B, caused either by electrostatic charging or electromagnetic interference.

A 2-wire system often may work though due to idle-line fail-safe resistors at the receiver inputs, which can be considered as a loosely coupled common ground. Nevertheless this operation mode cannot be recommended - what is working flawless in the laboratory may not work reliable under real conditions in an industrial environment.

Where do we get the third wire? Many times the outer cable shield is used as the third (fifth) wire. However, EKF recommends to use a two pair cable (three pairs for full-duplex operation), with one or both wires of the additional pair as the dedicated common ground. Connect these additional wires directly to the pin 5 of the Micro-D connector for proper grounding.

The optimum cable solution would comprise an inner shield for each signal twisted pair. The inner shield can then be used for establishing the common ground between TIA/EIA-485 nodes (connect to pin 5 of the CU3-TRIO Micro-D connector).

An additional outer cable shield, that may cover the inner signal and ground cable pairs, should be connected to the metallic shell of the Micro-D connector. This shield should be grounded at one point only (isolate the shield at the opposite cable end in order to avoid any contact with the connector hood).

ANSI/TIA/EIA-485-A
Interconnect Application



G = Generator • R = Receiver • RT = Termination Resistor
 A/A' = Generator/Receiver Interface Point
 B/B' = Generator/Receiver Interface Point
 C/C' = Generator/Receiver Common

www.ekf.com/c/ccom/cu3/img/rs485_common_ground.pdf

Useful External Documents

Wikipedia	RS-485 Three-wire connection https://en.wikipedia.org/wiki/RS-485#Three-wire_connection
Article/ Blog	RS485 Cables – Why you need 3 wires for 2 (two) wire RS485 • www.chipkin.com/articles/rs485-cables-why-you-need-3-wires-for-2-two-wire-rs485
Application Note	AN960 • RS-485/RS-422 Circuit Implementation Guide • www.analog.com/static/imported-files/application_notes/AN-960.pdf

CompactPCI® Peripheral Slot Connector J1

The CU3-TRIO is equipped with a PCI to PCI Express® bridge. The card can be inserted in any peripheral slot of the CompactPCI® backplane for proper operation. As an option, the board can be populated with a +5V to +3.3V switched regulator, which would allow to use the CU3-TRIO in a +5V only system.

#J1	A	B	C	D	E
25	+5V	REQ64#	ENUM#	+3.3V	+5V
24	AD1	+5V	VI/O	AD0	ACK64#
23	+3.3V	AD4	AD3	+5V	AD2
22	AD7	GND	+3.3V	AD6	AD5
21	+3.3V	AD9	AD8	M66EN	C/BE0#
20	AD12	GND	VI/O	AD11	AD10
19	+3.3V	AD15	AD14	GND	AD13
18	SERR#	GND	+3.3V	PAR	C/BE1#
17	+3.3V	IPMB SCL	IPMB SDA	GND	PERR#
16	DEVSEL#	GND	VI/O	STOP#	LOCK#
15	+3.3V	FRAME#	IRDY#	BD_SEL#	TRDY#
14					
13			Not Keyed		
12					
11	AD18	AD17	AD16	GND	C/BE2#
10	AD21	GND	+3.3V	AD20	AD19
9	C/BE3#	IDSEL	AD23	GND	AD22
8	AD26	GND	VI/O	AD25	AD24
7	AD30	AD29	AD28	GND	AD27
6	REQ#	GND	+3.3V	CLK	AD31
5	BRSVP1A5	BRSVP1B5	RST#	GND	GNT#
4	IPMB PWR	HEALTHY#	VI/O	INTP	INTS
3	INTA#	INTB#	INTC#	+5V	INTD#
2	TCK	+5V	TMS	TDO ¹	TDI ¹
1	+5V	-12V	TRST#	+12V	+5V

pin positions printed grey: not connected

1 TDO - TDI internally connected

Driver Software

UART drivers are available for download from the EKF website at:
<http://www.ekf.com/c/ccom/cu3/drv/>

Ordering Information

Ordering Information

For popular CU3-TRIO SKUs please refer to
www.ekf.com/liste/liste_20.html#CU3

Related Links to CompactPCI® UART Cards

CU3-TRIO Home	www.ekf.com/c/ccom/cu3/cu3.html
CompactPCI® UART Solutions	www.ekf.com/c/ccom/ccom.html
CompactPCI® Serial UART Solutions	www.ekf.com/s/serial.html#SU

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