SYSTEM

Technical Information

DU1-MUSTANG

XMC Module

Dual-Port Isolated RS-485 Interface

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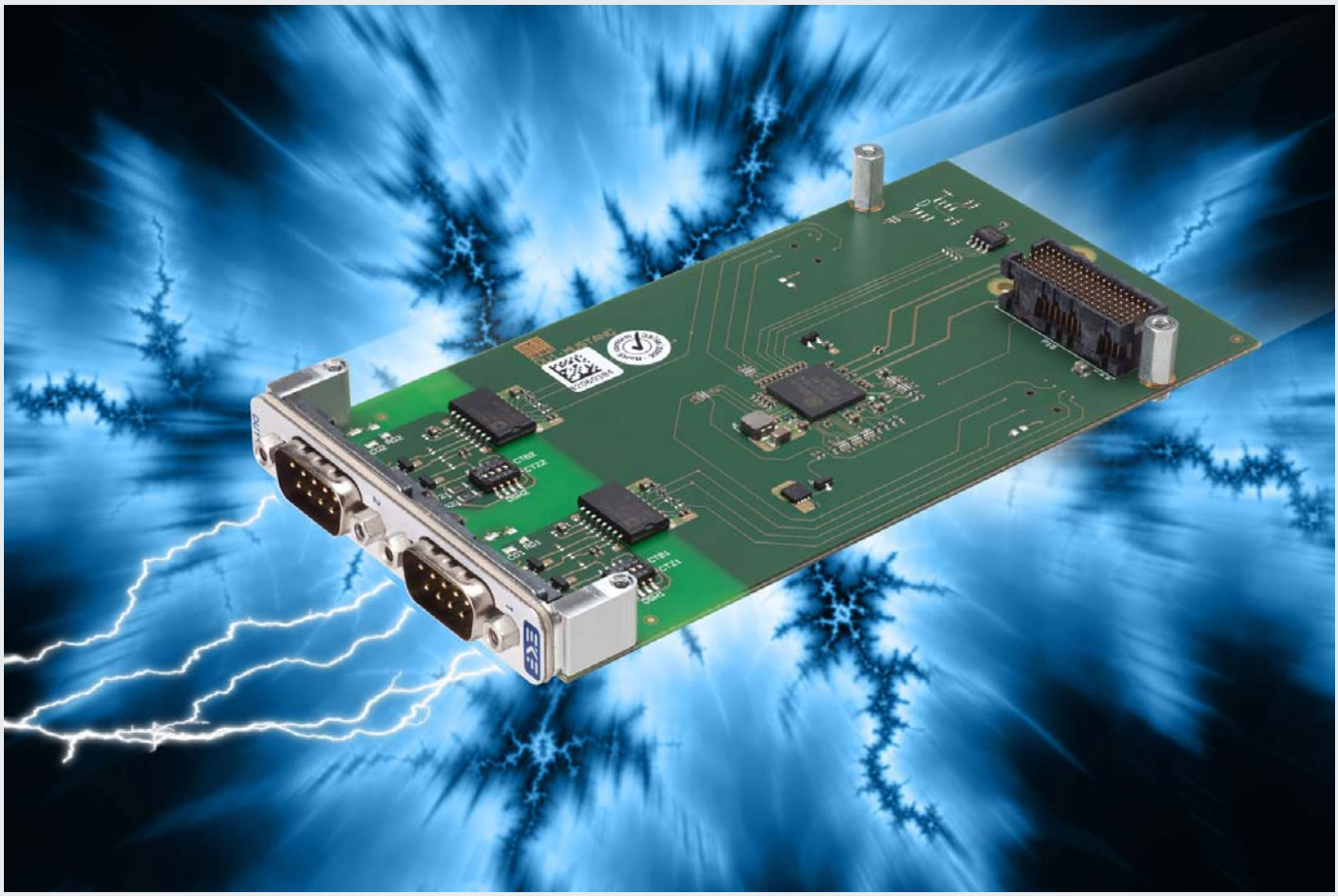


Contents

About this Manual

This manual is a short form description of the technical aspects of the DU1-MUSTANG, required for installation and system integration. It is intended for the advanced user only.

Edition History

Ed.	Contents/*Changes*	Author	Date
1	Technical Information DU1-MUSTANG, english, preliminary edition Text #6706, File: du1_ti.wpd	jj	15 May 2012
2	Added photos	jj	23 August 2012
3	Added photos	jj	11 September 2012
4	Storage temperature -40°C to +125°C, added photo	jj	17 January 2013
5	Added photos XMC 2.0 VITA 61 connector P15	jj	13 August 2014
6	Changed photo	jj	20 November 2014
7	MTBF added	jj	24 June 2016
8	Added photo with EK4-WALTZ CompactPCI® Express carrier card	jj	24 June 2016

Related Documents

Related Information	
DU1-MUSTANG Home	www.ekf.com/d/dcom/du1/du1.html
DU2-PONY Home	www.ekf.com/d/dcom/du2/du2.html
SK2-SESSION XMC Carrier (CompactPCI® Serial Card)	www.ekf.com/s/sk2/sk2.html
SK3-MEDLEY XMC Carrier (CompactPCI® Serial Card)	www.ekf.com/s/sk3/sk3.html
SK4-WALTZ XMC Carrier (CompactPCI® Serial Card)	www.ekf.com/s/sk4/sk4.html
EK4-WALTZ XMC Carrier (CompactPCI® Express Card)	www.ekf.com/e/ek4/ek4.html

Nomenclature

Signal names used herein with an attached '#' designate active low lines.

Trade Marks

Some terms used herein are property of their respective owners, e.g.

- CompactPCI, CompactPCI PlusIO, CompactPCI Serial: ® PICMG
- Windows: ® Microsoft
- EKF, ekf system: ® EKF

EKF does not claim this list to be complete.

Legal Disclaimer - Liability Exclusion

This document has been edited as carefully as possible. We apologize for any potential mistake. Information provided herein is designated exclusively to the proficient user (system integrator, engineer). EKF can accept no responsibility for any damage caused by the use of this manual.

Standards

Reference Documents		
Term	Document	Origin
CompactPCI®	CompactPCI Specification, PICMG® 2.0 R3.0, Oct. 1, 1999	www.picmg.org
CompactPCI® PlusIO	CompactPCI PlusIO Specification, PICMG® 2.30 R1.0, November 11, 2009	www.picmg.org
CompactPCI® Serial	CompactPCI Serial Specification, PICMG® CPCI-S.0 R1.0, March 2, 2011	www.picmg.org
CompactPCI® Express	CompactPCI Express Specification, PICMG® EXP.0 R2.0, March 22, 2013	www.picmg.org
PXI™ Express	PXI Express Hardware Specification, PXI Systems Alliance	www.pxisa.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
XMC XMC 2.0	ANSI/VITA 42.0 & 42.3, IEEE P1386.1 / Draft 2.4 & Draft 2.4a ANSI/VITA 61	www.vita.com

Technical Features

Feature Summary

Feature Summary
▸ Form factor XMC single-width mezzanine card 139mm x 74mm
▸ Stack height 10mm XMC to host
▸ Host I/F Connector P15 XMC - PCI Express, single lane, single link
▸ Option P15 connector according to XMC 2.0 (white housing)
▸ +3.3V operated (VPWR not in use)
▸ PCI Express® bridge to dual-port UART
▸ PLX Oxford 950 UART w. 128-byte transmit/receive FIFO
▸ Asynchronous baud rates up to 15Mbps
▸ Windows® & Linux device driver support
▸ 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/μs
▸ Thermal shutdown protection
▸ Two front bezel 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
▸ Suitable e.g. for industrial, transportation & instrumentation applications
▸ Designed & manufactured in Germany
▸ ISO 9001 certified quality management
▸ Long term availability
▸ Rugged solution
▸ Coating, sealing, underfilling on request
▸ RoHS compliant
▸ Operating temperature: -40°C to +85°C
▸ Storage temperature: -40°C to +125°C, max. gradient 5°C/min
▸ Humidity 5% ... 95% RH non condensing
▸ Altitude -300m ... +3000m
▸ Shock 15g 0.33ms, 6g 6ms
▸ Vibration 1g 5-2000Hz
▸ MTBF 121.5 years
▸ EC Regulations EN55022, EN55024, EN60950-1 (UL60950-1/IEC60950-1)

Short Description

The DU1-MUSTANG is a XMC standard single-width mezzanine card, equipped with a PCI Express® to dual-UART bridge. Two 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.

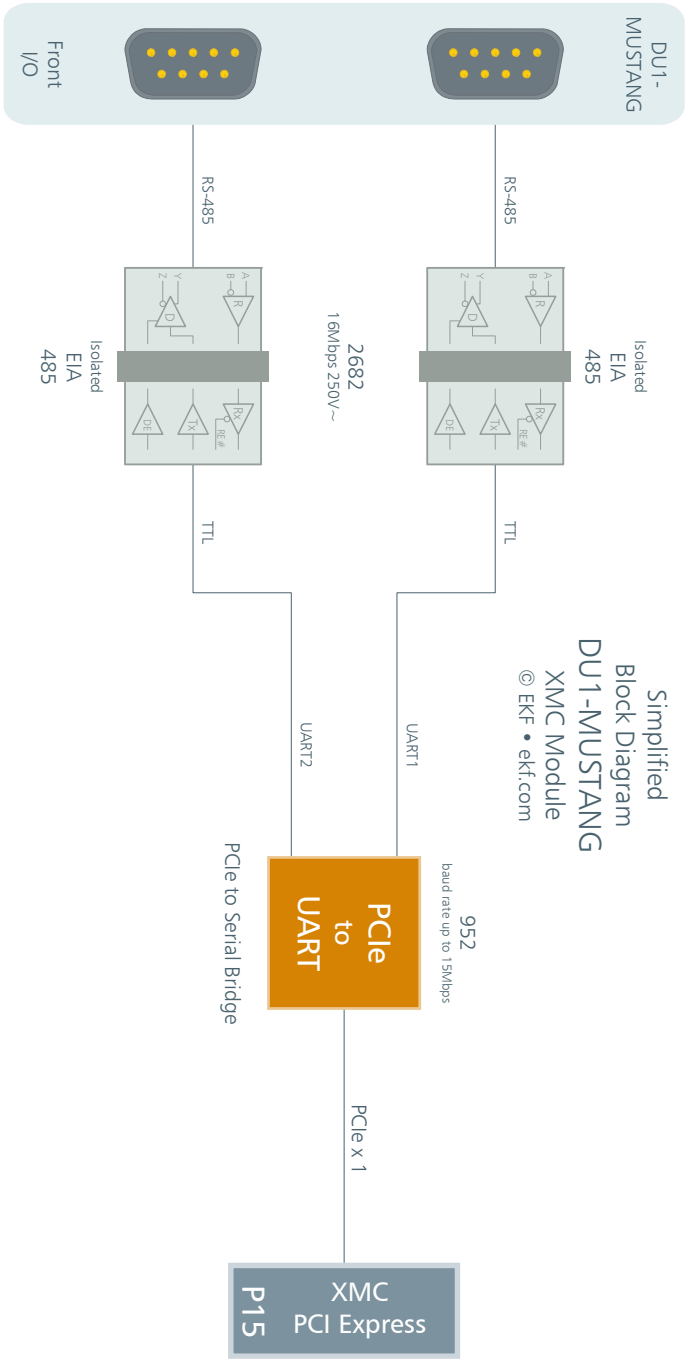
The 950-style UARTs (COM ports) are compatible with any asynchronous serial application. Certified device drivers are available for Windows®. The 16Mbps EIA/TIA-485 transceivers can be configured for full-duplex operation (4+1 wire cable) or half-duplex (2+1 wire cable), either point-to-point or multipoint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

Theory of Operation

The DU1-MUSTANG is equipped with the PLX OXPCIe952 single chip PCI Express® to UART bridge, 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.

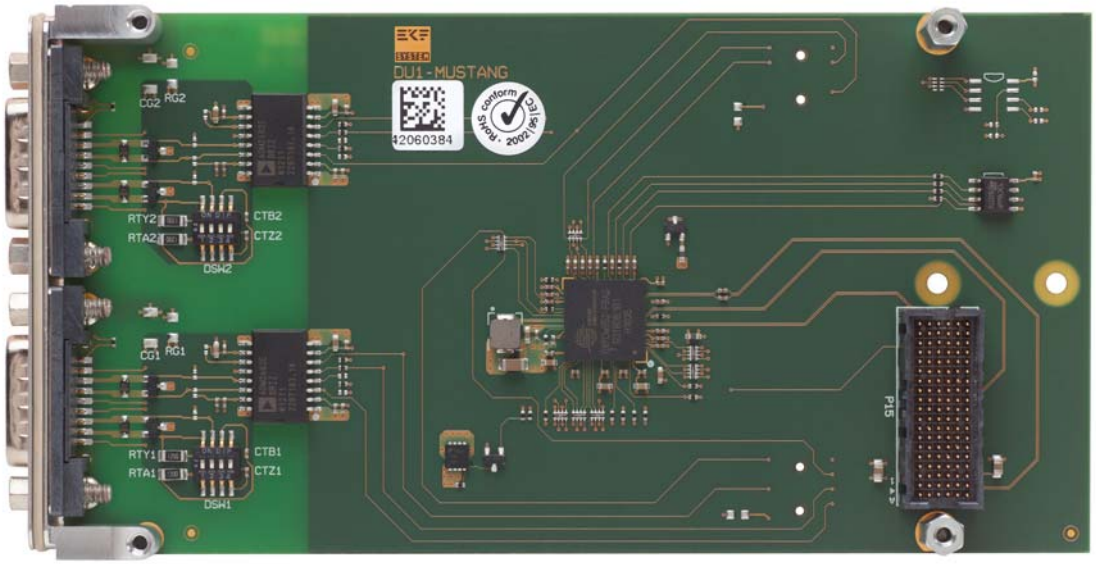
Two ADM2682E transceivers are provided to meet the RS-485 physical layer specifications. The RS-485 signals of both serial ports are isolated from the board circuitry, and also isolated from each other. Due to the D-Sub connector specification, a maximum of 250VAC between the RS-485 signals measured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

Block Diagram



Front Bezel

Assembly View



Installing and Replacing Components

Before You Begin

Warnings

The procedures in this chapter assume familiarity with the general terminology associated with industrial electronics and with safety practices and regulatory compliance required for using and modifying electronic equipment. Disconnect the system from its power source and from any telecommunication links, networks or modems before performing any of the procedures described in this chapter. Failure to disconnect power, or telecommunication links before you open the system or perform any procedures can result in personal injury or equipment damage. Some parts of the system can continue to operate even though the power switch is in its off state.

Caution

Electrostatic discharge (ESD) can damage components. Perform the procedures described in this chapter only at an ESD workstation. If such a station is not available, you can provide some ESD protection by wearing an antistatic wrist strap and attaching it to a metal part of the system chassis or board front panel. Store the board only in its original ESD protected packaging. Retain the original packaging (antistatic bag and antistatic box) in case of returning the board to EKF for repair.

Installing the Board Assembly

Warning

This procedure should be done only by qualified technical personnel. Disconnect the system from its power source before doing the procedures described here. Failure to disconnect power, or telecommunication links before you open the system or perform any procedures can result in personal injury or equipment damage.

Typically you will perform the following steps:

- Switch off the system, remove the AC power cord
- Attach your antistatic wrist strap to a metallic part of the system

- Remove the board packaging, be sure to touch the board only at the front panel
- Identify the related CompactPCI® slot (peripheral slot for I/O boards, system slot for CPU boards, with the system slot typically most right or most left to the backplane)
- Insert card carefully (be sure not to damage components mounted on the bottom side of the board by scratching neighboured front panels)
- A card with onboard connectors requires attachment of associated cabling now
- Lock the ejector lever, fix screws at the front panel (top/bottom)
- Retain original packaging in case of return

Removing the Board Assembly

Warning

This procedure should be done only by qualified technical personnel. Disconnect the system from its power source before doing the procedures described here. Failure to disconnect power, or telecommunication links before you open the system or perform any procedures can result in personal injury or equipment damage.

Typically you will perform the following steps:

- Switch off the system, remove the AC power cord
- Attach your antistatic wrist strap to a metallic part of the system
- Identify the board, be sure to touch the board only at the front panel
- unfasten both front panel screws (top/bottom), unlock the ejector lever
- Remove any onboard cabling assembly
- Activate the ejector lever
- Remove the card carefully (be sure not to damage components mounted on the bottom side of the board by scratching neighboured front panels)
- Store board in the original packaging, do not touch any components, hold the board at the front panel only

Warning

Do not expose the card to fire. Battery cells and other components could explode and cause personal injury.

EMC Recommendations

In order to comply with the CE regulations for EMC, it is mandatory to observe the following rules:

- The chassis or rack including other boards in use must comply entirely with CE
- Close all board slots not in use with a blind front panel
- Front panels must be fastened by built-in screws
- Cover any unused front panel mounted connector with a shielding cap
- External communications cable assemblies must be shielded (shield connected only at one end of the cable)
- Use ferrite beads for cabling wherever appropriate
- Some connectors may require additional isolating parts

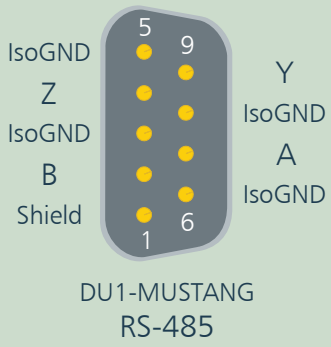
Technical Reference

D-Sub Connectors

The DU1-MUSTANG is equipped with two male 9-pin D-Sub front bezel connectors. Each connector is wired to an associated ADM2682E isolating RS-485 transceiver, hence insulation of both ports from each other and to the DU1-MUSTANG module GND has been achieved.

Serial Ports 1 / 2 • Male D-SUB 9

EKF Part No. 261.02.009.23



www.ekf.com/d/dcom/du1/img/du1_dsub.pdf

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)

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 document. In some cases the additional ground wire can be omitted, if all RS-485 nodes are grounded by other means. Sometimes the RS-485 cable shield is used as common ground.

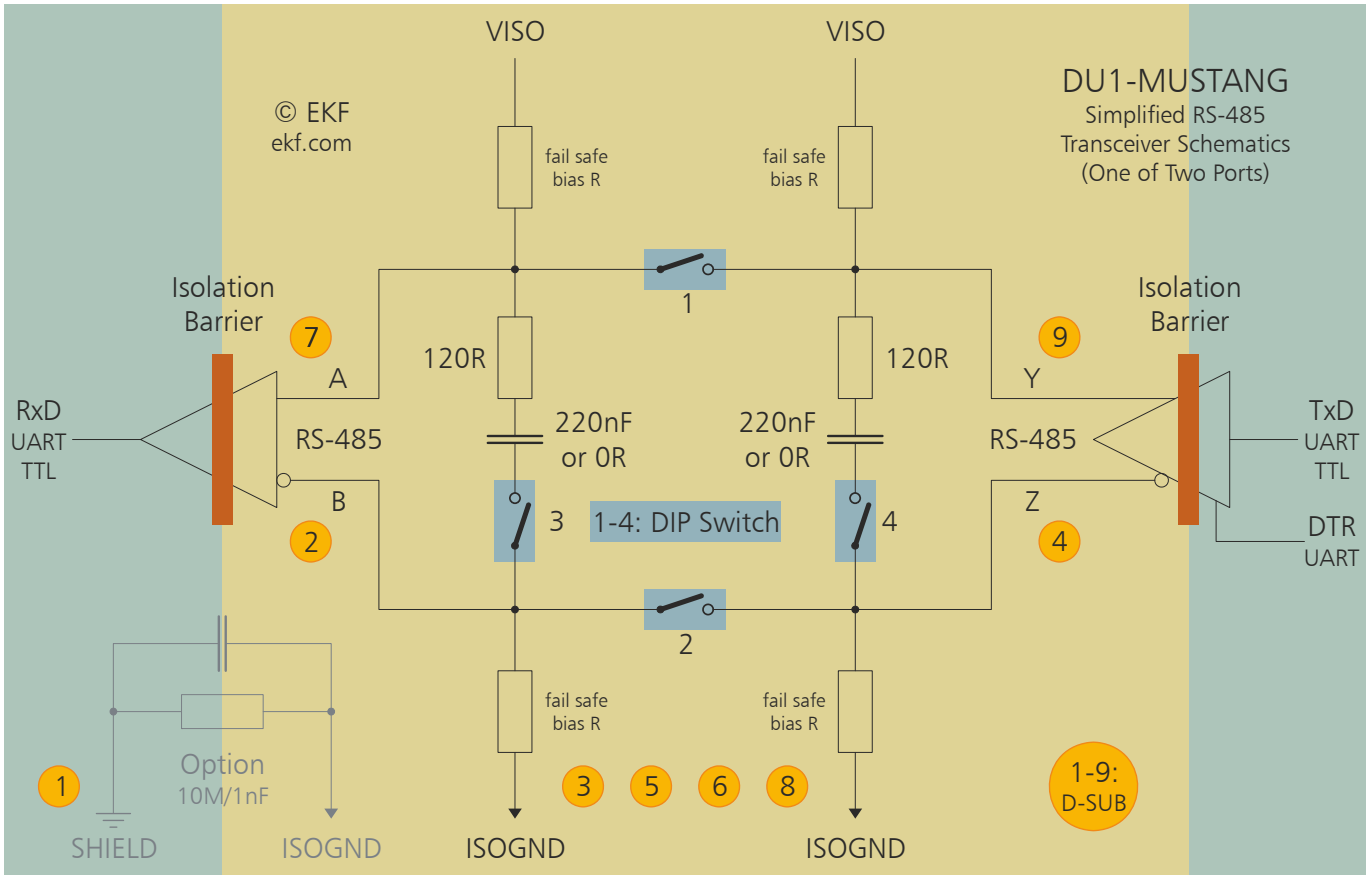
For a half duplex RS-485 point-to-point or multipoint application, the receiver data lines A/B and the driver signals Y/Z must be tied together (A=Y, B=Z). This solution requires a single twisted-pair wire, resulting in a 2+1 wire network cable. The strapping between A/Y and B/Z can be done within the shell of the mating DB9 connectors. As an alternate, the DU1-MUSTANG provides on-board DIP-switches, which allow to join A/Y and B/Z internally (1=ON 2=ON).

DIP Switches 1/2 EKF Part No. 160.15.04.0		
	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 DU1-MUSTANG 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 DU1-MUSTANG 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/d/dcom/du1/img/du1_termination.pdf

The maximum isolation voltage with respect to the DU1-MUSTANG 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 10MOhm/1nF 500VAC in parallel. On request, the DU1-MUSTANG 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 ore 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 pins 3, 6 & 5, 8 of the DB9 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 pins 3, 6 & 5, 8 of the DB9 connector).

An additional outer cable shield, that may cover the inner signal and ground cable pairs, should be connected to the pin 1 of the connector (it is equivalent and sufficient to connect the shield with the metallic shell of the DB9 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

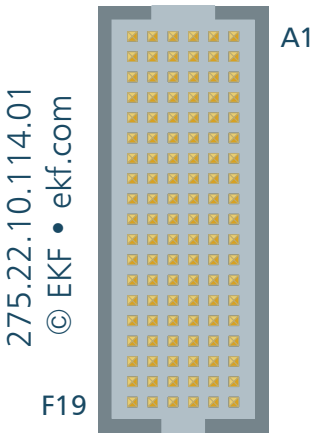
G = Generator • R = Receiver • RT = Termination Resistor
A/A' = Generator/Receiver Interface Point
B/B' = Generator/Receiver Interface Point
C/C' = Generator/Receiver Common

www.ekf.com/d/dcom/du1/img/rs485_common_ground.pdf

Useful External Documents	
TIA-485-A	ANSI/TIA/EIA-485-A Standard • Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems • www.tiaonline.org/standards/
ADM2682E	Datasheet • 16Mbps, 5 kV rms Signal & Power Isolated RS-485 Transceiver with ±15 kV ESD Protection • www.analog.com/static/imported-files/data_sheets/ADM2682E_2687E.pdf
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

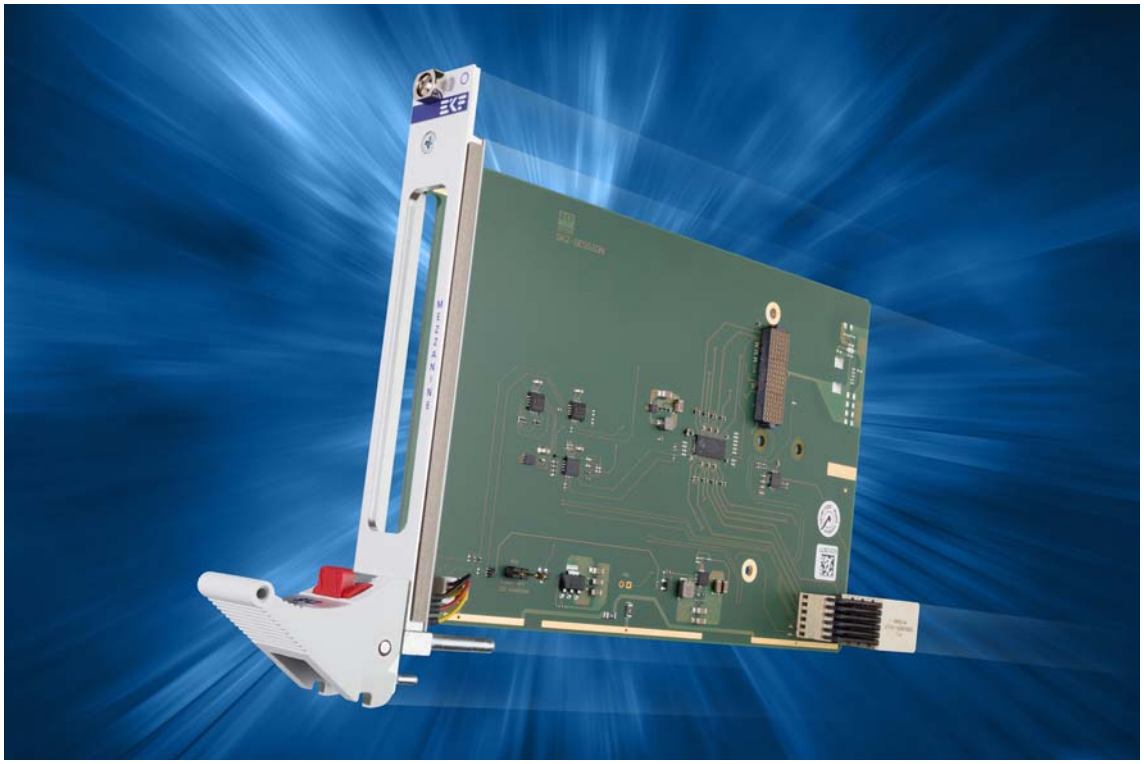
P15 Mezzanine Connector

The DU1-MUSTANG is equipped with a high speed XMC mezzanine connector P15, mating with the host board J15 and establishing the data path (PCI Express®) and power link to the carrier. The pin assignment of P15/J15 is specified by VITA 42.3. The DU1-MUSTANG is organized as single-lane single-link PCI Express® device.



XMC Module

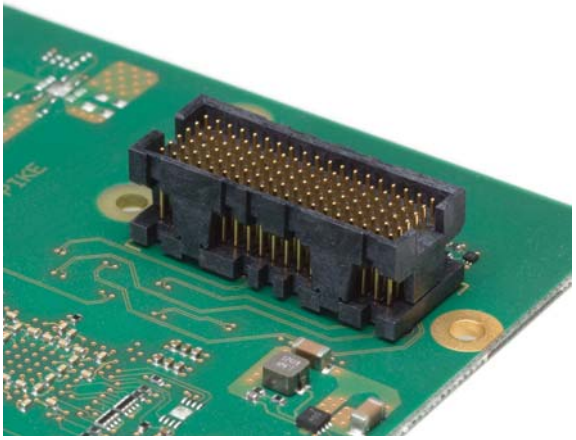
ANSI/VITA 42.3 defines a primary XMC connector P15, which is mandatory (for PCIe fabric), and a secondary XMC connector P16, which is optional (either fabric or user I/O). The DU1-MUSTANG does not make use of P16. Suitable carrier cards are available from EKF, e.g. the SK2-SESSION CompactPCI® Serial XMC module carrier board.



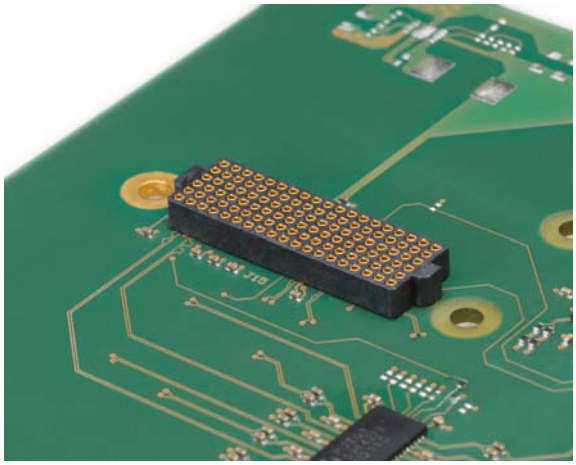
SK2-SESSION • CompactPCI® Serial • XMC Module Carrier Board

As an option, the DU1-MUSTANG can be equipped with a P15 connector according to the XMC 2.0 style, as defined by VITA 61.0. Carrier card and module connectors J15/P15 must match - VITA 61 and VITA 42 XMC connectors are not intermateable. Both connector styles can be easily distinguished from each other by the connector body colour as visual key.

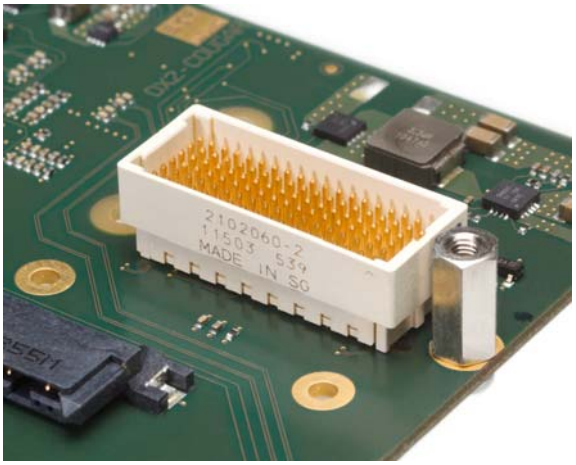
Black = VITA 42 XMC
Off-white = VITA 61 XMC 2.0



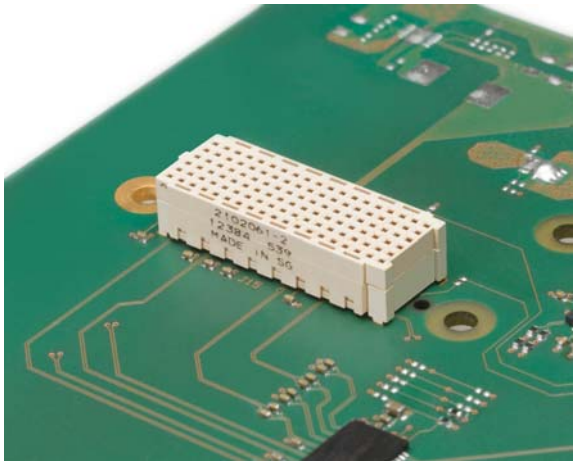
XMC Connector P15



XMC Connector J15



XMC 2.0 Connector P15



XMC 2.0 Connector J15

XMC Connector P15 - PCIe Fabric • EKF Part No. 275.22.10.114.01						
	A	B	C	D	E	F
1	PET0P0	PET0N0	+3.3V	*PET0P1*	*PET0N1*	VPWR [2]
2	GND	GND	TRST# [1]	GND	GND	MRSTI#
3	*PET0P2*	*PET0N2*	+3.3V	*PET0P3*	*PET0N3*	VPWR [2]
4	GND	GND	*TCK*	GND	GND	*MRSTO#*
5	*PET0P4*	*PET0N4*	+3.3V	*PET0P5*	*PET0N5*	VPWR [2]
6	GND	GND	*TMS*	GND	GND	*+12V*
7	*PET0P6*	*PET0N6*	+3.3V	*PET0P7*	*PET0N7*	VPWR [2]
8	GND	GND	*TDI*	GND	GND	*-12V*
9	*RFU*	*RFU*	*RFU*	*RFU*	*RFU*	VPWR [2]
10	GND	GND	*TDO*	GND	GND	GA0 [1]
11	PER0P0	PER0N0	*MBIST#*	*PER0P1*	*PER0N1*	VPWR [2]
12	GND	GND	GA1 [1]	GND	GND	MPRESENT#
13	*PER0P2*	*PER0N2*	*+3.3V_AUX*	*PER0P3*	*PER0N3*	VPWR [2]
14	GND	GND	GA2 [1]	GND	GND	MSDA [1]
15	*PER0P4*	*PER0N4*	*RFU*	*PER0P5*	*PER0N5*	VPWR [2]
16	GND	GND	MVMRO	GND	GND	MSCL [1]
17	*PER0P6*	*PER0N6*	*RFU*	*PER0P7*	*PER0N7*	*RFU*
18	GND	GND	*RFU*	GND	GND	*RFU*
19	CLKP_XMC	CLKN_XMC	*RFU*	*WAKE#*	*ROOT0#*	*RFU*

pin positions printed italic/gray: reserved by specification / not connected

1) Serial EEPROM not populated by default (no IPMI)

2) VPWR is not in use on the DU1-MUSTANG (+3.3V only design)

SK2-SESSION • CompactPCI® Serial Carrier Board

EK4-WALTZ • CompactPCI® Express Carrier Board

Drivers

The Windows® drivers for the PLX/Oxford UART can be downloaded here:

DU1-MUSTANG Driver Software
www.ekf.com/d/dcom/du1/drv/

The driver software has been configured for the UART DTR signal to control the enable status of the RS-485 line transmitters. In addition, a master/slave application protocol must be established by the customer. This is necessary to avoid data interference which would otherwise occur on a RS-485 bus. Only the point-to-point RS-485 full-duplex configuration (two nodes, 4+1 wire cable) does not need a protocol. As a manufacturing option, the transmitters can be set to permanently enabled for this application.

The DU1-MUSTANG has its RS-485 line receivers permanently enabled. Consequently, the echo of any string sent out will also be feed back to the sending node in a half-duplex configuration. As a manufacturing option, the receivers could be configured to be disabled whenever the transmitters are enabled, as an echo cancellation method.

Schematics

For better understanding, the schematics of the DU1-MUSTANG RS-485 line transceivers are available:

DU1-MUSTANG Schematics
www.ekf.com/d/dcom/du1/img/du1_scm_6_7.pdf

Complete circuit diagrams for this product are available for customers on request. Signing of a non-disclosure agreement would be needed. Please contact sales@ekf.de for details.

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MEZZANINE
DU1

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