



## Product Information

SUE - SUF - SUG - SUH - SUI - SUJ • Isolated RS-232 & RS-485 Transceiver Modules

Front Connectors Micro-D - RJ45 - D-Sub



## Short Description

*The SUE - SUJ series of isolated COM port transceiver modules are converters from an UART TTL-level interface to either RS-485 or RS-232 cable connection. The small modules are optionally available with Micro-D, RJ45, or D-Sub front connectors. All modules are equipped with a 2.0mm socket for either direct mounting to a suitable carrier card, or alternatively to be attached by means of a micro ribbon flat cable assembly.*

With their dimensions of 59mm (length) and 20mm (width), up to four SUE - SUH modules (Micro-D, RJ45) fit into a 3U/4HP front panel. The SUI - SUJ modules are provided with a classic D-Sub connector, which requires 31mm front space. All modules were designed for highest data rates and optimum isolation and ESD characteristics. The industrial temperature range makes them suitable for rugged applications (e.g. IoT, edge computing).



SUH-RS485 • SUG-RS232 • RJ45 Connector

## Feature Summary

## Feature Summary

## General

- ▶ Choice of isolated EIA/TIA asynchronous data interfaces
- ▶ Transceiver modules available for RS-232 (SUE-RS232, SUG-RS232, SUI-RS232)
- ▶ Transceiver modules available for RS-485 (SUF-RS485, SUH-RS485, SUJ-RS485)
- ▶ Choice of front connectors
- ▶ Transceiver modules available with Micro-D (SUE-RS232, SUF-RS485)
- ▶ Transceiver modules available with RJ45 (SUG-RS232, SUH-RS485)
- ▶ Transceiver modules available with D-Sub (SUI-RS232, SUJ-RS485)
- ▶ 2.0mm pitch dual row TTL interface socket connector (RX, TX, CTS, RTS)
- ▶ Direct mounting on a carrier card (mating pin header or socket w. pin stacker)
- ▶ Alternate attachment via flat cable assembly
- ▶ Two modules can be stacked on top of each other (back to back) using the same pin header
- ▶ Two modules can be attached via single flat cable assembly
- ▶ Power requirements +3.3V, maximum consumption 0.3W (RS-232), 1.0W (RS-485)
- ▶ Dimensions 59mm x 20mm (SUE-SUH), 59mm x 31mm (SUI-SUJ)
- ▶ CompactPCI<sup>®</sup> Serial carrier card for up to eight modules available (SU3-ENSEMBLE)

## RS-485 Transceiver Modules

- ▶ Choice of three front panel connector types
- ▶ SUF-RS485 - Micro-D (20mm width module)
- ▶ SUH-RS485 - RJ45 (20mm width module)
- ▶ SUJ-RS485 - D-Sub 9-pos. (31mm width module)
- ▶ 5kV rms isolation barrier RS-485/RS-422 transceivers (Analog Devices ADM2682)
- ▶ Configurable as half- or full-duplex
- ▶  $\pm 15$  kV ESD protection on RS-485 input/output pins
- ▶ Transceiver data rate 16Mbps max.
- ▶ Connect up to 256 nodes on one PartyLine bus (driver enable control via dedicated UART mode select outputs)
- ▶ Open- and short-circuit, fail-safe receiver inputs
- ▶ High common-mode transient immunity  $>25$  kV/ $\mu$ s
- ▶ Thermal shutdown protection
- ▶ Suitable for industrial fieldbus applications

## Feature Summary

**RS-232 Transceiver Modules**

- ▶ Choice of three front panel connector types
- ▶ SUE-RS232 - Micro-D (20mm width module)
- ▶ SUG-RS232 - RJ45 (20mm width module)
- ▶ SUI-RS232 - D-Sub 9-pos. (31mm width module)
- ▶ 2.5kV Isolation barrier RS-232 transceivers (Analog Devices *isoPower*)
- ▶ Transceivers meet EIA/TIA-232-E specifications
- ▶ High data rate > 460kbps (each board tested @921.6kbps)
- ▶  $\pm 8$  kV/ $\pm 15$  kV ESD protection on transceiver input/output pins
- ▶ High common-mode transient immunity > 25 kV/ $\mu$ s
- ▶ Suitable for high noise data communications and diagnostic ports

**Front Panel I/O**

- ▶ Up to 4 transceiver modules RJ45 and/or Micro-D within 3U/4HP front panel width
- ▶ Up to 8 transceiver modules RJ45 and/or Micro-D within 3U/8HP front panel width
- ▶ Up to 6 transceiver modules D-Sub within 3U/8HP front panel width (flat cable attachment)
- ▶ Up to 16 transceiver modules Micro-D within 3U/12HP front panel width
- ▶ Custom specific front panel design

## Feature Summary

**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°C (industrial temperature range)
- ▶ Storage temperature -40°C to +85°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 SUE-RS232 203.5 years
- ▶ MTBF SUF-RS485 210.1 years
- ▶ MTBF SUG-RS232 191.8 years
- ▶ MTBF SUH-RS485 197.7 years
- ▶ MTBF SUI-RS232 192.9 years
- ▶ MTBF SUJ-RS485 197.7 years
- ▶ EC Regulations EN55022, EN55024, EN60950-1 (UL60950-1/IEC60950-1)

items are subject to changes w/o further notice

Please note: If an EKF product was labelled with this contact [support@ekf.com](mailto:support@ekf.com) for availability of additional usage.



special sign according to ISO 7010 M002, please documentation which may be important for proper



Application Example • RJ45 Modules Stacked

## Module Overview

Transceiver Modules Available			
Front Connector	Isolated I/F	Module Width	Ordering No.
D-Sub 9-pos.	EIA-232	31mm	SUI-xxxx-RS232
D-Sub 9-pos.	EIA-485	31mm	SUJ-xxxx-RS485
Micro-D 9-pos.	EIA-232	20mm	SUE-xxxx-RS232
Micro-D 9-pos.	EIA-485	20mm	SUF-xxxx-RS485
RJ45 8-pos.	EIA-232	20mm	SUG-xxxx-RS232
RJ45 8-pos.	EIA-485	20mm	SUH-xxxx-RS485



SUF-RS485 • SUE-RS232 • Micro-D Connector



SUJ-RS485 • SUI-RS232 • D-Sub Connector



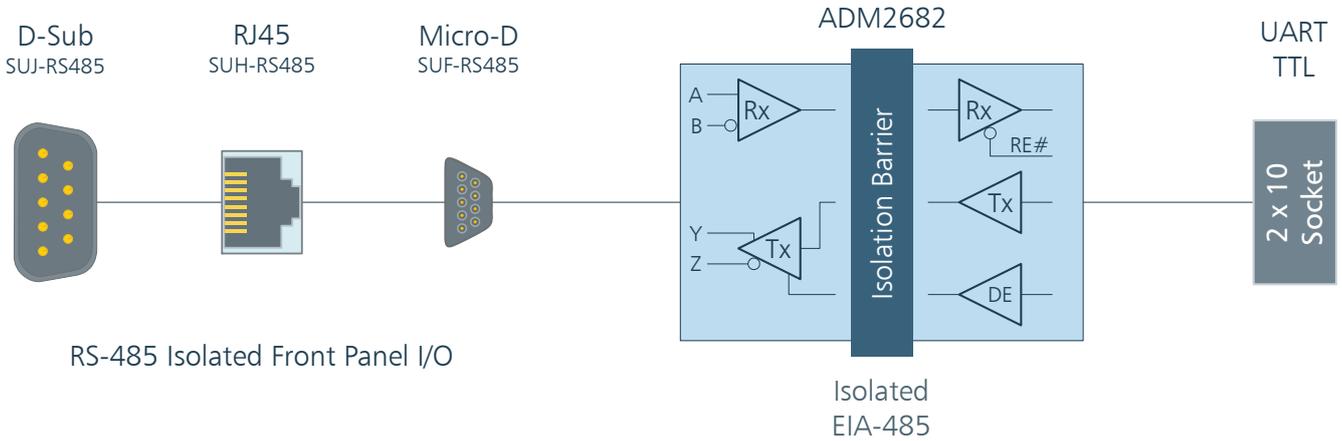
Application Example • Carrier Card w. 6 x D-Sub Transceiver Modules

Block Diagram

© EKF  
ekf.com

Simplified Block Diagram  
SUF/SUH/SUJ-RS485

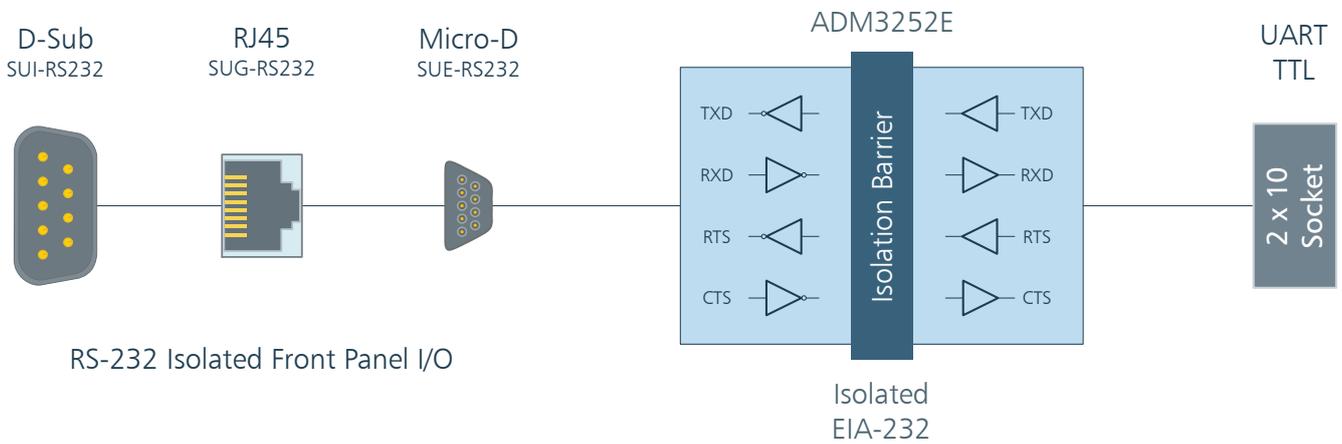
Isolated RS-485 Transceiver Modules



© EKF  
ekf.com

Simplified Block Diagram  
SUE/SUG/SUI-RS232

Isolated RS-232 Transceiver Modules



[www.ekf.com/s/sue-suj//img/sue-suj\\_blk.pdf](http://www.ekf.com/s/sue-suj//img/sue-suj_blk.pdf)

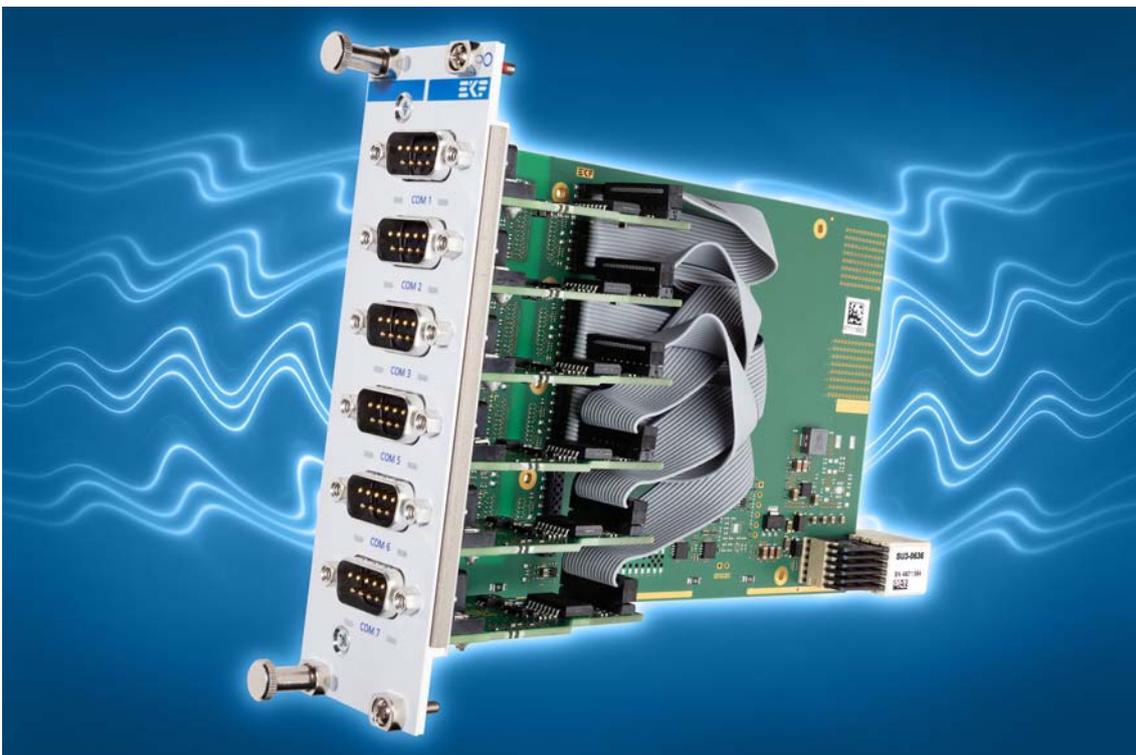
## Theory of Operation

The SUE - SUJ isolated RS-232 and RS-485 transceiver modules can be used with most TTL-level UART ports. Minimum interface lines required are Rx (receive data) and Tx (transmit). This would be sufficient for RS-232 (XON/XOFF in-band handshake). For RS-232 hardware handshake (out-of-band) and RS-485 PartyLine operation additional control signals are required (CTS/RTS protocol for RS-232, and driver/receiver enable for RS-485). Whereas most UARTs support RS-232 CTS/RTS hardware handshake, the RS-485 configuration for Half-Duplex (PartyLine) may differ.

The SUF/SUH/SUJ-RS485 transceiver modules are optimized for multi-point operation together with the Diodes PI7C9X795x PCI Express® UART bridges. PI7C9X795x WHQL and QNX drivers have been intensively tested with the SUx modules.

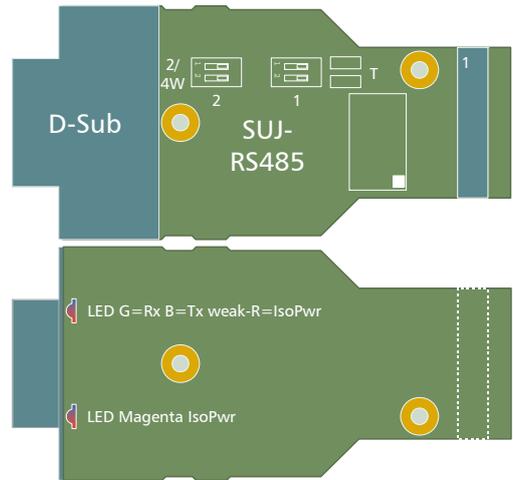
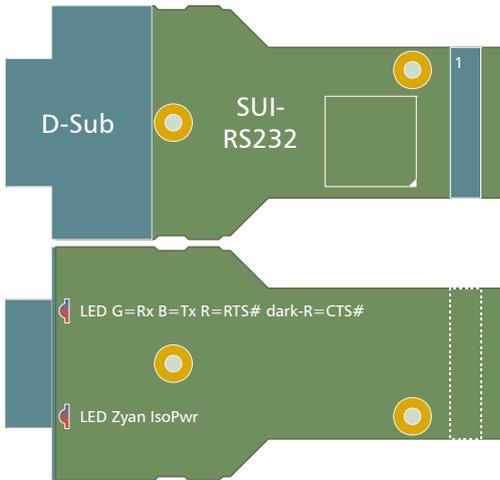
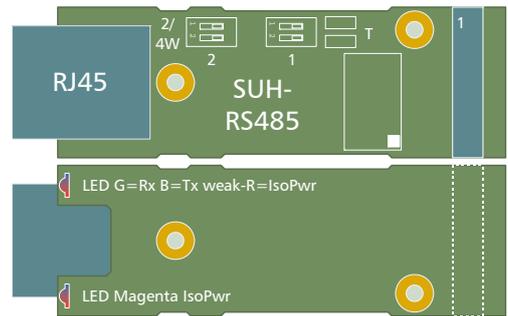
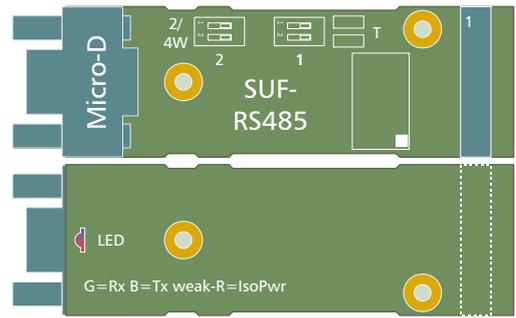
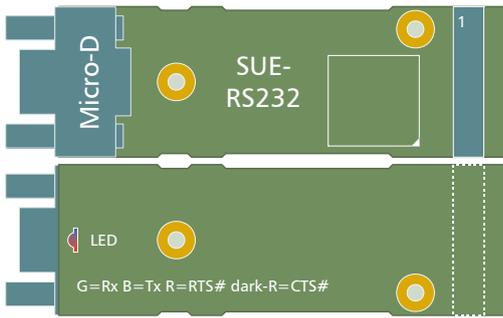
The SUx transceiver modules are available with three front panel connector types. The Micro-D is a small and professional solution, suitable for screw locked cable connectors. The RJ45 style connector is also small, and e.g. allows use of inexpensive Ethernet crossover patchcables for point-to-point RS-485 applications. In addition, the modules are also available with a classic D-Sub connector, which however requires considerably more space in a front panel.

The SUx isolated transceiver modules provide a 2x10 position host interface connector towards the UART, suitable for direct mounting to a carrier card, or micro ribbon flat cable attachment. The pin assignment of the sockets allows two modules stacked one upon the other (back to back orientation). Likewise two transceiver modules can be attached by means of a single flat cable.

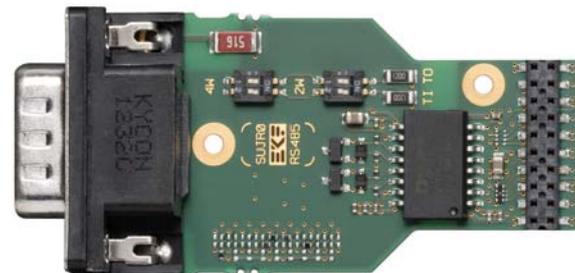
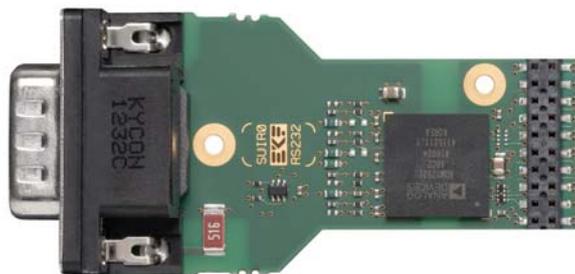
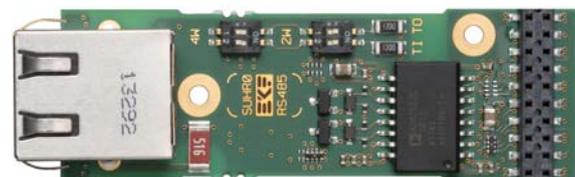
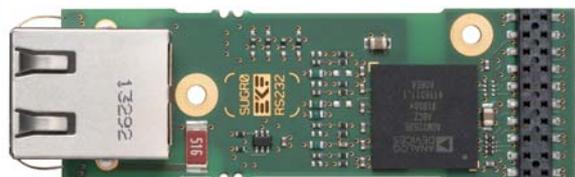
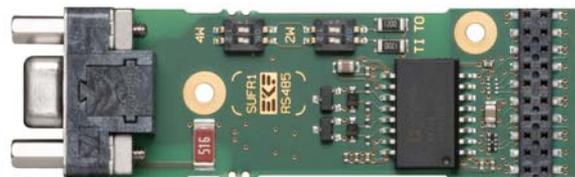
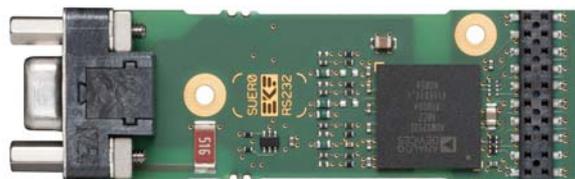


Any Two Adjacent Modules Sharing a Common Flat Cable Assy

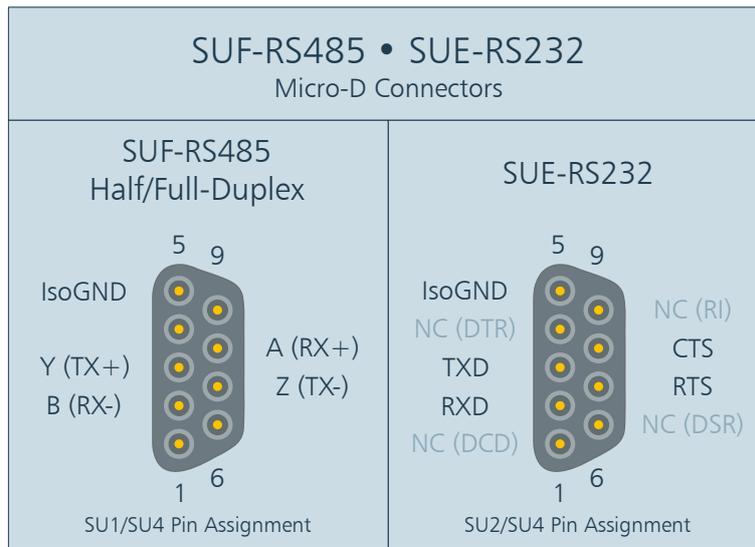
Component Orientation



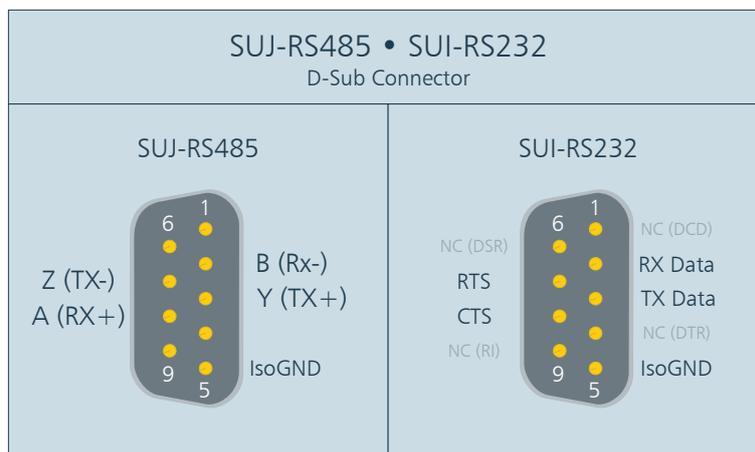
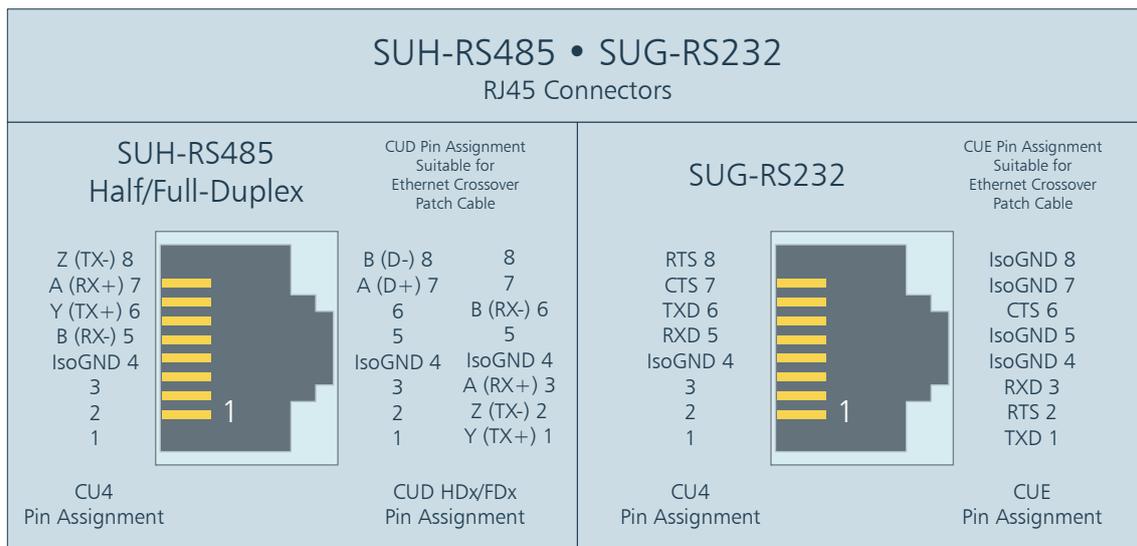
The SUE-SUJ transceiver modules are provided with one or two tri-colour signal LEDs, located at the PCB bottom side. The LEDs will be visible through suitable front panel cutouts. Their meaning varies according to the illustration above. Please note that the front panel view depends also on the mounting orientation of a particular transceiver module - component side down or up.



Front Panel Connectors

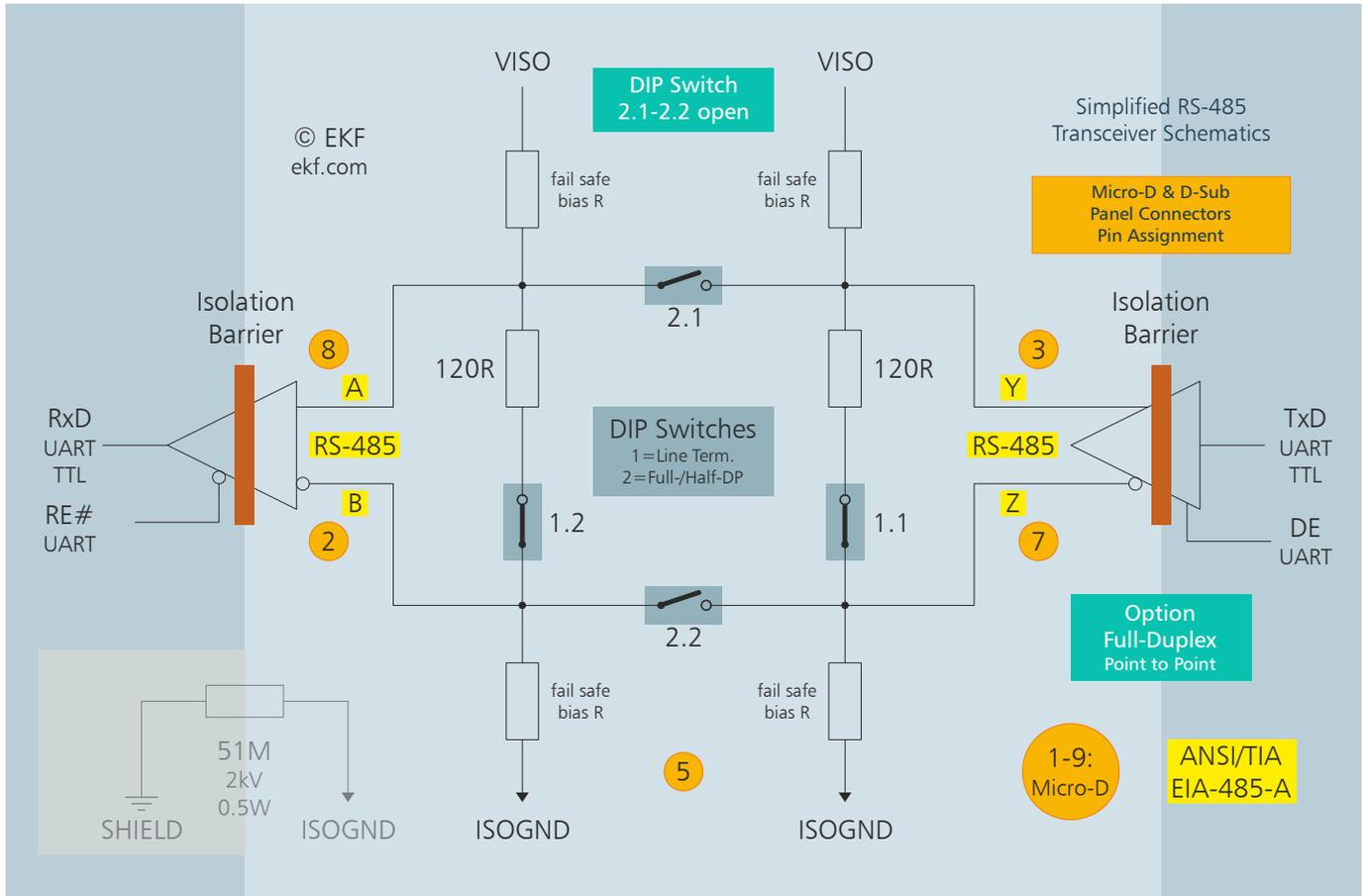


IsoGND is the reference ground for all signals of a particular I/O connector, isolated from the board and system logic GND, and from Shield (panel/chassis), and also from other transceiver modules.



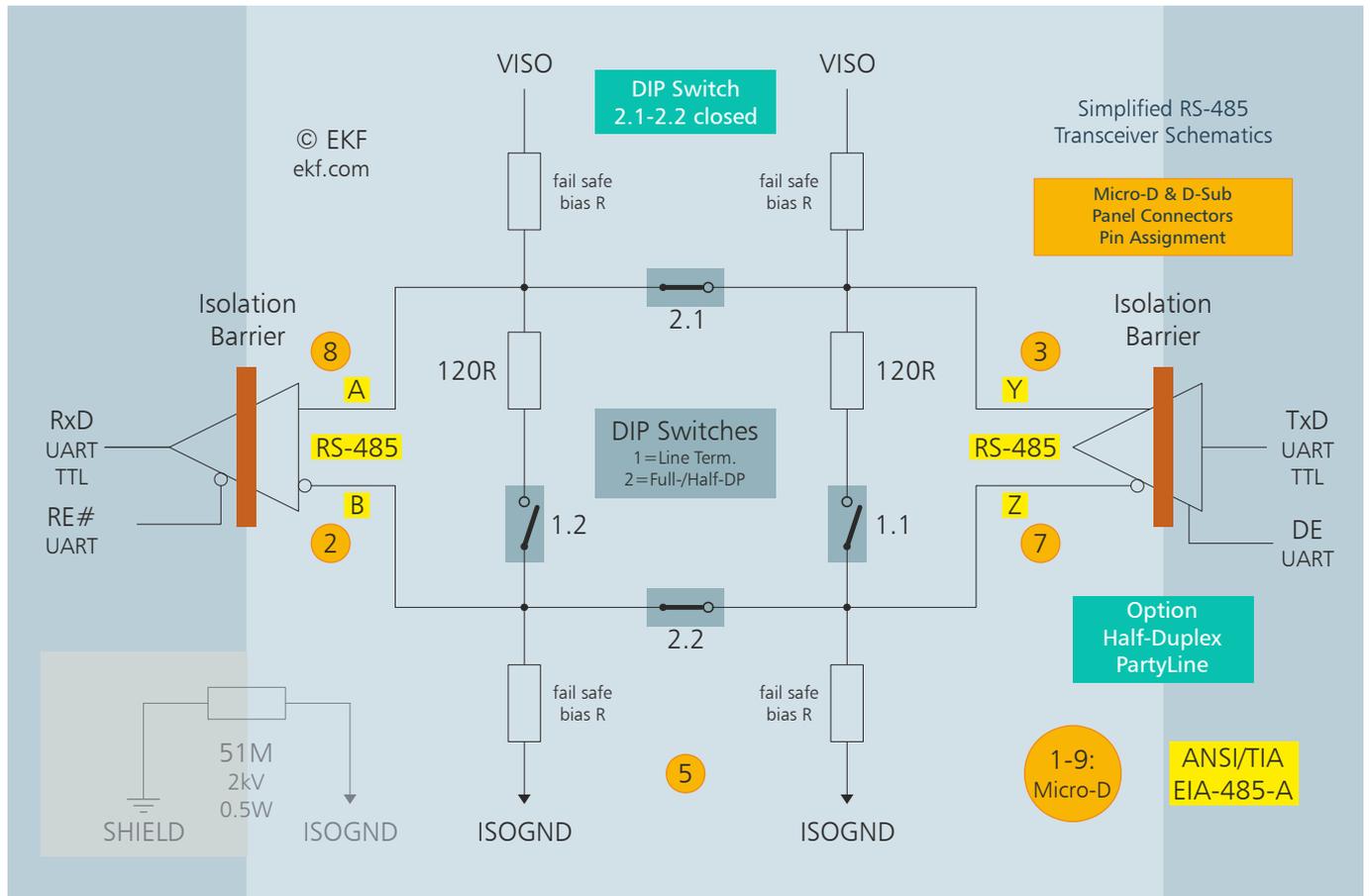
### RS-485 Transceiver Schematics

Illustrated below is the default transceiver circuitry. The light blue zone is the isolated area (front panel connectors). Please refer to the DIP-Switch configurations table for operation mode and line termination settings.



Illustrated above is a point-to-point 4-wire configuration (in addition to reference ground wire). Switches 2.1 and 2.2 are open. Setting of line termination switches 1.1 and 1.2 depends on data transfer bit rate and cable length. Normally set both switches on (off if external termination is applied).

Illustrated below is a multi-point (aka PartyLine) 2-wire configuration (in addition to reference ground wire). Switches 2.1 and 2.2 are closed (A=Y, B=Z). Setting of line termination switches 1.1 and 1.2 depends mainly on the position of a particular RS-485 node on the common data bus. Normally set both switches off. If a port is positioned on either cable ending however, set termination switches 1.2 on, 1.1 off (both off if external termination is applied).



On a PartyLine bus, no more than a single node is allowed to send data at a particular time; all other nodes must disable their drivers in order to avoid data collision at the same time. A suitable software protocol must be established which controls the driver enable (DE) pin of the transceiver. The SUx-RS485 were designed for the Pericom/Diodes PCIe® to UART bridge, which requires proprietary driver software for DE control.

### RS-485 Half-Duplex vs. Full-Duplex

For a full-duplex RS-485 point-to-point application, the receiver data lines A/B and the driver signals Y/Z require a twisted-pair wire each, plus reference ground, resulting in a total of 2x2+1 wires. By specification, RS-485 requires a common ground - 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 cable. The strapping between A/Y and B/Z will be often done externally, e.g. within the shell of a cable connector. As an alternate, the SUx-RS485 provides an on-board DIP-switch, which allow to join A/Y and B/Z internally (1=ON 2=ON).

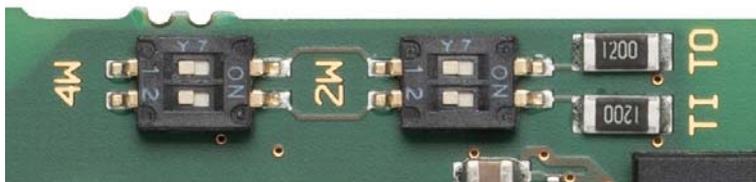
Termination DIP Switch 1 (TO/TI) EKF Part No. 160.15.02.0		
	1=ON	Y/Z Termination 120R Active (Full-Duplex Only)
	2=ON	AB Termination 120R Active

Half-/Full-Duplex Configuration DIP Switch 2 (2W/4W) EKF Part No. 160.15.02.0		
	1=OFF 2=OFF	Full-Duplex RS-485 (Point-to-Point)
	1=ON 2=ON	Half-Duplex RS-485 (PartyLine)

## 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 Micro-D or D-SUB cable connectors. As an alternate, the SUx-RS485 provides an on-board DIP-switch, which can individually activate internal termination resistors on A/B and Y/Z.

By default, the internal termination is achieved by 120 Ohm (DC termination), for maximum signal integrity with long cables and high data transfer rates. If no termination is required, set both termination switches 1.1/1.2 to off. In addition, each RS-485 port is provided with fail-safe bias resistors, 549R to ISO GND at the inverting inputs/outputs (B/Z), and 549R to VISO at the non-inverting inputs/outputs (A/Y). Each line is overvoltage protected by TVS components (PSD12C combined with SM712).



## RS-485 Isolation Voltage

The ADM2682E on-board transceivers withstand 5kVrms, which is far more than can be achieved for the SUx-RS485 assembly. The maximum safe isolation voltage depends mainly on the voltage rating specified for the Micro-D, RJ45 or D-Sub connectors in use (signal pins to frame/chassis ground).

For personal safety, EKF recommends strongly to limit a superimposed external voltage to less than 60V, measured against protective earth.

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.

The SUx-RS485 transceiver modules are populated with a 51 MOhm high voltage resistor between shield and isolated GND, suitable to withstand permanently 2kV.

## 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 inner and/or outer cable shields are used as the third (fifth) wire. When using a twisted pair Ethernet cable as RS-485 transmission line, two or more wires are available for common ground.*

### 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/s/su1/img/rs485\\_common\\_ground.pdf](http://www.ekf.com/s/su1/img/rs485_common_ground.pdf)

## Useful External Documents

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

## Standards - Specifications

Term	Document	Origin
RS-232	TIA/EIA-232-F Standard	<a href="http://www.tiaonline.org">www.tiaonline.org</a>
RS-485	ANSI/TIA/EIA-485-A Standard Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems	<a href="http://www.tiaonline.org">www.tiaonline.org</a>

### Host Connector

The SUE - SUJ isolated transceiver modules are equipped with a pass-through host connector socket (Samtec: CLT-110-02-G-D-A-K). EKF recommends the carrier card to be populated with the same socket type. For direct mounting of a SUx transceiver module to a carrier card, a 2.00mm pitch 2x10 board stacker (e.g. Samtec TW-10-05-G-D-190-175) must be used in addition.

Since a 2x10 position host connector is suitable for wiring two independent UART ports, two SUx transceiver modules can be attached this way to one socket on the carrier card, e.g. by mounting one module upon the other, with the help of a board stacker with longer pins. The transceiver module 1 must be mounted with its component side down, facing towards the carrier card. The transceiver modules 2 would be mounted on top of the modules 1, but with its component side up (both transceiver modules back to back).

As an alternate, one or two transceiver modules can be attached by a single flat cable assembly to the carrier card host connector.

M15 - M48 • TTL-Level Serial I/O				
2.00mm Socket Strip 2 x 10 (251.1.0210.10.09)				
	+5V	1	2	GND
	RTS# (1)	3	4	RXD (1)
	TXD (1)	5	6	+3.3V
	DE (1)	7	8	CTS# (1)
	RE# (1)	9	10	GND
	RE# (2)	11	12	GND
	DE (2)	13	14	CTS# (2)
	TXD# (2)	15	16	+3.3V
	RTS# (2)	17	18	RXD (2)
	+5V	19	20	GND

Driver enable (DE) and receiver enable (RE#) are required for RS-485 mezzanines configured for half-duplex (PartyLine) operation. The driver enable signal is generated e.g. by the Diodes PI7C9X795x UART in conjunction with the Diodes driver software.

## Host Connector Flat Cables

If the SUE-SUJ transceiver modules cannot be mounted directly on a carrier card, they may be attached to the host connector socket alternatively by means of a 16-lead 1.00mm pitch micro wire flat cable assembly. One or two modules can be connected in parallel. The cable connector (16 pins) *must* be aligned centric with respect to the transceiver module socket (20 pins). If two transceiver modules shall be connected via a single cable, one transceiver side cable connector *must* be attached 180° rotated vs. the other connector (please refer to the picture below).



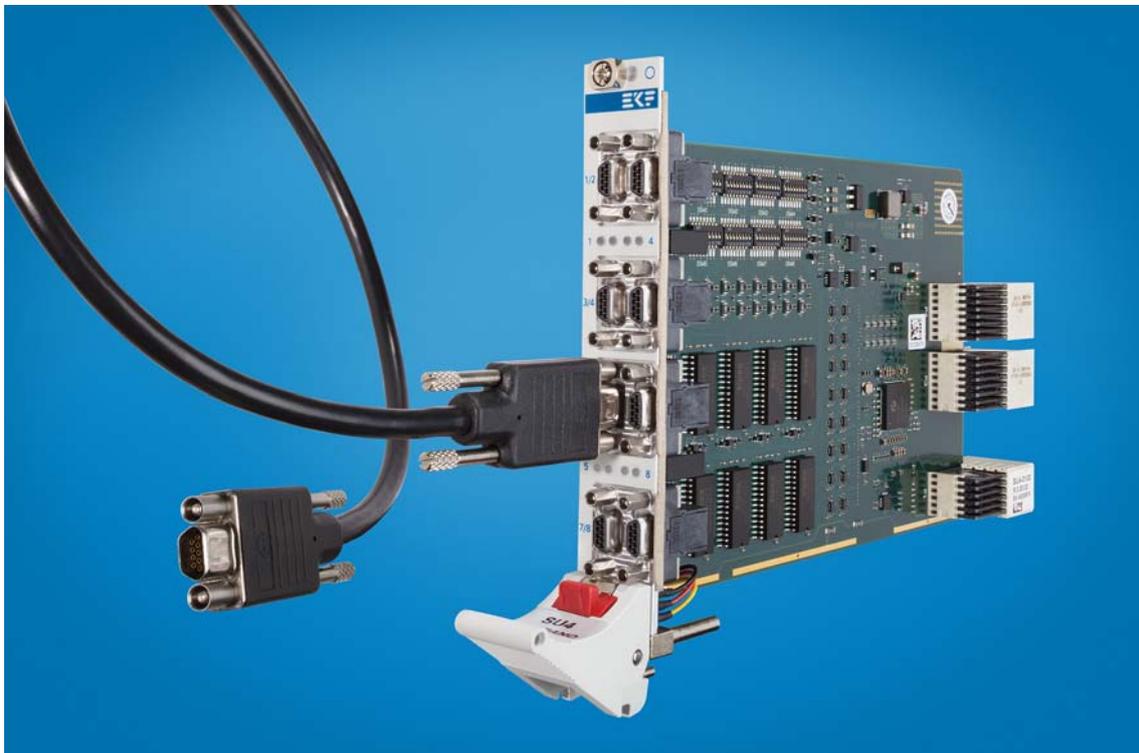
### EKF Part Numbers Flat Cable Assemblies

251.9.0208.24.09	16-lead cable & male connectors assembly, two connectors dual row 2.00mm pitch, ~10cm length
251.9.0208.29.09	16-lead cable & male connectors assembly, three connectors dual row 2.00mm pitch (end - middle - end), ~20cm length

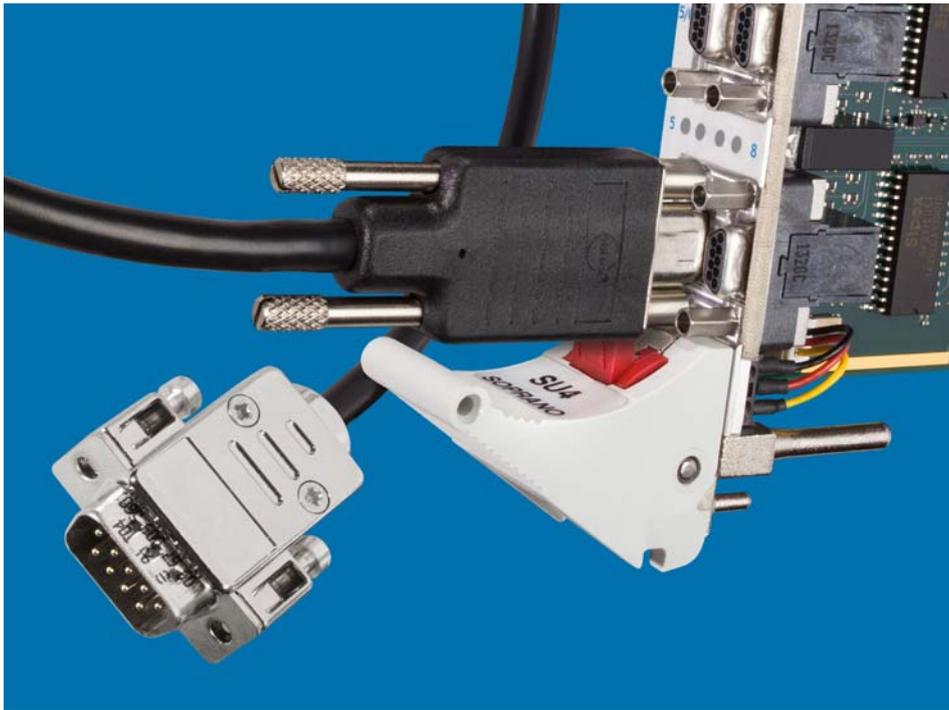
## Micro-D I/O Cables

Some ready to use adapter cable assemblies are available from stock, e.g. Micro-D to D-Sub (female or male), designed for RS-232 operation, wired straight pin to pin. No TXD/RXD cross-over is included by default, as would be required for DCE to DCE communication (e.g. two SUE-RS232 transceiver modules connected). In addition, custom specific cable assemblies are available on request.

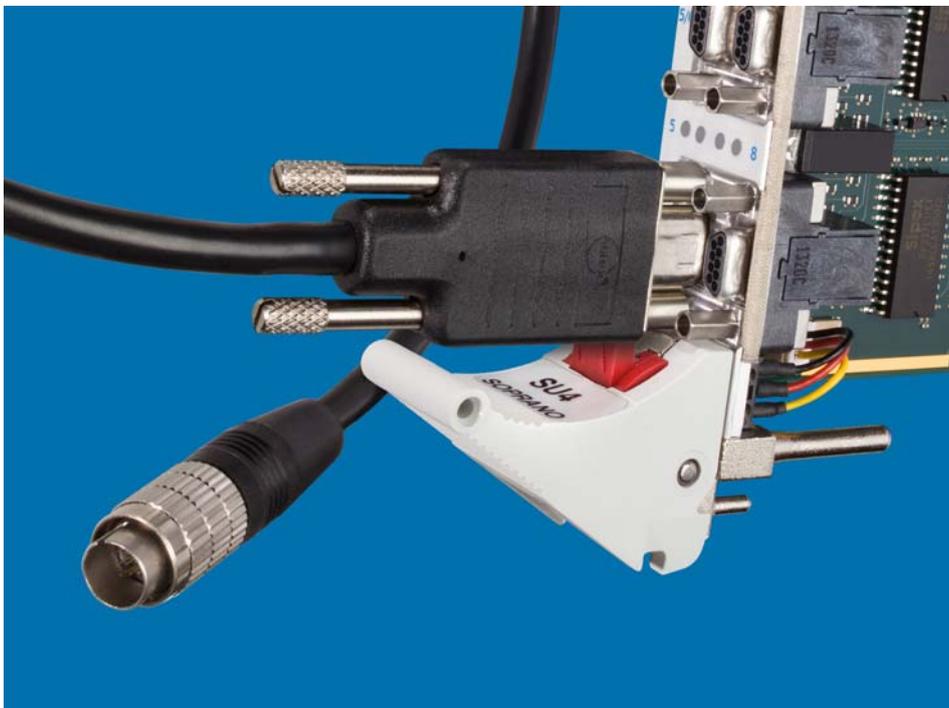
EKF Part Numbers Micro-D Cable Assemblies RS-232	
259.901.0009.18	Micro-D to Micro-D cable assembly, 9 circuits, 1.8m, female to female cable connectors
259.921.0009.18	Micro-D to D-SUB cable assembly, 9 circuits, 1.8m, Micro-D female connector to male D-Sub
259.931.0009.18	Micro-D to D-SUB cable assembly, 9 circuits, 1.8m, Micro-D female connector to female D-Sub
259.951.0009.18	Micro-D single ended cable assembly, 9 circuits, 1.8m, Micro-D female connector to pigtail



Micro-D to Micro-D Cable Assembly (Picture Similar)



Micro-D to D-SUB Cable Assembly (Picture Similar)



Micro-D to Custom Specific Connector Cable Assembly (Picture Similar)

## Ordering Information

### Ordering Information

For popular SUE-SUJ SKUs please refer to [www.ekf.com/liste/liste\\_21.html#SUE](http://www.ekf.com/liste/liste_21.html#SUE)

## High Performance Embedded

Industrial Computers Made in Germany  
boards. systems. solutions.

Document No. 9237 • 2 May 2019

EKF Elektronik GmbH  
Philipp-Reis-Str. 4 (Haus 1)  
Lilienthalstr. 2 (Haus 2)  
59065 HAMM  
Germany



Phone +49 (0)2381/6890-0  
Fax +49 (0)2381/6890-90  
Internet [www.ekf.com](http://www.ekf.com)  
E-Mail [sales@ekf.com](mailto:sales@ekf.com)