Technical Information

# SU4-SOPRANO • *CompactPCI® Serial* • Octal UART RS-232/485

Document No. 7823 • Edition 5 • 19 June 2015

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## About this Manual

This manual is a short form description of the technical aspects of the SU4-SOPRANO, required for installation and system integration. It is intended for the advanced user only.

## Edition History

| Ed. | Contents/*Changes* | Author | Date |
|---|---|---|---|
| 1 | Technical Information SU4-SOPRANO, English, preliminary edition<br>Text #7823, File: su4_ti.wpd | jj | 25 March 2015 |
| 2 | Modified illustration DIP switch #7 setup | jj | 21 April 2015 |
| 3 | Added photos | jj | 5 May 2015 |
| 4 | Added photos regarding various connector cables, added MTBF | jj | 21 May 2015 |
| 5 | Added photo SU4-SRS | jj | 19 June 2015 |
| | | | |

## Related Documents

| Related Information | |
|---|---|
| SU4-SOPRANO Home | www.ekf.com/s/su4/su4.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® Serial | CompactPCI Serial Specification, PICMG® CPCI-S.0 R1.0, March 2, 2011 | www.picmg.org |
| PCI Express® | PCI Express® Base Specification | www.pcisig.com |
| RS-232 | TIA/EIA-232-F Standard | www.tiaonline.org |
| RS-485 | ANSI/TIA/EIA-485-A Standard<br>Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems | www.tiaonline.org |

## Technical Features

### Feature Summary

| Feature Summary |
|---|
| *CompactPCI® Serial*<br><br>▸ PICMG® CompactPCI® Serial standard (CPCI-S.0)<br>▸ Single size Eurocard 3U 4HP 100x160mm$^2$<br>▸ Suitable for CompactPCI® Serial peripheral slot (PCI Express® enabled)<br>▸ CompactPCI® Serial backplane connector P1 for PCI Express®, single lane link<br>▸ Option CompactPCI® Serial backplane connectors P3, P4 for rear I/O |
| *UART*<br><br>▸ Pericom® PCI Express® Octal UART PI7C9X7958<br>▸ Eight high performance 950-class UARTs<br>▸ 16C550 software compatible<br>▸ 128-Byte FIFO for each transmitter/receiver<br>▸ Baud rate up to 15Mbps<br>▸ XON/XOFF in-band flow control<br>▸ CTS/RTS or DSR/DTR out-of-band control<br>▸ Data frame 5, 6, 7, 8 and 9 bits<br>▸ Clock prescaling 4 to 46 |
| *Front Panel I/O*<br><br>▸ 8 x Front panel Micro-D high density male connectors<br>▸ 8 x Multiprotocol transceivers RS-232/RS-485 EXAR SP337EU<br>▸ Protocol individually configurable for each port via on-board DIP-switches<br>▸ Maximum data rate of 1Mbps in RS-232 mode<br>▸ Maximum data rate of 15Mbps in RS-485 mode<br>▸ 3 Drivers, 5 receivers RS-232 (COM port assignment)<br>▸ 2 Drivers, 2 receivers RS-485<br>▸ RS-485 full-duplex or half-duplex configuration, advanced fail-safe<br>▸ RS-485 termination on/off selectable via on-board DIP-switch<br>▸ RS-485 full/half-duplex selectable via on-board DIP-switch<br>▸ 1/8th Unit load - up to 256 receivers on RS-485 bus<br>▸ Robust 15kV ESD protection (human body model)<br>▸ Micro-D cable assemblies available, e.g. Micro-D to classic style D-Sub male or female |

*Option Rear I/O*

- Ordering Option CompactPCI® Serial backplane connectors P3, P4 for rear I/O
- Each UART port can be individually redirected to P3, P4 backplane connectors (TTL level) via DIP-switch configuration
- Custom specific rear I/O module design, RS-232 or RS-485, isolated

*Environment, Regulatory*

- Long term availability
- Designed & manufactured in Germany
- Certified quality management according to ISO 9000
- Rugged solution (coating, sealing, underfilling 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 28.4 years
- EC Regulations EN55022, EN55024, EN60950-1 (UL60950-1/IEC60950-1)

## Short Description

*The SU4-SOPRANO is a peripheral slot card for CompactPCI® Serial systems, equipped with a PCI Express® eight channel UART (Universal Asynchronous Receiver Transmitter). All ports are available through Micro-D front panel connectors, and can be user configured individually for either RS-232 or RS-485 by means of DIP-switches. The on-board transceivers allow for maximum bit rates up to 15Mbps when operated in RS-485 mode and up to 1Mbps in RS-232 mode.*

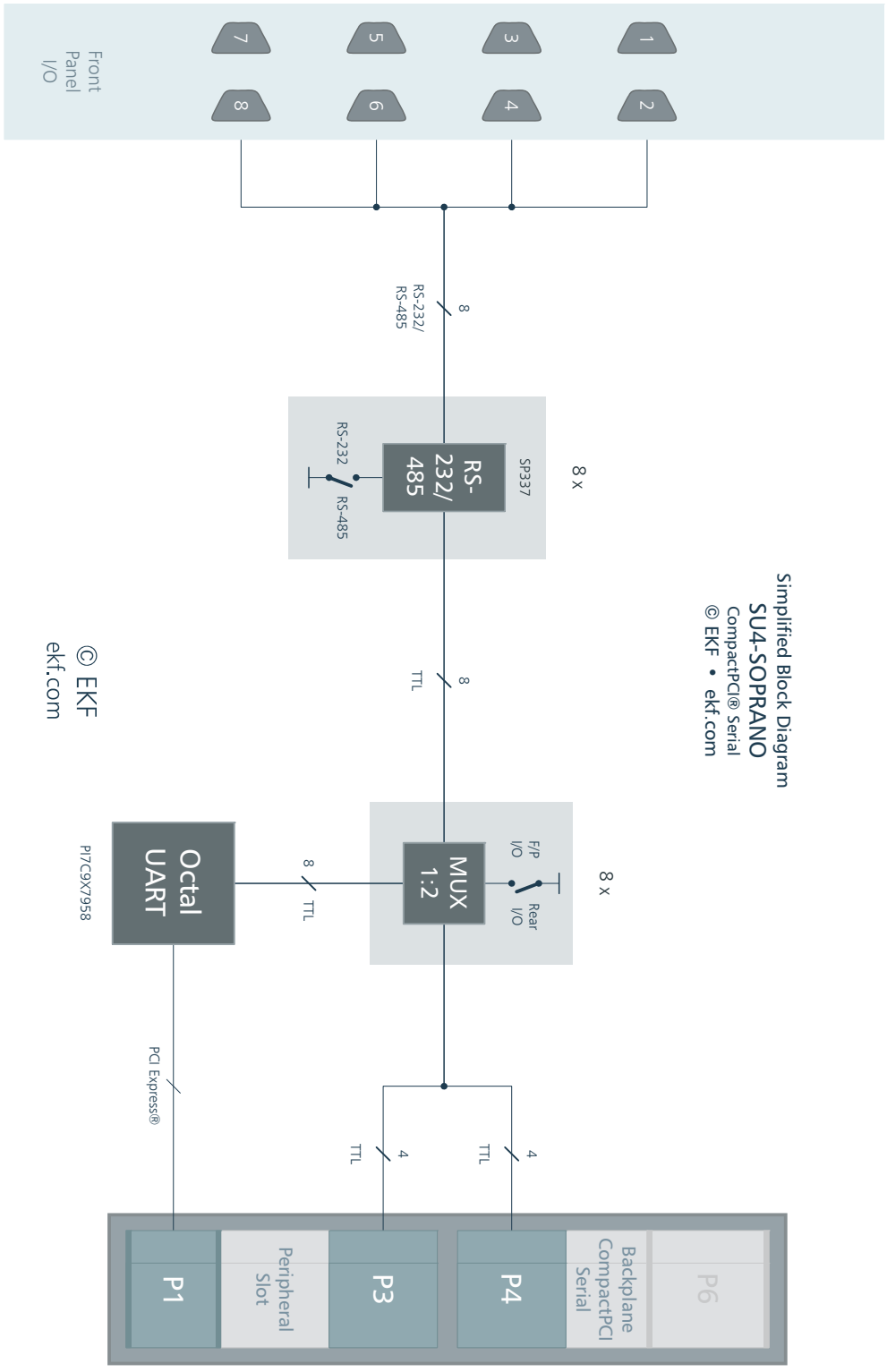
Full- and half-duplex is supported for RS-485, with up to 256 nodes on a bus. The line termination can be switched on/off individually.

As an alternate, any particular port (TTL level) can be redirected to the optional backplane connectors P3 and P4, for rear I/O usage together with a suitable rear I/O module.

The SU4-SOPRANO fits into any CompactPCI® Serial peripheral slot that is PCIe enabled.

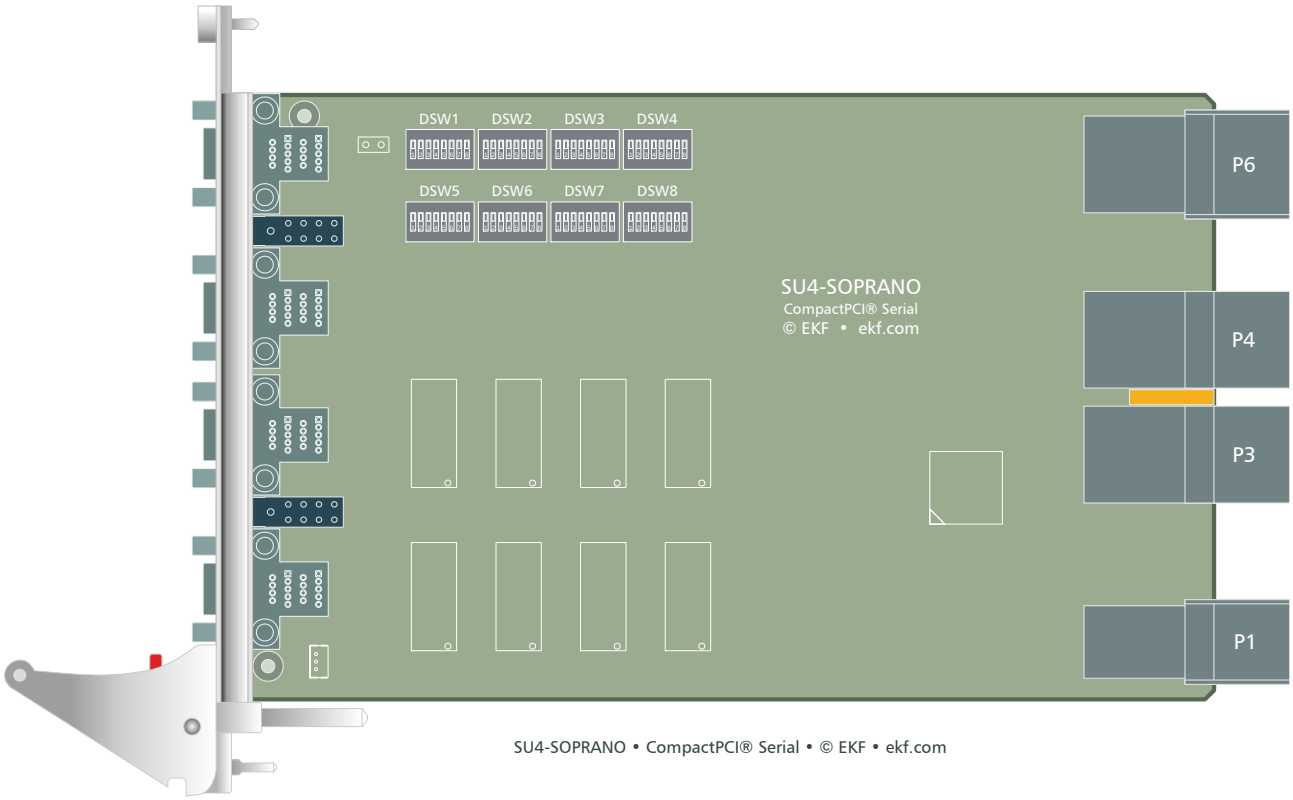

SU4-SOPRANO

## Block Diagram




www.ekf.com/s/su4/img/su4_blk.pdf

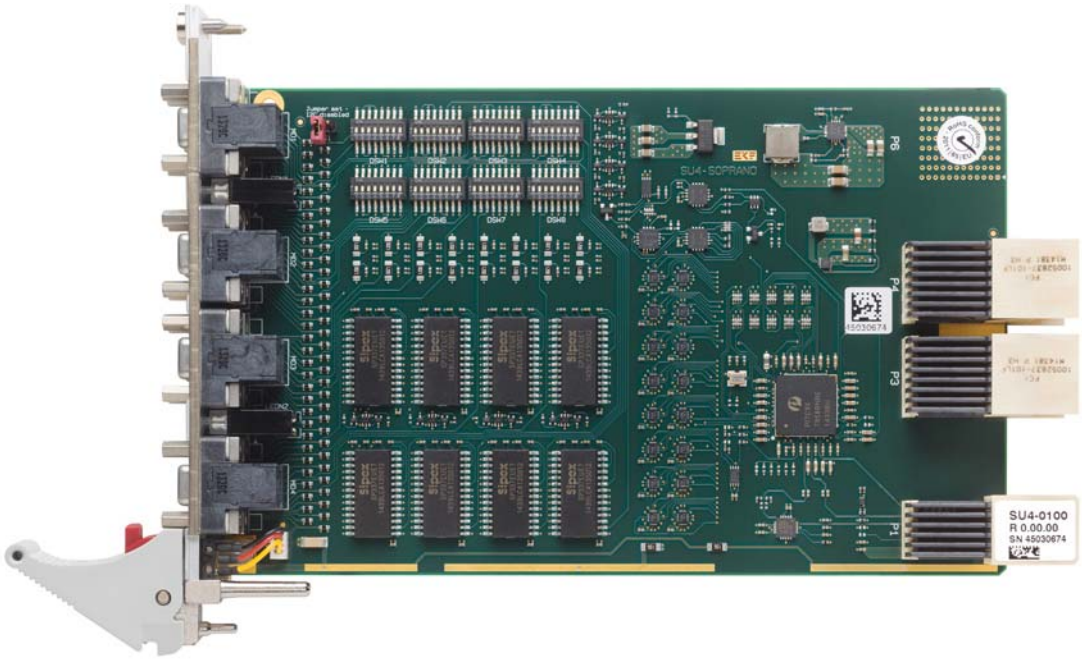
## Component Orientation



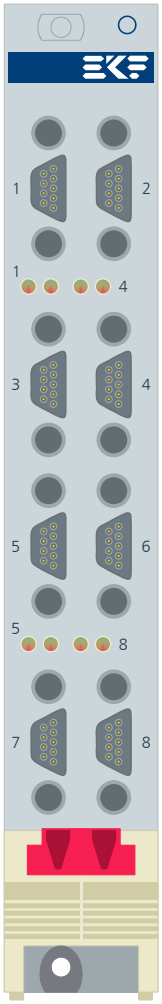

www.ekf.com/s/su4/img/su4_draft.pdf

P3 and P4 are available as an ordering option, for alternative rear I/O.

P6 is not populated by default. This connector can be provided on request for even more mechanical stability, e.g. railway applications.



## Front Panel




SU4-SOPRANO

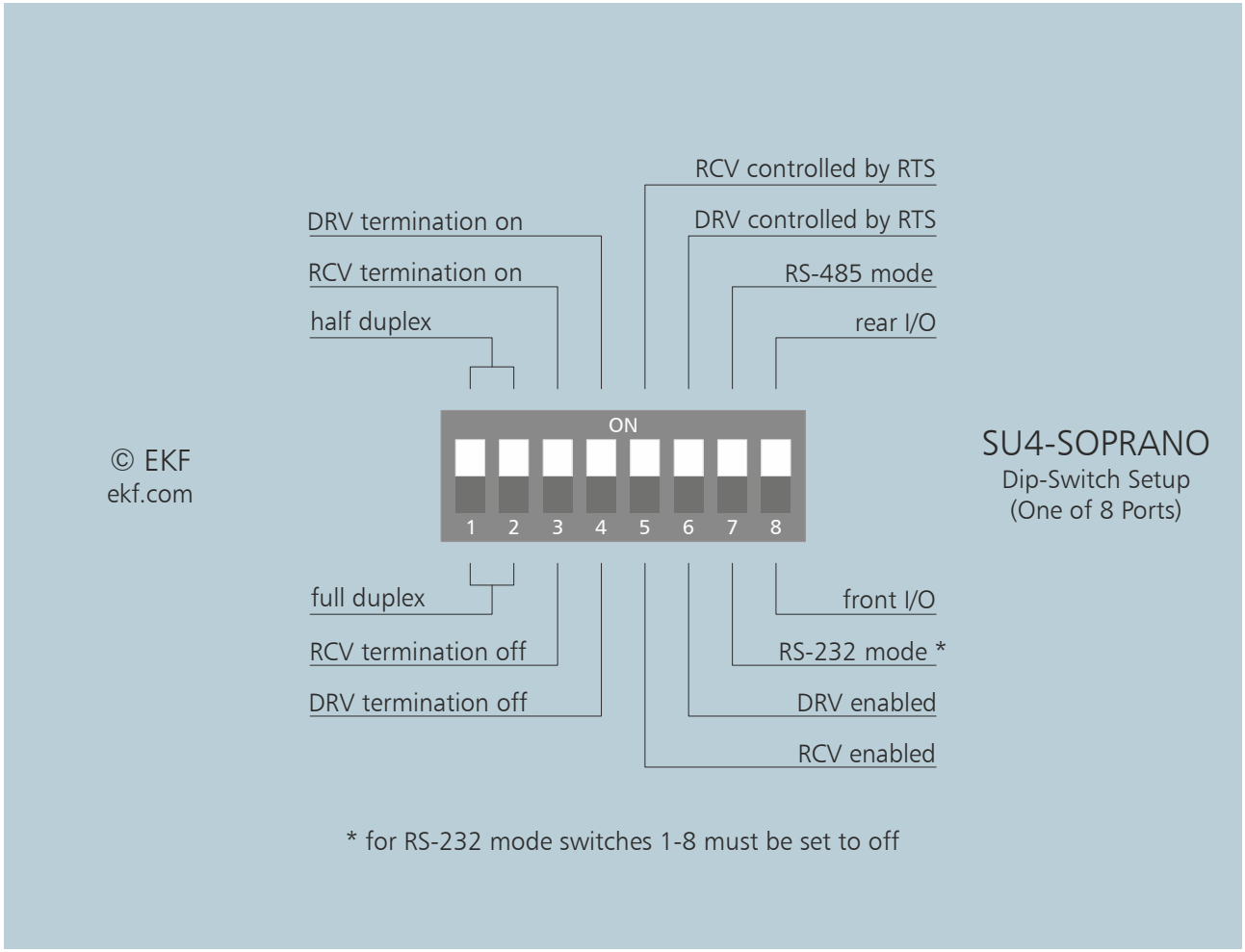
www.ekf.com/s/su4/img/su4_fpl.pdf

## Technical Reference

### Port Configuration

### DIP Switches

All eight serial I/O ports of the SU4-SOPRANO are built-up identical. The board is equipped with eight serial line transceivers, each configurable for either RS-232 or RS-485 operation. A particular DIP-switch array is assigned to any UART port, which allows to select between different operation modes, and also front or rear I/O. For front panel I/O, the switch #8 must be set to off. The illustration below shows the meaning for any switch #1 to #8.

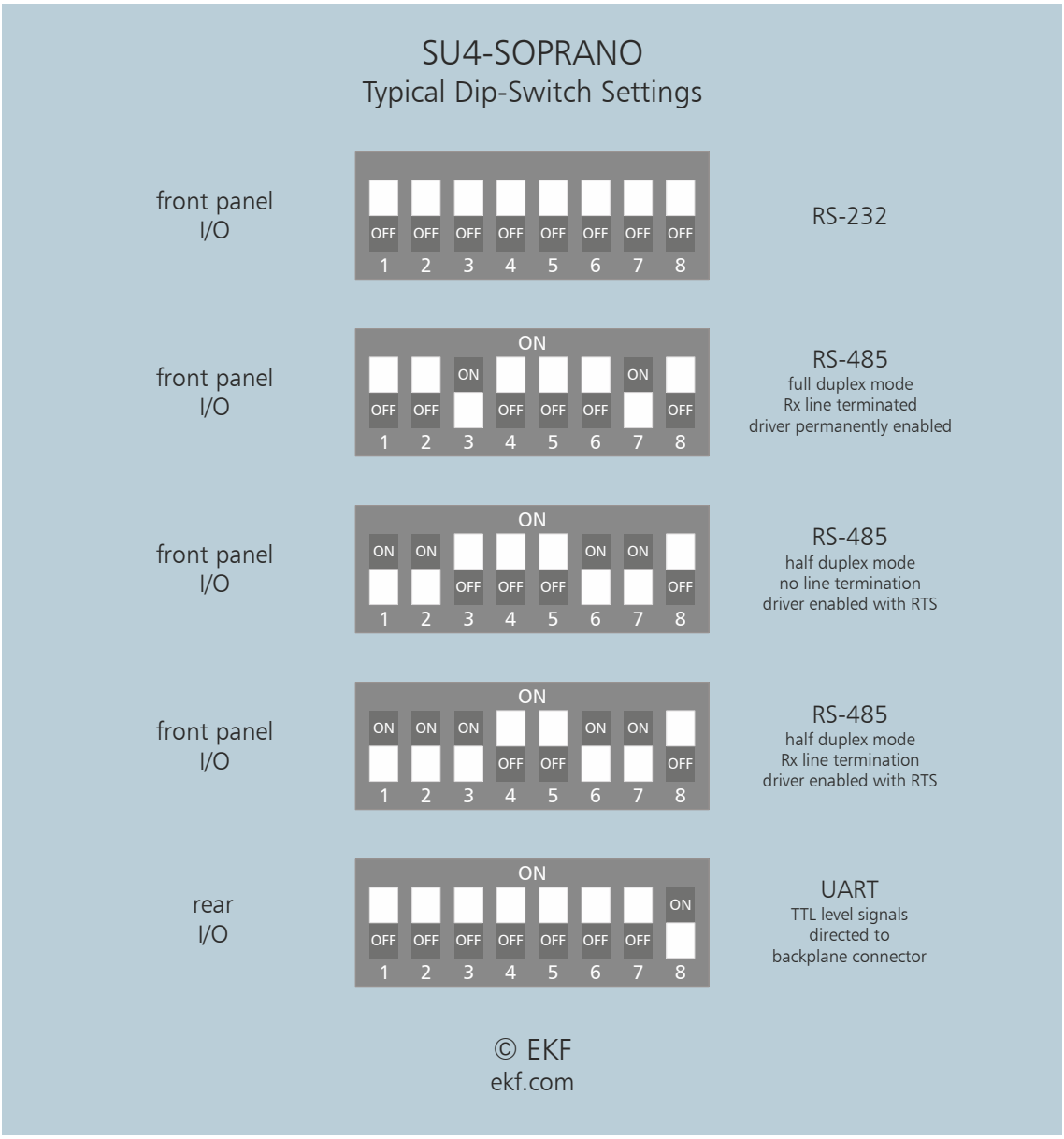



Individual Port Configuration

www.ekf.com/s/su4/img/su4_dsw.pdf

## RS-232 / RS-485 Setup Table

Switch #7 allows to differentiate between RS-232 (off) and RS-485 (on). The switches #1 to #6 are in use for RS-485 mode only and should be set all to off for RS-232. The illustration below shows typical port setup configurations for RS-232 and RS-485. For front panel I/O set the associated switch #8 to off; for rear I/O set switch #8 to on.

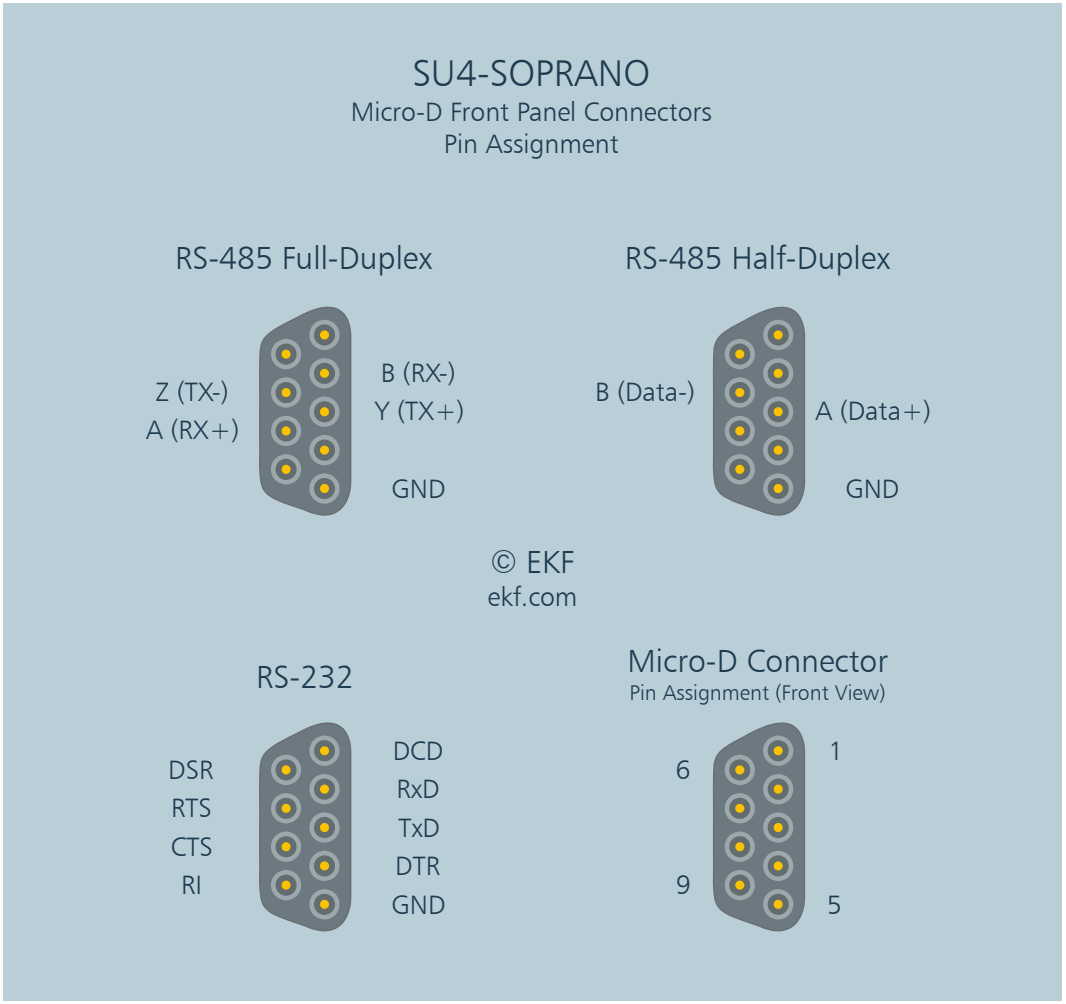



Typical Setup for RS-232 and RS-485 Front I/O

www.ekf.com/s/su4/img/su4_dsw-settings.pdf

## Front Panel Connectors

Due to space restrictions, the SU4-SOPRANO is provided with four stacked (dual) Micro-D male connectors, which are considerably smaller than standard D-Sub connectors and therefore allow a 4HP front panel for the board. The Micro-D pin assignment replicates the classic COM port 9-position D-SUB with respect to RS-232. For RS-485, the pinning is compelled by the internal SP337 transceiver circuitry.

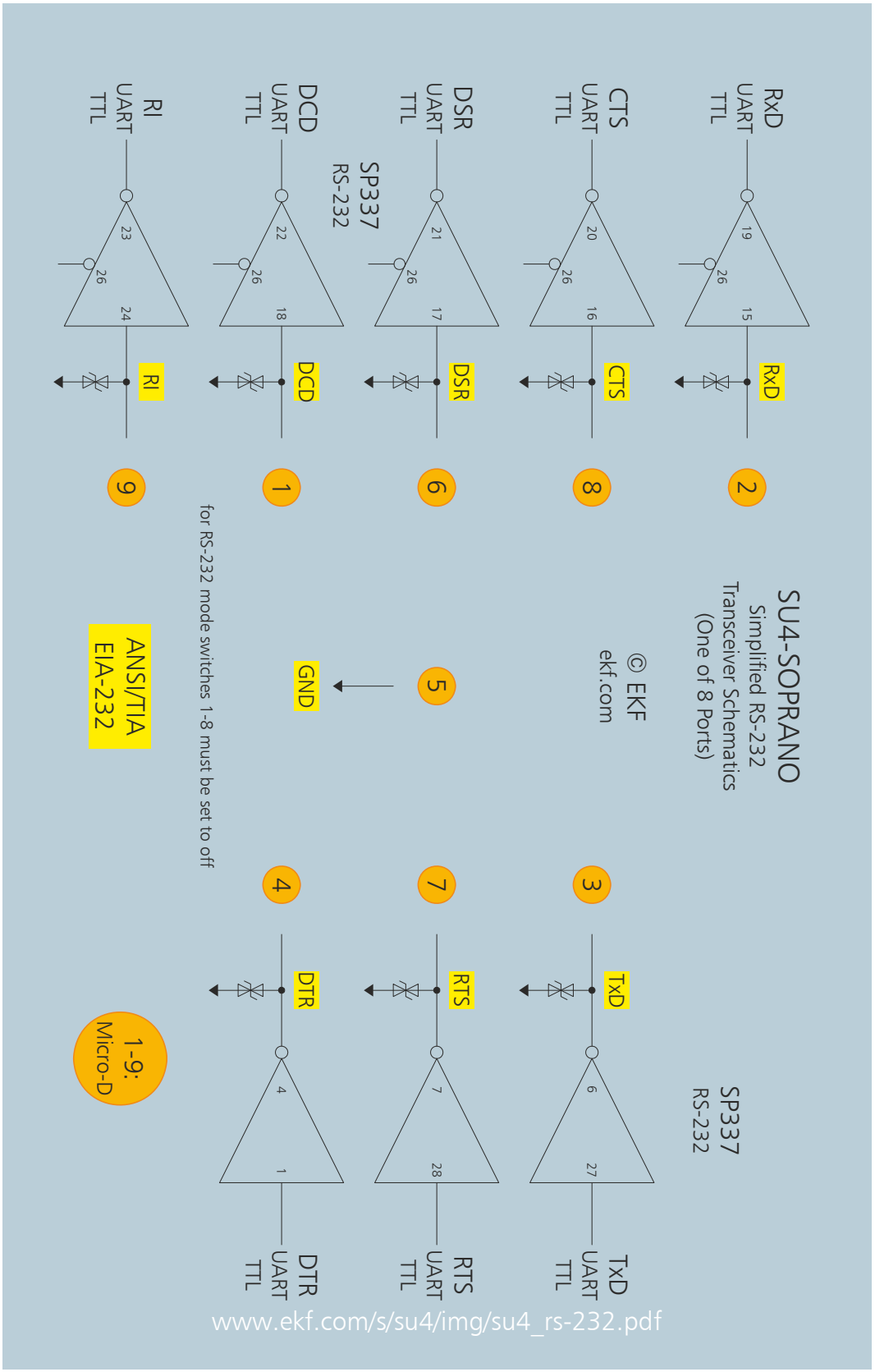



Front Panel Connectors Pin Assignment

www.ekf.com/s/su4/img/su4_micro-d.pdf

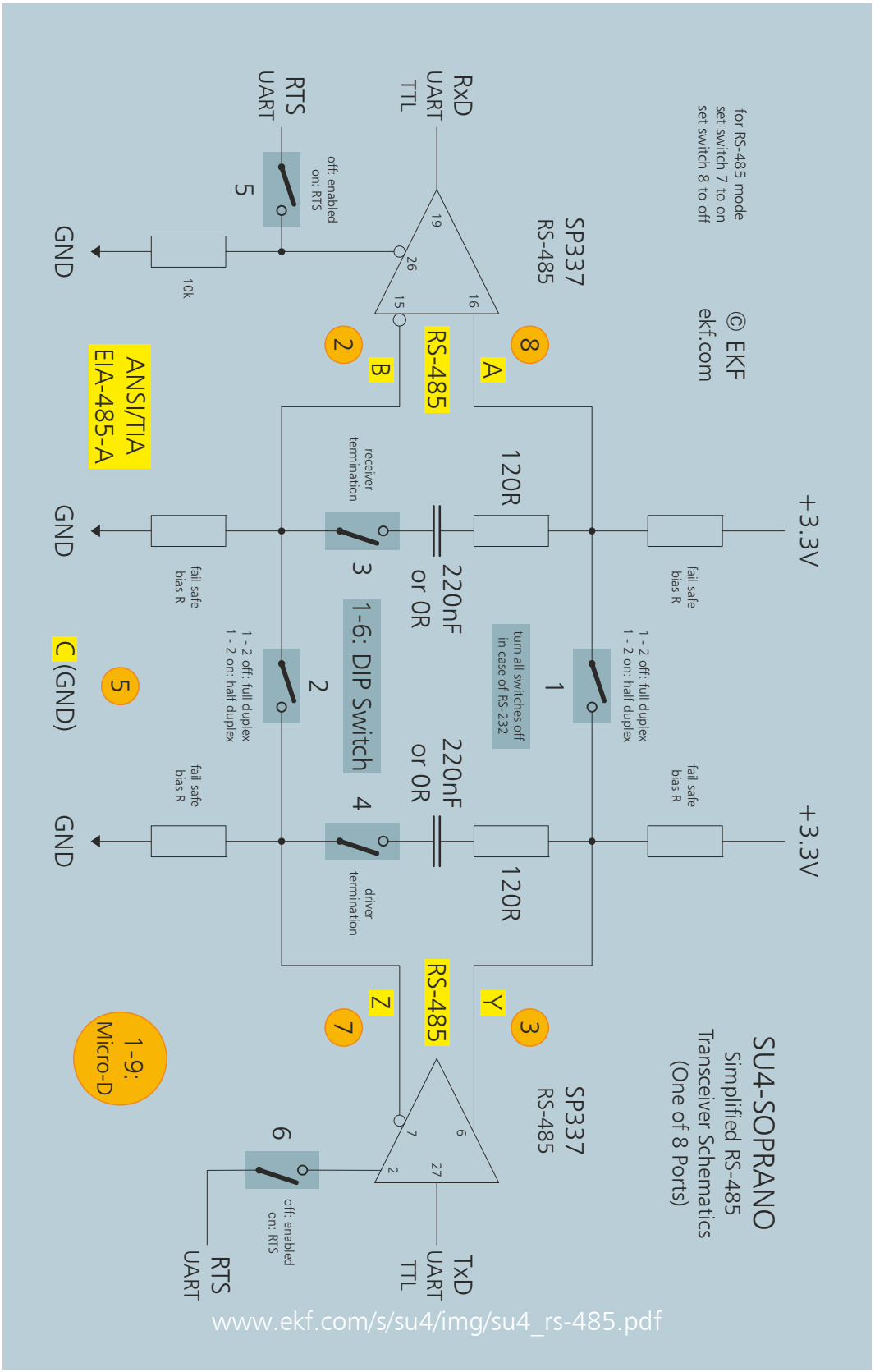
## RS-232 Transceiver Schematics

If a port has been setup for RS-232 mode (DIP switch #1-8 off), the associated Micro-D front panel connector emulates the legacy COM port pin assignment, with 5 receivers, and three drivers. Pins not in use can be simply left unconnected.



## RS-485 Transceiver Schematics

There are several configurations for the RS-485 mode, which are discussed in detail later on. The pin assignment of the associated Micro-D front panel connector is enforced by the SP337 transceiver internal circuitry, which shares or multiplexes its RS-485 I/O leads with RS-232.



## 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 cable connectors. As an alternate, the SU4-SOPRANO provides on-board DIP-switches (#3, #4), 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 here 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 SU4-SOPRANO can be manufactured with DC termination (0-Ohm as a replacement for 220nF), for maximum signal integrity with long cables, at higher power consumption.

## RS-485 Half- and Full-Duplex

The RS-485 full-duplex mode is typically used for point to point communication. The switches #1 and #2 must be set to off. A four-plus- one wire cable is used, to connect the inputs A, B of either node to the outputs Y, Z of the other node. Since drivers and receivers are typically always enabled in full-duplex mode, switches #5 and #6 should be set to off. Internal line termination would require to set the switches #3 and #4 both to on.

The maximum data transmission speed which can be achieved depends on the total cable length. A suitable twisted pair wire will allow 15Mbps full throughput up to 10m distance, and up to 100kbps at 1200m. A linear bus topology is mandatory (not star).

The RS-485 half-duplex mode (AKA multi-point or party line) allows for up to 256 nodes connected to a shared bus, via a two-plus-one wire cable. For half-duplex mode the switches #1 and #2 must be set to on (send lines and receive lines tied together, signal naming convention A, B). In addition, a master/slave software protocol must be established which compels that only one node is sending data at the same time. Set switch #6 to on, for driver enable control via the RTS signal. If required, set switch #5 to on for echo cancellation (receiver disable). For internal line termination, set either switch #3 or switch #4 to on, but not both. Please bear in mind that only the two extreme end nodes should be terminated.

## 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.*

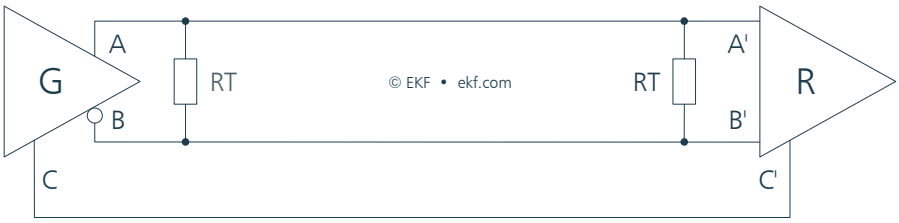
*A 2-wire system often may work though due to idle-line fail-safe resistors at the receiver inputs, which can be considered as a loosely coupled common ground. Nevertheless this operation mode cannot be recommended - what is working flawless in the laboratory may not work reliable under real conditions 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 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 SU4-SOPRANO 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/s/su4/img/rs485_common_ground.pdf

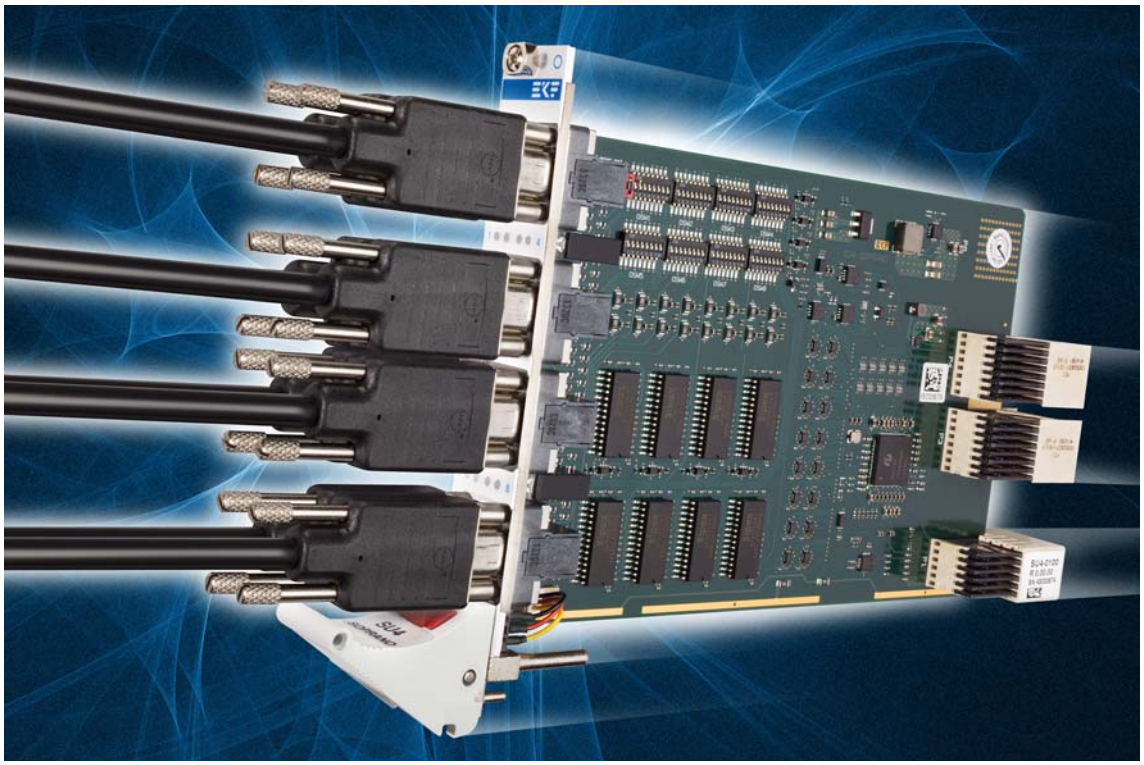
| Useful External Documents | |
|---|---|
| Wikipedia | RS-485 Three-wire connection<br>https://en.wikipedia.org/wiki/RS-485#Three-wire_connection |
| Article/ Blog | RS485 Cables – Why you need 3 wires for 2 (two) wire RS485 •<br>www.chipkin.com/articles/rs485-cables-why-you-need-3-wires-for-2-two-wire-rs485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

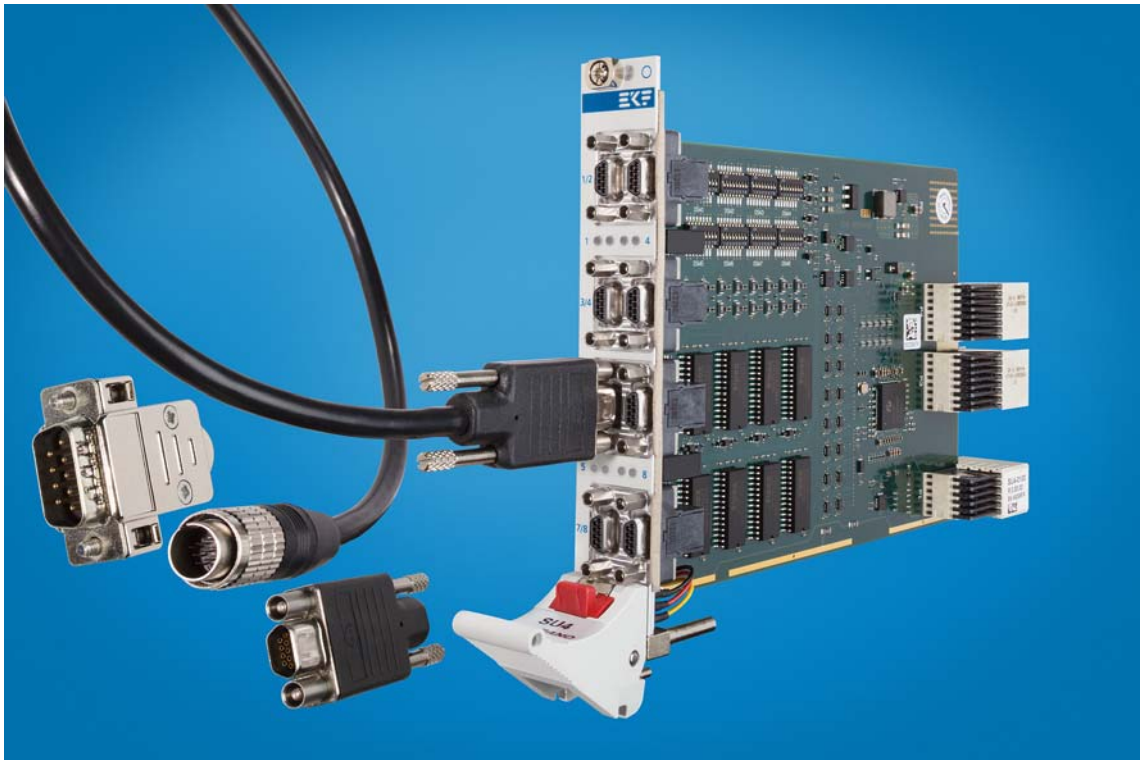
## Micro-D Cables

Some ready to use adapter cable assemblies are available from stock, 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, as would be required for DCE to DCE communication (e.g. two SU4-SOPRANO ports connected).

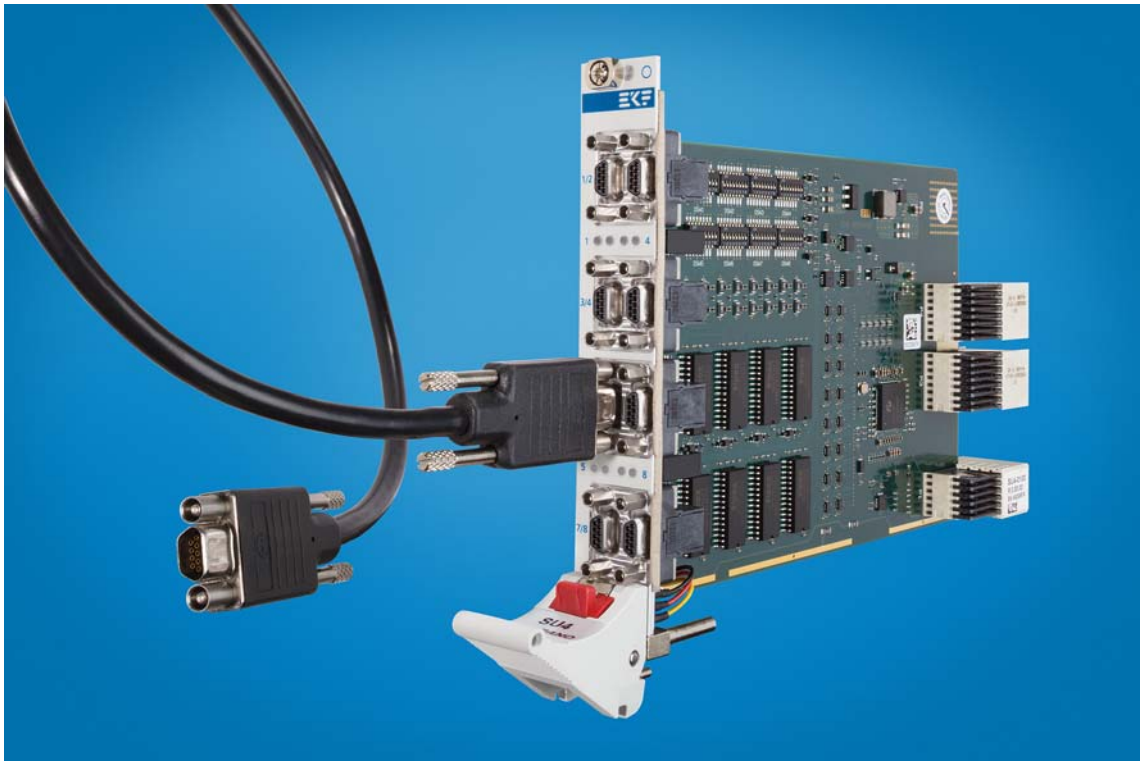
These cables may not be suitable for RS-485. Neither full-duplex operation cross-over wiring of signals Y, Z to A, B (driver output to receiver input) is supported, nor twisted pair differential signal wiring. If used as a patch cable to the RS-485 bus, the maximum data transmission rate may be reduced.

| 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 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 |

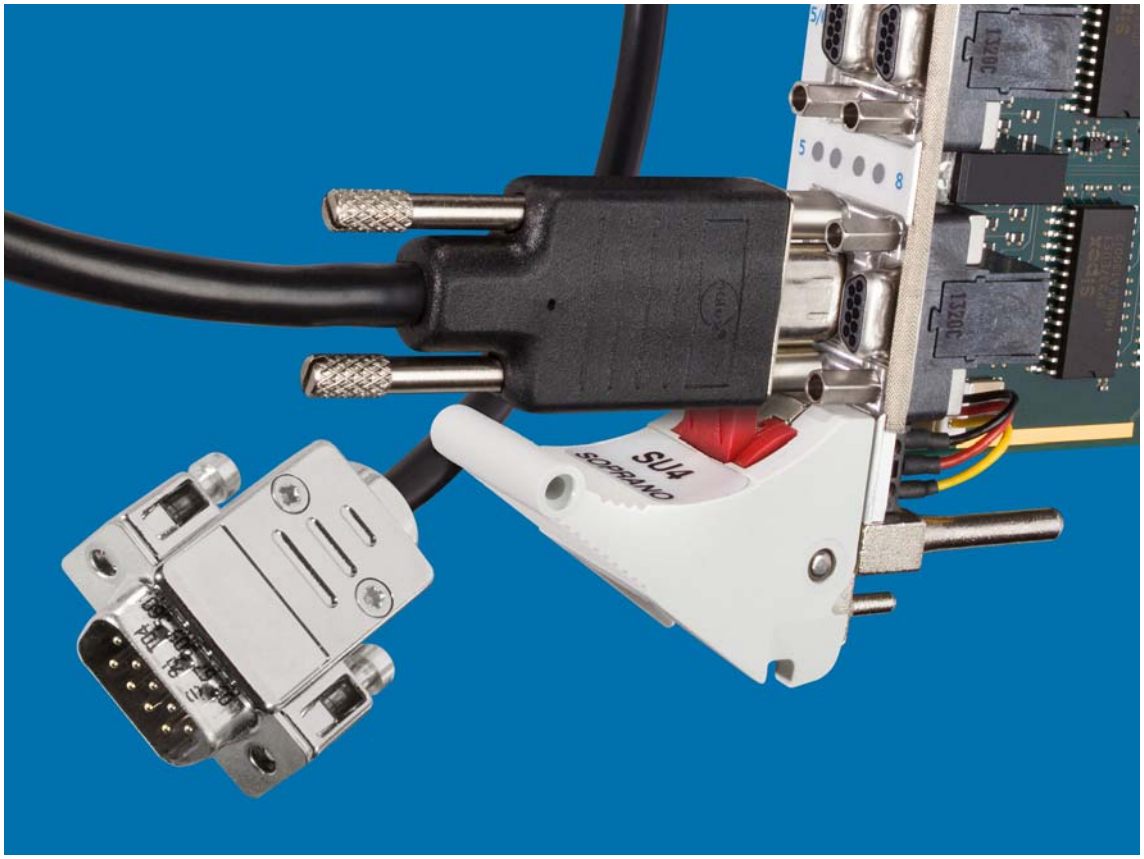




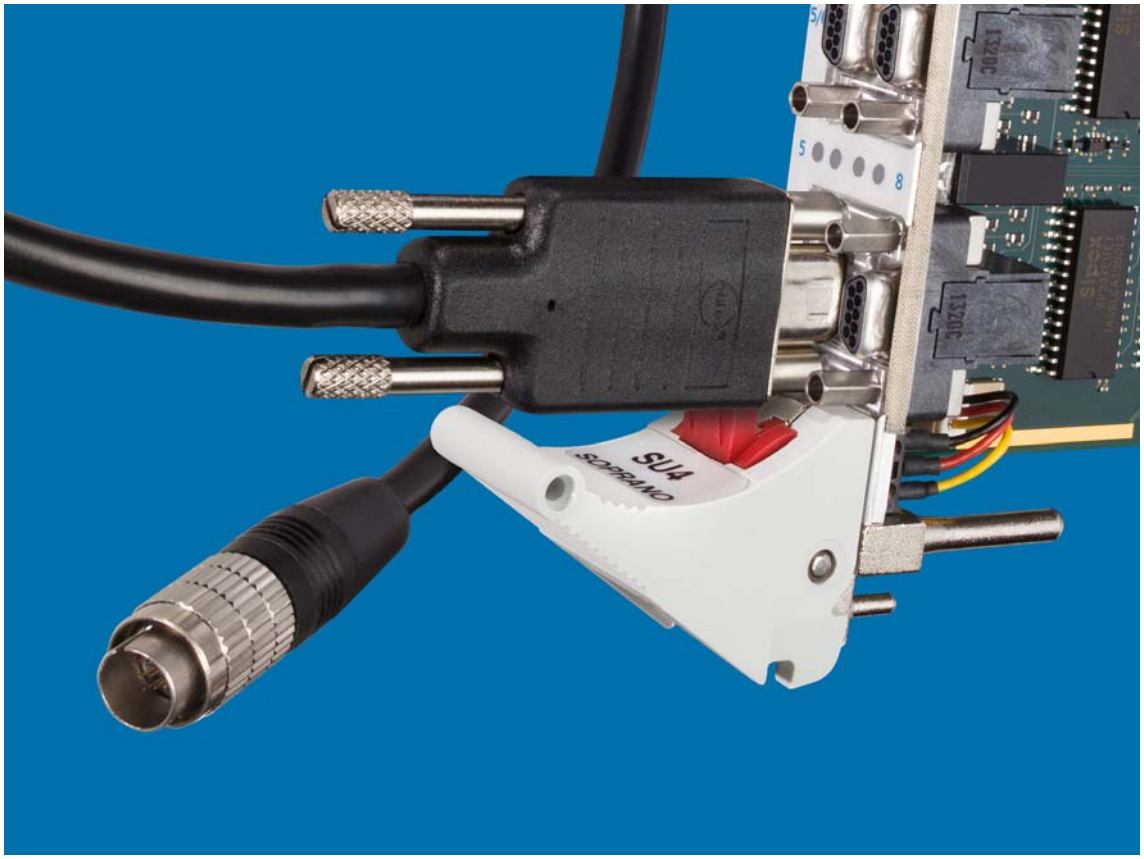
Custom Specific Cable Assembly



Micro-D to Micro-D Cable Assembly




Micro-D to D-SUB Cable Assembly




Micro-D to Hirose Circular Connector Cable Assembly

## CompactPCI® Serial Backplane Connectors

### Rear I/O Connectors P3, P4

Any of the eight SU4-SOPRANO UART ports can be configured for rear I/O usage. TTL level signal switches are used to branch all eight signals of a particular UART port either to the physical transceivers for front panel I/O, or to one of the rear I/O connectors P3, P4. A suitable rear I/O module would be required for rear I/O operation, which provides the physical transceivers and rear panel I/O connectors.

Population of P3, P4 may be optional - please consider your requirements before ordering.

**P4 CompactPCI® Serial Peripheral Slot Backplane Connector Type B**

EKF Part #250.3.1208.20.00 • 96 pos. 12x8, 16mm Width

| P4 | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | GND | UART SER8 RXD | UART SER8 DSR# | GND | UART SER8 CTS# | UART SER8 DCD# | GND | UART SER8 RI# | UART SER8 TXD | GND | UART SER8 RTS# | UART SER8 DTR# |
| 7 | UART SER7 RXD | UART SER7 DSR# | GND | UART SER7 CTS# | UART SER7 DCD# | GND | UART SER7 RI# | UART SER7 TXD | GND | UART SER7 RTS# | UART SER7 DTR# | GND |
| 6 | GND | UART SER6 RXD | UART SER6 DSR# | GND | UART SER6 CTS# | UART SER6 DCD# | GND | UART SER6 RI# | UART SER6 TXD | GND | UART SER6 RTS# | UART SER6 DTR# |
| 5 | UART SER5 RXD | UART SER5 DSR# | GND | UART SER5 CTS# | UART SER5 DCD# | GND | UART SER5 RI# | UART SER5 TXD | GND | UART SER5 RTS# | UART SER5 DTR# | GND |
| 4 | GND | | | GND | | | GND | | | GND | | |
| 3 | | | GND | | | GND | | | GND | | | GND |
| 2 | GND | | | GND | | | GND | | | GND | | |
| 1 | +12V | +12V | GND | +12V | +12V | GND | +3.3V | +3.3V | GND | +3.3V | +3.3V | GND |

all signals TTL level compliant, +3.45V maximum input voltage

## P3 CompactPCI® Serial Peripheral Slot Backplane Connector Type B

EKF Part #250.3.1208.20.00 • 96 pos. 12x8, 16mm Width

| P3 | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | GND | UART SER4 RXD | UART SER4 DSR# | GND | UART SER4 CTS# | UART SER4 DCD# | GND | UART SER4 RI# | UART SER4 TXD | GND | UART SER4 RTS# | UART SER4 DTR# |
| 7 | UART SER3 RXD | UART SER3 DSR# | GND | UART SER3 CTS# | UART SER3 DCD# | GND | UART SER3 RI# | UART SER3 TXD | GND | UART SER3 RTS# | UART SER3 DTR# | GND |
| 6 | GND | UART SER2 RXD | UART SER2 DSR# | GND | UART SER2 CTS# | UART SER2 DCD# | GND | UART SER2 RI# | UART SER2 TXD | GND | UART SER2 RTS# | UART SER2 DTR# |
| 5 | UART SER1 RXD | UART SER1 DSR# | GND | UART SER1 CTS# | UART SER1 DCD# | GND | UART SER1 RI# | UART SER1 TXD | GND | UART SER1 RTS# | UART SER1 DTR# | GND |
| 4 | GND | | | GND | | | GND | | | GND | | |
| 3 | | | GND | | | GND | | | GND | | | GND |
| 2 | GND | | | GND | | | GND | | | GND | | |
| 1 | +12V | +12V | GND | +12V | +12V | GND | +3.3V | +3.3V | GND | +3.3V | +3.3V | GND |

all signals TTL level compliant, +3.45V maximum input voltage

## CompactPCI® Serial Peripheral Slot Connector P1

The SU4-SOPRANO is equipped with a PCI Express® based UART (Gen1 single lane). The card can be inserted in any PCIe enabled peripheral slot of the CompactPCI® Serial backplane for proper operation.

**P1 CompactPCI® Serial Peripheral Slot Backplane Connector**

EKF Part #250.3.1206.20.02 • 72 pos. 12x6, 14mm Width

| P1 | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | GND | *PE TX02+* | *PE TX02-* | GND | *PE RX02+* | *PE RX02-* | GND | *PE TX03+* | *PE TX03-* | GND | *PE RX03+* | *PE RX03-* |
| 5 | PE TX00+ | PE TX00- | GND | PE RX00+ | PE RX00- | GND | *PE TX01+* | *PE TX01-* | GND | *PE RX01+* | *PE RX01-* | GND |
| 4 | GND | *USB2+* | *USB2-* | GND | PE CLK+ | PE CLK- | GND | *SATA TX+* | *SATA TX-* | GND | *SATA RX+* | *SATA RX-* |
| 3 | *USB3 TX+* | *USB3 TX-* | GA0 | *USB3 RX+* | *USB3 RX-* | GA1 | SATA SDI | SATA SDO | GA2 | SATA SCL | SATA SL | GA3 |
| 2 | GND | I2C SCL | I2C SDA | GND | RSV | RSV | GND | RST# | WAKE# | GND | PE EN# | SYS EN# |
| 1 | +12V | STBY | GND | +12V | +12V | GND | +12V | +12V | GND | +12V | +12V | GND |

pin positions printed white/grey: not connected

## Driver Software

Drivers are available for download from the EKF website at: http://www.ekf.com/s/su4/drv/

## Ordering Information

| Ordering Information |
| --- |
| For popular SU4-SOPRANO SKUs please refer to www.ekf.com/liste/liste_21.html#SU4 |

| Related Links to CompactPCI® Serial UART Cards | |
| --- | --- |
| SU4-SOPRANO Home | www.ekf.com/s/su4/su4.html |
| CompactPCI® Serial UART Solutions | www.ekf.com/s/serial.html#SU |

| Related Documents CompactPCI® Serial | |
| --- | --- |
| CompactPCI® Serial Concise Guide | www.ekf.com/s/serial_concise.pdf |
| CompactPCI® Serial Basics / Overview | www.ekf.com/s/smart_solution.pdf |
| CompactPCI® Serial Home | www.ekf.com/s/serial.html |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