KK SYSTEMS LTD

K3 RS232-RS422/485 Converter
K3-ADE RS232-RS485 Converter with ADE
K3-232 RS232-RS232 Isolator

- ✔ Plugs directly into IBM PC 9-way serial port
- ✔ Isolation 100% tested at 1500V RMS
- ✔ RS232 port-powered in most applications
- ✔ External socket for optional DC power
- ✔ Automatic Driver Enable (ADE) version for 2-wire RS485, selectable 1200-38400 baud
- ✔ RS232 output swings above and below GND
- ✔ Sony-compatible RS422 pinout
- ✔ Very low cost

The K3™ range of interface converters provides isolation and interface conversion between RS232 and RS232/422/485 interfaces.

The **K3** covers RS232-RS422 applications, and RS485 applications where driver control is not required or is provided via the RTS signal.

The **K3-ADE** covers RS232-RS485 applications where automatic driver control is required. A range of baud rates is switch-selectable.

The **K3-232** is an RS232-RS232 isolator.

Product Overview

This data sheet covers three isolated products based on similar hardware and package:

K3 is a general purpose RS232-RS422 (Fig. 1) converter. Can also be used for RS485 (Figs. 2, 3) if driver control is not required (e.g. if used as a Master on a 4-wire 485 system, Fig. 2) or if the RS232 device provides RTS Control (see RTS Control explanation below). The K3 replaces the following older KK products: K422-ISOL, K485-ISOL and its various options (e.g. -4W-FD).

K3-ADE Identical to K3 but with the addition of a microprocessor which enables and disables the RS485 driver according to the presence of RS232 data. The K3-ADE is intended for 2-wire RS485 applications (Fig. 3), and for 4-wire RS485 applications (Fig. 2) where the K3-ADE is on the Slave device. However the ADE function can be switched off entirely and then the K3-ADE can be used as a K3. The K3-ADE performs a similar function to the KK Systems KD485-ADE DIN rail mounted converter.

K3-232 RS232-RS232 isolator (Fig. 4). This simply isolates RS232. Data (RX, TX) signals are supported. Also, the RTS signal from the local RS232 device is passed through to the remote RS232 device. No other hardware handshake signals pass through.

RS422/RS485 Basic Principles

RS422 is full-duplex (data can flow in both directions simultaneously) and is suitable for point-to-point applications only; Fig. 1.

RS485 is half-duplex (data may flow only in one direction at any one time) and exists in two types: **2-wire** (Fig. 3) and **4-wire** (Fig. 2). RS485 systems are always Master/Slave. Each Slave has a unique address and responds only to a correctly addressed message (a "poll") from the Master. A Slave never *initiates* a communication. In a 2-wire system, all devices (including the Master) must have tri-state capability, i.e. its driver can be driving HIGH, LOW or be disabled (open-circuit). In a 4-wire system, the Slaves must have tri-state capability but the Master does not need it (i.e. it can be an RS422 device) because it drives a bus on which all other devices merely listen; this allows an RS422 device to operate as a Master on a 4-wire RS485 bus.

What is RTS Control?

RTS Control is a method with which the RS232 device (typically a PC) tells an RS232-RS485 converter when it should enable its RS485 driver. On low-cost converters this is not done automatically (internally) so an external signal is required. When providing RTS Control, the RS232 device raises its RTS output immediately before it starts to communicate, and drops it after the last bit of the message has been transmitted. The K3 uses this signal to control its RS485 tri-state driver. The K3-ADE does not need this signal because it generates it internally by monitoring the data with a microprocessor.

RTS Control has to be written into the application program and is not an operating system function. Many RS485-oriented application programs have it. Some, particularly under Windows, do not. Also, do not confuse RTS Control with the more common operating mode of the RTS signal which is hardware flow control and which is unsuitable for controlling a 232-485 converter.

Powering the converter from the RS232 port

In this mode, the converter is powered from the RS232 port's RTS and DTR outputs. Historically RS485 supports up to 32 devices on a bus. Since this is derived from the drive capability of a standard driver and from the load presented by a standard receiver (input resistance 12 kΩ), some RS485 devices use recently introduced high input resistance receivers to increase this to 128 (using "1/4-load" receivers) or even 256 (using "1/8-load" receivers). The K3 and K3-ADE use an 1/8-load receiver and under ideal conditions could drive a bus with up to 256 similar (i.e. 1/8-load) devices. In practice this cannot usually be achieved because:

- With long cables (e.g. 300m+) cable capacitance is the largest factor in the converter's power consumption, especially at high baud rates. The following table is a very conservative but useful guide for an RS232-port-powered K3 converter. Typical 422/485 twisted pair cables are around 100pF/metre so e.g. 30000pF is around 300m.

Baud Rate (baud)	Max total cable capacitance (pF)		Baud Rate (baud)	Max total cable capacitance (pF)
1200	250000		19200	15000
2400	120000		38400	7500
4800	60000		57600	5000
9600	30000		115200	2500

- The above table is for one standard (12 kΩ) RS422/485 load. For each additional standard load, reduce the cable length by 1/10th, i.e. the maximum recommended number of loads, without using external power, is 10.
- RS232 interfaces vary in their ability to supply power. At least one of the RTS or DTR signals must be continuously HIGH to power the converter; with many PC interfaces both of them need to be HIGH to deliver the required current.
- The K3 will often be driving non-KK devices that use "full-load" receivers; then the limit is 32 even with external power.

- Some RS485 systems use termination resistors. An RS232-powered converter will not have enough power to drive these. A capacitor, e.g. 1000pF, can be connected in series with terminators to eliminate this DC loading. However, the controlled slew rate driver used in this converter makes termination unnecessary for cables shorter than approximately 300m.

You can determine if the converter is receiving sufficient power from the RS232 device by measuring the voltage coming out of its DC Power socket, relative to the local port ground. The voltage comes out via a 100kΩ resistor so a high impedance voltmeter must be used; most standard digital voltmeters are suitable. The measured voltage should be at least +5.5V DC (centre pin is +).

Powering the converter from an external power supply

This is required in applications where the power available from the RS232 port is insufficient, or where no RTS/DTR signals exist.

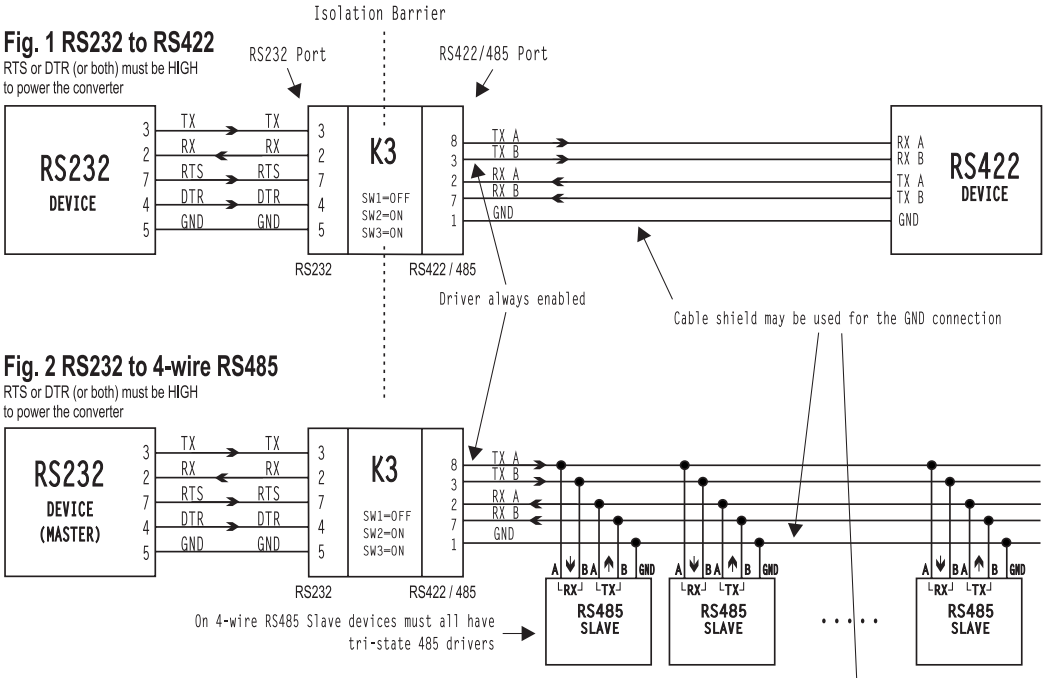
An external +9V DC or +12V DC power supply can be connected to either pin 9 of the local port RS232 connector, or be plugged into the Optional DC Input socket. The converter then achieves the full RS422/485 specification of 1200m of twisted-pair cable at 9600 baud, and 32 standard-load devices on the RS485 bus, and terminators can be used if necessary.

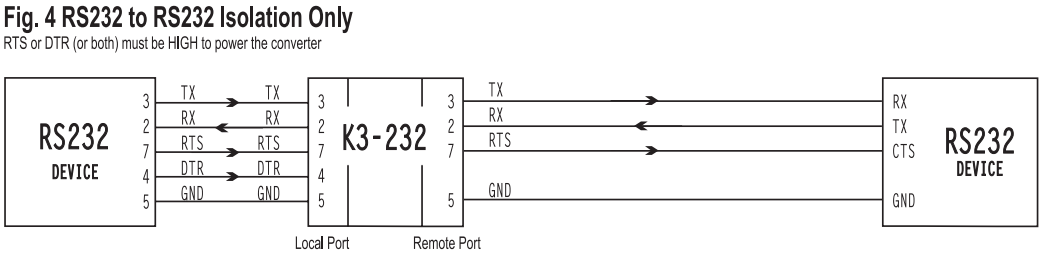
☞ The maximum external supply voltage is +16V. Be careful when using cheap unregulated power units because a “12V” power unit could output 20V or more at the very small load presented by this converter.

☞ The polarity of the external supply matters; the centre pin is +. However the K3 range is reverse polarity protected and no damage will occur if the supply is reversed.

☞ The external power input is not isolated from the data ports. Its ground is connected to the local port (RS232) ground.

Connections





RS232: The converter's RS232 port is "DCE" and is designed to plug directly into a standard 9-way IBM PC RS232 port. If your RS232 device's port is 25-way then you need a commonly available 9-25 moulded converter.

RS422/485 A or B: Following RS422/485 standards, the RS422/485 connections on the converter are marked **A** and **B**. They are defined as follows: When the RS232 TX input is at the RS232 HIGH level the A output is at the RS422/485 HIGH level (+5V nominally) and the B output is at the RS422/485 LOW level (0V nominally).

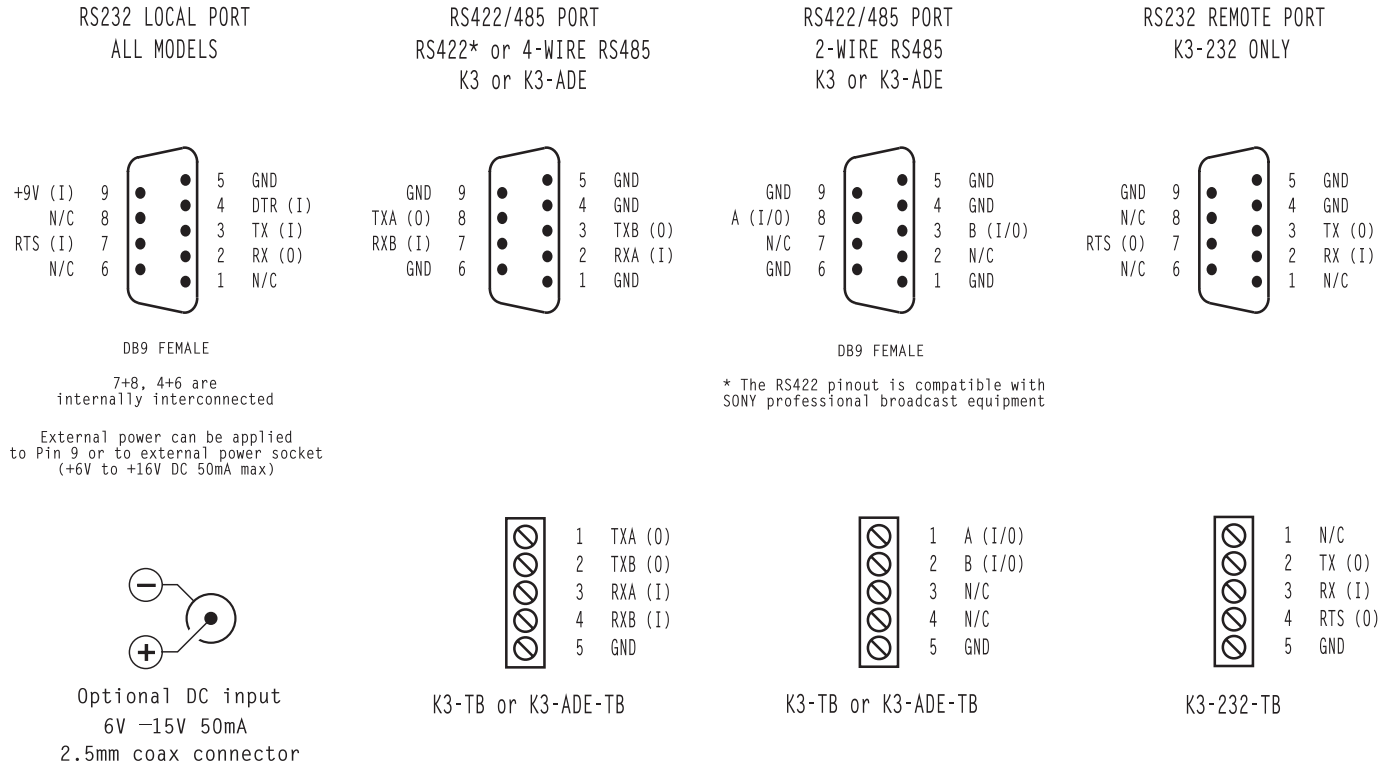
When connecting to other RS422/485 equipment, you may encounter markings such as HI/LO and +/–. Such non-standard markings are unclear and you may need to experiment. Normally, one assumes that the KK converter's A/B corresponds to the other device's A/B, HI/LO or +/– markings respectively but sometimes this is wrong. One simple way to help establish which is which is to measure the voltages on the other product's RS422/485 interface when no communications is taking place: B should be more positive than A, relative to its communications ground.

RX4xx Isolated Port Grounding: A connection between the converter's Isolated GND and the other device(s) interface ground is highly desirable for proper noise immunity. See Figs 1,2,3. Due to the isolation provided by the converter, there is no risk of ground loop currents. The cable shield should be used for this connection.

RS232 Isolated Port Grounding: A connection between the converter's Isolated GND and the other device's interface ground is mandatory, as RS232 is not a differential system. See Fig. 4. Due to the isolation provided by the converter, there is no risk of ground loop currents. The cable shield should be used for this connection.

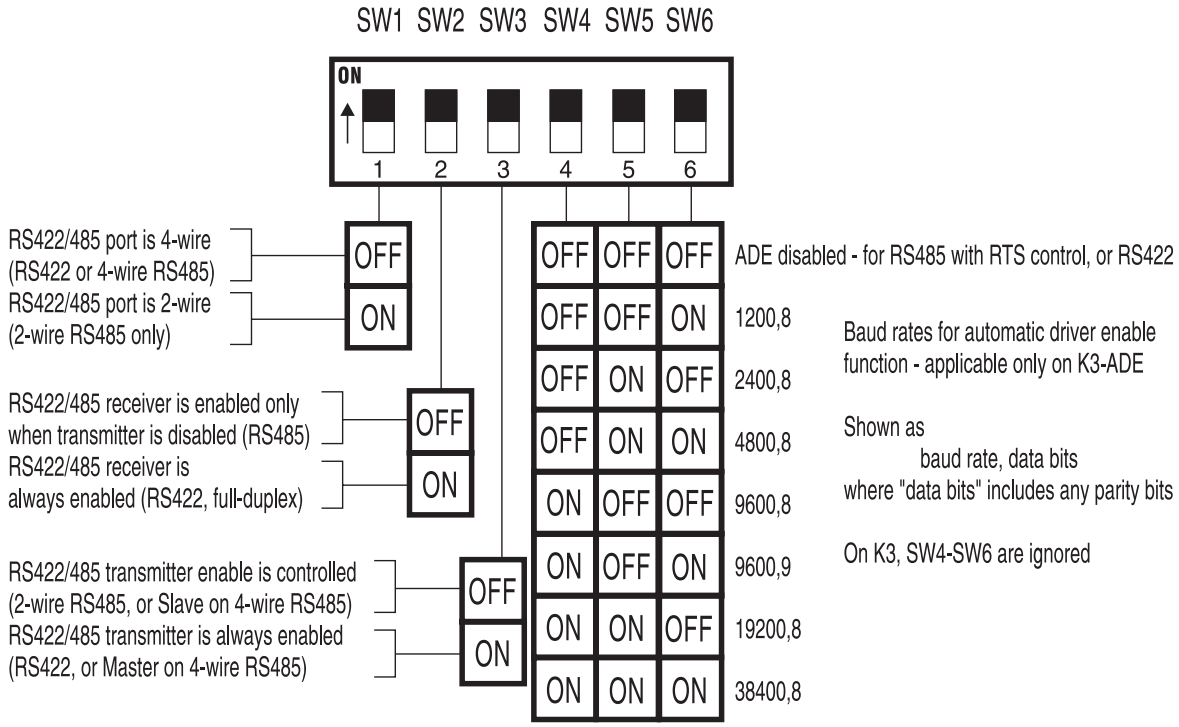
Fig. 5 Pin Connections

O=Output I=Input N/C=Do Not Connect



Switch Settings

Fig. 6 Dipswitch Description



Replacing older KK Systems isolated converters with the K3 or K3-ADE

	SW1	SW2	SW3
K422-ISOL	OFF	ON	ON
K485-ISOL	ON	OFF	OFF
K485-ISOL-FD	ON	ON	OFF
K485-ISOL-4W	OFF	OFF	OFF
K485-ISOL-4W-FD	OFF	ON	OFF

The K3 has a slightly higher power consumption than the Kxxx-ISOL but this will be of no consequence in all but the most marginal applications because it is still very low.

Troubleshooting

If you cannot establish communications, check the following:

- Check that the RS422/485 A/B connections on the converter are connected to the correct terminals of the other device. Due to commonly non-standard markings on some equipment you may need to experiment by swapping the A/B wires. One simple way to help establish which is which is to measure the voltages on the remote device RS4xx port (with nothing connected to it) when no communications are taking place: B should be more positive than A.
- If powering from RS232, check that the converter is receiving an adequate supply from the RTS,DTR signals. With a high impedance voltmeter (most digital multimeters are suitable) check the voltage coming out of the + pin of the DC Power socket, relative to the RS232 (local port) ground. This should be at least +5.5V. If it is too low, check that any RS422/RS485 termination resistors are removed, or have a series capacitor; see the “Powering the converter from the RS232 port” section.
- Ensure that the grounding instructions are followed; see the Connections section.
- If driver control is required (true for all 2-wire RS485 applications, and for Slave 4-wire RS485 applications) then check that your RS232 device is providing the correct type of RTS Control (see the “What is RTS Control” section). In the IBM PC (DOS or Windows) context, the application program must be specifically written to manipulate RTS - this is not an operating system function which you can simply configure. Alternatively, use the K3-ADE.

Specification

Serial parameters:	K3: 0-38400 baud, any character format including break levels. K3-ADE: 1200, 2400, 4800, 9600, 19200, 38400 (8 data bits, or 7 bits plus parity); 9600 (8 bits plus parity). Any number of stop bits. Break levels are supported at 19200 baud and below.
RS232 interface:	Receiver threshold +1.5V typ. Hysteresis 500mV typ. Receiver input impedance 5kΩ typ. Transmitter output swing ±4V typ. into 3kΩ load.
RS422/485 i/face:	Receiver threshold 200mV typ (differential). Hysteresis 50mV typ. Receiver input impedance 96kΩ min. Transmitter output swing 5V (no DC load); 1.5V (60Ω load, applies with external power only). Maximum common-mode voltage -7V to +12V.
Supply current:	All following figures are typical, with no cable load, and apply to both RS232 and external power modes: K3: 4.5mA (all baud rates, one standard 12kΩ RS4xx load) K3-ADE: 6mA (1200-9600 baud); 7mA (19200 baud); 8mA (38400 baud), one 12kΩ RS4xx load K3-232: 3.5mA (no load); 7.5mA (one standard 3kΩ RS232 load)
Environmental:	Operating 0 to +50C, storage -40V to +70C, RH 0 to 90% non-condensing
CE compliance:	Emissions EN50081-2, immunity EN50082-2
Dimensions:	50mm (W) x 20mm (H) x 80mm (L)

Ordering Information

K3	RS232-RS422/RS485 isolated converter, requires RTS Control for all 2-wire and Slave 4-wire applications
K3-TB	Terminal block version of the above
K3-ADE	As K3, adds automatic driver enable, 1200-38400 baud
K3-ADE-TB	Terminal block version of the above
K3-232	RS232 isolator (RX,TX data only, no hardware handshakes pass through, except RTS one-way)
K3-232-TB	Terminal block version of the above
PSU-UK-01	Optional UK (240V) power supply for the K3 range (9V DC output). Non-UK versions available.

Other products designed and manufactured by KK Systems

A range of high quality low cost RS232-RS422, RS485, 20mA, USB and fibre interface and protocol converters is also available in both inline and DIN rail packages, with and without isolation.

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