USER MANUAL

CE

KDF FIBRE MODEM

KK SYSTEMS

Extract from Conditions of Sale

Any electronic device or system can fail, possibly resulting in the loss of valuable programs or data. It is your responsibility to ensure that all such valuable material is backed-up at all times. We are not liable for any direct, indirect or consequential loss caused directly or indirectly through the use of this product. All our software is sold on an “as is” basis without a warranty of any kind. We do not claim that this product is suitable for all potential applications. It is your responsibility to verify that the product works in its intended application. In the interest of progress, we reserve the right to alter prices and specifications without prior notice.

Safety Warning

The KDF is not authorised for use in any situation where injury or death could result from its failure.

Year 2000 Compliance

There is no date dependent function in the KDF.

CE Compliance

See Specification.

Edition 2 27 April 2000

Table of Contents

KDF Overview 1
- KDF Order Codes 2
- Front Panel Description 2
- Loopback 2
- RS422/RS485 Modes Switch 3
- Synchronous operation 3
- Data Encoding and compatibility with non-KK fibre products 3
- Custom Versions 3
- KDF Specification 4

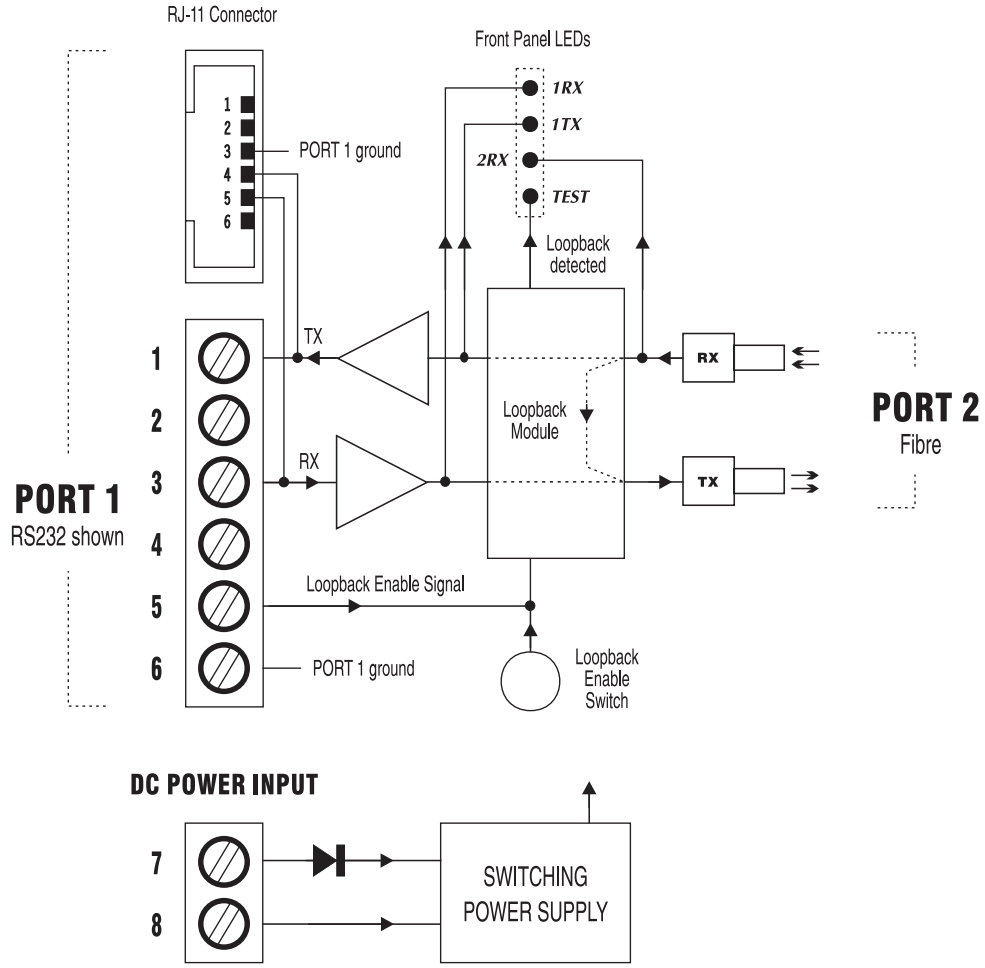
Installation 5
- Port 1 Interface and Port 2 Fibre Type identification 5
- DC Power Requirements 5
- Port 1 (Serial Comms) Connections 6
- Port 2 (Fibre) Connections 6
- DIN rail attachment and removal 7
- Wiring Examples 8

Reference 10
- RS232 Ports 10
- RS232 Ports - Detail Description of Terminals 10
- RS422/485 Ports 11
- RS422/485 Ports - difference between RS422 and RS485? 12
- RS422/485 Ports - Grounding 12
- RS422/485 Ports - A/B Terminal Markings 12
- RS422/485 Ports - Detail Description of Terminals 12
- RS422/485 Ports - Terminators 13
- RS422/485 Ports - Bus Pullups 14
- 20mA Loop Ports 15
- 20mA Loop Ports - Detail Description of Terminals 15
- KDF Dimensions 16

Troubleshooting 17
- KDF power-up problems 17
- No Communications 17
- RS232 Communications Problems 17
- RS422/485 Communications Problems 17
- Intermittent Comms Errors - General 17
- Intermittent Comms Errors - RS422/485 18

KDF Overview

The KDF is an interface converter with one serial communications port and one fibre optic port. This type of product is also called a fibre modem or a fibre line driver. One port is serial asynchronous and is available factory-fitted with one of RS232, RS422/485 or 20mA loop interfaces; the other port is a fibre port:



Port 1 and the power input are on a removable screw terminal. For additional convenience, Port 1 is electrically duplicated on an RJ-11 connector.

The KDF has electrical isolation between Port 1 and the power input. This means that the two ports and the power supply input are all isolated from each other. This offers great installation flexibility while avoiding ground loops.

The KDF is powered by a supply in the range +7V to +35V, 1-2 watts (typical). This is a high efficiency switching power supply which draws nearly constant power over the input voltage range and ensures very low power dissipation in the KD485.

☞ The constant power property of the KDF may require a larger power supply to be used. Please see the **Installation** chapter for details.

KDF Order Codes

The Port 1 interface and fibre connector type are specified as follows:

KDF-XX-YY-ZZ

where

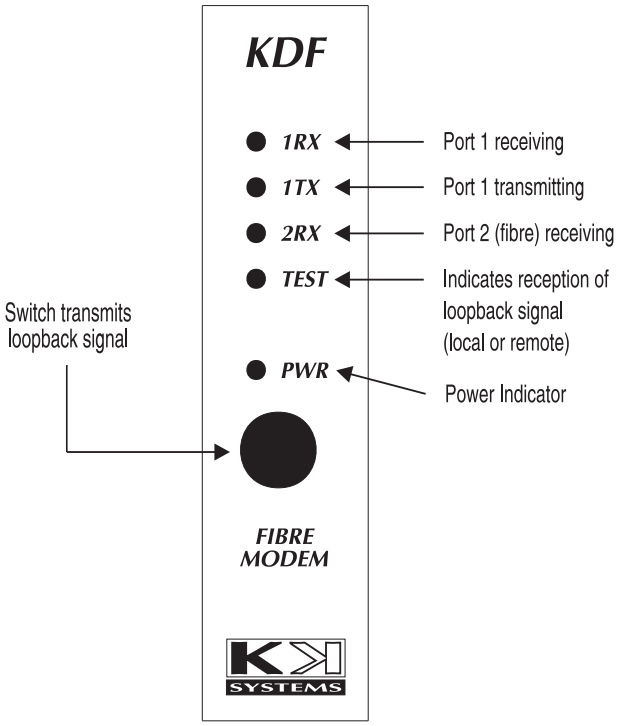
XX	Port 1 interface type: **232** or **422** or **20MA**
YY	Port 2 fibre connector type: **ST** or **SFH**
ZZ	Fibre type: **50** or **1000**

Examples:

KDF-232-ST-50	RS232 to ST connector and 50 micron glass fibre
KDF-422-SFH-1000	RS422/485 to SFH connector and 1000 micron (1mm) polymer fibre

Usually the fibre type is implicit from the type of fibre connector but it is possible to have e.g. the ST connector with 1mm fibre (e.g. KDF-232-ST-1000); the ST connector is more robust and may be preferred even for polymer fibre where very frequent disconnection is required.

Front Panel Description



Loopback

The KDF has a loopback test mode which tests both the KDF and the fibre connections.

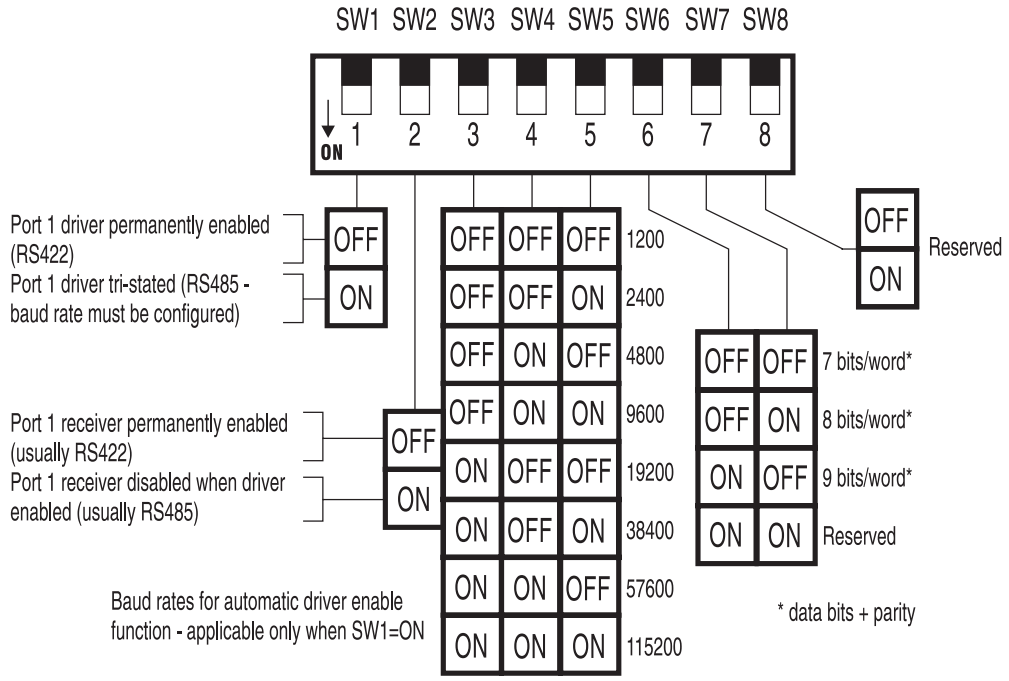
Pressing the front panel button causes the KDF to emit a special code which when successfully received by the remote KDF is returned by it and illuminates the “TEST” LED in both units. The test can be done even when there are active connections to Port 1.

The loopback feature can also be invoked with an external RS232-level signal.

☞ Invoking the loopback test stops Port 1 communication for the duration of the test.

RS422/RS485 Modes Switch

The KDF-422 has an additional dipswitch which selects various modes for Port 1:



The RS422 version offers automatic driver enable (ADE) on RS485, thereby supporting direct conversion from fibre to 2-wire and 4-wire RS485. The ADE function is performed with a microcontroller (not with a simple timer) and the line turn-around is very precisely timed enabling its use in RS485 systems with minimal intermessage gaps.

The bits/word setting (switches 6 and 7) represents the total number of bits/word plus parity. For example, 7 bits with parity is configured as “8 bits/word”. There is no configuration for 1 or 2 stop bits because the RS485 driver is turned off near the end of the first stop bit, and in an asynchronous system any subsequent stop bits are equivalent to intercharacter space which can legitimately have any duration.

Synchronous operation

While the KDF is intended for asynchronous applications, it is data transparent (except for RS485 operation with ADE; this works on async only) and can be used with any type of data encoding where the spacing of the transitions is no closer than 10 microseconds. However, many synchronous applications require the transmission of two signals (data and clock) and the KDF supports only one signal in each direction.

Data Encoding and compatibility with non-KK fibre products

The KDF uses proprietary data encoding on the fibre interface. This is done to maximise emitter lifetime (by reducing the average emitter power to a level far lower than that used in most non-KK products) while maximising useful range. The KDF’s fibre interface is therefore not compatible with products from other manufacturers.

Custom Versions

Other KDF versions are available, e.g. with special fibre connector types or laser emitters for very long ranges. Please contact Factory with your requirements.

Completely customised products, based on a combination of the KDF, the KD485 or the 4-port PPC Programmable Protocol Converter, can also be supplied. See www.kksystems.com for details of these products. Custom labelling and different physical layout (e.g. Eurocard) can also be supplied.

KDF Specification

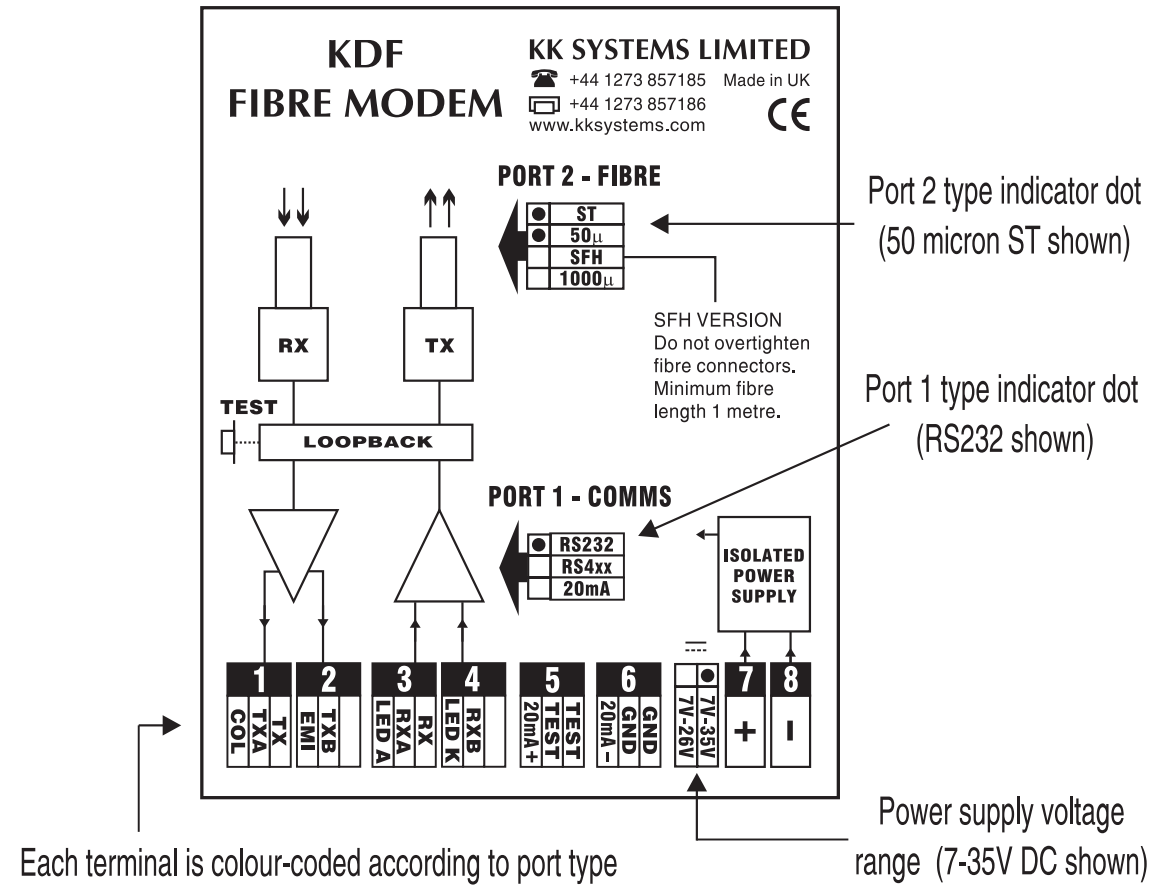
Interfaces:	One serial port RS232/422/485/20mA, one fibre port. TX & RX signals only.
Interface parameters:	Data transparent, all character formats and protocols supported. RS485 automatic driver enable (ADE) function: Asynchronous data only, 1200-115200 baud, 7/8 bits/word, with and without parity. 20mA Loop ports: 1200-19200 baud.
RS232 interface:	Receiver threshold +1.5V typ. Hysteresis 500mV typ. Receiver input impedance 5kΩ typ. Transmitter output swing $\pm$8V typ. into 3kΩ load.
RS422/485 interface:	Receiver threshold 200mV typ (differential). Hysteresis 50mV typ. Receiver input impedance 12kΩ min. Transmitter output swing 5V (no DC load); 1.5V (60Ω load).
20mA loop interface:	Input: LED, nominal drop 2V Output: open collector transistor, Vce(sat) < 2V 20mA current source: accuracy $\pm$20%; no-load output voltage is approximately equal to KDF supply voltage.
Fibre length:	ST interface (50/125 glass fibre): >16db power budget (approx 4000m). SFH interface (1000 micron polymer fibre): >100m. Longer distances optionally available.
Bit error rate:	Not measurable at < 120kbaud.
Bit timing jitter:	$\pm$2 microseconds.
Peak emitter power:	ST interface: 35 microwatts typ. infra-red 850nm. SFH interface: 200 microwatts typ. visible 660nm.
Power supply:	+7V to +35V DC. +7V to +26V DC if Port 1 is 20mA Loop type. Input power is approximately constant at 1-2 watts (startup current 300-600mA) depending on model. At startup, the supply voltage must reach 7V within 1 sec otherwise the power supply will not function.
Isolation voltages:	Between Port 1 and power input: 64V PK, 100% tested at >1000V AC RMS, 1 second. Between input, output and current source of 20mA Loop port: 100V AC, functionally (low voltage) tested.
Environmental:	Operating temperature 0 to +50C. Storage temperature -25C to +70C. Relative humidity (operating and storage) 0 to 90%, non-condensing.
Ventilation:	Rail-mounted KDF must have a 50mm gap above and below.
EMC compliance:	Emissions EN50081-2 (94), immunity EN50082-2 (95). Shielded cables must be used for Port 1 connections.
Dimensions:	29mm (W) x 114mm (H) x 97mm (L) approx. in rail-mounted position, including screw terminals.

Installation

For detail information on the various port types (RS232, RS422/485, 20mA loop) please also refer to the **Reference** section.

Port 1 Interface and Port 2 Fibre Type identification

The types of each of the two ports are marked on the side label and these are colour-coded to show which terminals are applicable to that port type:



DC Power Requirements

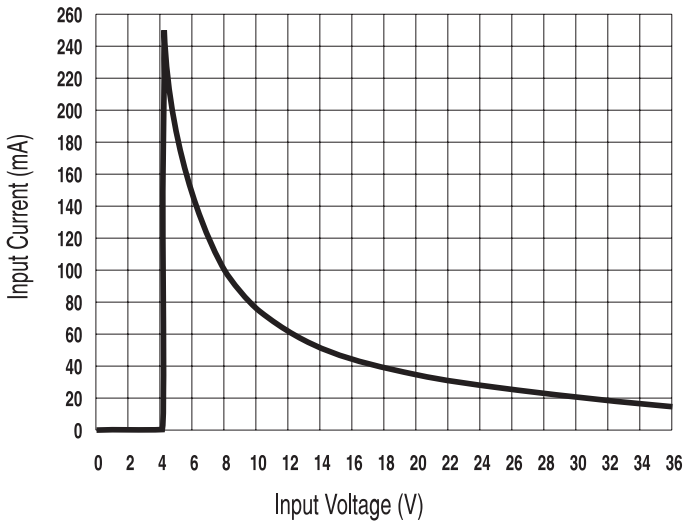
The KDF requires a regulated or unregulated DC power supply whose voltage must at all times be in the range +7V to +35V (+7V to +26V if Port 1 is 20mA loop type).

For efficiency, the KDF has an internal *switching* power supply. Therefore, **the current consumption varies with the supply voltage**, such that the power (in watts) remains fairly constant over the supply voltage range.

To ensure reliable startup your power supply must be capable of delivering up to 600mA. If you have a choice, a +9V or +12V regulated supply is recommended. There is no advantage in using higher voltages; the power supply needs to deliver (during startup) up to 600mA so if a higher voltage power supply is used, it needs to be a larger-wattage unit.

The following graph shows the input voltage to input current relationship for a typical KDF:

KDF Typical Power Input Characteristics



The peak current which occurs around 4V can reach 600mA on some models.

Input must reach the startup voltage (typ. 4V, guaranteed 7V) in less than 1 second otherwise the power supply will not start up.

Port 1 (Serial Comms) Connections

Port 1 can be accessed either via the screw terminals (numbered 1-6 on the 8-way terminal block), or via the RJ-11 connector.

☞ Do not connect to both the screw terminals and the RJ-11 simultaneously.

For maximum noise immunity, Port 1 connections should use a shielded cable.

Refer to the **Reference** section for detailed information on the pin functions.

Port 2 (Fibre) Connections

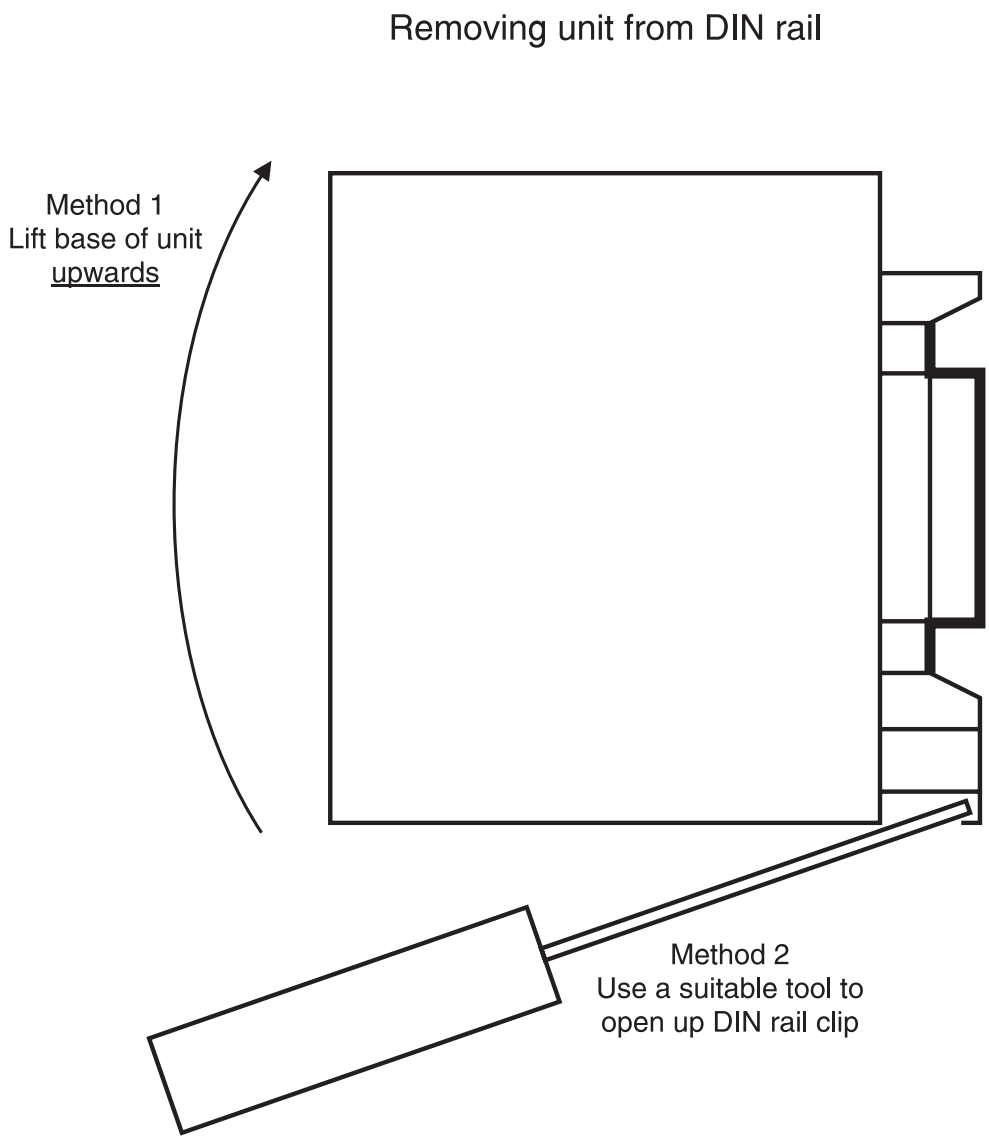
To terminate **1000 micron** (1mm) polymer fibre into the KDF's built-in SFH connector, simply cut it off with a sharp knife. A hot knife is the best but makes little difference except at the end of the range. The connector may be finger-tightened only; do not use any tools otherwise damage will result. Remember the minimum polymer cable length for the KDF is 1 metre.

For terminating **50 micron** glass fibre into an ST connector, there are many kits on the market. A popular one is the AMP LIGHTCRIMP/OPTIMATE connector; this requires the AMP LIGHTCRIMP field termination kit. There is generally a trade-off between connector cost and ease of termination in the field. Pre-assembled leads are also available from many sources.

DIN rail attachment and removal

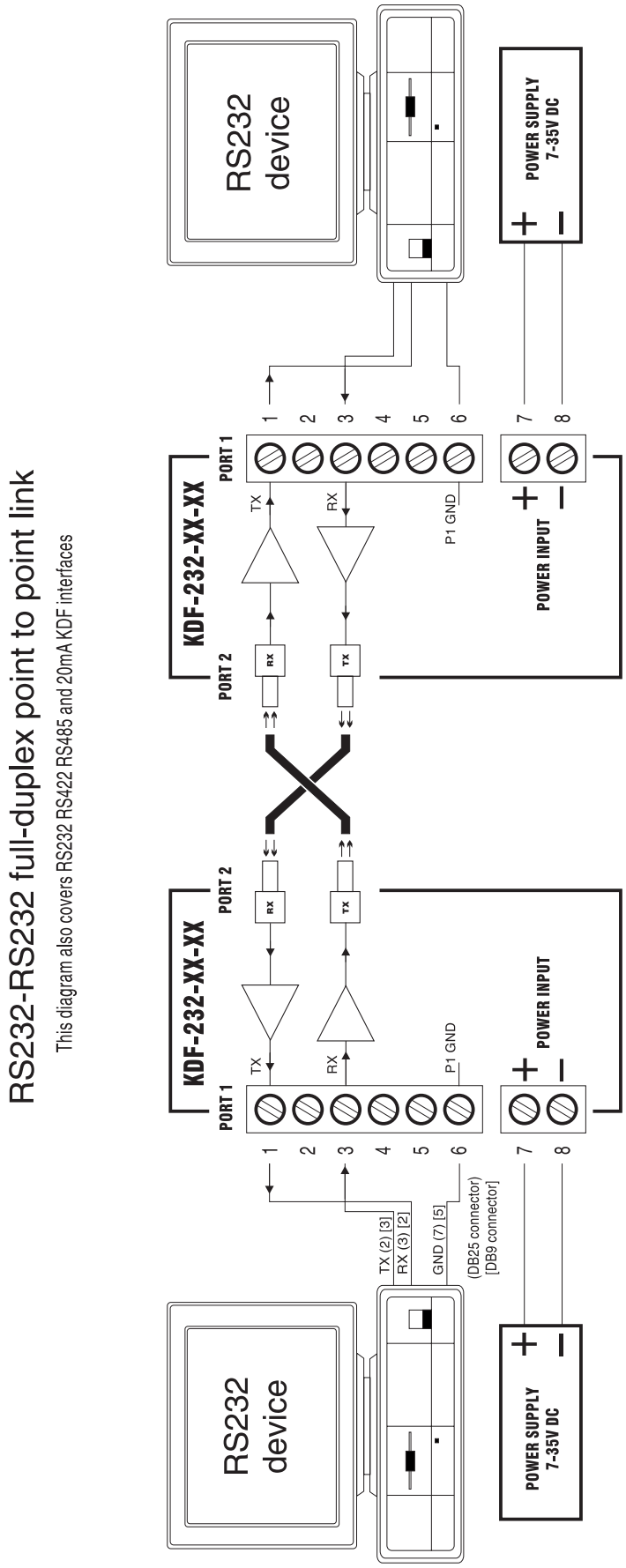
To fit the KDF to the rail, simply clip it on.

To remove the KD485 from the rail, lift the front end **upwards**. However, this may not be successful, particularly with the taller and thicker 35mm rails, in which case use a suitable tool (e.g. a flat screwdriver) to gently (very little force is required) open up the DIN rail clip as shown below:

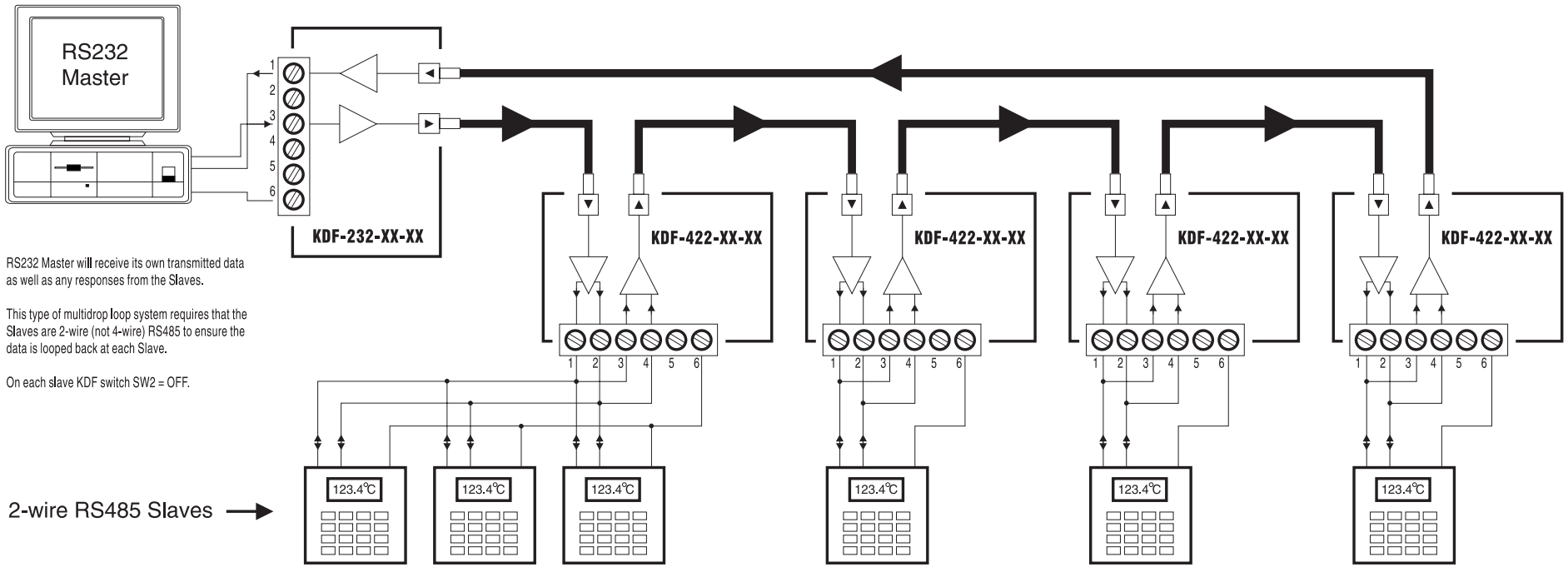


Wiring Examples

The following pages contain examples of typical applications.



Multidrop Fibre Loop with 2-wire RS485 Slaves



RS232 Master will receive its own transmitted data as well as any responses from the Slaves.

This type of multidrop loop system requires that the Slaves are 2-wire (not 4-wire) RS485 to ensure the data is looped back at each Slave.

On each slave KDF switch SW2 = OFF.

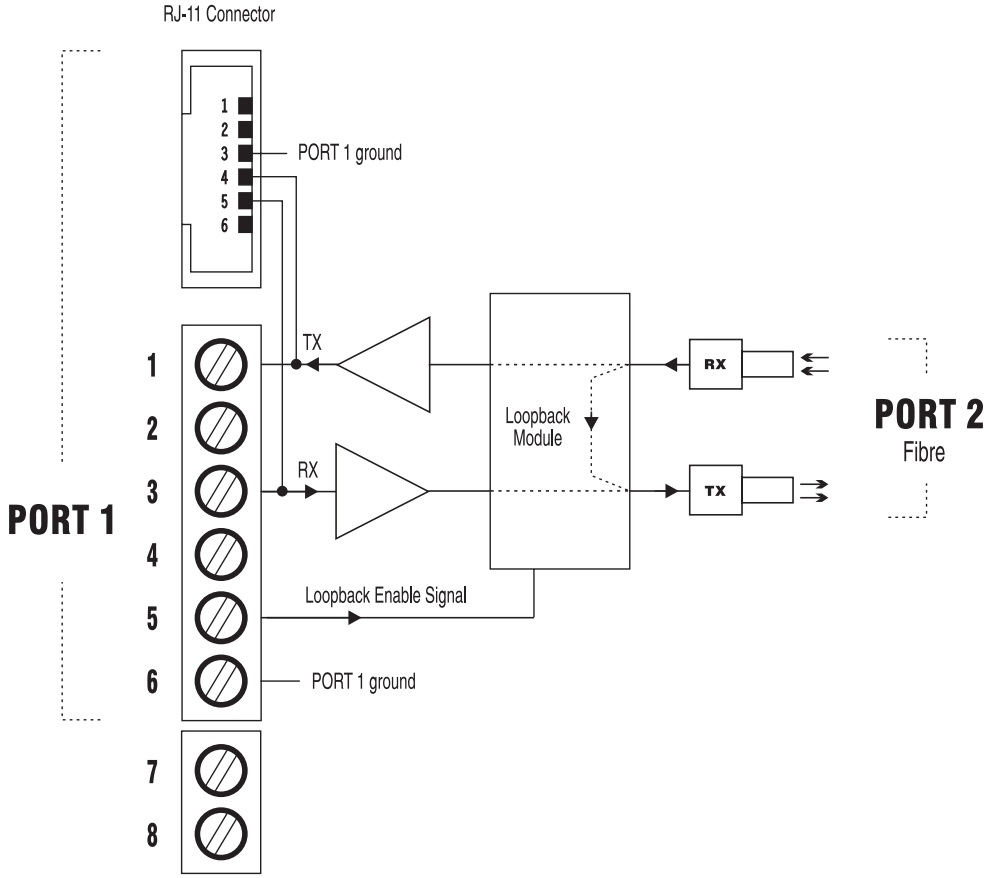
Reference

The KDF has two ports, called Port 1 and Port 2. Port 1 can be supplied factory configured as RS232, RS422/485, or 20mA loop interfaces. Port 2 is the fibre port. The port types are marked on the side label.

Port 1 is duplicated on an RJ-11 connector. The RJ-11 is not a second serial port.

The following text describes each of the three possible Port 1 interface types:

RS232 Ports



The RS232 port supports TX, RX signals only.

On Port 1 there is an additional input signal, TEST (pin 5), which can be used to initiate loopback test.

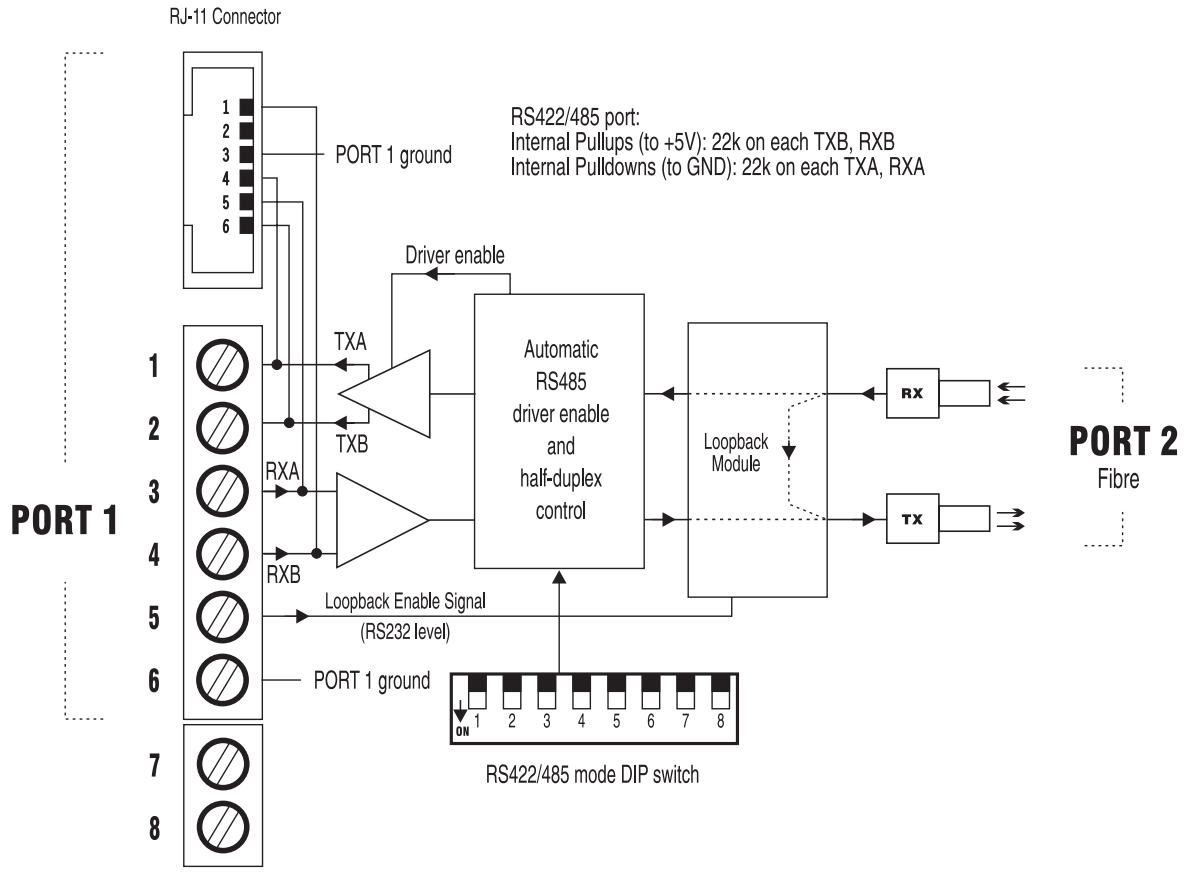
☞ On some very early versions of the KDF the internal supply voltage was +3.3V instead of the present +5V; therefore RS422/485 output swing would be 0 to +3.3V and RS232 output swing would be -5V to +5V. This raises no compatibility problems with standard 5V products.

RS232 Ports - Detail Description of Terminals

The numbers in brackets are the markings on the KDF terminals.

TX (1)	"Transmit Data" output.
RX (3)	"Receive Data" input.
TEST (5)	Applying an RS232 HIGH level (above +1.5V) to this input has the same effect as pressing the TEST (loopback) switch.
GND (6)	This signal must always be connected. This combines both Protective Ground and Signal Ground functions.

RS422/485 Ports



This is a multi-purpose port which supports the following operating modes:

- **RS422.** This is a four-wire (plus ground) interface whose driver is permanently enabled.
- **4-wire RS485**. This is a four-wire (plus ground) interface whose driver can be enabled or disabled; this is called tri-state capability. This interface is often incorrectly called “RS422”.
- **2-wire RS485**. This is a two-wire (plus ground) interface whose driver must have tri-state capability.

The selection of the operating mode is done partly with the dipswitch (which is present only on a KDF-422) and partly with the way the port is externally wired:

	DIP switch	**External Wiring**
RS422	All switches OFF	No external interconnections
4-wire RS485*	SW1=ON, SW2=OFF (usually) Set baud rate etc on SW3-SW7	No external interconnections
2-wire RS485	SW1=ON, SW2=ON (usually) Set baud rate etc on SW3-SW7	Interconnect TXA-RXA Interconnect TXB-RXB

* The Master on a 4-wire RS485 bus can be an RS422 device because driver can be permanently enabled.

RS422/485 Ports - difference between RS422 and RS485?

RS422 and RS485 drivers and receivers have identical electrical characteristics. Both systems transmit each signal with two wires. Each signal is driven with a differential driver, and received with a differential receiver. Both of the driver outputs swing between 0V and +5V (no load).

The main difference between the two systems is that while RS422 is a four-wire system suitable only for point-to-point use, the driver in an RS485 system has tri-state capability (its output can be disabled) which allows multiple transmitters to be connected to the same bus. RS485 thus supports "multi-drop" operation. In multi-drop systems there is always one device which is permanently a "master" and which periodically polls (sends messages to, requests data from) the "slaves". A slave never initiates a communication.

There can be more than one Master (for fault tolerance, or other reasons) but then separate precautions must exist to ensure only one can be driving the bus at any one time.

Furthermore, RS485 exists in two versions: 4-wire and 2-wire. The sole advantage of a 2-wire system is that it uses only two wires, (plus the ground connection, or the cable shield) and is thus cheaper to install.

The main advantage of a 4-wire system is more subtle: because the master is driving a pair of wires which no other device may drive, the master's driver does not need tri-state capability. Many systems do not have tri-state capability, usually because their software was not written for multi-drop operation. The other advantage of a 4-wire system is that it is theoretically possible for the slave to respond before the master has finished transmitting its poll, without risk of bus contention, but no properly designed system relies on this.

☞ Note that 4-wire RS485 with the driver left permanently enabled is the same as RS422.

RS422/485 Ports - Grounding

When the interface circuitry is fully floating (such as in the KDF), an extra conductor is required for interconnecting the signal grounds between the various devices connected to the RS485 bus. The cable shield can be used for this purpose.

☞ Although it is not unusual to find products which have the ground connection missing, you can get away with this only where the common mode voltage between all the devices attached to the *same* cable will never exceed the RS422/485 common mode voltage range which is typically -7V to +12V. This is difficult to guarantee in practice; this is why the KDF is an isolated converter with a GND connection (pin 6) which is intended to be used!

RS422/485 Ports - A/B Terminal Markings

The standard specifies that the terminals should be labelled "A" and "B". It also specifies their polarity: during the inter-character space (i.e. during the one or more stop bits which follow each character in asynchronous data) B is more positive than A by at least 200mV. Many manufacturers mis-label the terminals; some are reversed while others are marked + and – .

RS422/485 Ports - Detail Description of Terminals

The numbers in brackets are the markings on the KDF terminals.

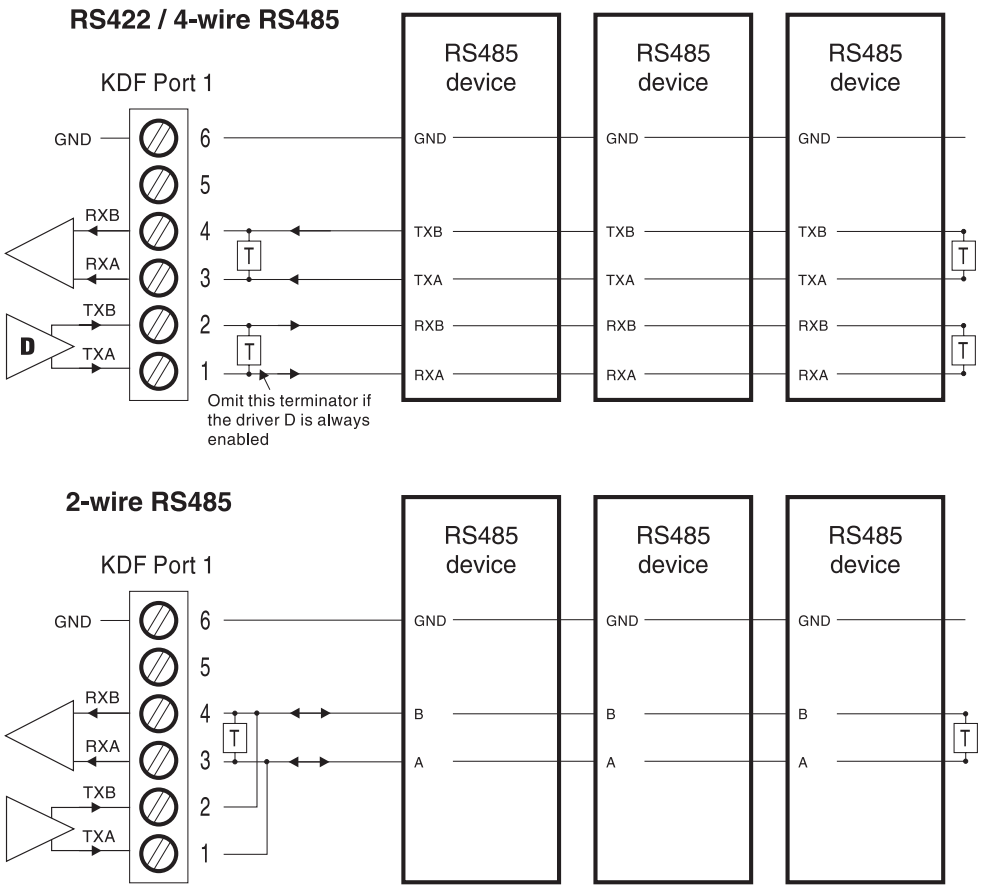
TXA (1), TXB (2)	"Transmit Data" output.
RXA (3), RXB (4)	"Receive Data" input.
TEST (5)	Applying a level above +1.5V to this input has the same effect as pressing the TEST (loopback) switch. This input is a standard RS232 receiver input but an RS422 HIGH level will also work. This input is level sensitive, not edge sensitive.
GND (6)	This is an isolated ground signal which should always be connected to the ground terminal(s) of the other RS422/485 equipment.

RS422/485 Ports - Terminators

Termination resistors are not normally required, because on cables below around 300m in length the reflections decay within the risetime of the signal.

When driving cables beyond 300m, you can connect a resistor equal to the cable impedance (typically 100 ohms) as shown:

Terminator Placement



☞ To minimise DC loading on the driver(s) and to maximise the effectiveness of pullup/pulldown resistors (see following text), a capacitor (e.g. 10nF) should be connected in series with any termination resistor.

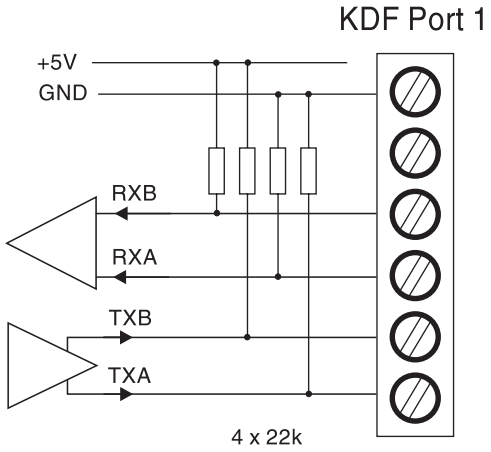
RS422/485 Ports - Bus Pullups

With multi-drop systems, it is important that when *none* of the connected devices is driving the bus, the level on the bus represents the inter-character space, i.e. B must be more positive than A by at least 200mV.

However, particularly where a number of devices are multi-dropped, driver leakage and other factors do sometimes cause A to float *above* B during the tri-state condition, in which case any attached receiver will see a permanent "start bit"; this is also known as a "break level". The effect of this depends on how well the firmware in the various devices is designed, and it can manifest itself as comms errors which are consistently cleared by a re-transmission of the data.

The KDF contains internal pulldown (to GND) and pullup (to +5V) resistors whose purpose is to ensure that when the bus is not being driven, B is above A:

Internal Pullup Resistors



However, these resistors may be inadequate in the following cases:

1 Where another instrument also contains its own pullups/pulldowns and they are connected to the wrong (opposite) voltages. This rather fundamental error is not uncommon.

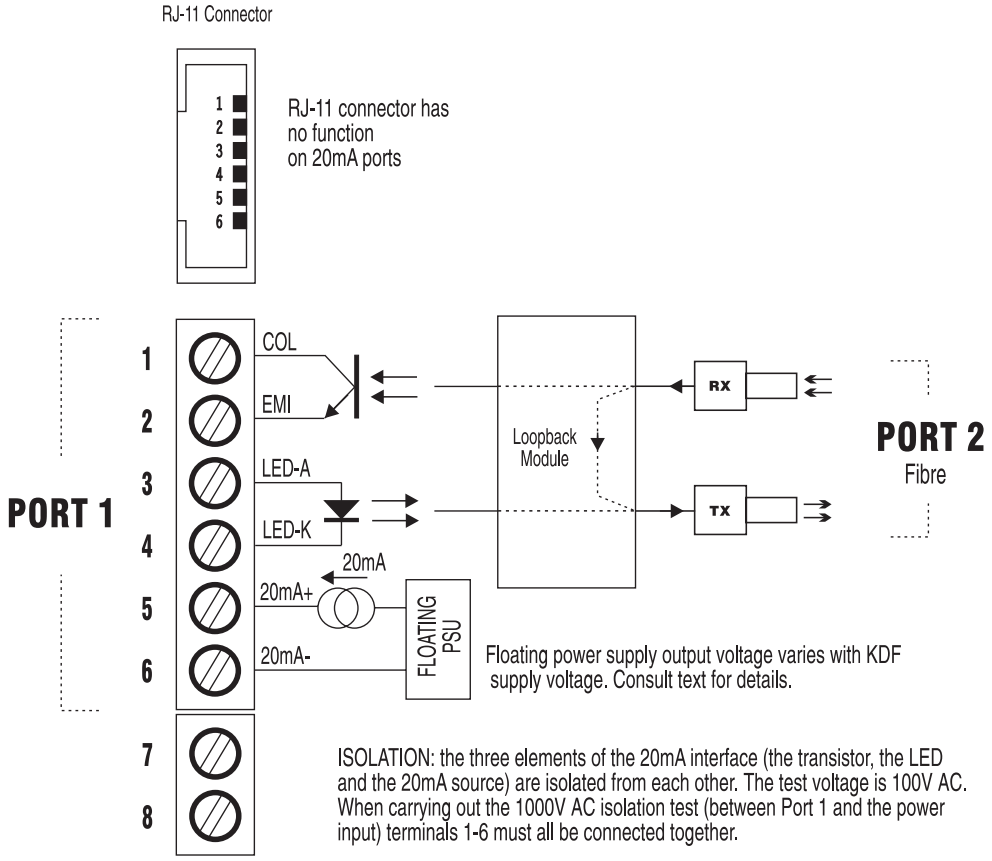
2 Where there is a terminator resistor (e.g. 100 ohms) connected directly across the 485 bus. The 22k resistors in the KDF cannot develop a voltage across 100R which is sufficient to be a defined RS485 "1" or "0" level (200mV or more is needed). A solution might have been to use much lower value pullup/pulldown resistors inside the KDF but this would present an excessive load if many KDF units were present on the bus.

To obtain a well defined level on the bus, the best solution is to connect a capacitor (e.g. 10nF) in series with each of the terminator resistors.

Another is to use external pullup/pulldown resistors to supplement those inside the KDF. Such external resistors are needed only in one place on a 485 bus; anywhere will do. The drawback of this method is that a suitable positive supply (+5V) is required for the pullup.

It is easy to verify, with a voltmeter, whether B is more positive than A when no communications are taking place. The voltages must be measured *between* A and B, or relative to the isolated signal ground.

20mA Loop Ports



20mA Loop Ports - Detail Description of Terminals

The numbers in brackets are the markings on the KDF terminals.

COL (1), EMI (2)	"Transmit Data" output. These are the collector and emitter terminals of the output transistor which is used to switch the externally supplied 20mA loop current.
LED-A (3), LED-K (4)	"Receive Data" input. These are the anode and cathode terminals of the LED which is used to receive the externally switched 20mA loop current.
20mA+ (5), 20mA– (6)	This is the output of the floating 20mA constant current generator.

Both the output transistor and the input LED are reverse polarity protected, with parallel diodes.

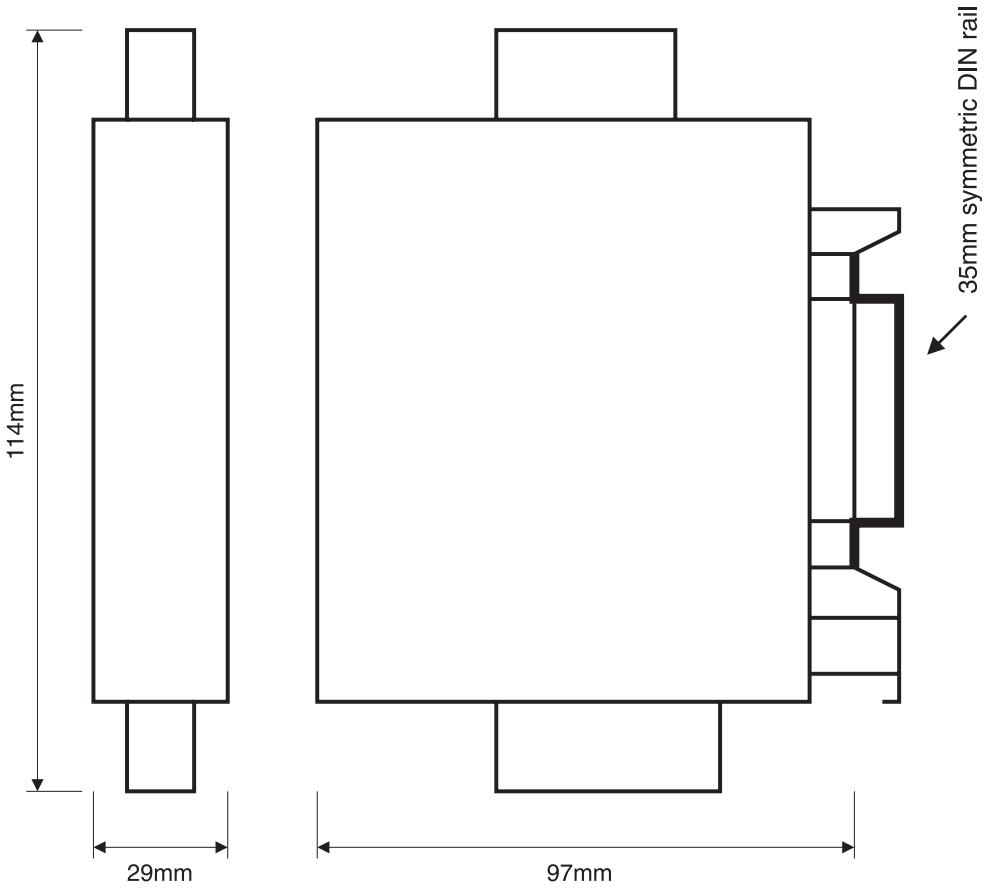
The internal supply voltage to the 20mA generator (i.e. its open circuit voltage) is not regulated. It is approximately equal to the KDF supply voltage.

For example, if the KDF is powered from +24V, the compliance of the 20mA current source is about 24V. In practice, any supply voltage in the range 12V to 24V is likely to be suitable, depending on the type and number of devices in the loop.

☞ If the KDF is fitted with a 20mA port, its supply voltage is limited to **26V**, to limit the maximum possible internal heat dissipation.

KDF Dimensions

KDF Dimensions
(including terminals)



Troubleshooting

KDF power-up problems

With a valid DC power input (7V to 35V), the PWR LED will light. If not, the supply voltage is rising too slowly (see Specification), or the KDF power supply has failed.

No Communications

Use the front panel button to run the loopback test. The TEST LED should illuminate on the local KDF and also on the remote KDF; if it does then the fibre connection is OK. If it does not, the two fibres are probably reversed, or the fibre link is broken, has defective connectors, or is too long (attenuation too high).

On the SFH version, the emitter emits visible red light. When the loopback button is pressed, this is emitted almost continuously and is visible at the other end of the fibre - even after 100m of polymer fibre.

On the ST version the emitter emits invisible infra red light which cannot be detected except with another KDF, or with a suitable optical power meter.

RS232 Communications Problems

1 Make sure TX,RX are correctly connected. RS232 is not a "bus" system; the TX terminal of one device feeds the RX terminal of the other device - unless one device is "DTE" and the other is "DCE". If in doubt, consult the device documentation.

2 The GND (Port 1 signal ground) connection is mandatory on RS232.

RS422/485 Communications Problems

1 Many RS422/485 equipment manufacturers have incorrectly labelled their A/B signals and you may need to swap them. Measured at the KDF RS422/485 interface relative to the signal ground (pin 6), a HIGH level (e.g. a start bit) is represented by A being more positive than B by at least 200mV. Conversely, with no data being sent, B is more positive than A by at least 200mV. The actual differential voltage will vary with loading, termination, etc. and can be up to 5V.

One way (other than swapping the wires) of determining how the manufacturer has labelled their terminals is to read the product's manual and look for a detailed description of the terminal functions.

Another is to measure the DC voltage on each of the product's terminals, with nothing connected and no data flowing, relative to ground. The terminal with the higher potential corresponds to our "B". This test is reliable only if the product has internal pullup/pulldowns and they are connected the right way!

2 Some RS485 systems use only the signal wires (2 or 4) and have *no ground connection*. While this should work where the ground connections of the equipment involved are interconnected via another route, it is not a recommended practice because the common mode range limits (-7V to +12V for all RS422/485 chips in common use) can easily be exceeded, resulting in comms errors or damage.

The isolation property of the KDF allows the grounds to be properly connected to their respective equipment without the danger of creating ground loops.

3 Check the DIP switch settings. On RS485 the baud rate and word length must be correctly set for the automatic driver enable (ADE) function to work.

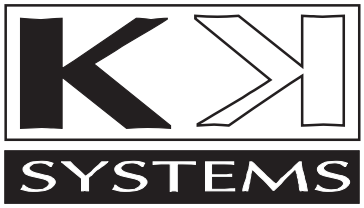
Intermittent Comms Errors - General

The usual cause of this is bad wiring or grounding, especially in an electrically hostile environment. Make sure wiring is shielded, with the shield connected to a good ground. If interconnecting devices which have isolated (floating) interfaces then whenever possible you should interconnect their signal grounds.

Intermittent Comms Errors - RS422/485

Check that your signal wiring is properly shielded and that the KDF Port 1 signal ground is connected to the ground of the other RS485 devices. While RS422/485 is known for its good noise immunity, this is true only if any induced common mode voltages are within the capability of the receiver. Also, even if the common mode voltage is always within this range but includes a very high frequency component, the receiver may again not function properly. This is true for all RS485 devices, when the ground terminal of an RS485 device is left unconnected.

Another cause of persistent comms problems may be that the bus is floating into an invalid state in between messages. See the discussion of Pullups in the **Reference** section.



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Any questions or suggestions are welcome.