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MODEL 485HF9

PLUG-IN

SIGNAL

LEVEL

ADAPTOR

9 PIN RS-232

TO RS-422/485

This Instruction Manual is supplied with the Model 485HF9 Adaptor to provide the user with sufficient information to utilise the purchased product in a proper and efficient manner. The information contained has been reviewed and is believed to be accurate and reliable, however **Amplicon Liveline Limited** accepts no responsibility for any problems caused by errors or omissions. Specifications and instructions are subject to change without notice.

Model 485HF9 Instruction Manual Part N° 859 864 34 Issue A2

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Prepared by D. Field

Approved for issue by A.S. Gorbald, Operations Director

DECLARATION OF CONFORMITY

**AMPLICON LIVELINE LIMITED
CENTENARY INDUSTRIAL ESTATE
HOLLINGDEAN ROAD
BRIGHTON BN2 4AW UK**

We declare that the product(s) described in this Instruction Manual are manufactured by Amplicon Liveline Limited and perform in conformity with the following standards or standardisation documents:

Electro Magnetic Compatibility (EMC):

EMC Directive	89/336/EEC
LVD Directive	73/23/EEC
CE Directive	93/68/EEC



Jim Hicks, I. Eng, MIEIE
Managing Director
Amplicon Liveline Limited

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1. INTRODUCTION

1.1 General Description

The Model 485HF9 Adaptor is a compact, plug-in unit providing bi-directional conversion of serial data communications signals between the following standards:-

RS-232 \longleftrightarrow RS-422
OR
RS-232 \longleftrightarrow RS-485

The Model 485HF9 Adaptor is equipped with a 9 way, female D type connector. Many RS-232 devices are similarly equipped, and when properly configured and powered, the adaptor can be plugged into the appropriate port to convert the transmit and receive signals to RS-422/485 levels. RS-232 hardware handshaking lines are looped back, and the RS-232 Request To Send (RTS) control line can be used for RS-485 transmission turnaround if required. The unit is supplied for the RS-232 host device configured as Data Terminal Equipment (DTE).

The data conversion process changes only electrical levels, and the pin-out configuration is in accordance with the appropriate standards. The adaptor itself is not considered as DTE or DCE, and where these terms are used, they apply to the RS-232 equipment to which the Model 485HF9 Adaptor is connected.

RS-485 multi-drop operation allows up to 32 devices to be connected in a simple network on a single serial bus. The transmitter has a tri-state output and may be disabled to allow reception over the same wire pair. The high impedance state (transmitter disabled) is commanded from an external control signal or from the host computer RTS line.

DC power for the Model 485HF9 Adaptor must be applied from an external source. The DC power lines plus the RS-422/485 data and control signals are connected through a pluggable 8 way screw terminal assembly at the free end of the Adaptor.

EMC Considerations

In order to maintain compliance with the EMC directive, 89/336/EEC, it is mandatory that the final system integrator uses good quality screened cables for external connections. It is up to the final system integrator to ensure that compliance with the Directive is maintained. Amplicon Liveline offers a series of good quality screened cables for this purpose. Please contact our sales staff.

1.2 Technical Features

- RS-422 or RS-485 compatible
- Multi-drop capability
- Plugs directly into standard 9 pin male connector
- Configured for operation with DTE host
- Single power supply connection. Polarity protected
- Remote connections via pluggable terminal strip
- Compact and versatile

1.3 What the Package Contains

1. The Model 485HF9 Adaptor board with 8 way free socket and the plastic case disassembled. The plastic case should not be snapped together until any necessary configuration changes have been made.

The complete 485HF9 Adaptor is supplied under Amplicon order code 909 458 03



CAUTION

Some of the components on the board are susceptible to electrostatic discharge, and proper handling precautions should be observed. As a minimum, an earthed wrist strap must be worn when handling the 485HF9 Adaptor outside its protective bag.

Full static handling procedures are defined in British Standards Publication BSEN100015/BSEN100015-1:1992

When removed from the bag, inspect the board for any obvious signs of damage and notify Amplicon if such damage is apparent. Do not apply power to a damaged board and do not plug it into the host computer. Keep the protective bag for possible future use in transporting the module.

2. This 485HF9 Instruction / Reference manual. Amplicon part number 859 864 34

Any additional accessories (mating gender changers, power supply etc.) may be packed separately.

1.4 The Amplicon Warranty Covering the Model 485HF9 Adaptor

This product is covered by the warranty as detailed in the Terms and Conditions stated in the current domestic or international **Amplicon Liveline** catalogue.

Changes made in accordance with the guidelines given in this manual will not void this warranty unless any damage is a direct consequence of mishandling.

DO NOT MAKE ANY MODIFICATIONS TO A PRODUCT THAT IS ON EVALUATION.

1.5 Contacting Amplicon Liveline Limited for Support or Service

The Model 485HF9 Adaptor is designed and manufactured by Amplicon Liveline Ltd. Maintenance is available throughout the supported life of the product.

1.5.1 Technical Support

Should the Model 485HF9 Adaptor appear defective, please check the information in this manual to ensure that the product is being correctly applied.

If an application problem persists, please request Technical Support on one of the following numbers:

Telephone:	UK	01273 608 331
	International	+44 1273 608 331
Fax:	UK	01273 570 215
	International	+44 1273 570 215
Internet	support@amplicon.co.uk www.amplicon.co.uk	

1.5.2 Repairs

If the Model 485HF9 Adaptor requires repair then please return the goods enclosing a repair order detailing the nature of the fault. If the product is still under warranty, which is for a period of 12 months from the date of shipment, there will be no repair charge unless the fault has been caused by misuse.

For traceability when processing returned goods, a Returned Materials Authorisation (RMA) procedure is in operation. Before returning the goods, please request an individual RMA number by contacting Amplicon Customer Services by telephone or fax on the above numbers.

Give the reason for the return and, if the goods are still under warranty, the original invoice number and date. Repair turnaround time is normally five working days but the Service Engineers will always try to co-operate if there is a particular problem of time pressure.

Please mark the RMA number on the outside of the packaging to ensure that the package is accepted by the Goods Inwards Department.

Address repairs to: Customer Services Department
AMPLICON LIVELINE LIMITED
Centenary Industrial Estate
Brighton, East Sussex
BN2 4AW
England

2. INSTALLATION INSTRUCTIONS

2.1 Requirements of Host Equipment

The Model 485HF9 Adaptor can be plugged into any device with an RS-232 port terminating in a 9 way D type male connector (DB-9). If the host device is equipped with a 9 way connector, it is normally male, and the 485HF9 Adaptor can be directly plugged into this port and held in position by its jack screws.

In addition to the 9 pin standard, many RS-232 interface connectors comply with the DB-25 standard and two types of 485 Adaptor are available from Amplicon Liveline Ltd to mate with male or female versions of the DB-25 connector. In addition, DIN, mini-DIN and other types of connector are sometimes used for RS-232 ports. If the pin connections of the host device interface are known, then enough information is given in this manual to make up a suitable adaptor connection cable.

2.2 Connections to Model 485HF9 Adaptor

Connections are made to the Model 485HF9 Adaptor at each end. The RS-232 connections are automatically made when the Adaptor is plugged into the port, and the RS-422/485 data, control and power connections must be made through a pluggable 8 way screw terminal connector assembly at the free end.

2.2.1 RS-232 Connections on 9 way D Connector

The connections conform to the RS-232 adopted 9 way pin-out standard, and are shown in figure 2.1 below. The diagram shows the connector as viewed from the face of the socket mounted on the Model 485HF9 Adaptor.

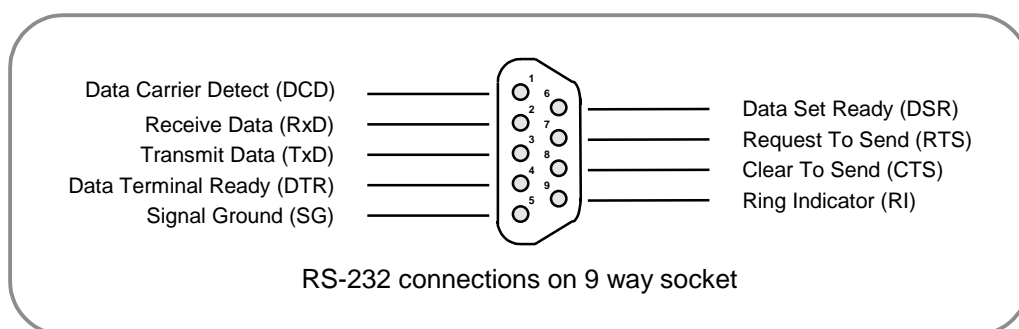


FIGURE 2.1 RS-232 CONNECTIONS

2.2.2 RS-422/485 Connections on 8 way Pluggable Terminal Strip

The DC power input, RS-485 transmission turnaround external control signal and RS-422/485 data signal connections are made via an eight way screw terminal connector. The supplied connector can be unplugged from the Adaptor for ease of making the cables without removing the Adaptor from the port.

The connections are compatible with other 485 Adaptors in the Amplicon range, and are shown in figure 2.2 below. The diagram shows the connector as viewed from the top face of the Model 485HF9 Adaptor. The abbreviated function names are printed on the PCB extension below the fixed part of the connector.

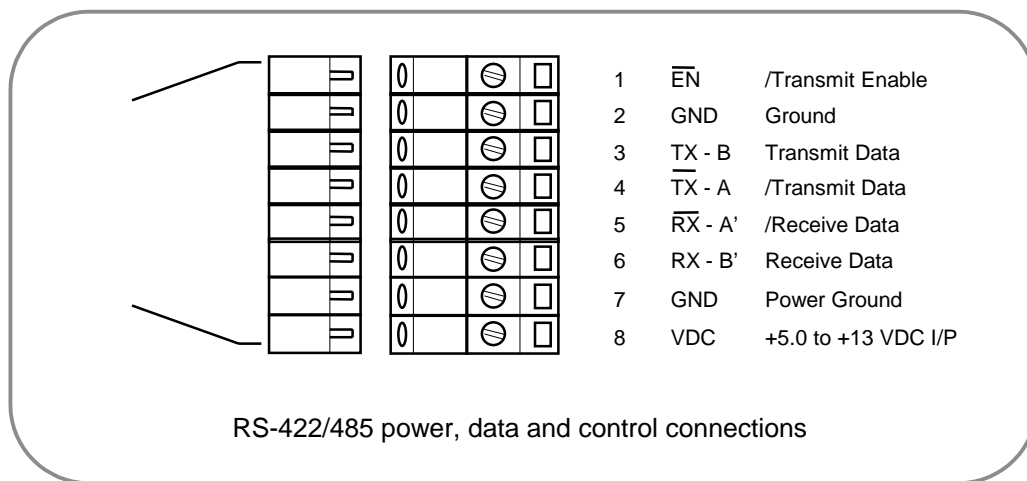


FIGURE 2.2 RS-422/485 CONNECTIONS

2.3 Configuration of Model 485HF9 Adaptor Options

Configuration of the options is undertaken by cutting or bridging solder pad links on the reverse (non-component) side of the Model 485HF9 Adaptor printed circuit board. The Adaptor as supplied is configured to suit the majority of applications requiring full duplex operation or half duplex with echo.

For convenience, the plastic case is supplied in two parts and should only be clipped together when any configuration changes have been made. Operational tests can be performed before the case is fitted.

The configuration options listed below are available, and the appropriate connection bridges are shown in figure 2.3.

- | | | |
|-----------|------------------------------------|--|
| J1 | Transmit Enable - RTS or External. | (Factory configuration is 'External \overline{TXEN} ') |
| J2 | Receiver termination in or out. | (Factory setting is 'IN') |
| J3 | Receive echo on or off. | (Factory setting is echo on) |

The configuration options are described in more detail in the following paragraphs. For many applications, no changes need be made, but if re-configuration is required, locate the pad group from figure 2.3 which illustrates the non-component side of the printed circuit board. When an

existing link is not needed, cut the copper tie with a craft knife or remove any solder bridge with a desoldering tool, and make solder links as indicated for the required configuration. The pads are placed close enough that a solder bridge can be easily made without using wire. Before applying power to the Adaptor, inspect the changes carefully to ensure that the solder has properly wetted the pads and that no other bridges have been made.

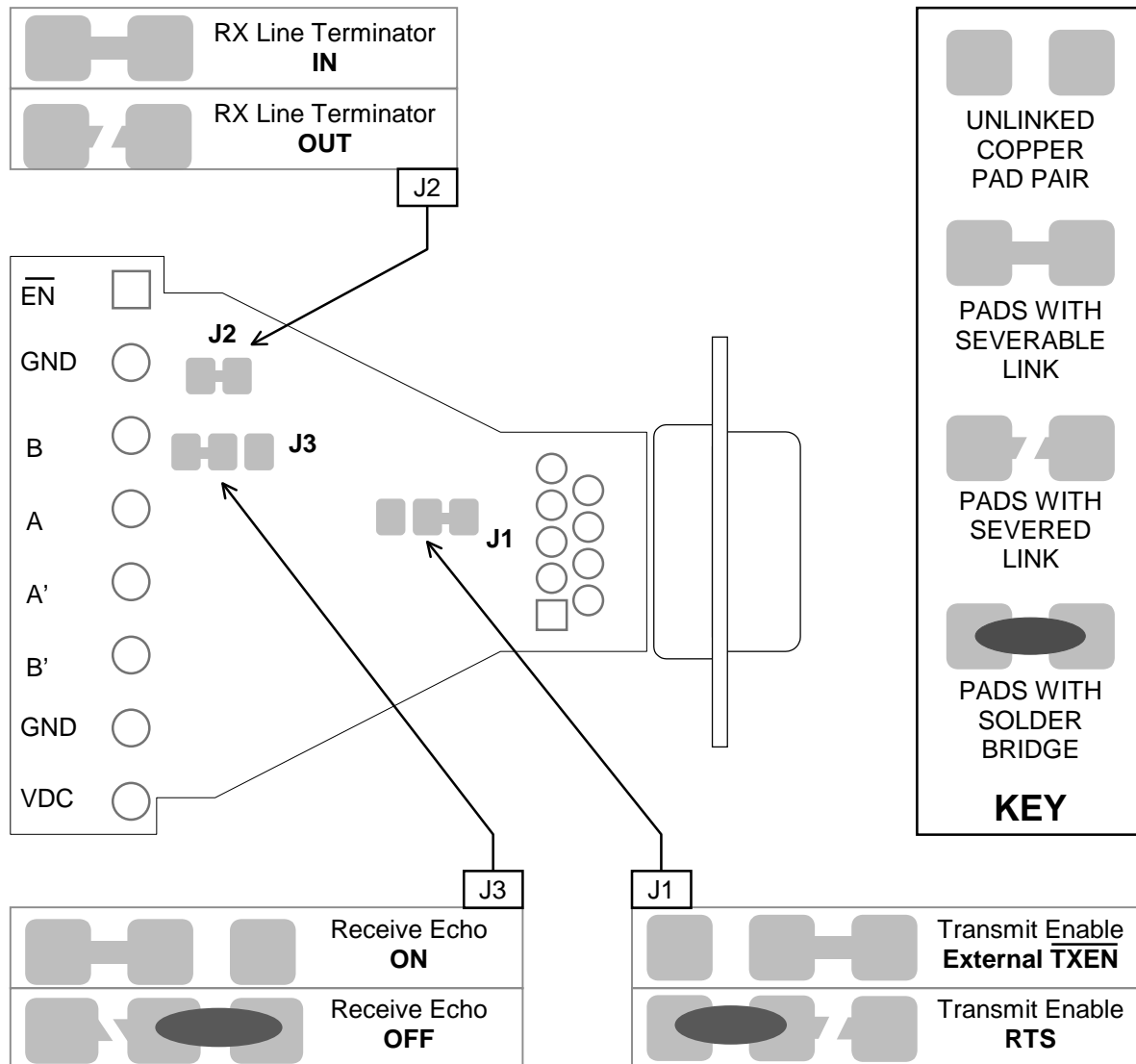


FIGURE 2.3 CONFIGURATION OPTIONS

2.4 Power Requirements

The Model 485HF9 Adaptor must be powered from an external power supply providing a positive output of between +5.0 VDC and +13.0 VDC. This auxiliary power supply unit should be capable of sourcing at least 100 mA for each 485 Adaptor that it supplies. Within this constraint, as many 485 Adaptors as are required can be fed from a single supply. The Amplicon Mains adaptor meets this requirement and the U.K. version is available under order code 919 135 69. See paragraph 2.4.1 for information on connecting this mains adaptor to the Model 485HF9 terminals.

The 485HF9 Adaptor is fitted with an eight way pluggable terminal strip at its free end, and the power supply should be connected to terminals 7 and 8. Terminal 7 is Ground or negative, terminal 8 is the positive supply. OBSERVE POLARITY when powering the adaptor. If the polarity is incorrect, the 485HF9 Adaptor will not operate, but is protected against damage. A wiring diagram for applying power to a single 485HF9 Adaptor is shown in figure 2.4 and the connections to multiple, parallel powered 485HF9 Adaptors are shown in figure 2.5.

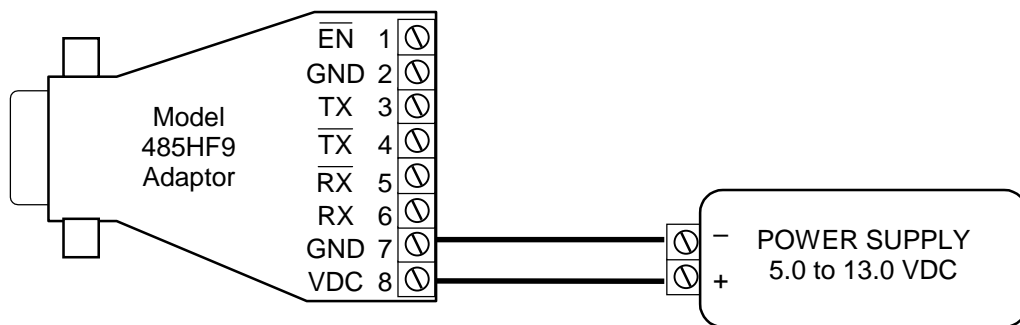


FIGURE 2.4 POWER SUPPLY CONNECTIONS FOR SINGLE MODEL 485HF9 ADAPTOR

When multiple 485 Adaptors are fed from a single supply as in figure 2.5, the grounds of all the devices on the RS-422/485 bus will be connected together through the common negative supply line and the internal ground connections of the Adaptors.

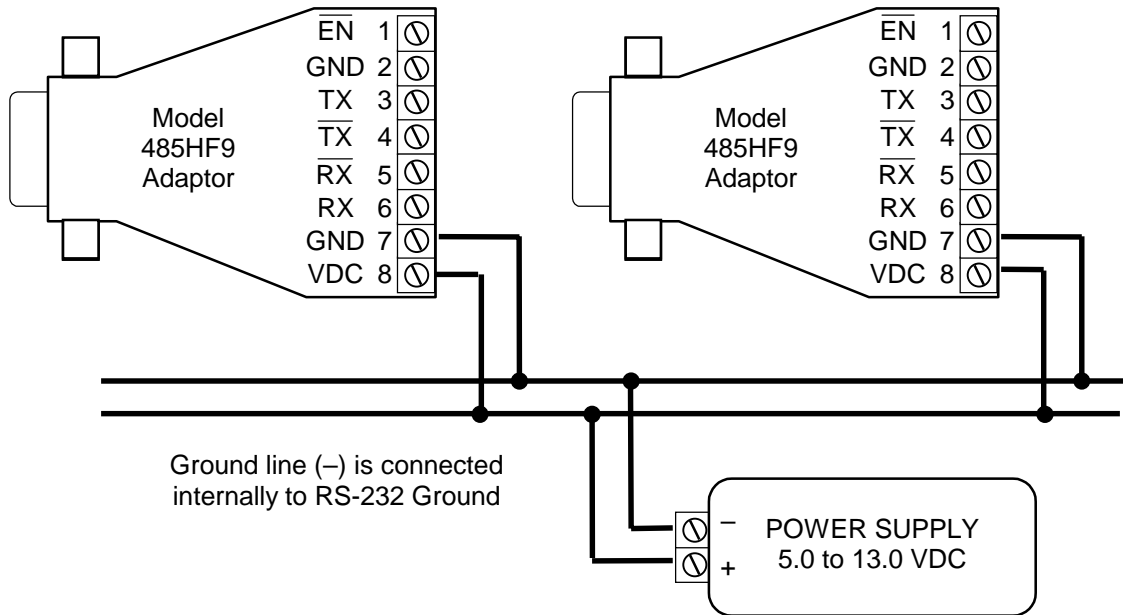


FIGURE 2.5 POWER CONNECTIONS FOR MULTIPLE MODEL 485 ADAPTORS

2.4.1 Connecting the Amplicon Mains Adaptor

The optional mains adaptor plugs directly into a 3 pin, 13 A mains socket (U.K. version), or must be fitted with a suitable plug (International version). The mains supply voltage must be 230 VAC $\pm 10\%$, 50 Hz. The DC output is by a two wire cable approximately 2 m in length. This cable is terminated in a moulded connector which must be cut off and discarded. The two wires can then be parted and stripped back about 6 mm. The black wire is negative and goes to terminal 7 (GND) of the 485HF9 Adaptor, and the black wire with a white stripe is positive and goes to terminal 8 (VDC). Section 5.3 gives the Amplicon order codes for the above adaptors.

2.5 Full Duplex / Half Duplex Operation

The Model 485HF9 Adaptor can be used in either full duplex (simultaneous transmission and reception over two independent wire pairs) or half duplex (sequential transmission or reception over a single wire pair).

In full duplex operation, a separate transmitter and receiver circuit is employed, and in this mode the transmitter can be left in its enabled state at all times. In half duplex operation, the transmitter must be disabled by switching to its high impedance state to allow reception of data over the same serial lines.

The Model 485HF9 Adaptor is provided with all the data input/output terminals required for full duplex operation. **If half duplex working is required, then the following external and internal configuration changes must be considered.** Also check that the termination resistor, paragraph 3.3.4, is correctly set for the system in use.

2.5.1 Selection of Full/Half Duplex

In the full duplex position, the serial RS-422/485 signals are transmitted on the wire pair Tx and /Tx and the incoming signals are received on Rx and /Rx. In half duplex operation, the data signals are both transmitted and received on the two pairs externally wired in parallel.

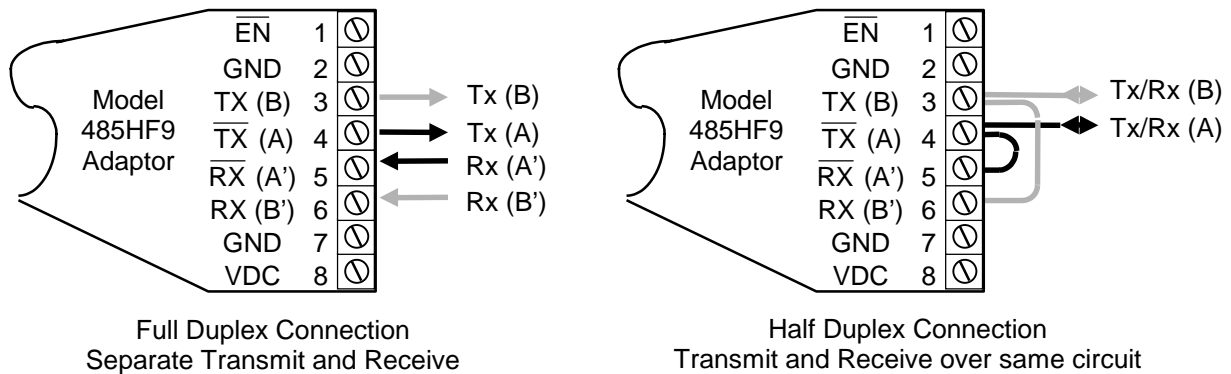


FIGURE 2.6 CONNECTIONS FOR FULL AND HALF DUPLEX OPERATION

2.5.2 Selection of Transmit Enable Control Signal

In half duplex operation over a single circuit or a multi-drop arrangement, the transmitter must be enabled when the device is ready to transmit, and disabled (tri-state) when the device is ready to receive. Two methods are provided for enabling the transmitter, and the desired method is selected by the link on J1. (See figure 2.3).

1. **External \overline{TXEN} .** With the External \overline{TXEN} option selected on J1, the transmit enable is under the control of a TTL level or RS-232 level signal applied to terminal 1 (/EN) of the connector strip. This control signal is active low, and is internally pulled down when no signal is applied. In full duplex or transmit only operation, this control line can be left open-circuit, when the transmitter will be continuously enabled.

In externally controlled half duplex operation, or any other situation where the transmitter requires external control, the signal applied to terminal 1 for enabling or disabling the transmitter must not exceed the following levels:-

ENABLE TRANSMITTER	'0' (Active Low)	-30 V to +0.8 V)	Input
)	Resistance
DISABLE TRANSMITTER	'1'	+2.4 V to +30 V)	5 k Ω typical.

Figure 2.7 shows how the external control connection is made.

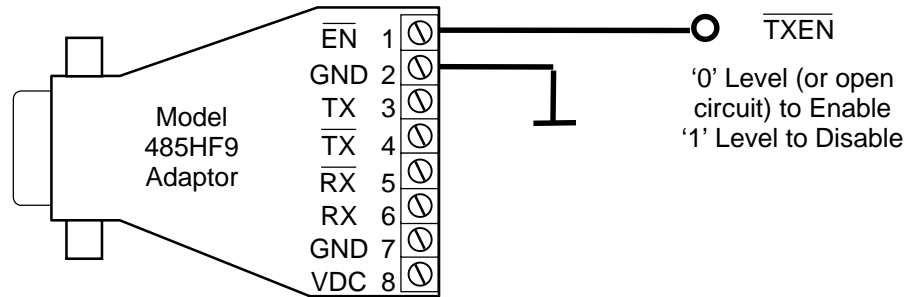


FIGURE 2.7 EXTERNAL TRANSMITTER ENABLE CONNECTIONS

In external control, the transmitter enable line can be controlled from a programmable bit on the host computer. If the computer is equipped with a parallel printer port, then D7 of this port may be used to control the transmitter. Connect a single wire from pin 9 of the Centronics compatible connector to the /EN terminal of the Model 485HF9 Adaptor. The program must clear D7 to transmit or set D7 to receive over the RS-485 interface.

2. **RTS Transmit Enable.** The transmitter can alternatively be enabled under control of the RTS (Request To Send) line of the RS-232 host DTE device. See J1 in figure 2.3 for the appropriate patching.

In normal RS-232 DTE operation, RTS is raised to its ON condition when the device is ready to commence transmission. In some circumstances, the use of RTS provides a simple means of enabling the transmitter, however, check overall system timing before using this control method.

Further information on half duplex and multi-drop operation is given in the applications section of this manual.

2.5.3 Selection of Local Echo On/Off in Half Duplex Operation

The factory default configuration of link J3 causes the transmitted data can be echoed to the receiver in half duplex operation. If this echo is not required, the copper link must be severed and the solder bridge made across the other gap (see paragraph 2.3). This change ensures that the RS-485 receiver is enabled/disabled in opposite phase to the transmitter.

For full duplex operation, the link J3 must be in its default condition for the receiver to be continuously enabled. Echo back is not appropriate to full duplex operation.

2.6 Transmission Line Termination

In RS-422 or RS-485 applications, the two wire transmission lines must be properly terminated, and a single resistor across the receiver input pair normally provides adequate termination.

The Model 485HF9 Adaptor is equipped with a terminator resistor for the receiver input pair, and this resistor is connected into circuit by the J2 link on the printed circuit board. See figure 2.3. Factory setting is with the receiver input terminator in circuit, but it can be removed from the circuit by cutting the link as described in paragraph 2.3. Removal of the link is required in some multi-drop applications.

See the applications section of this manual for a discussion of bus termination.

2.6.1 Network Biasing Resistors

In some instances, particularly in RS-485 multi-drop operation, noise may be detected at the receiver. In the multi-drop configuration, there can be brief periods when no transmitter is enabled, and the network is therefore allowed to float. The Model 485HF9 Adaptor is protected against this condition, but other devices on the network may be susceptible to noise and are liable to float to a potential that is detected as an input. The programmer can sometimes overcome this situation by ensuring that the communications protocol flushes the input buffer until the beginning of the message flag is found.

If this problem is encountered and a software solution is not viable, two extra resistors can be added externally to the 485HF9 transceiver at one end of the bus, so that the network is biased to about 1 volt when all transmitters are disabled. The arrangement is shown in figure 2.8.

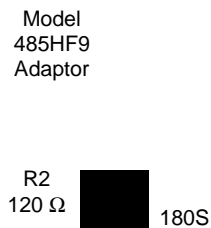


FIGURE 2.8 NETWORK BIASING RESISTORS

2.7 Software Installation

Software is not supplied with the 485HF9 Adaptor, but a choice of suitable software packages is available from Amplicon Liveline Ltd. to allow easy integration of serial communications into the user's application.

The 485HF9 Adaptor connected via an existing RS-232 port will operate in conjunction with many commercially available communications and data acquisition packages that support RS-232, RS-422 or RS-485 serial operations. The software should be installed according to the supplier's instructions, and due note should be taken of the required settings for the communications channels, and the communications circuit configurations set accordingly.

The following software limitations should be remembered when allocating COM channels:-

MS-DOS 3.2 and below provides support for the first two serial ports only, COM1 and COM2.

MS-DOS 3.3 and above supports COM1, COM2, COM3 and COM4.

Other operating systems allow the use of more than two ports. Check the instructions.

Most BASIC language interpreters/compiler only support COM1 and COM2.

Communications support toolkits such as Amplicon 'COMBIOS' and 'COMBIOS for Windows' allow add-on serial ports to several different language compilers.

2.8 Installation Testing

Many applications packages include a self test feature, and when the hardware and software have been satisfactorily installed, any such test should be performed to check correct operation.

If no self test is available, or a problem occurs, see the later section 4, 'TESTING AND TROUBLESHOOTING'.

3. APPLICATION INFORMATION

As previously noted, many applications packages are designed to support data transfer over the RS-422 or RS-485 standard serial communications ports. When set up as specified, the interface will be transparent to the user. However, for special applications, particularly when use of the RS-485 interface is required, the following notes will be helpful.

3.1 Applicable Standards

The prefix 'RS' signifies Recommended Standard, and the three interface types, RS-232, RS-422 and RS-485, are all well defined in the appropriate standards publications. The functions and features of the data interfaces presented by the Model 485HF9 Adaptor generally conform to normal industry practice employing subsets of the full standards.

The RS-232 serial interface standard is now at revision E and its full title is EIA (Electronic Industries Association) RS-232-C, *"Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Data Interchange"*. Similar European standards CCITT V.24 and V.28 define an interface which is operationally compatible with RS-232.

The RS-232 connection of the Model 485HF9 Adaptor is for equipment configured as DTE (Data Terminal Equipment), and the Adaptor has a female connector.

The RS-232 standard specifies a 25 pin connector, but the full 25 connector pins are not required to support the common functions of RS-232 as used by the Model 485 range of adaptors, and IBM and other manufacturers frequently adopt a 9 way D connector that provides all the necessary functionality. The Model 485HF9 Adaptor complies with this adopted pinout convention. Although three versions of the Amplicon 485 Adaptor are available, there may be occasions where a 9/25 pin conversion cable or adaptor such as the Amplicon PC-AT Serial Port Adaptor 909 245 77 is useful. Paragraph 3.2.2 gives the connection details for making up a suitable converter cable.

The RS-422 interface is defined in the EIA standard RS-422-A, *"Electrical Characteristics of Balanced Voltage Digital Interface Circuits"*.

As stated, this standard defines the electrical characteristics but does not specify a connector type or pin-out configuration. The Model 485 Adaptor meets the RS-422 standard electrical specification with communication via an 8 way terminal strip connector wired as shown in the installation diagrams.

The RS-485 specification is also published as an EIA standard and is closely allied to the RS-422. The 485 Adaptor meets the requirements for data signals as laid down in the standard.

3.2 RS-232 Application Notes

RS-232 was approved as a standard interface in 1969. Before and since that time, this interface in its various revisions has been very popular despite its many shortcomings and usage outside of its intended role. Most small computers now have an RS-232 interface as standard, or easily added, and many peripherals and instruments also support this serial interface, but not all in the same way. Hence an RS-232 application needs careful study of the host equipment manufacturers connections and methods before the Model 485HF9 Adaptor is installed. However RS-232 lines are quite safe if wrongly connected, so the experimental use of a break-out box or 'hit and miss' methods of establishing communication can be employed.

3.2.1 Electrical Levels

When checking out serial communications circuits, it is useful to know what signal levels to expect. The specified voltage levels of RS-232 data and control signals are summarised in the following table:-

Interchange Voltage	-3 to -15	+3 to +15
Binary State	1	0
Data Signal	Marking	Spacing
Control Function	OFF	ON

Signal Ground is at 0 volts, and the region between -3 and +3 volts is the transition region.

The Model 485 Adaptor will normally be used in close proximity to the RS-232 port, but in a case where it is not close, the following limits apply. The electrical levels at which RS-232 operates limit the maximum data rate to about 20 kilobaud (sometimes used up to 100 kBd) and the maximum cable length between transmitter and associated receiver to about 15 m (50 ft)

3.2.2 9/25 way Adaptors

The wiring list in figure 3.1 shows the necessary connections to adapt a 9 way RS-232 port to a 25 way RS-232 port, or vice versa. Due note should be taken of the gender of the mating connector, and a gender change can be incorporated in the adaptor if required.

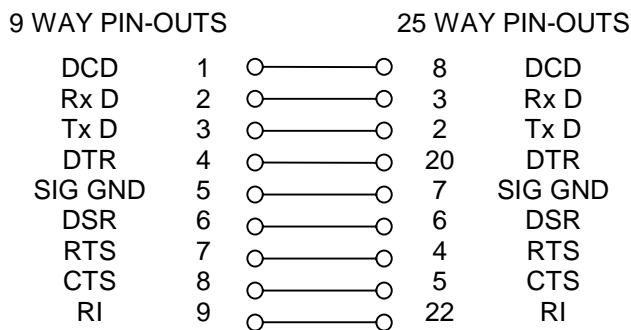


FIGURE 3.1 DTE ADAPTOR - 9 Way to 25 Way

3.3 RS-422/485 Application Notes

RS-422 and RS-485 have very similar characteristics, with RS-485 being compatible with, and offering all the advantages of RS-422 plus some additional capability. RS-422 pre-dated RS-485 as a standard, but RS-485 is now more popular and used in new system design. For the 485 Adaptor, the on board circuitry for the two modes is identical, the application deciding the mode of interface operation.

3.3.1 RS-422/485 Parameters

The following table in figure 3.2 summarises the principal parameters of the RS-422-B and RS-485 standards, and shows RS-232 for comparison.

EIA STANDARD	RS-232	RS-422-B	RS-485
Mode of Operation	Single ended	Differential	Differential
Number of Drivers and Receivers on line	1 Driver 1 Receiver	1 Driver 10 Receivers	32 Drivers 32 Receivers
Max. Cable Length	15 m	1200 m	1200 m
Max. Data Rate	20 kBd	10 MBd	10 MBd
Max. Common Mode	N/A	+7 V, -7 V	+12 V, -7 V
Driver Voltage	±5 V to ±15 V	±2 V min	±1.5 V min
Driver Load	3 kΩ to 7 kΩ	100 Ω min	60 Ω min
Driver Slew rate	30 V/μs	N/A	N/A
Driver Output Short Circuit Limit	500 mA to Vcc or Ground	150 mA to Ground	150 mA to Gnd 250 mA to Vcc
Driver Output Resistance	Power On-N/A Power Off-300 Ω	Power On-N/A Power Off-60 kΩ	Power On-120 kΩ Power Off-120 kΩ
Receiver Input Resistance	3 kΩ to 7 kΩ	4 kΩ	12 kΩ
Receiver Sensitivity	±3 V	±200 mV	±200 mV
Receiver Hysteresis	1.15 V	50 mV	50 mV

FIGURE 3.2 STANDARD RS-232/422/485 PARAMETERS

3.3.2 Cabling of RS-422/485 Bus

RS-232 data transmission rates are specified up to 20 kBd but are sometimes as high as 115 kBd. The Model 485HF9 Adaptor can therefore be used up to 115 kBd and the maximum cable length of 1200 m will apply at all usable data rates.

RS-422/485 employs a differential method of signal transmission, and each bus cable has to be a wire pair, preferably twisted and screened to keep induced noise to a minimum. The bus distribution cable is effectively a transmission line, and appropriate techniques should be used for installation of the cables. In a multi-drop environment, the cable should be 'looped through' each device, or if a spur is necessary, the spur length should be kept to a minimum.

If screened cable is used, some thought must be given to the connection of the screen. This screen should not normally be used as a ground return for non-isolated devices and it is safest to only connect the screen at a single point to the ground of one device.

The voltage between the grounds of the various devices must not cause the common mode voltage rating of any device on the bus to be exceeded.

3.3.3 Multi-drop Applications

RS-422 can provide limited multi-drop capability, using two twisted wire pairs in a broadcast mode. One wire pair connects one transmitter to multiple receivers, but if duplex operation is required, only one receiving station can answer back. See figure 3.3.

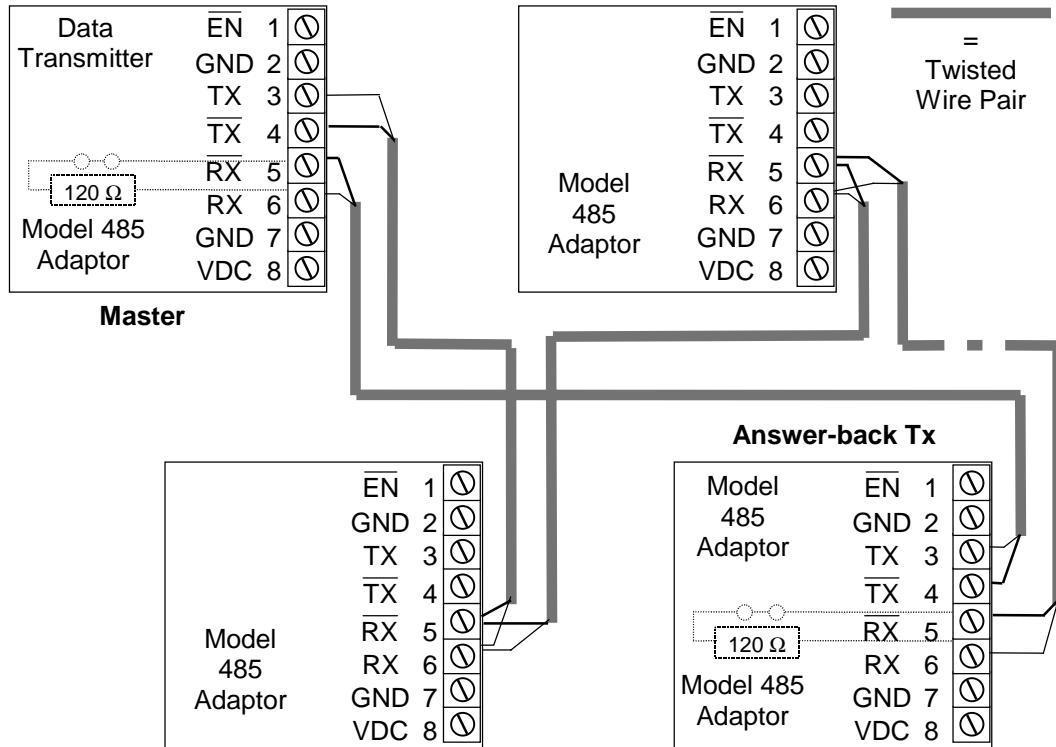


FIGURE 3.3 RS-422 CONNECTED IN BROADCAST MODE

RS-485 allows multiple (up to 32) transmitters and receivers to be connected in half duplex on a single twisted wire pair for 'party line' type of communications. See figure 3.4. A method must be used to stop more than one transmitter being on the line at any time, ensuring that all other transmitters are in a high impedance state, although the circuit design is such that no damage will be done to the transceivers if several transmitters are turned on together. In a multiple RS-485 transmitter installation, the application program controls the data communication turnaround and the selection of the bus 'talker'.

Two common ways of providing program control are the 'Master / Slave' and 'Token Ring' methods. The 'Master / Slave' method designates one device on the network as Master, and this device supervises all transmissions by communicating with each of the Slaves in turn and offering it a transmission slot. In token ring operation, each device knows its ID neighbour and only talks directly to this next device. Thus communication only occurs between adjacent pairs of devices and this makes for a flexible network but can be a more difficult method to implement.

The Model 485 Adaptor provides a method of communication turnaround by enabling the 'ON' transmitter using an external control signal or RTS from the RS-232 port. Default condition of the Model 485 Adaptor enables the transmitter, so that for full duplex operation of RS-422/485 no control signal is required.

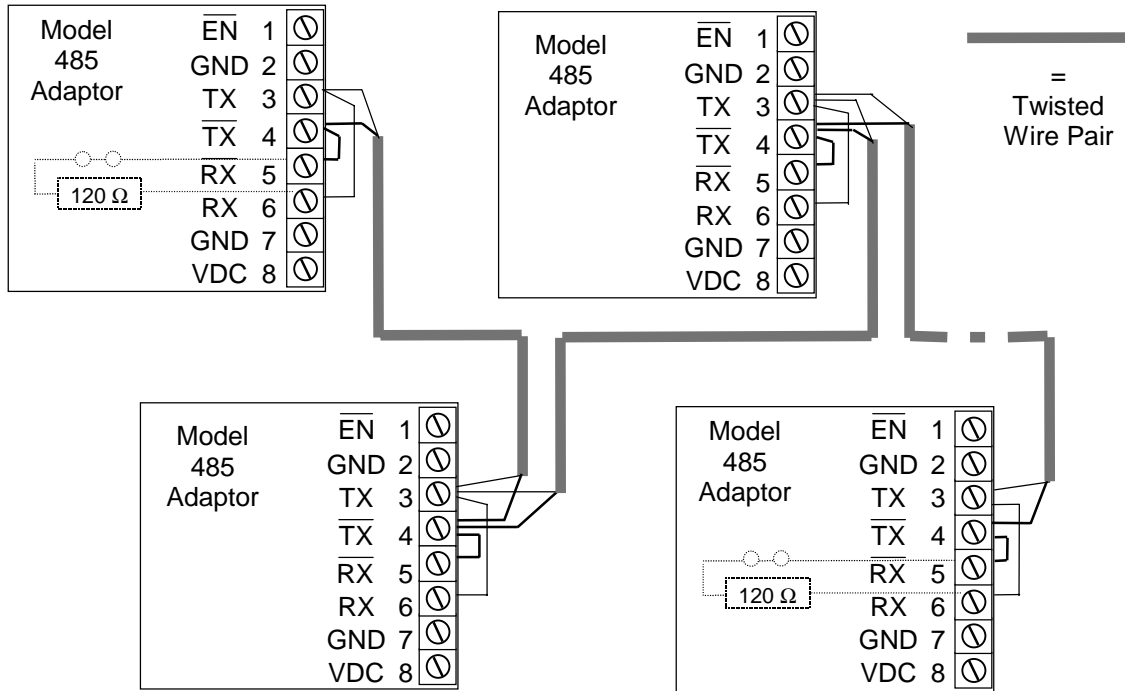


FIGURE 3.4 RS-485 CONNECTED IN MULTI-DROP, HALF DUPLEX MODE

3.3.4 Bus Termination

For proper operation of the RS-422/485 bus in full or half duplex, multi-drop or point-to-point communication, it is recommended that termination is applied to the receiver end of the data lines.

The simplest form of termination is line-to-line with typically a 120 Ω resistor across the differential input, and this terminator is available on the Model 485HF9 Adaptor board, selectable by J1.

In a multi-drop system, the terminator resistor is only required at the device receiver located at the far end of the cable. If this is in half duplex operation, then both ends of the bus cable are equipped with receivers (transceivers) so termination is necessary at both ends. Although the 485HF9 Adaptor will drive loads as low as 27 Ω, in general, RS-485 transmitter circuits are specified as being capable of driving a minimum load resistance of 60 Ω, so no more than two terminator resistors should be connected to any one bus.

4. TESTING AND TROUBLESHOOTING

4.1 Basic Testing and Fault Isolation

If the installation instructions have been correctly followed, and the serial communications port is being used in conjunction with a proven software driver, then it is unlikely that any problems will be experienced in establishing communications through the serial interface.

When difficulties do occur, the following notes may be helpful in isolating the problem area.

4.1.1 Testing with the Application Software

Before testing, ensure that the Model 485HF9 Adaptor is properly configured for the application. Use the test mode of the application program, and if a problem occurs, it is often possible to test the system using the looped back RS-232 port without the Model 485HF9 Adaptor. This test will identify that a problem is in the adaptor, its configuration or use.

4.1.2 Loop-back Testing Using a Simple BASIC Program

The Model 485HF9 Adaptor can be tested in isolation of external influences such as the signal cables, other devices and the applications program by performing the following loop-back test. It is necessary to link the terminals as shown in figure 11, and run the 4 line BASIC program given below. A copy of a BASIC interpreter such as QuickBASIC or GWBASIC will be required.

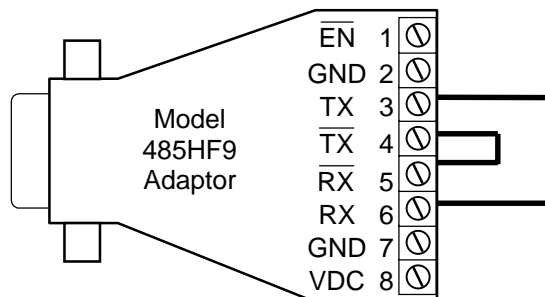


FIGURE 4.1 TERMINAL LINKS FOR LOOP-BACK TEST

The base address of the channel under test should be set to 3F8 (COM1) and the channel interrupt to IRQ4. The test can also be undertaken at 2F8 (COM2) and IRQ3 by changing the first line of the program accordingly.

To test the RS-422/485 port, the following 485HF9 Adaptor configuration settings must also be checked. This is the default configuration.

- J1 External Tx Enable**
- J2 Terminator Resistor In**
- J3 Echo-back ON**

The test sends the message "Loop-back test passed" from the RS-422/485 port and reads it back into the LB\$ variable. The message is then printed once to the screen. This test encompasses proper operation of both the RS-232 data and control interface and the RS-422/485 data lines.

```
10 OPEN "COM1:1200,N,8,1" AS #1
20 PRINT #1,"Loop-back test passed"
30 LB$=INPUT$( ( 21 ),#1)
40 PRINT LB$
```

The parameters in line 10 can be changed as required to perform the test at different baud rates etc.

If tests with the applications software or other loop-back tests indicate that the 485 Adaptor is working properly, then the following should be investigated.

Communication circuits. For a communications circuit to operate correctly, both ends of the circuit, and the interconnecting cables must be serviceable and the correct connections made. The vagaries of RS-232, RS-422 and RS-485 implementation often cause problems in making the proper connections, and the manufacturers instructions for the equipment at each end should be carefully checked.

Hardware handshaking control signals. If the communication is operating under a software handshaking protocol (X-ON, X-OFF etc.) then only the transmitted and received data lines need to be connected. If the application requires hardware handshaking by the use of control lines CTS, RTS, etc., the program is likely to hang.

Polarity of RS-422/485 differential data lines. Not all suppliers use the same convention for the polarity of the differential data lines. The Model 485 Adaptor lines are labelled A and B as defined in the RS-422/485 specification. If the other device is labelled differently, then:-

A is normally connected to **A** or **A'** or **Y** or **High** or **+**
B is normally connected to **B** or **B'** or **Z** or **Low** or **-**

If all devices are not so labelled and the polarity is not evident, or if a problem is suspected in this area, then some experimentation may be necessary. No damage can be done to the interface hardware by reversing polarity.

Termination of Data and Control Lines. The differential data lines must be properly terminated as described above.

5. TECHNICAL INFORMATION

5.1 Technical Specification

The technical characteristics of the Model 485HF9 Adaptor are in accordance with the following electrical and physical specifications.

Except where otherwise noted, all specifications are typical at 25° C

5.1.1 Electrical Specification

Supply Voltage	+5.0 VDC to +13.0 VDC from external supply via terminal strip
Supply Current	50 mA plus current drawn by output loads 100 mA fully loaded
RS-232 'High' signal input	+2.4 to +30 V
RS-232 'Low' signal input	-30 to +0.8 V
RS-232 Input Resistance	5 kΩ
RS-232 'High' signal output	+9 V
RS-232 'Low' signal output	-9 V
RS-232 Output Resistance	300 Ω
RS-232 Connector fitted to Adaptor	9 way D type socket
RS-422/485 Input sensitivity	0.2 V
RS-422/485 Input hysteresis	70 mV
RS-422/485 Output drive	1.5 V minimum, fully loaded
RS-422/485 Output load	27 Ω minimum
RS-422/485 Receiver I/P Termination	120 Ω resistor across differential input terminals. Can be disconnected by cutting an on-board link
RS-485 Tx enable	-30 V to +0.8 V
RS-485 Tx disable	+2.4 V to +30 V
Tx Enable Input Resistance	5 kΩ
Data Rate	1 MBd
RS-232 Connector	9 way DB-9 female connector with screw-locks
RS-422/485 Connector	8 way pluggable screw terminal assembly

5.1.2 Physical/Environmental Specification

	<u>Module with connector</u>	<u>Packed</u>
Size	67 x 43 x 20 mm	215 x180 x 80 mm
Weight	60 gm	250 gm
Temperature Range	<u>Operating</u> 0° C to +60° C	<u>Storage</u> -20 to +70° C

5.2 Optional Accessories

5.2.1 U.K. Mains Adaptor Power Supply

Amplicon Order Code	Description	Function
919 135 69	Plug-in mains adaptor	Provides +9 VDC at 200 mA to power one or two Model 485 Adaptors. Mains operated 230/240 VAC. Integral 3 pin, 13 A, UK style plug. Two wire output cable of 2 m length. Moulded connector to be removed for screw terminal connection to 485HF9 Adaptor. Wire with white stripe is positive, see paragraph 2.4.1.

The U.K. Mains Adaptor complies with the requirements of British Standard BS415

5.2.2 International Mains Adaptor Power Supply

919 448 69	Wired-in mains adaptor	Provides +9 VDC at 200 mA to power one or two Model 485 Adaptors. Mains operated 220/230 VAC. Two wire (Brown - live, blue - neutral), 1.5 m length mains input cable. Two wire output cable of 2 m length. Moulded power connector to be removed for screw terminal connection to 485HF9 Adaptor. Wire with white stripe is positive, see paragraph 2.4.1.
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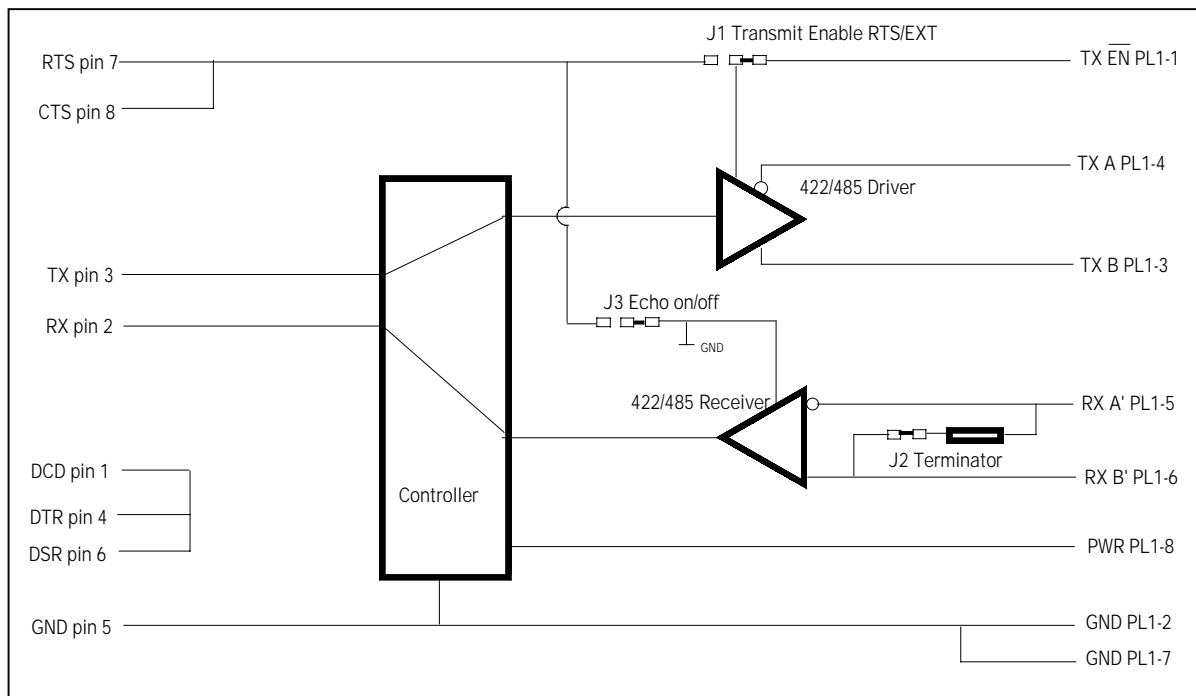


FIGURE A.1 MODEL 485HF9 CIRCUIT SCHEMATIC