

Sieger System 57

Modbus Interface Module Kit RS422/485 (05701-A-0312)

Modbus Interface Module Kit RS232 (05701-A-0313)

Helping to make a safer world

Ensure that you read and understand these instructions **BEFORE** operating the equipment.

Please pay particular attention to the Safety Warnings.



WARNINGS

The items of equipment covered by this manual are:

1. Not designed or certified for use in hazardous areas.
2. Designed for indoor use only.
3. Not to be exposed to rain or moisture.

CAUTIONS

1. Use only approved parts and accessories with the System 57 Control System.
2. To maintain safety standards, regular maintenance, calibration and operation of the System 57 Control System by qualified personnel is essential.

IMPORTANT NOTICES

1. Zellweger Analytics Limited can take no responsibility for installation and/or use of its equipment if this is not done in accordance with the appropriate issue and/or amendment of the manual.
2. The user of this manual should ensure that it is appropriate in all details to the exact equipment to be installed and/or operated. If in doubt, the user should contact Zellweger Analytics Limited for advice.

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GLOSSARY

A1	-	Lower or Pre-warning Alarm Level.
A2	-	Second Pre-warning Alarm Level.
A3	-	Upper or Main Warning Level.
LED	-	Light Emitting Diode.
* LTEL	-	Long Term Exposure Limit (8 hours TWA value).
RFI	-	Radio Frequency Interference
RH	-	Relative Humidity.
* STEL	-	Short Term Exposure Limit (10 minutes TWA value).
* TWA	-	Time Weighted Average.

* Refer to the appropriate National Standards Authority for details. In the UK this detail is in the Guidance Note EH 40/89 from the Health and Safety Executive on Occupational Exposure Limits 1989.

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1. INTRODUCTION

1.1 PRINCIPAL FEATURES

The System 57 MODBUS Interface provides a facility for digital communication between the System 57 Control System and an external computer system. MODBUS is a well supported digital data communication protocol which provides a set of standard commands by which system data can be communicated. Two different interface modules are available to support the most widely used electrical interface standards, thereby ensuring compatibility with most external systems. Using the MODBUS Interface it is possible to read configuration, alarm status and other information from any channel in the rack and to perform calibration and other procedures.

The MODBUS Interface is commonly used to connect the System 57 Control System to plant control systems to provide central monitoring of system status often with graphical display.

The principal features of the MODBUS Interface are:

- Easily fitted to the Engineering Card.
- Compatible with 5701, 5704 and 5704F Control Cards.
- Simple field connections, via the DC Input Card terminal block, for wire up to 2.5mm² (14 AWG).
- Operates as a MODBUS RTU.
- Supports functions 02, 03, 04, 06 and 16 of the MODBUS protocol.
- Provides sensor gas readings and alarm status for Fault, Inhibit, A1, A2, A3, FIRE, STEL, LTEL and Rate alarms from all channels in the rack.
- Supports commands to Inhibit, Reset, Normalise (zero), Calibrate (span) and set Alarm Levels for all channels in the rack.
- Supports RS485, RS422 and RS232 electrical standards.
- Data signals isolated from System 57 power supply.
- Asynchronous serial link configurable for baud rate, parity and stop bits.
- Primary and secondary channel operation.
- Half duplex operation.
- Multi-drop capability.
- Easily configured using Engineering Interface Software.

1. INTRODUCTION

1.2 COMMONLY USED TERMS

The reader should be familiar with the following terms that are used throughout this instruction manual:

- MODBUS:** Modbus is a digital data communication protocol which provides a widely used set of standard commands by which system data can be communicated to an external device.
- RS485:** RS485 is an electrical standard that uses a twisted pair cable carrying differential signals to transfer digital data. RS485 permits up to 32 transceiver nodes to be connected onto a single twisted pair highway for 'multi-drop' bi-directional operation over distances up to 1.2km (3900ft).
- RS422:** RS422 is an electrical standard that uses a twisted pair cable carrying differential signals to transfer digital data. RS422 permits a single driver and up to 10 receiver nodes to be connected onto the highway for operation over distances up to 1.2km (3900ft).
- RS232:** RS232 is an electrical standard that uses multi-core cable carrying signals to transfer digital data. RS232 permits interconnection of two communicating devices for bi-directional operation over distances up to 15m (49ft).
- Baud Rate:** Baud is a unit of signalling speed equal to the number of discrete signal events per second. (Not necessarily the same as bits per second).
- Bit Rate:** The speed at which bits are transmitted, usually measured in bits per second (bits/s).
- Parity:** A technique used to detect single bit errors in a transmitted data byte (character) in electronic code transmission.
- Stop Bit:** A method to indicate the end of a transmitted data byte (character) in electronic code transmission.
- Full Duplex:** Refers to a communication system capable of simultaneous two way independent transmission of data.
- Half Duplex:** Refers to a communication system capable of transmission of data in either direction, but not simultaneously.

1. INTRODUCTION

Simplex:	Refers to a communication system capable of transmission of data in a single direction only.
Multi-drop:	A single communication line which is shared by a number of devices or 'nodes'.
Node:	An intelligent device present within a data communication system which is able to communicate.
Host:	The host system is a master device that controls the system operation. Typically a host will be either a PLC, DCS or SCADA Graphics package.
Master:	A master device is a node which controls transmission of data in a communicating system by issuing requests to slave devices.
Slave:	A slave device will only transmit data onto the communication line in response to a request from a master device.

1.3 CONSTRUCTION

The System 57 MODBUS Interface is available pre-installed in new systems or as a kit for retro-fitting into existing systems. Two kits are available, one supporting the RS485 and RS422 electrical standards and the other the RS232 electrical standard. Each kit consists of:

- a. A small pcb MODBUS interface module that plugs onto the Engineering Card J1 and J2 connectors.
- b. Two integrated circuits that plug into the expansion sockets provided on the Engineering Card.

Connections for the serial data interface are made via the six way expansion terminal block TB2 that is located on the DC Input Card.

An enhanced version of the Engineering Card software must be installed in order to provide the MODBUS Interface functions. The new software, which is fully compatible with the original Engineering Card software, is provided as a plug-in integrated circuit included in the kit.

1. INTRODUCTION

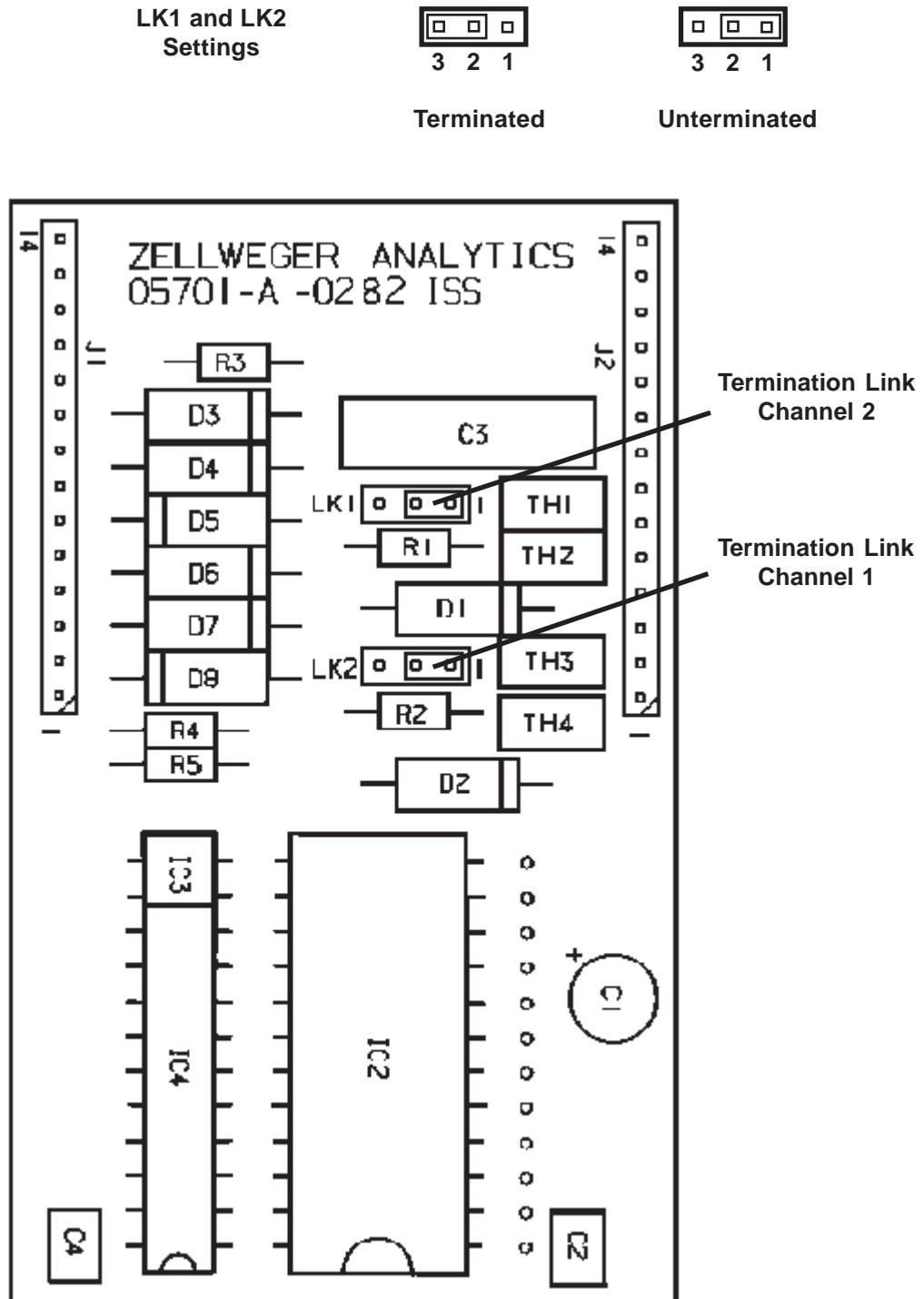


Figure 1 MODBUS Interface Module RS485/422

1. INTRODUCTION

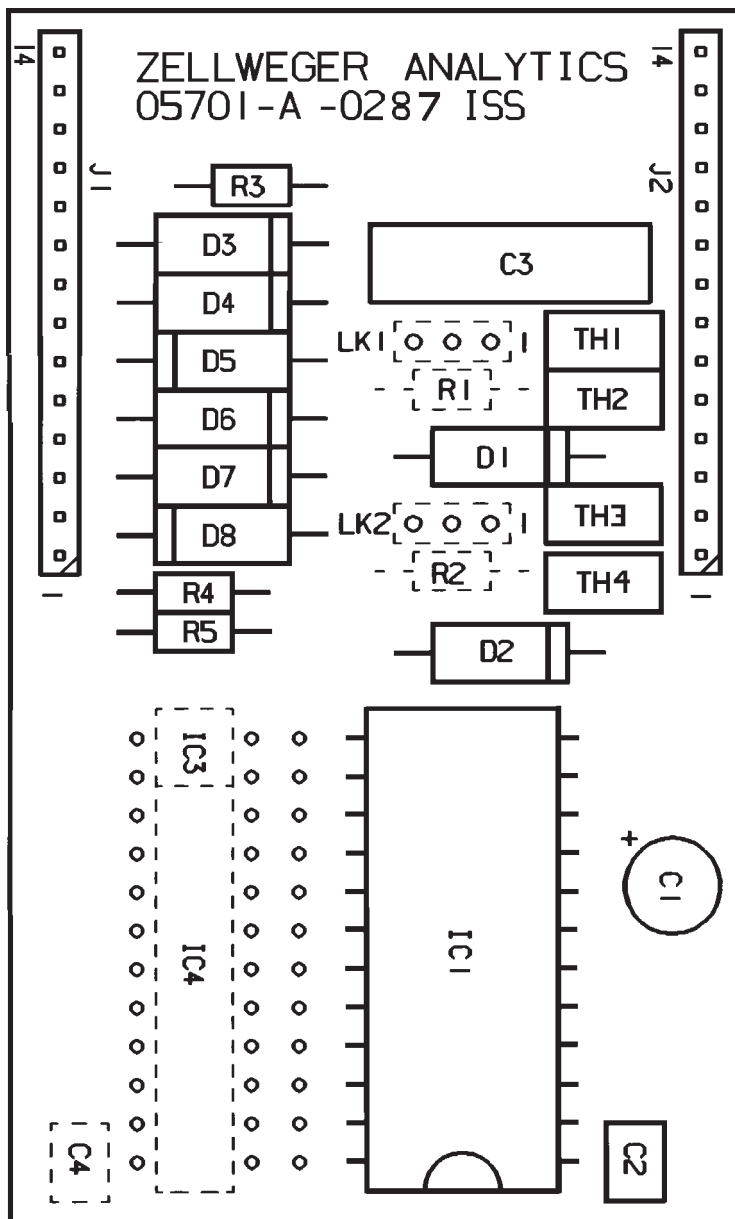


Figure 2 MODBUS Interface Module RS232

1. INTRODUCTION

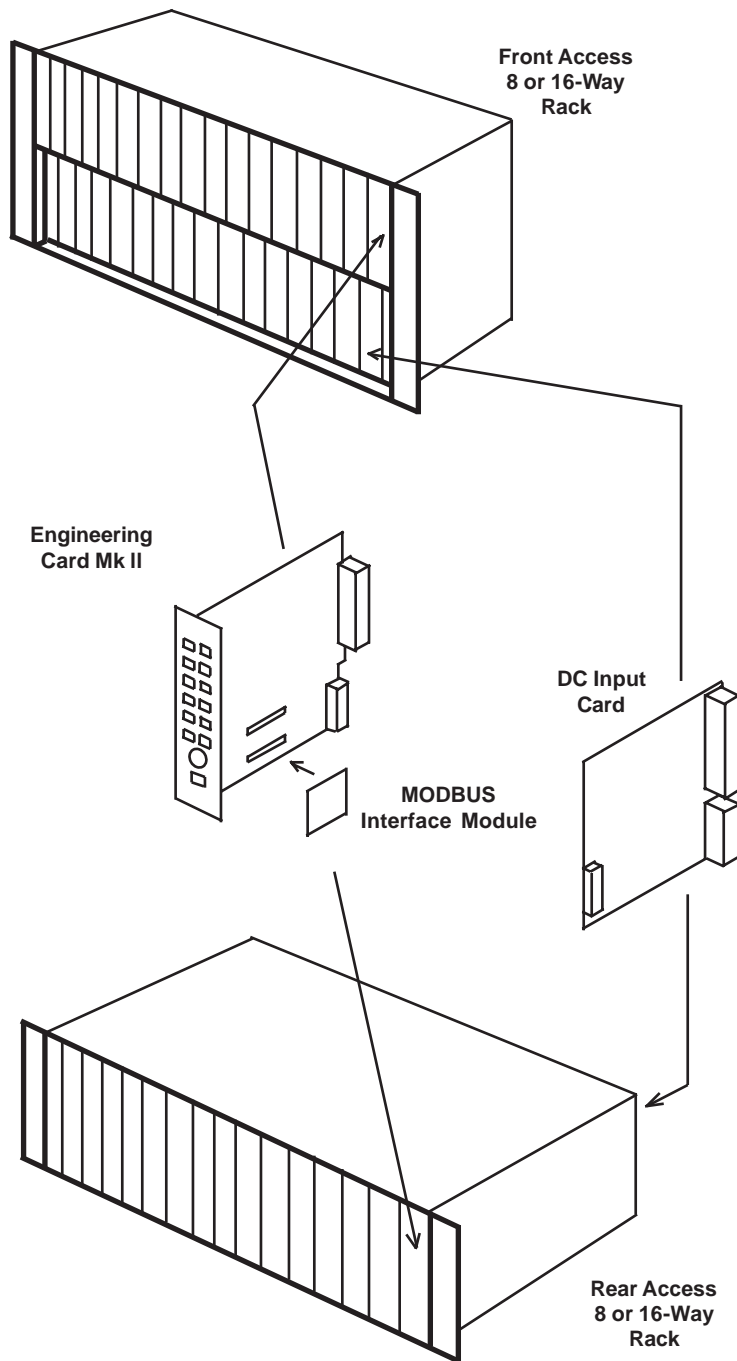


Figure 3 MODBUS Overview

2. CONTROLS AND FACILITIES

2.1 INTRODUCTION

The 5701 and 5704 control systems provide a complete solution for the operational and engineering requirements of a multi-channel fire and gas detection system. Each control card within the rack system provides sensor drive, signal acquisition, gas concentration display and comprehensive alarm facilities for one or more fire or gas sensors.

The MODBUS Interface facility extends the capability of the control system by providing an external computer system with monitoring and control functions for every gas sensor or fire detector connected to the rack. The operation and alarm integrity of the System 57 is not affected by the MODBUS Interface.

The digital data link uses a bi-directional 8-bit asynchronous serial connection that is configurable for baud rate, parity and stop bits. Two different modules are available, one supports both RS485 and RS422 electrical interface standards and the other supports the RS232 electrical interface standard. Depending upon the module type, system configuration and the capability of the host computer, various communication options are available as follows:

Interface Mode	Transmission Option	Dual Highway Option	Multi-drop
RS485	Half Duplex	Yes	Yes (31 Nodes)
RS422	Half Duplex	No	Yes (10 Nodes)
RS232	Half Duplex	No	No

The dual highway option provides a secondary or backup data link for increased communication integrity. Multi-drop configurations allow a single communication line to be shared by a number of devices reducing the number of communication ports required at the host computer.

RS232 provides the lowest cost solution for connecting a single System 57 rack to a host computer.

RS485 provides the best solution for multi-drop connection of more than one System 57 rack to a host computer and also gives the option of a secondary highway.

RS422 is useful to provide multi-drop connection where the host computer software does not have the facility for transceiver direction control (transmit/receive/high impedance) that is required with RS485 connections.

2. CONTROLS AND FACILITIES

In all cases the System 57 operates as a MODBUS Remote Terminal Unit (RTU), acting as a slave device node and transmitting data onto the communication line only in response to a request from a master device. The host computer system, typically a PLC, DCS or SCADA graphics package, acts as the master device controlling the communication system operation.

The subset of MODBUS functions supported by the System 57 RTU are 02, 03, 04, 06 and 16. The MODBUS broadcast commands are not supported and will be ignored, however, global commands are available to reset all cards in the rack simultaneously. For a detailed description of the available commands and data formats refer to the System 57 MODBUS Function Reference given in Section 7.

2.2 MODBUS INTERFACE MODULE - RS485/422

2.2.1 General

The RS485/422 Interface Module has two differential 5V transceivers designated channel 1 and channel 2. Each transceiver channel can be resistively terminated by setting LK1 and LK2 respectively (see Figure 1 and Section 3.4.3). The interface signals are isolated from the System 57 power supply 0V and Ground to protect the host computer against damage due to earth loops.

2.2.2 RS485 Operation

An outline RS485 connection diagram is shown in Figure 4.

When configured for the RS485 mode, transceiver Channel 1 is used in dual highway systems for the primary highway or the only highway in single highway systems. Transceiver Channel 2 is used only in dual highway systems where it functions as the secondary highway. Depending upon the type of installation, operation is possible over distances up to 1.2km (3900ft). In the multi-drop mode up to 32 nodes, including the host, can be connected. The terminal connections are:

CH1-A, CH1-B	Differential Transceiver Channel 1 (Primary).
CH2-A, CH2-B	Differential Transceiver Channel 2 (Secondary).
DGND	Isolated Data Ground.

In a dual highway system the MODBUS uses, at any one time, only one of the two available highways, either the primary or the secondary. The interface automatically switches between highways when a communication failure is detected.

2. CONTROLS AND FACILITIES

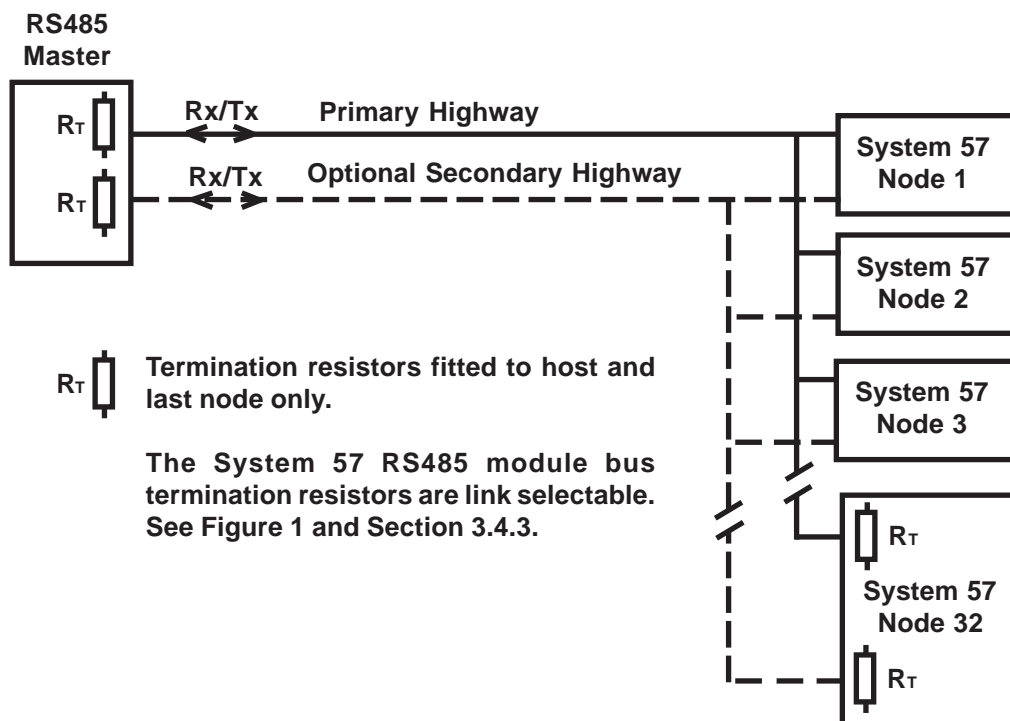


Figure 4 System Diagram for RS485 Connection.

The highway switching process is controlled as follows:

- a. The inactive highway is continuously monitored for data communication.
- b. If data communication is detected on the inactive highway, the inactive highway is assumed to be fully serviceable.
- c. If valid data communication ceases on the active highway and the inactive highway is perceived to be serviceable, the MODBUS interface switches between channels.

2. CONTROLS AND FACILITIES

2.2.3 RS422 Operation

A outline RS422 connection diagram is shown in Figure 5.

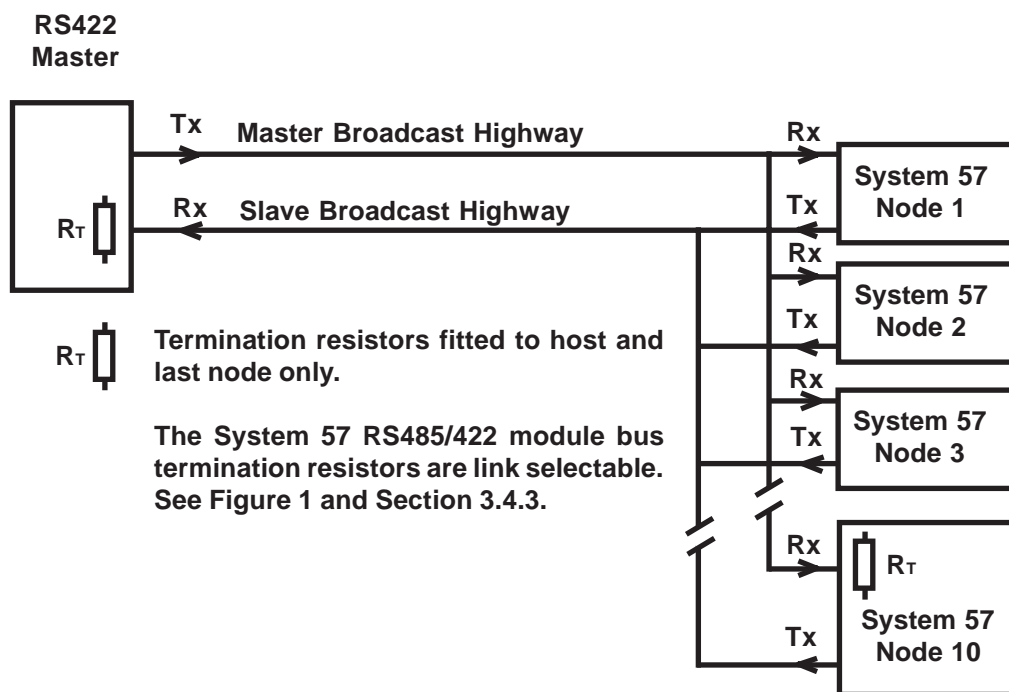


Figure 5 System Diagram for RS422 Connection.

When configured for RS422 mode, transceiver Channel 1 is used for transmission from the System 57 RTU to the host computer and transceiver Channel 2 is used as a receiver for transmissions from the host computer to the System 57 RTU. Depending upon the type of installation, operation is possible over distances up to 1.2km (3900ft).

Although the EIA RS422 standard specifies only point to point applications, the addressable operation of System 57 permits a modified 'broadcast' mode topology that allows multi-drop connection of up to 10 nodes. Each System 57 node is held in a high impedance state until it receives an appropriately addressed request, when it enables its transmitter for the duration of the response. The terminal connections are:

TX-A, TX-B Differential Transceiver Output from RTU.

RX-A', RX-B' Differential Receiver Input to RTU.

DGND Isolated Data Ground

2. CONTROLS AND FACILITIES

2.3 MODBUS INTERFACE MODULE - RS232

A outline RS232 connection diagram is shown in Figure 6.

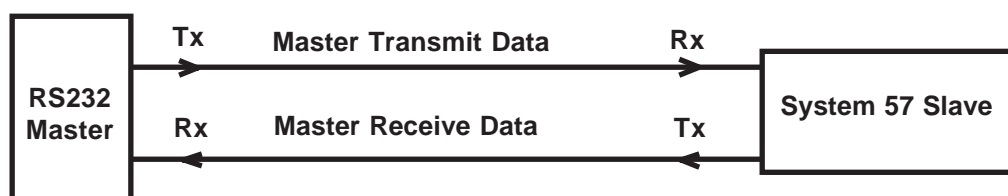


Figure 6 System Diagram for RS232 Connection

The RS232 Interface Module has transmit and receive data lines and two handshaking lines. The interface conforms to the RS232 standard giving $\pm 12V$ output drive. Depending upon the type of installation, operation is possible over distances up to 15m (49ft). To protect the host computer against damage due to earth loops, the interface signals are isolated from the System 57 power supply 0V and Ground. The terminal connections are designated as follows:

- RXD Receive Data input to RTU.
- TXD Transmit Data output from RTU.
- DSR Data Set Ready input to RTU.
- DTR Data Terminal Ready output from RTU.
- SGND Isolated Signal Ground.

3. INSTALLATION INSTRUCTIONS

WARNING

The Engineering Card and Upgrade Kit are susceptible to damage by static electricity and therefore the appropriate precautions should be taken.

3.1 INTRODUCTION

There are two versions of the Engineering Card. The MODBUS Interface Kit can only be fitted to the Mk 2 Engineering Card.

With the Engineering Card removed from the rack, the type of Engineering Card can be visually identified as follows:

- a. Mk I hardware by the presence of only one 28 pin DIL IC socket on the card pcb.
- b. Mark II hardware by the presence of two 28 pin DIL IC sockets and a rectangular cutout near the centre of the card pcb. (See Figure 7).

A summary of the MODBUS Interface installation procedure is shown below:

- a. Unpack and check the contents of the kit.
- b. Remove the Engineering Card from the rack.
- c. Install the Software Expansion EPROM Integrated Circuit.
- d. Install the RAM Expansion Integrated Circuit.
- e. Install the MODBUS Interface Module.
- f. Wire the DC Input Card terminal blocks to the host computer.
- g. Configure and Commission

After installation is complete perform the commissioning procedures outlined in Section 5. The following sections provide a detailed explanation of the installation operations.

3.2 UNPACKING

On receipt carefully unpack the equipment observing any instructions printed on or contained in the packaging. Check the contents for transit damage and ensure that the following items are present:

3. INSTALLATION INSTRUCTIONS

For the MODBUS Interface Module Kit: RS485/422:

- a. MODBUS Interface Module RS485/422 (05701-A-0282).
- b. Engineering Card Expansion Option EPROM integrated circuit (05701-A-0385).
- c. RAM expansion integrated circuit type HN6264ALP.
- d. User Manual (05701-A-5006).

For the MODBUS Interface Module Kit RS232:

- a. MODBUS Interface Module RS232 (05701-A-0287).
- b. Engineering Card Expansion Option EPROM integrated circuit (05701-A-0385).
- c. RAM expansion integrated circuit type HN6264ALP.
- d. User Manual (05701-A-5006).

3.3 INSTALLING THE MODBUS INTERFACE KIT

Except for Step (6) which applies to the RS485/422 Module only, the following installation procedure applies to both versions of the MODBUS Interface Kit:

- (1) Isolate the SYSTEM 57 Rack from all power sources.
- (2) Unscrew the two front panel screws that retain the Engineering Card and using the extraction tool supplied with the system pull the Engineering Card from the rack.

WARNING

The Upgrade EPROM can be permanently damaged by incorrect insertion.

- (3) Insert the Software Upgrade EPROM integrated circuit (05701-A-0385) into the socket IC2 on the Engineering Card, ensuring that pin 1 of the IC is aligned correctly with pin 1 of the socket and that all pins are properly inserted into the socket.

Note: If an IC is already fitted to socket IC2, this should be removed and discarded.

3. INSTALLATION INSTRUCTIONS

WARNING

The RAM chip can be permanently damaged by incorrect insertion.

- (4) Insert the RAM expansion integrated circuit (HN6264ALP) into the socket IC12 on the Engineering Card, ensuring that pin 1 of the IC is aligned correctly with pin 1 of the socket and that all pins are properly inserted into the socket.
- (5) Using small pliers or an electrical screwdriver gently remove the Engineering Card shorting link LK1 and replace to short pins 1 and 2. See Figure 7.
- (6) **This step applies to the RS485/422 module only.** For correct operation, especially at high baud rates, RS485 and RS422 highways should be resistively terminated.

In RS422 host systems, a terminator resistance is only required at the receiver device located in the host and at the receiver device located in the System 57 node at the far end of the cable.

In RS485 host systems, a terminator resistance is required at the transceiver device located in the host and at the transceiver device located in the System 57 node at the far end of the cable.

For dual highway RS485 systems, both highways should be terminated as described above.

By default the RS485/422 module transceivers are unterminated. If a resistive termination is required, use small pliers or an electrical screwdriver to gently remove the shorting links, LK2 (Channel 1) or LK1 (Channel 2), on the RS485/422 Module from pins 1 and 2 and replace to short pins 2 and 3. (See Figure 1 and Section 3.4.3).

- (7) Insert the MODBUS Interface Module into the socket headers J1 and J2 on the Engineering Card, ensuring that pin 1 of the module pin headers is correctly aligned with pin 1 of the Engineering Card socket headers.
- (8) Re-insert the Engineering Card into the rack, tighten the two front panel screws and go to the Section 3.4.

3. INSTALLATION INSTRUCTIONS

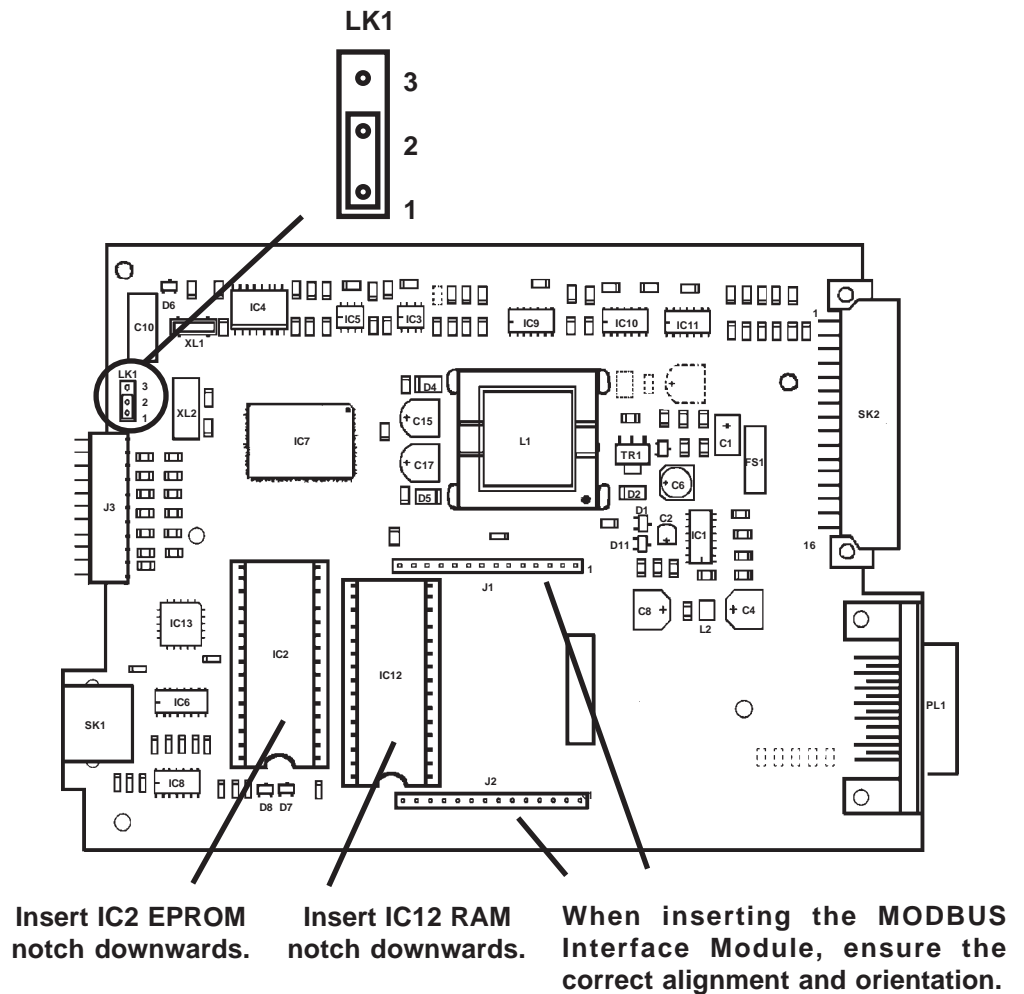


Figure 7 SYSTEM 57- Engineering Card Mark II

3.4 FIELD CONNECTIONS FOR RS485/422 INTERFACE

3.4.1 Connections

The field connections to the MODBUS Interface Module are made via the auxiliary terminal block TB2 on the DC Input Card. The terminal block is a two part type to aid the connection of field cables without removing the DC Input Card. The DC Input card terminal connections are shown in Figures 8 and 9.

3.4.2 RS485/422 Cabling

The field terminals of the DC Input Card accept single or multi-stranded wire up to 2.5mm² (14 AWG). Cables should be routed carefully to avoid physical and environmental hazards such as mechanical stress and high temperatures.

3. INSTALLATION INSTRUCTIONS

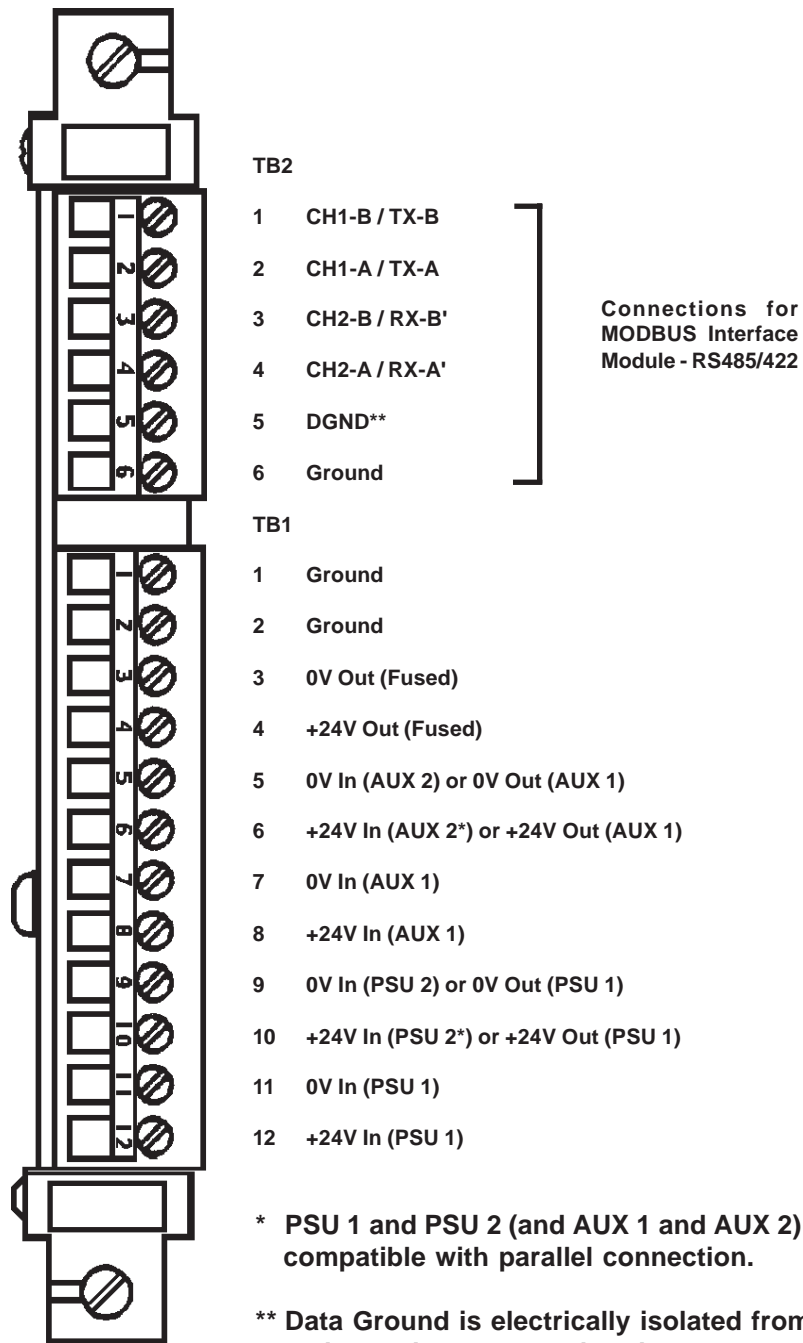


Figure 8 Front Access Connections for DC Input Card and MODBUS RS485/422 Option Module

3. INSTALLATION INSTRUCTIONS

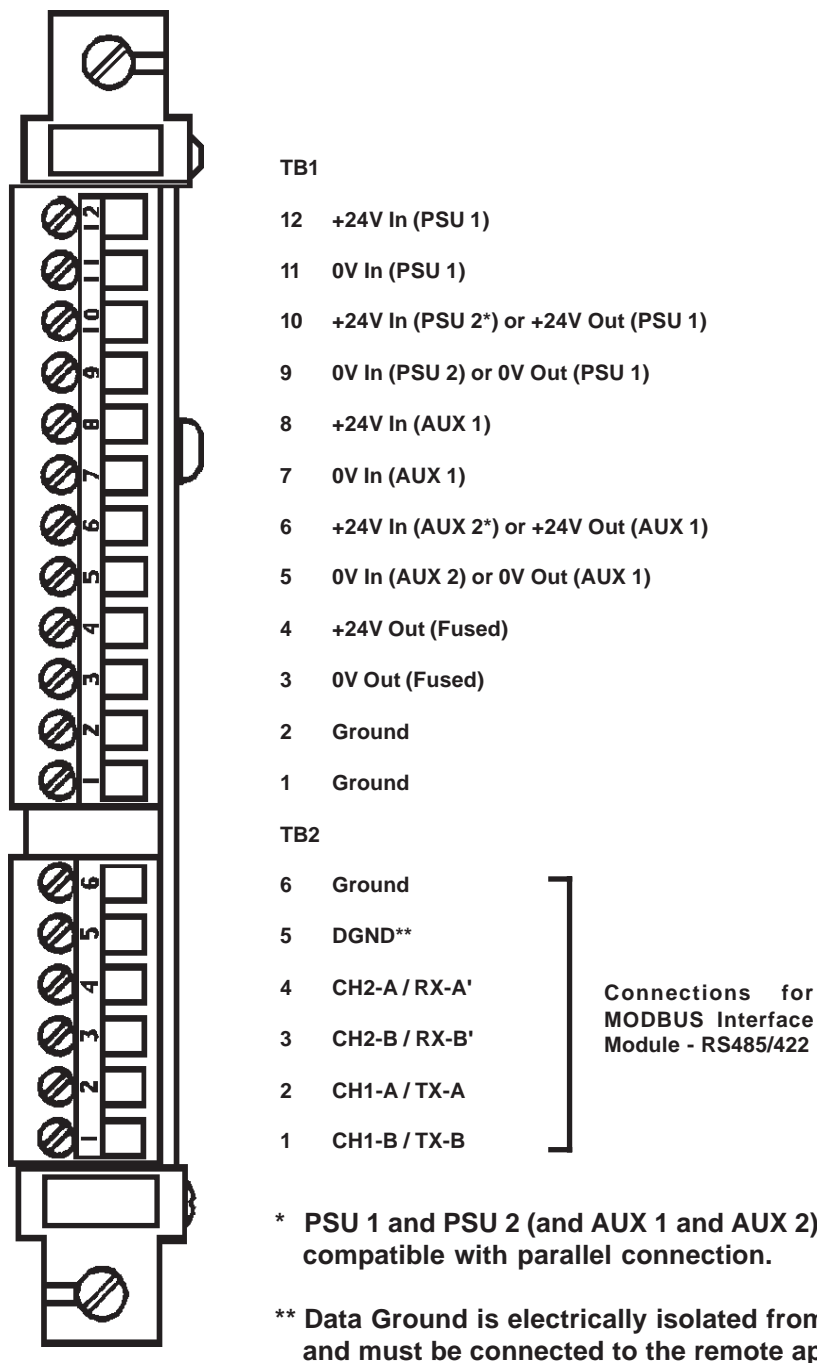


Figure 9 Rear Access Connections for DC Input Card and MODBUS RS485/422 Option Module

3. INSTALLATION INSTRUCTIONS

To achieve fast reliable data connections good quality screened twisted pair cable should be used. The maximum achievable data rate is limited by the cable capacitance and therefore the cable length should be kept as short as possible. In dual highway configurations a separate twisted pair should be used for each highway, however if required, these may be contained within a single cable.

In order to ensure the correct operation and to meet European Standards for RFI and EMC, it is recommended that all field cables should be of the screened type with the cable screen connected at one end only. If the screen is to be connected at the System 57 end, use either the ground terminal of the DC Input Card, the cabinet using a suitable metal cable gland or other suitable instrument earth point.

3.4.3 RS485/422 Transmission Line Termination

In RS485 or RS422 applications, the two wire transmission lines must be properly terminated. The simplest form of termination is typically with a 120 ohm resistor connected across the differential input as follows:

- a. In RS422 host systems, a terminator resistance is only required at the receiver device located in the host and at the receiver device located in the System 57 node at the far end of the cable.
- b. In RS485 host systems a terminator resistance is required at the transceiver device located in the host and at the transceiver device located in the System 57 node at the far end of the cable. For dual highway RS485 systems both highways should be terminated as described.

Jumper links are provided on the System 57 RS485/422 Module to make above termination easy (see Figure 1).

In general RS485 transmitter circuits are specified as being capable of driving a minimum load resistance of 60 ohms, therefore no more than two terminator resistors should be connected in parallel onto any one bus.

RS422 transmitter circuits are specified as being capable of driving a minimum load resistance of 100 ohms, therefore no more than one terminator resistor should be connected onto any bus.

3.4.4 RS485 Network Biasing Resistors

Note: In most systems network biasing resistors are not required. It is recommended that these resistors are only added as part of a troubleshooting procedure.

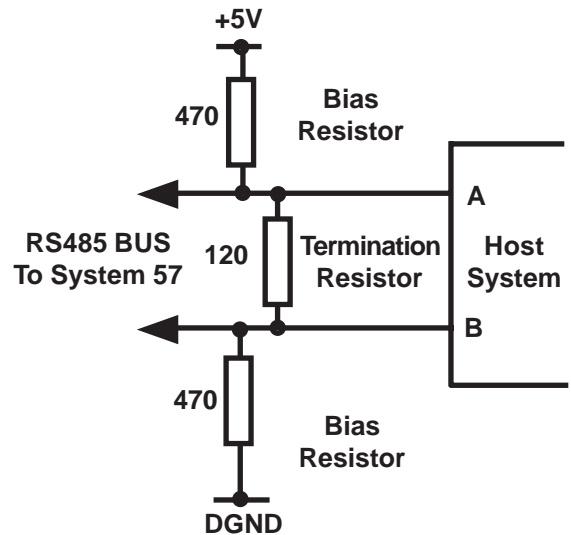
In a multi-drop RS485 system there are brief periods when no transmitter is enabled and the network is allowed to float. During these periods noise or erroneous data may be detected at the receiver, preventing communication or causing communications errors. The

3. INSTALLATION INSTRUCTIONS

System 57 MODBUS facility uses both hardware and software means to protected against this condition and therefore network biasing is not normally required. Other devices on the network may be susceptible in this state and as a preventative measure, two Network Biasing Resistors can be added externally to the transceiver at the host end of the bus so that the network is biased by a few volts when all transmitters are disabled. The normal network termination resistors must still be kept in circuit. The following diagram illustrates a typical biasing network:

Note:

Where access to the host interface hardware is limited it has been found that a single 120 ohm bias resistor connected between the System 57 terminals TB2 pin 2 and TB2 pin 5 has been effective.



3.4.5 RS485/422 Signalling Sense (or Signal Polarity)

The EIA standard for RS422 and RS485 description of the polarity of the signalling lines states:

“The signalling sense of the voltages appearing across the interconnection cable are defined as follows:

- a. The A terminal of the generator shall be negative with respect to the B terminal for a binary 1 (MARK or OFF) state.
- b. The A terminal of the generator shall be positive with respect to the B terminal for a binary 0 (SPACE or ON) state”.

Not all manufacturers use the same convention for the polarity of differential data lines. The System 57 RS485/422 Interface Module is labelled 1A, 1B and 2A, 2B for the primary and secondary transceivers in RS485 mode and A and B for the transmitter and A' or B' for the receiver in RS422 mode. Other common signal notation is:

Signal	Alternative Notation			
A	A'	Y	High	+
B	B'	Z	Low	-

3. INSTALLATION INSTRUCTIONS

If the host device is not labelled or the polarity is not evident, some experimentation may be necessary. The interface hardware can not be damaged by reversing the polarity.

3.4.6 RS485 Connections

The System 57 interface supports up to 32 nodes connected to a single RS485 highway. A secondary or backup highway is also available if required. All A connections within a highway should be connected together using one half of a twisted wire pair and all B connections within the same highway should be connected together using the other half of the twisted wire pair. Ideally the A and B connections should be 'looped through' each device. If a spur is necessary, the spur length should be kept to a minimum at typically less than 1m (3ft). The data ground return connection DGND of all devices must also be connected together.

The voltage between the data grounds of the various devices must not cause the common mode voltage rating of any device on the bus to be exceeded. The data ground of each System 57 interface is isolated from the System 57 ground to reduce earth loop current flow problems. The cable screen should not be used as a data ground return and in systems spread over a wide area the cable screen is best connected to system ground at a single point only. A comprehensive wiring example is shown in Figure 10.

3.4.7 RS422 Connections

The System 57 RS422 Interface supports up to 10 nodes connected to a single RS422 highway. The host transmitter output connection A should be connected to all device receiver inputs A' using one half of a twisted wire pair and the host transmitter output connection B should be connected to all device receiver inputs B' using the other half of the twisted wire pair. The host receiver input connection A' should be connected to all device transmitter outputs A using one half of a twisted wire pair and the host receiver input connection B' should be connected to all device transmitter outputs B using the other half of the twisted wire pair. Ideally the A and B connections should be 'looped through' each device. If a spur is necessary, the spur length should be kept at a minimum of typically less than 1m (3ft). The data ground return connection DGND of all devices must also be connected together.

The voltage between the data grounds of the various devices must not cause the common mode voltage rating of any device on the bus to be exceeded. The data ground of each System 57 interface is isolated from the System 57 ground to reduce earth loop current flow problems. The cable screen should not be used as a data ground return and in systems spread over a wide area the cable screen is best connected to system ground at a single point only. A comprehensive wiring example is shown in Figure 11.

3. INSTALLATION INSTRUCTIONS

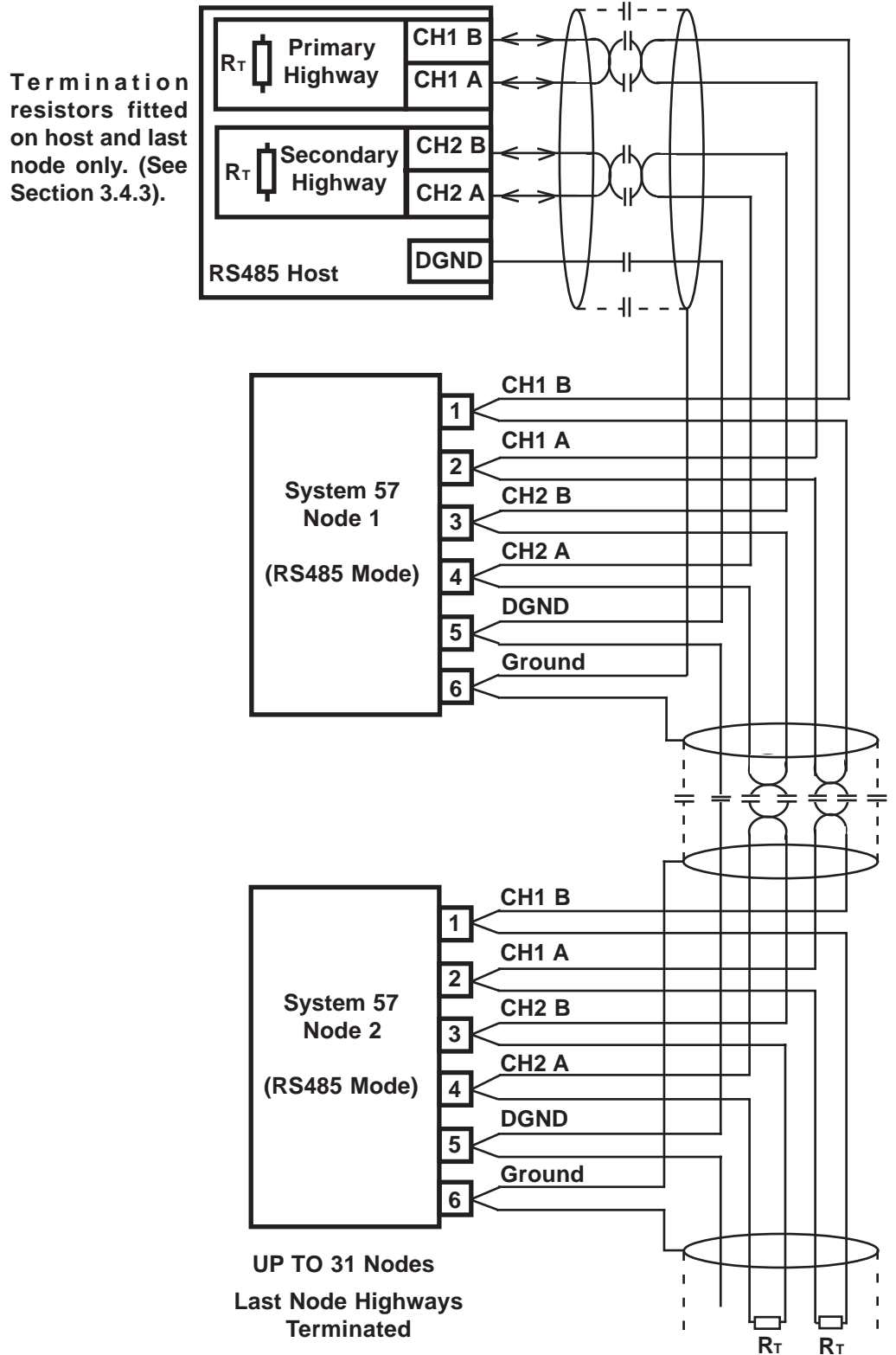


Figure 10 Wiring Example Showing Multi-drop Dual Highway RS485 Connections, Termination Resistors, Host, Nodes, etc.

3. INSTALLATION INSTRUCTIONS

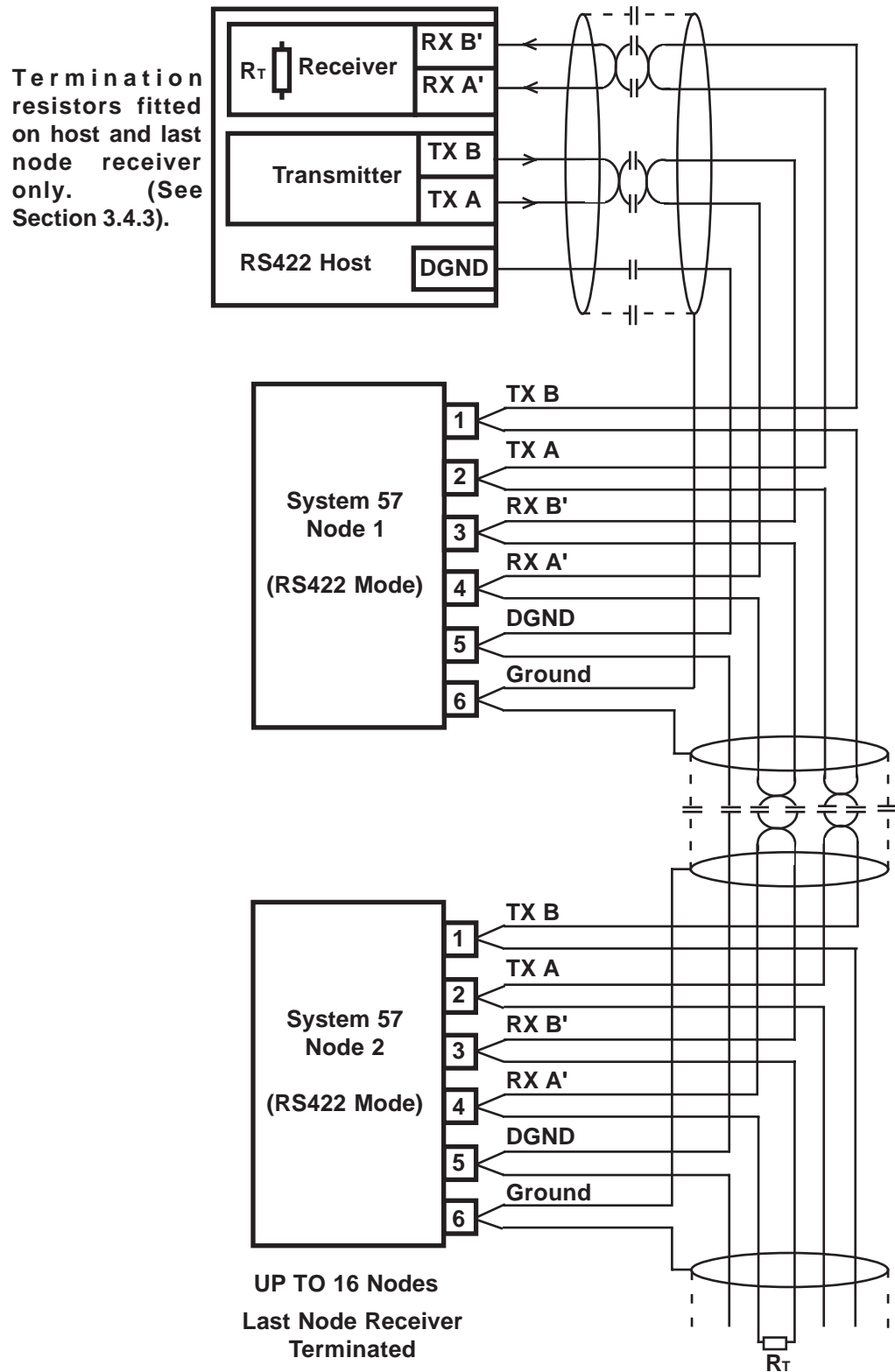


Figure 11 Wiring Example Showing Multi-drop RS422 Connections, Termination Resistors, Host, Nodes, etc.

3. INSTALLATION INSTRUCTIONS

3.5 FIELD CONNECTIONS FOR RS232 INTERFACE

3.5.1 General

The field connections to the MODBUS Interface Module are made via the auxiliary terminal block TB2 on the DC Input Card. The terminal block is a two part type to aid the connection of field cables without removing the DC Input Card. The DC Input card terminal connections are shown in Figures 12 and 13.

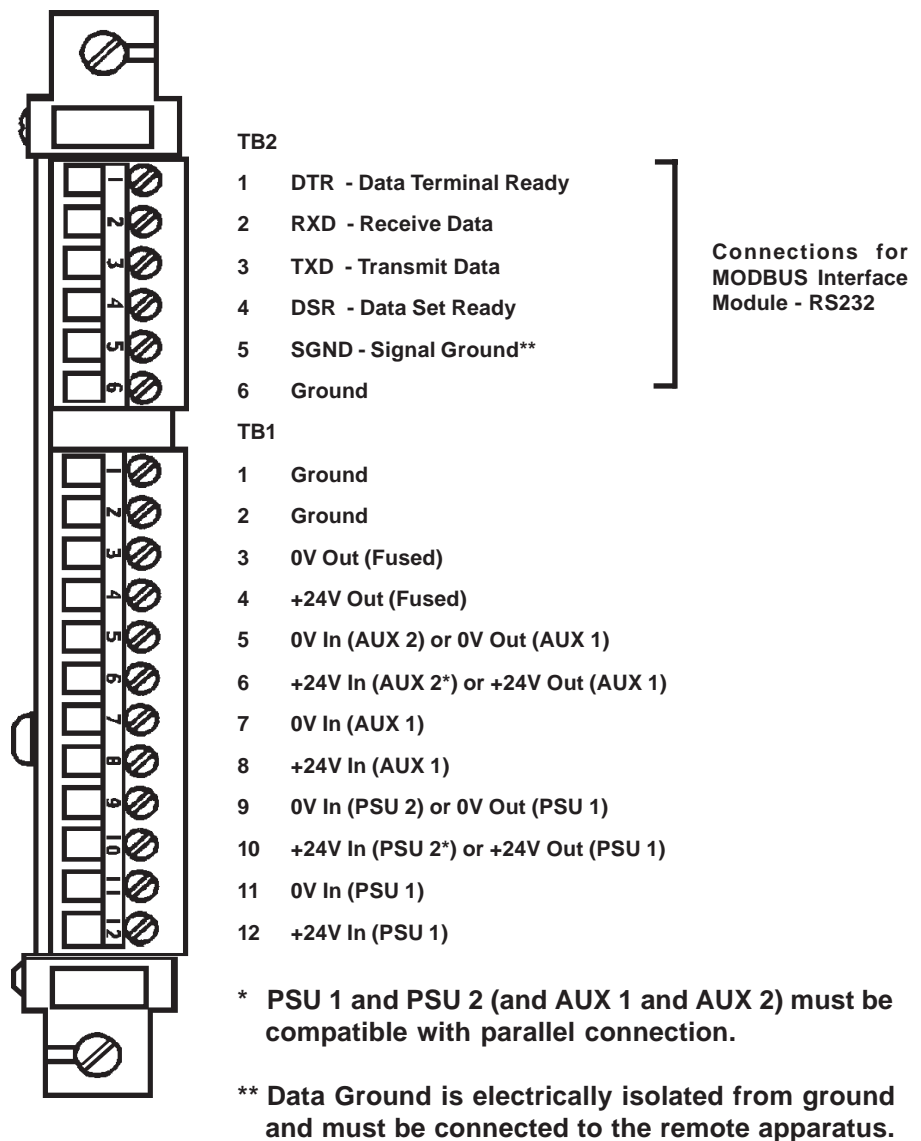
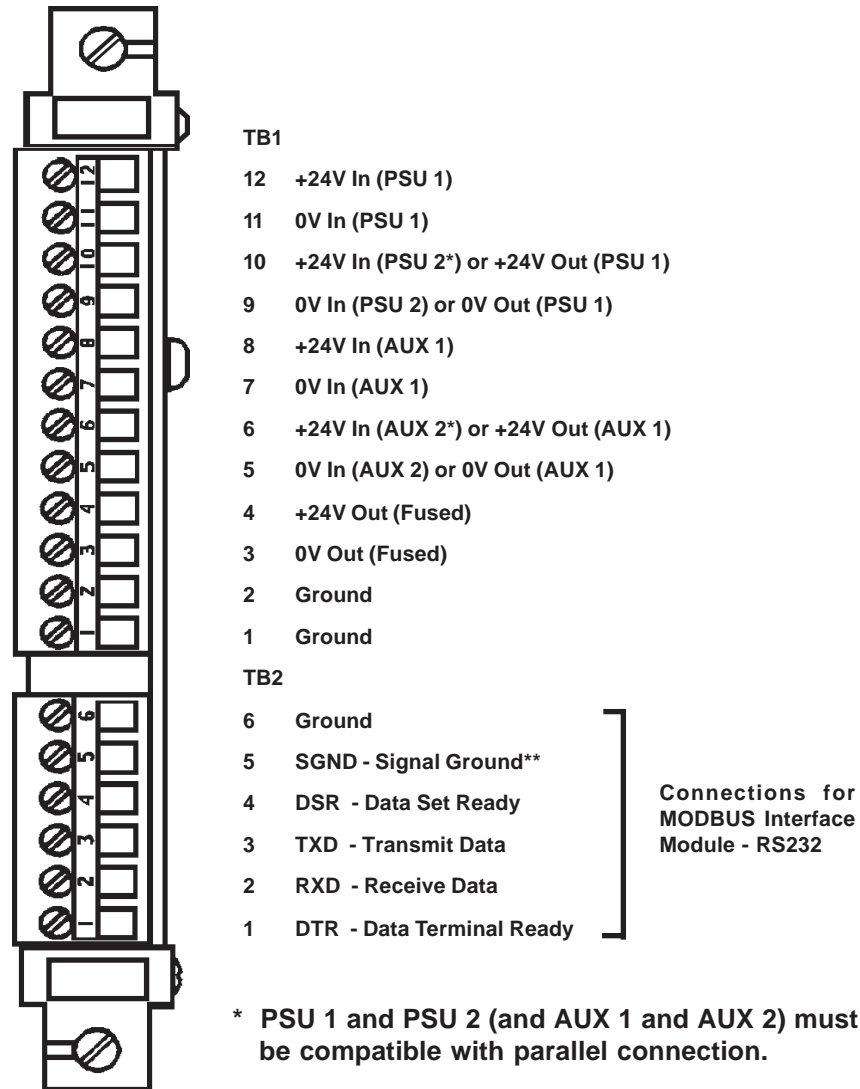


Figure 12 Front Access Connections for the DC Input Card and MODBUS RS232 Option Module

3. INSTALLATION INSTRUCTIONS



* PSU 1 and PSU 2 (and AUX 1 and AUX 2) must be compatible with parallel connection.

** Data Ground is electrically isolated from ground and must be connected to the remote apparatus.

Figure 13 Rear Access Connections for DC Input Card and MODBUS RS232 Option Module

3.5.2 RS232 Cabling

The field terminals of the DC Input Card accept single or multi-stranded wire up to 2.5mm² (14 AWG). Cables should be routed carefully to avoid physical and environmental hazards such as mechanical stress and high temperatures.

To achieve fast reliable data connections, good quality multi-core screened cable should be used. The maximum permitted cable length, as defined by the RS232 standard, is 15m (49ft).

3. INSTALLATION INSTRUCTIONS

In order to ensure the correct operation and to meet European Standards for RFI and EMC, it is recommended that all field cables should be of the screened type with the cable screen connected at one end only. At the System 57 end, use either the ground terminal of the DC Input Card, the cabinet using a suitable metal cable gland or other suitable instrument earth point.

3.5.3 RS232 Connections

The System 57 interface pinout connections follows the naming convention for data terminal equipment (DTE) and therefore usually requires a 'null modem' type cable connection to the host computer. Often the host computer will be an IBM Compatible personal computer system. These are usually fitted with either a 25 way (DB25) or 9 way (DB9) male D-type connector as illustrated in Figure 15. The System 57 signals, corresponding host computer signal and DB type connector pins are as follows:

System 57 Interface				Host Computer		
TB2 Pin	Abbr.	Name	Direction	Signal	DB25 Pin	DB9 Pin
1	DTR	Data Terminal Ready	Output	DSR	6	6
2	RXD	Receive Data	Input	TXD	2	3
3	TXD	Transmit Data	Output	RXD	3	2
4	DSR	Data Set Ready	Input	DTR	20	4
5	SGND	Signal Ground	-	SGND	7	5
-	-	-	-	RTS	4	7
-	-	-	-	CTS	5	8

Some host computers will not transmit unless a valid input signal is present on its CTS (Clear to Send) input. This is best achieved by linking the hosts RTS (Request to Send) and CTS connections.

The voltage between the signal grounds (SGND) of the two devices must not cause the common mode voltage rating of any device to be exceeded. The signal ground of the System 57 interface is isolated from the System 57 ground to reduce earth loop current flow problems. The cable screen should not be used as a data ground return and is best connected to the system ground at a single point only. A comprehensive wiring example is shown Figure 14.

3. INSTALLATION INSTRUCTIONS

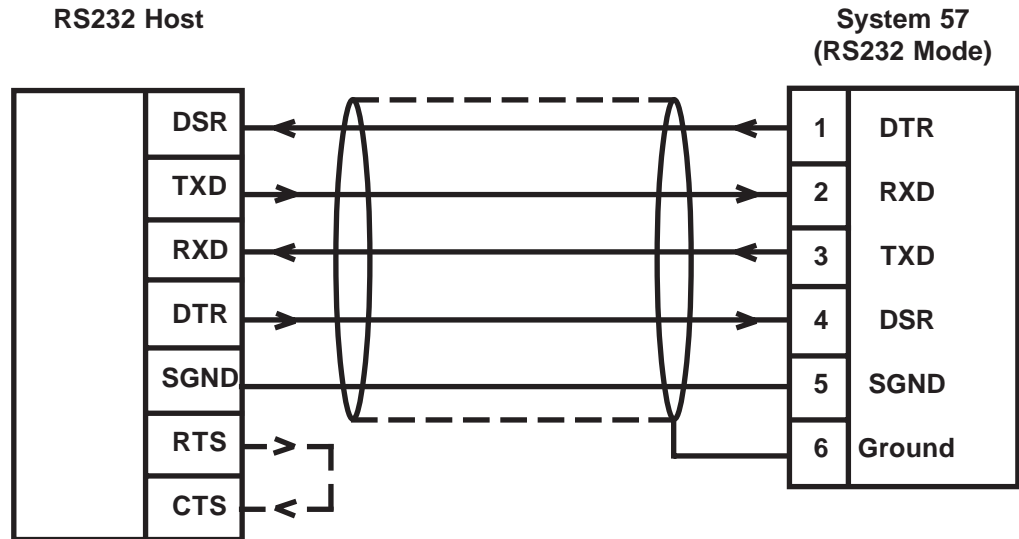
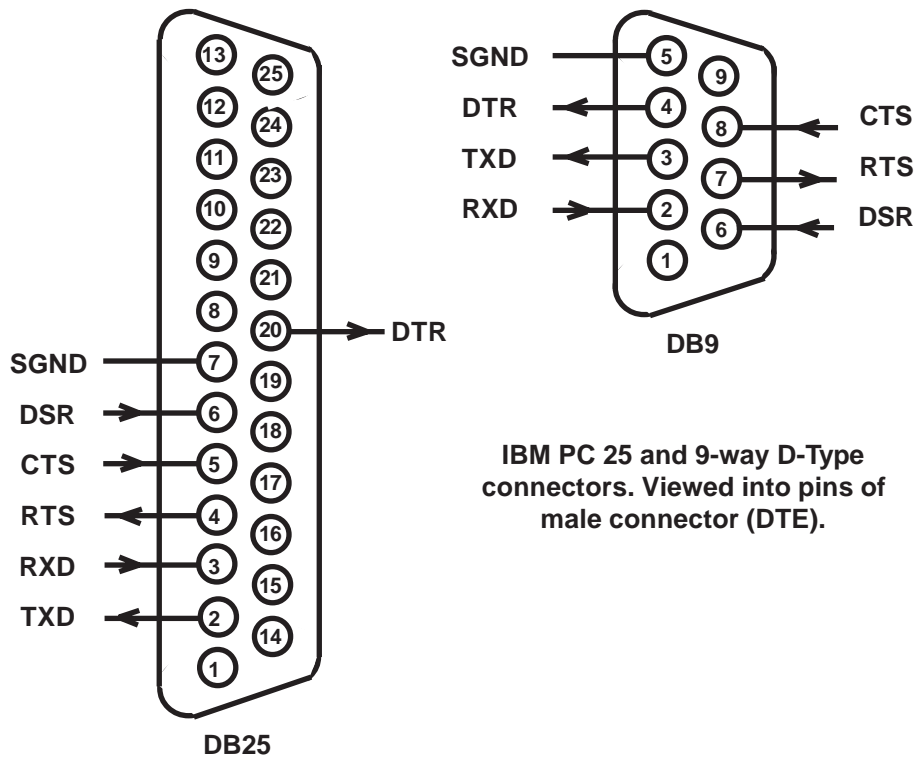


Figure 14 Wiring Example Showing RS232 Connections



IBM PC 25 and 9-way D-Type connectors. Viewed into pins of male connector (DTE).

Figure 15 Common Personal Computer RS232 Connector Pinouts

4. CONFIGURING THE MODBUS FUNCTION

4.1 GENERAL

The System 57 MODBUS Interface is highly configurable to allow compatibility with most host computer systems. It is essential that the same communication parameters are used on all nodes connected to any highway.

4.2 HOST COMPUTER CONFIGURATION

It is recommended that the host computer is configured to provide at least two retries in the event of a communication frame loss. Refer to the documentation supplied with the host computer for details of its communication and MODBUS configuration.

4.3 SYSTEM 57 CONFIGURATION

4.3.1 Introduction

The System 57 MODBUS Interface facility is configured using the Engineering Interface Software (EIS) tool supplied as part of the Engineering Interface Kit. Refer to the user manual supplied with the EIS for detailed instructions on using the software to change the configuration of a rack. The following sections give a brief summary of the configuration options available for the MODBUS Interface Facility.

4.3.2 MODBUS Interface Communication Parameters

Several settings are available to configure a MODBUS node data communication link. Typically communications use 9600 baud, odd parity, 8 data bits and 1 stop bit. The number of data bits is fixed at 8. Other communication parameters are adjustable as follows:

a. Mode

Depending upon the electrical transmission standard being used, select the required mode of operation for the communication link as follows:

i. RS422

Data is transmitted on two separate twisted pair cables. One pair carries data from the master to the slave device(s), the other carries data from the slave device(s) to the master. Up to 10 racks can be connected in multi-drop mode onto the highway.

4. CONFIGURING THE MODBUS FUNCTION

ii. RS485

Data is transmitted on a single twisted pair cable, either from the master to the slave device(s) or from a slave device to the master. Up to 31 racks can be connected in multi-drop mode onto the highway.

iii. RS232

Data is transmitted on separate cables. One carries data from the master to the slave device the other carries data from the slave device to the master. Only one rack can be connected in this mode.

b. Baud Rate

Select the required speed for communication of the data. This speed should be set to correspond to the baud rate of the host system.

Note: The maximum recommended baud rate for RS232 is 9600.

c. Stop Bits

Select the required number of stop bits in each data byte. This should be set to correspond to the number of stop bits set for the host system.

d. Parity Enable

Enable or disable parity checking of the transmitted and received data. This should be set to correspond to the parity checking set on the host system.

e. Parity

When parity checking is enabled odd or event parity checking can be used.

f. Secondary Bus Fitted

This feature, only available when using the half duplex RS485 method of communication, enables operation of a secondary or redundant highway. The host system must be able to support this feature for redundant operation.

4. CONFIGURING THE MODBUS FUNCTION

4.3.3 MODBUS Interface Address

The System 57 MODBUS facility operates as an RTU (Remote Terminal Unit) which provides for communication in the slave mode only. A master device is required to control all communications within the system. For RTU operation, a unique addresses must be specified for each rack connected to the system to ensure unambiguous communication between the multiple nodes.

a. Modbus Primary Address

This specifies the required address between 1 and 247 for the main communication channel of the rack. Each rack connected into the communication system must have a different address setting.

b. Modbus Secondary Address

This feature, only available when using the half duplex RS485 method of communication with the secondary bus enabled, specifies the required address between 1 and 247 for the auxiliary communication channel. Each rack connected into the communication system must have a different address setting, however, it is recommended that the secondary address is the same as the primary address. Setting the address above 247 will disable the secondary highway.

5. COMMISSIONING AND MAINTENANCE INSTRUCTIONS

IMPORTANT

For completely new System 57 installations that have not previously been tested, the commissioning procedure outlined in the Control System User Manual must be performed fully before attempting to commission the MODBUS Interface Facility.

5.1 START UP PROCEDURE

A detailed check of the system wiring should be carried out prior to this start-up procedure.

Start-up the system as follows:

- (1) Ensure that the system power supply is off.
- (2) Reconnect the power supply to the rack and verify that both Engineering Card front panel LED's flash for a short period after which the green POWER ON indicator illuminates continuously.
- (3) After the power on inhibit time period, ensure that the gas detection system is operating normally.
- (4) Switch on the host computer system and initiate the MODBUS master operation.
- (5) Using the alarm test mode of any one of the control cards in the rack, simulate an alarm condition. (Refer to the Engineer's alarm relay test procedure in the Control System User Manual for more details).
- (6) Check that the host computer observes the alarm and takes the appropriate action.
- (7) Repeat steps 5 and 6 to simulate additional alarms encompassing all levels that are being monitored.
- (8) Clear the simulated alarm(s) set up in Step (5).

5.2 MAINTENANCE

The MODBUS Interface Facility should be tested at regular intervals as outlined in the maintenance procedure given in the Control System User Manual.

5. COMMISSIONING AND MAINTENANCE INSTRUCTIONS

5.3 FAULT FINDING

The following table identifies common problems and suggests appropriate actions.

Description of Fault	Suggested Action
General Failure.	<p>Check the correct orientation and location of MODBUS module on the Engineering Card.</p> <p>Check the Enhanced Software EPROM is fitted correctly on the Engineering Card and that link LK1 is set accordingly.</p> <p>Check the MODBUS module configuration using the Engineering Interface Software.</p>
No Communication.	<p>Check the wiring between the DC Input Card terminal block TB2 and the host computer system port.</p> <p>Check the serial communication configuration parameters of the host computer system and the rack are the same.</p> <p>Ensure that the bus is correctly terminated. (See Section 3.4.3). If this is the case remove the bus terminators and retry communication.</p> <p>For RS485 systems add network bias resistors as indicated in Section 3.4.4.</p>
Communication data errors.	<p>Check the data signal wiring is not routed near sources of electrical noise. Check for ground loops etc.</p> <p>Ensure that the bus is correctly terminated. (See Section 3.4.3). If this is the case remove the bus terminators and retry communication.</p> <p>For RS485 systems add network bias resistors as indicated in Section 3.4.4.</p> <p>If possible use an oscilloscope to examine the signals on the highway and take appropriate corrective action.</p>
No response from rack.	<p>Check the address parameter used in requests issued by the host computer system matches the address allocated to the slave node.</p> <p>In multi-drop systems check that all nodes have a unique address.</p>

6. OPERATING INSTRUCTIONS

The most common use for the MODBUS Interface Facility is to connect the gas detection system to a plant control system to provide central monitoring of the system status, often with graphical displays.

Whilst the MODBUS protocol and communications system is well established and fully defined, there are no standard MODBUS function formats defined for the communications of data from a gas system. The host computer system will therefore require programming in order to interpret the signal and status data made available by the System 57 Control System. Full details of the MODBUS function subset supported by the System 57 Control System are given in Section 7.

It is recommended that the host computer system should, at a minimum, be programmed to use Function 02 to collect alarm and status data from all channels of the System 57 Control System. Function 06 or 16 must also be implemented if a facility to reset alarms is required.

Once properly configured and operating correctly, the MODBUS Facility requires no further attention and therefore has no user controls.

7. MODBUS FUNCTION REFERENCE

7.1 INTRODUCTION

This section does not give any detail of the MODBUS protocol. For this information refer to the MODICON MODBUS PROTOCOL REFERENCE GUIDE PI-MBUS-300 (Rev.G).

The System 57 MODBUS Interface supports the following functions:

- Function 02 - Read Input Status.
- Function 03 - Read Holding Registers.
- Function 04 - Read Input Registers.
- Function 06 - Preset Single Holding Register.
- Function 16 - Preset Multiple Holding Registers.

It should be noted that MODBUS 'broadcast' commands are not supported and will be ignored.

The MODBUS register values defined in this manual have the addressing convention used by Modicon DCS, SCADA or PLCs. ie. These correspond exactly to the poll configuration of such SCADA package as th Intellution's Midicon I/O driver for their FIX MMI SCADA package.

Other systems however, may use different addressing conventions. To configure these, an understanding of the Modicon register address to the 16 bit address transmitted in a MODBUS request must be known.

The first digit refers to the data type stored in the register and therefore defines the MODBUS function request that should be used when polling it. This digit is ignored when calculating the register address transmitted in the MODBUS request.

- | | |
|-------|---|
| 1xxxx | Registers address starting with '1' refer to the input status and are read using function 2. |
| 3xxxx | Registers address starting with '3' refer to the analogue inputs and are read using function 4. |
| 4xxxx | Registers address starting with '4' refer to the holding registers and are read using function 3. These registers can be written singly using function 6 or as a group using function 16. |

The xxxx refers to the 16 bit address transmitted in the poll **plus 1**.

7. MODBUS FUNCTION REFERENCE

Examples:

Modicon Address	Transmitted Address	Function	Description
10001	0	2	Slot 1 Subchannel 1 RATE alarm status input.
30022	21	4	Slot 6 Subchannel 2 analogue value.
40003	2	3, 6 or 16	Poll block 1 subchannel register.

7.2 CARD SLOT NUMBER AND SUB-CHANNEL DESIGNATION

Depending upon the rack width, the System 57 racks can accommodate up to 8 or sixteen control cards. For communication purposes each card slot has a unique 'slot' address. The slot addresses are numbered 1,2,3,...,8 or 1,2,3,...,16 from left to right across the rack. The Engineering Card slot always has address 17 irrespective of the rack width.

To support both single and multi-channel control cards, the slot address is used together with a 'sub-channel' number. For 5701 Single Channel Control Cards the sub-channel number must always be set to 1, for 5704/5704F Four Channel Control Cards the sub-channels are numbered from 1 to 4 to correspond with the cards four sensor inputs.

7.3 FUNCTION 02 - READ INPUT STATUS

7.3.1 General

This function reads the channel status bits. There are eleven status bits for each sub-channel. The maximum number of status bits read in one frame is 512. The status bit designations and functions are as follows:

7.3.2 Card Type 1, Card Type 0

These two bits denote the type of control card as follows:

Card Type 1	Card Type 2	Control Card
0	0	5701 Single Channel Control Card
0	1	5704 Four Channel Control Card
1	1	5704F Four Channel Fire Control Card

7. MODBUS FUNCTION REFERENCE

7.3.3 No Data

This bit can be used to determine the presence of an active card or sub-channel. During program initialisation this bit is set and all other status bits are cleared. This bit is cleared only when data is received for the associated slot sub-channel. If no card is fitted in a slot, this bit will always be set for all sub-channels. In a slot in which a 5701 card is fitted, sub-channels 2, 3, and 4 will always have this bit set. A 5704 gas card only transmits data for sub-channels that are enabled, therefore this bit is always set for the 5704 sub-channels that are disabled. A 5704F Fire Card always transmits data for all sub-channels, therefore this bit is cleared for all fire card sub-channels even those that are disabled. Once cleared, this bit cannot be reset except by resetting the Engineering Card software.

7.3.4 Fault

This bit reflects the fault status of each sub-channel. There are three types of fault that affect this bit:

- a. A control card hardware fault. This will set all the fault bits for the active sub-channels on the faulty control card. All other flags for the sub-channel, except the Inhibit flag and the Card Type bits, will be cleared.
- b. A channel sensor fault. This will set the appropriate sub-channel fault bit. Provided the sub-channel is not inhibited, the sub-channel Alarm flags will be cleared.
- c. Removal of a control card. This will set all fault bits for active sub-channels in the slot. All other flags for the sub-channel, except the Inhibit and the Card Type bits, will be cleared.

7.3.5 Inhibit

This bit reflects the inhibit status of each sub-channel. When set the Fault and Alarm sub-channel flags are cleared.

Note: If an inhibited control card is removed, this bit remains set and therefore no fault will be indicated.

7.3.6 A1, A2, A3 (Gas Card Only)

These bits reflect the corresponding A1,A2 and A3 level alarm conditions of each sub-channel.

7.3.7 STEL, LTEL (Gas Card Only)

These bits reflect the corresponding STEL and LTEL time weighted alarm conditions of each sub-channel.

7. MODBUS FUNCTION REFERENCE

7.3.8 Rate (5701 Gas Card Only)

This bit reflects the Rate alarm condition of each sub-channel.

7.3.9 Fire (5704F Only)

This bit reflects the Fire alarm condition of each sub-channel.

7.3.10 Walk Test (5704F Only)

This bit reflects the Walk Test status of each sub-channel.

7.3.11 Earth Fault (5704F Only)

This bit reflects the earth leakage status of the control card. An earth leakage fault will set the earth fault bits for all the sub-channels on the control card.

7.3.12 Remote Fault (5704F Only)

This bit reflects the fault status of the remote input on the control card. A remote input fault will set all the remote fault bits for all the sub-channels on the control card.

7.3.13 Silence (5704F Only)

This bit reflects the silence condition of the control card. A card silence condition will set all the silence bits for all the sub-channels on the control card.

7.3.14 Output Fault (5704F Only)

This bit reflects the fault status of each switched output on the control card. The fault status of output A will appear in the status bits of sub-channel 1. The fault status of output B will appear in the status bits of sub-channel 2. The Output Fault status bits of sub-channels 3 and 4 do not contain valid data and should be ignored.

7.3.15 Register Allocation Table

The status information relating to Gas Control Cards is different to that for Fire Control Cards, however the same set of status registers is used. In the following table, where a register holds alternative information, the Fire Control Card detail is shown in brackets.

The MODBUS Function 02 status registers for System 57 are allocated as follows:

7. MODBUS FUNCTION REFERENCE

Slot	Sub Channel	Card Type 1	Card Type 0	No Data	Fault	Inhibit	A1	A2	A3	STEL	LTEL	RATE
							(Fire)	(Walk) (Test)	(Earth) (Fault)	(Remote) (Fault)	(Silence)	(Output) (Fault)
1	1	10011	10010	10009	10008	10007	10006	10005	10004	10003	10002	10001
1	2	10027	10026	10025	10024	10023	10022	10021	10020	10019	10018	10017
1	3	10043	10042	10041	10040	10039	10038	10037	10036	10035	10034	10033
1	4	10059	10058	10057	10056	10055	10054	10053	10052	10051	10050	10049
2	1	10075	10074	10073	10072	10071	10070	10069	10068	10067	10066	10065
2	2	10091	10090	10089	10088	10087	10086	10085	10084	10083	10082	10081
2	3	10107	10106	10105	10104	10103	10102	10101	10100	10099	10098	10097
2	4	10123	10122	10121	10120	10119	10118	10117	10116	10115	10114	10113
3	1	10139	10138	10137	10136	10135	10134	10133	10132	10131	10130	10129
3	2	10155	10154	10153	10152	10151	10150	10149	10148	10147	10146	10145
3	3	10171	10170	10169	10168	10167	10166	10165	10164	10163	10162	10161
3	4	10187	10186	10185	10184	10183	10182	10181	10180	10179	10178	10177
4	1	10203	10202	10201	10200	10199	10198	10197	10196	10195	10194	10193
4	2	10219	10218	10217	10216	10215	10214	10213	10212	10211	10210	10209
4	3	10235	10234	10233	10232	10231	10230	10229	10228	10227	10226	10225
4	4	10251	10250	10249	10248	10247	10246	10245	10244	10243	10242	10241
5	1	10267	10266	10265	10264	10263	10262	10261	10260	10259	10258	10257
5	2	10283	10282	10281	10280	10279	10278	10277	10276	10275	10274	10273
5	3	10299	10298	10297	10296	10295	10294	10293	10292	10291	10290	10289
5	4	10315	10314	10313	10312	10311	10310	10309	10308	10307	10306	10305
6	1	10331	10330	10329	10328	10327	10326	10325	10324	10323	10322	10321
6	2	10347	10346	10345	10344	10343	10342	10341	10340	10339	10338	10337
6	3	10362	10361	10361	10360	10359	10358	10357	10356	10355	10354	10353
6	4	10379	10378	10377	10376	10375	10374	10373	10372	10371	10370	10369
7	1	10395	10394	10393	10392	10391	10390	10389	10388	10387	10386	10385
7	2	10411	10410	10409	10408	10407	10406	10405	10404	10403	10402	10401
7	3	10427	10426	10425	10424	10423	10422	10421	10420	10419	10418	10417
7	4	10443	10442	10441	10440	10439	10438	10437	10436	10435	10434	10433
8	1	10459	10458	10457	10456	10455	10454	10453	10452	10451	10450	10449
8	2	10475	10474	10473	10472	10471	10470	10469	10468	10467	10466	10465
8	3	10491	10490	10489	10488	10487	10486	10485	10484	10483	10482	10481
8	4	10507	10506	10505	10504	10503	10502	10501	10500	10499	10498	10497
9	1	10523	10522	10521	10520	10519	10518	10517	10516	10515	10514	10513
9	2	10539	10538	10537	10536	10535	10534	10533	10532	10531	10530	10529
9	3	10555	10554	10553	10552	10551	10550	10549	10548	10547	10546	10545
9	4	10571	10570	10569	10568	10567	10566	10565	10564	10563	10562	10561
10	1	10587	10586	10585	10584	10583	10582	10581	10580	10579	10578	10577
10	2	10603	10602	10601	10600	10599	10598	10597	10596	10595	10594	10593
10	3	10619	10618	10617	10616	10615	10614	10613	10612	10611	10610	10609
10	4	10635	10634	10633	10632	10631	10630	10629	10628	10627	10626	10625
11	1	10651	10650	10649	10648	10647	10646	10645	10644	10643	10642	10641
11	2	10667	10666	10665	10664	10663	10662	10661	10660	10659	10658	10657
11	3	10683	10682	10681	10680	10679	10678	10677	10676	10675	10674	10673
11	4	10699	10698	10697	10696	10695	10694	10693	10692	10691	10690	10689
12	1	10715	10714	10713	10712	10711	10710	10709	10708	10707	10706	10705
12	2	10731	10730	10729	10728	10727	10726	10725	10724	10723	10722	10721
12	3	10747	10746	10745	10744	10743	10742	10741	10740	10739	10738	10737
12	4	10763	10762	10761	10760	10759	10758	10757	10756	10755	10754	10753
13	1	10779	10778	10777	10776	10775	10774	10773	10772	10771	10770	10769
13	2	10795	10794	10793	10792	10791	10790	10789	10788	10787	10786	10785
13	3	10811	10810	10809	10808	10807	10806	10805	10804	10803	10802	10801
13	4	10827	10826	10825	10824	10823	10822	10821	10820	10819	10818	10817
14	1	10842	10841	10841	10840	10839	10838	10837	10836	10835	10834	10833
14	2	10859	10858	10857	10856	10855	10854	10853	10852	10851	10850	10849
14	3	10875	10874	10873	10872	10871	10870	10869	10868	10867	10866	10865
14	4	10891	10890	10889	10888	10887	10886	10885	10884	10883	10882	10881
15	1	10907	10906	10905	10904	10903	10902	10901	10900	10899	10898	10897
15	2	10923	10922	10921	10920	10919	10918	10917	10916	10915	10914	10913
15	3	10939	10938	10937	10936	10935	10934	10933	10932	10931	10930	10929
15	4	10955	10954	10953	10952	10951	10950	10949	10948	10947	10946	10945
16	1	10971	10970	10969	10968	10967	10966	10965	10964	10963	10962	10961
16	2	10987	10986	10985	10984	10983	10982	10981	10980	10979	10978	10977
16	3	11003	11002	11001	11000	10999	10998	10997	10996	10995	10994	10993
16	4	11019	11018	11017	11016	11015	11014	11013	11012	11011	11010	11009

There are five spare status registers for each sub-channel (eg. 10012 to 10016 are spare on slot 1, sub-channel 1). At present these always return 0 when read, but are reserved for future use.

7. MODBUS FUNCTION REFERENCE

7.3.16 Engineering Card Status Registers

The Engineering Card processes the status information from all active cards and sub-channels in the rack and provides registers to reflect the master alarm status for the whole rack as follows:

Global Status Registers							
Master Fault	Master Inhibit	Master A1	Master A2	Master A3	Master STEL	Master LTEL	Master RATE
11032	11031	11030	11029	11028	11027	11026	11025

Global Status Registers							
					Master Fire	Master Silence	Master O/P Fault
					11043	11042	11041

The Engineering Card status is also accessible by reading the following registers:

Engineering card status registers							
Unlock LED On	Attention Required	RTC Fail	Power Fail	EEPROM Fail	Timer Fail	ROM Fail	RAM Fail
11040	11039	11038	11037	11036	11035	11034	11033

7.4 FUNCTION 04 - READ INPUT REGISTERS

7.4.1 General

There are two types of input register for each channel, namely analogue signal value and animation value. Analogue signal values are not supported for Fire Control Cards. The input registers are returned as 16 bit data words. The maximum number of registers that can be read in one frame is 64. The input register designations and functions are shown in the following sections.

7.4.2 Analogue Register

The measured sensor signal value of each sub-channel is allocated to registers 30001 to 30065. These are formatted as 16 bit signed integers with a range of values from -10000 to +10000 in units of 1/10% fsd. (eg. 02F3_H equals 75.5% fsd and FFAB_H equals -8.5% fsd). These values are undefined for Fire Control Cards.

7. MODBUS FUNCTION REFERENCE

The analogue registers for each sub-channel are allocated as follows:

Slot No	Sub-Channel 1 Analogue Register	Sub-Channel 2 Analogue Register	Sub-Channel 3 Analogue Register	Sub-Channel 4 Analogue Register
1	30001	30002	30003	30004
2	30005	30006	30007	30008
3	30009	30010	30011	30012
4	30013	30014	30015	30016
5	30017	30018	30019	30020
6	30021	30022	30023	30024
7	30025	30026	30027	30028
8	30029	30030	30031	30032
9	30033	30034	30035	30036
10	30037	30038	30039	30040
11	30041	30042	30043	30044
12	30045	30046	30047	30048
13	30049	30050	30051	30052
14	30053	30054	30055	30056
15	30057	30058	30059	30060
16	30061	30062	30063	30064

7.4.3 Animation Registers

A group of animation values are allocated for registers 30065 to 30128. These are intended to be used by graphics packages for defining the colours of various screen objects based upon the status of a sub-channel. A 16 bit unsigned word format is used which is defined so that the highest priority event has the highest value. The same set of animation registers is used for Gas Control Cards and Fire Control Cards, however the values convey different information. The data value for each register can be one of the following:

Value	Condition	
	Gas	Fire
0	Sub-channel operating normally.	Sub-channel Operating normally.
1	RATE alarm active.	Remote fault active.
2	LTEL alarm active.	Earth fault active.
3	STEL alarm active.	Fire alarm active.
4	A1 alarm active.	Fault active (input fault or card fault).
5	A2 alarm active.	Output fault active.
6	A3 alarm active.	Card silence condition.
7	Fault active.	Walk test condition.
8	Inhibit active.	Inhibit active.

7. MODBUS FUNCTION REFERENCE

Value	Condition		
9	Gas		Fire
	Normalising	This status information is only available indirectly. However it can be assumed that if a normalising command is received from the host computer, the sub-channel is then in the normalising state. This also applies to the calibration command. <i>Note: This status data is lost if the Engineering card software is reset.</i>	
10	Calibrating		
11 or higher	No data available for this sub-channel		

The animation registers for each sub-channel are allocated as follows:

Slot No	Sub-channel 1 Animation Register	Sub-channel 2 Animation Register	Sub-channel 3 Animation Register	Sub-channel 4 Animation Register
1	30065	30066	30067	30068
2	30069	30070	30071	30072
3	30073	30074	30075	30076
4	30077	30078	30079	30080
5	30081	30082	30083	30084
6	30085	30086	30087	30088
7	30089	30090	30091	30092
8	30093	30094	30095	30096
9	30097	30098	30099	30100
10	30101	30102	30103	30104
11	30105	30106	30107	30108
12	30109	30110	30111	30112
13	30113	30114	30115	30116
14	30117	30118	30119	30120
15	30121	30122	30123	30124
16	30125	30126	30127	30128

7.5 FUNCTIONS 06 AND 16 - PRESET SINGLE / MULTIPLE HOLDING REGISTERS RESPECTIVELY

7.5.1 General

These functions enable the host to change the contents of the holding registers starting at address 40001. Depending on the contents of these registers, commands to inhibit, calibrate, normalise or query sensors can be carried out. Two types of holding register block are available, one for polling a control card and the other for sending commands to a control card. All registers use 16 bit data words. The maximum number of registers that can be set by function 16 is 35.

Note: Broadcast function 06 and 16 requests are not supported and will be ignored.

7. MODBUS FUNCTION REFERENCE

7.5.2 Query Poll Blocks

A query poll enables the host to obtain operational parameters and data, eg. sensor current, signal levels, alarm levels etc.. There are 10 independent query blocks available to the host. The Engineering Card scans through each in turn and for those with the block active flag set, instructs the specified sub-channel for the information requested. Any response is stored in the appropriate result string location.

The poll block registers start at 40001 as shown in the following table where 'n' ranges from 0 to 9 to indicate the poll block number.

Block Active	Slot Address	Sub-channel Address	Query Type	Result	Result String
40n01	40n02	40n03	40n04	40n05	40n07 to 40n35

The register functions are defined below:

a. Block Active

Indicates the Engineering card should use the parameters loaded in the block to poll the control card given by the Slot and Sub-channel address fields. Once set, the block cannot be changed until this flag is cleared by the Engineering Card when it has completed the request. A 'SLAVE_DEVICE_BUSY' exception may be returned (see Section 7.7) if an attempt is made to change an active poll block.

b. Query Type

The query poll function value. See Section 7.8 for a list of System 57 query poll types.

c. Result

When a query is completed, the block active register is cleared and this byte is set as follows to indicate success or failure as follows:

- i. A zero value indicates success.
- ii. A value of one indicates the command is not permitted via the MODBUS interface.
- iii. Other non zero values indicate failure and correspond to the error codes as defined in the System 57 Control Card User Manual for the type of card in the specified slot.

d. Result-string

These locations hold any data returned in response to the query. The data format of the result string depends upon the query type. Refer to Section 7.8 for more details.

7. MODBUS FUNCTION REFERENCE

7.5.3 Command Poll Blocks

A command poll enables the host to control the operation of a channel, eg. inhibit, reset, calibrate etc.. There are 10 independent command blocks available to the host. The Engineering Card scans through each in turn and for those with the block active flag set instructs the specified sub-channel to perform the function requested.

The command block registers start at address 41n01 as shown in the following table where 'n' ranges from 0 to 9 to indicate the poll block number.

Block Active	Slot Address	Sub-channel Address	Command Type	Command Data	Result	Backplane Protocol Command Data
41n01	41n02	41n03	41n04	41n05	41n06	41n07 to 41n35

The register functions are defined below:

a. Block Active

Indicates the Engineering card should use the parameters loaded in the block to poll the control card given by the Slot and Sub-channel address fields. A slot address of 32 generates a global command to all cards and sub-channels in the rack. As for query poll blocks, an active command block cannot be changed until the Engineering Card has dealt with the request.

b. Command Type

The command poll function value, see Section 7.9 for a list of System 57 command poll types.

c. Command Data

Data applicable to the request, eg. for calibration commands this value represents the span gas concentration.

d. Result

When a command is completed, the block active register is cleared and this byte set to indicate success or failure as follows:

- i. A zero value indicates success.
- ii. A value of one indicates the command is not permitted via the MODBUS interface.
- iii. Other non zero values indicate failure and correspond to the error codes as defined in the System 57 Control Card User Manual for the type of card in the specified slot.

7. MODBUS FUNCTION REFERENCE

e. Backplane Protocol Command Data

If a BACKPLANE_PROTOCOL request is loaded as a command type, the data in these registers is used to format the command relayed to the control card.

CAUTION

This request is reserved for Zellweger Analytics use only, incorrect use may cause erroneous system operation.

Length	Spare	Request	Data bytes
41n07	41n08	41n09	41n10 to 41n35

Where: Length - Indicates the number of data bytes. The valid range is 0 to 21.

Request - Request identifier as defined in the Backplane Communications Protocol.

Data - Request data as defined in the Backplane Communications Protocol.

The backplane communications protocol uses a byte format. Therefore, only the lower byte of the above registers shall be used when relaying the request to the backplane. If the upper byte is non-zero, an invalid request error shall result.

7.6 FUNCTION 03 - READ HOLDING REGISTERS

This function enables the host to read back the contents of the holding registers. The maximum number of registers that can be read in one frame is 35. The holding register values are defined in Section 7.5.

7.7 EXCEPTION RESPONSES

The MODBUS exception response is detailed in the Modicon MODBUS manual. Any one of the following exception responses may be returned by the system 57 MODBUS interface:

7. MODBUS FUNCTION REFERENCE

Exception	Description
01 ILLEGAL FUNCTION	Only MODBUS functions 02, 03, 04, 06 and 16 are supported. This response is returned if any other requests are received.
02 ILLEGAL DATA ADDRESS	The range of register addresses supported by each function are listed in the tables given above. Any attempt to access a register outside of these ranges shall result in this error.
03 ILLEGAL DATA VALUE	This exception is returned if the request has the incorrect length. Also the maximum number of registers that can be requested by function 02 is 512, function 04 is 64, and functions 03 and 16 are 35. If these values are exceeded, this exception response is returned.
06 SLAVE DEVICE BUSY	<p>Applies to functions 06 and 16 only. Once a poll or command block's active register has been set, it's contents must not be changed until the main program has carried out the request. This exception is returned if any attempt is made to change an active poll or command block.</p> <p><i>Note: A function 06 or 16 that leaves the block unchanged will not generate this error.</i></p>

7.8 QUERY POLL DEFINITIONS

The Engineering Card scans through the query poll blocks and carries out the following procedure when an active block is found:

- a. If the Slot number is between 1 and 16 the request is addressed to a control card and the request type is validated in the same way as for the Engineering Card. The slot number, sub-channel and request type registers are then used to format an internal communications request that is then sent to the applicable control card. If successful the response data from the control card is formatted according to the request type and loaded into the result-string registers. The result register is then set to zero. If an error response is obtained, the failure value is loaded into the result register. Finally the block active register is cleared.
- b. If the Slot number is 17 the request is addressed to the Engineering Card and the request type is then validated. Valid requests for the Engineering Card are listed below. When completed the result string registers are loaded with the applicable data and the result

7. MODBUS FUNCTION REFERENCE

register loaded with zero to indicate success. Otherwise an invalid request value (67) is loaded into the result register. Finally the block active register is cleared.

- c. If the slot number is greater than 17, an error value is loaded into the result register and the block active cleared.

The following table lists the query polls available, whether they are applicable to the Engineering Card and/or the Fire and Gas Control Cards, and the format of the response:

Poll No	Description	Applicable to:			Response Format
		Eng Card	Gas Control Card	Fire Control Card	
0	Read card type	Yes	Yes	Yes	A
1	Read serial number	Yes	Yes	Yes	B
2	Read user field 1 (tag name on control cards)	No	Yes	Yes	B
3	Read user field 2	No	Yes	Yes	B
4	Read range text	No	Yes	No	B
5	Read range unit text	No	Yes	No	B
6	Read range full scale	No	Yes	No	B
7	Read range zero scale	No	Yes	No	B
8	Read present signal (in % fsd)	No	Yes	No	B
9	Read sensor signal (scaled)	No	Yes	No	B
10	Read measured signal (mV for bridge or mA for current loop)	No	Yes	No	B
11	Read bridge current (error response given if polling a 4 - 20mA loop sensor)	No	Yes	No	B
12	Read card status	No	Yes	Yes	C
15	Read channel status (applicable to 5704 only)	No	Yes	Yes	C
21	Read EEPROM data. (reserved for Zellweger Analytics use only) The sub-channel number register should be loaded with the EEPROM page number for this request. One page comprises of 16 bytes of data.	Yes	Yes	Yes	D
26	Read lowest signal (in % fsd)	No	Yes	No	B
27	Read highest signal (in % fsd)	No	Yes	No	B
50	Read fire counter	No	No	Yes	E
51	Read date and time at last fire	No	No	Yes	F
110	Read A1 threshold	No	Yes	No	E
111	Read A2 threshold	No	Yes	No	E
112	Read A3 threshold	No	Yes	No	E

If the result register is loaded with a non-zero value the contents of the result-string registers should be ignored.

7. MODBUS FUNCTION REFERENCE

Response Format A

The result of a successful card type request is loaded into the result-string register at address 40n07. The following values are defined, all others should be ignored.

- 1 - 5701 Single Channel Control Card.
- 2 - 5704 Four Channel Catalytic Control Card.
- 3 - 5704 Four Channel 4-20mA Control Card.
- 4 - 5704F Four Channel Fire Control Card
- 128 - Engineering Card (Mark II fitted with enhanced software).

Response Format B

The data loaded into the response-string will be an ASCII text null (00_H) terminated character string. Two characters are packed into each response-string register in byte reversed order. The following example shows how the text '10.00 mV' would be packed into the result-string registers.

40n07	40n08	40n09	40n10	40n11	40n12	40n35
Hi Lo	Hi Lo	Hi Lo	Hi Lo	Hi Lo	HiLo	Hi Lo
'0' '1'	'0' '.'	'.' '0'	'V' 'm'	nul ??	????	?? ??

Response Format C

Status requests return a card or channel current alarm/fault state as a set of bits in the result-string register at address 40n07. The result data format differs for Gas and Fire Cards as shown in the following tables.

- Notes:*
1. *The read card status request (12) when used with a 5704 Four Channel Control Card returns the master alarm state for all active channels on the specified card. The read channel status request (15) should be used with 5704 Four Channel Control Card to determine individual sub-channel alarm states.*
 2. *For Fire Cards the output fault and output active bits returned by the read channel status request (15) contain information about the switched outputs. This information is only valid for sub-channels 1 and 2 and refers to switched outputs A and B respectively. For sub-channels 3 and 4 the information contained in these bits should be disregarded.*

7. MODBUS FUNCTION REFERENCE

Gas Card Response Format		
Bit No	Read Card Status	Read Channel Status
0	Master RATE	Channel RATE Alarm
1	Master STEL	Channel STEL Alarm
2	Master LTEL	Channel LTEL Alarm
3	Master A3	Channel A3 Alarm
4	Master A2	Channel A2 Alarm
5	Master A1	Channel A1 Alarm
6	Master Inhibit	Channel Inhibit
7	Master Fault	Channel Fault
8 - 15	Always Clear	Always Clear
Fire Card Response Format		
Bit No	Read Card Status	Read Channel Status
0	Master Walk Test	Walk Test Status
1	Master Silence	Not Used
2	Remote Input Fault	Output Fault
3	Earth Leakage Fault	Output Active
4	Hardware Fault	Channel Walk Test
5	Master Fire	Channel Fire
6	Master Inhibit	Channel Inhibit
7	Master Input/Output Fault	Channel Input Fault
8 - 15	Always Clear	Always Clear

Response Format D

16 bytes of EEPROM data are returned by this request. These are loaded into the lower byte of the result-string registers from address 40n07 to 40n23. The upper bytes of these registers are cleared.

Response Format E

For the Gas Card the alarm threshold data is returned by the request at address 40n07. The value is stored as a 16 bit signed integer in units of 1/10% fsd (eg. 02F3_H equals 1/10% fsd and FFAB_H equals -8.5% fsd).

For the Fire Card the sub-channel fire counter value is returned by the request at address 40n07. The value is stored as a 16 bit unsigned integer.

7. MODBUS FUNCTION REFERENCE

Response Format F

Five bytes of time data are returned by this request. these are loaded into the lower byte of the result-string from address 49n07 to 40n11 as follows:

40n07 - Year
40n08 - Month
40n09 - Day
40n10 - Hour
40n11 - Minute

The upper bytes of these registers are cleared.

7.9 COMMAND POLL DEFINITIONS

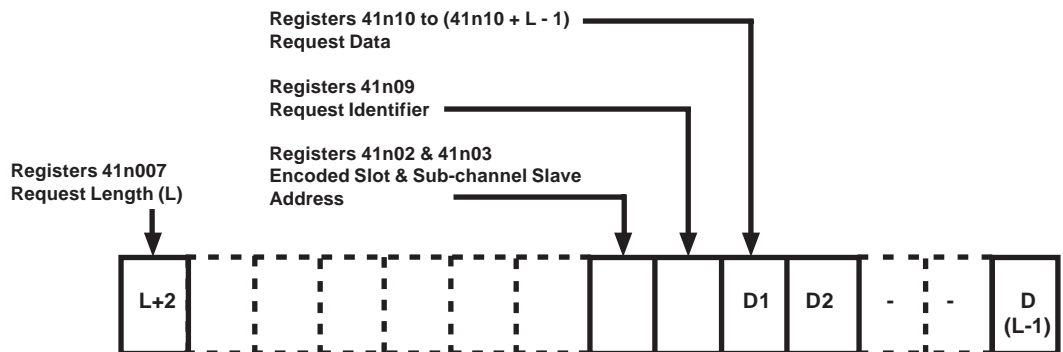
Command poll blocks are treated similarly to query poll blocks. The following table lists the command polls available, whether they are applicable to the Engineering Card and/or the Fire and Gas control cards, and if the command can be used globally. Global commands are issued by setting the command poll block slot address register to 32.

Command Type	Description	Command Data	Applicable to:			Global Command Possible
			Eng Card	Gas Control Card	Fire Control Card	
13	Inhibit / Enable Card The sub-channel register should be set to one because this command is addressed to a card and not an individual channel.	Zero - Enables card Non-zero - Inhibits card	No	Yes	Yes	Yes
14	Reset Card Alarms The sub-channel register should be set to one.	Ignored	No	Yes	Yes	Yes
16	Inhibit / Enable Channel Applies only to multi-channel cards.	Zero - Enables channel Non-zero - Inhibits channel	No	Yes	Yes	No
17	Reset Channel Alarms Applies only to multi-channel cards.	Ignored	No	Yes	No	No
18	Normalise Command For 5701, the sub-channel register must always be set to one.	Ignored	No	Yes	No	No
19	Calibrate Command For 5701, the sub-channel register must always be set to one.	Reference gas level in 1/10% fsd.	No	Yes	No	No
20	New Sensor Calibration For 5701, the sub-channel register must always be set to one.	Reference gas level in 1/10% fsd.	No	Yes	No	No

7. MODBUS FUNCTION REFERENCE

Command Type	Description	Command Data	Applicable to:			Global Command Possible
			Eng Card	Gas Control Card	Fire Control Card	
22	Write EEPROM Reserved for Zellweger Analytics use only. Only applies to the Engineering Card. 16 bytes of EEPROM data should be loaded into the lower byte of the command block registers at address 41n07 to 41n23. The upper bytes must be zero or an error response will result.	Page address	Yes	No	No	No
24	Soft Re-boot Card The sub-channel register should be set to one.	Ignored	Yes	Yes	Yes	No
40	Accept Card Alarms The sub-channel register should be set to one.	Ignored	No	No	Yes	Yes
41	Silence Card Alarms The sub-channel register should be set to one.	Ignored	No	No	Yes	Yes
113	Set A1 Threshold	Alarm threshold as a signed word in 1/10% fsd.	No	Yes	No	No
114	Set A2 Threshold					
115	Set A3 Threshold					
125	Set Real Time Clock Five bytes of time data are required. These parameters should be loaded into the command block register lower bytes (with the high byte clear) as follows: 41n07 - Year 41n08 - Month 41n09 - Date 41n10 - Hour 41n11 - Minute. If an attempt is made to load the RTC with an invalid time and/or date a real time clock hardware fault will occur. To clear this, the Engineering Card software should be reset or a valid time and date set.	Ignored	Yes	No	No	No
124	Backplane Protocol Command Reserved for Zellweger Analytics use only. Not applicable to Engineering Cards. This command should not be used without a full knowledge of the System 57 Backplane Communications Protocol.	Ignored	No	Yes	Yes	No

The contents of the holding registers are formatted into a backplane request frame as follows:



8. SPECIFICATION

8.1 ENVIRONMENTAL

Operating Temperature:	-5°C to +55°C.
Storage Temperature:	-25°C to +55°C.
Humidity:	0 to 90% RH (Non-condensing).

8.2 EMC/RFI CONFORMITY

EN50081 Part 1 and Part 2	EMC/RFI (Generic Emission).
EN50082 Part 1 and Part 2	EMC/RFI (Generic Immunity).

8.3 SERIAL COMMUNICATION

Format:	Asynchronous Serial Data.
Data Bits:	8.
Speed:	19200, 9600, 4800, 2400 baud.
Stop Bits:	1 or 2.
Parity:	Odd, Even or None.
Mode:	Half Duplex.

8.4 MODBUS PROTOCOL

Mode:	RTU.
MODBUS Functions:	02, 03, 04, 06 and 16.

8.5 RS485/422 INTERFACE MODULE

Power Supply:	Powered from Engineering Card.
Power Consumption:	1.5W (maximum).
Weight:	30g.
Field Terminals:	2.5mm ² (14 AWG) located on DC Input Card.
Cable Type:	Screened twisted pair with separate drain wire recommended.

8. SPECIFICATION

Inputs/Outputs:	Two RS485 transceivers - Channel 1, Channel 2.
Operating Modes:	Single RS485 Highway. Dual RS485 Highway (Primary and Secondary). RS422 Highway.
Multi-drop Capability:	31 nodes maximum (RS485). or 10 nodes maximum (RS422).
Transceiver Specification:	
Maximum Cable Length:	1200m (3900ft).
Maximum Data Rate:	19.2k baud.
Common Mode Voltage:	-7V minimum to +12V maximum.
Input Sensitivity:	±200mV.
Input Hysteresis:	20mV typical.
Output Drive:	1.5V minimum, fully loaded.
Output Load:	54 ohms minimum.
Protection:	Thermal shutdown.
Isolation:	50V relative to system 0V.

8.6 RS232 MODULE

Power Supply:	Powered from Engineering Card.
Power Consumption:	0.75W (maximum).
Weight:	30g.
Field Terminals:	2.5mm ² (14 AWG) located on DC Input Card.
Cable Type:	Screened multi-core wire recommended.
Inputs/Outputs:	Two data (RXD, TXD) and two handshake (DTR, DSR).

8. SPECIFICATION

Input/Output Specification:

Maximum cable length:	15m (49ft).
Maximum Data Rate:	9600 bits per second.
Output Voltage:	±5V minimum.
Positive Going Input Threshold:	3.0V maximum.
Negative Going Input Threshold:	0.6V minimum.
Input Hysteresis:	500mV typical.
Common mode voltage:	-15V minimum to +15V maximum.
Protection:	Thermal shutdown.
Isolation:	50V relative to system 0V.

Find out more

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