Serial Communication Protocol

Honeywell

Touchpoint 4

CONTENTS

Introduction

Overview

This manual describes the setup and operation of the Touchpoint 4 Serial Communication protocol.

Your Touchpoint 4 gas detector controller is equipped with a serial remote device communication port. With this communication port, you can monitor the Touchpoint 4 system's operation with master from a remote location. It will also allow you to gather gas concentration data for analysis or reports.

The Touchpoint 4 gas detector controller accepts commands and issues responses to any valid command it receives. The Touchpoint 4 gas detector controller is always the "slave" device, and the remote equipment is the "master" device. The master can be a personal computer (PC), a programmable logic controller (PLC), or other device capable of RS-485 serial communications. This configuration requires a "master" device.

Therefore, one Touchpoint 4 gas detector controller will not communicate directly with another Touchpoint 4 gas detector controller. However, one master can be used to communicate with more than one Touchpoint4 gas detector controllers on a two-wire RS-485 bus.

The Touchpoint 4 gas detector controller supports multiple baud rates. These user selectable rates are 1200, 2400, 4800, 9600, and 19,200. Additional port settings are 8-bit, 1 stop bit, and no parity.

The slave is identified by an address configured into the Touchpoint 4 gas detector controller (selectable 1-16). Each Touchpoint4 gas detector controller on an RS-485 network must have a unique address.

The master is always at address 0. Each Touchpoint 4 gas detector controller will respond to a signal directed to it from the master. To prevent a collision of messages, the master must avoid transmitting any information after a packet until the slave responds. Touchpoint 4 will respond in 500ms.

Glossary

The following terms are used in this manual:

Handshake: The process of acknowledging a communication has been received. The Touchpoint4 gas detector controller uses ACK/NAK responses.

Hexadecimal: A type of numbering system with a base of 16. In this numerical system, the letters A through F represents numbers 10 through 15 respectively. For example, 3F in hexadecimal represents 63 in decimal. The shortened version of the word hexadecimal is generally "Hex", as in "Hex 3F." "0x" is the notation used in this manual for hexadecimal (e.g. 0x3F).

Instrument: This term is used to refer to the Touchpoint4 gas detector controller.

Master: A computer or PLC that communicates with slaves using the Touchpoint4 protocol.

Packet: A block of information that is passed between the master and the slave. A packet is made from many bytes of information.

Protocol: The manner in which data is transferred and the format used for the transfer. Touchpoint4 protocol refers to the packets of transferred data the Touchpoint4 instrument recognizes.

Slave: Touchpoint4 gas detector controller. A network may have several slaves.

Time-Out: The maximum amount of time allowed between the time the last byte of a packet is sent from the “master” device to the time the “slave” device responds. The time-out period of 1 second is recommended for this protocol. In fact, the period from request transmission to response reception is not more than 500ms.

Communication Port

Access to the Touchpoint4 protocol is through the terminal block on the common module of Touchpoint4 gas detector controller. This port is designed for bidirectional communications between the Touchpoint4 instrument and your master.

Signals present at the port conform to RS-485 specifications. The pin-out specifications are described in the chapter **connectors pin-out**.

Address Setting Procedure

After the networking cabling has been connected to the slave, the slave must be configured to communicate. Baud rate and address are selectable. Configuration is performed with the following sequence:

1. Access the menu system and select the *RS485 communication link* settings menu option. Press UP/DOWN, the icon flashes.
2. Press OK, the controller's current address is displayed.
3. Use UP/DOWN to change the address (between 1 and 16 available).
4. Press OK to accept the change.
   The display changes to display the current baud rate.
5. Use UP/DOWN to change the baud rate (1200, 2400, 4800, 9600, 19200 available).
6. Press OK to accept the change.

Please refer to the Technical Manual for more details.

Protocol Specifics

The protocol has been designed for flexibility and efficiency. This byte-wise protocol communicates information by transferring bytes of data back and forth between master and slave. A group of bytes for each communication is called a packet.

The master and slave(s) transfer information via data packets. These packets will always contain bytes to start communication, an address, a length, a command, one or more data and a checksum.

Additional optional variable-length data bytes or optional parameters can also be sent or received. This section is a brief overview of the protocol specifics.

Packet Length
Just as all words are not the same length (number of letters), packets may also vary in length. In this protocol, the length of command and data field is put before command field in the packet. Your data containing "0x42, 0x41, 0x44" will then become “0x03, 0x42, 0x41, 0x44”.

Checksum
During transmission of the packet, an error could change the value of the data. Suppose in our example, for instance, the packet 0x03, 0x42, 0x41, 0x44 is actually 0x03, 0x42, 0x30, 0x44. How can you determine that the numbers you get are the same as the numbers sent?

Touchpoint4 serial communication protocol uses a XOR check-character as a method of assigning a value to the packet to check if any of bytes have been modified.

If all the data bytes are XOR-ed together and this check made into a byte, this byte could be called a checksum character. For the Touchpoint4, the checksum is the bit-wise XOR result of all the bytes in the packet. In our example, the packet is 0x03, 0x42, 0x41, 0x44. For this packet, the XOR result 0x44 of all the bytes added to the checksum must be zero (0). Any other result indicates there is an error with the data.

It is usually important for the master to thoroughly check data coming from the slave for validity before accepting it. This is because in many installations, an alarm from the Touchpoint4 indicates severe danger to life and property. The master's determination that an alarm exists may stimulate a vigorous and possibly expensive human response. Therefore it is important to avoid false alarms. The master should reject any packets that contain an invalid start character, an invalid address, an invalid length byte or an invalid checksum. Otherwise the probability of an evacuation because of simple network noise is unnecessarily large.

The actual data in the packet is interpreted in a somewhat different manner from our previous examples. Both the master and the slave communicate using the packet format in **Figure 2**. It contains a start code, an address, a length, a command and its associated data, and a checksum. The start code is fixed. The address is the slave address regardless of the packet's origin. The length indicates the number of bytes of command and data field. The command indicates what type of information is being transmitted in the packet. The Data field is null in some cases. If exist, it contains specific arguments or values to be interpreted. The checksum is XOR result of all previous bytes.

ACK/NAK Handshake
Each slave (Touchpoint4) uses a handshake scheme between itself and the master. The simplest response back from the instrument is called an ACK (an abbreviation for ACKnowledge). When the slave receives the handshake command (0X40) packet from the master, it will send back an ACK response. The ACK response will be 0x01 followed by the handshake command 0x40 **(see Handshake command)**.

If however, the checksum does not match, the slave will send a NAK (an abbreviation for Negative AcKnowledge). A NAK indicates that a data packet has been received, but the checksum did not match with the packet data.

The master may send the request again. An example of an ACK packet is 0x7F, 0x01, 0x02, 0x40, 0x01, 0x3D (7F XOR 01 XOR 02 XOR 40 XOR 01 = 0x3D).

Time diagram

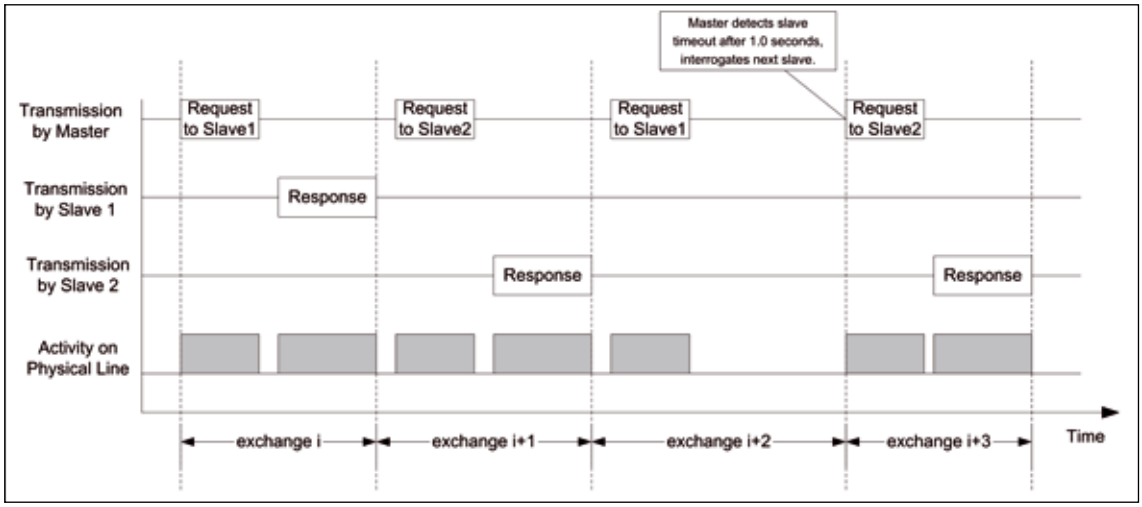

Figure 1. Communication time diagram

Protocol Packet Definition

Packet Format

The format of packets using Touchpoint4 SERIAL COMMUNICATION PROTOCOL is as follows:

Start Code	Slave Address	Length	Command	Data	Checksum

Figure 2. Protocol packet format

Start Code Size: 1 byte. Always 0x7F.

Slave Address Size: 1 byte.
Represents the Touchpoint4 gas detector controller address, 0X01 to 0X10 (1 to 16 decimal).

Length Size: 1 byte.
The number of bytes in the Command field and Data field.
The total packet length is 4 bytes larger than this.

Command Size: 1 byte.
This is 0x30, 0x40 or 0x41 as defined in the remainder of this book.

Data Size: 0-250 byte(s).
This section varies according to the chosen command and may be omitted.

Checksum Size: 1 byte
The bit-wise XOR result of all the previous bytes in the packet.
This makes the XOR of the entire packet 0X00.

Generic Data Formats

Date Format 2 bytes.

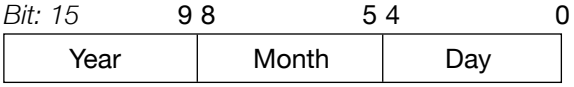

Figure 3. Data format

Year: (7 bits)
Month: (4 bits)
Day: (5 bits)

Year is based from 1980. 1989 would be 1989 - 1980 = 9.

Time Format 2 bytes

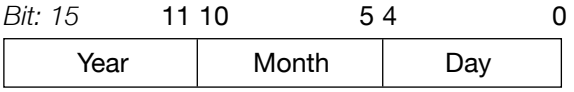

Figure 4. Time format

Hours: (5 bits)
Minutes: (6 bits)
Seconds: (5 bits)

Seconds always be 0.

Date/Time Examples:

Date: 1F 56 Oct. 22. 1995
Date: 1F 75 Nov. 21, 1995
Time: 13 C0 02:30:00
Time: 74 00 14:32:00
Time: 47 00 08:56:00

Concentration Code:

2 bytes

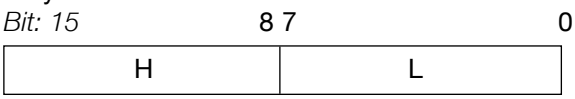

Figure 5. Concentration code format

For example, (HEX) 013D represents the value is 317.

Concentration Data Format Code

UUXXXYYY		
UU	Unit	
	UU=00	ppm
	UU=01	%LEL
	UU=10	%V/V
	UU=11	kppm
XXX	reserved	
YYY	decimal place	
	YYY=000	no decimal places
	YYY=001	1 decimal place
	YYY=010	2 decimal places
	YYY=011	3 decimal places

For example, (HEX) 81 (1000 0001) represents %V/V with 1 decimal place.

Concentration Example:

For a concentration value (HEX) 0062, 98 decimal, Format Code Interpretation:

0000 0000 (00)	98 ppm
1000 0001 (81)	9.8 %V/V
0100 0000 (40)	98 %LEL

Generic Responses

There are four generic responses. Each of these response packets is 6 bytes, and contains the start byte, address, length, command code, ACK/NAK code and Checksum. All ACK/NAK code is sent following the command code in the last received packet.

ACK - 0x01
This is used for an acknowledgement of the handshake command.

NAK - 0x21
This is used for a negative acknowledgement of packet if the last received packet had an incorrect checksum.

Bad Packet - 0x66
This is sent to the master when the start byte or length in the last received packet is incorrect.

Unknown CMD –0x67
This response is sent by the slave when a command is not recognized.

Protocol Command Definition

Handshake command – 0x40

This is used to test for communication between the master and the specified slave.

Command packet to instrument:

Command code:	0x40
Data field:	null
Checksum:	1 byte

Example:
If the master wants to test the communication with the addressed 01 instrument, it should send out:

0x7f 0x01 0x01 0x40 0x3f.

Response packet from instrument:

Command code:	0x40
ACK code:	0x01
Checksum:	1 byte

Example:
The addressed 01 instrument receives the handshake command and responses:

0x7f 0x01 0x02 0x40 0x01 0x3d .

Get unit and points status - 0x30

This command requests the instrument date, time, alarm status, fault status and up-to-four channel(s) status.

Command packet to instrument:

Command code:	0x30
Data field:	null
Checksum:	1 byte

Example:
0x7f 0x01 0x01 0x30 0x4f means the master requests the status of the instrument whose address is 1.

Response packet from instrument:

Command code: 0x30
Date field:

Date:	2 bytes
Time:	2 bytes
Unit alarm status:	1 byte

0x00:	no alarm
0x01:	A1 alarm
0x02:	A2 alarm
0x03:	A1 and A2 alarm

Unit fault status: 1 byte
- 0x00: no fault
- 0x01: line circuit fault
- 0x02: negative draft
- 0x03: in DC2 AC fault
- 0x04: in DC2 DC low voltage
- 0x05: in DC2 DC fault

Channel(s) status: 6 * n bytes
(n = quantity of channels)

Every channel status has 6 bytes, defined as following:

Channel number:	1 byte (1 to 4)
Concentration format:	1 byte
Concentration:	2 bytes
Channel alarm status:	1 byte (refer to unit alarm status)
Channel fault status:	1 byte (refer to unit fault status)
Checksum:	1 byte

Each channel status data contains 6 bytes, so the length field of the response packet depends on the quantity of the channel of Touchpoint4. For example, if there are 4 channels, the length will be

1 (Command)+ 6 (Data + Time + Unit alarm status + Unit fault status) + 6 (bytes per channel) * 4 (channels) = 31.

If there are 2 channels, the length will be

1 + 6 + 6*2 =19.

Note that once instrument receives the **Get unit and points status command**, it always send out all its channels' status.

Example:

Example 1:

0x7f 0x01 0x0d 0x30	
0x1f 0x56	date: OCT. 22, 1995
0x13 0xc0	time: 02:30:00
0x01	alarm: A1 alarm
0x00	fault: no fault
0x01	channel number: 1
0x81 0x00 0x62	concentration: 9.8 %V/V
0x01	alarm: A1 alarm
0x00	fault: no fault
0x3b	checksum

The example means this Touchpoint4 gas detector controller only has one channel connected.

Example 2:

0x7f 0x01 0x13 0x30	
0x1f 0x56	date: OCT. 22, 1995
0x13 0xc0	time: 02:30:00
0x01	alarm: A1 alarm
0x00	fault: no fault
0x02	channel number: 2
0x81 0x00 0x62	concentration: 9.8 %V/V
0x01	alarm: A1 alarm
0x00	fault: no fault
0x03	channel number: 4
0x81 0x00 0x62	concentration: 9.8 %V/V
0x01	alarm: A1 alarm
0x00	fault: no fault
0xC7	checksum

The example means this Touchpoint4 gas detector controller has two channels connected, Channel 2 and Channel 4.

Example 3:

0x7f 0x01 0x1f 0x30	
0x1f 0x56	date: OCT. 22, 1995
0x13 0xc0	time: 02:30:00
0x01	alarm: A1 alarm
0x00	fault: no fault
0x01	channel number: 1
0x81 0x00 0x62	concentration: 9.8 %V/V
0x01	alarm: A1 alarm
0x00	fault: no fault
0x02	channel number: 2
0x81 0x00 0x62	concentration: 9.8 %V/V
0x01	alarm: A1 alarm
0x00	fault: no fault
0x03	channel number: 3
0x81 0x00 0x62	concentration: 9.8 %V/V
0x01	alarm: A1 alarm
0x00	fault: no fault
0x04	channel number: 4
0x81 0x00 0x62	concentration: 9.8 %V/V
0x01	alarm: A1 alarm
0x00	fault: no fault
0xCE	checksum

The example means this Touchpoint4 gas detector controller has four channels connected, Channel 1 to Channel 4.

Reset fault & alarm – 0x41

This command allows a remote reset of latched visual, audio and relay outputs resulted from an alarm or fault.

Command packet to instrument:
Command code: 0x41
Data field: null

Example:
If the master wants to reset latched outputs of addressed 01 instrument, it should send out:

0x7f 0x01 0x01 0x41 0x3e

Response packet from instrument:
Command code: 0x41
Data field: null

Example:
The addressed 01 instrument receives the reset fault & alarm command and responses:

0x7f 0x01 0x01 0x41 0x3e

PHYSICAL LAYER

Preamble

The physical layer of Touchpoint4 serial communication protocol is an electrical interface in accordance with EIA/TIA-485 standard (also known as RS485 standard). In Touchpoint4 serial communication system, a Master Device and one or several Slave Devices communicate on a balanced twisted pair, on which bi-directional data are transmitted, at the bit rate as user configured.

Electrical Interfaces

Multipoint Serial Bus Infrastructure
Touchpoint4 Serial Communication system implements a “Two-Wire” electrical interface in accordance with EIA/TIA-485 standard. On such a 2W-bus, at any time only one driver has the right for transmitting.

The following figure gives a general overview of the serial bus infrastructure in Touchpoint4 Serial Communication system.

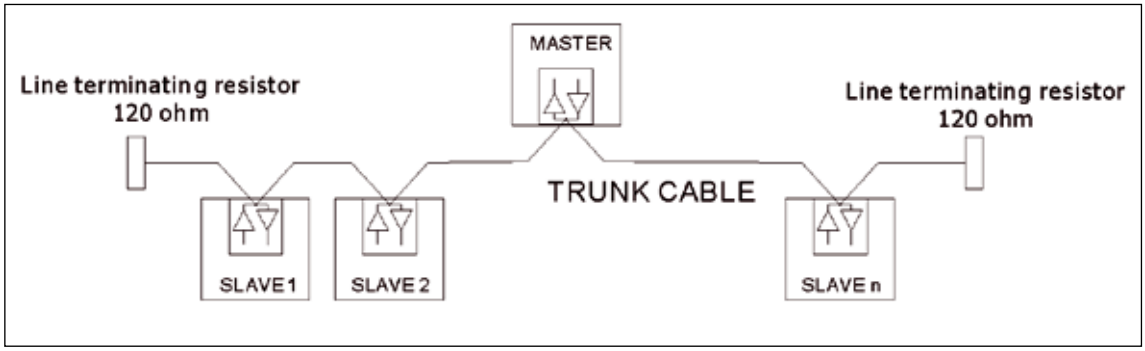

Figure 6. Communication infrastructure

The Touchpoint4 gas detector controllers are connected directly to the trunk cable. The master, PC or PLC, is connected directly or via a derivation, according to the master instruction. The cable should be shielded.

Note: the Touchpoint4 RS-485 interface is not electrically isolated. A common mode voltage of 7 volt or greater between any two nodes on the network will interfere with communications. Proper earthing of every Touchpoint4 and the Master is essential.

Multipoint System requirements
Maximum number of devices:

Although a figure of 32 devices is always authorized on any RS485 system without repeater, the total number is limited to 16 in Touchpoint4 Serial Communication protocol because of addressing limitations.

Topology
Touchpoint4 Serial Communication system has one trunk cable, along which devices are connected, directly (daisy chaining) or by short derivation cables.

The trunk cable, also named “Bus”, can be long (see hereafter). Its two ends should be connected to Line Terminations.

Length
The end-to-end length of the trunk cable must be limited. The maximum length depends on the baud rate, the cable (Gauge, Capacitance or Characteristic Impedance), and the quantity of loads on the daisy chain.

For a maximum 9600 Baud Rate and AWG26 (or wider) gauge, the maximum length is 1000m.

If the derivation cable is needed for the connection of the master, the derivation must be short, never more than 20m.

Grounding Arrangements
At one end of each cable its shield must be connected to protective ground.

Line Termination
To minimize the reflections from the end of the RS485-cable, it is recommended to place a Line Termination near each of the 2 Ends of the Bus.

It is important that the line must be terminated at both ends since the propagation is bi-directional, but it is not allowed to place more than 2 LT on one passive D0-D1 balanced pair. Never place any LT on a derivation cable.

Each line termination must be connected between the two conductors of the balanced line: D0 and D1.

Line termination may be a resistor of 100 ohms to 150 ohms (0.5 W).

Pull-up and Pull-down Resistors
Line control has been implemented in Touchpoint4 gas detector controller so that the bus contains a valid "off" signal when no node is transmitting. No external pull-up or pull-down resistors are needed.

Mechanical Interfaces

Connectors pin-out

The following figure shows the pin-out on the terminal block of Touchpoint4 gas detector controller.

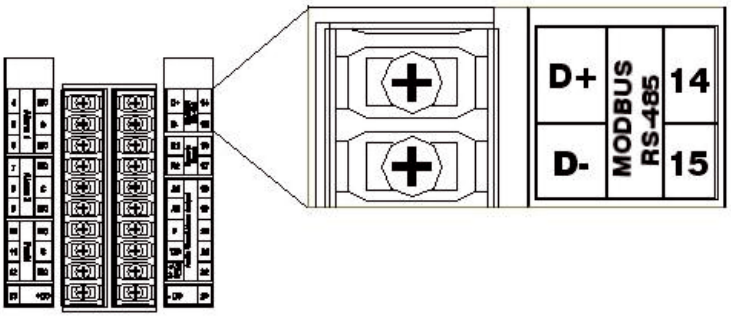

Figure 7. Touchpoint4 communication pin-out

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