Operating Instructions

4600 Series Transmitters

Serial Data Communication Supplement

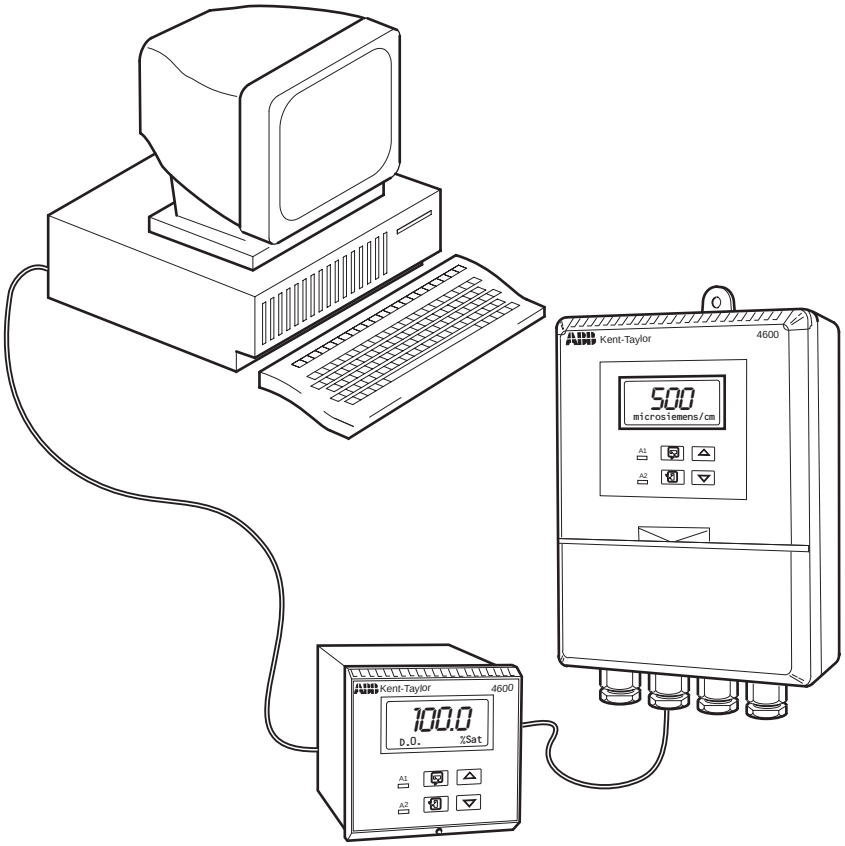

ABB Instrumentation

ABB INSTRUMENTATION

The Company

ABB Instrumentation is an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

The NAMAS Calibration Laboratory No. 0255(B) is just one of the ten flow calibration plants operated by the Company, and is indicative of ABB Instrumentation's dedication to quality and accuracy.

BS EN ISO 9001

St Neots, U.K. – Cert. No. Q5907
Stonehouse, U.K. – Cert. No. FM 21106

EN 29001 (ISO 9001)

Lenno, Italy – Cert. No. 9/90A

Stonehouse, U.K. – Cert. No. 0255

Use of Instructions

Warning.
An instruction that draws attention to the risk of injury or death.

Note.
Clarification of an instruction or additional information.

Caution.
An instruction that draws attention to the risk of damage to the product, process or surroundings.

Information.
Further reference for more detailed information or technical details.

Although **Warning** hazards are related to personal injury, and **Caution** hazards are associated with equipment or property damage, it must be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process system performance leading to personal injury or death. Therefore, comply fully with all **Warning** and **Caution** notices.

Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

1. The relevant sections of these instructions must be read carefully before proceeding.
2. Warning labels on containers and packages must be observed.
3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
4. Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
6. When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

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1 INTRODUCTION

The 4600 Series of transmitters is extended by the addition of a serial data communication option which allows addressing and reprogramming via a computer terminal or host computer.

The RS422/485 communication standard is used with the following logic levels:

a) for logic '1' (MARK condition or IDLE state) the 'A' terminal of the transmitter is negative (0V) with respect to the 'B' terminal (+5V)

b) for logic '0' (SPACE condition or ACTIVE state) the 'A' terminal of the transmitter is positive (+5V) with respect to the 'B' terminal (0V).

✶ **Note.** 'A' terminal is Tx + or Rx + and 'B' terminal is Tx – or Rx –.

Parity is used for simple error checking. The parity bit is a one-bit code which is transmitted in addition to the ASCII character. It can detect only one error per character, since two errors may cancel out. Parity is calculated by finding the sum of logic '1's in the character and either:

a) setting the parity bit to logic '1' if the sum is odd, or logic '0' if the sum is even, when using even parity
or
b) setting the parity bit to logic '0' if the sum is odd, or logic '1' if the sum is even, when using odd parity.

The block check character (BCC) is an additional form of checking and is the arithmetic sum of all the characters in a complete message (excluding parity bits) – see Appendix A3. Error detection is achieved by comparison of the BCC's of the transmitted and received messages.

This manual must be read in conjunction with the approipriate Operating IInstructions, depending on the instrument type:
4620 & 4625 Conductivity Transmitters – IM/4600–CON
4630 & 4635 pH/Redox Transmitters – IM/4630–PH
4640 & 4645 Dissolved Oxygen Transmitters – IM/4600–DO

2 PREPARATION

The procedure is similar to that described in the Operating Instructions (IM/4600–CON, –PH or –DO) with additions as detailed in this section.

2.1 Company Standard Settings

Only those parameters detailed on the customer order are programmed at the factory. If any parameters are unsuitable for the application they can be reprogrammed – see Section 7 of the Operating Instructions (IM/4600–CON, –PH or –DO). Serial data programming details are to be found in Section 7 of this manual.

Standard parameter settings for the serial data programme are as follows:

Instrument Identity	01
Parity	odd parity
Block Check Character (BCC)	BCC on
Transmission Rate	9600 baud.

3 INSTALLATION

Observe the limitations outlined in the Operating Instructions (IM/4600–CON, –PH or –DO). The maximum serial data transmission line length for both RS422 and RS485 systems is 1200m.

3.1 Serial Communication Adaptors for Personal Computers

An RS422/485 communications adaptor board is required for serial links. It is strongly recommended that the card used has galvanic isolation to protect the computer from lightning damage and increase immunity from noise pick-up from cables.

4 Wire Configuration

The following OPTO22 boards are recommended for use with the 4600 serial instruments:

Part No.	Computer Type
AC24	XT Bus IBM PC compatible
AC24 AT	AT Bus IBM PC compatible
AC34	Microchannel IBM PC.

The following 'Jumper' selections are required on OPTO22 boards (usually supplied as the default configuration):

RX & TX	install line termination jumper Install pull-up and pull-down jumpers
CTS & RTS	disable jumper installed.

Select board address and interrupts as described in the OPTO22 manual.

2 Wire Configuration

The adaptor card must have the provision for disabling the transmitter after each message is transmitted, so that bus contention does not occur. This is often implemented by the use of the RTS signal to control the transmitter enable. Consult the adaptor card manufacturer to determine suitability.

Caution. Install the pull-up/pull-down resistors on either the RX **or** TX lines. The resistors **must not** be connected on **both** pairs of lines.

4 ELECTRICAL CONNECTIONS

All connections, apart from those for serial data communication, are made as shown in Figs. 4.3 and 4.4 of the Operating Instructions (IM/4600–CON, –PH or –DO).

4.1 Serial Connections – Figs. 4.1 and 4.2

The transmitters must be connected in parallel as shown in the schematic diagram – Fig. 4.1. The RS485 standard quotes connection of maximum thirty two slaves (4600 Transmitters) to any single driver (computer terminal or host computer); the RS422 standard quotes connection of up to ten slaves. However, these numbers can be increased if the driver's serial port permits.

Make serial data connections and check the processor board links as shown in Fig. 4.2. The type of cable used is dependent on the transmission speed and cable length:

4 Wire Cable (refer also to Fig. 9.1 on page 14)

Up to 6m (all speeds) – standard screened or twisted pair cable.

Up to 300m – twin twisted pair with overall foil screen and an integral drain wire, e.g. Belden 9502 or equivalent

Up to 1200m – twin twisted pair with separate foil screens and integral drain wires for each pair, e.g. Belden 9729 or equivalent

2 Wire Cable (refer also to Fig. 9.2 on page 15)

Up to 6m (all speeds) – standard screened or twisted pair cable.

Up to 1200m – single twisted pair with overall foil screen and integral drain wire, e.g. Belden 9501 or equivalent.

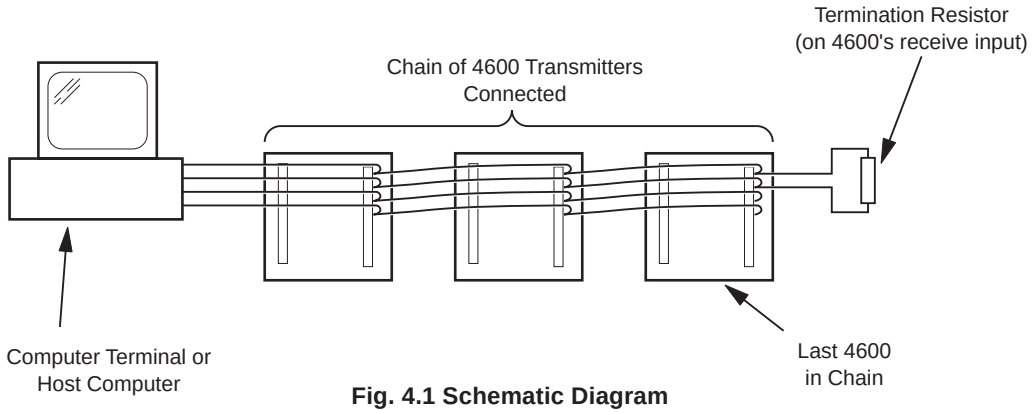
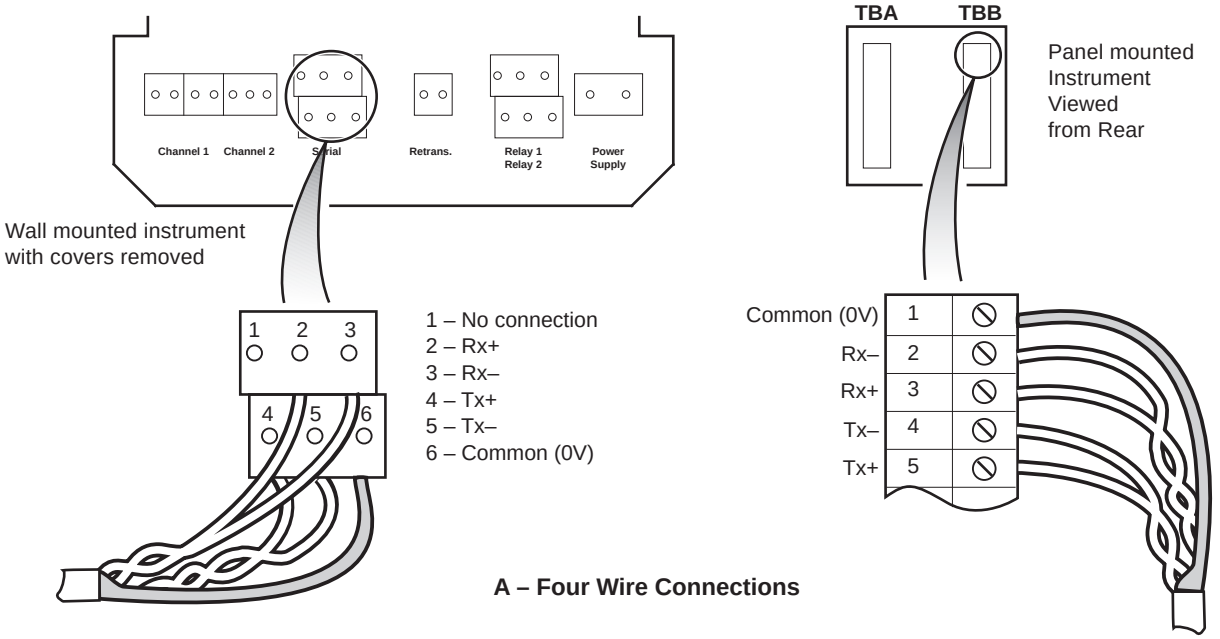


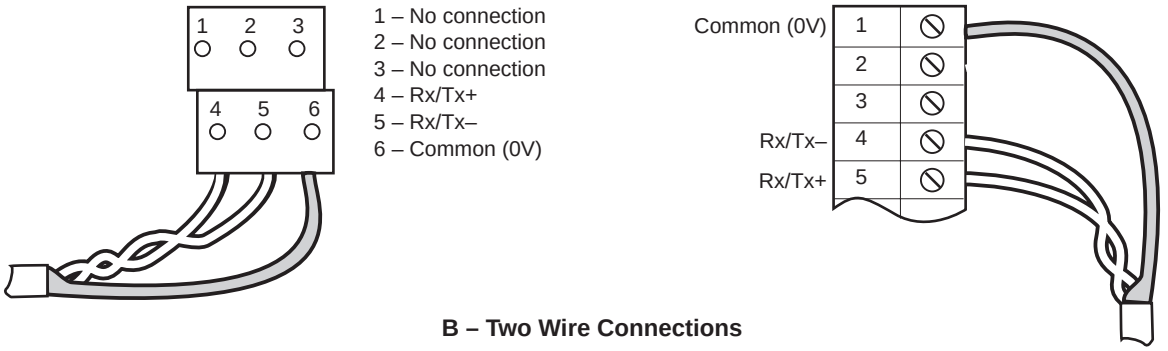
Fig. 4.1 Schematic Diagram

…4 ELECTRICAL CONNECTIONS

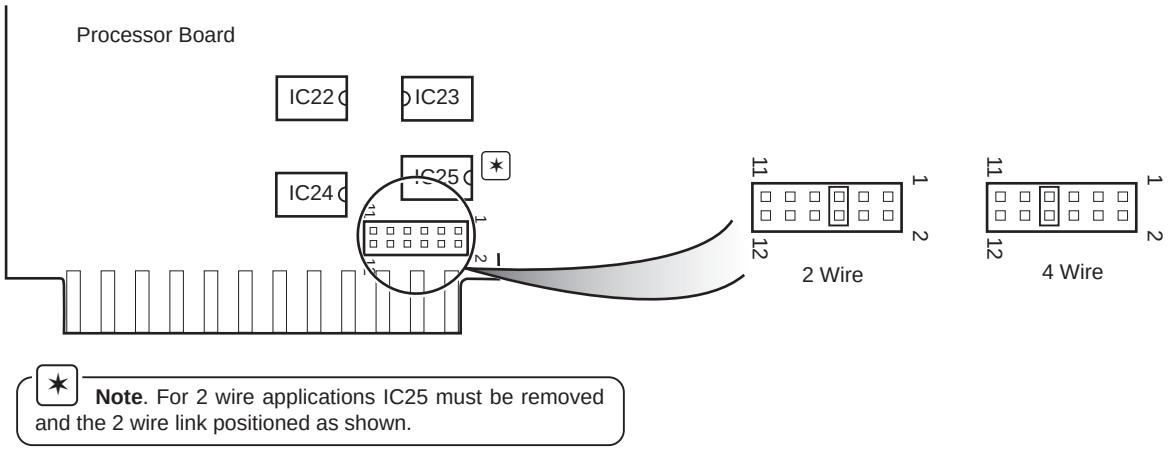
…4.1 Serial Connections



A – Four Wire Connections



B – Two Wire Connections



✶ **Note**. For 2 wire applications IC25 must be removed and the 2 wire link positioned as shown.

C – Two and Four Wire Links

Fig. 4.2 Serial Connections

5 SETTING UP

For all aspects other than serial data transmission the transmitter is set up as shown in the Operating Instructions (IM/4600–CON, –PH or –DO). Unless otherwise requested, the instrument is despatched with a transmission rate of 9600 baud and transmission line termination resistors linked-out. If the resistors are to be linked-in (see Fig. 5.1) carry out the following section.

5.1 Termination Resistors – Fig. 5.1

For long transmission lines, termination resistors are required on the last 4600 Transmitter in the chain and at the host computer/computer terminal. Under normal operating conditions the resistors are required at the last 4600 receive inputs only – see Fig. 4.1. The transmitter's resistors are selected using plug-in links – see Fig. 5.1.

Switch off the supply and gain access to the processor board (Section 4 in the Operating Instructions, IM/4600–CON, –PH or –DO). Set the termination resistor links as shown in Fig. 5.1.

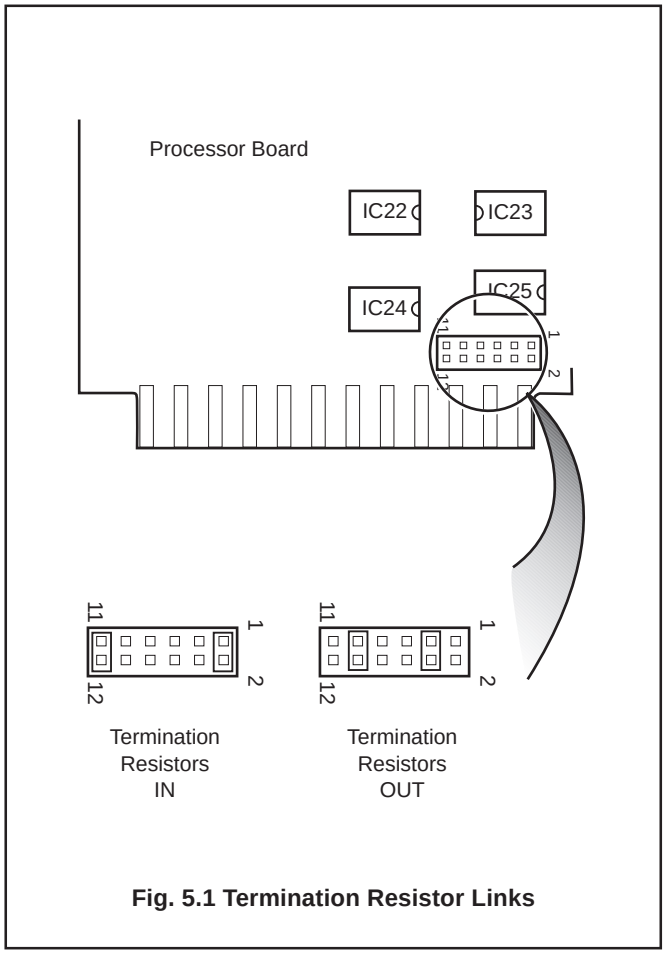


Fig. 5.1 Termination Resistor Links

6 PROTOCOL

The protocol used is based on ANSI-X3.28-1976-2.5-A4 and is used for master (host computer) to slave (4600 Transmitter) systems. This is the **recommended protocol for use with supervisory systems** such as ABB Kent-Taylor PC30. The Protocol is:

Start transmission (STX) – Command – Identification…
…End transmission (ETX) – see Figs. 8.1 to 8.6.

Transmissions of commands and processing of the subsequent replies must be incorporated into the host computer programme.

7 PROGRAMMING

The general programming procedure is as detailed in the Operating Instructions (IM/4600–CON, –PH or –DO) but with an additional **Serial Interface** page between the **Set Up Outputs** and **Electrical Cal** pages – see Fig. 7.1.

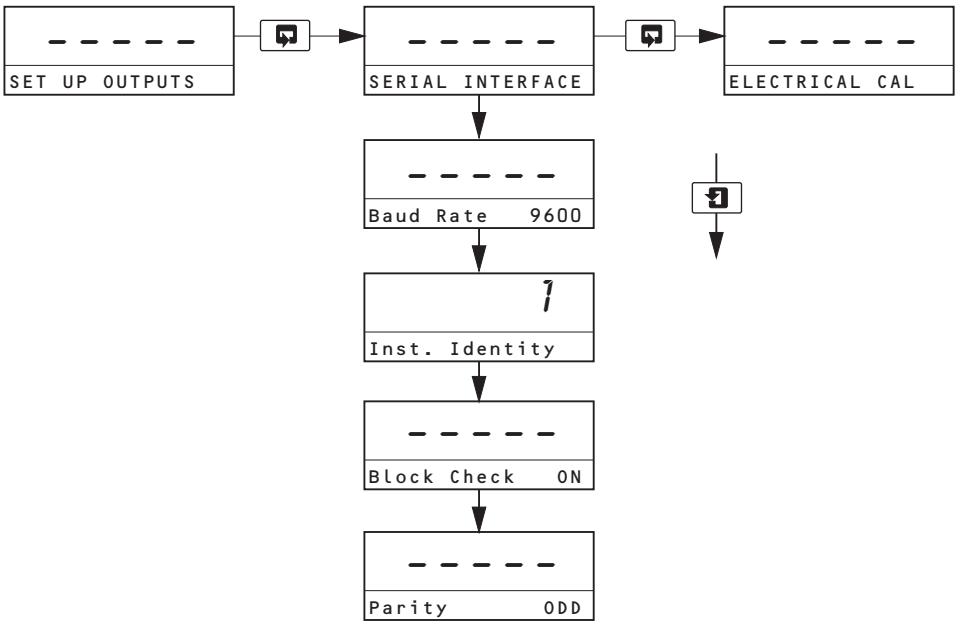
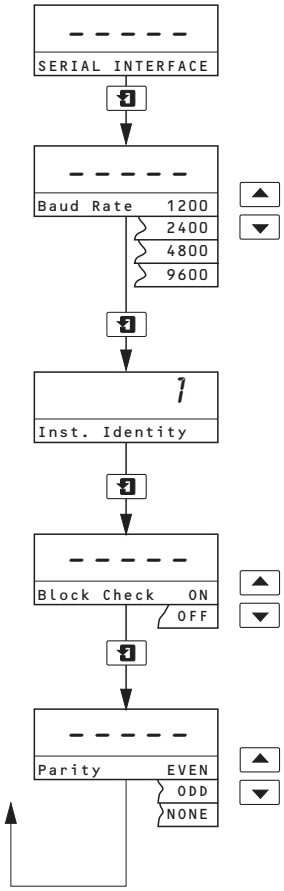


Fig. 7.1 Location of Serial Data Interface Page

7.1 Serial Interface Page



Page Header – **Serial Interface**

Transmission Rate
Select the retransmission rate required (1200 slowest, 9600 fastest).

Transmitter Identification
Assign the transmitter an identification number (1 to 99) – see Section 4.1. The maximum number (99) allows transmitters to be connected to more than one communication channel.

Block Check Character
Select ON or OFF as required – see Section A3.

Parity
Select the appropriate parity to match the computer terminal or host computer.

Return to the top of the **Serial Interface Page** or advance to the next page.

8 COMMUNICATION

8.1 Communication Between Master and Slaves

The commands from the master are coded as single characters as follows:

R – 'Read' (read parameters)

M – 'Multiple Read' (read a selection of parameters)

W – 'Write' (write new parameter values).

8.1.1 Mnemonics

Each mnemonic for the 4600 Transmitter parameters comprises two characters – see Section 8.6.

8.2 Command Format – Figs. 8.1 to 8.3

The protocol is based on ANSI-X3.28-1976-2.5-A4. Entries are made directly from the host computer using the command format shown in Figs. 8.1 to 8.3.

8.2.1 Term Clarification for Command Format

Start – one ASCII control character (always 'STX') signifying the start of transmission.

Command – one character, R, M or W – see Section 8.1.

Instrument Identification – two characters identifying the 4600 Transmitter, 1 to 99.

Parameter – two-character mnemonic selected from Section 8.6.

Sign – one character:
'+' – parameter value is positive (optional)
'–' – parameter value is negative.

Data – usually up to six characters (including decimal point) used to write a new parameter value.

Limiter – one character (always 'ETX') signifying the end of data transmission.

Block Check Character (BCC) – one character, the arithmetic sum of the complete message (excluding parity bits), transmitted by the host computer for error detection – see Appendix A3.

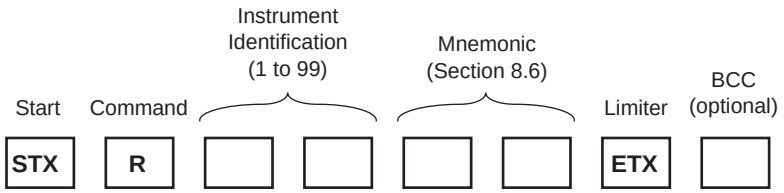


Fig. 8.1 'Read' Command Format

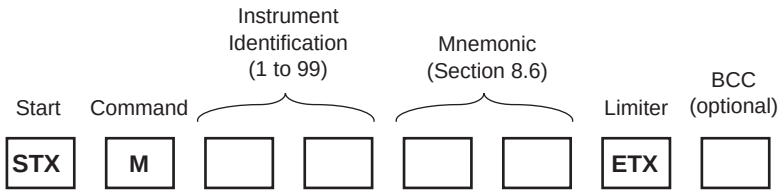


Fig. 8.2 'Multiple Read' Command Format

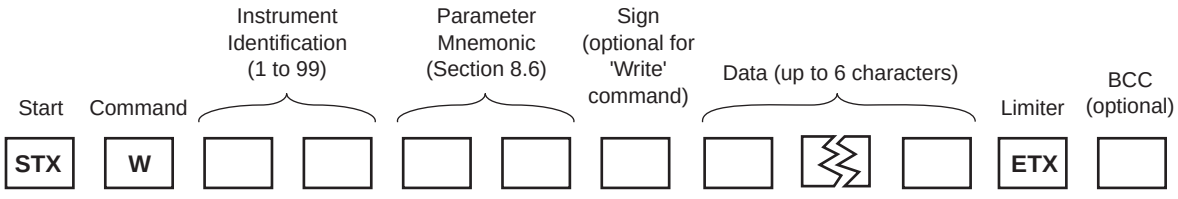


Fig. 8.3 'Write' Command Format

8.3 Reply Format – Figs 8.4 to 8.6

The 4600 Transmitter replies to the command using the reply format shown in Figs. 8.4 to 8.6.

8.3.1 Term Clarification for Reply Format

Instrument Identification – two characters identifying the 4600 Transmitter, 1 to 99.

Data – usually up to six characters (including decimal point) showing the new parameter value.

Error Code – two-character mnemonic – see Section 8.5.

Reply – one ASCII control character (see Appendix A1):

‘ACK’ – command understood
‘NAK’ – command not understood
‘ETB’ – end of multiple read reply block.

Block Check Character (BCC) – one character, the arithmetic sum of the complete message (excluding parity bits), transmitted by the transmitter for error detection – see Appendix A3.

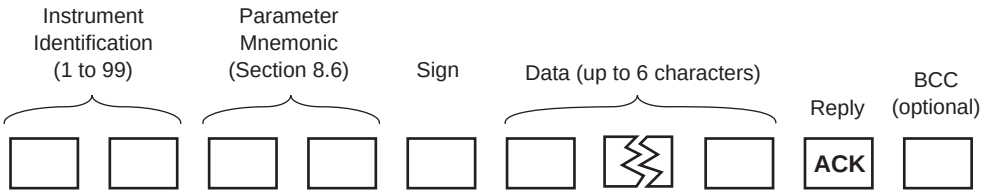


Fig. 8.4 Reply Format (Command Understood)

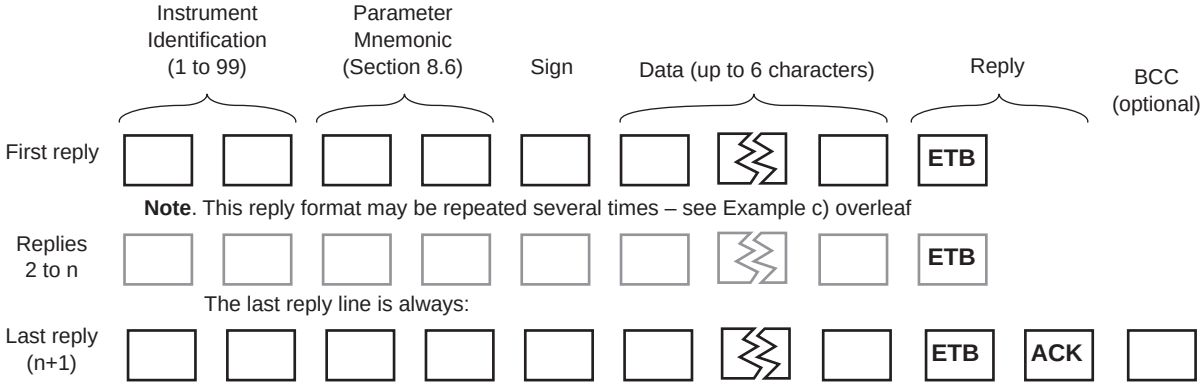


Fig. 8.5 Multiple Read Reply Format

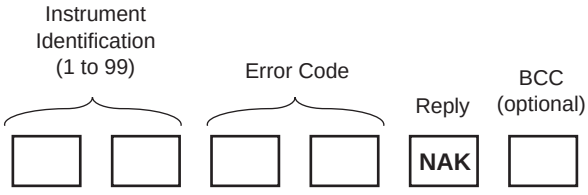


Fig. 8.6 Reply Format (Command Not Understood)

8.4 Communication Examples

The following examples show typical master-to-slave transmissions and the subsequent slave-to-master replies. For **Error Code** and **Parameter** interpretations refer to Sections 8.5 and 8.6.

a) Command – STX **R06DS** ETX

STX R 06 DS ETX
- End of text
- Display Span
- Transmitter number six
- 'Read' command
- Start of text

Reply – **06PB10.00** ACK

06 DS 100.0 ACK
- Command understood
- Display span is 10
- Transmitter number 06

b) Command – STX **R07IX** ETX

STX R 07 IX ETX
- End of text
- Parameter 'IX'
- Transmitter number seven
- 'Read' command
- Start of text

Reply – **0702** NAK

07 02 NAK
- Command not understood
- Error code 2
- Transmitter number seven

i.e. 'IX' in the original command is not a recognised 'Read' parameter – see Section 8.6.

c) Command – STX **M01 M2** ETX

STX M 01 M2 ETX
- End of text
- Multiple read mnemonic
- Transmitter number one
- 'Multiple Read' command
- Start of text

Reply:

Transmitter number 1
- Command understood

01 DS 10.00 ETB — Display span value 10.00
01 DZ 0.00 ETB — Display zero value 0.00
01 IT 0 ETB ACK — Instrument type 0
- End of transmission block

d) Command – STX **M05MV** ETX

STX M 05 MV ETX
- End of text
- Measured Variable
- Transmitter number five
- 'Multiple Read' command
- Start of text

Reply – **0519** NAK

05 19 NAK
- Command not understood
- Error code 19
- Transmitter number five

i.e. the 'Multiple Read' command cannot be used for a single parameter – see Section 8.6.

e) Command – STX **W11A112.00** ETX

STX W 11 A1 12.00 ETX
- End of text
- Write **to** 12.00
- Alarm A1 set point
- Transmitter number eleven
- 'Write' command
- Start of text

Reply – **11A112.00** ACK

11 A1 12.00 ACK
- Command understood
- Alarm A1 setting is 12.00
- Transmitter number eleven

f) Command – STX **W05R21** ETX

STX W 05 R2 1 ETX
- End of text
- Relay 2 energised above set point
- Relay 2 Action
- Transmitter number five
- 'Write' command
- Start of text

Reply – **0503** NAK

05 03 NAK
- Command not understood
- Error code 3
- Transmitter number five

i.e. 'R2' in the original command is not a recognised 'Write' parameter.

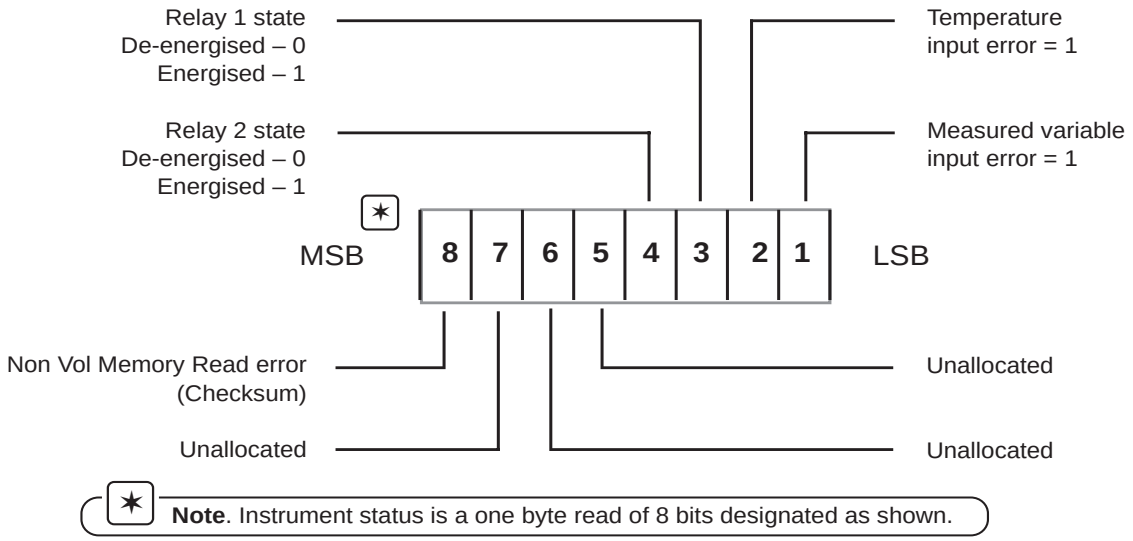


Fig. 8.7 Instrument Status

8.5 Error Codes

Error Code	Error
01	Invalid command – the received command was not R (read), W (write) or M (multiple read).
02	Invalid 'Read' parameter – parameter cannot be used with Read command.
03	Invalid 'Write' parameter – parameter cannot be used with Write command.
04	Too many characters entered into buffer – received message length is greater than 32 characters.
05	Invalid decimal point position.
08	The 'Write' value is not within the controllers limits.
10	Non-numeric character entered in data .
15	Received block check character error.
16	No STX character in complex format.
17	Received parity check error.
18	Overrun or framing error detected in received data.
19	Error in Multiple read command.
20	No data in 'Write' command.
21	More than one decimal point in data.
22	No data after decimal point in data.
23	More than six characters in data field.
26	Invalid characters in 'Read' command.

8.6 Command Mnemonics

i **Information**. In the following Sections:
- All parameters can be 'Read'.
- Some parameters can be written to ('Write' Command) – see Sections 8.6.1, 8.6.4 and 8.6.6
- Some parameters can be read as a group ('Multiple' Read) – see Section 8.6.7.

8.6.1 Conductivity Mnemonics

Parameter	Mnemonic	Write	Interpretation
Measured Variable	MV	No	Within programmed display range
Measured Temperature	MT	No	–10 to +110°C (14 to 230 °F)
Alarm 1 Set Point	A1	Yes	Within programmed display range
Alarm 2 Set Point	A2	Yes	Within programmed display range
Measurement Units	UM	No	0 – microsiemens/cm 1 – microsiemens/m 2 – millisiemens/cm 3 – millisiemens/m 4 – T.D.S 5 – Salinity 6 – Megohms – cm
Cell Constant	KK	No	0.05 to 1.00
Decimal Point Position	DP	Yes	0 – xxxxx 1 – xxxx.x 2 – xxx.xx 3 – xx.xxx Refer to IM/4600–CON for maximum and minimum ranges which must not be exceeded
Display Span	DS	Yes	Refer to IM/4600–CON for maximum and minimum ranges which must not be exceeded
Display Zero	DZ	No	Zero (for UM 0 to 5) or 2MΩ–cm (for UM 6)
Temperature Compensation	TK	No	0 – No 1 – Yes
Temperature Coefficient	TA	No	0.000 to 0.030 (0 to 3%/°C)
UPW Temperature Compensation	PT	No	0 – No 1 – Yes If TDS or Salinity selected then UPW Temperature Compensation is not available
Temperature Reference	TR	No	0 – 20°C or 68°F 1 – 25°C or 77°F
Temperature Units	TD	No	0 – °C 1 – °F
Alarm 1 Action	R1	No	0 – EA 1 – EB
Alarm 2 Action	R2	No	0 – EA 1 – EB
Retransmission Type	RT	No	0 – 0 to 10 mA 1 – 0 to 20 mA 2 – 4 to 20 mA
Non-Vol Memory (Enable/Disable)	NV	Yes	0 – Disable 1 – Enable
Instrument Status	IS	No	See Fig. 8.7

8.6.2 T.D.S. Mnemonics

The command mnemonics are as for conductivity with the following addition:

Dissolved Solid Multiplying Factor – DF (Read only).

8.6.3 Megohms Mnemonics

The command mnemonics are as for conductivity with the following exceptions:

Decimal Point Position – DP (Read only)
Display Span – DS (Read only)
UPW Temperature Compensation – PT (excluded).

8.6.4 pH Mnemonics

Parameter	Mnemonic	Write	Interpretation
Measured Variable	MV*	No	Within programmed display range
Preset Temperature	PT	No	–10 to +110°C (14 to 230°F)
Measured Temperature	MT	No	–10 to +110°C (14 to 230°F)
Alarm 1 Set Point	A1*	Yes	Within programmed display range
Alarm 2 Set Point	A2*	Yes	Within programmed display range
Display Span	DS*	Yes	5 to 14 pH (–700 to +1,000mV*)
Display Zero	DZ*	Yes	0 to 9 pH (–1,000 to +700mV*)
Instrument Type	IT*	No	0 – Redox (ORP) 1 – pH Glass 2 – pH Antimony
Temperature Units	TD	No	0 – °C 1 – °F
Alarm 1 Action	R1*	No	0 – EA 1 – EB
Alarm 2 Action	R2*	No	0 – EA 1 – EB
Retransmission Type	RT*	No	0 – 0 to 10 mA 1 – 0 to 20 mA 2 – 4 to 20 mA
Temperature Compensation	TK	No	0 – No 1 – Yes
Sample Compensation	SK	No	0 – No This mnemonic is not used with the Antimony 1 – Yes Electrode
Sample Coefficient	SA	No	This mnemonic is not used with the Antimomy Electrode
Hold Outputs	HO	No	0 – No 1 – Yes
pH Slope Value	PS	No	80 to 105% typ.
pH Check Value	PC	No	6 to 8pH typ. (glass) or 0 to 2 pH typ.(antimony)
Non-Vol Memory (Enable/Disable)	NV*	Yes	0 – Disable 1 – Enable
Instrument Status	IS*	No	See Fig. 8.7

8.6.5 Redox Mnemonics

The command mnemonics for a Redox instrument are shown in the above table marked with an asterisk (*).

8.6.6 Dissolved Oxygen Mnemonics

Parameter	Mnemonic	Write	Interpretation
Measured Variable	MV	No	Within programmed display range
Measured Temperature	MT	No	0 to 40°C (32 to 104°F)
Alarm 1 Set Point	A1	Yes	Within programmed display range
Alarm 2 Set Point	A2	Yes	Within programmed display range
Display Span	DS	No	3.00 to 20.00 ppm or 30.0 to 200.0 %Sat.
Display Zero	DZ	No	0.00 ppm or 0.0 %Sat.
Instrument Type	IT	No	0 – ppm 1 – % Sat
Temperature Units	TD	No	0 – °C 1 – °F
Alarm 1 Action	R1	No	0 – EA 1 – EB
Alarm 2 Action	R2	No	0 – EA 1 – EB
Retransmission Type	RT	No	0 – 0 to10 mA 1 – 0 to 20 mA 2 – 4 to 20 mA
Hold Outputs	HO	No	0 – No 1 – Yes
Salinity Correction	SC	No	0 – No This mnemonic is not used with % Sat 1 – Yes
Salinity (ppt)	SP	No	This mnemonic is not used with % Sat
Non-Vol Memory (Enable/Disable)	NV	Yes	0 – Disable 1 – Enable
Instrument Status	IS	No	See Fig. 8.7

8.6.7 Multiple Read Mnemonics

Parameter Group	Mnemonic	Parameters
General Parameters	M1	Measured Value (MV) Measured Temperature (MT or PT) see **Note** ✶ Instrument Status (IS) Alarm 1 Set Point (A1) Alarm 2 Set Point (A2)
Display Parameters	M2	Display Span (DS) Display Zero (DZ) Display Units Conductivity – Units Measurement (UM) pH/DO – Instrument Type (IT)

✶ **Note**. The MT or PT parameter in the M1 'Multiple Read' command is optional, depending on the instrument type:

Conductivity – without temperature compensation, parameter not available
– with temperature compensation, measured temperature (MT) available

pH/Redox – pH mode, with manual temperature compensation, preset temperature (PT) available
– pH mode, with automatic temperature compensation, measured temperature (MT) available
– Redox mode, parameter not available

DO – measured temperature (MT) parameter always available.

9 OPERATION

Before attempting any serial communication, first ensure that the 4600 Transmitters connected to the computer terminal or host computer by serial link are functioning correctly as individual instruments. This is achieved by connecting all analogue inputs, applying the input signals and checking that the digital display reads appropriately.

Ensure that the serial data connections to 4600 Transmitter have been made correctly with respect to the computer terminal, or host computer, interface. If the above check appears satisfactory, test the serial communication by sending an appropriate message from the computer terminal or host computer to a transmitter and observe if it replies; thus establishing communication. If communication is not established, check that the computer terminal, or host computer, interface is correctly set up and that the plug-in links within each transmitter are correctly positioned – see Section 5.

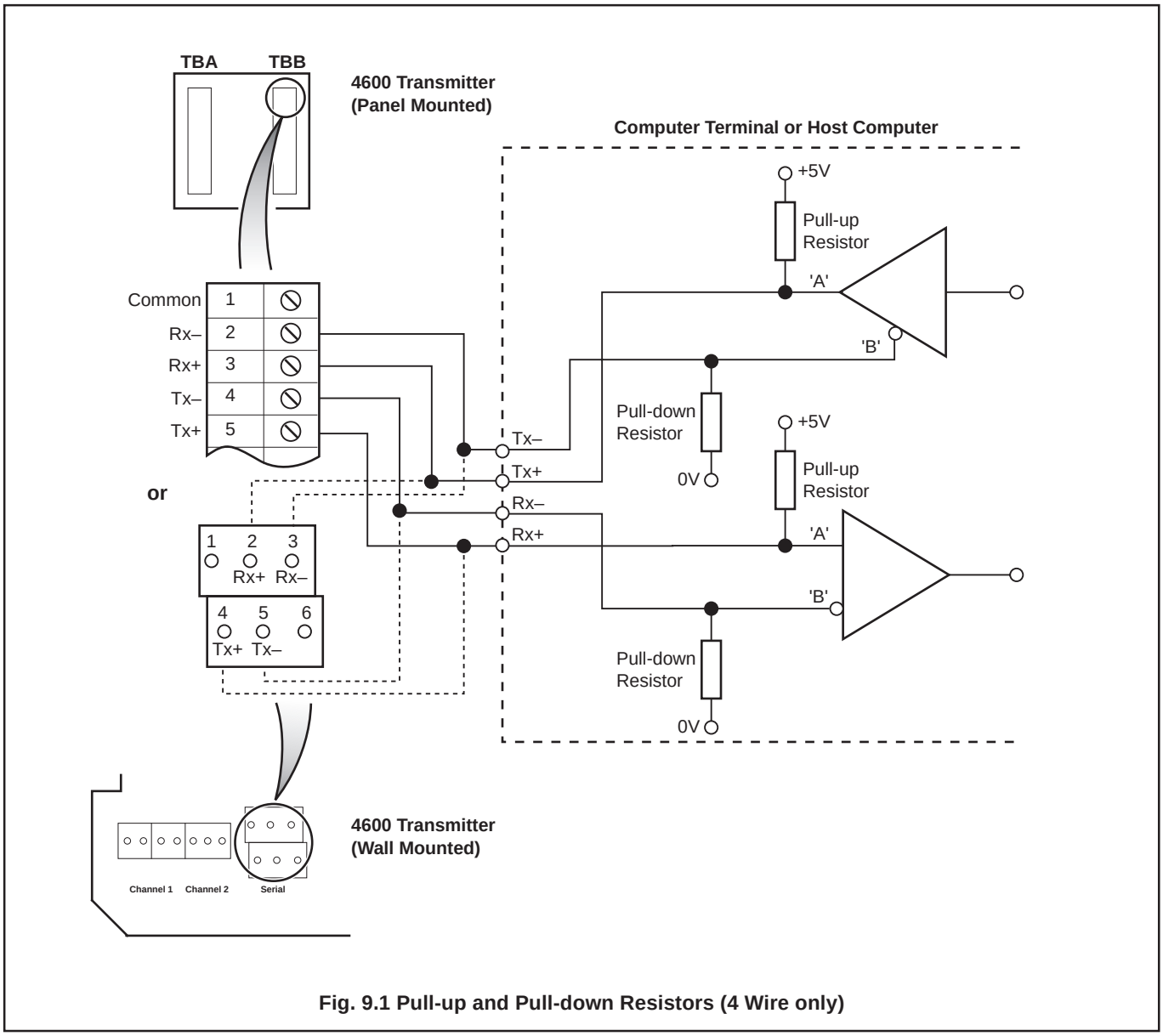


Fig. 9.1 Pull-up and Pull-down Resistors (4 Wire only)

…9 OPERATION

Check that the parameters programmed in the instrument's **Serial Data Communication Page** are compatible with those of the computer terminal or host computer – see Section 7.

If communication is still not possible or is erratic, check that the computer terminal, or host computer, interface has pull-up and pull-down resistors connected as shown in Figs. 9.1 and 9.2.

✶ **Note.** If no reply is received from the instrument within 160ms, retransmit the command. If after five command re-entries a satisfactory reply has not been received, the communication link has been broken and must be rechecked.

10 SPECIFICATION

As detailed in the Operating Instructions (IM/4600–CON, –PH or –DO), with the following additions:

EIA Communication Standards	RS422, RS485 2-wire or 4-wire modes	
Parity	None Odd Even	Programmable
Block check character	Programmable on or off	
Transmission line length	1200m max.	
Transmission speeds	1200 baud 2400 baud 4800 baud 9600 baud	Programmable

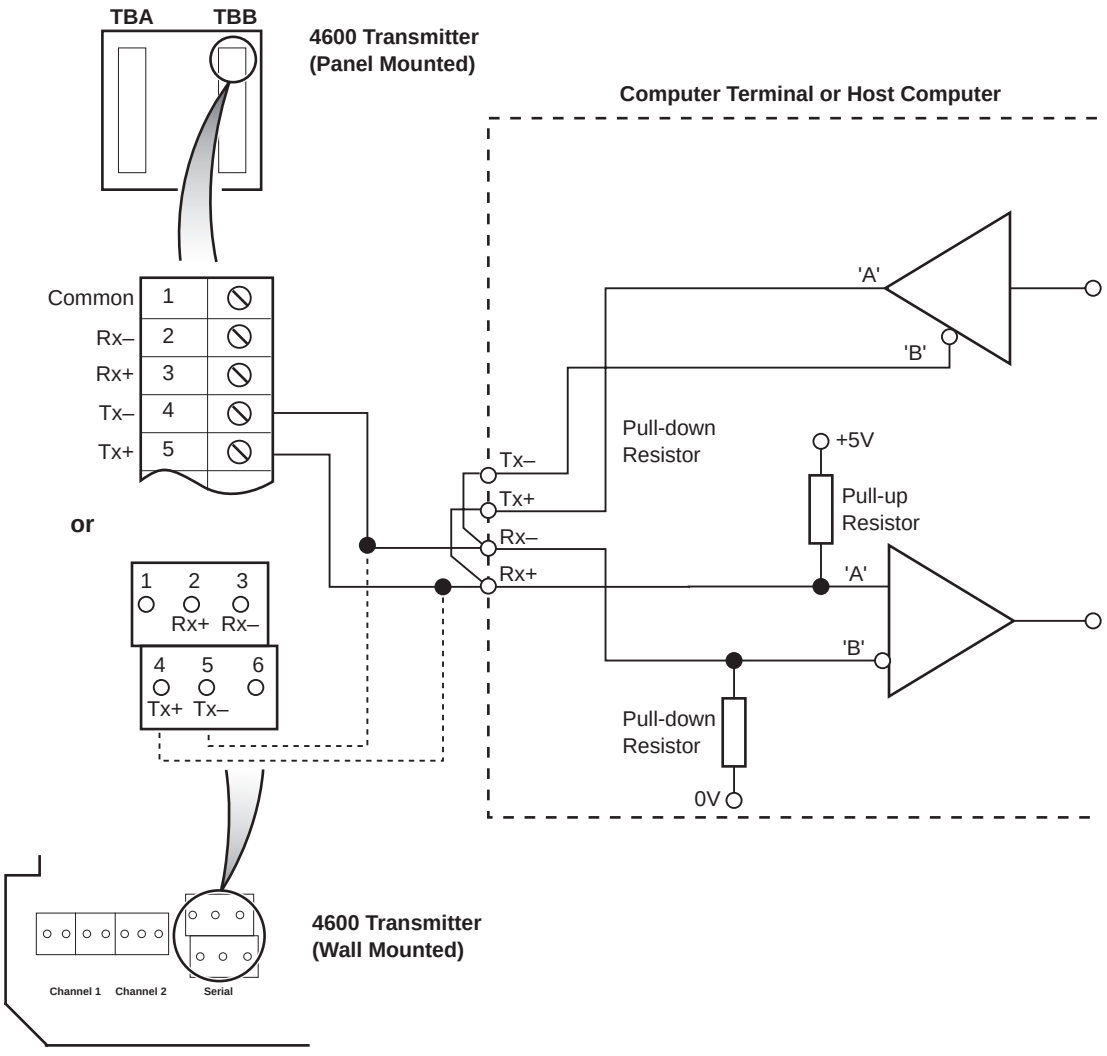


Fig. 9.2 Pull-up and Pull-down Resistors (2 Wire only)

APPENDICES

A1 The American Standard Code for Information Interchange (ASCII)

Character	Significance	Decimal	Hex.	Binary
NUL	Null, Operation	0	00	0000000
SOH	Start of Heading	1	01	0000001
STX	Start of Text	2	02	0000010
ETX	End of Text	3	03	0000011
EOT	End of Transmission	4	04	0000100
ENQ	Enquiry	5	05	0000101
ACK	Acknowledgement	6	06	0000110
BEL	Bell	7	07	0000111
BS	Backspace	8	08	0001000
HT	Horizontal Tabulation	9	09	0001001
LF	Line Feed	10	0A	0001010
VT	Vertical Tabulation	11	0B	0001011
FF	Form Feed	12	0C	0001100
CR	Carriage Return	13	0D	0001101
SO	Shift Out	14	0E	0001110
SI	Shift In	15	0F	0001111
DLE	Data Link Escape	16	10	0010000
DC1	Device Control 1	17	11	0010001
DC2	Device Control 2	18	12	0010010
DC3	Device Control 3	19	13	0010011
DC4	Device Control 4	20	14	0010100
NAK	Negative Acknowledge	21	15	0010101
SYN	Synchronous Idle	22	16	0010110
ETB	End of Transmission Block	23	17	0010111
CAN	Cancel	24	18	0011000
EM	End of Medium	25	19	0011001
SUB	Substitute Character	26	1A	0011010
ESC	Escape	27	1B	0011011
FS	File Separator	28	1C	0011100
GS	Group Separator	29	1D	0011101
RS	Record Separator	30	1E	0011110
US	Unit Separator	31	1F	0011111
SP	Space	32	20	0100000
!	.....	33	21	0100001
“	.....	34	22	0100010
#	Number detection	35	23	0100011
$	Other currency symbol	36	24	0100100
%	.....	37	25	0100101
&	. .....	38	26	0100110
´	.....	39	27	0100111
(	.....	40	28	0101000
)	.....	41	29	0101001
*	.....	42	2A	0101010
+	.....	43	2B	0101011
’	.....	44	2C	0101100
—	.....	45	2D	0101101
.	.....	46	2E	0101110
/	.....	47	2F	0101111
0	.....	48	30	0110000
1	.....	49	31	0110001
2	.....	50	32	0110010
3	.....	51	33	0110011
4	.....	52	34	0110100
5	.....	53	35	0110101
6	.....	54	36	0110110
7	.....	55	37	0110111
8	.....	56	38	0111000
9	.....	57	39	0111001
:	.....	58	3A	0111010
;	.....	59	3B	0111011
<	.....	60	3C	0111100
=	.....	61	3D	0111101
>	.....	62	3E	0111110
?	.....	63	3F	0111111

…A1 ASCII

Character	Significance	Decimal	Hex.	Binary
@	.....	64	40	1000000
A	.....	65	41	1000001
B	.....	66	42	1000010
C	.....	67	43	1000011
D	.....	68	44	1000100
E	.....	69	45	1000101
F	.....	70	46	1000110
G	.....	71	47	1000111
H	.....	72	48	1001000
I	.....	73	49	1001001
J	.....	74	4A	1001010
K	.....	75	4B	1001011
L	.....	76	4C	1001100
M	.....	77	4D	1001101
N	.....	78	4E	1001110
O	.....	79	4F	1001111
P	.....	80	50	1010000
Q	.....	81	51	1010001
R	.....	82	52	1010010
S	.....	83	53	1010011
T	.....	84	54	1010100
U	.....	85	55	1010101
V	.....	86	56	1010110
W	.....	87	57	1010111
X	.....	88	58	1011000
Y	.....	89	59	1011001
Z	.....	90	5A	1011010
[	.....	91	5B	1011011
\	.....	92	5C	1011100
]	.....	93	5D	1011101
^	.....	94	5E	1011110
--	.....	95	5F	1011111
`	.....	96	60	1100000
a	.....	97	61	1100001
b	.....	98	62	1100010
c	.....	99	63	1100011
d	.....	100	64	1100100
e	.....	101	65	1100101
f	.....	102	66	1100110
g	.....	103	67	1100111
h	.....	104	68	1101000
i	.....	105	69	1101001
j	.....	106	6A	1101010
k	.....	107	6B	1101011
l	.....	108	6C	1101100
m	.....	109	6D	1101101
n	.....	110	6E	1101110
o	.....	111	6F	1101111
p	.....	112	70	1110000
q	.....	113	71	1110001
r	.....	114	72	1110010
s	.....	115	73	1110011
t	.....	116	74	1110100
u	.....	117	75	1110101
v	.....	118	76	1110110
w	.....	119	77	1110111
x	.....	120	78	1111000
y	.....	121	79	1111001
z	.....	122	7A	1111010
{	.....	123	7B	1111011
|	.....	124	7C	1111100
}	.....	125	7D	1111101
~	.....	126	7E	1111110
DEL	Delete	127	7F	1111111

A2 Non-volatile Memory Limitations

Note. A non-volatile memory is used to store any parameter changes made via the serial link to ensure that the information is retained during mains interruption or power-down. The memory used is rated at 10^4 write cycles per register and each register is assigned a particular parameter, e.g. Alarm setpoint value. If the number of write cycles to any particular register exceeds this value, the register's contents may not be retained.

To restrict unnecessary use of the non-volatile memory registers the memory enable/disable command (NV) is provided. The command can be used before parameters which do not need to be stored in the non-volatile memory, e.g. frequently changed parameters or parameters which do not have to be retained on power-down.

A3 Block Check Characters

The block check character (BCC) transmitted is determined by the seven least significant bits in the binary arithmetic sum of a complete message (excluding parity bits). All characters transmitted before the BCC must be included in the arithmetic sum. Refer to Appendix A1 for ASCII characters.

A3.1 BCC Example

Message – STXR01A1ETX

Find the ASCII decimal equivalent of each character in the message, calculate the decimal arithmetic sum and hence obtain the binary arithmetic sum.

STX	=	2
R	=	82
0	=	48
1	=	49
A	=	65
1	=	49
ETX	=	3

Arithmetic sum =
298 decimal
100101010 binary

Only the seven least significant bits (LSB) of the binary arithmetic sum are required to determine the BCC:

MSB LSB
10 0101010

'*' is the BCC transmitted –
see Appendix A1

…NOTES

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Fax: +44 (0)1480 470787

United States of America

ABB Instrumentation Inc.
Tel: +1 716 292 6050
Fax: +1 716 273 6207

Italy

ABB Kent-Taylor SpA
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Client Warranty

Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification. Periodic checks must be made on the equipment's condition.

In the event of a failure under warranty, the following documentation must be provided as substantiation:

1. A listing evidencing process operation and alarm logs at time of failure.
2. Copies of operating and maintenance records relating to the alleged faulty unit.

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ABB Kent-Taylor Ltd.
St. Neots
Cambs.
England, PE19 3EU
Tel: +44 (0) 1480 475321
Fax: +44 (0) 1480 217948

ABB Instrumentation Inc.
PO Box 20550, Rochester
New York 14602-0550
USA
Tel: +1 716 292 6050
Fax: +1 716 273 6207

ABB Kent-Taylor SpA
22016 Lenno
Como
Italy
Tel: +39 (0) 344 58111
Fax: +39 (0) 344 56278