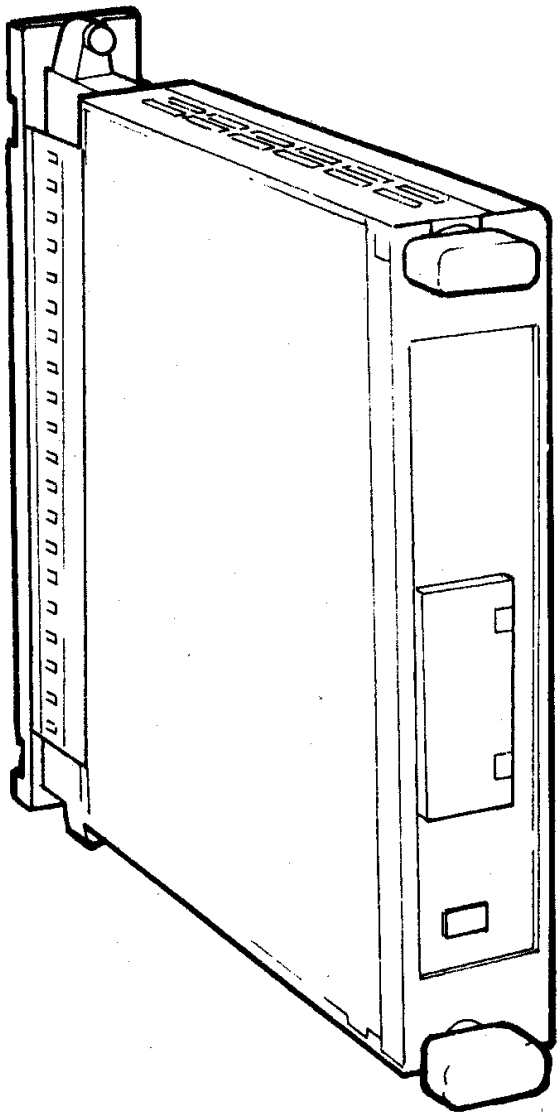
EUROTHERM

ASYNCHRONOUS BI-DIRECTIONAL ADDRESSABLE D TO A AND A TO D CONVERTER TYPES 480-482

INSTALLATION AND OPERATING INSTRUCTIONS



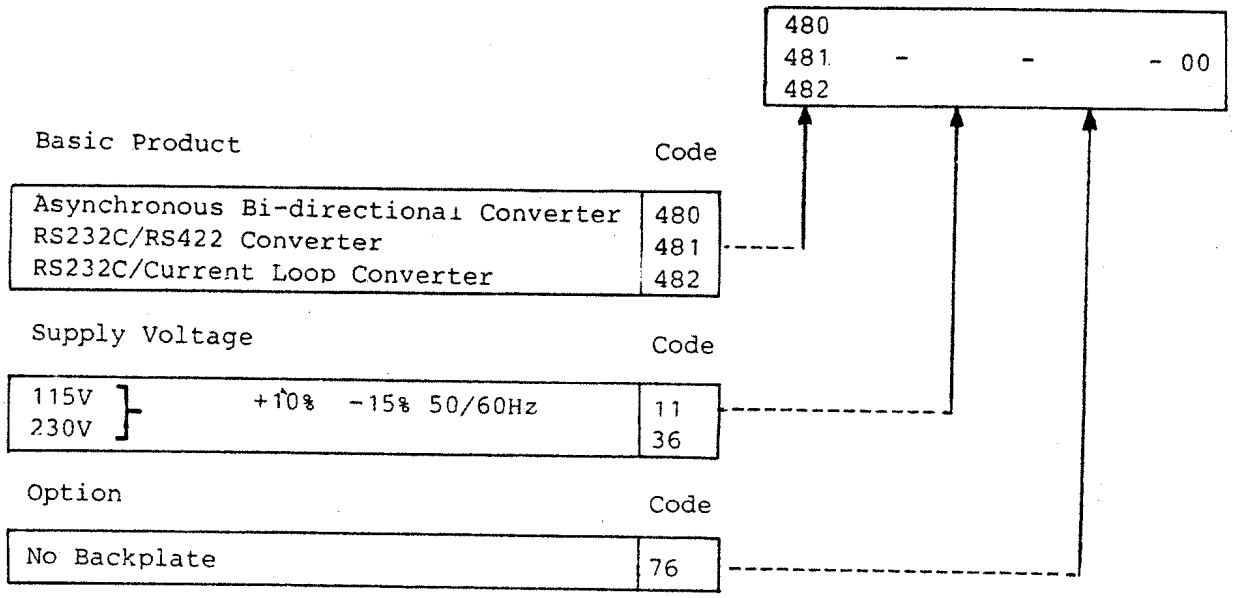
Part No. HA020138

480-482W-2

Contents List

1.0 Ordering Information/Product Identification Code

You are welcome to order by description or by the code below which is a useful checklist.



Note: The standard protocol is ANSI X3.28.
A special protocol is available for use with a computer, video terminal or printer; to drive the screen (or printer).

Example Order Code:
To specify - Asynchronous Bi-directional Converter (480), for supply voltage 240V 50Hz (36), standard protocol. Write:

480-36-00

2.0 GENERAL DESCRIPTION

The 480 module is an addressable digital to analogue and analogue to digital converter allowing the following functions.

Analogue value emitting (output):
A number received on an asynchronous serial link (ASCII message) will be converted to a 0-10V voltage (4 outputs).

Analogue value receiving (input):
A 0-10V voltage will be converted into an ASCII message on an asynchronous serial link (4 inputs).

The digital inputs/outputs may be selected by jumpers as RS232C, RS422 or 0-20mA current loop (passive or active). The digital communication is isolated. The transmission baud rate is also selected by jumpers from 300, 1200, 2400 or 9600 baud, with odd or even parity, again selected by jumpers.

Using the RS422 standard, module address can be selected by jumper to address 256 different modules. Conversion is continuous, with the results stored in RAM. Refresh time is 5ms for outputs and 20ms for inputs.

The MC68705U3 microprocessor used in the module is a special industrial applications device. The microprocessor activity is monitored by a watchdog circuit with automatic reset in case of failure or noise corruption.

2.1 ANSII X3.28 (Standard) Protocol

2.1.1 General Features

This protocol is the same as that of the Eurotherm 820 Controller, TCS and Chessell equipment.

The communication parameters must be selected by the appropriate jumpers:-
data transmission (baud) rate, address, parity.
The instrument address must be unique when used in a multi-drop system. The instrument will only respond to messages that are prefixed with the correct address.
All communications with the 480 instrument are initiated by the supervisory computer and the protocol used corresponds to ANSI X3.28 revision 1976, sub-categories 2.5 and A4.

The protocol defines the standard control procedures to perform the communication function neccessary for:

1) Establish connection - Clear line <EOT>, address instrument, and if data request, the data mnemonic.

2) Message transfer - Data read - data from 480
- Data write - data to 480

3) Terminate connection - Clear line <EOT>.

The characters used to control the link are standard ASCII control characters. There are two sequences associated with this protocol:

1) Polling sequence where a supervisory computer requires information from a 480

2) A selection sequence where a supervisory computer wishes to send new data to a 480.

2.1.2 Polling Sequence

480 instruments are polled for data by the supervisory computer using the polling sequence illustrated in Figure 1. It can be seen from this diagram that the sequence can be divided up into three distinctive procedures which are described in the following sections.

2.1.2.1 Establish Connection Procedure

The supervisor computer initially has Master status and begins by transmitting an eight character polling supervisory message. This message identifies a single tributary instrument and includes other information while the ENQ control character defines the end of the message. The 8 character message is in the following format:

(EOT) (GID) (GID) (UID) (UID) (C1) (C2) (ENQ)

(EOT)
This control character resets all tributary instruments and causes them to examine the next 4 transmitted characters to see if they correspond with their own Group-Unit address identifier.

(GID) (GID)

These data characters are the required Group Address Identifier, repeated for security. The Group identifier can vary from 0 to F (hexadecimal).

(UID) (UID)

These data characters are required Unit-Address Identifier, repeated for security. The Unit Identifier can vary from 0 to F (hexadecimal).

Note: Thus there are 16 possible GID's and 16 possible UID's allowing the supervisor station to address a maximum of 256 tributary instruments.

(C1) (C2)

These two alpha-numeric characters specify the required parameter within the 480 instrument to be interrogated by the Control Station.

(ENQ)

Finally the polling sequence ends with the ENQ control character. It can be seen from Figure 1 that the supervisor computer starts off the polling sequence, initially with an EOT character, to reset all the 480 instruments and causes them to look for a valid Group Unit address identifier. The polling sequence can be re-entered subsequently, if required, after the EOT character as shown. This would be termination procedure, for example, as it can be seen that an EOT character is generated by the supervisor computer as part of the termination procedure itself. It should also be noted that the Supervisor computer can generate EOT characters at any time and restore order on the data link.

2.1.2.2 Message Transfer Procedure

After the Supervisor computer has transmitted the ENQ character at the end of the establish connection procedure, the protocol enters the message transfer procedure. It can be seen from Figure 1 that the message transfer procedure itself can be divided into 2 phases according to which device is acting as the sending station. These two phases are considered as follows:

2.1.2.2.1 Phase A - 480 Instrument Sender

Figure 1 shows that upon initial entry to the message transfer procedure there are three possible replies that the tributary station can make.

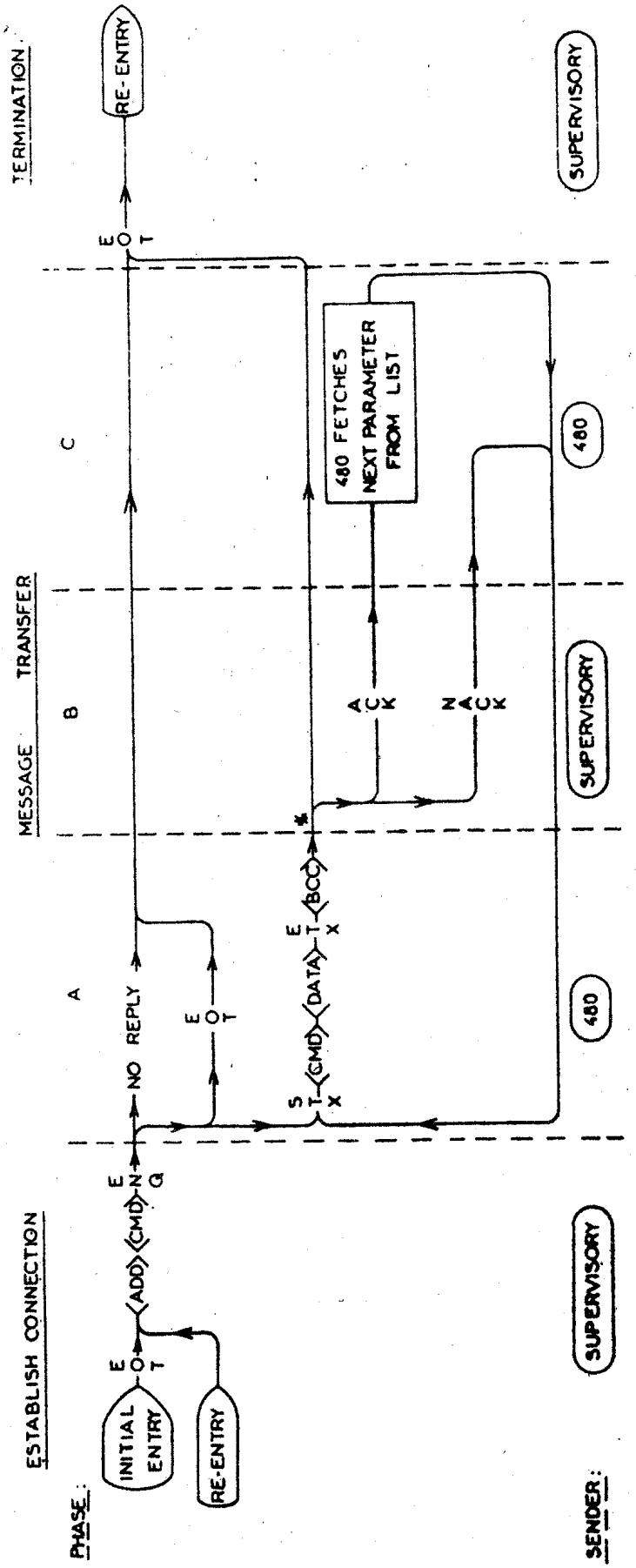


Figure 1. Polling Sequence Diagram.

2.1.2.2.2 No Reply

Under certain circumstances the supervisor computer may not receive any message at all in response to a polling sequence. This can be due to any of the following reasons:

a) Group Unit address parameters are not recognised.

b) An error is found in one of the characters up to and including the ENQ

c) Polled instrument has wrong baud rate or parity set

d) Noise on the communications link or link failure

e) Hardware failure in the polled instrument.

In these cases the Supervisor computer will either find the reply invalid or "timed out" and so it will retain Master Status and enter the Termination procedure of section 2.1.2.3.

2.1.2.2.3 Invalid Reply

A polled instrument may recognise the Group-Unit address parameter transmitted by the Supervisor computer but could find that the 2 command characters do not correspond to any of the valid mnemonic combinations listed in its appropriate command parameter list in Appendix 3. In this case the instrument will terminate its Master Status by sending an EOT Control character to terminate the logical connection. Master Status then reverts to the Supervisor computer which may then Poll or Select another instrument after entering the Termination procedure.

2.1.2.2.4 Valid Reply

Once the 480 instrument has successfully recognised the GID-UID and command parameters and it has a message to send it assumes Master Status and initiates the message Transfer Procedure.
The Supervisor computer assumes Slave Status for the duration of this procedure and the instrument starts off by transmitting the following 10 character sequence:

(STX) (C1) (C2) (D1) (D2) (D3) (D4) (.) (EXT) (BCC)

These characters have the following functions:

(STX)
This control character indicates that the instrument is now the master and is transmitting data in the text mode.

(C1) (C2)
These characters are a repeat of the requested Command Mnemonic specified in the Establish Connection phase. They are repeated for security. The following command mnemonics are available:-
E1 E2 E3 E4 to emit (output) a value on a specified analogue channel.
R1 R2 R3 R4 to receive (input) a value on a specified analogue channel.

(D1) (D2) (D3) (D4)
These parameters are transmitted in engineering units without sign digit.

(.)
A decimal point follows the four digits.

(ETX)
The ETX control character terminates the transmission of the textual part of the message.

(BCC)
This character is transmitted by the instrument at the end of its message to be used by the Supervisor computer for data verification purposes. It is in fact a Longitudinal Redundancy Block Check Control (BCC) performed upon all the characters transmitted after the STX.

Thus the BCC character field excludes the initial STX but includes the following characters:

(C1) (C2) (D1) (D2) (D3) (D4) (.) (ETX)

The BCC is effectively the same as the character generated by taking the exclusive-OR of all the characters transmitted after the STX character up to and including the ETX character.

2.1.2.2.5 Phase B - Supervisor Sender

After the polled instrument has transmitted a valid message in Phase A of the Message Transfer procedure, the protocol enters Phase B where the Supervisor computer becomes the sender. At this point, indicated by * in Figure 1, the instrument will ignore all characters on the data link other than those shown along a specific path. It therefore remains at this point until one of the 3 valid replies are received, as follows:

2.1.2.2.6 Repeat Parameter Facility - NAK

If the Supervisor computer transmits a NAK response it causes the polled instrument to remain in the Message Transfer procedure, retain Master Status and re-transmit the last parameter polled. This response saves time when the Supervisor computer needs to continuously monitor the same parameter from a particular instrument because it is not necessary to enter the Establish Connection procedure before each poll.

2.1.2.2.7 Scroll-Mode Facility - ACK

If the Supervisor computer transmits an ACK response it causes the polled instrument to remain in the Message Transfer procedure, retain Master Status and transmit the next parameter from the appropriate command parameter table in Appendix 3. This response is time saving when the Supervisor computer requires to sequence through several parameters of the same instrument because it is not necessary to enter the Establish Connection procedure before each poll.

2.1.2.2.8 Termination Reply

Figure 1 shows that if the Supervisor computer wishes to stop polling a particular instrument after the Message Transfer procedure, then it may enter the Termination procedure of Section 2.1.2.3 directly and break the logical connection.

2.1.2.3 Termination Procedure

The Termination Procedure of the protocol is entered whenever the Supervisor computer wishes to stop polling a particular Tributary instrument and establish a new logical connection.

Figure 1 shows that this can occur if a 480 instrument does not respond to a poll or if it replies with an EOT during Phase A of the Message Transfer procedure. In these cases the Supervisor computer first assumes Master Status and then transmits an EOT to reset the GID-UID address parameter. After transmitting the EOT, the Supervisor computer may poll a different instrument, perform a selection sequence via Re-Entry points, or wait.

2.1.3 Selection Sequence

The Supervisor computer transmits data to a 480 instrument using the Selection Sequence illustrated in Figure 2.

It can be seen from this diagram that the sequence can be divided up into three distinctive procedures which are described in the following sections:

2.1.3.1 Establish Connection Procedure

The Supervisor computer retains Master Status throughout the whole of the Selection Sequence as it is the originator of all data transfers. The Selection sequence is initiated by the Supervisor computer transmitting the following 5 character messages:

(EOT) (GID) (GID) (UID) (UID)

It can be seen from section 2.1.2.1 that this is identical to the first five characters of the Polling Sequence. Thus:

EOT
The EOT control character resets all instruments.

(GID) GID) (UID) (UID)
These repeated data characters constitute the Group and Unit address identifier parameters of the required instrument.

Figure 2 shows that the initial Entry point of the Selection sequence starts off with the Supervisor computer transmitting an EOT character to reset all the tributary instruments. However, the selection sequence may be Re-Entered after the EOT character, as shown, provided that an EOT character has been transmited within a previous Termination procedure, such as section 2.1.2.3.

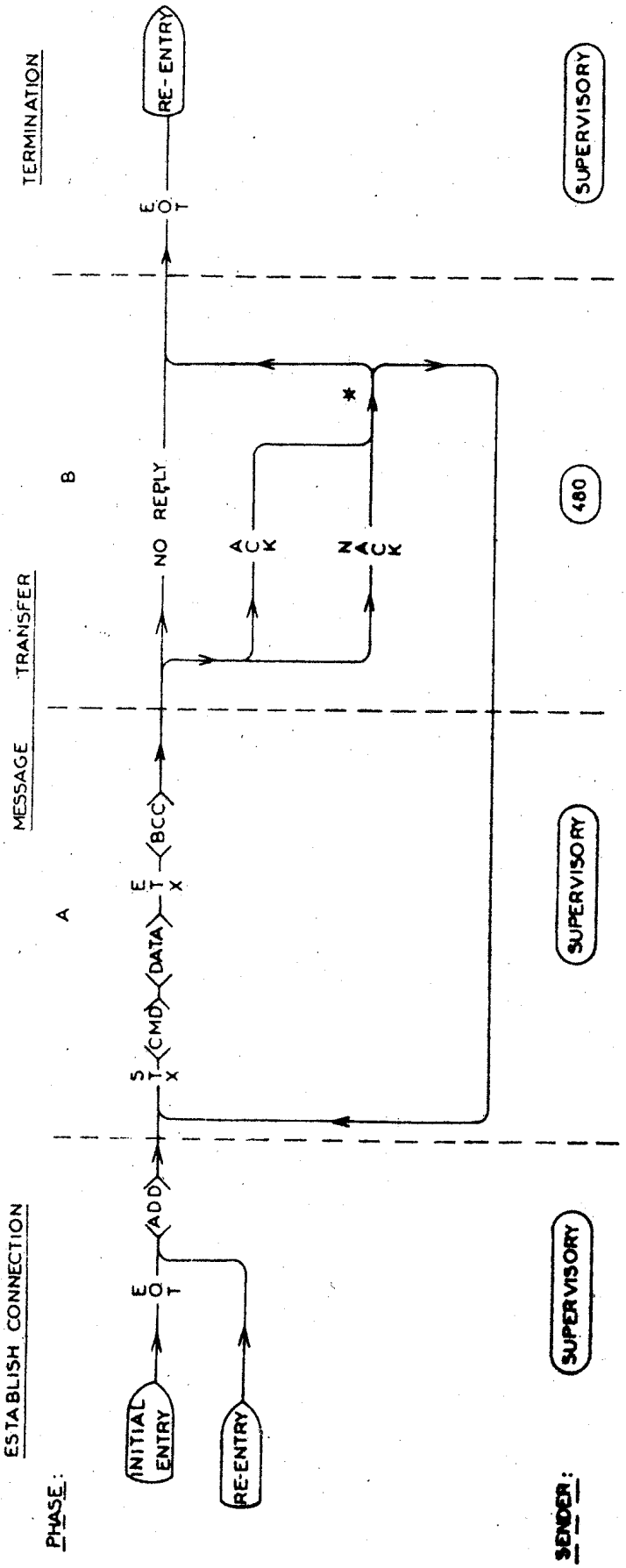


Figure 2. Selection Sequence

2.1.3.2 Message Transfer Procedure

After the Supervisor computer has transmitted the 5 character message of the Establish Connection Procedure, it retains Master Status and enters the Message Transfer Procedure directly. It can be seen from Figure 2 that Message Transfer Procedure itself can be divided up into two phases according to which device is acting as the sender. These two phases are considered as follows:

2.1.3.2.1 Phase A - Supervisor Sender

Figure 2 shows that upon initial entry to the message transfer procedure the Supervisor computer transmits the new parameter value by means of the following message:

(STX) (C1) (C2) (D1) (D2) (D3) (D4) (ETX) (BCC)

It can be seen from section 2.1.2.2.1 that the message is identical to that transmitted by the instrument in response to a poll. The exact significance of each character is as follows:

Note: A decimal point can be included but is not taken into account.

(STX)
The STX Control character identifies the message as being part of a selection sequence. The STX therefore informs the selected instrument that it has slave status and that new data is contained in the characters preceding the ETX control character.

(C1) (C2)
These characters are the command mnemonic of the parameter to be updated by the transfer and can be any one of the following:
E1, E2, E3, E4.
(The monitor only parameters R1, R2, R3, R4 cannot be cancelled).

(D1) (D2) (D3) (D4)
These characters represent the value of the selected parameter to be updated in engineering units without sign digit. A decimal point is accepted but not used. The format of the 'D' characters is identical to those transmitted by an instrument during the Message Transfer procedure of a Polling Sequence.

(ETX)
The ETX control character indicates that transmission of the textual part of the message has been completed.

(BCC)
This is the Longitudinal Redundancy Block Check Control Character (BCC) performed on the last characters previously transmitted. Thus the BCC character field excludes the initial STX but includes the following characters:

(C1) (C2) (D1) (D2) (D3) (D4) (ETX)

The BCC character itself is formed in exactly the same manner as described in the section for a Polling Sequence.

2.1.3.2.2 Phase B - 480 Instrument Sender

After the Supervisor computer has transmitted phase A of the Message Transfer procedure, the protocol enters phase B where the instrument becomes the sender. Figure 2 shows that there are three possible replies that the instrument can make at this stage - Positive Acknowledgement, Negative Acknowledgement or No Response, as detailed below.

2.1.3.2.3 Positive Acknowledgement - (ACK)

When the instrument, identified by the GID-UID address parameters of the Establish Connection procedure, has received the message transmitted by the Supervisor computer during phase A of the Message Transfer procedure, it performs the following tasks:

1. Verifies that the BCC character corresponds to the data pattern actually received. If not, then it

2. Verifies that the (C1) (C2) command parameters correspond with a valid mnemonic combination. If there are errors, then it

3. Verifies that the data specified by the (D1) (D2) (D3) (D4) characters contain valid data. If so, then it

4. Updates the selected parameter with the new value contained in the data field of the message.

Only when all of these tasks have been successfully completed does the instrument send the ACK response back to the Supervisor computer. This signifies that the message was correctly received, verified, and the parameter updated by the instrument.

Upon receipt of the ACK the Supervisor may enter the Termination procedure of section 2.1.2.3 or may remain in the Message Transfer procedure. If the Supervisor computer stays in the Message Transfer procedure it may send another message to the same instrument without having to re-establish the logical connection. This is known as 'Fast Select' sequence and saves time when the Supervisor computer wishes to continuously update parameters in the same instrument because it is not necessary to enter the Establish Connection procedure before each selection.

2.1.3.2.4 Negative Acknowledgement - (NAK)

The instrument selected by the Establish Connection procedure may detect an error in the message transmitted by the Supervisor computer during phase A of the message transfer procedure. An error may occur for one or more of the following reasons:

1. The comand parameter defined by the (C1) (C2) characters may not be a valid mnemonic combination.

2. The command parameter specified by the (C1) (C2) characters may be a monitor only parameter.

3. The data field specified by the (D1) (D2) (D3) (D4) characters may be invalid or out of range.

4. The BCC character may not correspond with the data actually received by the instrument or a parity error may exist, due to line noise etc.

If any of these conditions are detected by the instrument it sends back a NAK response to the Supervisor computer. This signifies to the Supervisor that the message received by the instrument contained an error.

Upon receipt of the NAK the Supervisor may enter the Termination procedure of section 2.1.4 or may remain in the Message Transfer procedure and transmit the same or a new message by means of the fast select sequence. If the Supervisor stays in the Message Transfer procedure it may send a message to the same instrument without having to re-establish the logical connection. The use of this 'Fast Select' sequence saves time when the Supervisor wishes to attempt repeated tramsmissions of a message after the instrument has found an error, because it is not necessary to enter the Establish Connection procedure before attempting a repeat.

It can be seen from Figure 2 that on 'Fast Select' after an ACK or NAK reply the instrument will ignore all transmitted characters except STX or EOT. i.e. at the point marked * the instrument ignores all characters on the data link other than those shown along the two specific paths.

2.1.3.2.5 No Response

Under certain circumstances the Supervisor computer may not receive any message at all in response to the selection sequence. This can be due to any of the following reasons:

1. Group-Unit address parameters not recognised

2. An error is found in any of the characters up to and including the BCC

3. Selected instrument has the wrong Baud Rate

4. Hardware failure in the selected instrument

In these cases the Supervisor computer will either find the reply invalid or "timed out" and so it will enter the termination procedure.

2.1.4 Termination Procedure

The termination procedure of the protocol is entered whenever the Supervisor computer wishes to stop selecting a particular instrument and establish a new logical connection, or when order has to be re-established on the data link after a transfer.

2.1.4.1 Break Logical Connection

Figure 2 shows that after the instrument has transmitted an ACK or NAK response in Phase B of the Message Transfer procedure , then the Supervisor computer may enter the Termination procedure. The Supervisor retains Master Status and transmits an EOT character to reset all tributary instruments back to looking for the next GID-UID address parameter. After transmitting the EOT the Supervisor may select a different instrument, perform a polling sequence via Re-Entry points, or wait.

2.1.4.2 Re-Establish The Link

Figure 2 also shows that if the instrument does not respond at all to the selection sequence, the Supervisor computer also enters the Termination procedure. It retains Master Status, transmits an EOT character and may then re-select or poll via re-entry points or wait.

2.2 SPECIAL PROTOCOL

2.2.1 General Features

This protocol was designed to be used with a computer, with a video terminal or with a keyboard printer. In this case the 480 drives the screen (or printer).
This special protocol is different from the ANSI X3.28 protocol which needs a checksum.

Each module has a 2 hexadecimal digit address <adr> such that:

(00)h <= <adr> <= (FF)h

On each module there are 4 analogue inputs numbered 1 to 4 shown here as <channel>.
On each module there are also 4 analogue outputs numbered 1 to 4 also shown as <channel> (the transmissipn direction differentiates inputs from outputs).

LF and EOT characters must have the same signification.
A character chain must always be ended by EOT or LF.

A character chain can never exceed 18 characters.

A character chain begins with STX, but this STX character must be deleted or replaced by a space character if a video terminal is used.

The space separator character is always optional.
The space characters are ignored.

In case of format or syntax error, the analogue output values are not changed.

If the character chain does not start with STX, the protocol is automatically that of a video terminal.

If no module answers a specified address, the communications must be re-initialised by EOT.

2.2.2 Set Point Emit (Output) Procedure

Digital to Analogue

2.2.2.1 Without Module Address

(METTLER weighing scales protocol or URGENCY procedure).

2.2.2.1.1 From A Computer:

COMPUTER :----->STX/S/[..sp..]/<NUMBER>/[..sp..]/EOT

+ or - sign can lead the number.
Only numbers >= 0 are converted.
Negative numbers are taken as 0.
The first decimal digit encountered is recognised as the start of the number.
The number cannot exceed the number of decimal digits chosen by the appropriate jumpers.
Spaces are ignored.
All characters between <NUMBER> and EOT are ignored.

NO REPLY, NO ECHO, NO NAK.

RESULT: ALL the outputs of ALL the modules follow the <NUMBER> value.

2.2.2.1.2 From A V.D.U.

V.D.U. ----->S/[..sp..]/<NUMBER>/[..sp..]/LF

NOTE.
Space characters are always optional.
All the characters between <NUMBER> and LF are ignored.
This protocol works with METTLER PE6000 weighing scales or with similar protocols.

RESULT: same as 2.2.2.1.1

2.2.2.2 With Module Address

2.2.2.2.1 Without Channel Address

2.2.2.2.1.1 From A computer

COMPUTER :----->STX/E/<adr>/EOT

ANSWER:----->E/<adr>

COMPUTER :----->STX/<NUMBER>/EOT

ANSWER:----><NUMBER>/EOT

NAK answer indicates a format error.

RESULT: ALL the ADDRESSED module outputs follow the <NUMBER> value.

2.2.2.2.1.2 From A V.D.U.

V.D.U. :---->E/<adr>/LF

ANSWER:---->E/:/<adr>/sp/sp/

V.D.U. :---><NUMBER>/LF

? indicates a format error.

ANSWER: All characters are echoed and followed by a CR.

RESULT: same as 2.2.2.2.1.1

2.2.2.2.2 With A Channel Address

2.2.2.2.2.1 From A computer

COMPUTER :---->STX/E/<adr>/<channel>/EOT

ANSWER:---->E/<adr>/<channel>

NOTE.
If the address is correct but not the channel, NAK is echoed.
In this case, the communication must be re-initialised by EOT.

COMPUTER :---->STX/<NUMBER>/EOT

ANSWER:---><NUMBER>/EOT

NAK indicates a format error

RESULT: Only the specified output on the addressed module follows the <number> value.

2.2.2.2.2.2 From A V.D.U.

V.D.U. :---->E/<adr>/<channel>/LF

ANSWER:---->E/:/<adr>/sp/sp/<channel>/sp

? indictaes that the channel does not exist. LF must be sent to re-initialise the communication.

V.D.U. :---><NUMBER>/LF

ANSWER: All characters are echoed and followed by CR.
? shows a format error.

RESULT: same as 2.2.2.2.2.1

2.2.3 Receive Procedure

Analogue to Serial

2.2.3.1 Without Channel Address

2.2.3.1.1 From A Computer

COMPUTER :---->STX/R/<adr>/EOT

ANSWER:---->R/<adr>/sp/<value1>/sp/<value2>/sp/<value3>/sp/<value4>/EOT

RESULT: The 4 analogue input values are sent using a 4 digit format.

2.2.3.1.2 From A V.D.U.

V.D.U. :---->R/<adr>/LF

ANSWER:---->R/:/<adr>/sp/sp/sp/1/:/<value1>/sp/
2/:/<value2>/sp/3/:/<value3>/sp/4/:/<value4>/CR/LF

RESULT: same as 2.2.3.1.1

2.2.3.2 With A Channel Address

2.2.3.2.1 From A Computer

COMPUTER :---->STX/R/<adr>/<channel>/EOT

ANSWER:---->R/<adr>/<channel>/sp/<value>/EOT

RESULT: The specified channel value is sent on the serial link.

2.2.3.2.2 From A V.D.U.

V.D.U.:---->R/<adr>/<channel>/LF

ANSWER:---->R/:/<adr>/sp/sp/<channel>/sp/sp/<value>/CR/LF

RESULT: same as 2.2.3.2.1

3.0 Specification

Quoted at 25°C unless otherwise stated

Power Supply

	115/230V +10% -15% 50/60Hz link selectable.

Digital Input/Output

Serial Asynchronous Link	Transmission Standard. RS232C, RS422, 0-20mA current loop (passive or active). Digital communication is isolated. Baud Rate. 300, 1200, 2400 or 9600 baud, jumper selectable. Parity. Odd or even, jumper selectable.
Protocols	Standard. ANSI X3.28 used to transmit the address and numerical data.Data transmission as ASCII chains. Special. For use with a computer, video terminal or printer.
Addressing	Module address is jumper selectable. RS422 allows the address of 256 modules on a single communications bus.

Analogue Outputs/Inputs

Outputs	Four 0-10V multiplexed outputs with a sample and hold. The scales (2 to 5 digit) are jumper selectable. (Not ANSII X3.28)
Inputs	Four 0-10V voltage inputs.
Accuracy	12 bit conversion using temperature compensated reference (0-60°C).
Conversion	Continuous conversion (input & output) with the result stored in RAM. Refresh time 5ms for outputs, 20ms for inputs. A logic signal with adjustable delay indicates that the ASCII message conversion has been completed.

4.0 INSTALLATION

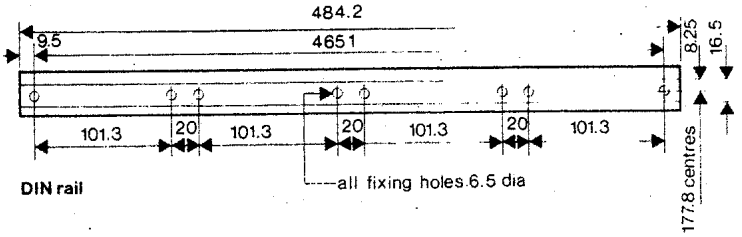
4.1 Mechanical

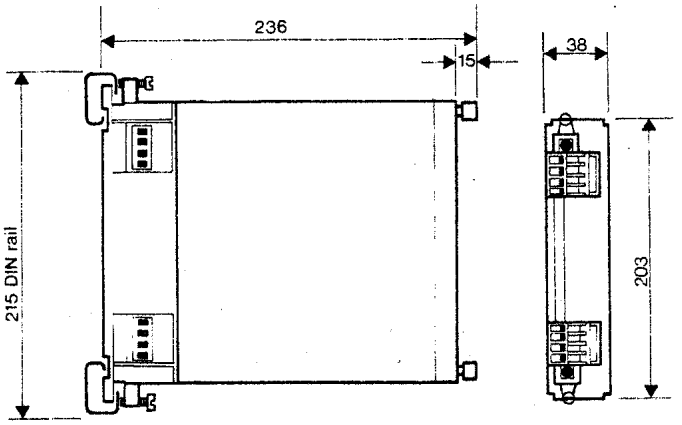
For each converter unit a pressed steel baseplate mounts on a pair of DIN rails or onto a wall or bulkhead, and the unit plugs into its baseplate. Connections for customer wiring form part of the baseplate, wiring being carried out from the front with the unit unplugged.

DIN Rail Mounting

On the baseplate, slacken the topmost screw and the one above the earth screw, one or two turns. Insert the top edge of the baseplate under the top lip of the upper DIN rail and move the baseplate down to a vertical position.
Now the bottom edge of the baseplate can be slotted downwards into the DIN rail. Move the baseplate laterally into position and tighten the two screws.

Dimensional Details





All dimensions in millimetres

Front elevation is drawn with unit removed

4.2 General Features

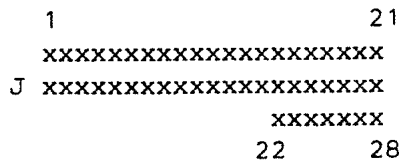
The 480 module is fully configurable by the user.
The following configuration possibilities are available:

Communication Standard Configuration:-

RS232C Active Current Loop
RS422 Passive Current Loop
Address Configuration:-
Each module has a 2 hexadecimal digit address <adr> such that:
(00)h <= <adr> <= (FF)h
Baud Rate Selection
300, 1200, 2400, 9600 baud
0-10V Scale Selection
2, 3, 4 or 5 digit (not for ANSI X3.28 protocol).
Parity Selection
Odd or even
Conversion or Reset Indicators
Output level 5V or 15V selection.

4.3 Transmission Standard Selection

J Jumpers:



A star * indicates the setting of the instrument when shipped.

	RS232C*	RS422	Active C.L.	Passive C.L.
J1				
J2				
J3	x			
J4			x	x
J5		x		
J6	x			
J7			x	x
J8		x		
J9			x	
J10			x	
J11	x			
J12	x			
J13			x	x
J14			x	x
J15			x	x
J16			x	x
J17			x	
J18			x	
J19		x		
J20		x		
J21		x		
J22		x		
J23		x		
J24				x
J25				x
J26				
J27				
J28				

4.4 481 Module

The 481 module can be configured to a simple RS232C/RS422 converter. In this case the following jumpers are positioned:

J1, J2, J5, J8, J11, J12, J22, J23, J26, J27, J28

The connector wiring is then:

```
B11 ----> RS232C input
B10 ----> RS232C output
B8  ----> RS232C common

B4  ----> +
B5  ----> - RS422 output

B6  ----> -
B7  ----> + RS422 input

B18 ---->
B19 ----> Power Supply
```

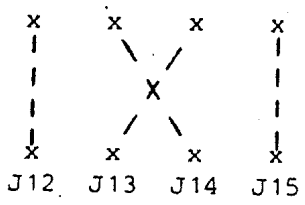
IMPORTANT: THE MICROPROCESSOR MUST BE REMOVED.

4.5 482 Module

The 480 instrument can also be configured as a simple RS232C/Current Loop Converter. In this case the following jumpers are positioned:

J1, J2, J4, J7, J11, J12, J15, J16

J13, J14 must cross.



Passive Current Loop (Not Isolated)

J24, J25

Active Current Loop (Not Isolated)

J9, J10, J17, J18

Resistor R21 must be removed.

The connector wiring is then:

B11 ----> RS232C Input

B10 ----> RS232C Output

B8 ----> RS232C Common

B4 ----> +
Active C.L.
B5 ----> -

Passive C.L. TXD
+

B6 ----> +
-
Active C.L.
B7 ----> -

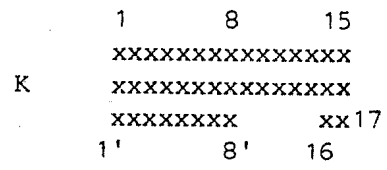
Passive C.L. RXD
+

B18 ---->
Power Supply
B19 ---->

IMPORTANT: THE MICROPROCESSOR MUST BE REMOVED.

4.6 General Configuration

4.6.1 K Jumpers.

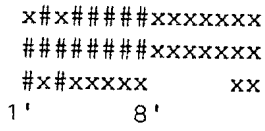


4.6.1.1 Address Configuration

From 1 to 8 and 1' to 8' K jumpers are used to configure the hexadecimal address.

A logical 1 is configured by a jumper in position 1 to 8. On the other hand a logical 0 is configured by the position 1' to 8'.

example: address 5F ----> 1 8 15 (5F)h = (01011111) binary



* Standard delivery configuration: 00

4.6.1.2 Baud Rate Transmission

Baud	K9	K10
300		
1200		x
2400	x	
9600 *	x	x

4.6.1.3 Parity

	K11
* Even	
Odd	x

4.6.1.4 Scale Range

	K12	K13
2 Digit		
3 Digit		x
4 Digit	x	
5 Digit *	x	x

(Not used with ANSI X3.28 Protocol).

4.6.1.5 Reset Indicator Voltage

	K14	K16
5V		x
15V *	x	

Output on Terminal B2.

4.6.1.6 Conversion Indicator Voltage

	K15	K17
5V		x
15V	x	

Output on Terminal B9.

4.6.1.7 Power Supply

The 110V or 220V power supply connection is between terminals B18 and B19.

A tnree link configuration sets the power voltage.

Link 2		220V
Link 1	and 3	110V

The transformer is protected by a fuse. A neon lamp indicates fuse failure.

4.7 Connector Wiring

B1	0VM (analogue)
B2	RESET Indicator
B3	Not Used
B4	TXD_RS232C//TXD+_RS422//TXD+_C.L. ACT//TXD-_C.L. PASS.
B5	TXD-_RS422//TXD-_C.L. ACT.//TXD+_C.L. PASS.
B6	RXD_RS232//RXD-_RS422//RXD+_C.L. ACT.//RXD-_C.L. PASS.
B7	RXD+_RS422//RXD-_C.L. ACT.//RXD+_C.L. PASS.
B8	OVT (Transmission)
B9	Conversion Indicator
B10	AI1]
B11	AI2] >--- 0-10V Input
B12	AI3]
B13	AI4]
B14	AO1]
B15	AO2] >--- 0-10V Output
B16	AO3]
B17	AO4]
B18	Phase
B19	Neutral
B20	Earth

Communications Connector Wiring

RS232C	TXD ----> B4	**Active** C.L.	TXD+ ----> B4
	RXD ----> B6		TXD- ----> B5
	Common ----> B8		RXD+ ----> B6
			RXD- ----> B7
RS422	TXD+ ----> B4		
	TXD- ----> B5	Passive C.L.	TXD- ----> B4
	RXD- ----> B6		TXD+ ----> B5
	RXD+ ----> B7		RXD- ----> B6
			RXD+ ----> B7

5.0 Diagnostic Socket

1	+15VM
2	+10V ref
3	-15VM
4	0V ref
5	+5VM
6	AO4
7	AO3
8	AO2
9	AO1
10	AI1
11	AI2
12	AI3
13	AI4
14	Conversion Indicator
14	RESET Indicator
16	
17	
18	0VM
19	
20	

APPENDIX 1

FLOWCHART TERMINOLOGY

The symbols used in the flowchart sequences have the following meanings:

EOT, ENQ, STX, ETX, ACK and NAK are ASCII control characters.

<ADD> is the address of the 480 module being transmitted to in the form of the group identifier followed by the unit identifier, (GID.UID). The address consists of four characters A1, A1, A2, A2 . A1 and A2 are hexadecimal numbers between 0 and F and are selected via the jumpers as A1.A2 (eg 5F). The message repeats each Group and Unit identifier for security. The address format (GID) (GID) (UID) (UID) is transmitted as ASCII.

<CMD> is the two character mnemonics C1, C2 which define the required parameter in the 480 (e.g. E1 to emit (output) an analogue value on channel 1, R2 to receive (input) an analogue value on channel 2).

<DATA> consists of a number of ASCII characters D1, D2, D3, D4 etc. and is the value of the parameter. The maximum number of digits is four (decimal point is not counted).

<BCC> is the Block Check Character and is effectively the same as the character generated by taking the exclusive - OR of all the characters transmitted after the STX character up to and including the ETX character.

APPENDIX 2

CONTROL CHARACTERS

EOT - End of Transmission (ASCII code 04 hex) (Control D)

This is effectively a reset character and terminates a message transfer. When used by the host it restores order to the link and makes all tributary stations (480's) examine the next four characters for their address.

ENQ - Enquiry (ASCII code 05 hex) (Control E)

This character terminates the host message, initiates the polling sequence and passes master status to the addressed 480.

STX - Start of Text (ASCII code 02 hex) (Control B)

This character denotes the beginning of the string that is to be passed to the station that holds slave status. When sent by the host it also initiates the selection sequence.

ETX - End of Text (ASCII code 03) (Control C)

This is the end of string character. It also informs the receiving station that the next byte will be a BCC character.

ACK - Acknowledge (ASCII code 06 hex) (Control F)

This is the reply character sent by an 480 which recognises it's address and the preceeding message had: no parity errors, a BCC character that is correct and valid parameter mnemonics with relevant data. The host can use this reply to examine the value of the next parameter in a parameter list without having to establish a new link with the same 480.

NAK - Negative Acknowledge (ASCII code 15 hex) (Control U)

This is the reply character sent by an 480 which recognises it's address but has detected an error in the preceeding message.
The host can use this reply for the same reason, however, as the 480 repeats the parameter polled with it's current value. A host can use this reply to continuously monitor a particular parameter.

APPENDIX 3

Parameters Accessible Via External Link

Parameter	Function	Note
E1	Emit (output) an analogue value on AO1	
E2	Emit (output) an analogue value on AO2	
E3	Emit (output) an analogue value on AO3	
E4	Emit (output) an analogue value on AO4	
R1	Receive (input) an analogue value on AI1	Monitor only
R2	Receive (input) an analogue value on AI2	Monitor only
R3	Receive (input) an analogue value on AI3	Monitor only
R4	Receive (input) an analogue value on AI4	Monitor only.

APPENDIX 4

Binary Number / Alpha Numeric Equivalent

BINARY NUMBER	ALPHA NUMERIC CHARACTER
0 0 0 0	0
0 0 0 1	1
0 0 1 0	2
0 0 1 1	3
0 1 0 0	4
0 1 0 1	5
0 1 1 0	6
0 1 1 1	7
1 0 0 0	8
1 0 0 1	9
1 0 1 0	A
1 0 1 1	B
1 1 0 0	C
1 1 0 1	D
1 1 1 0	E
1 1 1 1	F

APPENDIX 5

ASCII Control Codes

CHARACTER	CONTROL	7-BIT BINARY CODE	HEXA-DECIMAL	DECIMAL CODE
NUL - Null		000 0000	00	0
SOH - Start of Heading	A	000 0001	01	1
STX - Start of Text	B	000 0010	02	2
ETX - End of Text	C	000 0011	03	3
EOT - End of transmission	D	000 0100	04	4
ENQ - Enquiry	E	000 0101	05	5
ACK - Acknowledge	F	000 0110	06	6
BEL - Bell	G	000 0111	07	7
BS - Backspace	H	000 1000	08	8
HT - Horizontal tabulation	I	000 1001	09	9
LF - Line feed	J	000 1010	0A	10
VT - Vertical tabulation	K	000 1011	0B	11
FF - Form feed	L	000 1100	0C	12
CR - Carriage return	M	000 1101	0D	13
SO - Shift Out	N	000 1110	0E	14
SI - Shift In	O	000 1111	0F	15
DLE - Data link escape	P	001 0000	10	16
DC1 - Device control 1	Q	001 0001	11	17
DC2 - Device control 2	R	001 0010	12	18
DC3 - Device control 3	S	001 0011	13	19
DC4 - Device control 4 (stop)	T	001 0100	14	20
NAK - Negative acknowledge	U	001 0101	15	21
SYN - Synchronous idle	V	001 0110	16	22
ETB - End of Trans BLOCK	W	001 0111	17	23
CAN - Cancel	X	001 1000	18	24
EM - End of Medium	Y	001 1001	19	25
SUB - Substitute	Z	001 1010	1A	26
ESC - Escape		001 1011	1B	27
FS - File Separator		001 1100	1C	28
GS - Group Separator		001 1101	1D	29
RS - Record Separator		001 1110	1E	30
US - Unit Separator		001 1111	1F	31
DEL - Delete, Rubout		111 1111	7F	127

CHARACTER	7-BIT BINARY CODE	HEXA-DECIMAL	DECIMAL CODE
- space	010 0000	20	32
! - exclamation mark	010 0001	21	33
" - double quotation mark	010 0010	22	34
# - hash (£ sign - ISO 7)	010 0011	23	35
$ - dollar sign (or £ sign)	010 0100	24	36
% - percentage sign	010 0101	25	37
& - ampersand	010 0110	26	38
' - single quotation mark	010 0111	27	39
(- left-hand bracket (round)	010 1000	28	40
) - right-hand bracket(round	010 1001	29	41
* - asterisk	010 1010	2A	42
+ - plus	010 1011	2B	43
, - comma	010 1100	2C	44
- - minus	010 1101	2D	45
. - period	010 1110	2E	46
/ - oblique	010 1111	2F	47
0	011 0000	30	48
1	011 0001	31	49
2	011 0010	32	50
3	011 0011	33	51
4 > numerals	011 0100	34	52
5	011 0101	35	53
6	011 0110	36	54
7	011 0111	37	55
8	011 1000	38	56
9	011 1001	39	57
: - colon	011 1010	3A	58
; - semi-colon	011 1011	3B	59
< - less than	011 1100	3C	60
= - equals	011 1101	3D	61
> - greater than	011 1110	3E	62
? - question mark	011 1111	3F	63

CHARACTER	7-BIT BINARY CODE	HEXA-DECIMAL	DECIMAL CODE
@ - "at" sign	100 0000	40	64
A	100 0001	41	65
B	100 0010	42	66
C	100 0011	43	67
D	100 0100	44	68
E	100 0101	45	69
F	100 0110	46	70
G	100 0111	47	71
H	100 1000	48	72
I	100 1001	49	73
J	100 1010	4A	74
K	100 1011	4B	75
L	100 1100	4C	76
M	100 1101	4D	77
N upper case letters	100 1110	4E	78
O	100 1111	4F	79
P	101 0000	50	80
Q	101 0001	51	81
R	101 0010	52	82
S	101 0011	53	83
T	101 0100	54	84
U	101 0101	55	85
V	101 0110	56	86
W	101 0111	57	87
X	101 1000	58	88
Y	101 1001	59	89
Z	101 1010	5A	90
[- LH bracket (square)	101 1011	5B	91
/- oblique	101 1100	5C	92
]- RH bracket (square)	101 1101	5D	93
^- up arrow (common usage)	101 1110	5E	94
- underline (common usage)	101 1111	5F	95

CHARACTER	7-BIT BINARY CODE	HEXA-DECIMAL	DECIMAL CODE
`	110 0000	60	96
a	110 0001	61	97
b	110 0010	62	98
c	110 0011	63	99
d	110 0100	64	100
e	110 0101	65	101
f	110 0110	66	102
g	110 0111	67	103
h	110 1000	68	104
i	110 1001	69	105
j	110 1010	6A	106
k	110 1011	6B	107
l	110 1100	6C	108
m	110 1101	6D	109
n lower case letters	110 1110	6E	110
o	110 1111	6F	111
p	110 0000	70	112
q	111 0001	71	113
r	111 0010	72	114
s	111 0011	73	115
t	111 0100	74	116
u	111 0101	75	117
v	111 0110	76	118
w	111 0111	77	119
x	111 1000	78	120
y	111 1001	79	121
z	111 1010	7A	122
{ - LH bracket (curly)	111 1011	7B	123
¦ - vertical broken line	111 1100	7C	124
} - RH bracket (curly)	111 1101	7D	125
~ - tilde	111 11100	7E	126

APPENDIX 6

INSTALLING DIGITAL COMUNICATIONS

1. RS422 Serial Link Interface Conditions

Fail safe and Termination Requirements
The transmitter positive (TX +), rear terminal B4, and transmitter negative (TX-), rear terminal B5, of the 480's are connected to the positive and negative inputs of a remote RS422 receiver. For input protection, connections are normally made via 1K resistors and to provide fail safe operation, the TX- line of the 480 (RX- line of the supervisor) must be pulled positive by a resistor of value twice the terminating resistance (2 RT) with the TX+ line of the 480 (RX+ line of the supervisor) being held at ground by a similar resistor. If a terminal resistor is not used then the value should be approximately 1000 times the bias voltage. e.g. For 5V use 4.7K ohms.

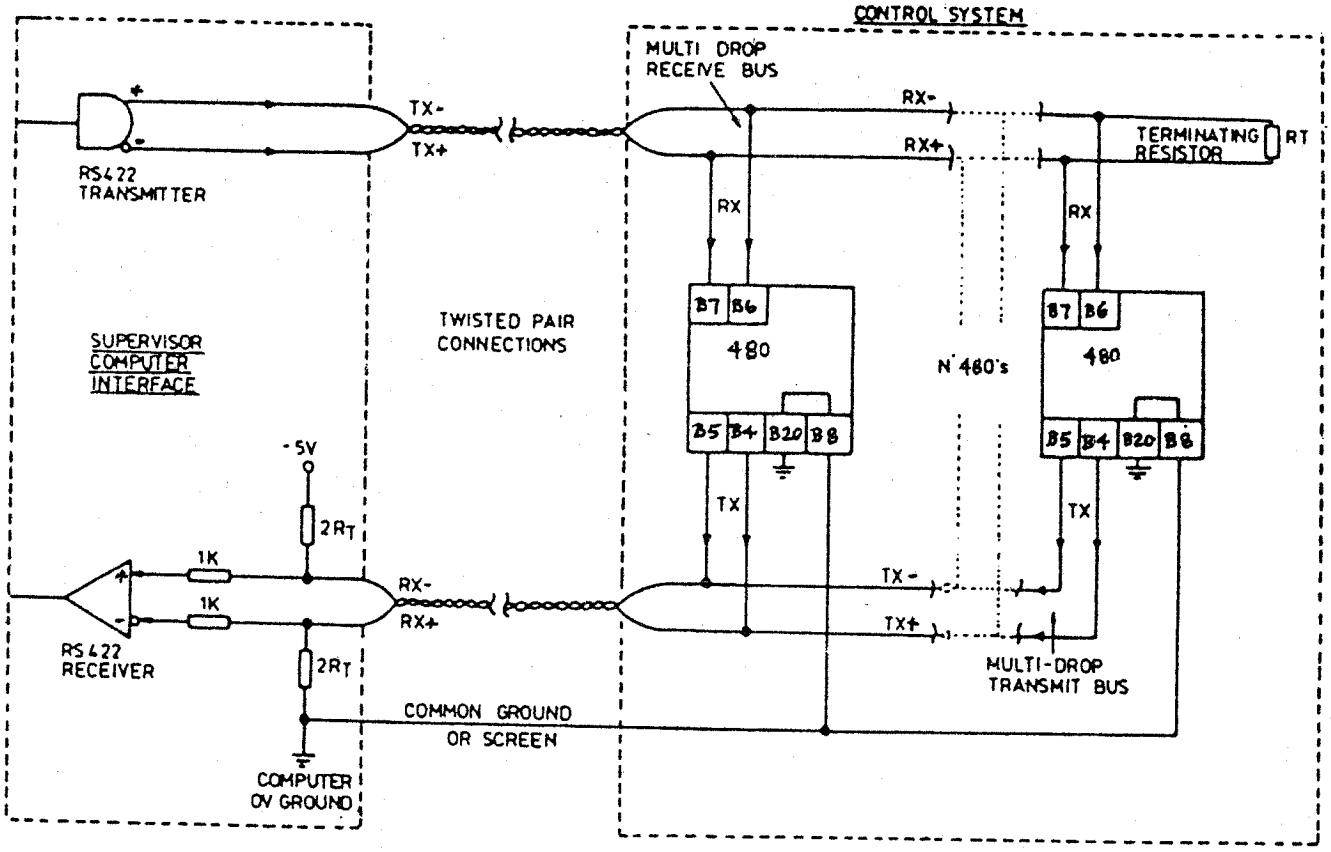


Figure 1 RS422 Data Bus Connections

Fail safe operation is required because when no communication is taking place the transmitter of each 480 is tristated, and it is necessary therefore to bias the receiver inputs into their idle states. A similar condition would exist if any 480 was powered down or removed from its baseplate.

For maximum power transfer the line should be terminated by a load with the same impedance as the characteristic impedance of the line. RS422 specifies a maximum line resistance of 120 ohms, however, a

terminating resistor(RT) of this value would reduce the signal level as well as the drive capability of the remote transmitter. A value of RT around twice this,(e.g. 220 ohms) would be suitable for most applications, with fail safe resistors of 470 ohms.

With the low data rates employed on the 480 it is possible, with short line lengths in some applications, for the line to be not terminated where extra drive capability is required.

Earthing Requirements

A reference line is required when using multiple transmitters for common mode reasons. The simplest way of achieving this is via the mains earth where both the 480 (terminal B20) and the supervisor have their 0V lines connected to earth. This is the preferred method when the two earth grounds have a potential difference of less than four volts.

Alternatively a common line has to be run between the 480 (terminal B8) and the supervisor, and to avoid earth loops, this line is earthed at the quieter of the two earth grounds. This is the preferred method when the two earth grounds have a potential difference of more than four volts.

2. RS232 Interface Requirements

The use of biasing and termination resistors are inherent in this standard. RS232 uses an unbalanced line so a common wire is always connected between the 480 and the supervisor. One end of this wire is earthed (most computers have their 0V grounded) and can be run through a cable screen to provide added noise immunity for the signal lines.

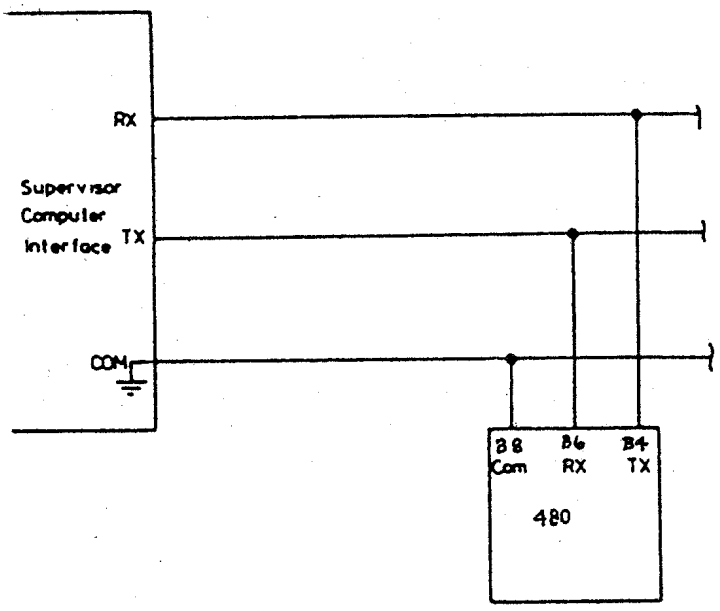
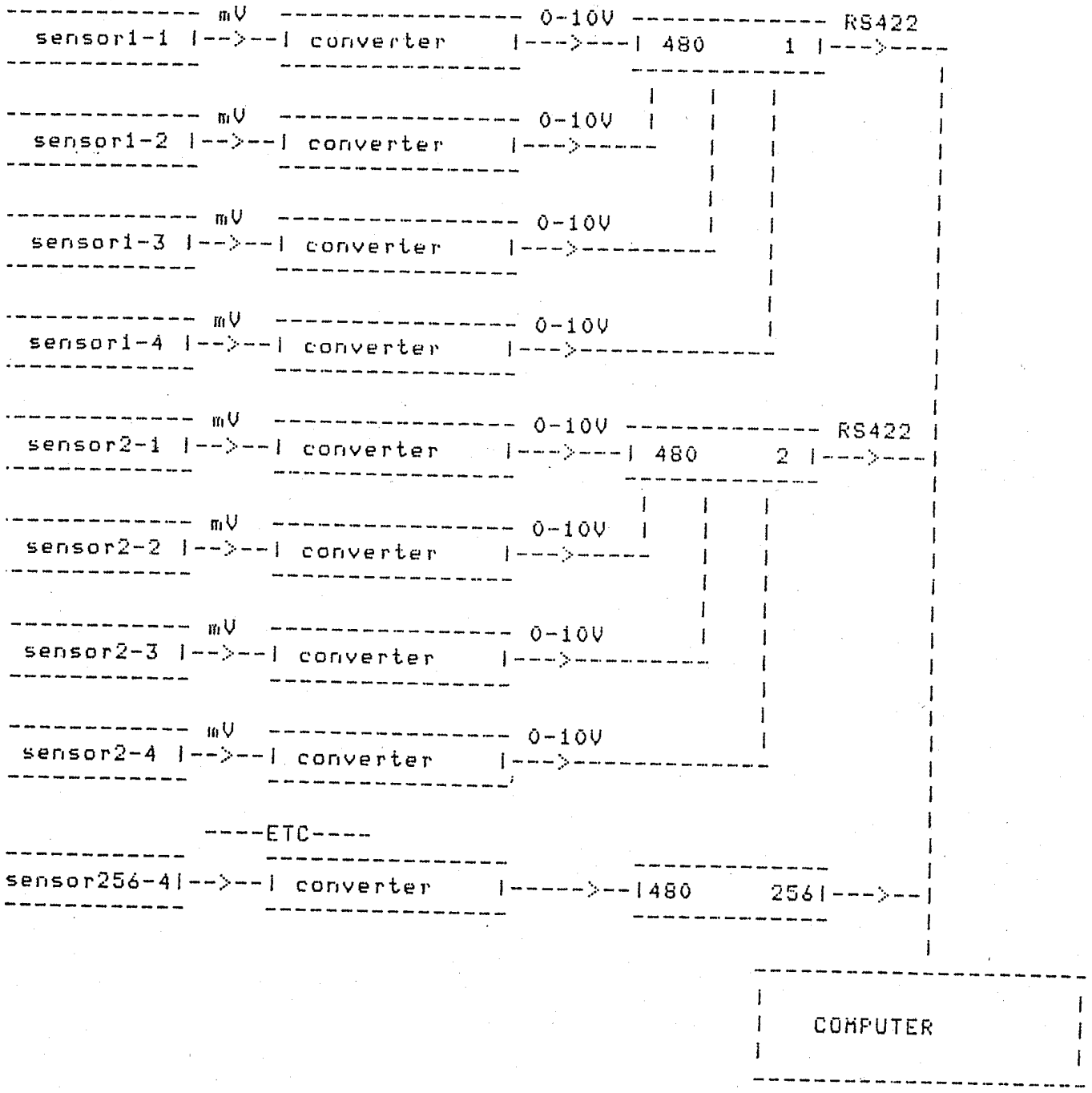


Figure 2 RS232 Data Bus Connections

APPENDIX 7

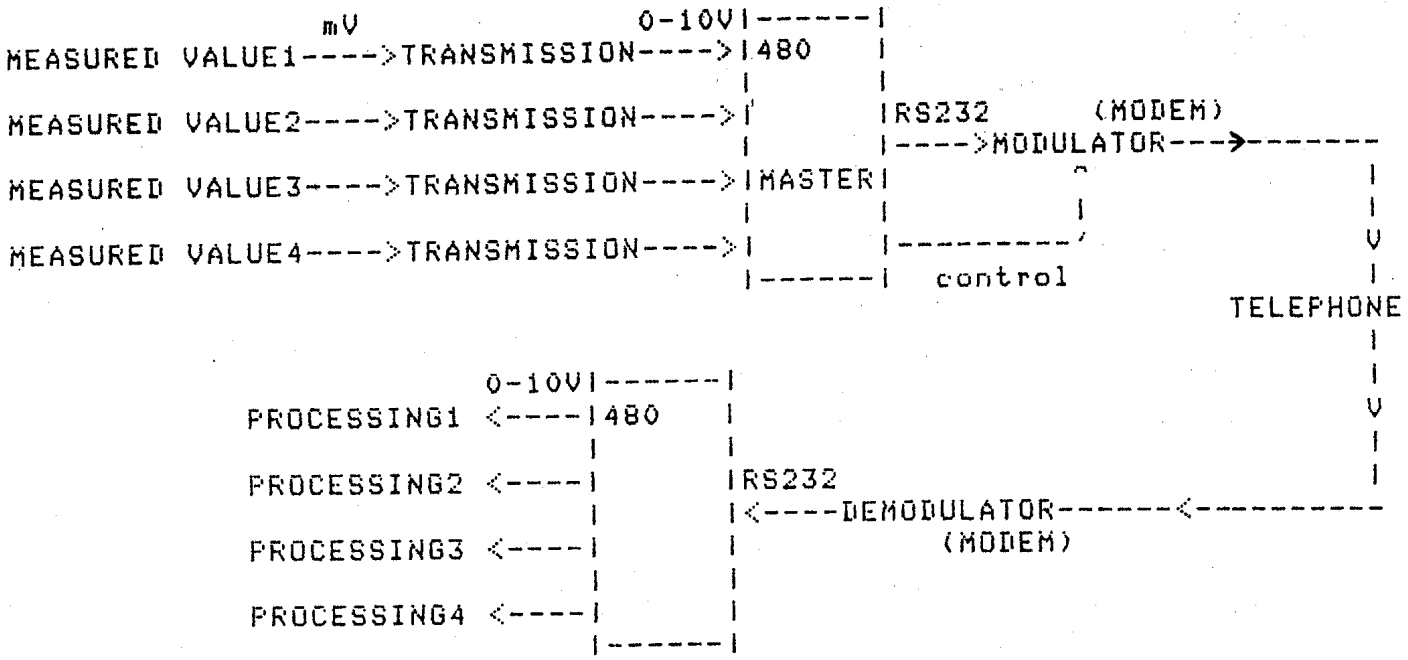
Applications Examples

Analogue Data Aquisition. 0-10V sensor outputs can be sent to a computer by a serial asynchronous transmission. Up to 256 addressable modules are possible, with 4 sensors per module. Wiring is reduced compared with conventional analogue wired equipment, and long distance transmission is possible via telephone lines using modems.



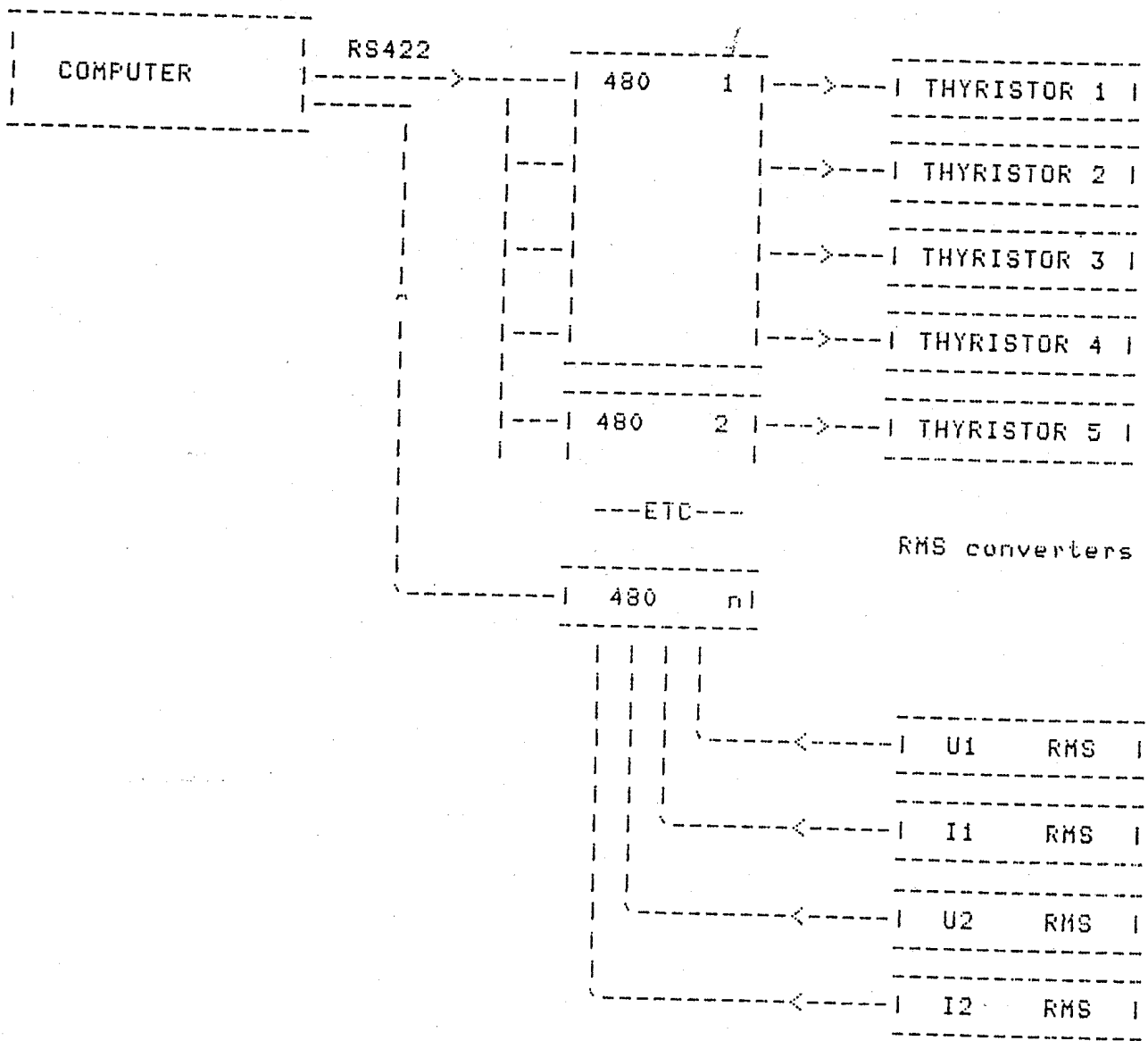
Up to 256 x 4 = 1024 inputs.

Up to 256 modules



The 480 Master requires special programming in this application, but no hardware change.

Set Point Control. Up to 256 addressable modules can provide analogue set points to analogue input controllers or analogue drive to thyristor units.



Thyristor Stack Driving

Supervising of Non-communicating Controllers. (e.g. 810 Controller)

If a controller has an analogue measured value output, this can be converted and sent to a computer. (One 480 for 4 controllers). The set point can also be controlled.

Weighing. Current loop (0-20mA) signals from scales weighing material inputs to processes can be converted and sent to a process controller for hopper control