XT4-WT

Dual Input

Intelligent Load Cell Interface

Operation & Instruction Manual

AMALGAMATED INSTRUMENT CO PTY LTD ACN 001 589 439

Unit 5/28 Leighton Place
Hornsby NSW 2077 Australia

Telephone: (02) 9476 2244
Facsimile: (02) 9476 2902

www.aicpl.com.au
E-mail: sales@aicpl.com.au

Table of Contents

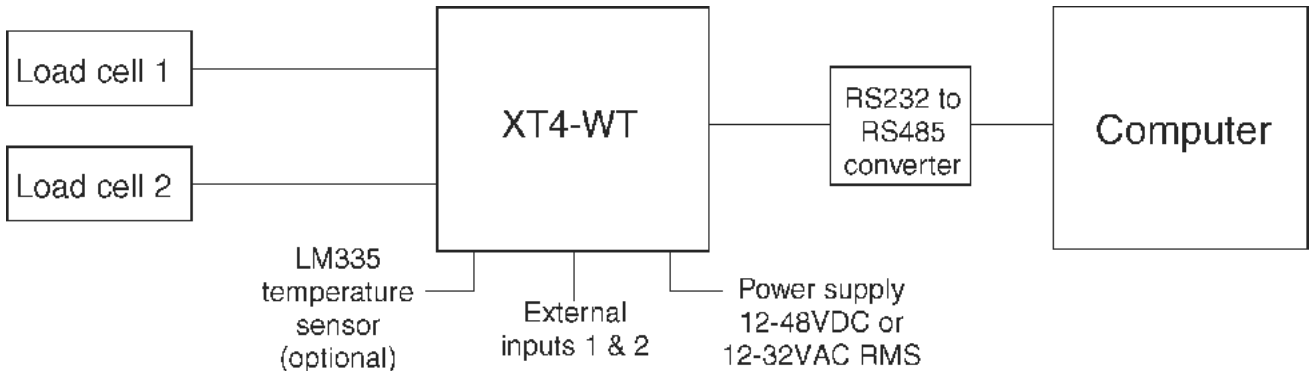
1 Introduction

The XT4-WT2 load cell interface provides one or two 4 wire load cell inputs. Power supply for the unit is 12 to 48 Volts DC or 12 to 32VAC RMS. The output is RS485 serial communications (isolated & non isolated versions available). RS485 communications allows for up to 32 XT4 units to be connected on one serial wiring loop.

The XT4 requires connection to a PC for setup and calibration except when used with remote display instruments fitted with XT4 interface software. The PC requires terminal communications software such as "Telix" or "Hyperterminal" in order to communicate with the XT4. The terminal program must be set to operate in ANSI mode. The default communications settings for the XT4 are:

baud rate	9600
data bits	8
parity	none
stop bits	1
flow control	none

The computer will require RS485 communications, this will normally be accomplished via a RS232 to RS485 converter such as model PC485.



1 .1 Basic operation from computer

The XT4 responds to poll requests from the communications software. If the "Esc" key on the computer keyboard is pressed three times within 1 second the XT4 will bring up its commands and the screen should appear as shown below. There has to be a delay of at least 3 seconds before pressing the "Esc" key three times. See page 5 for alternative addressed polling method of access to this menu.

XT4-WT 0.6 UNIT NAME (s/n: XT-000) Unit Address: 1

System Menu

1) Display Values
2) Zero Input 1
3) Zero Input 2

Instrument Setup & Calibration

4) General Settings
5) Analog Input Settings
6) Digital Input Settings

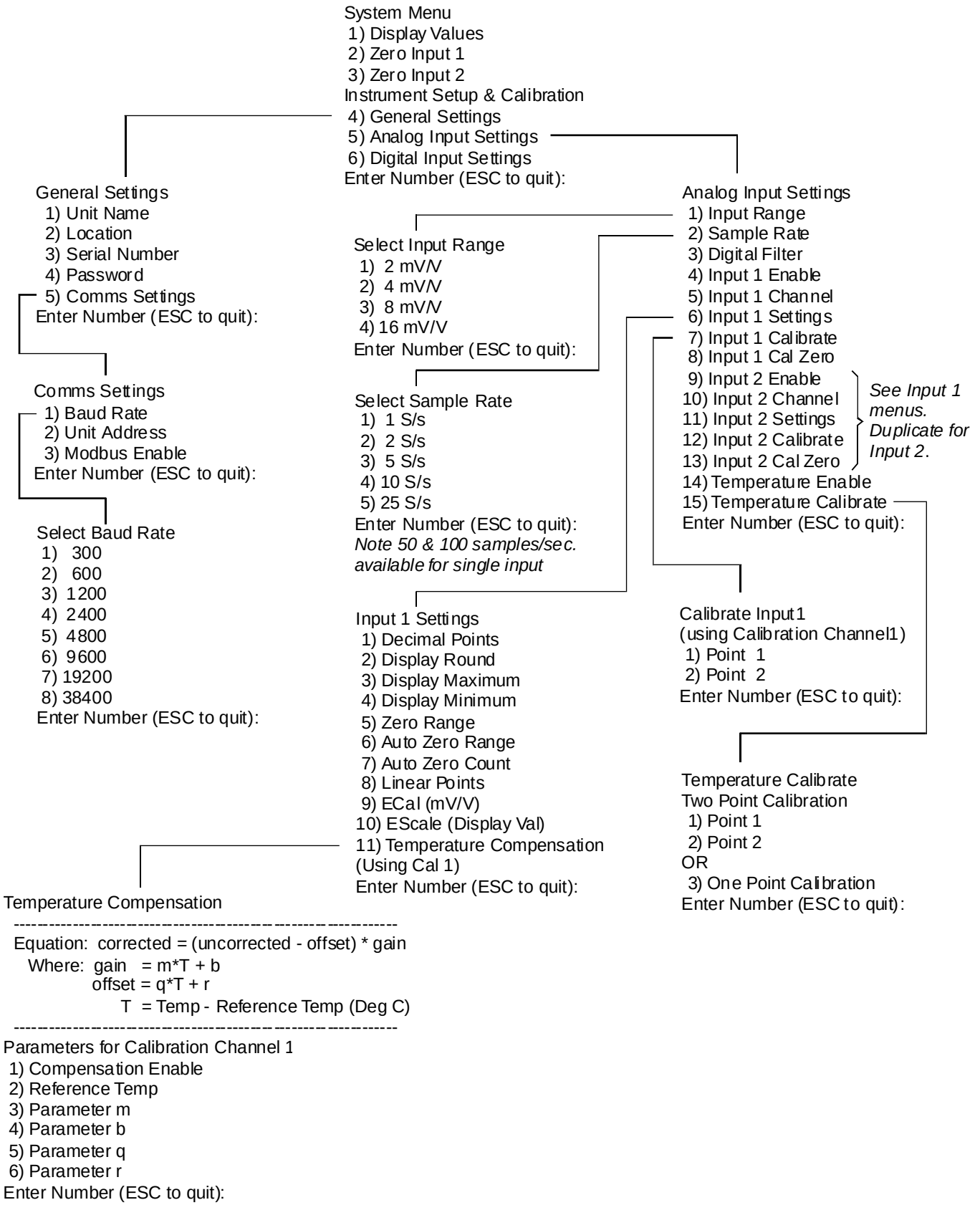
Enter Number (ESC to quit):

If option 1) is selected the display values for the load cells & temperature (if used) will appear as shown below. See "Explanation of functions" chapter for remaining commands. See the "Explanation of functions" chapter for description of other functions.

Input 1	Input 2	Temp
6565	2943	22.4

Values for inputs 1 & 2 can be up to 8 digits including any decimal points and negative signs, values for temperature can be up to 6 digits including any decimal points and negative signs.
A tree structure showing the main menu layout is on the following page. See "Explanation of functions" chapter for a description of each menu.

Main Menu Tree Structure



Notes: Viewing of these menus requires connection to a PC using a "terminal" program such as Hyperterminal. An RS232 to RS485 converter will usually be required for connection to the PC.

The System Menu and all the other menus can be accessed by one of two methods:

1. If only one XT4 is connected then pressing the "ESC" key on the keyboard 3 times within 1 second will bring up the System Menu.
2. If multiple XT4 instruments are connected to a single RS485 loop then each requires a separate address.

The "Jump to terminal mode" polling command will allow access to the System Menu for the XT4 at the address given in the command. See section 1.2 for a list of polling commands with examples.

1 .2 Polling input commands from computer, PLC etc.

Polling can be used to allow the input to be obtained by computer etc. via standard ASCII serial communications without running the XT4 standard communications program. Once the XT4 has been set up and calibrated via a computer connection using the XT4 standard communications program the unit can be polled from a computer or other device such as a PLC with serial communications capability. Again an RS232 to RS485 converter may be required.

The polling commands used by the XT4 are in the format:

Start of text character Command character Unit address Carriage return

The available commands are:

1. Transmit channel 1 value: <STX>P<address><CR>
2. Transmit channel 2 value: <STX>S<address><CR>
3. Transmit temperature value: <STX>T<address><CR>
4. Transmit all values (temperature compensated): <STX>A<address><CR>
5. Transmit all values (uncompensated): <STX>a<address><CR>
6. Transmit Ecal & EScale values: <STX>e<address><CR><channel><CR>
7. Set Ecal & EScale values: <STX>E<address><CR><channel><CR><Ecal>,<EScale><CR>
8. Set offset value: <STX>O<address><CR><channel><CR><offset><CR>
9. Jump to terminal mode: <STX>V<address><CR>, this command allows the System menu for an addressed XT4 to be accessed, this allows access to setup and calibration menus for any XT4 when more than one XT4 is connected to the same RS485 loop.

Note: overrange inputs will be sent as dashes "--------"
Note: the **Auto Zero Range** function option will affect the temperature compensated reading but not the uncompensated value. The **Zero Input 1** or **Zero Input 2** function option will zero the compensated value and the uncompensated value will change by the same amount (will read zero plus or minus the temperature compensation value).

Example 1 the “Transmit channel 1 value” command is <STX>P<address><CR>

Where:	<STX>	is the start of text character (2 Dec, 02 Hex)
	P	is the character “P” (80 Dec, 50Hex)
	<address>	is the unit address offset by 32 e.g. address 1 is the character “!” (33 Dec, 21Hex)
	<CR>	is a carriage return character (13 Dec, 0D Hex)

e.g. <STX>P!<CR> which is the request for the channel 1 value from the XT4 with address 1 would be sent as: ^BP!^M using Telix or similar.

The request must be sent with less than 10mS between characters, this normally means that the request must be sent as one string. If using “Telix”, “Hyperterminal” or similar this is accomplished by assigning the string to a key on the keyboard or writing a suitable program.

Format of the returned data for this command is:-

<ACK>P<address>WWWWWWWW<CR>

Where:	<ACK>	is the acknowledge character (6 Dec, 06 Hex)
	P	echo command received ‘P’ (80 Dec, 50 Hex)
	<address>	is the responding unit’s address (! for address 1)
	WWWWWWWW	is the display value in ASCII (8 characters transmitted with decimal point (if used) counting as one character, spaces transmitted instead of leading zeroes, spaces transmitted prior to any negative sign)
	<CR>	is a Carriage Return (13 Dec, 0D Hex)

For example a channel 1 value of “-4321” from an XT4 with address 1 would be returned as:

<ACK>P!<SP><SP><SP>-4321<CR>

Where: <SP> is a SPACE character (32 Dec, 20 Hex)

Example 2 the “Transmit temperature value” command is <STX>T<address><CR>

Where: <STX> is the start of text character (2 Dec, 02 Hex)

T is the character “T” (84 Dec, 54Hex)

<address> is the unit address offset by 32
e.g. address 1 is the character “!” (33 Dec, 21Hex)

<CR> is a carriage return character (13 Dec, 0D Hex)

e.g. <STX>T!<CR> which is the request for the temperature value from the XT4 with address 1 would be sent as: ^BT!^M using Telix or similar.

The request must be sent with less than 10mS between characters, this normally means that the request must be sent as one string. If using “Telix”, “Hyperterminal” or similar this is accomplished by assigning the string to a key on the keyboard or writing a suitable program.

Format of the returned data for this command is:-

<ACK>T<address>ZZZZ.Z<CR>

Where: <ACK> is the acknowledge character (6 Dec, 06 Hex)

T echo command received ‘T’ (84 Dec, 54 Hex)

<address> is the responding unit’s address (! for address 1)

ZZZZ.Z is the temperature value in ASCII (6 characters transmitted with decimal point counting as one character, spaces transmitted instead of leading zeroes, spaces transmitted prior to any negative sign). The temperature is always transmitted to one decimal point place.

<CR> is a Carriage Return (13 Dec, 0D Hex)

For example a temperature value of “22.5” from an XT4 with address 1 would be returned as:

<ACK>A!<SP><SP>22.5<CR>

Where: <SP> is a SPACE character (32 Dec, 20 Hex)

Example 3 the “Transmit all active channel values (temperature compensated)” command is:

<STX>A<address><CR>

Where: <STX> is the start of text character (2 Dec, 02 Hex)

A is the character “A” (65 Dec, 41Hex)

<address> is the unit address offset by 32
e.g. address 1 is the character “!” (33 Dec, 21Hex)

<CR> is a carriage return character (13 Dec, 0D Hex)

e.g. <STX>A!<CR> which is the request for the all channel values from the XT4 with address 1 would be sent as: ^BA!^M using Telix or similar.

The request must be sent with less than 10mS between characters, this normally means that the request must be sent as one string. If using “Telix”, “Hyperterminal” or similar this is accomplished by assigning the string to a key on the keyboard or writing a suitable program.

Format of the returned data for this command is:-

<ACK>A<address>WWWWWWWW,YYYYYYYY,ZZZZ.Z<CR>

Where: <ACK> is the acknowledge character (6 Dec, 06 Hex)

P echo command received ‘P’ (80 Dec, 50 Hex)

<address> is the responding unit’s address (! for address 1)

WWWWWWWW is the channel 1 value in ASCII (spaces transmitted instead of leading zeroes, spaces transmitted prior to any negative sign)

YYYYYYYY is the channel 2 value in ASCII (spaces transmitted instead of leading zeroes, spaces transmitted prior to any negative sign)

ZZZZ.Z is the temperature value in ASCII, fixed one decimal point place (spaces transmitted instead of leading zeroes, spaces transmitted prior to any negative sign)

<CR> is a Carriage Return (13 Dec, 0D Hex)

For example a channel 1 value of “-54321”, channel 2 value of 5110 and temperature value of 21.4 from an XT4 with address 1 would be returned as:

<ACK>P!<SP><SP>-54321,<SP><SP><SP><SP>5110,<SP><SP>21.4<CR>

Where: <SP> is a SPACE character (32 Dec, 20 Hex)

Note: for the transmit all commands "A" and "a" only the inputs selected will be sent. e.g. for the example above the following would be the return if input 2 was turned off.

<ACK>P!<SP><SP>-54321,<SP><SP>21.4<CR>

Example 4 the “Transmit Ecal & EScale values” command is:

<STX>e<address><CR><channel><CR>

Where: <STX> is the start of text character (2 Dec, 02 Hex)

e is the character “e” (101 Dec, 65 Hex)

<address> is the unit address offset by 32
e.g. address 1 is the character “!” (33 Dec, 21Hex)

<CR> is a carriage return character (13 Dec, 0D Hex)

channel is the channel number e.g. 2 for channel 2 input

e.g. <STX>e!<CR>2<CR> which is the request for the Ecal & EScale values from channel 2 of XT4 with address 1 would be sent as: ^Be!^M2^M using Telix or similar.

The request must be sent with less than 10mS between characters, this normally means that the request must be sent as one string. If using “Telix”, “Hyperterminal” or similar this is accomplished by assigning the string to a key on the keyboard or writing a suitable program.

Format of the returned data for this command is:-

<ACK>e<address><CR><channel>AAAA.AAA,BBBBBBBB<CR>

Where: <ACK> is the acknowledge character (6 Dec, 06 Hex)

e echo command received ‘e’ (101 Dec, 65 Hex)

<address> is the responding unit’s address (! for address 1)

channel is the channel number e.g. 2 for channel 2 input

AAAA.AAA is the Ecal value in ASCII (8 characters transmitted with decimal point counting as one character, spaces transmitted instead of leading zeroes, spaces transmitted prior to any negative sign). The Ecal value is always transmitted to three decimal point places.

BBBBBBBB is the EScale value in ASCII (8 characters transmitted with decimal point counting as one character, spaces transmitted instead of leading zeroes, spaces transmitted prior to any negative sign).

<CR> is a Carriage Return (13 Dec, 0D Hex)

For example Ecal & EScale values of “2.000 and 1000” from an XT4 with address 2 would be returned as:

<ACK>e@<SP><SP><SP>2.000,<SP><SP><SP><SP>1000<CR>

Where: <SP> is a SPACE character (32 Dec, 20 Hex)

Example 5 the “Set the Ecal & EScale values” command is:

<STX>E<address><CR><channel><CR><Ecal>,<EScale><CR>

Where: <STX> is the start of text character (2 Dec, 02 Hex)

E is the character “E” (69 Dec, 45 Hex)

<address> is the unit address offset by 32
e.g. address 1 is the character “!” (33 Dec, 21Hex)

<CR>	is a carriage return character (13 Dec, 0D Hex)
channel	is the channel number e.g. 2 for channel 2 input
Ecal	is the Ecal value e.g. 2.000 for 2mV/V
EScale	is the EScale value e.g. 1000

e.g. <STX>E!<CR>2<CR>2.000,1000<CR> which is the set Ecal & EScale values to 2.000 and 1000 command for channel 2 of XT4 with address 1 would be sent as: ^BE!^M2^M2.000,1000^M using Telix or similar. Note: the same result could be achieved by sending an Ecal value of 2 or 2.0 or 2.00 i.e. unnecessary decimal point values can be left off if required.

The request must be sent with less than 10mS between characters, this normally means that the request must be sent as one string. If using "Telix", "Hyperterminal" or similar this is accomplished by assigning the string to a key on the keyboard or writing a suitable program.

Format of the returned data for this command is:-

<ACK>E<address><CR><channel>AAAA.AAA,BBBBBBBB<CR>

Where: <ACK>	is the acknowledge character (6 Dec, 06 Hex)
E	echo command received 'E' (69 Dec, 45 Hex)
<address>	is the responding unit's address (! for address 1)
channel	is the channel number e.g. 2 for channel 2 input
AAAA.AAA	is the Ecal value in ASCII (8 characters transmitted with decimal point counting as one character, spaces transmitted instead of leading zeroes, spaces transmitted prior to any negative sign). The Ecal value is always transmitted to three decimal point places.
BBBBBBBB	is the EScale value in ASCII (8 characters transmitted with decimal point counting as one character, spaces transmitted instead of leading zeroes, spaces transmitted prior to any negative sign).
<CR>	is a Carriage Return (13 Dec, 0D Hex)

For example Ecal & EScale values of "2.000 and 1000" from an XT4 with address 2 would be returned as:

<ACK>E@<SP><SP><SP>2.000,<SP><SP><SP><SP>1000<CR>

Where: <SP>	is a SPACE character (32 Dec, 20 Hex)

Example 6 the "Jump to terminal mode" command is <STX>V<address><CR>

Where: <STX>	is the start of text character (2 Dec, 02 Hex)
V	is the character "V" (86 Dec, 56 Hex)
<address>	is the unit address offset by 32 e.g. address 1 is the character "!" (33 Dec, 21 Hex)
<CR>	is a carriage return character (13 Dec, 0D Hex)

e.g. <STX>C#<CR> which is the jump to terminal mode for XT4 with address 3 would be sent as: ^BT#^M using Telix or similar.

The request must be sent with less than 10mS between characters, this normally means that the request must be sent as one string. If using "Telix", "Hyperterminal" or similar this is accomplished by assigning the string to a key on the keyboard or writing a suitable program.

Format of the returned data for this command is:-

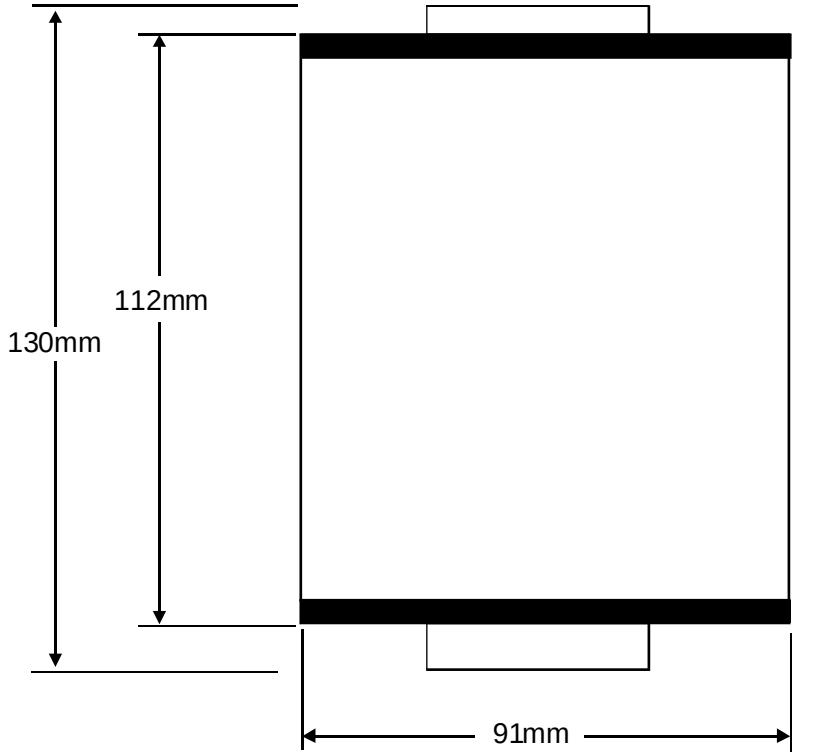
<ACK>V<address><CR> followed by the terminal mode System menu

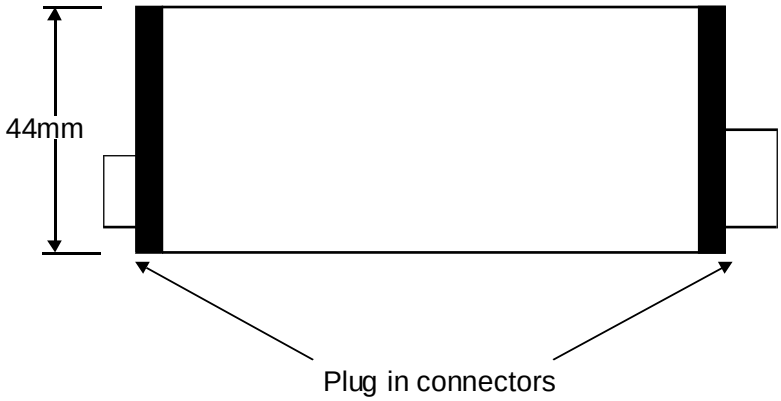
Where: <ACK>	is the acknowledge character (6 Dec, 06 Hex)
V	echo command received 'V' (86 Dec, 56 Hex)
<address>	is the responding unit's address (! for address 1)
<CR>	is a Carriage Return (13 Dec, 0D Hex)

2 Mechanical installation

The XT4 is available in a standard aluminium housing or in various alternative housings to order. Dimensions for the standard aluminium housing are shown below.

Instrument dimensions





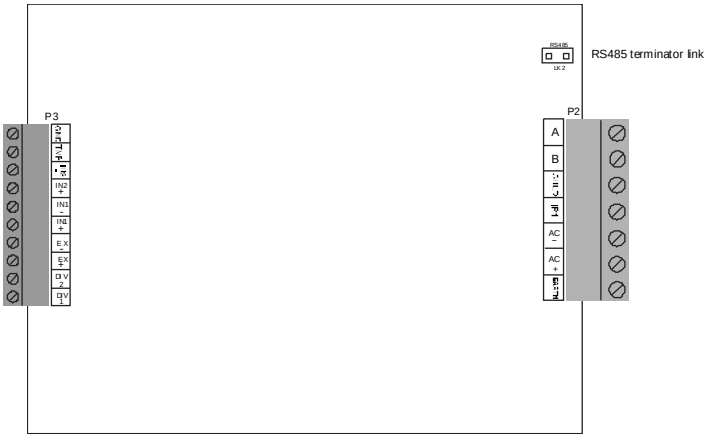
3 Electrical installation

The XT4 is designed for continuous operation and no power switch is fitted to the unit. It is recommended that an external switch and fuse be provided to allow the unit to be removed for servicing.

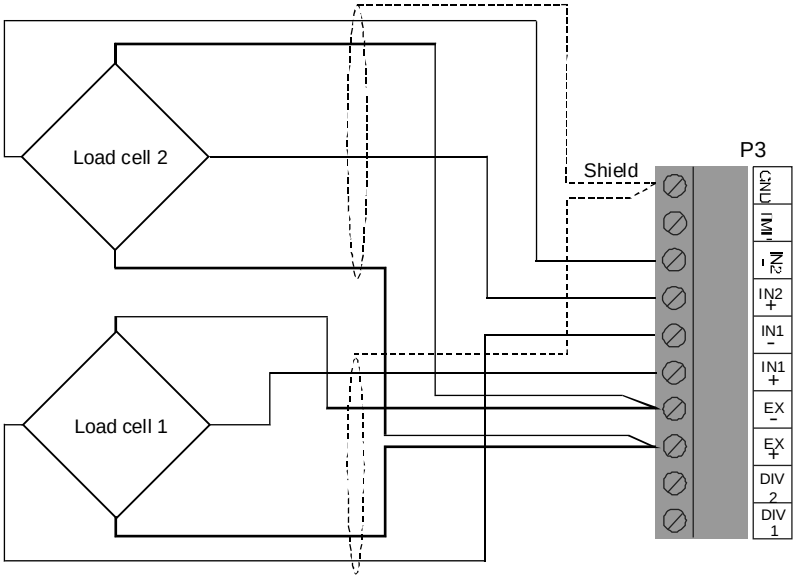
The plug in, screw type, terminal blocks allow for wires of up to 2.5mm^2 to be fitted for power supply and RS485 or 1.5mm^2 for other connections. Connect the wires to the appropriate terminals as indicated below.

To reduce susceptibility to electrical interference use shielded cable where indicated and earth the metal case of the circuit board enclosure. Reducing the sample rate can also reduce the susceptibility to interference.

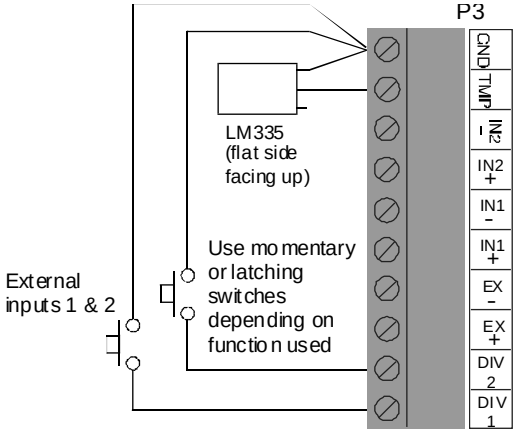
XT4 circuit board layout



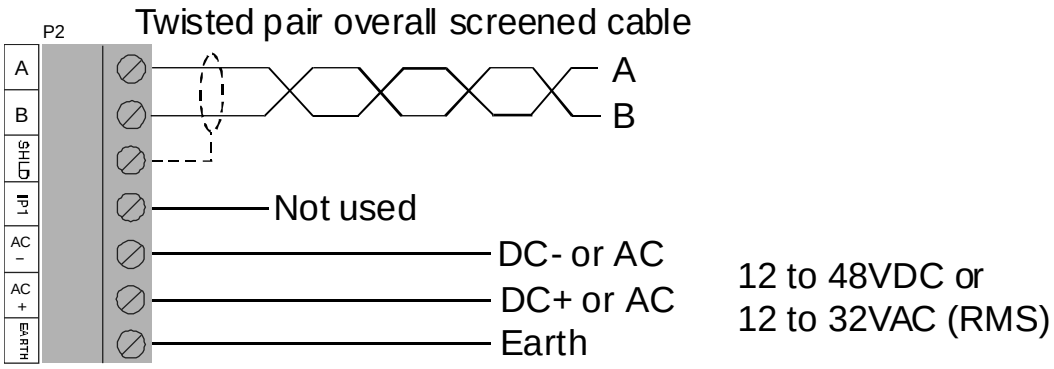
Load cell connections



External inputs and temperature sensor connections (note optional temperature sensor may be supplied connected internally if specified when ordered.)

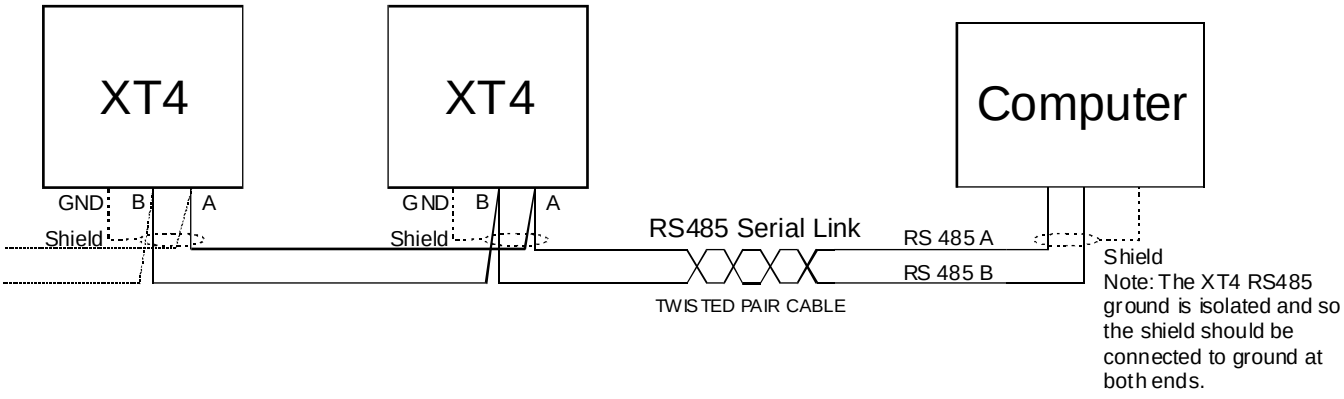


RS485 and power supply connections



RS485 multidrop connections

Link LK2 should be in if the XT4 is the last instrument in an RS485 multidrop chain. This link places a 100Ω resistor across terminals A & B to reduce the chance of data reflection back down the cable.



4 Explanation of functions

4 .1 The system menu

With the terminal program running and the communications settings set to match those in the XT4 (see “Introduction” for default settings) press the “Esc” key on the computer keyboard three times in 1 second, the XT4 will bring up its commands and the screen should appear as shown below. If the menu is not seen wait at least 3 seconds then try again. See page 5 for alternative addressed polling method of access to this menu.

```
XT4-WT 0.6    UNIT NAME (s/n: XT-000)    Unit Address:  1

System Menu

 1) Display Values
 2) Zero Input 1
 3) Zero Input 2

Instrument Setup & Calibration

 4) General Settings
 5) Analog Input Settings
 6) Digital Input Settings

Enter Number (ESC to quit):
```

4 .2 Display Values

If option 1) is selected the following display showing inputs 1, 2 and temperature (if used) will be seen. The maximum number of display characters is 8 (including decimal point) for input 1 & 2 and 6 for temperature.

```
Input 1   Input 2   Temp
-------   -------   -----
6565      2943      22.4
```

4 .3 Zero inputs 1 & 2 commands

Options 2) & 3) of the system menu can be used to zero the value on channel 1 or channel 2. i.e channel 1 or channel 2 will read zero for the load in place at the time of the zero operation. See also the **Auto Zero** and **Auto Zero Count** and **Zero Range** functions described in the “Calibration” chapter. Note: if the error message "Zero Failed!" is seen when attempting to zero an input the most likely cause is the **Zero Range** setting being too low.

4 .4 General settings menu

If option 4) is selected from the system menu the following menu will be seen.

```
General Settings

 1) Unit Name
 2) Location
 3) Serial Number
 4) Password
 5) Comms Settings

Enter Number (ESC to quit):
```

Note if the password option appears as: 4) Password 1 ********
then a password has been previously stored and must be entered before changes can be made to some of the functions. If the password is entered then changes can be made for the next 5 minutes after which time the program will ask for the password to be entered again before certain functions can be changed. If no password is used or if the password has been entered the user can now enter a **Unit Name**, **Location** and **Serial Number**, if required, to the XT4 unit being used.

The **Comms Settings** option is described below in section 4.5.

4 .5 The Comms Settings menu

The Comms. Settings option brings up the following menu. Note settings shown below such as 9600 are default settings and may differ in the XT4 unit being used.

Comms Settings

1) Baud Rate 9600
2) Unit Address 1
3) Modbus Enable Off

Enter Number (ESC to quit):

The Baud Rate can be set to **300, 600, 1200, 2400, 4800, 9600, 19200** or **38400** baud.

The Unit Address can be set from **0** to **254**. If using Modbus do not select address 0 and use a baud rate of no greater than 9600. When multiple XT4 units are to be used on one RS485 system each XT4 must be given a different unit address.

The Modbus Enable can be set to either **On** or **Off** - see "Modbus Communications" chapter.

4 .6 Analog Input Settings menu

If option 5) is selected from the system menu the following menu will be seen. Note settings shown below such as 4mV/V are default settings and may differ in the XT4 unit being used.

Analog Input Settings

1) Input Range 4 mV/V
2) Sample Rate 10 S/s
3) Digital Filter 3

4) Input 1 Enable On
5) Input 1 Channel Cal 1
6) Input 1 Settings
7) Input 1 Calibrate
8) Input 1 Cal Zero

9) Input 2 Enable On
10) Input 2 Channel Cal 2
11) Input 2 Settings
12) Input 2 Calibrate
13) Input 2 Cal Zero

14) Temperature Enable On
15) Temperature Calibrate

Enter Number (ESC to quit):

Option 1) **Input Range** can be set to either **2**, **4**, **8** or **16** mV/V

Option 2) **Sample Rate** can be set to **1**, **2**, **5**, **10** or **25** samples/sec. Additionally **50** or **100** samples/sec can be selected if only one input is selected i.e. one channel disabled.

Option 3) **Digital Filter** can be set from **0** to **8**. This is software filter using weighted averaging to help reduce the effect of reading errors due to short term electrical interference.

Option 4) **Input 1 Enable** can be set to either **On** or **Off**. If set to **On** then the input from this channel will be read. If set to **Off** any input on this channel will be ignored and will show as **OFF** in the **Display Values** option in the **System Menu**.

Option 5) see "Calibration" chapter for **Input 1 Channel** instructions.

Option 6) see section 4.7 for **Input 1 Settings** options.

Option 7) see "Calibration" chapter for **Input 1 Calibrate** instructions.

Option 8) the calibration zero can be used to select a zero point other than the display zero as the reference for the **Zero Range** function. The calibration zero function is used only with the **Zero Range** function. For example if the **Input 1 Cal Zero** operation is carried out with a input 1 reading of 500 and a **Zero Range** reading of 10 the zero range function will allow the display to zero only if the current display reading is between 490 and 510. The **Input 1 Cal Zero** function does not zero the display value for input 1.

Option 9) **Input 2 Enable** can be set to either **On** or **Off**. If set to **On** then the input from this channel will

be read. If set to **Off** any input on this channel will be ignored and will show as **OFF** in the **Display Values** option in the **System Menu**.

Option 10) see "Calibration" chapter for **Input 2 Channel** instructions.

Option 11) see section 4.7 for **Input 2 Settings** options.

Option 12) see "Calibration" chapter for **Input 2 Calibrate** instructions.

Option 13) the calibration zero can be used to select a zero point other than the display zero as the reference for the **Zero Range** function. The calibration zero function is used only with the **Zero Range** function. For example if the **Input 2 Cal Zero** operation is carried out with a input 2 reading of 500 and a **Zero Range** reading of 10 the zero range function will allow the display to zero only if the current display reading is between 490 and 510. The **Input 2 Cal Zero** function does not zero the display value for input 2.

Option 14) **Temperature Enable** can be set to **On** (enable temperature readings) or **Off** (disable temperature input). If temperature readings are to be made a LM335 temperature sensor must be fitted. If the temperature input is switched off the temperature display in the **Display Values** menu will show **OFF**.

Option 15) see "Calibration" chapter for **Temperature Calibrate** instructions.

4 .7 Input 1 Settings & Input 2 Settings menus

The menu for input 1 and input 2 are identical. **Input 1 Settings** options are described below. Notes: settings shown below such as 9600 are default settings and may differ in the XT4 unit being used. The **(Using Cal 1)** note on the **Input 1 Settings** menu below indicates that input 1 has been assigned to the scaling values set by **Cal1**, this is set by the **Input 1 Channel** option in the **Analog Input Settings** menu, see "Calibration" chapter for further details.

Input 1 Settings

```
 1) Decimal Points          0
 2) Display Round           1
 3) Display Maximum       OFF
 4) Display Minimum       OFF
 5) Zero Range           1000
 6) Auto Zero Range         0
 7) Auto Zero Count       100
 8) Linear Points           2
 9) ECal (mV/V)       2.002 mV/V
10) EScale (Display Val)  2000
11) Temperature Compensation

(Using Cal 1)

Enter Number (ESC to quit):
```

Option 1) allows the decimal points for input 1 to be set, allowed settings are **0** to **6** decimal point places.

Option 2) allows a display rounding value to be set. For example if the display rounding is set to 5 then the display will only show multiples of 5 e.g. 0, 5, 10, 15 etc. values in between will be rounded up or down to the nearest multiple of 5.

Option 3) allows a maximum display value to be set. If the value exceeds this maximum value the warning display **-- OR --** will be seen. Type "OFF" at this function if it is not required.

Option 4) allows a minimum display value to be set. If the value goes below this minimum value the warning display **-- OR --** will be seen. Type "OFF" at this function if it is not required.

Option 5) allows a zero range to be set. This is the maximum value which can be zeroed from the display. The zero action is cumulative e.g. if the zero range is set to 1000 then the XT4 can be zeroed up to 5 times with a reading of 200 before an error message **Zero Failed!** indicates that the zero range has been exceeded. To zero beyond this range the zero range value can be increased or a new zero reference calibration point entered at the **Input 1 Cal Zero** or **Input 2 Cal Zero** option in the **Analog Input Settings** menu. If a positive value is zeroed then a negative value is zeroed the effect is the difference between the two values will be added to the zero range accumulating total. Type "OFF" at this function if it is not required.

Option 6) allows the XT4 output value to be automatically zeroed if it is below the value set in this option

for the number of counts set at the **Auto Zero Count** option. Setting the auto zero to **0** will disable the auto zero operation.

Option 7) sets the number of samples (counts) for which the output value must be below the auto zero value before the output will automatically zero. e.g. if the Auto Zero Range is set to 10 and the Auto Zero Count is set to 20 then the output value will only zero automatically when the value has been below 10 for 20 consecutive samples.

Option 8) sets the number of calibration points for linearisation purposes. See "Calibration" chapter.

Options 9) & 10) set the ECal & EScl values for mV/V calibration. See "Calibration" chapter.

Option 11) allows access to the automatic temperature compensation menu and options. See section 4.9 for details.

4 .8 Digital Input Settings menu

Digital Input Settings

1) Digital Input 1 Off
2) Digital Input 2 Off

Enter Number (ESC to quit):

If option 1) is selected the following menu appears:

Select Digital Input 1

1) Off
2) Zero Input 1
3) Zero Input 2
4) Clear Mem Input 1
5) Clear Mem Input 2
6) Tare Input 1
7) Tare Input 2

Enter Number (ESC to quit):

The **Digital Input 1** & **Digital Input 2** can be set to either **Off** (no function), **Zero Input 1**, **Zero Input 2**, **Clear Mem Input 1**, **Clear Mem Input 2** , **Tare Input 1** or **Tare Input 2** (clear Hi & Lo memory and tare commands for inputs 1 & 2 are for use with modbus communications only). The zero function will operate when a short circuit (via switch or relay contact) is placed between the DIV1 (digital input 1) or DIV2 (digital input 2) terminals and the GND terminal. The difference between the **Zero** and **Tare** selection is that the **Tare** is a temporary zero and will be lost when the instrument is powered down i.e. if at a given input the display is tared then for that input the display will show zero but if power is removed and then re-applied the tare is not retained in memory and the display value for that input will be the value shown prior to the tare operation. The **Zero** operation is retained even if power is removed.

Note that if the Hi & Lo memory values are required (available via modbus communications only) then the memory should be cleared by the **Clear Mem Input 1** or **Clear Mem Input 2** command prior to the start of any Hi & Lo measurement . This will clear the memory of any previously stored Hi & Lo values. The Hi memory is the highest load value in memory, the Lo memory is the lowest load value in memory.

4 .9 Temperature compensation

If the **Temperature enable** option at the **Analog Input Settings** menu is set to **on** provision is made for automatic temperature compensation of load cells using the optional LM335 temperature sensor input. The formula and parameter settings for temperature compensation are as shown below. The temperature compensation parameters can be found under "Input 1 Settings" or "Input 2 Settings" which are part of the "Analog Input Settings" menu. Individual parameters can be set for inputs 1 & 2 but both inputs share a common temperature sensor input.

Temperature Compensation

Equation: corrected = (uncorrected - offset) * gain

Where: gain = m*T + b
offset = q*T + r
T = Temp - Reference Temp (Deg C)

Parameters for Calibration Channel 1

1) Compensation Enable On
2) Reference Temp 25.0 C
3) Parameter m -0.0003
4) Parameter b 1.0000
5) Parameter q 0.1250
6) Parameter r 0.0000

Enter Number (ESC to quit):

Option 1) allows the temperature compensation to be set to **On** or **Off**.

Option 2) allows for an offset on the temperature value read from the LM335 sensor. For example if the load cells were calibrated at a temperature of 25°C and 25.0 is entered at option 2 as the reference temperature then when the temperature measured by the LM335 is 25.0°C the m*T and q*T values in the compensation formula will be zero.

Options 3), 4), 5) & 6) allows the parameters m, b, q & r to be set.

Example: for the parameters shown above with an uncompensated reading of 3000 and a measured temperature of 30°C from the LM335 sensor the compensated or corrected value will be:

T = Measured temperature - reference temperature = 5

Offset = q*T + r = (0.125*5) + 0 = 0.625

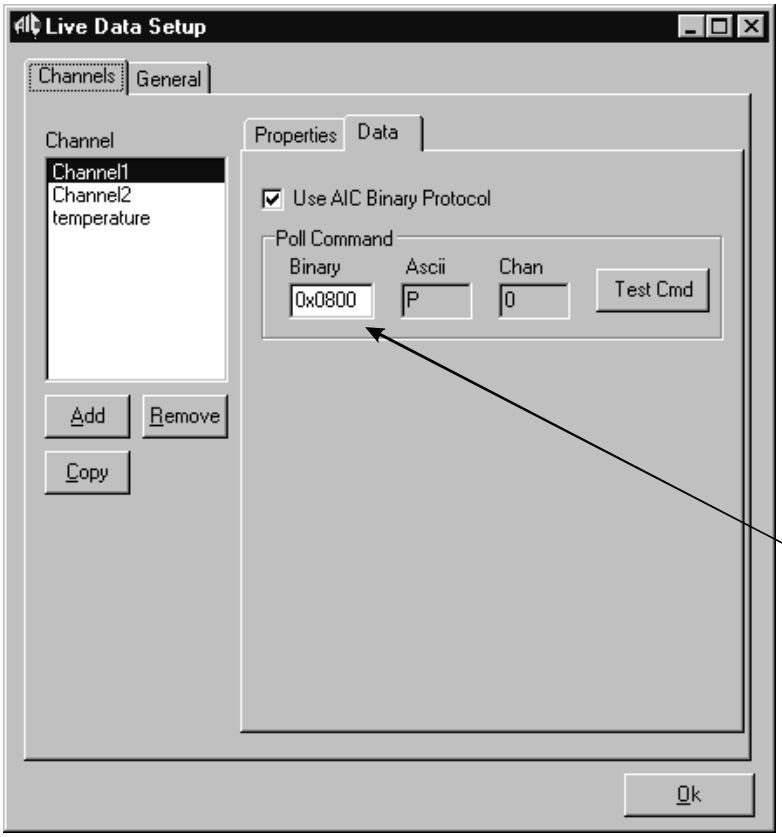
Gain = m*T + b = (0.0003*5) + 1 = 0.9985

Corrected value = (3000 - 0.625) * 0.9985 = 2995

4 .10 Using the XT4 with optional Windows software

Windows compatible PC software is optionally available allowing live data viewing, graphing and logging data directly onto hard disk. Refer to the download software manual supplied with this option for setup information. Below is a window from this software indicating the polling address settings required for the XT4. Note that when this software is used the data logger download facilities of the software do not apply to the XT4 since this instrument has no internal data logger.

The optional download software does not allow setup and calibration of the XT4 itself. This still needs to be accomplished using the standard XT4 software as described in this chapter.



0x0800 for channel 1
0x0801 for channel 2
0x0802 for temperature
Select the input required in the "Channel" box and then type in the required address in the "Binary" box.

4 .11 Error Messages

Zero Failed! this indicates that a zero attempt has failed. Check the Zero Range option setting.

************ or **--OR--** indicates that the value is too big to display or has exceeded the **Display Maximum** or **Display Minimum** limits set at the **Input 1 Settings** or **Input 2 Settings** menu.

-------- input mV is higher than the selected mV/V range. See the **Input Range** option setting.

ERROR ADC values too close indicates that an attempt to calibrate using live inputs has been made but the live inputs are too close together in mV value. The difference in mV input values should be at least 10% of the mV range. e.g. if the Select Input Range setting is 2mV/V and the excitation voltage is 5V this gives a full range of 10mV, there must be a change of at least 1mV between calibration point 1 & point 2 for the calibration to be accepted. Usually this is accomplished by increasing the difference between the two load values e.g. increasing the weight of the second load.

Other error messages should be self explanatory, some examples are shown below.

ERROR - Value out of range. (0 - 8) indicates that a value outside the accepted range cannot be input.

Input1 is not Enabled!! indicates that an attempt has been made to change input 1 parameters when input 1 is set to **Off** at the **Input 1 Enable** option.

5 Calibration

5.1 Calibration settings

Calibration options are reached via the **Analog Input Settings** menu

Analog Input Settings

1) Input Range 4 mV/V
2) Sample Rate 5 S/s
3) Digital Filter 3
4) Input 1 Enable On
5) Input 1 Channel Cal 1
6) Input 1 Settings
7) Input 1 Calibrate
8) Input 1 Cal Zero
9) Input 2 Enable On
10) Input 2 Channel Cal 2
11) Input 2 Settings
12) Input 2 Calibrate
13) Input 2 Cal Zero
14) Temperature Enable On
15) Temperature Calibrate

Enter Number (ESC to quit):

Options 5), 7), 10), 12) and 15) are covered in this chapter, for descriptions of other options in this menu refer to the "Explanation of functions" chapter.

Input 1 Channel & Input 2 Channel options

Options 5) & 10) allows calibration parameters for **Cal 1** and **Cal 2**. These two are independent calibration scaling memories and can be assigned to either input 1 or input 2 via option 5) **Input 1 Channel** or option 10) **Input 2 Channel**. i.e the calibration scaling and settings for **Cal 1** can be assigned to either channel 1 or channel 2 input. When used with a single input this allows 2 sets of scaling values to be entered e.g. kilograms at **CAL 1** and Tonnes at **CAL 2** and the single input channel can be switched between these scaling values without the need for recalibration.

5.2 Calibration

Two point calibration

If the **Linear Points** option in the **Input 1 Settings** or **Input 2 Settings** menu is set to **2** the calibration method used is a two point “live input” calibration. In this method two known loads are placed on the load cell or platform and the value for each in turn is entered via the computer. Ideally the two loads should be as close to zero load and full capacity load as possible. If the difference between the two loads is less than 10% of the mV range an error message **ERROR ADC values too close** will appear and the scaling attempt will be rejected. If this message is seen the difference between the two loads must be increased before attempting to re-calibrate.

The procedure for calibration of input 1 is shown below:

1. Place a know load on the loadcell or platform (typically zero load).

2. Choose option 7) in the **Analog Input Settings** menu. The following menu will appear.

Calibrate Input 1
(using Calibration Channel 1)

1) Point 1
2) Point 2

Enter Number (ESC to QUIT):

3. Choose option 1) Point 1, the following menu will appear.

Press ENTER when value is stable

Point 1
Current Value: 25

4. The **Current Value** displayed is the display scale value for this input using the previous calibration values. The value displayed is not important but should be stable. If this value is not stable the input should be checked. If the display is stable press “Enter” , the following

command will appear

Enter current value?

5. Enter the value required for this load e.g. enter “0” if the display required for this load is zero. The display will now return to the “Calibrate Input 1” menu.

6. Change the load on the load cell and select option 2) Point 2. The following display will appear.

Press ENTER when value is stable

Point 2
Current Value: 100

7. If the **Current Value** display is stable press “Enter”, the following display will appear.

Enter current value?

8. Enter the value required for this load e.g. enter “500” if the required display value for this load is five hundred. Calibration is now complete.

The same procedure can be followed for option 12) **Input 2 Calibrate**

Note: if temperature compensation is being used the values displayed will not necessarily be the same as the value entered. For example in step 8 above if 500 is entered as the second point value and the display value for this input is checked the reading will be 500 plus or minus the temperature compensation value.

Multipoint calibration

Calibration using more than two points is only required if the input to the XT4 is not a linear representation of the load. The number of points chosen can be from 2 to 5. The calibration method is identical to that described in “Two point calibration” above except that the menus will prompt for more points and will expect the load to be changed as many times as the number of points selected requires. The number of calibration points is chosen at the **Linear Points** option under the **Input 1 Settings** or **Input 2 Settings** sub-menus which are found in the **Analog Input Settings** menu.

It is essential when multipoint calibrating that the values between each point are rising i.e. point 2 should be a higher (more positive) value than point 1 etc. Also it is essential that all points selected are calibrated i.e. If an adjustment of one point is required than you cannot just recalibrate that single point, all the points will have to be recalibrated.

Calibration by ECal and EScale

Note: this method can only be used if the **Linear Points** function is set to 2.

This is an alternative scaling method to the 2 point live input scaling, only one of these methods should be used. This alternative calibration method allows the known mV/V value of the load cell to be entered together with the full capacity of the cell. The XT4 should then be zeroed for the input being calibrated to ensure that the zero point is correct and any offsets or dead weight is ignored.

An example of calibration using this method for input 1 is given below.

1. Go to the **Input 1 Settings** menu and choose option 9) **ECal mV/V**, the following message will be seen:

Enter ECal (mV/V)?

2. At this prompt enter the mV/V output for the load cell being used (up to 3 decimal point places can be entered) then press the "Enter" key. e.g. if a 2mV/V load cell is being used enter the value " 2.000" then press "Enter".

3. Choose option 10) **EScale (Display Val)**, the following message will be seen:

Enter EScale (Display Val)?

4. At this prompt enter the full scale value for the load cell. For example if using a 1 Tonne load cell and the display is to read in kilograms enter the value "1000" then press the "Enter" key.

5. Connect the load cell when it is in a no load condition i.e. the load at which the display should read zero. Go to the System Menu and choose option 2) **Zero Input 1**. The message **Zero Done!** should be seen. The calibration scaling is now complete.

Note: see page 5 for an alternative polling method of setting and reading Ecal and EScale values. There is also an alternative command for setting a calibration offset e.g. zero, see page 5.

5.3 Temperature calibration

In the **Analog Input Settings** menu option 15) **Temperature Calibrate** allows for LM335 temperature sensor calibration. When option 15) is chosen the following will appear:

Temperature Calibrate

Two Point Calibration

1) Point 1
2) Point 2

OR

3) One Point Calibration

Enter Number (ESC to quit):

Options 1) & 2) are used together to allow a two point temperature calibration. Option 3) is used for single point calibration. Single point calibration is most commonly used. If the slope of the temperature read out is not correct e.g. if the temperature is accurate at low temperatures but not at high temperatures then use two point calibration. If the temperature sensor is not enabled the error message **Unable to Calibrate - Temperature is not enabled** will be seen when a calibration attempt is made.

If a two point calibration is carried out incorrectly the temperature reading may be inaccurate and possibly unstable. If the reading is unstable perform option 3) **One Point Calibration** to return to a stable display before attempting another two point calibration.

The two point calibration requires that the LM335 temperature sensor be placed in two accurately known temperature environments, ideally these temperatures should be at least 20°C apart (10°C apart minimum). Typically a reference thermometer will be used to check the temperature and the temperatures used will span the normal operating temperatures.

The two point calibration method is as follows:

1. Place the LM335 temperature sensor in the lower of the two temperature environments being used.

2. Select option 1), the message **Enter Point 1?** will be seen, at this prompt enter the value of the known temperature and press "Enter".

3. Place the LM335 temperature sensor in the higher of the two temperature environments being used, ideally this should be at least 20°C higher than the first.

4. Select option 2), the message **Enter Point 2?** will be seen, at this prompt enter the value of the known temperature and press "Enter".

The two point calibration is complete.

The **single point calibration method is as follows:**

1. Place the LM335 temperature sensor in a known temperature environment and then select option 3) One Point Calibration. The message **Enter One Point Calibration?** will be seen.

2. At this prompt enter the value of the known temperature then press "Enter".

The single point calibration is complete.

6 Modbus communications

Modbus commands

Note: the maximum recommended baud rate is 9600.

The following commands are available:

Function 3 Read holding registers

This function reads the binary contents of the holding registers in the XT4 being addressed. The value for this function is stored as a 32 bit two's compliment number, 2 registers per channel are used.

Registers 1 and 2 hold display values for input 1. Note a value of 1,000,000 represents a positive over range and -100,000 a negative over range. Registers 1 and 2 are addressed as 0X00 and 0X01.

Registers 3 and 4 hold display values for input 2. Note a value of 1,000,000 represents a positive over range and -100,000 a negative over range. Registers 3 and 4 are addressed as 0X02 and 0X03.

Registers 5 and 6 hold the temperature value. Registers 5 and 6 are addressed as 0X04 and 0X05.

Registers 9 and 10 hold the tare value for input 1. Registers 9 and 10 are addressed as 0X08 and 0X09.

Registers 11 and 12 hold the tare value for input 2. Registers 11 and 12 are addressed as 0X0A and 0X0B.

Registers 13 and 14 hold the peak high value for input 1. Registers 11 and 12 are addressed as 0X0C and 0X0D.

Registers 15 and 16 hold the peak low value for input 1. Registers 15 and 16 are addressed as 0X0C and 0X0D.

Registers 17 and 18 hold the peak high value for input 2. Registers 17 and 18 are addressed as 0X10 and 0X11.

Registers 19 and 20 hold the peak low value for input 2. Registers 19 and 20 are addressed as 0X12 and 0X13.

Register 25 represents the decimal point setting for channel 1. Register 25 is addressed as 0X18.

Register 26 represents the decimal point settings for channel 2. Register 26 is addressed as 0X19.

Register 27 represents the decimal point settings for temperature. Register 27 is addressed as 0X1A.

An example of a query to read input channels 1 and 2 from the XT4 at address 5 is given below.

Field Name	**Example (Hex)**
Unit address	05
Function	03
Starting address Hi	00
Starting address Lo	00
Number of points Hi	00
Number of points Lo	04
Error check (LRC or CRC)	–

An example of a response is given below:

Field Name	**Example (Hex)**
Unit address	05
Function	03
Byte count	08
Data Hi (register 1)	00

Data Lo (register 1)	01
Data Hi (register 2)	86
Data Lo (register 2)	A0
Data Hi (register 3)	FF
Data Lo (register 3)	FF
Data Hi (register 4)	D8
Data Lo (register 4)	F0
Error check (LRC or CRC)	–

The value of channel 1 is 0X000186A0 which is 100,000.

The value of channel 2 is 0XFFFFD8F0 which is -10,000.

Note: Two registers should be read at a time to get both halves of the 32 bit value.

Register table

Address	Register	Description
0X00	1	Channel 1 high word
0X01	2	Channel 1 low word
0X02	3	Channel 2 high word
0X03	4	Channel 2 low word
0X04	5	Temperature high word (always set to zero)
0X05	6	Temperature low word
0X06	7	Not used (always set to zero)
0X07	8	Not used (always set to zero)
0X08	9	Channel 1 tare value high word
0X09	10	Channel 1 tare value low word
0X0A	11	Channel 2 tare value high word
0X0B	12	Channel 2 tare value low word
0X0C	13	Channel 1 Hi memory high word
0X0D	14	Channel 1 Hi memory low word
0X0E	15	Channel 1 Lo memory high word
0X0F	16	Channel 1 Lo memory low word
0X10	17	Channel 2 Hi memory high word
0X11	18	Channel 2 Hi memory low word
0X12	19	Channel 2 Lo memory low word
0X13	20	Channel 2 Lo memory low word
0X14	21	Not used (always set to zero)
0X15	22	Not used (always set to zero)
0X16	23	Not used (always set to zero)
0X17	24	Not used (always set to zero)
0X18	25	Channel 1 decimal point
0X19	26	Channel 2 decimal point
0X1A	27	Temperature decimal point
0X1B	28	Not used (always set to zero)

Function 6 Preset single register

The registers for mode 6 are shown below. Note the tare and zero commands can be used to preset a value e.g. if 00 64 hex is sent as the Zero Channel 1 word then the input at the time the command is sent will now be set to 100 (64 hex), only if zero is sent as the tare or zero command will the value for the input at the time be set to zero. Any value sent as the Clear Channel commands will reset both Hi & Lo memories for the channel selected. For example to zero channel 1 of a unit with address 1 the command would be:

01 06 00 32 00 00

Where: 01 is the unit address
06 is the modbus function number
00 32 is the register address to zero channel 1
00 00 is the value zero to be sent to that register

A two byte checksum will also be generated by the system e.g. full string sent: 01 06 00 32 00 00 28 05

Address	Register	Description
0X32	51	Zero Channel 1
0X33	52	Zero Channel 2
0X34	53	Tare Channel 1
0X35	54	Tare Channel 2
0X36	55	Clear Channel 1 Hi and Lo memory
0X37	56	Clear Channel 2 Hi and Lo memory
0X40	66	Channel 1 CAL 1 high word
0X41	67	Channel 1 CAL 1 low word
0X42	68	Channel 1 CAL 2 high word
0X43	69	Channel 1 CAL 2 low word
0X44	70	Channel 1 CAL 3 high word
0X45	71	Channel 1 CAL 3 low word
0X46	72	Channel 1CAL 4 high word
0X47	73	Channel 1 CAL 4 low word
0X48	74	Channel 1 CAL 5 high word
0X49	75	Channel 1 CAL 5 low word
0X50	76	Channel 2 CAL 1 high word
0X51	77	Channel 2 CAL 1 low word
0X52	78	Channel 2 CAL 2 high word
0X53	79	Channel 2 CAL 2 low word
0X54	80	Channel 2 CAL 3 high word
0X55	81	Channel 2 CAL 3 low word
0X56	82	Channel 2 CAL 4 high word
0X57	83	Channel 2 CAL 4 low word
0X58	84	Channel 2 CAL 5 high word
0X59	85	Channel 2 CAL 5 low word

When calibrating using Modbus commands the required load for each callibration point must be present at the time the Modbus commands are sent. For function 6 commands both high and low words must be sent for each calibration point. The number of calibration points which need to be sent is set via the **Linear Points** function for each channel.

As with calibration using a terminal program it is essential that incresing loads are applied between calibration points and that all points have to be recalibrated if an adjustment is required.

Function 16 Preset multiple registers

Function 16 allows multiple registers to be set in a single line. For example to send the high and low word values 0000 1234 to Channel1 CAL2 in an XT4 with Modnus address 1 the command would be:

01 10 00 42 00 02 04 00 00 04 d2

Where: 01 is the unit address
10 is the modbus function number (10 hex. = 16 dec.)
00 42 is the starting register address
00 02 is the number of registers to be written to
04 is the number of bytes to follow
00 00 is the value sent to register address 00 42
04 d2 is the value sent to register address 00 43 (04d2 hex. = 1234 dec.)

A two byte checksum will also be generated by the system e.g. full string sent:

01 10 00 42 00 02 04 00 00 04 d2 f4 db

The registers for this mode are as follows.

Address	Register	Description
0X40	66	Channel 1 CAL 1
0X42	68	Channel 1 CAL 2
0X44	70	Channel 1 CAL 3
0X46	72	Channel 1CAL 4
0X48	74	Channel 1 CAL 5
0X50	76	Channel 2 CAL 1
0X52	78	Channel 2 CAL 2
0X54	80	Channel 2 CAL 3
0X56	82	Channel 2 CAL 4
0X58	84	Channel 2 CAL 5

When calibrating using Modbus commands the required load for each callibration point must be present at the time the Modbus commands are sent. For function 16 commands both high and low words can be sent in one command. The number of calibration points which need to be sent is set via the **Linear Points** function for each channel.

As with calibration using a terminal program it is essential that incresing loads are applied between calibration points and that all points have to be recalibrated if an adjustment is required.

7 Specifications

7 .1 Technical Specifications

Input:	1 or 2 four wire load cells/pressure sensors, up to four 350Ω load cells can share the two inputs 1 or 2 external switch inputs for special functions LM335 temperature sensor
Excitation:	5VDC
mV/V Range:	User selectable 2, 4, 8 or 16mV/V
Sample Rate:	User selectable 1, 2, 5, 10 or 25 samples/sec (dual input) or 1, 2, 5, 10, 25, 50 or 100 samples/sec (single input)
Accuracy:	Up 0.005% of full scale depending on mV range, filter and sample rate, calibrated using live input calibration. Using ECAL & ESCL calibration 1% accuracy
Microprocessor:	MC68HC11F CMOS
Ambient Temperature:	-40 to 60^{O}C
Humidity:	5 to 95% non condensing
Power Supply:	DC 12 to 48V or AC 12 to 32V RMS
Power Consumption:	Typically 25mA @ 24VDC or 50mA @ 12VDC
Output:	RS485 serial communications. Isolated & non isolated versions available
Weight:	300gms
Dimensions:	130mm (l) including connectors, 91mm (w), 44mm (h) (Standard aluminium housing)

8 Guarantee and Service

The product supplied with this manual is guaranteed against faulty workmanship for a period of 2 years from the date of dispatch.

Our obligation assumed under this guarantee is limited to the replacement of parts which, by our examination, are proved to be defective and have not been misused, carelessly handled, defaced or damaged due to incorrect installation. This guarantee is VOID where the unit has been opened, tampered with or if repairs have been made or attempted by anyone except an authorised representative of the manufacturing company.

Products for attention under guarantee (unless otherwise agreed) **must be returned to the manufacturer freight paid** and, if accepted for free repair, will be returned to the customers address in Australia free of charge.

When returning the product for service or repair a full description of the fault and the mode of operation used when the product failed must be given.

In any event the manufacturer has no other obligation or liability beyond replacement or repair of this product.

Modifications may be made to any existing or future models of the unit as it may deem necessary without incurring any obligation to incorporate such modifications in units previously sold or to which this guarantee may relate.

This product is designed and manufactured in Australia.