

Reference manual
Digital Temperatur Indicator
Jofra DTI-1000 A/B



Reference Manual

Digital Temperature Indicator

JOFRA DTI-1000 A/B

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About this manual....

- **The structure of the manual**

This reference manual is aimed at users who are familiar with AMETEK calibrators, as well as those who are not. The manual is divided into 8 chapters, which describe how to set up, operate, service and maintain the indicator. The technical specifications are described as well.

- **Safety symbols**

This manual contains a number of safety symbols designed to draw your attention to instructions which must be followed when using the instrument, as well as any risks involved.



Warning

Conditions and actions which may compromise the safe use of the instrument and result in considerable personal injury or material damage.



Caution...

Conditions and actions which may compromise the safe use of the instrument and result in slight personal or material damage.



Note...

Special situations which demand the user's attention.

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1.0 General information

Congratulations on your new JOFRA DTI-1000!

With the AMETEK indicator, you have chosen an extremely effective instrument which we hope will live up to all your expectations. Over the past many years, we have acquired extensive knowledge of industrial temperature calibration. This expertise is reflected in our products which are all designed for daily use in an industrial environment. Please note that we would be very interested in hearing from you if you have any ideas or suggestions for changes to our products.

This reference manual applies to the following products:

- **DTI-1000 A**
- **DTI-1000 B**

ISO-9001 certified

AMETEK Denmark A/S was ISO-9001 certified in September 1994 by Bureau Veritas Certification Denmark.

CE/UKCA-label



Your new temperature calibrator bears the CE label and conforms to the Electromagnetic Compatibility (EMC) Directive 2014/30/EU and the Low Voltage Directive 2014/35/EU and RoHS Directive 2011/65/EU amended by Directive 2015/863/EU*.

* DTI-1000 A / DTI-1000 B from serial no. xxxxxx-00649



Your new temperature calibrator bears the UKCA label and conforms to The Electromagnetic Compatibility Regulations 2016, The Electrical Equipment (Safety) Regulations 2016, and The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (RoHS).

Technical assistance

Please contact the dealer from whom you acquired the instrument if you require technical assistance.

1.1 Warranty

This instrument is warranted against defects in workmanship, material and design for two (2) years from date of delivery to the extent that AMETEK will, at its sole option, repair or replace the instrument or any part thereof which is defective, provided, however, that this warranty shall not apply to instruments subjected to tampering or, abuse, or exposed to highly corrosive conditions.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED AND AMETEK HEREBY DISCLAIMS ALL OTHER WARRANTIES, INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY. AMETEK SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, ANY ANTICIPATED OR LOST PROFITS.

This warranty is voidable if the purchaser fails to follow any and all instructions, warnings or cautions in the instrument's User Manual.

If a manufacturing defect is found, AMETEK will replace or repair the instrument or replace any defective part thereof without charge; however, AMETEK's obligation hereunder does not include the cost of transportation, which must be borne by the customer. AMETEK assumes no responsibility for damage in transit, and any claims for such damage should be presented to the carrier by the purchaser.

2.0 Safety instructions



Read this manual carefully before using the instrument!

Please follow the instructions and procedures described in this manual. They are designed to allow you to get the most out of your DTI system and avoid any personal injuries and/or damage to the instrument.



Disposal – WEEE Directive

These calibrators contain Electrical and Electronic circuits and must be recycled or disposed of properly (in accordance with the WEEE Directive 2012/19/EU).



Warning

- The indicator **must not** be used for any purposes other than those described in this manual, as it might cause a hazard.
- The indicator has been designed for **indoor use only** and is not to be used in wet locations.
- The indicator is **not to be used in hazardous areas**, where vapour or gas leaks, etc. may constitute a danger of explosion.
- The indicator is **not** designed for operation in altitudes above 2000 meters.
- Only use the specified mains adaptor approved for the voltage and plug configuration in your area.
- **Do not** connect rated voltages to earth with a maximum above 30V to the input terminals.
- **Always** position the indicator to enable easy and quick disconnection of the power source (mains adaptor).



Caution...

When connecting the PC and the indicator please ensure that both the PC and the indicator are switched off at the mains. Failure to do so may result in your equipment being damaged.

3.0 Introduction

The DTI (Digital Temperature Indicator) system is designed for fast and traceable calibration. The system is portable.

The DTI is prepared for re-calibration by your local calibration laboratories, and all necessary instructions for the re-calibration is stated in this manual.

The DTI is a precision instrument and to achieve the precision, a set of sensor coefficients relating to the specific sensor must be present in the DTI. Before use of the DTI, ensure that the correct coefficients for each channel in the DTI are equal to those from the sensors calibration certificate – see section 5.2.6.

How to install new sensor coefficients can be found in section 8.2.3.



Note...

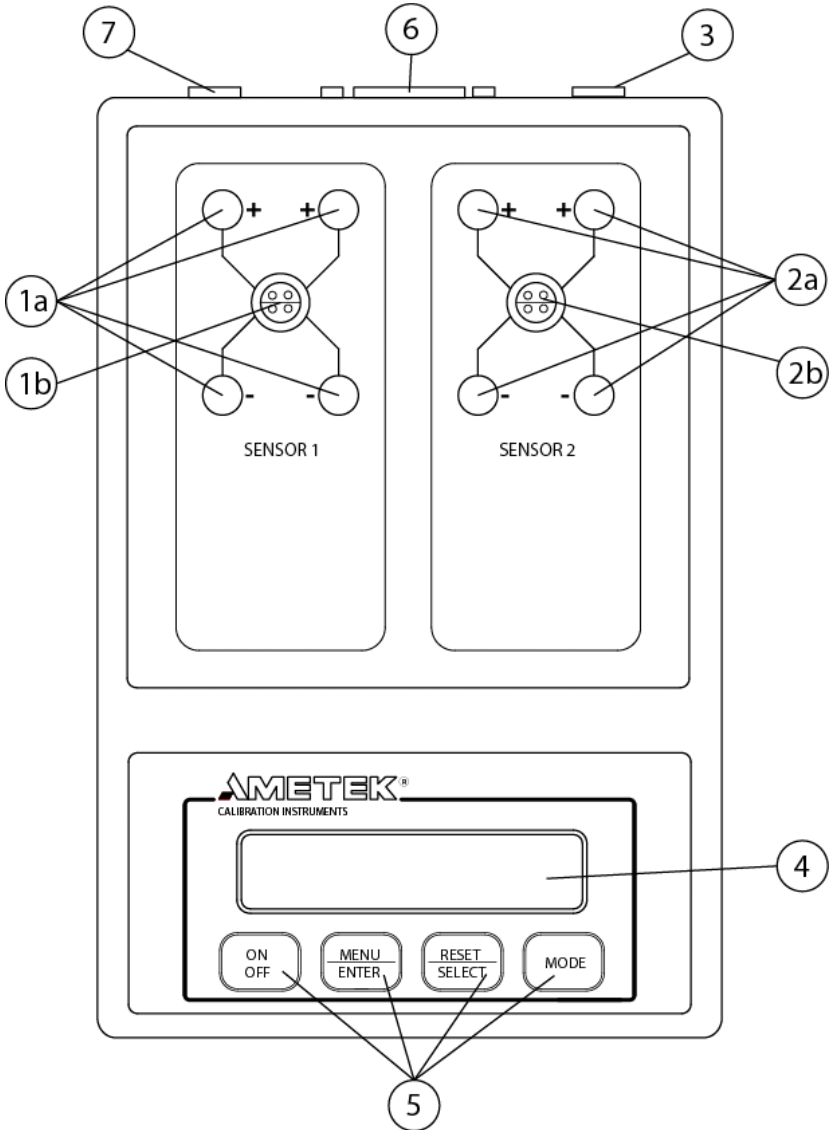
The DTI is not designed for continuously data-logging recording, since there is no guarantee for missed log values during the data-logging

Definitions and terminology used in this manual:

- a. Text inside <> refer to soft-keys on the DTI panel or keys on the PC keyboard.
Text with big letters indicate the activated function if there are more than one function (example <ON/Off>).
- b. Display text on the DTI is shown inside rounded frames.
- c. Screen menus in the DTI software are shown inside edged frames.

4.0 Functionality

Overview:



POS	Description
------------	--------------------

- | | |
|----|-----------------------------------|
| 1a | Sensor 1 connections |
| 1b | Sensor 1 connections |
| 2a | Sensor 2 connections |
| 2b | Sensor 2 connections |
| 3 | Ground terminal for cable shields |
| 4 | Display with 2 * 20 characters |
| 5 | Soft keys |
| 6 | RS232 connector |
| 7 | Power inlet for mains adapter |

4.1 Functional description

The DTI is used for measuring inputs from two RTD sensors. The two sensors are connected to the connectors in the top plate. The input signal is compared to the two internal resistor references from which the input signal can be determined.

The DTI operates with a 2*20 character display, which continuously read out the two inputs.

The input value can be shown as the actual read value for both sensors, the peak values for sensor 1 or 2, the differential value for the two sensors or as the differential peak value for the two sensors.

The input value can be shown in Ω , $^{\circ}\text{C}$, $^{\circ}\text{F}$ or K selected by the user.

The resolution in temperature can be 0.1, 0.01 or 0.001.

The sensor coefficients can be inspected by the user and changed in the software program.

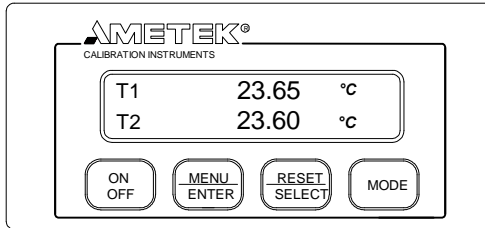
The power supply is made by eight 1.5 Volt batteries or a mains adapter. Use only mains adapter supplied by AMETEK in order to comply with the requirements in EN50081-1 (1992) and EN50082-1 (1992).

It is possible to connect the shields from the cables to the cabinet, in order to reduce the influence of noise.

The DTI-1000 is supplied with RS232 and software, in order to have the possibility of saving the measured data and to recalibrate the DTI or the sensors.

4.2 Indicators

The DTI only uses the display for all indications. The display has 2*20 characters which will swap between read-out values or menu selection when requested. Please see section 5.2.1 to 5.2.7 for possible display read-outs. Please note that the error messages will also be showed in the display, see section 7.3.



4.3 Touch pad

There are 4 soft-keys on the touch pad panel, where 2 of the soft-keys have a double function.



Switch ON or switch OFF the DTI. Please press down the key at least 0.2 seconds in order to switch on the unit.



MENU toggles between the menus:
Mode/Unit/Resolution/Sensor
ENTER enters the menu function selected with the RESET/SELECT key.



RESET resets peak values for both channels.
SELECT toggles between the selected menu functions.



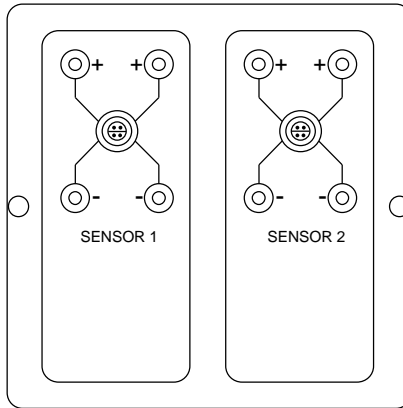
Toggles between the following display modes: T1/T2, Diff(T1-T2), T1MAX./T1MIN., T2 MAX./T2 MIN., DIFF MAX./DIFF MIN.

4.4 Connections

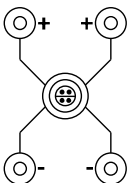
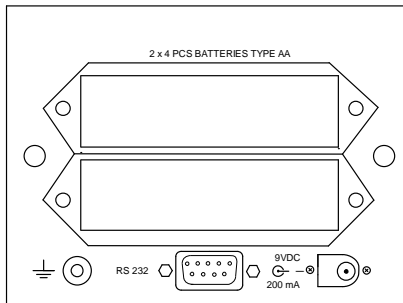
All signal cables have to be connected to the top plate (grounding on the back plate).

Power and communication cables have to be connected on the back plate.

Top plate connections



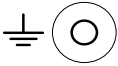
Back plate connections



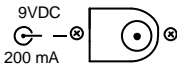
SENSOR 1

Connections for sensors, where channel 1 is shown.

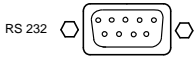
Please note that the LEMO-connector is only available on the DTI-1000 model.



Ground terminal for shield on the signal cables.



Power input for mains adapter 9VDC 200mA.



Connector for RS232C interface.

5.0 Operation

5.1 Operating area

Both of the DTI models are intended for use in areas which meet the following:

Temperature range	:	0°C to 50°C (32°F to 122°F)
Humidity	:	0% to 90%
Protection class	:	IP20

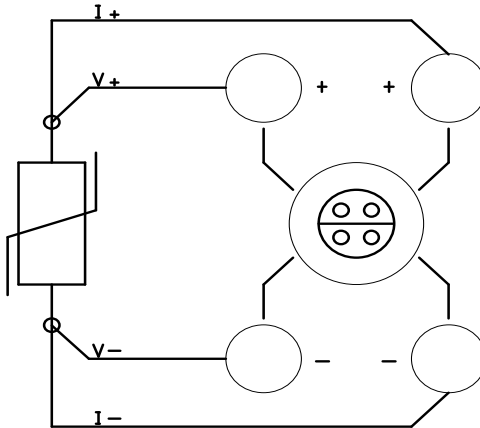


Warning

- The indicator **must not** be used for any purposes other than those described in this manual, as it might cause a hazard.
- The indicator has been designed for **indoor use only** and is not to be used in wet locations.
- The indicator is **not to be used in hazardous areas**, where vapour or gas leaks, etc. may constitute a danger of explosion.

5.2 Connection of sensors

The sensor should be connected to the terminals as shown in the figure below:



Use the ground terminal (see the figure "Overview" section 4, pos. 3) for the cable shields in order to reduce noise.

The connector type to extra connector on DTI-1000 is: LEMO FFA 1S 304 CNAC.

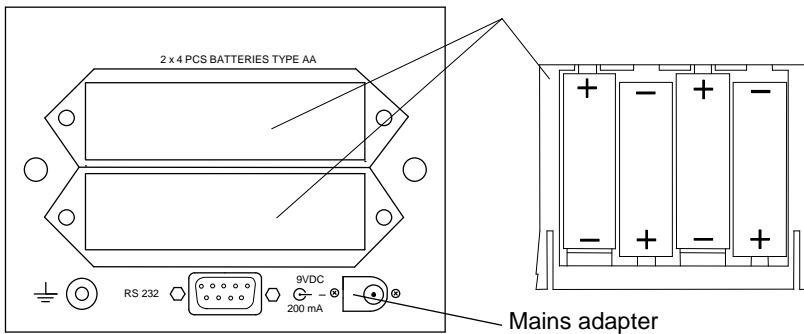
5.2.1 Power supply

The DTI is supplied with 8 1.5 Volt batteries as standard. When the battery voltage is low following message will appear:



This message will only appear one time after the DTI has been switched on, and is removed by pressing the key <Menu/Enter> or <Reset/Select>. The DTI is still able perform accurate measurements a little while longer.

The batteries are placed in the two battery holders shown in the figure below:



It is also possible to supply the DTI from a mains adapter at the connector shown in the figure above. The mains adapter can be supplied by AMETEK.

5.2.2 On / Off

Start the DTI by activating the softkey <ON/Off>. Following message will be shown in the display:

SELF-CALIBRATION
AND TESTING 1

This information states that the internal references and the sensor coefficients are checked. If the coefficients are incorrect an error message will occur which is described in section 7.3.

The next message shown in the display will be:

SELF-CALIBRATION
AND TESTING 2

In this step the A/D converter is calibrated which approximately takes 1 second. When the calibration is over following message will be shown:

SELF-CALIBRATION
AND TESTING 3

Test 3 is an internal voltage reference check, which approximately takes 4 seconds.

When all tests have succeeded, the DTI will show the model type and last calibration date in the display:

Ver. X.XX DTI-1000
CAL. DATE 031216

After this the input values will be shown in the display in the same format, as before the DTI was shut off last time:

T1	23.65	°C
T2	23.60	°C

If there is no input signal or it is outside the measuring range a hyphen will be shown for that specific channel.

5.2.3 Reset

Use the softkey <RESET/Select> in order to reset the peak values in the selected difference mode.

5.2.4 Units

In order to change the unit of the read-out, you must press the softkey <MENU/Enter> 1 time. The following message will be shown in the display:

UNIT: °C

Use the softkey <Reset/SELECT> to scroll between following types of units:

UNIT SELECTION MENU

READ-OUT MODE

UNIT: °C	T1 23.65 °C T2 23.60 °C
UNIT: °F	T1 74.57 °F T2 74.48 °F
UNIT: Ω	R1 109.210 Ω R2 109.191 Ω
UNIT: K	T1 296.80 K T2 296.75 K

Use the softkey <Menu/ENTER> to select the specific read-out unit.

Please note that read-out in Ω has one more digit than specified in the resolution set-up.

5.2.5 Resolution

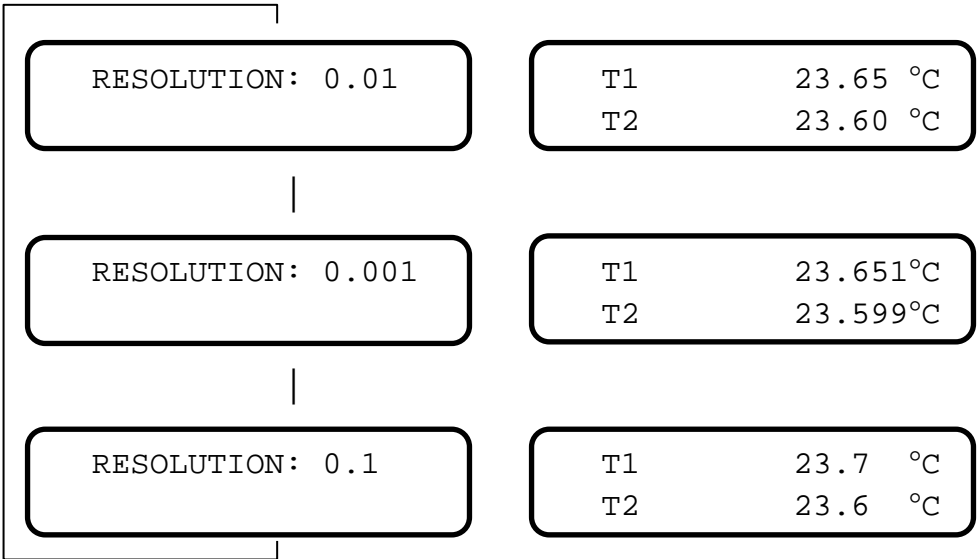
In order to change the resolution on the read-out, you must press the softkey <MENU/Enter> 2 times. The following message will be shown in the display:

RESOLUTION: 0.01

Use the softkey <Reset/SELECT> to scroll between following types of resolution:

RESOLUTION SELECTION MENU

READ-OUT MODE



Use the softkey <Menu/ENTER> to select the specific read-out unit.

The sample period is dependent on the selected resolution which can be longer than sample rate to the display if a resolution above 0.1 is selected. The sample rates for the different resolutions are shown below:

Resolution	0.1	0.01	0.001
Sample period	2 s	3 s	12 s

Please note that read-out in Ω has one more digit than specified in the resolution set-up.

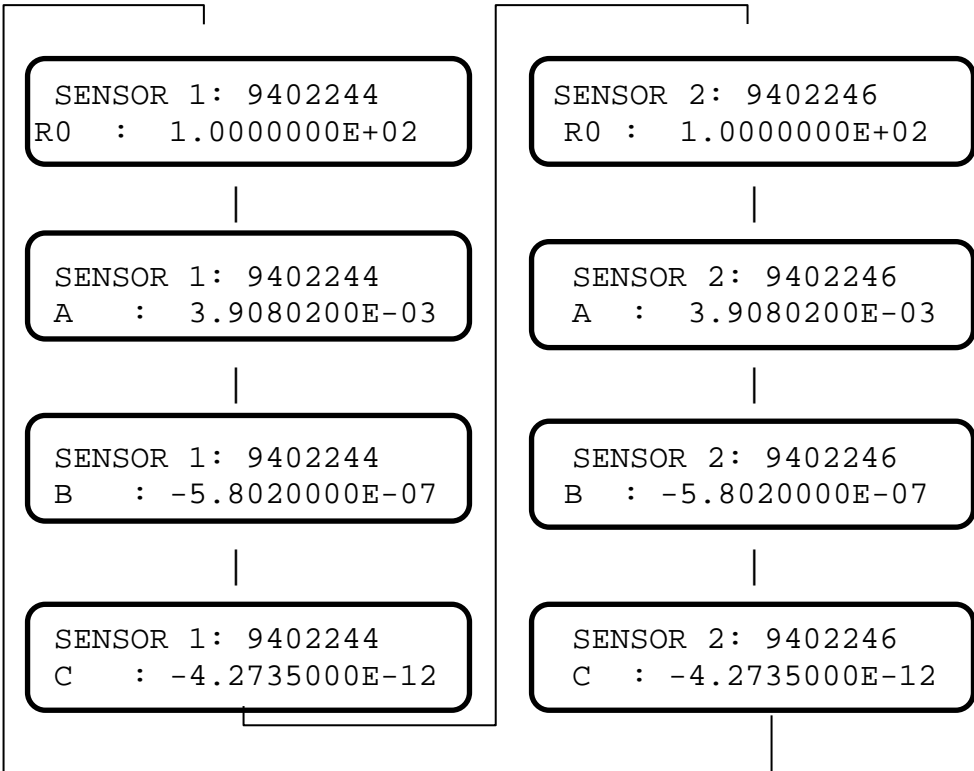
5.2.6 Checking sensor coefficients

In order to check the sensor ID and coefficients on the DTI, press the softkey <MENU/Enter> 4 times.

If Callendar van Dusen coefficients is used for the sensor, the following message will be shown in the display:

```
SENSOR 1: 9402244  
R0 : 1.0000000E+02
```

Use the softkey <Reset/SELECT> to scroll through the coefficients:
(example with both sensors using default coefficients)



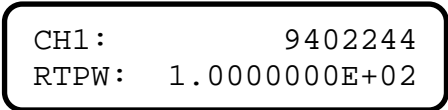
Use the softkey <Menu/ENTER> to leave this menu.

The coefficients are used in the equations:

Below 0°C: $R(t) = R_0 \cdot (1 + A \cdot t + B \cdot t^2 + C \cdot (t - 100)t^3)$

Above 0°C: $R(t) = R_0 \cdot (1 + A \cdot t + B \cdot t^2)$

If ITS-90 coefficients is used for the sensor, the following message will be shown in the display:



```
CH1 :          9402244
RTPW:  1.0000000E+02
```

Use the softkey <Reset/SELECT> to scroll through the coefficients:
(example with both sensors using default coefficients)

CH1: 9402244
RTPW: 1.0000000E+02

CH1: 9402244
aLR: 0.0000000E-00

CH1: 9402244
bLR: 0.0000000E-00

CH1: 9402244
cLR: 0.0000000E-00

CH1: 9402244
aHR: 0.0000000E-00

CH1: 9402244
bHR: 0.0000000E-00

CH1: 9402244
cHR: 0.0000000E-00

CH1: 9402244
dHR: 0.0000000E-00

CH2: 9402245
R0 : 1.0000000E+02

CH2: 9402245
aLR: 0.0000000E-00

CH2: 9402245
bLR: 0.0000000E-00

CH2: 9402244
cLR: 0.0000000E-00

CH2: 9402245
aHR: 0.0000000E-00

CH2: 9402245
bHR: 0.0000000E-00

CH2: 9402245
cHR: 0.0000000E-00

CH2: 9402245
dHR: 0.0000000E-00

Use the softkey <Menu/ENTER> to leave this menu.

Use the table below to convert ITS90 coefficient nomination to DTI-1000 nomination.

		ITS90 Subrange								
		3	4	5	6	7	8	9	10	11
DTI-1000 coefficient	aLR	a3	a4	0						
	bLR	b3	b4	0						
	cLR	c3	0	0						
	aHR			a5	a6	a7	a8	a9	a10	a11
	bHR			b5	b6	b7	b8	b9	0	0
	cHR			0	c6	c7	0	0	0	0
	dHR			0	d	0	0	0	0	0

5.2.7 Mode

In order to change the reading, you must press the softkey <MODE> to scroll between following types of read-out:

READ-OUT MODE

T1	23.65 °C
T2	23.60 °C

DIFF (T1-T2)
0.05 °C

T1MAX.	23.66 °C
T1MIN.	23.64 °C

T2MAX.	23.61 °C
T2MIN.	23.59 °C

DIFFMAX.	0.07 °C
DIFFMIN.	0.03 °C

6.0 Technical specifications

Electrical specifications

Measuring input:	: 2 channels for 4 wire RTD sensors
Measuring range DTI-1000 A	: 0 to 360 Ω (-200 to 750°C / -328 to 1382°F)
Measuring range DTI-1000 B	: 0 to 95 Ω (-200 to 750°C / -328 to 1382°F)
Accuracy DTI-1000 A	: ± 6 ppm rdg + 1,4 m Ω (12 months use)
Accuracy DTI-1000 B	: ± 6 ppm rdg + 0,7 m Ω (12 months use)
Measuring current	: 1mA, 18% duty cycle
Temperature coefficient	: ± 0.8 ppm/°C. outside 23 \pm 3°C (73.4 \pm 5.4°F)
Temperature resolution	: 0.1 / 0.01 / 0.001.
Units	: °C / °F / Ω / K.
Supply	: 8 pcs. 1.5 V type AA batteries or 9 V mains adapter.
Battery life	: 15 hours

Mechanical specifications

Weight	: 2.2 kg. / 4.9 lb.
Dimensions (H/W/D)	: 195 mm / 135 mm / 225 mm. 7.7 in. / 5.3 in. / 8.9 in.
Operating conditions	:
Temperature range	: 0 to 50 °C (32 to 122°F)
Humidity range	: 0 to 90 %
Protection class	: IP20
Storage temperature	: -20 to 60°C (-4 to 140°F)

Mechanical specifications

Electromagnetic environment : Designed for use in controlled electromagnetic environment as defined EN61326-1 2013.

Additional data - directives observed

The following standards are observed according to the EMC-Directive (2014/30/EU)

EN 61326-1: 2013: Electrical equipment for measurement, control and laboratory use – EMC requirements.

7.0 Maintenance and display error messages

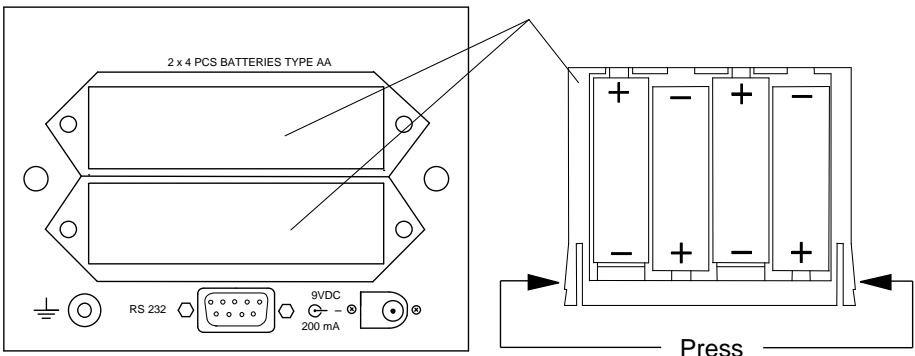
7.1 Maintenance

The DTI does not require specific maintenance before or after use. The user may carry out the following procedures himself.

- | | |
|---|---|
| Cleaning surfaces | Use alcohol or water and a soft cloth. |
| Re-calibrate or change coefficients for sensors | Use the software in order to re-calibrate/change the sensor coefficients (see section 8.0). |
| Re-calibration of DTI references or analog out | Use the calibration routines in the software to re-calibrate the DTI (see section 8.0). |

7.2 Changing batteries

The batteries are placed in the two battery holders shown in the figure below. The battery holders can be pulled out by pressing the locks on both sides simultaneously.



7.3 Display and error messages

If the DTI detects an error while running, it will automatically appear in the display. Following error messages can occur:

Display message:

Meaning/Action:

BATTERY LOW
PRESS ANY KEY

Battery voltage low.
Change batteries
(section 7.2).

T1 ////.///°C
T2 ////.///°C

No sensor connected to input
or measuring input outside
range.

CONSTANT ERRORS
DEFAULT VALUES

Downloaded coefficients
rejected.
Check calibration.
Default sensor coefficients
used are:
R0: +100.000000
A: +3.90802E-3
B : -5.80200E-7
C : -4.27350E-12
Press any key to continue

8.0 Adjusting and calibrating the instrument

You are advised to return the DTI-1000 A/B to AMETEK Denmark A/S or an accredited laboratory at least once a year for calibration.

Alternatively you can calibrate/adjust the DTI-1000 A/B yourself using the AmeTrim-ATC/DTI Adjust and Calibration software. AmeTrim-ATC/DTI also supports DTI-100 and DTI-1000 manufactured in 1996 or later or with firmware version 1.60 or later. This software is divided into 5 different processes:

- **Reference sensor:** Use this feature to manage the coefficients of the sensors in the DTI.
- **Set to default values:** Use this feature to set internal reference resistor values to default values if odd values have been downloaded.
- **RTD-input adjustment:** Use this feature to calculate and download new values for internal reference resistors.
- **Calibration date:** Use this feature to download a new calibration date to the DTI.
- **Analog output adjustment:** Use this feature to adjust the analog output (only DTI-1000 with firmware version 1.60 or earlier).

8.1 Introduction to AmeTrim-ATC/DTI Software

This software is supplied on the JOFRACal CD-ROM. It can be run directly from this CD-ROM and requires no special installation. It is possible to make a disk containing the AmeTrim-ATC/DTI software. From this disk AmeTrim-ATC/DTI can be installed on the harddisk of the computer, but the disk has to be in the disk drive when running the software.

To use the software, you need:

PC hardware requirements

- IBM compatible PC with 486 or higher processor (Pentium™ 200 MHz recommended).
- 32 MB of RAM (64 MB recommended).
- 4 MB available hard-disk space.
- Standard VGA monitor (800 x 600, 256 colours), (1024 x 768 recommended).
- CD-ROM drive.
- One vacant RS 232 Serial Port.

PC software requirements

- Microsoft Windows®98, Microsoft Windows® NT 4.0, Microsoft Windows® 2000, Microsoft Windows® ME, Microsoft Windows® XP.
- System font: MS Sans Serif and Arial.

8.2 Installing the AmeTrim-ATC/DTI Software

The software comes on a CD-ROM and is ready to run – no installation is required. Simply insert the CD-ROM and run the ATC/DTI-adjustment program.

8.2.1 Connecting the PC and the ATC/DTI



Caution...

1. Ensure that both the PC and the ATC/DTI are switched off at the mains. Failure to do so may result in your equipment being damaged.
2. Connect the serial cable provided to the “RS 232” port on the back of the DTI and to the COM port on the PC.
3. Switch on the PC and the DTI.

8.2.2 Starting the AmeTrim-ATC/DTI Software



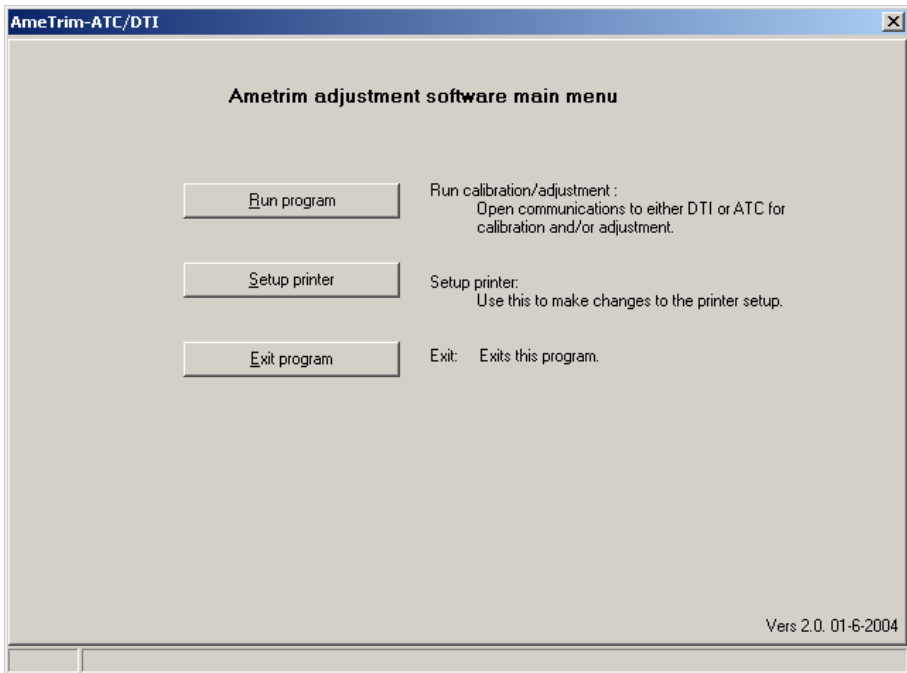
Note...

Before starting this software, the PC and the ATC/DTI must be connected together and the indicator switched on (see section 8.2.1).

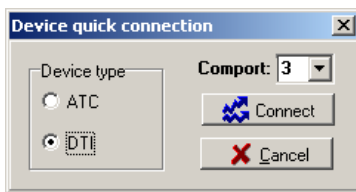
The ATC must not be performing any tasks like switch test, auto step or workorders. That means that the ATC must be in the main menu before starting the software.

Use the normal Windows procedure to start the AmeTrim-ATC/DTI software.

If you are unsure on how to start software programs, refer to your Windows Help

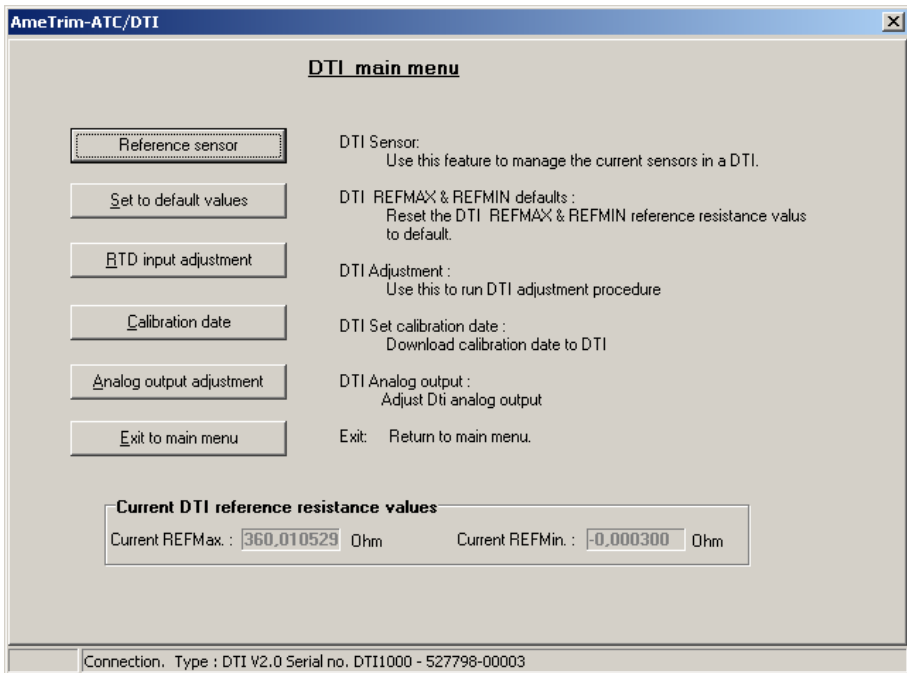


In the main menu select “Run Program” to start the calibration.



Select “DTI” and “Comport” in the “Device Quick Connect” dialog box and press “Connect”. If the DTI is not switched on or is not connected to the selected port, then the software returns to the Ametrin adjustment software main menu.

As the software starts, it detects the type of calibrator connected to the PC and reads its serial number. This information is displayed at the bottom of the DTI main menu window



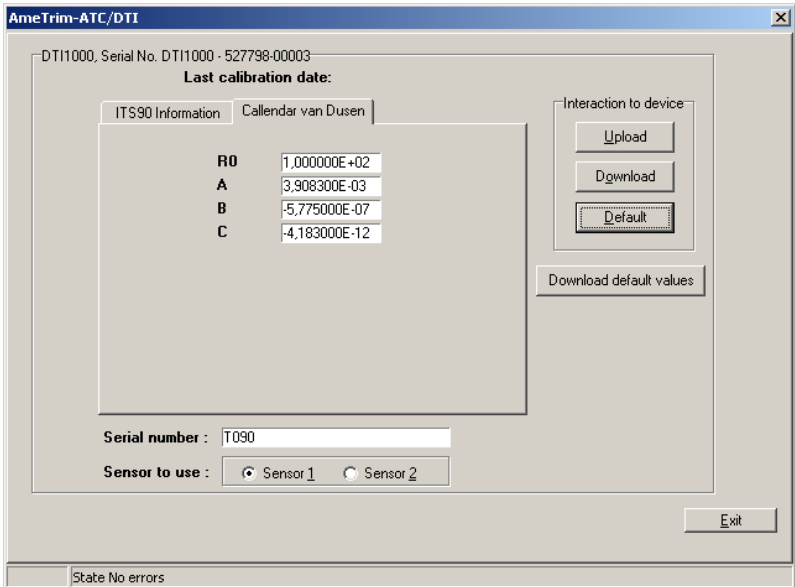
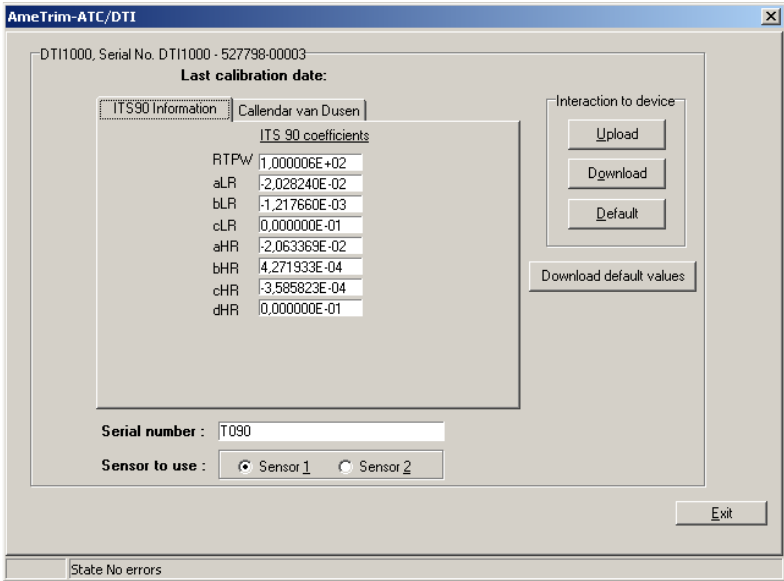
8.2.3 Reference sensor

This option enables you to view the calibration values currently loaded in the DTI for the reference sensors as well as enter and download values for new reference sensors. In addition to the equipment already described in sections 8.1 and 8.2.1, you also require the calibration certificate for the new reference sensor.







In DTI main menu, click “Sensor coefficients”.

A new dialogue with a table containing the coefficients stored in the DTI for sensor 1 and sensor 2. Current sensor coefficients are automatically uploaded.



To enter values for a new reference sensor

-  Click a radio button to select sensor 1 or sensor 2. And press “Upload” to read current coefficients.
-  Type in a unique and descriptive name for the reference sensor.

Use the mouse to position the pointer in the boxes in the table.
-  Select “ITS-90” or “Callendar van Dusen coefficients” and type in the coefficients from the Calibration Certificate supplied with the reference sensor.
-  When all the values from the Calibration Certificate have been entered, click “Download” values.

When the values are downloaded they overwrite the ones stored in the indicator.

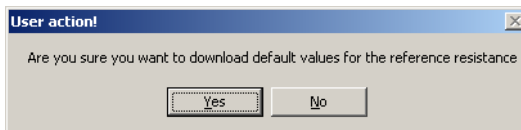


Note...

These coefficients are not saved. Therefore, they must be typed in and downloaded when they need to be used.

8.2.4 Default values

This option downloads a set of default values, which are stored in the AmeTrim-ATC/DTI software.



Press “Yes” to download default values to the DTI.

8.2.5 RTD input adjustment

This option allows you to adjust the DTI by calculating and downloading new values for the internal reference resistors. For adjusting the internal reference resistors, you need the following:

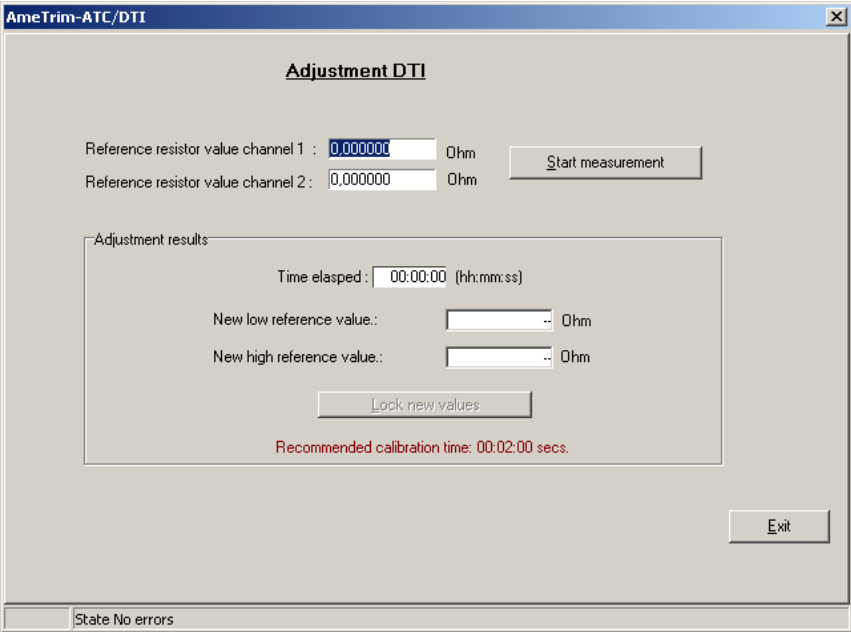
DTI-100 / DTI-1000 / DTI-1000 A :

50 ohm resistor
350 ohm resistor

DTI-1000 B :

12 ohm resistor
85 ohm resistor

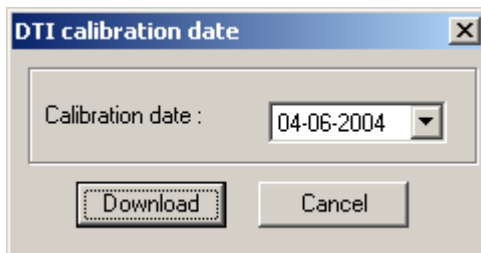
It is recommended to use resistors with an accuracy of 6 ppm or better.



Connect the reference resistors to the input channels and enter the resistor values. Press “Start measurement”, wait until the readings for “New low reference value” and “New high reference value” have stabilized (approx. 2 minutes) and press “Lock new values” to stop the measurement. The locked values can now be downloaded to the DTI or cancelled.

8.2.6 Calibration date

This option allows you to change the calibration date without adjusting the DTI.

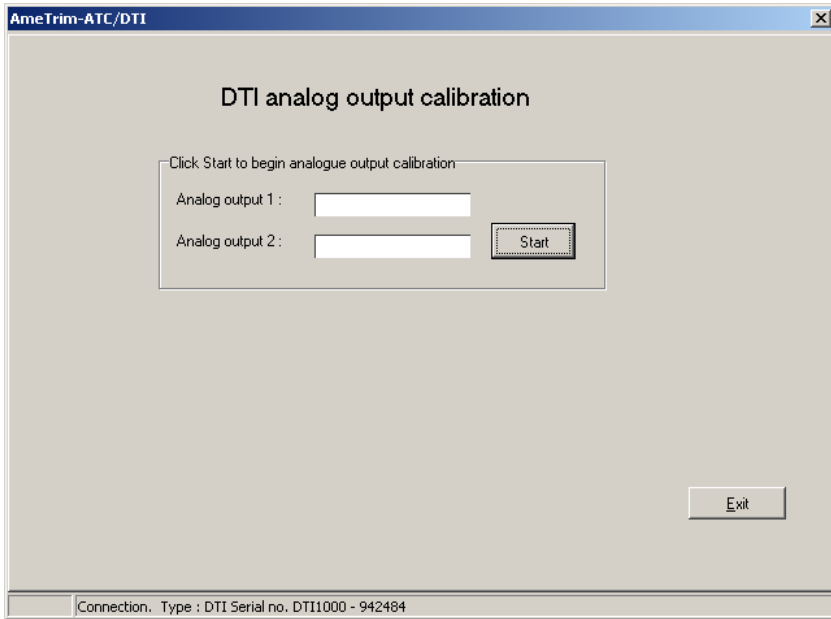


Select the date of calibration and press “Download”.

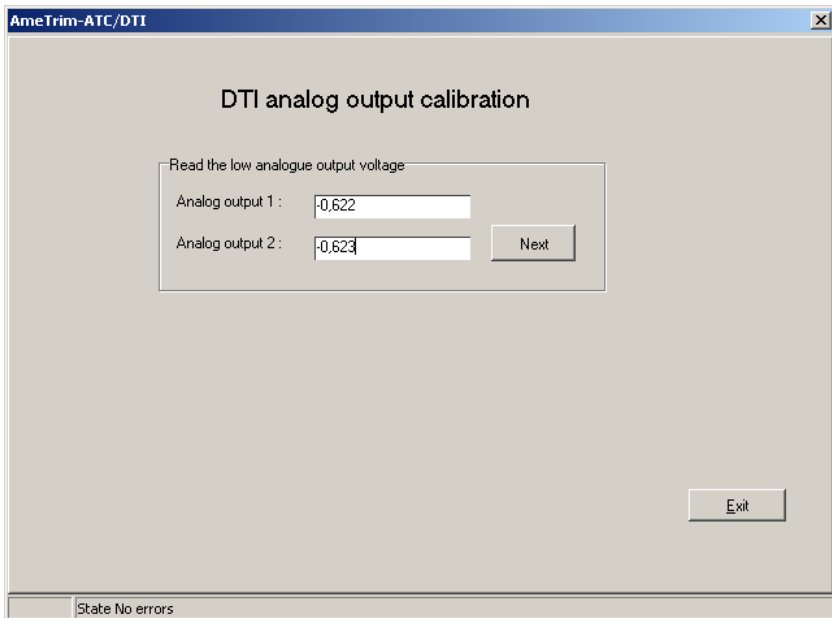
8.2.7 Analog output adjustment

(only DTI-1000 with firmware ver. 1.60 or earlier).

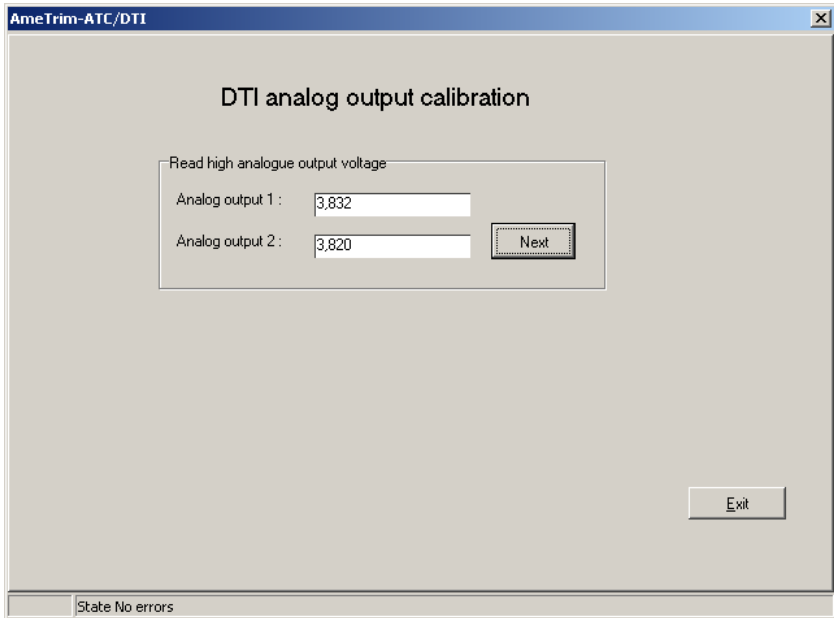
This option allows you to adjust the analog output of the DTI-1000. For adjusting the analog output you need a voltmeter 0V to 5V range with 0.1mV resolution and an accuracy of 0.1 mV.



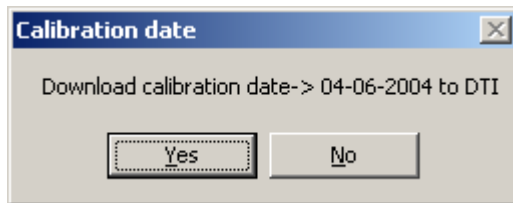
After entering the DTI analog output adjustment window, press "Start" to begin the adjustment procedure.



Measure the output voltages of the two analog outputs, enter the values and press “Next”.



Repeat the measurement of the output voltage for high output, enter the values and press “Next”.



Press “Yes” to download calibration date and then “Exit” to return to the main menu.

8.3 Setup Printer

This option provides a standard Windows® procedure which enables you to edit the settings for the current printer or change to another printer.

If you are unsure how to use these settings, refer to your Windows® Help.

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