nanodac™ Recorder/Controller

MODEL

invensys

Eurotherm


# Heat only Temperature Control and Carbon Potential Control using the nanodac Recorder/Controller

Application Note

## Purpose of this note

The purpose of this application note is to describe how the nanodac recorder/controller may be used to control temperature and carbon potential in metal heat treatment furnaces. Using the measurements of oxygen level and temperature the nanodac recorder/controller may be used to calculate the carbon potential levels using the Zirconia function block.

## Product

The nanodac recorder/controller provides combined recording and control in a single ¼ DIN package.

There are two control loops. One of these loops is used to control the temperature. The second loop is used to control the enriching gas valve and the dilution air valve.

A manual probe clean request and a sooting alarm relay is included.

The nanodac recorder/controller can accommodate a range of probes from various manufacturers. A suitable probe is the Eurotherm ECprobe which is interchangeable with all other carbon sensors. It is available in 600mm or 900mmm lengths with or without integral thermocouple in types K, N, S, or R. A typical order code is CP600-K.

In addition to the features listed above, the nanodac recorder provides powerful logging and secure archiving of data. It can store information in either open CSV format or in a secure (UHH), check summed format to protect data integrity.

In addition to live trending, a simple menu allows any selected portion of the recorder history to be archived, either to a ‘memory stick’ plugged into the USB port at the rear of the recorder (Local Archiving) or to a computer or server, by means of the FTP protocol (Remote Archiving). The archived data remains in the flash (50MB) memory of the instrument and can be reviewed directly on the instrument display.

The archive period can be chosen between the last hour, last day, last week, last month, archive everything in the recorders history or archive all files created since or updated since the last archive.

The status of the archive is displayed on the nanodac recorder/controller which shows when data is being transferred or is complete.

The archive data includes actual values from real or comms channels (PV), Alarm Messages, and Operator Input Messages all of which are accurately dated and time stamped from the on-board real time clock.

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# Heat only Temperature Control & Carbon Potential Control using the nanodac Recorder/Controller

## Introduction

When mild steels or certain low carbon steels are heated at temperatures above 900°C in a carbon rich atmosphere the surface of the steel absorbs carbon by diffusion. The depth of carbon enrichment depends on the time and temperature of the treatment known as carburising. The presence of carbon in the steel causes a change in its physical properties.

A Zirconia probe is used to measure the level of oxygen. It generates a millivolt signal based on the ratio of oxygen concentration between the reference airside of the probe (outside the furnace) and the amount of oxygen actually inside the furnace.

The temperature of the furnace is measured using a thermocouple. This may be a thermocouple mounted within the Zirconia probe or installed as a separate item. Together the temperature and oxygen level signals are used by the nanodac recorder/controller to calculate the actual percentage of carbon in the furnace atmosphere.

The carbon potential control loop increases the carbon potential by opening a solenoid valve which allows a carburising or enriching gas (e.g. propane) to enter the furnace. Conversely, to decrease the carbon potential, dilution air or nitrogen is introduced into the furnace.

The nanodac recorder/controller can trigger an alarm when the atmospheric conditions within the furnace are such that carbon will be deposited as soot on all surfaces inside the furnace, including the workpiece. Avoiding sooting protects the furnace lining, maintains the accuracy of the zirconia probe and stops formation of a soot barrier on the workpiece which can prevent carbon diffusion.

The nanodac recorder/controller has a probe cleaning strategy that can be programmed to occur between batches or manually requested by the operator. A short blast of compressed air is used to remove any soot and other particles that may have accumulated on the probe. Once the cleaning has taken place the time taken for the probe to recover is measured. If it is too long this indicates that the probe is ageing and needs replacement or refurbishment.

## Application Example

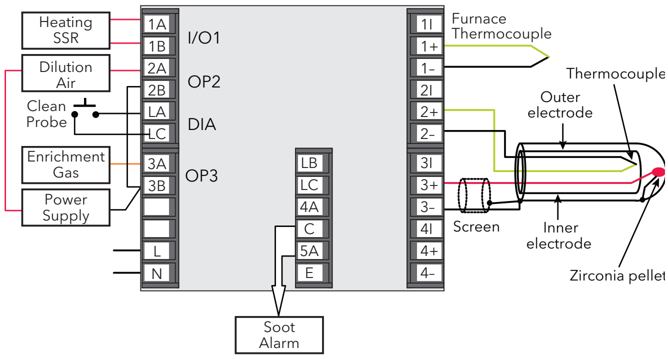
Channel 1 thermocouple input

Loop 1 is configured for heating control. The heating channel is a time proportioning logic output used to drive a solid state relay or thyristor unit.

The Zirconia block measures both oxygen and temperature using input channels 2 and 3 respectively and a third virtual channel is used to chart the level of oxygen.

Loop 2 is configured for carbon potential control using the carbon potential output from the Zirconia block as the process value.

Dilution air and enrichment gas is admitted to the furnace using digital outputs 2 and 3 respectively.




**Physical Wiring**

## Internal 'Soft' Wiring

### Temperature Control

Configure Channel 1 for thermocouple. Configure Loop 1 for PID heat/cool control. Wire Channel.1.Main.PV to Loop.1.Main PV to provide the temperature input to the control loop. (Alternatively use the internal thermocouple in the Zirconia probe to control the furnace temperature as well as providing the temperature input to the zirconia block).

Wire Loop1.OP.Ch1Out to DIO_1A1B PV to provide the drive to the SCR.

### Carbon Potential Control

Configure Channel 2 for thermocouple. Wire Channel2.Main.PV to Zirconia.TempInput. (Alternatively, use the temperature measurement from Channel 1).

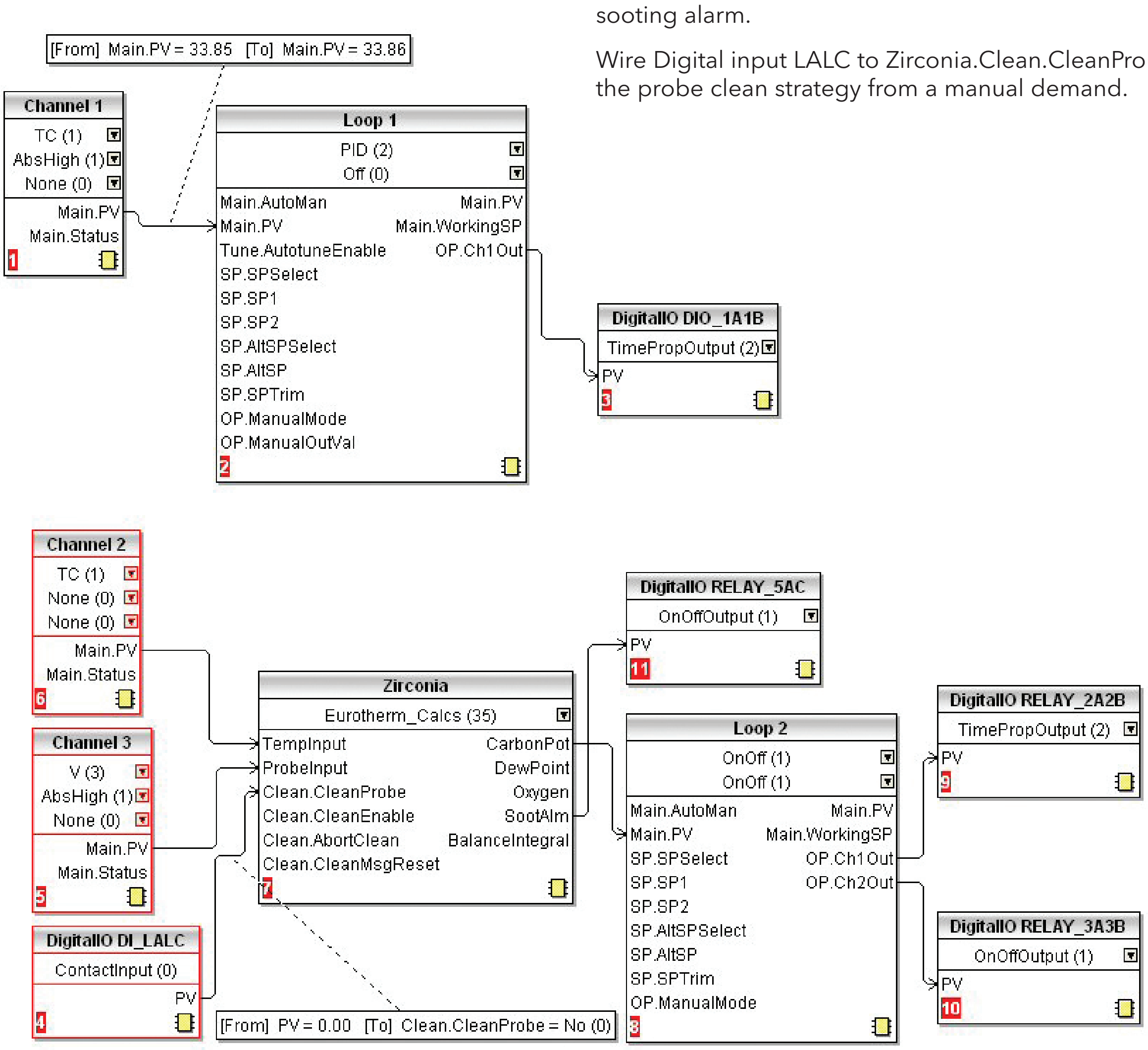
Configure Channel 3 for V (voltage input). The input range must be configured as 0 – 2V (max) and scaled in mV. Wire Ch3.Main.PV to Zirconia.ProbeInput.

The calculated carbon potential level forms the input to the carbon control loop 2 by wiring Zirconia.CarbonPot to Loop2.MainPV.

Configure Relays 2 and 3 for on/off control and wire these from Loop2.OP.Ch1Out and Loop2.OP.Ch2Out to provide the drives to the dilution air and enrichment gas relays.

Wire Zirconia.SootAlm to Relay5.PV to provide the external sooting alarm.

Wire Digital input LALC to Zirconia.Clean.CleanProbe to run the probe clean strategy from a manual demand.




**Graphical View of 'Soft' Wiring using iTools**

## Further information may be downloaded from www.eurotherm.co.uk

### nanodac Recorder/Controller

**User Guide HA030554**
**Brochure HA030685**
**Specification sheet HA030686**

### iTools Configuration & Monitoring Software

**Help Manual HA028838**

### Eurotherm Review PC Based Software Package

**Brochure HA028081**

### Dream Report Software

**Brochure HA029515**
User Friendly Reporting Software

### Data Security with Store & Forward

**Brochure HA029878**

### Environmental Quality Monitoring System

**Brochure HA030142**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