Addendum for 2404*f* ATMOSHERE CONTROLLER Version ES0278

CONTENTS

INTRODUCTION

This addendum to describes additional features offered in the 2404*f* Atmosphere Controller version ES0278. This version of the controller supports Profibus-DP or Modbus communications, an optional third DC input to measure and automatically compensate for the %CO in the reference gas, process value retransmission and additional alarm/event relay outputs.

The Controller controls the carbon level (Carbon potential) in the atmosphere of a heat treatment furnace. It connects to a Zirconia probe which measures the %oxygen in the furnace. The carbon level is calculated from the oxygen reading and the temperature of the probe. In addition to measuring the level of carbon, the controller can be configured to measure %oxygen, or dewpoint temperature. In the latter case the hydrogen concentration in the reference air must be known and entered as a parameter value.

Typical applications are:

- **carburising steel**
- **ceramic firing kilns**

Zirconia (ZrO_2) sensors are designed for measuring the carbon potential in a furnace, where the operating temperature is above 600°C. Typical operating temperature is in the range 600 - 1100°C. The zirconia probe is a sandwich of zirconia between two metal electrodes with one side open to reference air of a known composition and the other to the furnace atmosphere. The probe generates a millivolt output which is a function of the difference in the partial pressure of oxygen on the two sides of the probe and the temperature of the probe. Some zirconia probes are fitted with a thermocouple to give the process temperature at the probe tip. The zirconia probe will output 0.0 - 1.5 volts depending on the probe temperature. The normal operating voltage for carbon potential measurement is 1.0 to 1.3 volts.

Sooting Alarm

The airways in zirconia probes are prone to sooting due to the carbon and fumes present in the furnace atmosphere. The resulting build up of deposits in the zirconia cell can cause the probe to give an inaccurate reading, which could damage the furnace and the load being treated. The 2404*f* controller provides an alarm if the soot deposits on the probe are excessive. It checks that the carbon reading, based upon the probe millivolts and temperature, is within an allowable region defined by the probe manufacturer. If the calculated carbon potential falls outside the allowable band it indicates that the probe has deteriorated outside its tolerance limits and the sooting alarm will be activated. This alarm is only available for carbon potential measurement only.
The sooting alarm will not be flashed in the display but it can be attached to a physical output.

Probe Cleaning (burn)

To overcome the sooting problem, the probes are cleaned by forcing compressed air through them at regular intervals - which burns off the soot deposits. Typically this is carried out every four to eight hours during a firing cycle. The 2404*f* Atmosphere Controller has a probe cleaning routine which allows automatic or manual cleaning using a logic or relay output.

During the cleaning cycle the controller will freeze the atmosphere PV reading and will only resume calculating the PV when the probe clean sequence is complete. The control output, during the cleaning cycle, can either be frozen to the steady state 'integral' value to minimise any change in the atmosphere, or can be set to continue controlling. After the probe clean period, the probe health is monitored by setting a limit on the time it takes for the probe millivolts to return to 95% of the reading before cleaning. If the value does not return in the set time a probe health alarm will be generated. This alarm is not flashed in the display but can be attached to a physical output. In addition a minimum recovery time 'Bmrt' can be set. The controller will not resume controlling until after this minimum recovery time.

Sensor Break

The controller has three analogue inputs.

- **A high impedance DC input** fitted in Slot 6A to measure the probe millivolts.
- **A temperature input** – usually from a thermocouple
- **An optional high impedance DC input** fitted in Slot 3A to measure the CO (or H) concentration.

It is not possible to detect sensor break on the DC inputs. The controller can only detect sensor break on the temperature input. The controller will behave in the same way as a standard controller if the temperature sensor is broken. Please refer to the main handbook for the details.

WIRING CONNECTIONS

The **fixed connections** are in the right-hand column and comprise:

- The supply voltage
- A digital input configured to initiate probe cleaning
- A digital input configured to enable CO compensation
- The probe clean output on relay 'AA'.
- The probe temperature input

The following **modules are always installed**:

- A high impedance DC input in Module 6 position for the probe voltage input
- Dual relay in positions 4 and 5 configured as shown in the wiring diagram

Modules 1, 2 and 3 are optional and must be specified in the ordering code:
They are configurable for control, retransmission or alarms

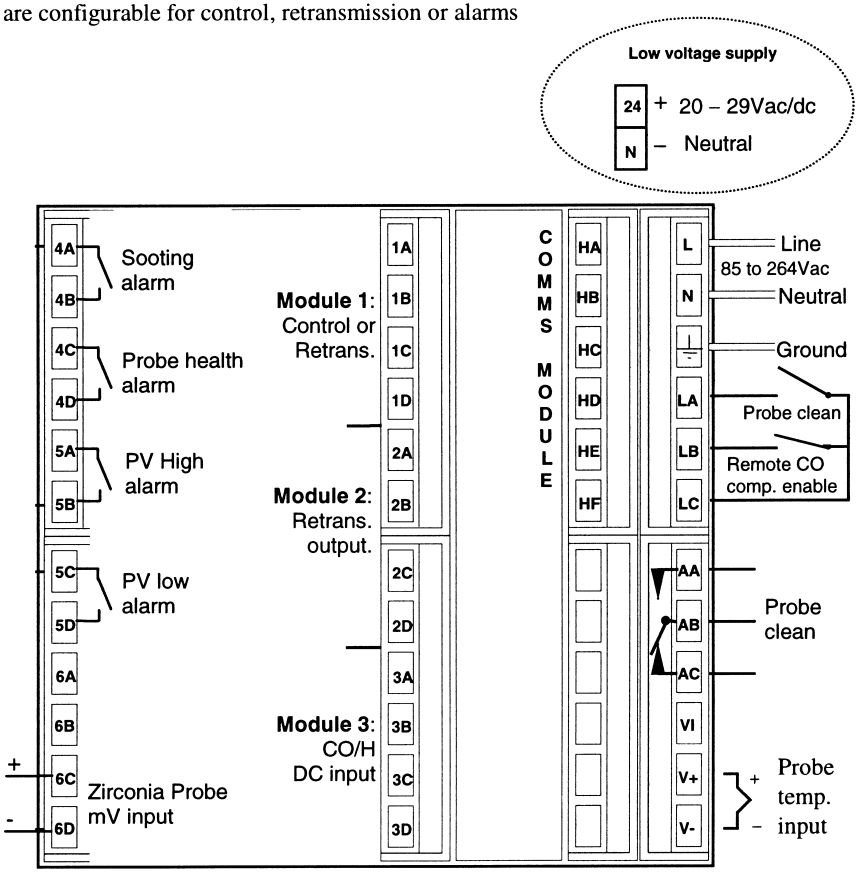
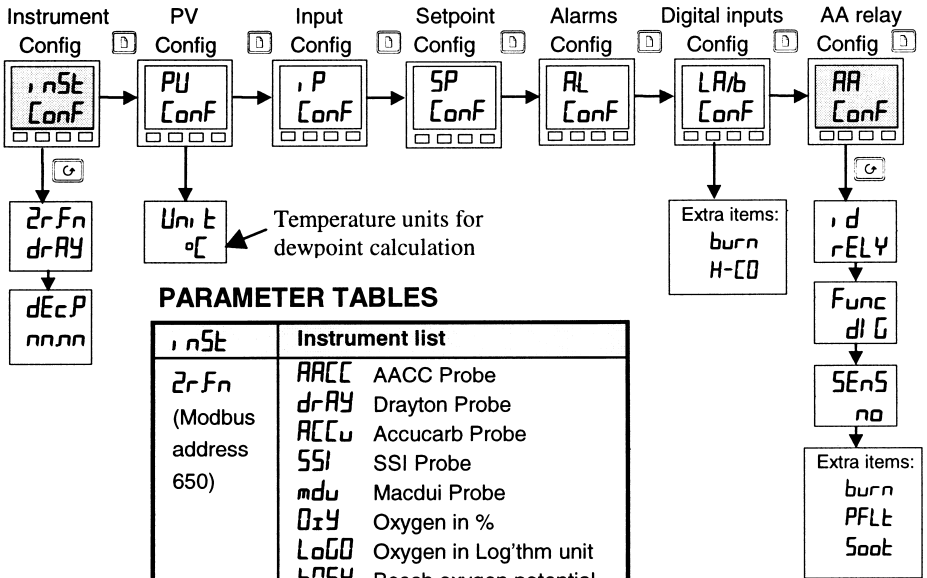


Figure B-1 Controller connections

ADDITIONAL CONFIGURATION PARAMETERS *(PART A)*

1. In the ı nSt list: Select the probe type in 2rFn. Set the number of decimal places dEcP to nn.nn (two decimal places)
2. In the ı P list: Select the temperature input type ı nPt. Set rnG.L and rnG.H to 0.0 to 2.00 respectively.
3. The AA relay output will normally be configured as the probe clean output 'burn'.
4. The LA and Lb digital inputs will normally be configured to initiate: probe clean 'burn' and CO or H compensation enable 'H-CO'.



PARAMETER TABLES

ı nSt	Instrument list	
2rFn (Modbus address 650)	AACC	AACC Probe
	drAY	Drayton Probe
	ACCu	Accucarb Probe
	SSI	SSI Probe
	mdu	Macdui Probe
	OxY	Oxygen in %
	LoGO	Oxygen in Log'thm unit
	bOSH	Bosch oxygen potential
	dwP	Dewpoint
	PmU	Probe millivolt input.
	bOSC	Bosch carbon potential

AA	Extra outputs types
PFLt	Probe health alarm
burn	Probe clean output
Soot	Sooting alarm

LA/Lb	Extra Digital inputs functions
burn	Probe clean initiate
H-CO	External ref. gas compensation enable

Figure B-2a Additional Configuration Parameters (Part A)

ADDITIONAL CONFIGURATION PARAMETERS *(PART B)*

The 6A list configures the zirconia probe input. The values shown are the default values. InPL and InPH set the input voltage range from the probe - in this case 0.0 to 2.0 volts. URLL and URLH set the corresponding value in millivolts - in this case to 0 to 2000 mV.

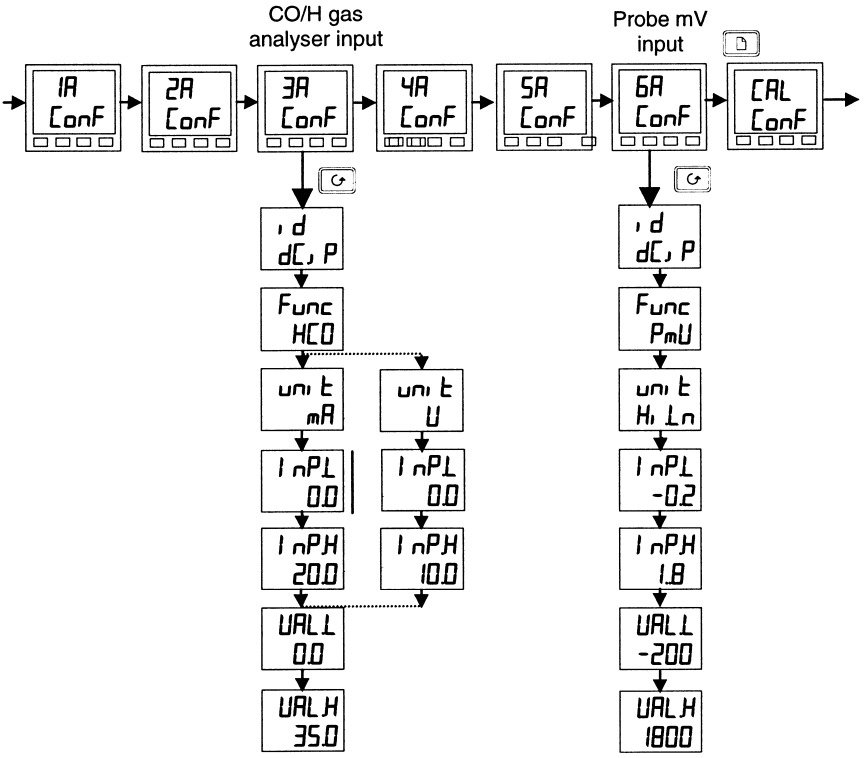
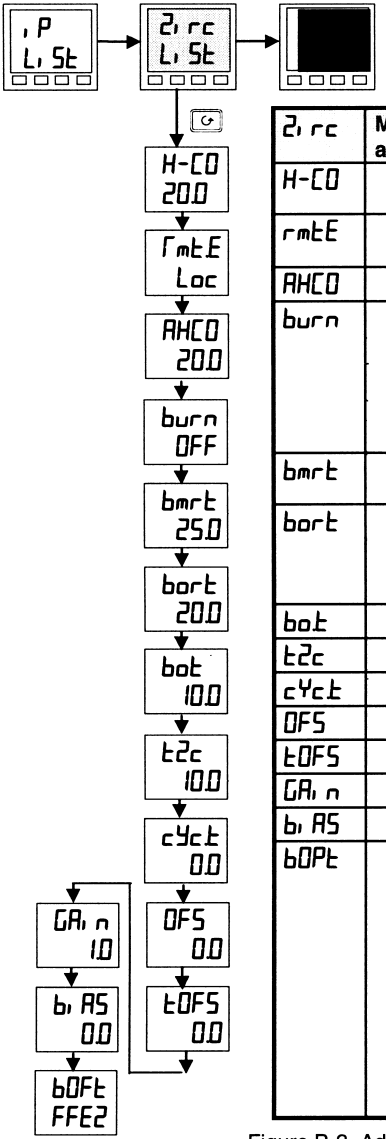


Figure B-1b Additional Configuration Parameters (Part B)

ADDITIONAL OPERATION PARAMETERS

A '2i rc' list has been added in Operator level. This is used to monitor and control the probe cleaning cycle, monitor and manually enter the %CO or %H in the reference gas and apply gain and bias calibration to the carbon potential reading.



2irc	Modbus address	Zirconia list
H-CO	300	Manually entered %CO or %H in the reference gas.
rmtE	267	Remote reference gas input enable, Loc/rmt
AHCO	298	Actual working reference gas value.
burn	307	Probe clean (burn) status. (on or OFF). Probe clean can be manually selected or initiated from a digital input. It is also set by the automatic cleaning cycle. This is initiated by setting the parameter 'cYc.t' to a value other than zero.
bmrt	313	Minimum time for probe recovery after cleaning.
bort	302	Time limit (in mintues) for probe recovery after cleaning. Probe health status will be set to FALSE if the actual recovery time exceeds this limit.
bot	303	Probe cleaning time in minutes
t2c	306	Time to next probe clean in minutes.
cYct	304	Auto probe cleaning frequency in hours.
OFS	305	Offset for probe millivolt input in millivolt.
tOFS	294	Offset for temperature input in C/F or Kelvin
GAin	295	Multiplier of Process Value scaling.
biAS	296	Offset of Process Value scaling.
bOPt	299	Burn-off output power type. This parameter defines the output power during a probe cleaning and recovery cycle. Two choices are offered: FFE2 This is the recommended setting. It will freeze the output at the current integral value. This will minimise disturbance to the process and avoid sooting. It will also ensure that, during start up, the output goes to zero to avoid overshoot and sooting. Cont: continue controlling at the frozen PV

Figure B-3 Additional Operation Parameters

TEST POINTS DATA

The data below is given for the purpose of testing the calibration of the controller.

Carbon Potential measurement
Test conditions: Drayton probe, 900°C, 20% CO

Probe mV	1070	1086	1099	1110	1119	1128	1135	1142	1149	1152
% CP	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.16

Dewpoint measurement
Test conditions: dwP, 900°C, 40% H_2

Probe mV	1070	1086	1099	1110	1119	1128	1135	1142	1149
°C	12.45	7.93	4.29	1.05	-1.16	-3.60	-5.53	-7.43	-9.05

% Oxygen measurement
Test conditions: Oxy, 1000°C

Probe mV	-30	0	30	60	90	200
% Vol	65.0	20.9	6.8	2.3	0.8	0.8

Log 0_2 measurement
Test conditions: Log.O, 1000°C

Probe mV	-30	0	100	600	900	1700
% CP	1.81	1.32	-0.27	-8.14	-12.9	-25.4