

Model AC20 Atmosphere Controller

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- *Controls Carbon Potential, Dew Point, or Probe mV*
- *1/4 DIN*
- *Probe Burn Off and Purge Cycles*
- *Automatic Probe Test*
- *SMART AutoTuning*
- *Three Analog Inputs:*
Temperature, Probe mV, Analog CO Value
- *RS-485, ModBus Protocol*



Optional Features

- Soft I/O – 8 Digital Inputs and 10 Digital Outputs

Introduction

The Model AC20 is a PID Carbon Potential Controller designed specifically for heat treating applications. Its state of the art design provides front panel selection of % Carbon, Dew Point, or Sensor mV control, and “scroll to” indication of non-controlled variables.

In addition to RS-485 serial link with ModBus protocol, the Model AC20 features LED bar graphs, and SMART Auto-Tuning.

Burn Off

Two versions of the probe burn off are available: batch furnace and continuous furnace. In both versions, burn off interval, burn off duration, and recovery duration are keyboard selectable, or downloadable through RS-485 serial link. The burn off interval for a batch furnace can be initiated from an external event, or from the controller keyboard. You can set burn off duration and recovery duration, each for one to 15 minutes. When burn off and recovery are complete, normal control is resumed.

In a continuous furnace, burn off interval can be initiated by an internal timer, or from the controller keyboard. You can set the burn off internal timer to start at any interval of one to 24 hours. You can set burn off time and purge time, each for one to 15 minutes. When burn off and purge is complete, normal control is resumed by returning to automatic control

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Introduction (continued)

mode. If power to the controller is disrupted, timers will reset to zero when power is restored. Probe temperature must be above 1000°F in order to manually initiate burn off.

During burn off and purge, the Smart AutoTune, if in control, must be switched off until the instrument automatic mode is resumed.

Probe Test

The Model AC20 Carbon Controller can test probe resistance and probe response time. It will display the last result, and store it for later recall. You can initiate the probe test from the keyboard, or configure the instrument to start it automatically at any interval of one to 24 hours. The probe can be tested only when its temperature is above 900°F, and probe potential is above 1000 mV.

During the test, the instrument will show "PROB" on the upper display and "TEST" on the middle display. the lower display is blank. 100 kΩ is applied across the probe terminals for 15 seconds. When the shunt is removed, the instrument measures the response time for the probe to return to within 10 mV of its initial value.

Soft I/O – 8 Digital Inputs and 10 Digital Outputs

Optional on the Model AC20 is Soft I/O – 8 Digital Inputs and 10 Digital Outputs. This option gives the use of an auxiliary card with contact closure input sensing and 0.5A relay output capability. The status of these inputs and outputs is accessible through RS-485 Modbus status registers only. Output status is changeable through RS-485 command writes. Soft I/O – 8 Digital Inputs and 10 Digital Outputs is typically used when the RS-485 communications link is active and supplementary PC programs are running.

Ordering Instructions

Model No. A C 2 0 - 8 1 1 1 5 - □ 3 0 - 0 - 0 0

Field No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Fields 1, 2, 3, 4. BASE MODEL

AC20 - Carbon Controller

Field 5. INPUT

8 - TC, Carbon Probe, Logic

Field 6. OUTPUT 1

1 - Form C Relay

Field 7. OUTPUT 2

1 - Form A Relay

Field 8. OUTPUTS 3, 4, 5

1 - Form A Relays

Field 9. OUTPUTS 6, 7

5 - Analog Outputs

Field 10. OPTIONS

0 - None

5 - Soft I/O – 8 Digital Inputs and
10 Digital Outputs

Field 11. POWER SUPPLY

3 - 100 to 240 Vac

Fields 12 through 15. RESERVED

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Specifications

Case:	PC/ABS black color. Self extinguishing degree V0 according to UL 94.
Front Panel:	Designed and tested for IP65 and NEMA 4X for indoor location when panel gasket is installed. Tests were performed in accordance with IEC 529, CEI70-1 and NEMA 250-1991 STD.
Installation:	Panel mounting.
Rear Terminal Block:	55 screw terminals with safety rear cover.
Dimensions:	DIN 43700. 3.82" x 3.82" x 5.04" (97 mm x 97 mm x 128 mm)
Cutout:	3.62" x 3.62" (92 mm x 92 mm)
Weight:	1.34 pounds (500 g)
Upper Display:	4 digits, 7 segment green LEDs with decimal point, 0.4" (10.16 mm) high.
Middle Display:	4 digits, 7 segment orange (or amber) LEDs with decimal point, 0.3" (7.62 mm) high.
Lower Display:	4 digits, 7 segment orange (or amber) LEDs with decimal point, 0.3" (7.62 mm) high.
Indicators:	Two green LEDs annunciator for: CP Carbon potential is the primary control variable. DP Dew point is the primary control variable. 16 red (orange for LITE ON) LEDs annunciator for: mV Sensor output when mV is the primary control variable. MAN Manual mode. DP Dew point shown on lower display. mV Sensor output in mV shown on lower display. TP Temperature shown on lower display. KΩ Probe resistance value shown on lower display. CP Carbon potential shown on lower display. SEC Sensor response time shown on lower display. COF Carbon monoxide factor shown on lower display. H2F Hydrogen factor value shown on lower display. LT Probe temperature at last probe test shown on lower display. 1 Lit when main/secondary output is on, or when alarm 1 is in alarm state and acknowledged; flashing when alarm 1 is in alarm state. 2 Lit when main/secondary output is on, or when alarm 2 is in alarm state and acknowledged; flashing when alarm 2 is in alarm state. 3 Lit when alarm 3 is in alarm state and acknowledged; flashing when alarm 3 is in alarm state. ST Flashing when the first step of SMART algorithm is activated. Lit when second step of SMART algorithm is activated. RM Lit when device is controlled by serial link.
Bargraph:	Column of 33 green LEDs indicate process variable value, or deviation error. Column of 33 orange (or amber) LEDs indicate operating setpoint, or process out value.
I/O Indicator:	Four LEDs labeled IN1 . . . IN4 indicate optional digital input; ten red LEDs labeled OUT1 . . . OUT10 indicate optional digital output. Digital I/O status available through RS485 access.
Keyboard:	Six pushbuttons covered by silicon rubber extension, labeled MENU, ▲, TST, FUNC, ▼, and MAN.
Power Supply:	100 to 240 Vac, 50/60 Hz switching.
Power Supply Variation:	-15% to 10%.
Power Consumption:	20 VA maximum.
Insulation Resistance:	>100 MΩ
Insulation Strength:	1500 V rms for 1 minute.
Electromagnetic Compatibility:	Conforms with EEC 89/336 directive.
Emission:	Complies with generic emission standard EN50081-1, basic emission standard EN55022.

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Specifications (continued)

Immunity:	Complies with generic immunity standard EN50082-2, basic immunity standard: a) Radio frequency elect. magnetic field (AM) severity level 3, according to ENV50140. b) Electrostatic discharge requirements severity level 3, according to IEC 1000-4-2. c) Electrical fast transient/burst requirements: severity level 3 according to IEC 1000-4-4. d) Radio frequency common mode: severity level 3, according to ENV50141. e) Power frequency magnetic field: severity level 4, according to EN61000-4-8. f) Radio frequency elect. magnetic field (pulse modulation), according to ENV50240.
Safety:	Complies with EEC73/23 and 93/68 directives regarding low voltage apparatus. Reference standard is EN61010-1, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General Requirements. Insulation Requirements: Reinforced between power supply and input: 2650 Vac Requirements for Terminal Board Plastic: VICAT 266°F (130°C).
Common Mode Rejection Ratio:	120 dB @ 50/60 Hz.
Normal Mode Rejection Ratio:	60 dB @ 50/60 Hz.
Ambient Temperature:	32° to 122°F (0 to 50°C).
Storage Temperature:	-4 to 158°F (-20 to 70°C).
Humidity:	Maximum 85% RH non-condensing.
Main Input:	1000 to 1250 mV when carbon potential or dew point is selected as primary control variable; 0 to 1500 mV when mV sensor output is selected as primary control variable.
Percent Carbon Range:	0.00 to 2.00
Resolution:	0.01
Accuracy:	±0.02 digits over central 60% of range; ±0.03 digits on remainder of range.
Temperature Drift:	350 ppm/°C on range 1000 to 1250 mV; 200 ppm/°C on range 0 to 1500 mV.
Input Impedance:	>10 MΩ
Sampling Time:	125 milliseconds (typical)
Temperature Input:	Type K thermocouple: -100 to 1370°C (IEC 584-1); -150 to 2500°F Type S thermocouple: -50 to 1760°C (IEC 584-1); -60 to 3200°F Type R thermocouple: -50 to 1760°C (IEC 584-1); -60 to 3200°F
Sampling Time:	1.125 seconds if carbon monoxide input is used; 750 milliseconds otherwise.
Accuracy:	±0.2% fsv ± 1 digit @ 25°C and nominal power supply voltage.
Temperature Drift:	<200 ppm/°C of full span
Source Impedance:	100 Ω maximum for TC/mV input.
Input Current, Detect Open TC:	-100 nA.
Input Impedance:	>1 MΩ.
Reference Junction:	Automatic compensation from 32° to 122°F (0 to 50°C).
Reference Junction Drift:	0.1°C/°C.
Carbon Monoxide Input Range:	0 to 20 mA; 0 to 5 V; 0 to 10 V. Type of input is keyboard and jumper selectable. All inputs are factory calibrated. Span is fixed from 0.000 to 1.000.
Sampling Time:	1.125 seconds.
Accuracy:	±0.2% fsv ±1 digit @ 25°C and nominal power supply voltage.
Temperature Drift:	<300 ppm/°C of full span.
Input Impedance:	>200 kΩ for 0 to 5 V input; >400 kΩ for 0 to 10 V input; <5 Ω for mA input. Note: CO input is not isolated from temperature input.
3 Digital Inputs:	Two inputs (DIG 1, DIG 2) from contact closure (voltage free). At each input can be assigned one of the following functions: auto/manual selection; output limiter activation; alarm manual reset/acknowledge. One input (DIG 3) from contact closure (voltage free) to initiate probe burn off routine. Input can be assigned the active logic level open/closed.
Operating Mode:	On/off or PID/PI; automatic/manual operation; SMART.

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Specifications (continued)

- Control Outputs: Time proportioning, linear 0 to 20 mA (4 to 20 mA).
- Out 1: Can be relay 3A, form C @ 250 Vac resistive load; or voltage output for SSR (optional).
Logic level 1: 14 Vdc \pm 20% @ 20 mA max., 24 Vdc \pm % @ 1 mA max.
Logic level 0: <0.5 Vdc. Output function can be selected as time proportional (main or secondary) control, or alarm 1 output.
 - Out 2: Can be relay 3A, form A @ 250 Vac resistive load (form B with internal solder jumper); or voltage output for SSR (optional).
Logic level 1: 14 Vdc \pm 20% @ 20 mA max., 24 Vdc \pm % @ 1 mA max.
Logic level 0: <0.5 Vdc. Output function can be selected as time proportional (main or secondary) control, or alarm 2 output.
 - Out 3: Can be relay 3A, form A @ 250 Vac resistive load. Output function can be selected as time proportional (main or secondary) control, or alarm 3 output.
 - Out 4: Relay 3A, form A @ 250 Vac resistive load. Output is used to initiate probe burn off cycle.
 - Out 5: Relay 3A, form A @ 250 Vac resistive load. Output is used to purge probe.
 - Out 6: Isolated output 0 to 20/4 to 20 mA with 600 Ω maximum load. Output function can be selected as:
linear control (main or secondary);
process variable re-transmission; or
operating setpoint re-transmission.
When used as signal re-transmission, the value is scaled and can be filtered. The filter time constant is configurable.
 - Out 7: Isolated output 0 to 20/4 to 20 mA with 600 Ω maximum load. Output function can be selected as:
linear control (main or secondary);
process variable re-transmission; or
operating setpoint re-transmission.
When used as signal re-transmission, the value is scaled and can be filtered. The filter time constant is configurable.
- Out 6/7 Resolution: 0.1% when used as control output; 0.05% when used as signal re-transmission. Output re-transmission resolution is influenced by the scalable function.
- Alarm Function: Process alarm on primary variable; deviation alarm on primary variable; band alarm on primary variable.
- Type of Alarm: High/low (outside/inside if band alarm); direct/reverse; automatic/manual reset; standby sequence/no standby sequence.
- Alarm Setpoint: Span limits for primary alarm: 0 to 1000 digits for band alarm; -1000 to 1000 digits for deviation alarm.
- Alarm Hysteresis: 1 to 200 digits.
- Serial Interface: RS-485, opto-isolated.
- Protocol Type: Modbus/Jbus (RTU mode).
- Device Address: 1 to 255.
- Baud: 600 to 19,200.
- Format: One start bit; eight bits with/without parity; one stop bit.
- Parity: Even/odd.
- Optional Digital Input: Eight inputs from contact closure (voltage free). Status can be read through serial link.
- Optional Digital Output: Ten relays 0.5A form A @ 250 Vac resistive load. Note: The side C of relays is common. The digital output can be driven through serial link.
- Watch Dog: Hardware/software is provided for automatic restart.
- Protections: Internal DIP switches for calibration and security code setting.

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Operator Interface

The Model AC20 is designed to control both endo generators and atmosphere furnaces. To accomplish both, the Model AC20 can display and control on any of three units of measure: % carbon, dew point, or probe millivolts. In addition, probe resistance, probe temperature, COF, H2F, and probe recovery can be displayed.

Four, 7 Segment Yellow LEDs for Process Value Display

Four, 7 Segment Red LEDs for Setpoint Display

LEDs Clearly Define Variable Being Controlled (Carbon Potential, Dew point, or mV)

Four, 7 Segment Red LEDs for Secondary Variables Display

LEDs Clearly Define Units Being Displayed

33 Segment Yellow Bargraph Displays Process Variable



33 Segment Red Bargraph Displays Setpoint

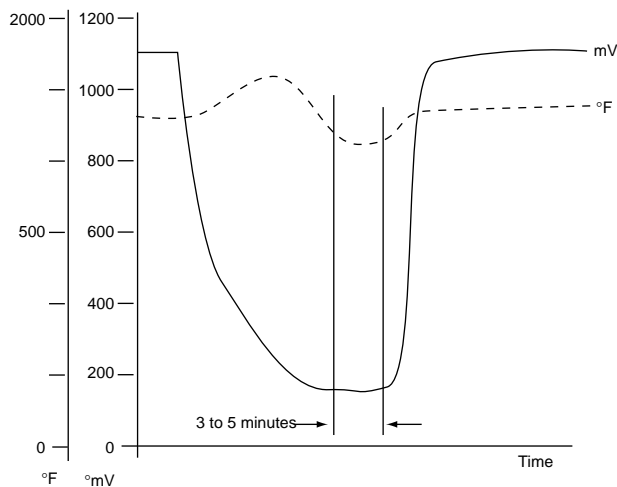
CO and H2 Entry



To solve carbon (dew point) equation, COF: carbon monoxide factor (H2F: hydrogen factor) can be made available via keyboard entry or through analog input.

Analog Input
4 to 20 mA or 0 to 5 Vdc

Probe Testing



Oftentimes, carbon probes are replaced from in-service use as the result of improper furnace troubleshooting. Since probe costs are significant, proper troubleshooting can reduce heat treater's costs.

Two characteristics define the functionality of the carbon probe: probe resistance and probe recovery time.

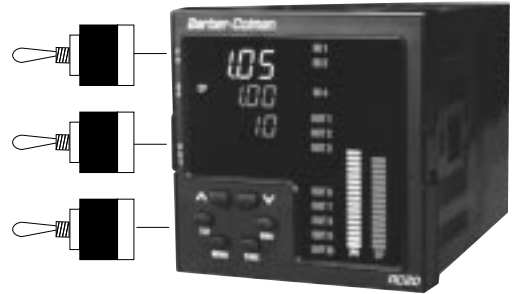
After burn off cycles are complete, special measurement circuits within the Model AC20 Controller record probe resistance and recovery time. With these two values, the heat treater can determine if the carbon probe is functioning properly.

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Digital Inputs

Three digital inputs are standard. Inputs can be assigned to:

- Up to four carbon or dew point setpoints
- Door closure to initiate probe burn off
- Manual/auto selection
- Local/remote control
- Alarm acknowledgement



Internal Timers

24.00
05.30
05.30

Three internal timers are dedicated to functionality of probe burn off:

Burn off interval: Used in continuous furnace to define the start of burn off cycle. hh.mm (1 to 24 hours).

Burn off duration: Used to define the length of time to burn off probe soot. mm.ss (1 to 15 minutes).

Recovery duration: Used to define the length of time that the probe requires to settle after burn off. mm.ss (1 to 15 minutes).

Wiring

