

## **AT-NEALC21 Controller Installation and Operation Manual**

Accurate Gas Control Systems offers two controller assemblies: the AT-MODEA, and the AT-NEA. Each controller assembly houses a complete single or dual channel control system in either a compact free-standing enclosure (AT-MODEA) or a heavy duty, wall mounted, NEMA4X enclosure (AT-NEA). The controller is designed for use with Accu-Trace Heat Tracing Systems, AT-HTZ Cylinder Heating Systems and other applications requiring temperature control.

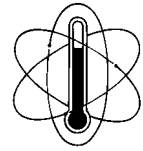
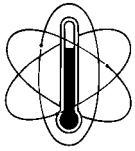
The proportional-integral-derivative (PID) microprocessor based temperature controller is fully programmable either manually, or using the advanced Auto-tune algorithm function to tune control parameters automatically.

Power switching is accomplished via a solid state relay connected to the controller's primary solid state driver output allowing fast response control modes. A normally open mechanical relay is connected to the controller's secondary output providing a safety alarm circuit for interrupting power to the application in the event of a high temperature alarm. Cord connected models include fuse protection in the event of a short-circuit or power failure.

### **1. Specifications NEALC21**

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Power Handling Capacity:	1625 W Total Output (one or two zones)
Min. Circuit Requirements:	100-125 VAC, 15 A, 50/60 Hz per channel (120 VAC)
Controller:	1/16 DIN, Microprocessor based PID Controller
Protection Devices:	GFCI Power Supply Required
Temperature Sensor:	Type J or K Thermocouple
Primary Output, SP1:	Solid state / external solid state relay
Secondary Output, SP2:	SPDT mechanical relay / external SPDT mechanical relay
Dimensions:	15.38" high X 12" wide X 7" deep
Part Number Designation:	<b>AT-NEALC X Y</b>
	<b>X = 1</b> $\Rightarrow$ single channel <b>Y = 1</b> $\Rightarrow$ 100-125 VAC
	<b>X = 2</b> $\Rightarrow$ dual channel <b>Y = 2</b> $\Rightarrow$ 208-240 VAC
	<b>LC</b> = Limit Control (for use with temperature limited loads)
Analog Output	4-20mA / 500 $\Omega$ / $\pm$ 0.1% of full scale typical / user scaled



## **2. Installation Instructions**

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The Controller Assembly has been pre-programmed at the factory for basic operation. **The user must program the high temperature alarm output (SP2) set point and control set point.** Depending on the application, other controller settings may be recommended. Recommended controller settings given by the application over-ride the basic factory pre-set settings.

### **2.1 Controller Assembly Installation**

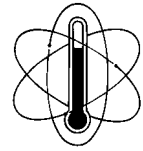
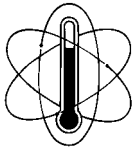
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- Locate the controller assembly in a dry and level location not subject to movement.
- Connect the input (TB1) to a properly sized electrical supply. Refer to Electrical Schematic N21E102 for specifications. Enclosure penetrations will be required for installing this product. Follow appropriate electrical codes for installation of pipe and wire. This product is to be installed in accordance with Article 427 of the National Electric Code (NEC). Do not use this product outside of its Listed ratings. Do not use extension cords, in addition to the supplied connection cord, with this product.

NEC 1999, 427-22 may require a **ground fault circuit interrupt power supply** to be used with installations controlling Accu-Trace Heat Tracing or AT-HTZ Cylinder Heating Systems.

NEC 1999, 427-55 requires a power supply with a **disconnect means** for controllers used with installations controlling Accu-Trace Heat Tracing or AT-HTZ Cylinder Heating Systems.

- Connect the heating panels to load terminals TB2 and TB3. Refer to Electrical Schematic N21E102 for connection specifications. Enclosure penetrations will be required for the power and thermocouple wires. Make certain that the "Process" and "Element" thermocouples for each zone are connected as show in the electrical schematic. The "Process" Thermocouple is connected to the process controller (PC1 or PC2). The "Element" Thermocouple is connected to the limit controller (LC1 or LC2). Make certain that the power and thermocouple cables are connected in the correct group or zone to the correct terminal group. AT-HTZ Cylinder Heaters are fitted with (2) Type K Thermocouples. The NEALC21 Controller is programmed for use with Type K Thermocouples.
- Label each process zone to a particular gas cabinet or cylinder.



## **2.2 Controller Programming**

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### **2.2.1 Programming the Secondary Output (SP2) - High Temperature Alarm**

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The secondary output (SP3) of the controller will be activated, shown by the illuminated red light on the face of the controller, upon first applying power. No output voltage will be present to the application. The alarm set point should be set 2 to 3 degrees above the control set point.

- Press the ▲ and ▼ keys simultaneously and hold for three seconds to enter the menu mode. The display should read *TUNE*.
- Press the ▼ key once and the display will show *LEVL 1*.
- Press the ★ key and the ▼ until the display shows *LEVL A*.
- Press the ▲ key until the display reads *SET.3* and flashes the current set point (set to 0 from the factory)
- Press the ★ key and the ▲ or ▼ to adjust the alarm set point.
- Release the ★ key and press the ▲ and ▼ keys simultaneously and hold for three seconds to return to the standard display.

### **2.2.2 Entering the Operating Set Point**

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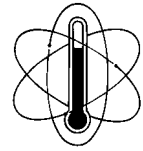
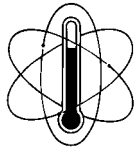
- While pressing the ★ key, enter the desired operating temperature using the ▲ or ▼ arrows.

### **2.2.3 Recommended Parameter Settings**

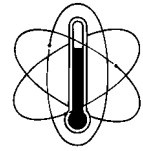
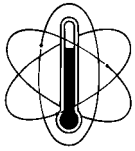
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The controller assembly is tested and pre-programmed at the factory. Below is a list of the pre-programmed control parameters. To change parameters on menu levels higher than 1 you must change menu levels. From the menu mode select the menu parameter and hold the ★ key, enter the desired menu level by using the ▲ or ▼ arrows. Parameters shown in bold are required for the application. Parameters not in bold are either not critical or not used for the application.

<b>Menu Level</b>	<b>Option</b>	<b>Description</b>	<b>Setting (or default)</b>
<i>LEVL A</i>	<i>AN.HI</i>	<i>High Scale</i>	<i>1000</i>
	<i>AN.LO</i>	<i>Low Scale</i>	<i>0</i>
	<i>HI.IN</i>	<i>Input High</i>	<i>50.0</i>
	<i>LO.IN</i>	<i>Input Low</i>	<i>0.0</i>
	<i>DECP</i>	<i>Decimal Place</i>	<i>0000</i>
	<b>SP3.A</b>	<b>Alarm Mode – High Temp</b>	<b>FS.HI</b>
	<i>SP3.B</i>	<i>Alarm Second Mode</i>	<i>NONE</i>
	<b>SET.3</b>	<b>High Temp Alarm Setpoint</b>	<b>User Set High Temp Alarm</b>
	<i>HYS.3</i>	<i>Alarm Hysteresis</i>	<i>0.1</i>
	<i>BRN.3</i>	<i>Alarm Burnout</i>	<i>UPSC</i>
	<i>REV.3</i>	<i>Alarm Output Sense</i>	<i>3D</i>



<b>Menu Level</b>	<b>Option</b>	<b>Description</b>	<b>Setting</b>
<b>LEVL P</b>	<i>PROG</i>	Program Number	1
	<i>RUN</i>	Run Program	OFF
	<i>FAIL</i>	Power Failure Recovery Mode	RSET
	<i>ST.U</i>	Program Start Value	PV
	<i>SPRU</i>	Setpoint Ramp Time	HOUR
	<i>SEG</i>	Segment Number	1
	<i>TYPE</i>	Segment Type	SPR
	<i>SPRR</i>	Setpoint Ramp Rate	100
	<i>T.SP</i>	Adjust Target Setpoint	20
	<i>HB.U</i>	Holdback Value	OFF
	<i>EO.P</i>	Event Output	NONE
<b>LEVL 1</b>	<b>TUNE</b>	<b>Autotune Mode</b>	<b>OFF</b>
	<b>BAND</b>	<b>Proportional Band</b>	2.5
	<b>INT.T</b>	<b>Integral Time</b>	5.0
	<b>DER.T</b>	<b>Derivative Time</b>	25
	<b>DAC</b>	<b>Derivative Approach</b>	1.5
	<b>CYC.T</b>	<b>Output Cycle Time</b>	0.1
	<b>OFST</b>	Offset	0
	<b>SP.LY</b>	Setpoint Lock	OFF
	<b>SET.2</b>	<b>Analog Output Midpoint</b>	<b>User Set Midpoint (50)</b>
	<b>BND.2</b>	<b>Analog Output Range</b>	<b>User Set Range (100)</b>
	<b>CYC.2</b>	<b>Analog Output Cycle Time</b>	0.1
<b>LEVL 2</b>	<b>SPI.P</b>	<b>Power Output Percent Read</b>	0 (read only)
	<b>HAND</b>	Manual Output Power Percent	OFF
	<b>PL.1</b>	Power Output Limit Percent	100
	<b>PL.2</b>	<b>Analog Output Limit Percent</b>	100
	<b>SP2.A</b>	<b>Analog Output Mode</b>	<b>FS.HI</b>
	<b>SP2.B</b>	Second Analog Output Mode	NONE
	<b>DISP</b>	<b>Display Resolution</b>	1*
	<b>HI.SC</b>	<b>High Scale Sensor Maximum</b>	1200
	<b>LO.SC</b>	<b>Low Scale Sensor Maximum</b>	0
	<b>INPT</b>	<b>Input Type</b>	<b>TC K</b>
	<b>UNIT</b>	<b>Select Units</b>	<b>C</b>
<b>LEVL 3</b>	<b>SPI.D</b>	<b>Power Output Type</b>	<b>SSD</b>
	<b>SP2.D</b>	<b>Second Power Output Type</b>	<b>ANLG</b>
	<b>BURN</b>	Sensor Burnout Mode	UP.SC
	<b>REU.D</b>	Output Sense	1R.2D
	<b>REU.L</b>	Indicator Sense	1N.2N
	<b>SPAN</b>	Sensor Span	0.0
	<b>ZERO</b>	Sensor Zero	0.0
	<b>CHEY</b>	Set Monitor	OFF
	<b>READ</b>	Read Accuracy Monitor	VAR*
	<b>TECH</b>	Read Autotune Data	CTA
	<b>UER</b>	Software Version	Read Only
	<b>RSET</b>	Reset Parameters	NONE



### **2.3 Display Indicators**

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- The display will show the temperature reading as measured by the thermocouple.
- The primary SP1 and secondary SP2 output indicators are located on the main display screen. SP1 is located in the upper left corner of the display. SP1 will be energized when the green square light is lit. SP2 is located in the lower right hand corner of the display. SP2 will be energized when the analog output is on. SP3 will be energized in alarm mode when the circular red light is lit.

### **2.4 Tuning the Controller**

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The controller will need to be tuned for best performance. Each load requires a different response from the controller to achieve minimum variation from setpoint. The controller can be tuned manually or by an internal auto-tuning feature. For best results first Autotune the controller. If the system does not respond favorably try manual adjustments. If tuning becomes difficult check the system for proper installation then call the factory for assistance.

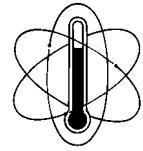
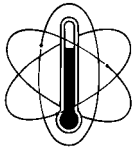
#### **2.4.1 AutoTune**

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Always let the system cool to ambient conditions before starting this procedure. Follow instructions in Section 2.2.1 to set the high temperature alarm to highest value that is safe for the system. Follow instructions in Section 2.2.2 to set the desired system setpoint. Follow this procedure to Autotune the controller.

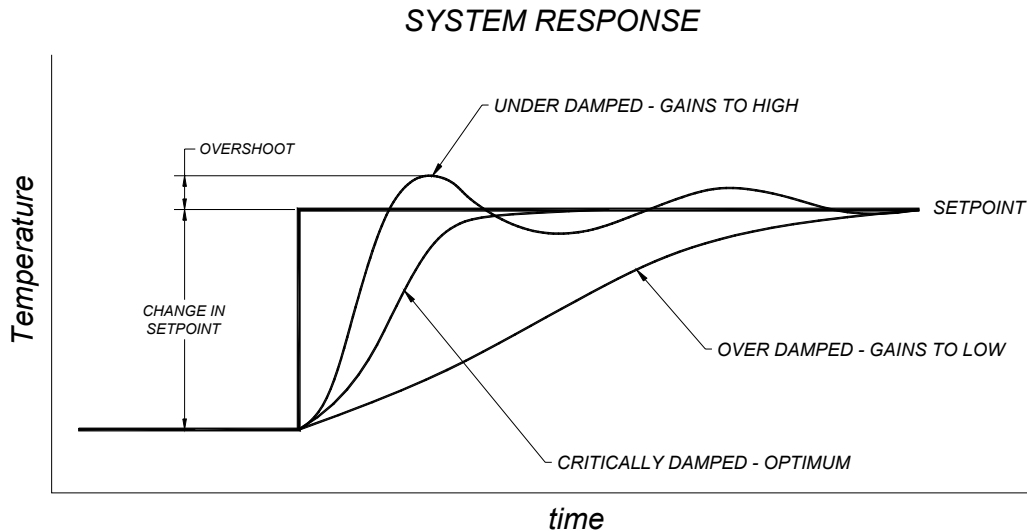
- Press the ▲ and ▼ keys simultaneously and hold for three seconds to enter the menu mode. The display should read *TUNE*.
- Press the ★ key and the ▲ or ▼ to display *AT.SP*
- Press the ▲ and ▼ keys simultaneously and hold for three seconds to exit the menu mode.

Once you exit the menu mode the controller will run the Autotune routine. The display will show the process temperature alternating with *TUNE*. When the routine is complete the controller will resume normal operation with PID values calculated from the Autotune. Once normal operation has resumed follow instructions in Section 2.2.1 to set the high temperature alarm. The alarm set point should be set 2 to 3 degrees above the control set point.



### 2.4.2 Manual Tuning

Follow instructions in Section 2.2.1 to set the high temperature alarm to highest value that is safe for the system. Follow instructions in Section 2.2.2 to set the system setpoint 3 to 5 degrees below the desired setpoint. Allow the system to stabilize as best possible. Raise the setpoint at least 2 degrees and observe the system response.



If the process temperature overshoots the setpoint the system is “under damped”:

- Lower the *BAND* (SP1 Proportional band / Gain)
- Raise the *IN.NT* (SP1 Integral time)

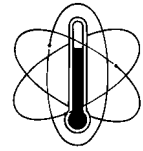
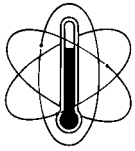
If the process temperature responds slowly or does not reach the setpoint the system is “over damped”.

- Raise the *BAND* (SP1 Proportional band / Gain)
- Lower the *IN.NT* (SP1 Integral time)

Make adjustments of 20% to 50% initially then make successively smaller adjustments. Optimum performance will occur when the system responds very quickly with little or no overshoot. It may be necessary to allow the system to cool down after several steps have been made. Always tune the system at or near the desired setpoint. Manual tuning may require many adjustments to discover the best set of parameters.

If tuning becomes difficult check the system for proper installation then consult the factory.

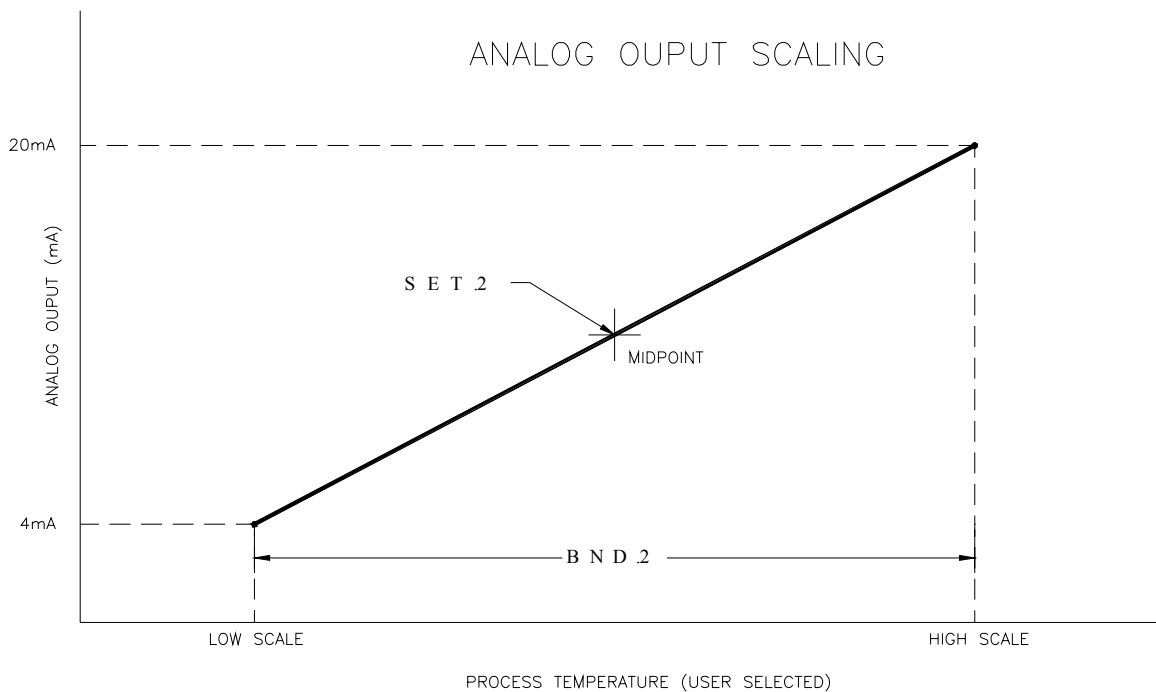
### 2.4.3 Analog Output

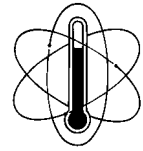
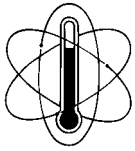


The process controller is fitted with a 4-20mA analog output. A user scaled 4-20mA analog output signal corresponds to the process temperature of the system. The signal can be used to supply supervisory equipment with continuous process data.

Signal connections are made at the process controller (PC1 or PC2). Connect a shielded signal cable to pins 17 (+) and 18 (-). Terminate the shield to an instrument ground at the signal destination. Enclosure penetrations will be required to fit the signal cable. Follow appropriate electrical codes for installation of pipe and wire.

Scaling of the analog output signal is achieved by adjusting program setting. Refer to Section 2.2 of this manual for menu navigation and parameter adjustment instructions. Two parameters are used to control the scaling of the 4-20mA output. *SET.2* will define the **midpoint** of the output curve. *BND.2* will define the **range** of the output. Output specifications for this 4-20mA output are 500Ω / ±0.1% of full scale typical.





### **3. Troubleshooting Guide**

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*Should the system not operate properly, reference the table below.*

#### **Fault Symptom**

- *Display shows an **INPTFAIL** sensor burnout error message.*
- *No output is registered at system.*
- *Continuous output*
- *Temperature will not reach set point*

#### **Possible Cause and Remedy**

*Check sensor integrity. Replace sensor if faulty.*

*Temperature set point has not been entered. Check the temperature set point. Alarm output is activated. Check alarm set point value. The alarm set point must be above the temperature set point.*

*If both the temperature and alarm set points are properly entered, check all wiring.*

*Sensor is not properly sensing system temperature. Check sensor location and installation. The temperature sensor must make intimate contact with system and be thermally isolated from the ambient surroundings.*

*The solid state relay has failed and the high alarm set point is not properly programmed. Test the solid state relay and replace if faulty, and check the high alarm set point value.*

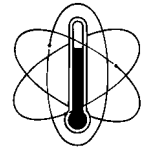
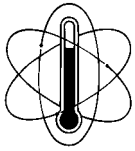
*Sensor is not properly sensing system temperature. Check sensor location and installation. The temperature sensor must make intimate contact with system and be thermally isolated from the ambient surroundings.*

*Check the control parameters. If the temperature is stable but a few degrees below set-point, raise the manual reset value (menu Level 1 **OFST**) incrementally.*

### **4. Performance and Rating Data**

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#### 4.1 Accu-Trace Heat Trace Ratings

Part Number	Service Voltage (Volts)	Maximum Length (Feet)	Maximum Maintenance Temperature	Maximum Intermittent Exposure	T-Rating <sup>1</sup>
AT-BTXG5-1	120	270	150°F	180°F	T6
AT-BTXG8-1	120	210	150°F	180°F	T6
AT-BTXG10-1	120	180	150°F	180°F	T6
AT-UTXG5-1	120	310	250°F	428°F	T6
AT-UTXG8-1	120	190	250°F	428°F	T6
AT-UTXG10-1	120	135	250°F	428°F	T6

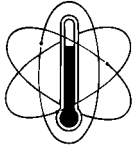
1.) Electrical equipment T-Rating codes define the maximum surface temperature that the equipment will reach. It is used in hazardous classified area applications.

#### 4.2 Accu-Trace Heat Trace Circuit Breaker Selection Guide

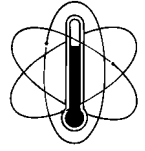
Watts/Ft	Start-Up Temp.	120 Volt				240 Volt			
		15A	20A	30A	40A	15A	20A	30A	40A
AT-BTXG 5W/ft	50°F	225	270			460	540		
	0°F	155	205	270		310	415	540	
	-20°F	135	180	270		275	370	540	
8W/ft	50°F	145	195	210		295	390	420	
	0°F	100	130	195	210	200	265	395	420
	-20°F	90	115	175	210	175	235	350	420
10W/ft	50°F	115	150	180		230	305	360	
	0°F	85	110	155	180	165	220	325	360
	-20°F	75	100	145	180	150	195	290	360
AT-BTXG 5W/ft			185	245	310		385	500	620
8W/ft			115	150	190		225	300	375
10W/ft			80	110	135		160	215	270

**Notes:**

- 1.) Circuit breakers are sized per article 427-4 of NEC and are based on start-up temperature between -20°F and 50°F.
- 2.) When using 240 volt product at 208, 220 or 277 volts, use the circuit adjustment factors shown in the voltage adjustment table.
- 3.) When using 2 or more heater cables of different wattage ratings in parallel on a single circuit breaker, use the 15A column amperage of 15 amps combination loads. These amps/foot factors include the NEC sizing factor in Article 427-4.
- 4.) The G series heater cable contains a metal ground shield. This qualifies them for use on nonmetallic pipe (Article 427-23 NEC) and allows their use without ground fault protection (Article 427-22 NEC for all applications except Division 1 Hazardous Areas).



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*Revision History*

<i>Rev</i>	<i>Date</i>	<i>ECN</i>	<i>By</i>	<i>Description</i>
1	8/6/02	221	CD	Released to Manufacture
A	8/26/02	221	CD	As Built
B	4/10/03	230	CD	Standard Product Issue