# SERIES 6075

TEMPERATURE CONTROLLERS WITH AUTO-TUNING PID AND PLUG-IN COMPUTER INTERFACE

Instruction Manual


ATHENA

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# SERIES 6075
# AUTO-TUNING PID TEMPERATURE CONTROLLER

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## FIGURES

# GENERAL INTRODUCTION

## SECTION 1

### 1.1 General Description and Cautions

**Athena Controls, Inc. is proud of the Series 6075 which you will now use It has been manufactured to our exacting production standards, and packed for maximum protection in shipment You will get years of reliable service from the unit if the information in the manual is followed regarding location, adjustments, and general operation.**

**CAUTION**

**High Voltage and High Temperature can cause injury and are a Fire Hazard. Please read all instructions, have only skilled professionals wire the unit, and use an approved temperature and/or pressure safety control. Even the best components can be damaged or may not failsafe.**

**Warning Notes:**

1. **"B" Output for resistance load only.**
2. **An open thermocouple will disable the INDEX function.**
3. **Note also that in units utilizing only heating output the cooling gain should be set by user to the equivalent heating gain. The inverse IS also true.**
4. **A unique algorithm in the Model 6075 prevents continual buildup of oscillation due to grossly misadjusted rate/reset (-rt-) or gain. When this occurs the unit will control at some point higher or lower than set point outside the proportional band. If this occurs -rt- was probably set too low and/or gain set too high.**
5. **-rt- sets Rate (Derivative) and Reset (Integral) action. The number displayed is the Rate time in seconds. This is tracked by the Reset time in seconds (1:6 ratio).**

6. The computer interface board must be removed from the unit when not connected to a remote terminal or computer, or interference may occur.
7. Calibration Positions ·cL· and ·cH· must not be changed unless a calibrator is connected to the unit by an experienced technician and the output and sensor are disconnected (refer to Section 7).

## 1.2 Specifications

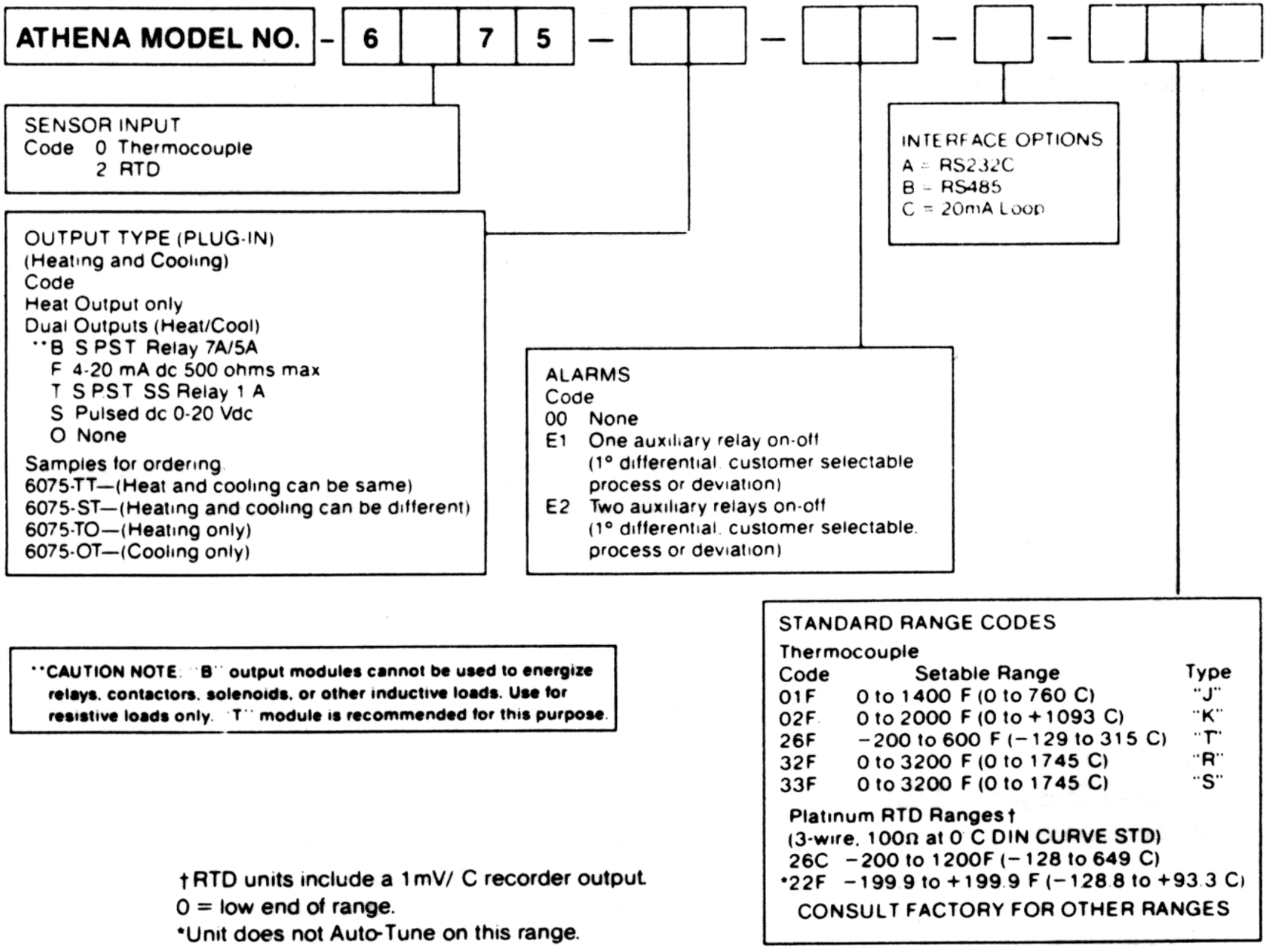
| | |
|---|---|
| **Line Voltage:** | 120/240 Vac $^{+10\%}_{-15\%}$ 50-60 Hz |
| **Power Consumption:** | Less than 6 VA (instrument) |
| **Input:** | Thermocouple Type: "J" or "K", "R" or "S", or "T". Maximum lead resistance 100Ω for rated accuracy. Cold junction compensation standard.<br>Linearization: continuously calculated and updated using ROM based algorithm.<br>RTD Type: Platinum 3-wire, 100Ω at 0°C, DIN curve standard (.00385) |
| **Sensor break protection:** | Upscale standard |
| **Accuracy:** | ±0.2% of full scale, ± one digit |
| **Temperature stability:** | 5μV/°C maximum 3μV/°C typical |
| **T/C Cold end tracking:** | 0.05°C/°C ambient |
| **Operating ambient for rated accuracy:** | 32 to 131°F (0 to 55°C) |
| **Series mode noise rejection:** | 80 dB |
| **Common mode noise rejection:** | 120 dB |
| **Dual display:** | Process temperature or parameter code is shown on upper display; set point or parameter value can be selected on lower display. |
| **Update rate:** | Process display updated 2.5 times per second; digitally filtered to eliminate noise fluctuation. |
| **°F/°C:** | Front panel selectable, set point and alarms affected. |

| | |
|---|---|
| **Alarms:** | 1 and 2, auxiliary on/off, adjustable for high or low temperature triggering; LED on front panel displays alarm status; process/deviation mode selectable; optically isolated solid-state relays, rated 1 A at 120/240 Vac (on/off) |
| **Outputs, primary set point:** | |
| "B" Relay (time proportional) | SPST relay, 7 amps resistive at 120 Vac, 5 amp resistive at 240 Vac, 50 VA inductive |
| "F" Current Proportional | 4-20 mA dc into 500 Ohms maximum. |
| "S" Pulsed Voltage | 20 Vdc pulsed time proportional signal for driving solid-state relays |
| "T" Triac (time proportional) | Solid-state plug-in relay output zero voltage switched; rated 1 amp holding and 10 amps inrush for inductive or resistive loads |
| **Communications:** | |
| Digital Format: | 7 bit ASCII, asynchronous with 1 start and 1 stop bit, odd parity, selectable baud (300, 600, 1200, 2400) |
| Electrical: | Isolated RS232C, RS485, 20 mA loop on plug-in cards |
| Mechanical: | 9 pin "D" connector, DB-9 Type on rear of unit |
| Analog Output (6275) | 1 m V/°C; 0 mV = bottom of range |
| **Connections:** | Inputs and outputs via barrier strips with UL listed locking terminals; communication via 9 pin sub miniature "D" connector |
| **Dimensions:** | Front panel: 3.780"$^2$ (96 mm$^2$)<br>Case: 5.646" (143.4 mm)<br>Depth behind panel: 4.78" (121.4 mm)<br>Panel Cut-out: 3.622"$^2$ (92 mm$^2$) |
| **Mounting:** | Channel slides and screws |
| **Weight:** | 2 lbs (0.9 kg) |

All specifications subject to change.

## 1.3 Model Number Identification

### Figure 1.1 ORDERING CODE




**CAUTION NOTE: "B" output modules cannot be used to energize relays, contactors, solenoids, or other inductive loads. Use for resistive loads only. "T" module is recommended for this purpose.

†RTD units include a 1mV/ C recorder output.
0 = low end of range.
*Unit does not Auto-Tune on this range.

# SECTION 2 INSTALLATION INSTRUCTIONS

## 2.1 Unpacking

Unpack the instrument and inspect for shipping damage. Report any damage to the carrier immediitely.

## 2.2 Locating

Select a location for the controller where it will not be subject to excessive shock vibration, dirt moisture or oil. The ambient temperature of the area should be between 32° and 131 °F (A model DC-15 dust, oil and water resistant cover is available to protect from harsh environments.)

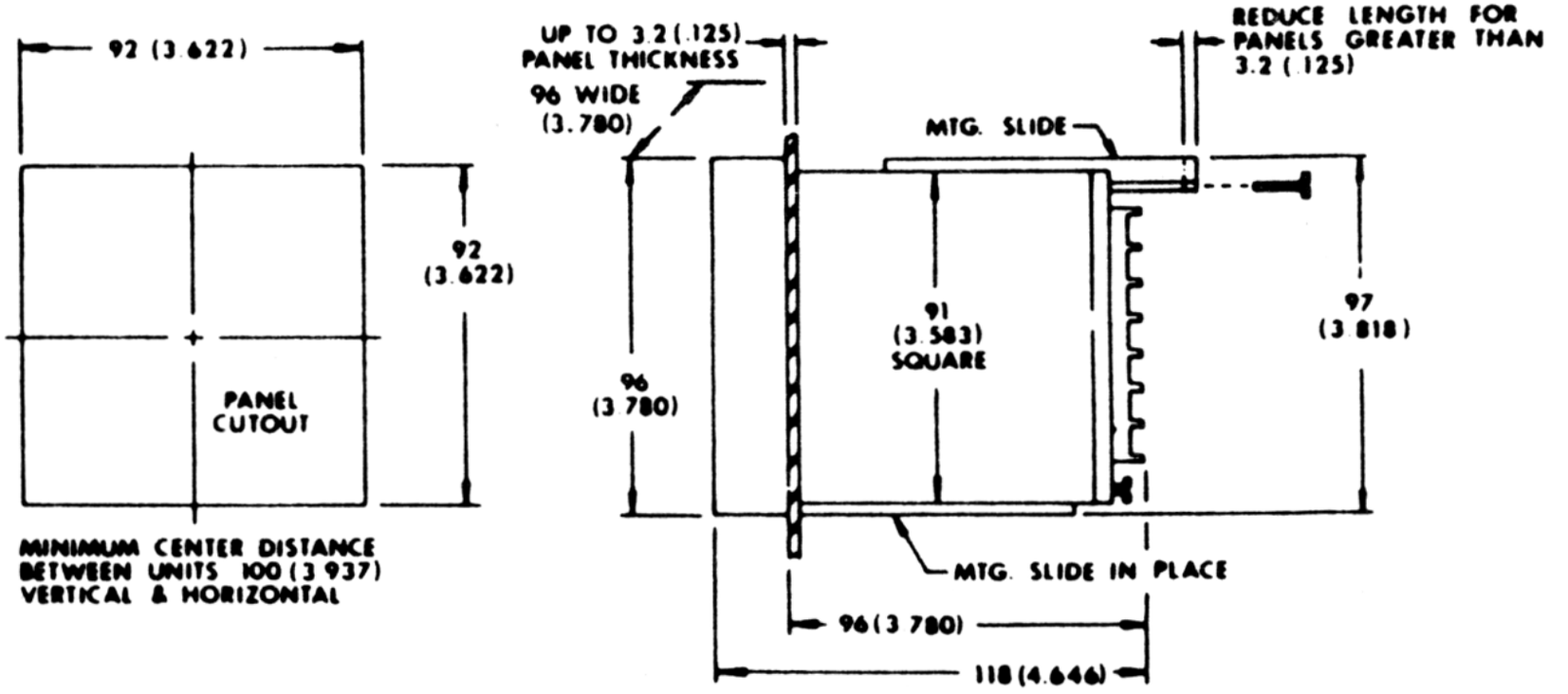
## 2.3 Mounting

Mount the controller into a 92 mm (3 5/8") square cutout See figure for the cutout and case dimensions. The plug-in controller does not have to be removed from its housing for mounting. Remove two screws that hold the mounting slides and then remove the slides. Insert case from front panel and re-install the two slides and two screws. Do not over-tighten screws. The length of the slides must be reduced if the controller is to be mounted in an extra thick panel. If the controller has been unplugged from its housing, the top of the housing can be determined because it features the serial tag.

## 2.4 Removing Unit

The 6075 can be removed from its housing by pulling firmly on the black front bezel. If a communication port is connected, it should be removed first

## 2.5 Figure 2.1 SERIES 6075 CASE DIMENSIONS




NOTE:
ALL DIMENSIONS ARE IN MILLIMETERS;
INCHES ARE SHOWN IN PARENTHESIS.
FACE DIMENSIONS 96 MM x 96 MM SQ.

# SECTION 3 OUTPUT MODULES

## 3.1 Module Description

The Athena 6075 offers field interchangeable output modules. This unique feature makes it possible to fill output requirements for a variety of applications with a single controller model.

Module Type B: This 7A/5A relay (at 120/240 Vac) is used for driving resistive heaters.

**NOTE:**

Do not use this output module with mechanical contactors because they generate an excessive EMI field which can interfere with the 6075's microprocessor, Instead, we recommend "T' output modules for this application

Module Type F: This 4-20mA output module can deliver full output to loads having an input impedance of 500 Ohms or less. The cycle time setting must be ZERO for smooth current output.

Module Type S: Similar to F. but pulsed 20 Vdc output for driving solid state relays. Up to 6 (input series connected) solid state relays can be used. Cycle time can be set to optimize the load response time requirements.

**"F' & "S" MODULE NOTE:**

A push-on terminal is utilized as a return for ground currents of the milliamp source. It is connected internally by the mating lug on the circuit board. To avoid ground loops, drive floating (ungrounded) loads.

Module Type T: This solid state relay is capable of 1 amp at 120/240 Vac. It is zero voltage switched and optically isolated from the drive signal. With it resistive loads up to 120 watts at 120 Vac and 240 watts at 240 Vac may be

controlled directly. Using direct control there is no lower limit on the cycle time setting (down to 200 milliseconds). Larger loads may be controlled utilizing an external contactor. In this case, it is advisable to use cycle settings of ten seconds or greater to minimize contactor wear. **External suppression of the contactor is mandatory**. See Section on electrical noise.

# SECTION 4 BASIC WIRING

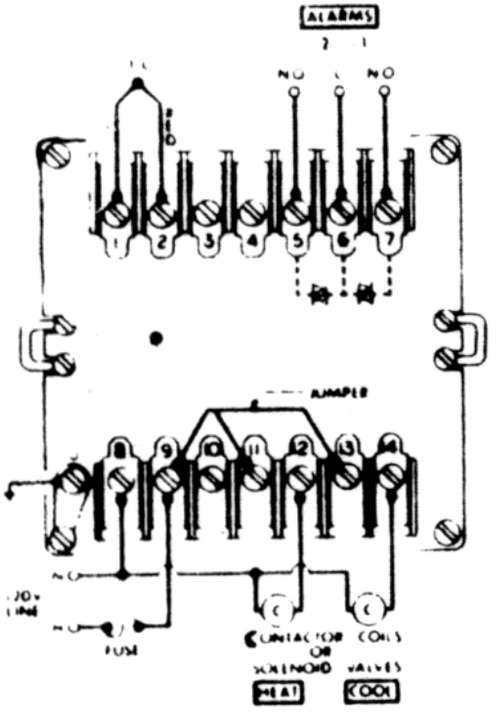
## 4.1 Figure 4.1 TYPICAL WIRING EXAMPLES

**NOTES:**

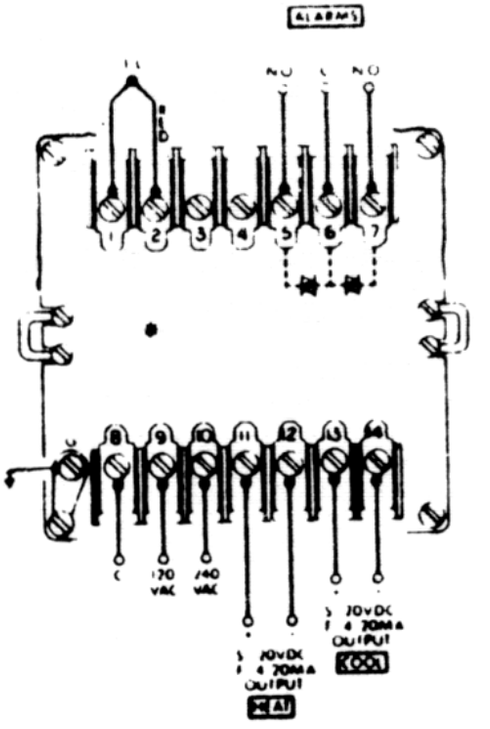
1) for 240 Vac supply move connection shown to terminal 9 over to terminal 10 and fuse both of the supply legs.
2) "B" output (Mechanical Relay) for use on small resistive heaters only, see specifications for rating. Use the "T" wiring diagram for the "B" output.
3) The Plug-in outputs allow users to have any combination of output types. Consult factory if additional definition is needed.

*Denotes location of communication connector.

120V
FOR OT, TO AND TT OUTPUTS

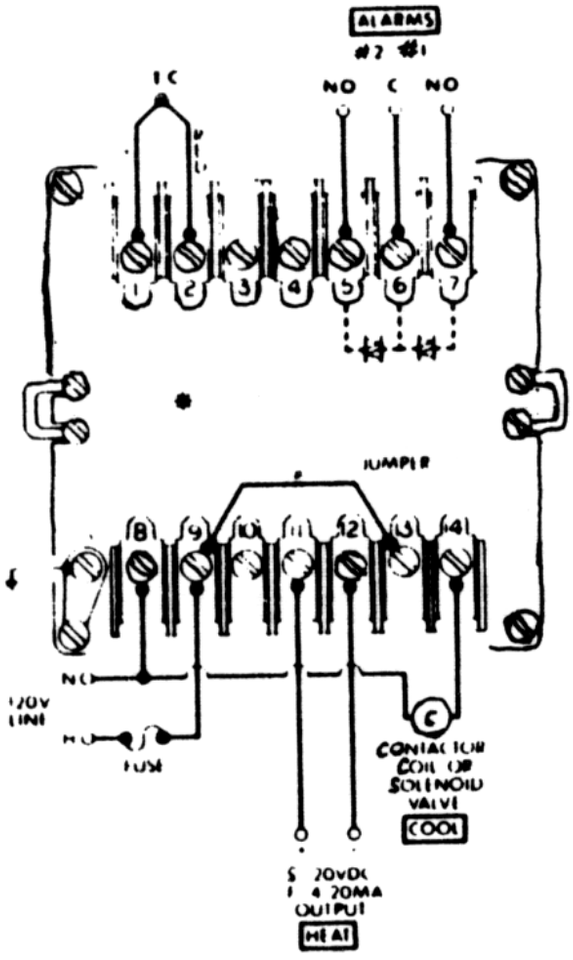


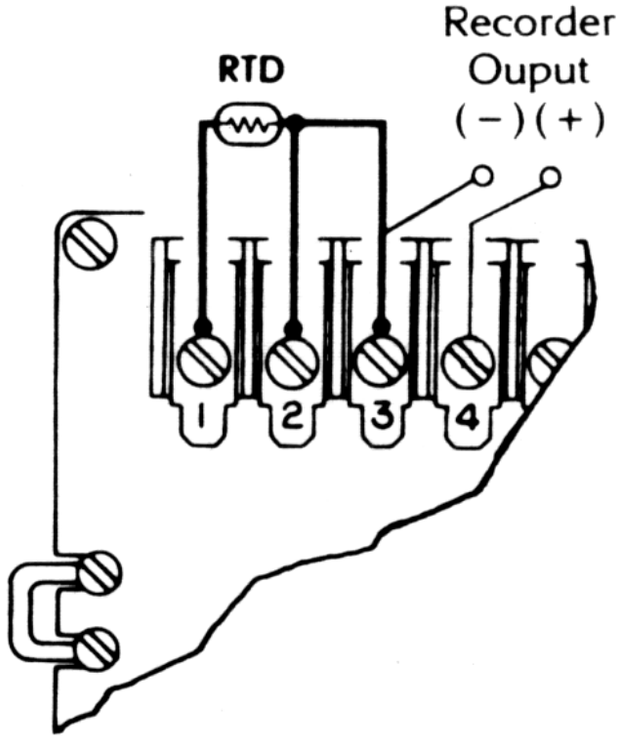

120/240V
FOR F OR S OUTPUTS



## Section 4.1 (continued) TYPICAL WIRING EXAMPLES

120V
FOR FO, SO, ST, AND FT OUTPUTS




## 4.2 Wiring Thermocouple Circuits

Before wiring, check thermocouple and extension wire to make sure that they conform to the appropriate thermocouple type. In thermocouple circuits, the negative lead is colored red. Extension wires must be the same alloy and polarity as the couple. The thermocouple circuit resistance should not exceed 100 Ohms for rated accuracy. Slight errors will occur if resistance is higher.

Do not run thermocouple leads in the same conduit as the power lines. If shielded thermocouple wire is used, terminate the shield only at the controller end using the corner screw provided for that purpose.

**Standard Thermocouples**

| I.SA. Type | Materials | Color Code |
|---|---|---|
| J | Iron-Constantant (I/C) | White( + ) Red( – ) |
| K | Chromel-Alumel | Yellow( + ) Red( – ) |
| T | Copper-Constanan | Blue( + ) Red( – ) |
| R | Platinum-Platinum 13%Rhodium | - |
| S | Platinum-Platinum 10% Rhodium | - |

**Wiring RTD Circuits**

**6275 units are designed for 100 Ohm Platinum RTD's 2-wire RTD's are connected to terminals 1and 2 with a jumper connecting 2 to 3. Keep leads short and useheavygauge copper extension wires if necessary, to minimize lead resistance. For long runs 3-wire RTD should be used and wire gauge should be sufficient that resistance does not exceed 10 Ohms. An error of 0.2ºF will result for each additional 10 Ohms Per lead**

**DO NOT RUN RTD LEADS IN IN THE SAME CONDUIT AS POWER LINES.**

**If shielded RTD wire is used, terminate the shield only at the controller end, using the comer screw provided for that purpose.**

**NOTE RTDs tend to be shock sensitive and require extra care in handling and installation.**

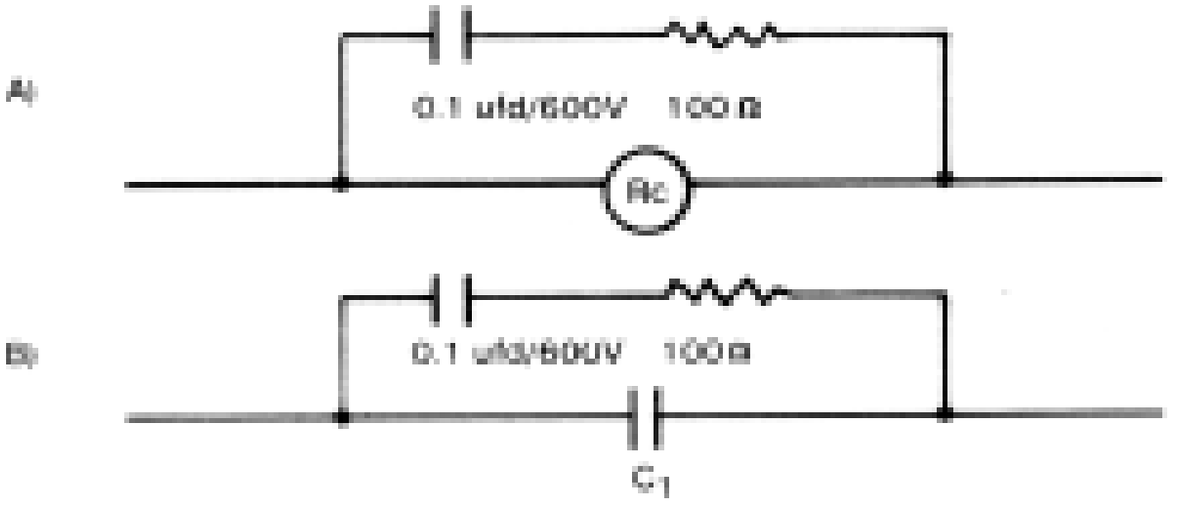
**THERMOCOUPLE PLACEMENT (or RTD)**

**Proper thermocouple placement can eliminate many problems in the system. The probe should be placed so that it can detect any temperature change with minimal thermal lag. In a process that requires fairly constant heat output, the probe should be placed close to the heater. In processes where heat demand is variable, the probe should be close to the work area. Some experimenting with probe location is often needed to find its optimum Position.**

**A WORD ON ELECTRICAL NOISE**

**Microprocessor are essentially small computers. As such they can randomly be interferred with by large electrical spikes, even with elaborate**

watchdog circuits and filtering built into the unit Contacts and coils must be suppressed! One very effective filter is a .1 ufd/600V capacitor in series with a 100 Ohm, 1/2 watt (min.) resistor. This network must be put on all contacts, especially across hard contacts that are switching coils and across the coils themselves. The filter should be placed as close to the noise source as Possible i.e. right on a contactors coil etc.




Other recommended practices include:

* Run sensor wires separately, shield if possible and ground only one end of the shield.
* Install .01 ufd/100V or greater capacitors from each sensor terminal to case ground (the green screw).
* Connect each unit's ground (the green case screw) directly to the machine (ground). Do not connect it to the panel Paint and corrosion can cause poor signal transmission Do not connect ground wires in series from unit to unit Ground wires must be connected from each unit directly to ground
* Make sure the machine is connected to earth ground Do not assume it is.

# SECTION 5 OPERATION

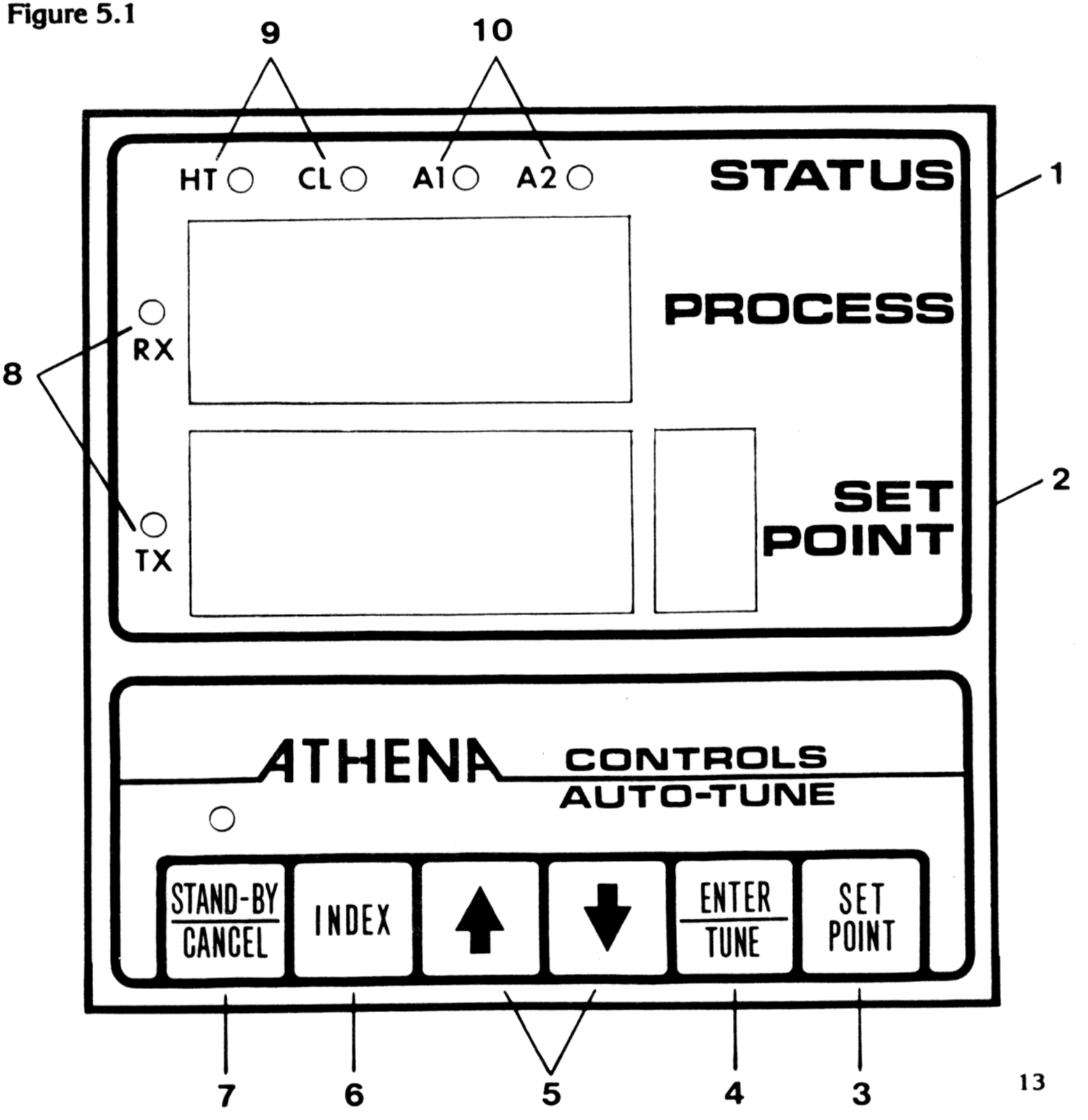
## 5.1 Front Panel Features

**Touch Key and Indication Operation Layout**

1. **Process Temperature or Parameter code is viewed on the upper display.**
2. **Set Point or Parameter setting is viewed on the lower display. Degrees F and C is also displayed.**
3. **Set Point Key: Allows user to return to set point**
4. **ENTER/TUNE Key: Enters a selected value into nonvolatile memory. Also initiates Auto-Tuning when used in the correct sequence.**
5. **Up and Down Keys: Raises and lowers setting respectively. 2 Step scan rate: Slow and Faster (after 5 seconds).**
6. **Index Key: Selects Parameters to be addressed**
7. **STAND-BY/CANCEL Key: Disables outputs. Unit is put in idle mode. LED above switch lights in STAND-BY mode. STAND-BY is also used as the position from which AUTO-TUNE is accessed. If the key is pressed during Auto-Tuning the unit will cancel the Auto-Tuning procedure and return to the STAND-BY mode.**
8. **Receive (RX) and transmit (TX) lights: Indicate a signal is present at the communication port tights only momentarily**
9. **Heat (HT) and Cool (CT) Output Lighk Lights when output drive signal is present**

**Alarm Lights (A1 and A2): Lights when unit is in alarm. (programmable Hi, Low, process or deviation.)**

Figure 5.1


9
10
HT
CL
A1
A2
STATUS
1
PROCESS
RX
8
TX
SET
POINT
2
ATHENA
CONTROLS
AUTO-TUNE
STAND-BY
CANCEL
INDEX
ENTER
TUNE
SET
POINT
7
6
5
4
3

## 5.2 Basic Series 6075 Setup

1. **The 6075 has dual-input ranges which allow selection of one of two ranges and T/C types, by simply moving the position of the internal jumper.**

**To set unit to proper range, remove unit from case and position jumper on top board. Front position is range A, rear position is range B, grouped s offered.**

| | | | | |
|---|---|---|---|---|
| A = 01F | No Jumper = 26F | A = 33F | A = 22F | No Jumper = 22C |
| B = 02F | | B = 32F | B = 26C | |

**Consult Serial Tag for actual range and sensor type ordered. Ranges are defined in Section 1.3, Model Number Identification.**

**The Series 6075 is shipped from the factory with the following settings:**

| | | |
|---|---|---|
| SP = 100 | CG = 30 | Id = 01 |
| A1 = 105 | CC = 05 (F=00) | bd = 02 |
| A2 = 95 | cd = 08 | cL = Range dependent |
| rt = 00 | AT = 00 | cH = Range dependent |
| HG = 30 | cF = 08 (05 for ºC ranges) | |
| HC = 05 (F=00) | ct = 00 | |

## 2. Range of Adjustments (Parameters)

All parameters are accessed by pressing the INDEX key. They are listed in the order they are displayed when the INDEX key is pressed.

The front panel of the Model 6075 contains a lower display of 5 digits which displays the set point temperature, the other parameter values and degrees F or C. The upper display consists of 4 digits which display the process value or the parameter abbreviations; e.g. -A1- identifies Alarm 1. As the INDEX key is pressed the second column abbreviations appear in the upper display. To the right of the ENTER Key is an EXIT Key labelled 'SET POINT' which allows the user to EXIT parameters 2 thru 16 back to parameter #1 (set point). After changing a value the ENTER Key must be pressed. This enters the new value in memory. If it is not pressed and power is removed, the last value entered for that parameter will be set up for that parameter.

| NUMBER | DISPLAYED CODE | PARAMETER | RANGE |
|---|---|---|---|
| 0 | - | Process Temperature | Zero to span of unit (°F or °C) |
| 1 | - | Set Point | Zero to span of unit (°F or °C) |
| 2 | -A1- | Alarm One | Zero to span of unit (°F or °C) |
| 3 | -A2- | Alarm Two | Zero to span of unit (°F or °C) |
| 4 | -rt- | Rate/Reset (1:6 ratio) | 0 to 255 Seconds (See Note 6) |
| 5 | -HG- | Heat Gain | 1 to 400 (See Note 2) |
| 6 | -HC- | Heat Cycle Time | 0 to 120 Seconds (See Note 7) |
| 7 | -CG- | Cool Gain | 0 to 400 (See Note 2) |
| 8 | -CC- | Cool Cycle Time | 0 to 120 Seconds (See Note 7) |
| 9 | cd- | Access Code | 0 to 255 (See Note 3) |

**Locally Adjustable only (Not by Remote Keyboard)**

| | | | |
|---|---|---|---|
| 10 | -At- | Auto-Tune Damping | 0=Low, 1 =normal, 2=High |
| 11 | -cF- | Configuration (See Note 4) | 0 to15 |
| 12xx | -ct- | Cooling Type | 0-Oil or none, 1 -Air, 2-Water |
| 13 | -Id- | Unit ID CODE | 0 to 99 (See Note 5) |
| 14 | -bd- | Baud Rates | 300(0),600(1) 1200(2), 2400(3) |
| 15 | -cL- | Calibration, Low (ZERO) | ±3% Span (°F/°C) |
| 16 | -cH- | Calibration, High (SPAN) | ±3% Span (°F/°C) |

xx Not on RTD units

3. When setting up the unit for the first time, push the "STAND BY" key (LED above button is on), and the unit will be placed into an idle condition. Outputs and alarms will be off. On completion of inital setup, push the key again (LED off) for normal operation.

4. press the INDEX key until parameter #9 (-cd-) appears in the process displayarea.
   a. Set 14 in lower display to gain access to configuration code, by pressing the up or down arrow and then pressing the ENTER key.

5. press the INDEX key until parameter #11 (-cF-) appears in the process displayarea.
   a. Refer to the configuration code chart and select a number that represents the desired configuration of thealarms and display units e.g., #06 = °F, Deviation Alarms Alarm 1=Low Acting, Alarm 2=High Acting.
   b. Set this number into the lower display, using the keys
   c. press the ENTER key.



**Note: Changing temperature scale requires re-setting of all points.**

**Figure 5.2 CONFIGURATION CODE CHART**

**Settings**

| | | | | |
|---|---|---|---|---|
| 0 | F | P | H1 | H2 |
| 1 | C | P | H1 | H2 |
| 2 | F | D | H1 | H2 |
| 3 | C | D | H1 | H2 |
| 4 | F | P | L1 | H2 |
| 5 | C | P | L1 | H2 |
| 6 | F | D | L1 | H2 |
| 7 | C | D | L1 | H2 |
| 8 | F | P | H1 | L2 |
| 9 | C | P | H1 | L2 |
| 10 | F | D | H1 | L2 |
| 11 | C | D | H1 | L2 |
| 12 | F | P | L1 | L2 |
| 13 | C | P | L1 | L2 |
| 14 | F | D | L1 | L2 |
| 15 | C | D | L1 | L2 |

**ABBREVIATION CODES**

F - Fahrenheit
C - Celsius
P - Process Alarms
D - Deviation Alarms
H1 - High Alarm
L1 - Low Alarm
H2 - High Alarm
L2 - Low Alarm

6. If unit will interface with a computer:
   Press the INDEX key until parameter #13 (-Id-) identification code appears in the upper display area.
   a. If a digital communication option module is installed select a value between 00 and 99 and set into the lower display. This is the unit's address.
   b. Press the ENTER key.
7. Baud Rate: Index to position #14 (-bd-) and enter the code for the proper baud rate; e.g., 00 = 300, 01 = 600, 02 = 1200, 03 = 2400 baud. Press the ENTER key.
8. Press the return to set point key (SET POINT) and set in the desired temperature value on the lower display, then press ENTER. **If you have**

pressed the INDEX key, the unit will advance to the High and Low Calibration positions. but index no further until the SETPOINT key is depressed.

**CAUTION: DO NOT CHANGE THE CALIBRATION LOW [cL(Zero)] OR CALIBRATION HIGH [cH(Span)] ADJUSTMENT UNLESS YOU INTEND TO, ARE QUALIFIED AND HAVE A CALIBRATION TEST SETUP CONNECTED.**

9. Press Index and Alarm One (Al) appears in the upper display area. If this option is installed. set in the desired temperature value, then press ENTER.
10. Repeat for (-A2-) Alarm two, if installed
11. Refer to the section on tuning the 6075 for the remainder of the settings.

NOTE: When finished entering all parameters return to -cd- using the INDEX key. Select the level of security desired and enter the appropriate value into memory.

#1 - Allows changes to set point only.
#8 - Allows changes to first nine parameters only.
#14 - Allows changes to 9 parameters and calibration constants.

NOTE: Any other value only allows changes to -cd-

## Reference Notes

NOTE 1: Parameters #10 thru #16 are accessed from the front panel only, and can not be set from a remote terminal

NOTE 2: The gain value (-HG-&-CG-) is multiplier used to increase the sensitivity of the controller according to the formula: Output = Gain (E + I + D) where E = Error. I = Integral. D= Derivative, Its relationship to proportional band is as follows:

$$\text{PROP BAND} = \frac{\text{Unit Span}}{\text{Heat Gain (HG) or Cool Gain (CG)}}$$

Note that proportional band is an inverse function of gain, The range of adjustment is 0 to 400 for Heat. 0 to 400 for Cool.

## SPECIAL NOTE:

**For Units utilizing only heating output, the cooling gain should be set by the user to the equivalent heat gain. The inverse is also true. Setting CG to 0 initiates an on-off (narrow deadband) output for cooling, which is recommended for cooling-only applications. Setting HG to 0 disables the Heat output.**

**NOTE 3: The access code is a number stored in ROM that upon entering in location -cd- allows user access to change parameters. Depending on the code entered the user may then alter calibration and configuration of the controller. When this is accomplished the code may be changed to prevent tampering with critical values. When the number is "1" only the set point can be changed. When the number is "8", changes are allowed to the first nine parameters. When the number is "14" all settings can be altered. When neither 1, 8 or 14 are entered only the access code can be altered.**

**NOTE 4: The configuration code allows the user to configure the alarms for process/deviation, high or low energizing. The code also selects °F or °C operation of the unit. SEE THE CONFIGURATION CODE CHART.**

**NOTE 5: -Id- is the unit identification code. It is variable from 00 thru 99 and is used with the communications interface to allow a remote device to identify which controller it is communicating with.**

**NOTE 6: Setting RT to 0 disables rate and reset action for proportional only control. This will cause an offset between set point and process termperature.**

**NOTE 7: Set the heat cycle (-HC-) and cool cycle (-CC-) according to power handler being used. 0 for "F" (4-20mAdc) outputs, 5-20 for contactors and solenoids. Setting HC or CC to 0 initiates 200 millisecond timebase for fast cycling of the respective output. Use with external solid state relays ("S" Modules) or SCR Power Controllers ("F" Modules).**

## 5.3 Tuning the Controller

### 5.3.1 Introduction

**The Series 6075 is a state-of-the-art automatic tuning PID temperature controller. The user has the option of automatically selecting the controller's PID settings or manually setting the unit as desired.**

**Tuning a 3-Mode controller involves three (3) major adjustments; proportional Band (Gain), Rate (Derivative) and Reset (Integral) action. Athena has simplified the adjustment procedure with the incorporation of the Rate and Reset settings into one adjustment "RT" which is displayed in seconds of Rate time. The Reset time is automatically set at six (6) times the displayed Rate values.**

### 5.3.2 Automatic PID Tuning procedure

NOTE FOR OPTIMUM RESULTS

1. **Set point must be a minimum of 100°F above the starting or ambient temperature when tuning is initiated for accurate tuning. Less than**
2. **100ºF may not yield effective tuning settings.**
   **Multi-zone applications require Auto-Tune units on each zone and simultaneous warmup.**
3. **Loss of power or a turn-off during the Auto-Tune cycle requires a restart from ambient (or at least I00ºF rise to set point) for reliable PID values.**
4. **Change of state processes, i.e. solid to liquid or liquid to gas, may introduce erroneous tuning parameters during process warmup. Tuning should be done after the change has occured**

#### 5.3.2.1 Damping Settings

Heat Damping Choices ("-At-": position # 10)

**To allow the controller to provide automatic tuning for a wide variety of processes that may exhibit varying heating characteristics and/or varying heating capabilities, the controller offers three damping choices:**

00 **Low Damping - For processes that (any combination of the following)**

- **are adequately powered with excellent coupling between heater and probe.**
- **require quick response and the tightest possible temperature control is desired**

**01 Normal Damping – For processes that: (any combination of the following)**

- **have heaters that are properly sized.**
- **have good coupling between heater and probe.**
- **are considered standard with moderate lags and response time.**

**02 High Damping – For processes that (any combination of the following)**

- **are overpowered**
- **have multiple lags**
- **are poorly coupled between the heater and probe**

**COOL ("ct-": position #12) (Not On RTD Units)**

**When using the controller on heating and cooling applications, such as extruders, the "ct" number allows setting of the controller for the type of cooling used:**

**00 – Oil cooling (Use this Setting if No cooling is used)**

**01 – Air cooling – Forced air**

**02 – Water cooling (above 212ºF set point)**

### 5.3.2.2 Operating Instructions (Read "Damping Settings" before proceeding)

**How to Start the Automatic Tunina procedure**

**STEP 1: Energize the unit and Proceed immediately to step 2.**
**STEP 2: Place the unit on standby by pushing the stand-by button. LED above button will light Auto-tune can only be accessed from the stand-by position.**
**STEP 3: Index down and enter access code, position 9, then press set point**
**STEP 4: Index down and enter all settings per section 5.2 Basic Setup. e.g. set point Al, A2, HC, CC, AT, cF, ct, Id, bd, and press set point RT, HG, and CG will be set by controller during Auto-Tuning.**
**STEP 5: Index down to "-At-".**

STEP 6: **When ready to start Auto-Tuning calculation of PID settings press the "Enter/Tune" button. The displays will return to process and set point displayed. The F/C digit will blink while tuning is in process. Upon completion of tuning, the digit will stop blinking. To stop the Auto-Tuning press standby/cancel.**

**NOTE: Series 6275, RTD input will not Auto-Tune when the decimal point range is used. If tenth degree range is desired either auto tune on the other range and then move the range jumper or use manual tuning methods.**

**How to override automatic tuning parameters (Also refer to Ziegler-Nichols Tuning Method)**

**It is possible to set or fine tune the three mode parameters manually.**

**To manually enter parameters**

**1) Press Index button until "Rt"(Rate), "HG" (Heat Gain) or CG (Cool Gain) are displayed.**
**2) Enter new parameter setting desired using the up/down buttons.**
**3) Press the "Enter" key.**

**The new parameters will now take control of the process.**

### 5.3.3 Manual Tuning procedure

**The following procedure can be used for fine tuning after or instead of Auto-Tuning.**

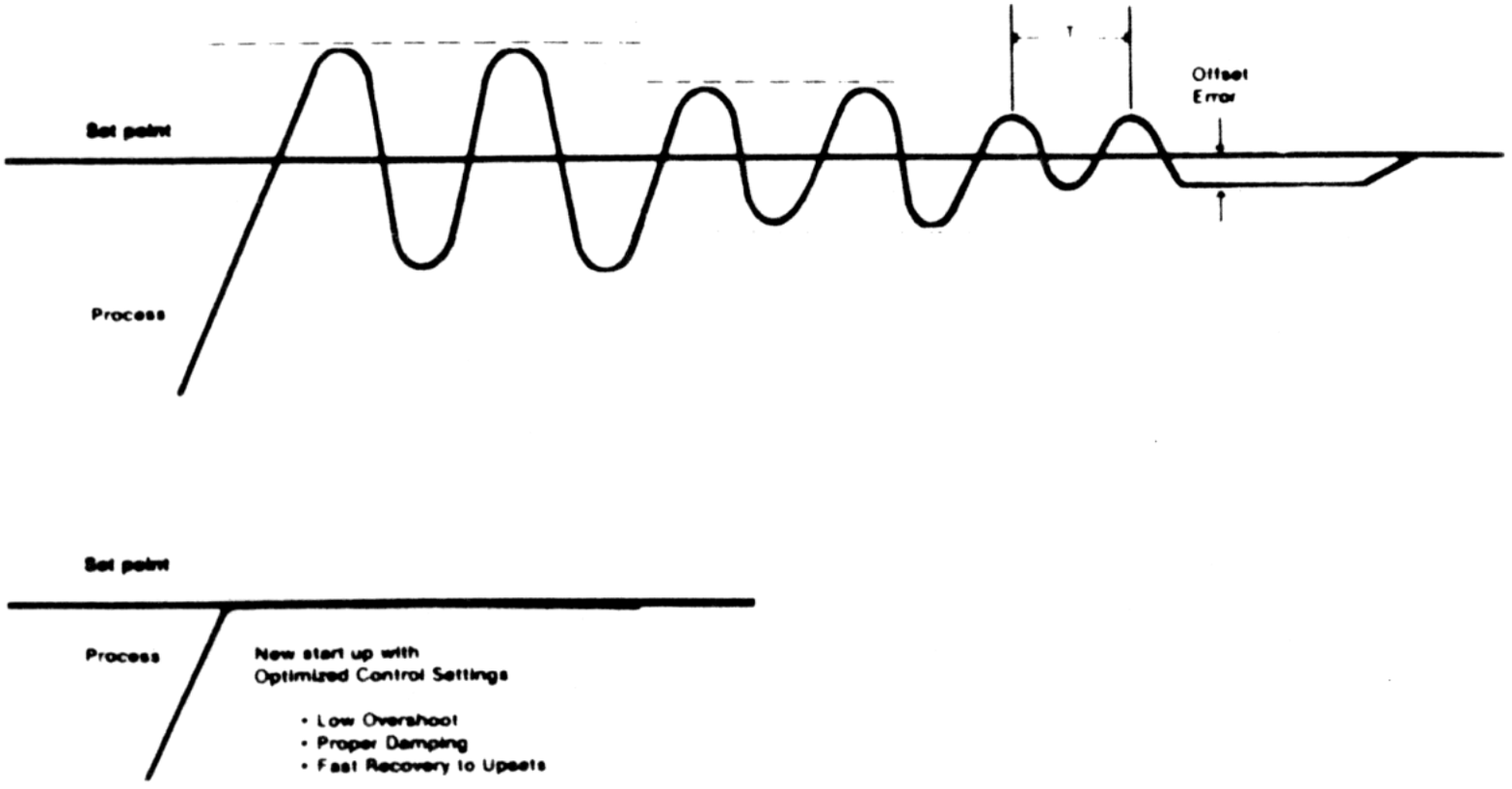
Ziegler-Nichols PID Tuning Method

**This has long been an accepted method of tuning PID (3 Mode) controllers using a minimum of time and set up to reach effective tuning parameters. Before proceeding make sure the basic unit setup is done as discussed in section 5.2.**

NOTE: If cooling is not used, enter heat gain value in cool gain also.

1. Apply power and immediately press the STAND-BY key. The STAND-BY light will come on.
2. Adjust desired set point. If oscillations and overheating will damage equipment, a lower set point should be used for initial tuning.
3. Set Heat Gain (-HG-) and Cool Gain (-CG-) to 400 (even if no cooling is to be used, the cooling gain should be set the same as the heat gain). Disconnect the cooling apparatus.

**Figure 5.3 ZIEGLER-NICHOLS TUNING TECHNIQUE**



4. Press STAND-BY again and temperature will begin to rise. When the process rises to the desired set point it will probably oscillate. Periodically decrease the Gain (lower the HG number) until a small constant oscillation is obtained. Reducing the Gain by steps of one half (1/2) the previous -HG- setting is an acceptable method to obtain the desired small oscillation. Note time between oscillations in seconds ("T" on Figure 5.3).

5. Decrease the Heat Gain to 60% of the value obtained in the previous step. The Gain is now tuned. Enter the same number in the Cool Gain.

6. The best rate time (-RT-) setting is one-eighth (1/8) the time in seconds of one cycle (see cycle time "T" in Figure 5.3). This will give a conservatively tuned system. If faster response and/or faster rise to set point is desired one-twelth (1 /12) of "T" may be used. Note that faster settings may yield instability and temperature overshoots on startup. Remember that the reset automatically tracks the rate (-rt-) adjustment

7. Connect cooling apparatus Observe control stability.

8. If oscillation occurs lower the cool gain number. If cooling is sluggish raise the cooling gain number.

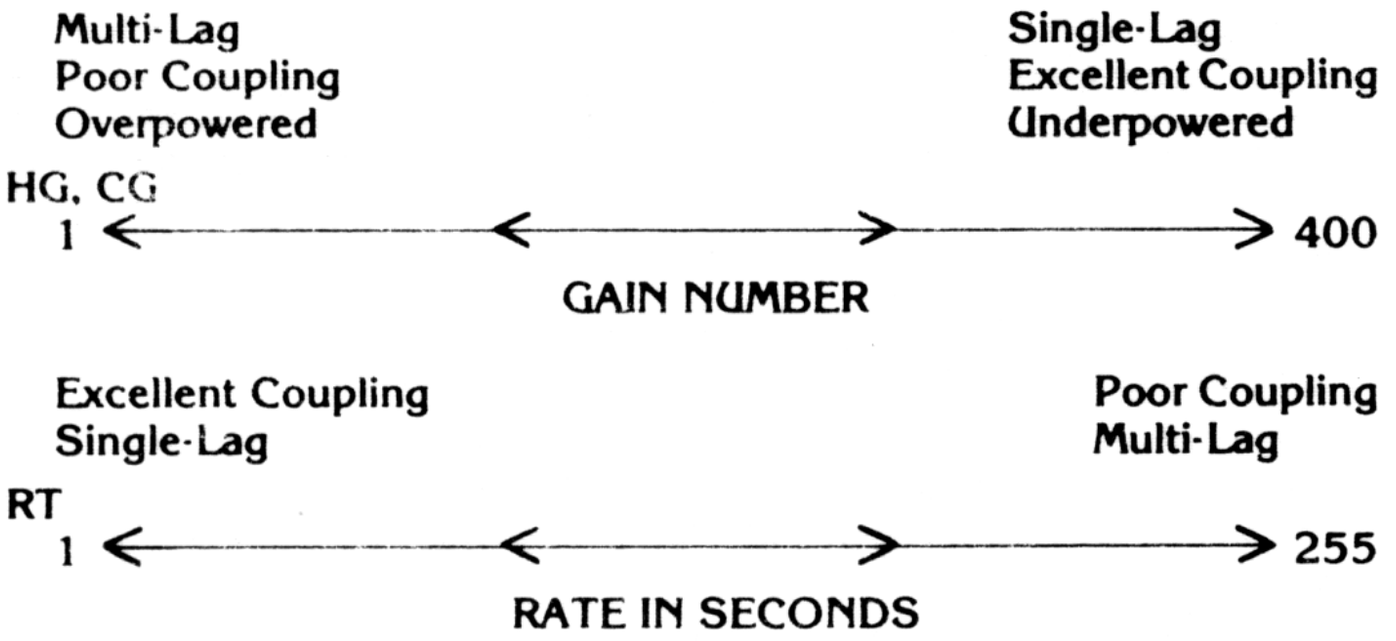
NOTE: In order to observe changes in process temperature, especially as they relate to time, it is helpful to use a temperature recorder in conjunction with all tuning and parameter setting procedures.

## TUNING HINTS

1. Once the optimum -rt- and -HG- have been set into the unit, cold start tests of the process should be tried. Remember that start-up and running parameters will usually be different and it is desirable to adjust both gain (HG) and rate/reset (RT) ±25% to strike a balance between good startup and running settings.

   Generally higher settings of -rt- will give more controlled start-ups with less overshoot lower values will give faster recovery from process upsets Higher gain settings will give tighter control of the running process. but may give more overshoot on start-up.

## CHARACTERISTICS vs SETTINGS




2. If difficulty is encountered in tuning the cooling control:
   a. Be sure that cool cycle is optimized (faster settings give less "ripple" and better control, but must be weighed against shortened solenoid life, motor starter wear, etc.)
   b. Cooling mechanisms may have excessive lag (time delay). If possible improve the dynamics of the cooling transfer, otherwise use a higher (2X) -rt- value.
   c. Optimize cooling gain.
      If temperature continues to climb, begin doubling the value of cooling gain (-CG-). Allow sufficient time for the process to stabilize between adjustment. If the process begins to oscillate on cooling, reduce the cool gain (CG) setting. Optimum setting of the cooling gain will minimize temperature excursions without causing oscillation.
   d. Since heat rate has been compromised, reduce heat gain to 1/2 previous value.
3. On/Off Cooling

   Setting the cool gain (-CG-) to 00 produces on/off action for cooling. The deadband is 1 degree.

# SECTION 6 COMMUNICATIONS

## 6.1 Communications Modules

Optional plug-in modules are available for the Series 6075 to allow interfacing to the most common industry standards. A brief description of each type follows.

### 6.1.1 RS485

RS485 is a specification standard for balanced voltage digitial interface circuits published by the EIA.

It was published in 1983 as an upgrade of RS422A electrical specifications, with emphasis given to the application of multipoint systems. The interface circuits used in the Athena Model 6075 meet the electrical characteristics of the RS485 standard.

The RS485 multipoint capability allows up to thirty-two (32) units to be connected together in a half duplex network More can be added with the use of "repeaters" such as the Athena Model CC.1 interface box

This module allows bi-directional data transfer over a shielded twisted pair. The twisted pair is a transmission line with drops to communicating devices. Since it is a transmission line, terminating resistors are required at the most distant ends of the line to minimize reflections. (Typically 60 ohms from each line to signal ground). The Model 6075 RS485 module is fully optically isolated, eliminating ground loop problems, Parallel drops from the transmission line should be kept as short as possible. Alternately the line could be daisy chained at each DB-9 connector. Note that the polarity of the line is important and each device will specify an "A" and "B" connection. On the 6075 RS485 module, "A" is pin 8 and 4; "B" is pin 7 and 3 and communications ground is available on pins 1,2, and 6. Frame ground is pin 5 and 9.

### 6.1.2 RS232C

The RS232C is a standard that was published in 1968 by the "Electronic Industries Association" (EIA). The RS is an acronym for Recommended

Standard and the 232 is the identification number for that particular Standard. The C designates the last revision made to the RS232 standard. The purpose of this standard is to define the electrical characteristics for the interfacing of ”data terminal equipment” and “data communications equip ment”. The standard providesvoltage ranges for data and control signals to provide proper transmission.

This module allows bi-directional data transfer via a three conductor cable consisting of signal ground (pin 7). receive (input, pin 2) and transmit (output, pin 3). It is recommended for less than fifty feet between computer/ terminal and instrument Note that multiple instruments cannot be tied to the same port The module is optically isolated to eliminate ground loop problems. Note that in a typical installation, “data out” of the computer/ terminal connects to "receive data" of the 6075 and "receive data" of the computer/terminal connects to *‘data out” of the 6075. If shielded cable is used it should be connected to frame ground at one end only. Signal ground is connected at both ends. The RS232 module is configured for active operation.

### 6.1.3 20 mA Current Loop

This module allows bi-directional data transfer via a current loop with each instrument series connected within the loop (10 Units Maximum). The module is “passive” i.e. an external current source is required. This is usually available at the computer/terminal. Typically the receive and transmit section of each instrument is series connected and inserted into the loop: however a separate loop for receive and transmit may be used in the event there is insufficient headroom in the energizing supply. For series transmit and receive approximately two volts of headroom is taken for each instrument on line. For operation with separate loops, approximately 1.5 volts is taken for receive and 0.5 volts for transmit Care must be observed to insure the polarity of connections is correct because current will still flow in the loop if polarity is reversed making troubleshooting difficult Wiring connections are: pin 3 = Transmitting Position (+), pin 4 = Transmit (-), pin 7 = Receive (+), pin 8 = Receive (-), pins 5 and 9 are Frame Ground.

## 6.2 Installing the Communications Modules

A. Plug the 11 point receptacle on the module into the header on processor module (vertical board behind display). Be sure the connector is properly centered on the header connector.

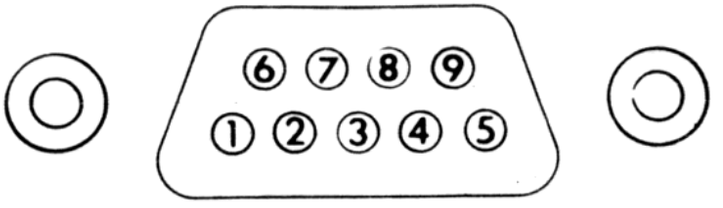
B. Slide the notch on the P.C. board into the slot on the stand-off.

C. RS485 and RS232C MODULES: Plug the three pin connector into the mating header on the power supply (lower board). Be sure leads are free of other components.

NOTE: TRANSMIT, RECEIVE INDICATORS

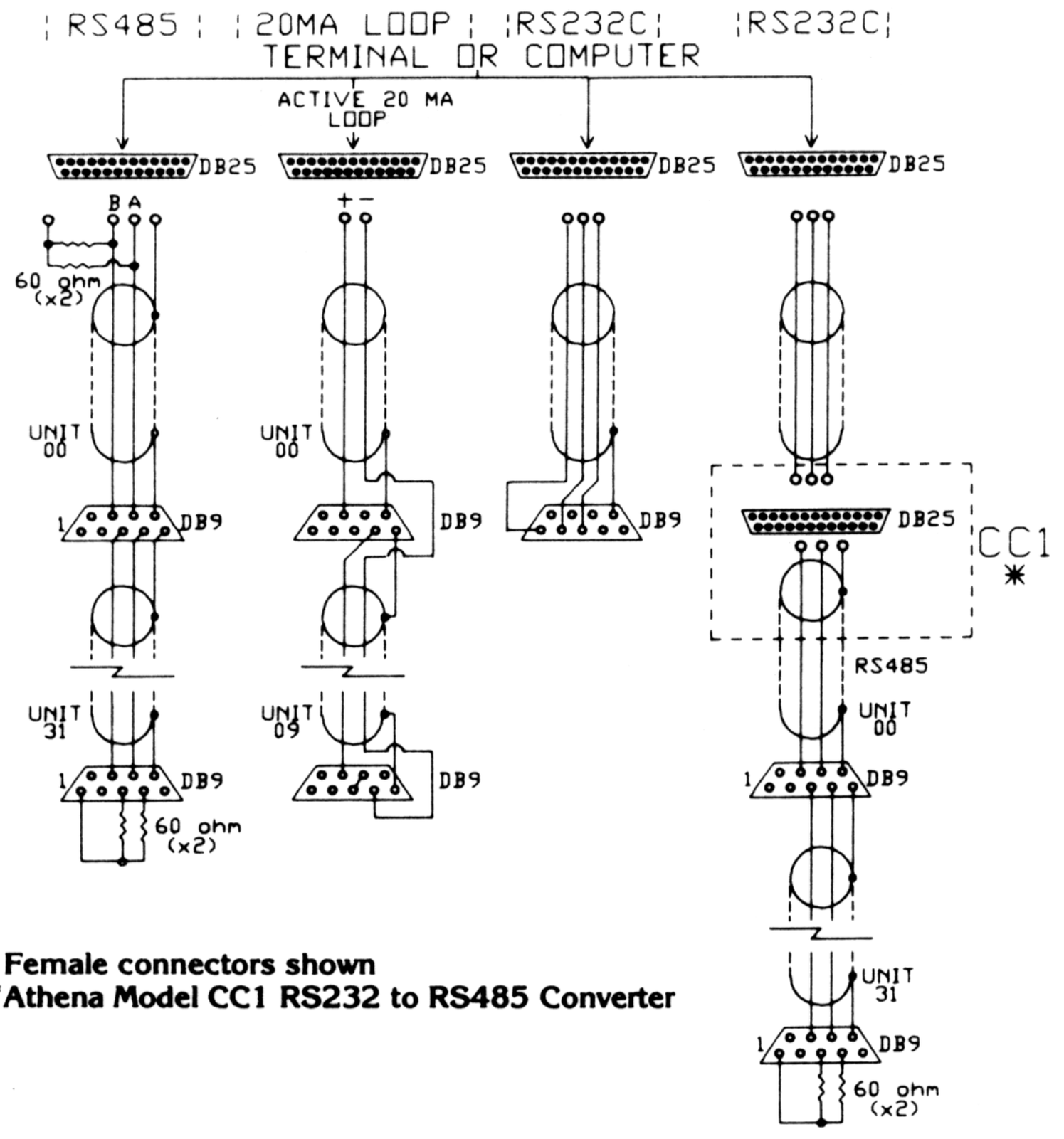
To the left of the upper 4 digit display is a LED indicator for the receive function. This LED will illuminate briefly when a transmission is present on the communications bus. To the left of the lower 5 digit display is a LED indicator for the transmit function. This LED will illuminate briefly when the Model 6075 that has been addressed transmits information onto the communications bus.

**Figure 6.1 COMMUNICATIONS CONNECTOR PINOUT**




| PIN # | RS 485 | 20 MA LOOP | RS 232 |
|---|---|---|---|
| 1 | SIGNAL GROUND | NC | SIGNAL GROUND |
| 2 | SIGNAL GROUND | NC | RECEIVE (INPUT) |
| 3 | "B" | TRANSMIT (+) | TRANSMIT (OUTPUT) |
| 4 | "A" | TRANSMIT (−) | NC |
| 5 | FRAME GROUND | FRAME GROUND | FRAME GROUND |
| 6 | SIGNAL GROUND | NC | SIGNAL GROUND |
| 7 | "B" | RECEIVE (+) | SIGNAL GROUND |
| 8 | "A" | RECEIVE (−) | NC |
| 9 | FRAME GROUND | FRAME GROUND | FRAME GROUND |

## Figure 6.2 TYPICAL WIRING FOR COMMUNICATIONS OPTIONS




**Female connectors shown**

***Athena Model CC1 RS232 to RS485 Converter**

## 6.3 Interface Examples

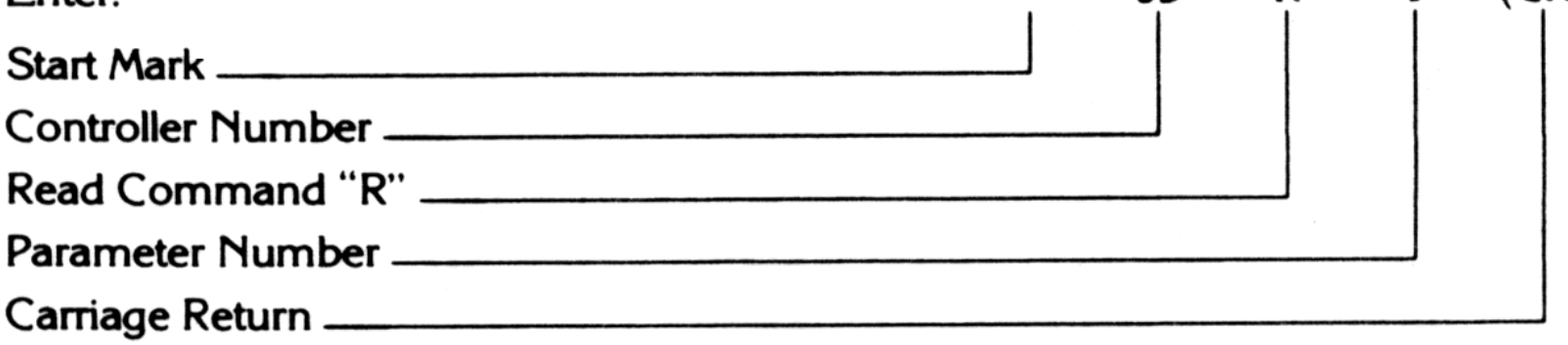
General

The Model 6075 is designed to respond to data transmitted in ASCII 7 bit code with one start bit, 1 stop bit and odd parity from any terminal or computer. Baud rate is selectable at 300, 600, 1200 or 2400 baud.

### 6.3.1

**To Read a Parameter** (e.g. controller #5, reading set point)

Enter: # 05 R 1 (CR)




Controller Response:

(LF) #05R1 0123F (CR) (LF)

Parameter #1 (Set Point) on controller 05 is presently 123°F.

CR = Carriage Return

LF = Line Feed

### 6.3.2 To modify a parameter (but not enter into memory)

Enter: # 05 M 1 — 0125 F (CR)

Start Mark

Controller Number

Modify "M"

Parameter Number to be changed

Space or Minus

New Value (4 Digits)

F, C, or space (whichever applies)

Carriage Return

Controller Response:

(LF) #05C1 0125F (CR) (LF)

"C" Temporary Change confirmed.

The set point (Parameter 1) for controller 05 has now been temporarily changed to 125°F. If power is removed the previously "Entered" value will appear.

NOTE: For the RTD Series 6275 an extra character must be added to accommodate the decimal point feature.

Example:

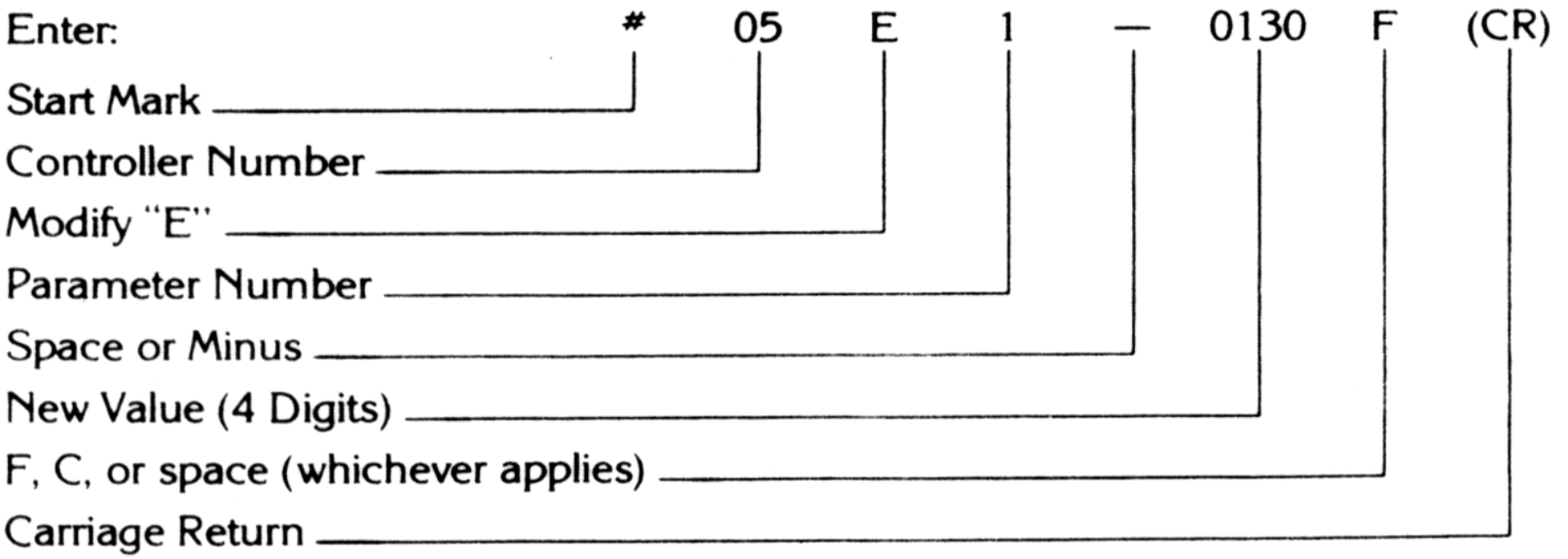
ENTER: #05M1-0125__F (CR) For range 26C

ENTER: #05M1-125. 0 F (CR) For range 22F

ENTER: #05M4-0125___ (CR) For Parameters

Space

### 6.3.3 To modify and store in nonvolatile memory




Controller Response:

(LF) #05A1 0130F (CR) (LF)

Parameters Alteration "A"

The set point (Parameter 1) for controller 05 has now been changed to 130°F and entered in non-volatile memory.

NOTE: For the RTD Series 6275 an extra character must be added to accommodate the decimal point feature.

Example:

ENTER: #05M1-0130__F (CR) For range 26C

ENTER: #05M1-130. 0 F (CR) For range 22F

ENTER: #05M4-0130___ (CR) For Parameters

Space

# SECTION 7 CALIBRATION

**WARNING: These adjustments are factory set and should only be changed by a qualified person using calibrated equipment. Adjustment is not necessary during the life of these controllers.**

## 7.1 Zero (-cL-) and Span (cH) Calibration

1. Unlock access to the calibration constants by entering the unlock number (14) into location 9 (-cd-).
2. Use a tempemture calibmtor with a range appropriate for the unit to be calibrated. Set in the value for low scale calibration, e.g. (1 % of range).
3. Step to -cL- (calibmte low [ZERO]) using tie index key on the 6075.
4. press the up/down keys on the 6075 until both instruments agree press the 'ENTER' key.
5. Set in a value on the calibrator equivalent to the high-end capability of the unit under test e.g. (95% of range).
6. Step to -cH- (calibrate high [SPAN]) using the INDEX key.
7. Press the up/down keys on the 6075 until both instruments agree. Press the "ENTER" key.
8. Repeat steps2 thru 7 until readings agree. Some interaction between Zero(-cL-) and Span (-cH-) calibration usually occurs
9. Lock out configumtion access, if desired, and return to set point by pressing "SET POINT" key.

NOTE: Pressing index continuously selects -cH- or -cL- (Span and Zero) in the calibrate mode to faciliite testing. Exit this mode by pressing the 'SET POINT" key.

# SECTION 8 TROUBLESHOOTING

## 8.1 Troubleshooting – General

| Symptom | Probable Cause & Corrective Action |
|---|---|
| **Display does not light up.** | **No power, blown fuse.** |
| **Process display shows (- - -) or 'HHHH'** | **Open thermocouple circuit Shorting terminals 1 and 2 should indicate temperature at back of case. Repair or replace thermocouple.** |
| **Process display shows LLLL or counts down scale when temperature is rising.** | **Check for reversed thermocouple.** |
| **About 30% error.** | **Wrong thermocouple type connected or internal range jumper in wrong position. Check serial tag for sensor type and then check probe. Consult manual for jumper location for desired range and then check unit and sensor.** |
| **No heat** | **Incorrect heater wiring, wrong output module. Check for cause and correct the components** |
| **Display blinks; entered values change.** | **Electromagnetic interference (EMI). To eliminate high voltage spikes, separate sensor and controller wiring from "dirty" power lines. Ground heated devices. Suppress all coils and contacts. See section on Electrical Noise.** |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