

**ANAFAZE 12LS**  
**Installation And Operation Manual**

Revision 3  
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## **WARNING**

**ANAFAZE HAS MADE EFFORTS TO ENSURE THE RELIABILITY AND SAFETY OF THE 12LS AND PROVIDE RECOMMENDATIONS FOR ITS SAFE USE IN SYSTEMS APPLICATIONS. PLEASE NOTE THAT IN ANY APPLICATION, FAILURES CAN OCCUR THAT WILL RESULT IN FULL CONTROL OUTPUTS OR OTHER OUTPUTS THAT MAY CAUSE DAMAGE OR UNSAFE CONDITIONS IN THE EQUIPMENT OR PROCESS CONNECTED TO THE ANAFAZE 12LS.**

**GOOD ENGINEERING PRACTICES, ELECTRICAL CODES, AND INSURANCE REGULATIONS REQUIRE INDEPENDENT, EXTERNAL, SAFETY DEVICES BE USED TO PREVENT POTENTIALLY DANGEROUS OR UNSAFE CONDITIONS ASSUMING THAT THE ANAFAZE 12LS CAN FAIL WITH OUTPUTS FULL ON, OR OUTPUTS FULL OFF, OR OTHER CONDITIONS THAT WOULD BE UNEXPECTED.**

**THE 12LS INCLUDES A RESET CIRCUIT THAT WILL SET THE CONTROL OUTPUTS OFF OR TO THE DATA STORED IN MEMORY IF THE MICROPROCESSOR RESETS -- NORMALLY THE RESULT OF A POWER FAILURE AND POWER RETURN. IF THERE IS ANY POSSIBILITY THAT A RESTART BASED ON MEMORY WILL BE UNSAFE, THE 12LS MUST BE PROGRAMMED TO START WITH OUTPUTS OFF. FOR ADDITIONAL SAFETY, THE COMPUTER OR OTHER HOST DEVICE SHOULD BE PROGRAMMED TO AUTOMATICALLY RELOAD THE DESIRED OPERATING CONSTANTS, OR SAFE VALUES FOR THE PROCESS, UPON RETURN OF SYSTEM POWER. IN ANY EVENT, THESE SAFETY FEATURES DO NOT ELIMINATE THE NEED TO PROVIDE EXTERNAL, INDEPENDENT SAFETY DEVICES IN POTENTIALLY DANGEROUS OR UNSAFE CONDITIONS.**

**ANAFAZE ALSO OFFERS ANASOFT, AN OPTIONAL SOFTWARE PROGRAM FOR IBM PC COMPATIBLE COMPUTERS THAT WILL RELOAD THE 12LS WITH THE CURRENT VALUES IN THE COMPUTER MEMORY UPON A RESET. THE USER MUST INSURE THAT THIS WILL BE SAFE FOR THE PROCESS. AGAIN, USING THIS FEATURE STILL DOES NOT ELIMINATE THE NEED FOR APPROPRIATE EXTERNAL, INDEPENDENT SAFETY DEVICES.**

**PLEASE CONTACT ANAFAZE IMMEDIATELY IF THERE ARE ANY QUESTIONS ABOUT SYSTEM SAFETY**

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## 1.0 INTRODUCTION

The ANAFAZE 12LS is a powerful 1/8th DIN controller that delivers 12 fully independent loops of PID control. It functions as both a stand alone controller and as the key element in computer supervised data acquisition and control systems. An LCD front panel display and a touch keypad are available for local entry of control and other operating parameters. The ANAFAZE 12LS can also be supervised by a computer or programmable controller through the standard serial interface.

The ANAFAZE 12LS delivers critical flexibility needed for multiple loop industrial and other control applications:

**Direct Connection of Mixed Sensors:** Versatile analog inputs allow direct connection of most industrial sensors. Thermocouple inputs include reference junction compensation, linearization, upscale break detection, and a choice of °F or °C display.

**Automatic Scaling:** All sensors can be automatically scaled by entering any two measurement points. For example, to scale a pressure sensor, enter two points such as 28% is 80 PSI, and 82% is 260 PSI. All subsequent readings, and entries such as setpoint and alarms will be in PSI.

**Selectable Control Outputs:** Each digital control output can be selected as: on/off, time proportioning, or distributed zero crossing. Each loop can be independently set for on/off, P, PI, or PID control with reverse acting [heat] or direct acting [cool] output.

**Alarms -- Complete Process Monitoring:** For process monitoring a unique alarm capability is included. A deviation band alarm, and high and low process [fixed] alarms can be independently set for each loop. In addition to global annunciator digital output, each alarm can include a single or grouped digital output. For example, the digital output from all the high process alarms can be directed to a single output for automatic process shutdown.

**Front Panel or Computer Operation:** Controller operation and setup is possible from the front panel or from a local or remote computer. ANAFAZE offers ANASOFT, an IBM PC or compatible, menu driven program to set the ANAFAZE 12LS parameters. In addition, ANASOFT features graphic trend plotting, process overviews, printouts, and data archiving in LOTUS compatible files.

**Multiple Job Storage:** Up to 8 jobs can be stored in protected memory and selected with a single entry. Each job is a set of operating conditions, including setpoints and alarms. Thus if a single oven is producing multiple products, entry of the job number will setup all the loops. **Dual Output Standard:** The ANAFAZE 12LS includes dual control outputs for each loop with a second set of control constants for heat/cool applications.

**Optional Ramp and Soak:** The ANAFAZE 12LS is also available with a built in powerful ramp and soak programmer for batch processing.

### Intelligent Front Panel Delivers Convenient Operation



The ANAFAZE 12LS front panel provides an intelligent method for both viewing the process conditions and operating the controller. Displays show information in increasing detail: bar graph summary, single loop displays, and detailed guided setup menus. For operating security, all front panel entries can be password protected with two levels. With the panel "unlocked" common operator changes, such as setpoint or manual/auto, are made easier with single dedicated keys. Detailed setup requires a password, and entries are made on guided menus. The result is a controller that is both easy and logical to use.

The front panel features a two line alphanumeric LCD display. Different process displays are quickly selected with the front panel push-buttons:

**Bar Graph Display:** Provides a system overview by displaying a deviation bar graph for each loop. Loop status including acknowledged alarms, manual or auto are also displayed.

**Single Loop Display:** Highlights the detailed status for any selected loop including the process variable, engineering units, the setpoint, any alarms, and the control output percentage.

**Scanning Display:** The scanning display sequentially shows the single loop display for all the loops.

**Alarm Display:** If an alarm occurs, the front panel switches to the alarm display which is the single loop display with the alarm condition flashing. Pressing ALARM ACK stops the flashing and allows the display to be switched to any function.

## Guided Menus Simplify Setup

The ANAFAZE 12LS directs operator and supervisor changes with guided menus. Two levels are provided: one for operator changes and one for supervisor controller setup.

**Operator Changes:** Single dedicated keys are used to make process changes from the single loop display. The setpoint can be changed, the loop can be set to auto or manual, and ramp and soak loops can be started, held, or stopped. If the loop is set to manual, the percent output can be changed. These changes can be locked out from the supervisor menus if desired.

**Supervisor Setup:** Detailed editing is done by pressing a special sequence of keys to enter the setup menus. The supervisor is guided through a list of functions to change:

**Global?** This is used to save and restore jobs, define action on power up, communications address and baud rate, communications error checking, panel lock, and alarm delay.

**Inputs?** Input sensor type, engineering units, scaling, and sample time for pulse inputs.

**Control?** The loop control constants including: Proportional gain [P], Integral or reset [I], and derivative or rate [D], and a digital output filter. For the dual outputs, a second gain, reset, rate, filter and spread can be entered for the second output.

**Output?** Selects the control output including: analog, on/off, cycle time proportioning, distributed zero crossing, and reverse [heat] or direct [cool] action. The heat output can be directed to the terminals or ribbon connector.

**Alarms?** Independent deviation alarm band, high process, and low process alarms can be set for each loop. Each alarm can be set to activate any of the digital outputs on alarm. A deadband can be entered for each loop.

**Ramp/Soak?** If this option is installed up to eight, 20 segment ramp and soak profiles can be defined.

**I/O Test?** This is used to check the state of the digital inputs and outputs.

## Digital Inputs and Outputs Expand Versatility

Digital inputs and outputs are provided to further enhance the ANAFAZE 12LS flexibility. Digital outputs are provided for global alarms, systems status, individual high and low alarms, and ramp and soak events. Digital inputs are available to control the ANAFAZE 12LS in response to external conditions.

**Annunciator Alarm Output:** One of the digital outputs is setup as a global output for connection to an annunciator. This output is turned on when any alarm occurs. The output will be turned off when the operator acknowledges the alarm from the computer or the front panel. New alarms will cause the output to be turned on again.

**Digital Outputs:** 9 digital outputs can be assigned through the front panel or the computer as alarms or as ramp and soak events. The same output can be used by more than one alarm or event. This allows alarms to be grouped as needed. For example output 1 could be set to respond to a high alarm on loops 2, 4, 7, and 8 or any other combination.

**Digital Inputs:** 8 digital inputs can be assigned as triggers for controller functions. These would be used to change setpoint in response to an external event or as hold/continue inputs for ramp and soak profiles.

## Ramp, Soak, and Batch Control

The ANAFAZE 12LS ramp and soak version delivers powerful batch control. Independent ramp and soak profiles can be assigned to any or all loops. Up to 12 profiles, one for each loop, can be stored in non-volatile memory. Each profile can have up to 20 segments with digital inputs for triggers, digital outputs for events, assured soak limits, and unlimited repeats. The profiles can be started, stopped, held or continued from the front panel, the computer, or through the digital inputs. Up to 9 digital outputs can be used as events and included in any profile.

## 2.0 SPECIFICATIONS

### 2.1 Analog Inputs

Analog Inputs	12, Solid state, common ground.
Isolation:	Between inputs and ground: 10volts peak.
A/D Converter:	Integrating voltage to frequency.
Range:	-10 to 60mv, can be changed with scaling resistors to any range from 0 up to 25v.
Resolution:	0.02%, greater than 12 bits.
Accuracy:	0.1% at 25°C
Calibration:	Automatic zero and full scale.
Temperature Coef:	Less than 100ppm/°C, 0.01%/°C.
Normal Mode Rejection:	60db at 60Hz, full scale range maximum.
Loop Update Time:	1 time per second, every input.
Thermocouple Inputs:	J, K, T, B, S, and R. Measurement Ranges: J -350 to 1500    B 150 to 3200 K -450 to 2700    S 0 to 3200 T -300 to 800    R 0 to 3210
T/C Break:	Pulse type for up scale break.
Milliamp Inputs:	4-20ma, 10-50ma, 0-50ma, etc. with scaling resistors.
Infrared Inputs:	Power supply included, with scaling resistors.
Source Impedance:	Measurements are within specification with up to 500 ohms source resistance.

## 2.2 Control Capability

Number of Loops:	12, Dual Output.
Control Outputs:	Cycle Time Proportioning, Distributed Zero Crossing, or On/Off; all independently selectable for each loop.
Control Action:	Reverse [heat] or Direct [cool], independently selectable for each loop.
Digital Control Outputs:	Nominal 5vdc at 10ma to drive optically- isolated solid-state relays.
Cycle Time:	Programmable for each loop, 1-255 secs.
Output Resolution:	16 bits.

## 2.3 Digital Outputs

Number:	11
Configuration:	1 Global Alarm 9 for alarms or events. 1 not used standard PROM

## 2.4 Digital Inputs

Number:	9
Configuration:	8 for triggers 1 not used standard PROM

## 2.5 Serial Interface

Type:	RS-232 or RS-485 4 wire, factory select
Isolation:	RS-232: None. RS-485: To RS-485 Specification.
Baud Rate:	2400 or 9600, menu selectable.
Protocol:	Form of ANSI X3.28-1976, Compatible with Allen-Bradley PLC, Half Duplex.
Error Check:	BCC or CRC, menu selectable.
Number of Controllers:	Each communications line: 32 with RS- 485, 1 with RS-232.

## 2.6 Power Supply

Power input: 10 to 30VDC, 3 Watts typical, 110VAC adapter provided.

### 3.0 INSTALLATION

There are some precautions that must be observed when installing ANAFAZE 12LS.

#### **WARNING! -- ELECTRICAL SHOCK DANGER**

**It is very important that all system power including the power input be disconnected before servicing the ANAFAZE 12LS. HIGH VOLTAGE MAY BE PRESENT EVEN WHEN POWER IS TURNED OFF! To reduce the danger of electrical shock always mount the 12LS in an enclosure that prevents personal contact.**

Although the ANAFAZE 12LS makes measurements of input signals that are referenced to ground, the 12LS ground and other signal lines can inadvertently have power line or other high voltage present even if the input power is turned off. This is possible, for example, if a thermocouple was shorted to the AC power line.

#### **WARNING!**

#### **USE CORRECT INSULATION TRIM LENGTH AND WIRE GAUGE**

**The correct insulation trim length is 1/4" or 5 mm. Care must be taken to prevent contact between wires and the case, which is grounded. The terminal manufacturer has UL approval for #14 to #30 (AWG). ANAFAZE recommends using #18 or #20 AWG.**

To effectively use the terminals, the wire insulation should be trimmed so that the wire fits inside the terminal with no bare wire exposed. Stranded wire should be tinned.

#### **WARNING! -- SUPPORT CABLES**

**Power, input and output cables should be supported to reduce strain on the terminals and to prevent wires from being pulled out.**

#### **WARNING! -- PROVIDE CLEARANCE FOR VENTILATION**

**Always install the 12LS such that the slots in the housing will have unrestricted air flow. Do not block the slots with other equipment. If temporary covers are placed over the 12LS during wiring ensure they are removed prior to operation.**

### 3.1 PHYSICAL CONSIDERATIONS

The ANAFAZE 12LS consists of a 1/8th DIN housing with a front plug in electronics module.

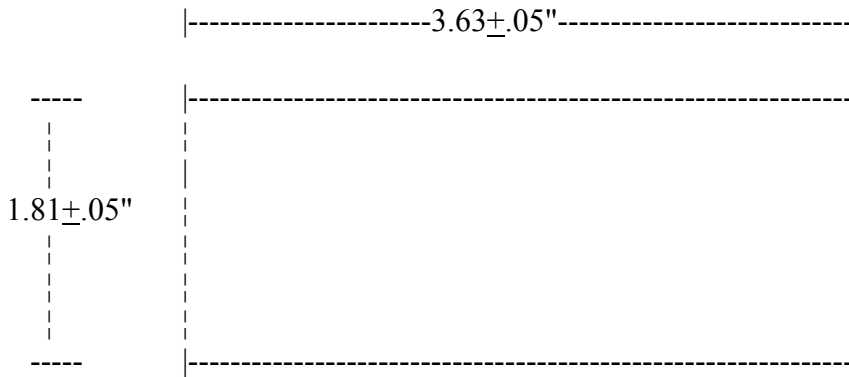
### 3.1.1 MOUNTING

For optimum performance when directly connecting thermocouple inputs the unit should be protected from thermal shocks whenever possible. This will minimize any temperature gradients across the terminal strips and ensure the highest accuracy.

The required panel cutout is a rectangular hole 46mm x 92mm [1.81in x 3.63in]. This should be carefully cut since the 1/8th DIN specification only allows a front panel of 48mm x 96mm [3.78in x 3.78in] -- so there is not a lot of room for error.

After the hole is cut the ANAFAZE 12LS is inserted through the front of the panel and the top and bottom clamps are screwed into place. If excessive vibration is anticipated a rear support may be required both for the 12LS and the interconnecting cables.

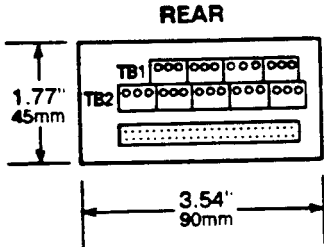
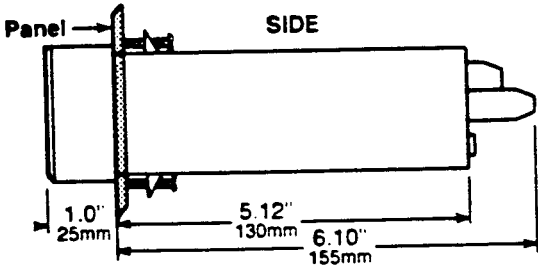
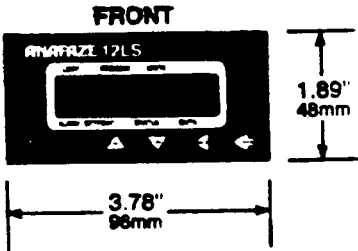
#### Mounting Hole Dimensions



Dimensions are in inches.



1/8th DIN HOUSING



### **3.1.2 EXTERNAL WIRING**

During wiring, it is recommended that the 12LS electronics be removed or temporary covers be put over the housing slots to ensure pieces of wire do not enter the housing and lodge in the electronics. Always ensure that the housing is clean when the electronics is plugged in.

The successful installation of the ANAFAZE 12LS control system will be the result of selecting the proper equipment and the use of correct installation techniques with appropriate material. One area of concern is the wiring type and placement of the wiring.

The wiring is selected as to the function of the wire, the installation requirements, and the possible mechanical/electrical problems that may occur.

The function of the wire is divided into two basic categories: INPUTS and OUTPUTS. The process control requirements will dictate the TYPE of INPUTS and the TYPE of OUTPUTS along with the mechanical electrical requirements of the individual installation.

As defined by ANAFAZE, the term AC power is applied to the 120 VAC control supply. High power is applied to 240 VAC or higher, primarily used for control loads.

### **3.1.3 GENERAL WIRING REQUIREMENTS**

1. Use stranded wire. Solid wire is recommended for fixed service and tend to make intermittent connections when moving the field wiring around for maintenance.
2. Use 18 or 20 ga. size wire. The use of 16,18,20,22, or 24 ga.is permissible also. The power requirement is not a factor in the wire size. Only the mechanical strength and the ohmage of the wire may be factors to consider. Smaller or larger sizes are not easily installed, may be easily broken and/or cause intermittent connections.
3. Use shielded wire. The electrical shield is used primarily to protect from unwanted electrical noise.

Normal use of the INPUT WIRING SHIELD is to connect one end only to the 120 VAC panel ground at the 12LS panel location.

Normal use of the OUTPUT WIRING SHIELD would be to connect one end only to the 120 VAC panel ground in the panel that the 12LS is mounted in. Actual use of the shields will be determined by the installation requirement.

For additional noise suppression measures see NOISE SUPPRESSION FOR Digital Outputs.

4. Use **Thermocouple Extension Wire for all thermocouple (T/C) inputs.** Most T/C Ext. Wire is solid wire unshielded. When using such, the shield function cannot be utilized and only 16, 18, or 20 ga should be used. **Install all T/C wiring in its own conduit away from AC Power and High Power wiring.** Depending on type and wire size up to 400-500 feet in length may be used to be within stated accuracy and source impedance.

5. Use **multiconductor stranded shielded cable for analog inputs.**

Most inputs will use a shielded twisted pair, but some may require a 3 wire input. **Run all analog input wiring in its own conduit away from AC Power and High Power wiring.** Wire sizes of 20, 22, or 24 ga. may be used.

6. Use **multiconductor stranded shielded cable for analog outputs and PID digital outputs** connected to panel mount SSR's. The analog output will normally use a twisted pair while the digital outputs will be up to 9 or 20 conductors depending on wiring techniques. All cables will be shielded. The wiring size will normally be 24 ga. **The maximum length for the digital outputs should not exceed 25 feet. The maximum length for the analog outputs should not exceed 400 feet. All wiring must be in a separate conduit away from AC Power and High Power wiring.**

When using the 50 conductor flat ribbon cable for the I/O, use of the 50-pin connector is recommended for both ends of the cable. The wire is too small to withstand much flexing when connected to a screw terminal. **The cable length should not exceed 15 feet.**

7. When installing communications wiring, by pulling in an extra pair, a sound power phone system could be utilized for communications between the ANAFAZE controllers and the computer. This could be used for maintenance, checking calibration and many other functions. A David Clark #H5030 sound powered system has been used successfully in systems requiring this function.

8. **When installing any I/O wiring to the ANAFAZE controllers inside a panel, it should never be run in the same bundle as AC power wiring.**

**Also wiring bundles of low power ANAFAZE circuits next to bundles of high power AC wiring should never be done.** The physical separation of the high power circuits from the ANAFAZE controllers should be of prime importance. In fact most AC voltage high power circuits are installed in a separate panel.

### 3.1.4 RECOMMENDED CABLES P/N

Use these cables or equivalent.

FUNCTION	MFR P/N	# of WIRE
Analog Inputs	Belden #9154	2-20ga
	Belden #8451	2-22ga
RTD Inputs	Belden #8772	3-20ga
	Belden #9770	3-22ga
T/C Inputs	T/C EXT.WIRE	2-wire
Carbon Probe Input	Belden #88760	2-18ga
Digital PID Outputs and Digital I/O	Belden #9539	9-24ga
	Belden #9542	20-24ga
	Ribbon Cable	50-wire
Analog Outputs	Belden #9154	2-20ga
	Belden #8451	2-22ga
Computer Communication --RS232,RS422,RS485, or 20ma--	Belden #9729	4-24ga
	Belden #9730	6-24ga
	Belden #9842	4-24ga
	Belden #9843	6-24ga

### 3.1.5 NOISE SUPPRESSION FOR DIGITAL OUTPUTS

When using the digital outputs from ANAFAZE multiloop controllers to energize dry contact electrical- mechanical relays with inductive loads, generation of RFI may become a problem.

This problem may cause the display on the 8LS to blank out and then re-energize as if power had been momentary turned off. It may also cause the CPU in the equipment to reset, thus losing the PID output levels. It may also damage the digital output IC circuit, thus not being to energize the digital outputs. If, the IC circuit is damaged, factory repair will be required.

The type of loads that may cause a problem are motor starters, alarm horns, etc. The RFI is generated upon opening of the metallic relay contacts.

To correct the problem of RFI noise problems:

1. Use Solid State Relays (SSR) wherever possible in place of electrical-mechanical relays (E-M relays).
2. When using E-M relays, if possible do not mount them in the same panel as the ANAFAZE equipment.

3. Separate the 120 vac power leads from the low level input and outputs leads from the ANAFAZE. Do not run the digital outputs or PID control outputs leads in the same wire bundle as any 120 vac wires. Inputs leads should never be run in the same bundle with any high power leads. See 3.3.3.

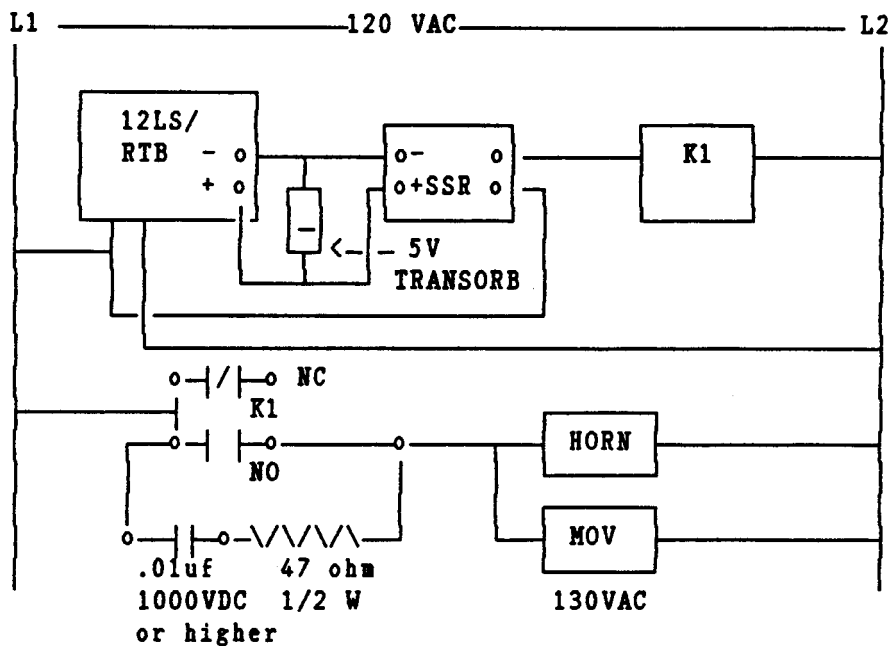
4. If, E-M relays are required and must be in the same panel as the ANAFAZE equipment, use a .01 uF at 1000 vdc or higher vdc disk capacitor in series with a 47 ohm 1/2 W resistor across the NO contacts of the relay load contacts. This is the most important step in suppressing RFI from relay contacts. This network is known as arc suppresser or snubber networks.

5. Use of other voltage suppressing devices may also be used, but are not normally required. A device known as a MOV rated at 130 vac for 120 vac control circuits may be placed across the load. This will limit the peak ac voltage to about 180 vac. A device known as a transorb (back to back zeners) may be used across the digital output. The rating of 5 vdc should be used. This will limit the dc voltage to 5 vdc on the digital output loop.

See diagrams for proper placement of the above devices. The parts for RFI suppression are available from ANAFAZE.

The above steps should eliminate any noise problems that might be present with using E-M relays. If, problems persists and/or any questions about the above steps arises, please call ANAFAZE.

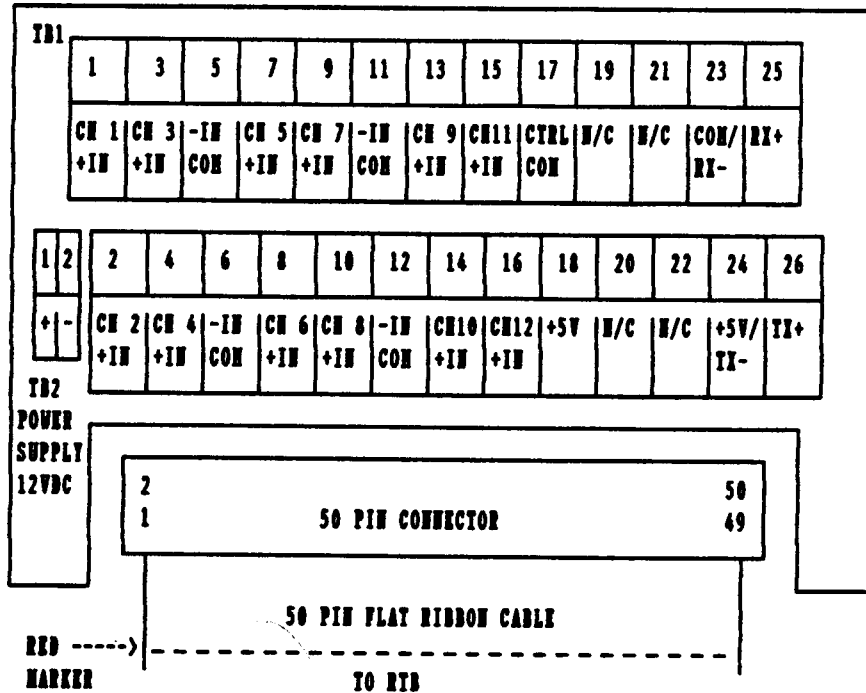
### DIAGRAM OF TYPICAL DIGITAL OUTPUTS WITH RFI SUPPRESSION



### 3.2 TERMINAL BLOCK AND CONNECTOR LAYOUT

The ANAFAZE 12LS terminal blocks and connectors are assigned according to the following two pages. Subsequent sections provide detailed connection descriptions.

#### 12LS REAR PANEL



#### NOTES:

1. THE CH (LOOP NUMBER) +IN IS THE ANALOG POSITIVE OF THE INPUT SIGNAL FOR THAT LOOP.
2. -IN COM IS THE ANALOG COMMON NEGATIVE OF THE INPUT SIGNAL.
3. CTRL COM IS THE COMMON FOR THE DIGITAL I/O CIRCUITS, SERIAL COMMUNICATIONS, AND IS CONNECTED TO THE NEGATIVE OF THE POWER SUPPLY.
4. THE COMMUNICATIONS SELECTION OF RS-232 OR RS-485 WILL DETERMINE THE FUNCTION OF TERMINALS #23 AND #24. SEE SECTION 3.5.1 RS-232 CONNECTIONS AND SECTION 3.5.3.3 RS-485 CONNECTIONS.
5. TERMINAL #24 WILL SUPPLY +5VDC FOR THE SOURCE TO OPERATE THE GLOBAL ALARM AND DIGITAL OUTPUTS WHEN USED WITH RS-232 COMMUNICATIONS.
6. DIGITAL OUTPUTS #8 AND #9 ARE DUPLICATED ON TERMINAL #19 AND #20 RESPECTIVELY AS WELL AS THE RTB TERMINALS OF #14 AND #12.

## REMOTE TERMINAL BLOCK CONNECTIONS

The remote terminal block (RTB) provides the control outputs and additional digital inputs and outputs as follows:

FUNCTION	TERMINAL		FUNCTION
+5VDC	1	2	+5VDC
CTRL COM	3	4	CTRL COM
SPARE	5	6	SPARE
SPARE	7	8	BOX SELECTED
PIDHEAT 1	9	10	GLOBAL ALARM
PIDHEAT 2	11	12	DIG OUTPUT 9
PIDHEAT 3	13	14	DIG OUTPUT 8
PIDHEAT 4	15	16	DIG OUTPUT 7
PIDHEAT 5	17	18	DIG OUTPUT 6
PIDHEAT 6	19	20	DIG OUTPUT 5
PID HEAT 7	21	22	DIG OUTPUT 4
PIDHEAT 8	23	24	DIG OUTPUT 3
PIDHEAT 9	25	26	DIG OUTPUT 2
PIDHEAT 10	27	28	DIG OUTPUT 1
PIDHEAT 11	29	30	PID COOL 12
PIDHEAT 12	31	32	PID COOL 11
PIDCOOL 1	33	34	PID COOL 10
PIDCOOL 2	35	36	PID COOL 9
PIDCOOL 3	37	38	PID COOL 8
PIDCOOL 4	39	40	PID COOL 7
PID COOL 5	41	42	PID COOL 6
DIG INPUT 1	43	44	DIG INPUT 2
DIG INPUT 3	45	46	DIG INPUT 4
DIG INPUT 5	47	48	DIG INPUT 6
DIG INPUT 7	49	50	DIG INPUT 8

### WARNING

All digital outputs and PID outputs on this flat ribbon connection are SINK OUTPUTS. They are in reference to the 5Vdc supply. The outputs will be low when they are ON.

All digital inputs are TTL level inputs and may be selected from software if they will be high/false or low/true inputs. The inputs are in reference to CTRL COM.

NOTE! WHEN USING THE RTB, PROPER POLARITY OF THE FLAT RIBBON CABLE IS NECESSARY FOR CORRECT PIN TERMINATIONS. INSTALL THE RED MARKER INDICATING PIN #1 TO THE LEFT WHEN TERMINAL #1 OF THE RTB IS TO THE LEFT. THE FLAT RIBBON CABLE SHOULD HAVE THE RED MARKER TO THE LEFT WHEN IT IS INSTALLED ON THE REAR OF THE 12LS. TO CONFIRM PROPER POLARITY, CHECK THAT PIN #1 IS +5VDC WITH RESPECT TO PIN #3.

## **3.3 ANALOG INPUTS**

Connecting analog signals to the ANAFAZE 12LS is normally straightforward. Most thermocouples can be directly connected and mixed in any order. Other types of analog signals such as mAdc or Vdc require scaling resistors installed on the 12LS inputs. However, some problems may occur that could reduce accuracy and possibly damage the unit. Sections 3.1 through 3.4 indicate some of the potential areas for concern. [See typical input DIAGRAM in section 3.13].

### **3.3.1 COMMON MODE VOLTAGE**

Common mode voltage is the voltage between the ground at the sensor and the ground at the ANAFAZE 12LS. It can be an AC or DC voltage and appears equally at the high and low input terminals. Frequently it is caused by large currents flowing in the ground path between the 12LS and the sensors. The effects are minimized by using isolated sensors or ungrounded thermocouples. Since the 12LS uses common ground inputs, if grounded sensors are used, any common mode voltage will cause current flow in the sensor leads and reading errors.

### **3.3.2 NORMAL MODE VOLTAGE**

Normal mode voltage appears across the terminals of the input and is the signal from the sensor plus any undesirable noise. The major cause of this noise is AC power line pick-up. The effects are reduced by the ANAFAZE 12LS capacity to integrate the signal over a multiple of the power line frequency. Further reduction can be achieved by locating the 12LS near the sensors and by using twisted and shielded sensor wires. To ensure accurate readings, the maximum of normal mode plus signal should not exceed -10mv to +60mv.

### **3.3.3 GROUNDING**

For best accuracy, observe the grounding recommendations for connecting each input and output signal. The analog signal grounds should be connected to the analog ground terminals. The communication and control outputs should be connected to their respective grounds. Do not mix the grounds or connect them together. If possible, route the analog signal cables separately from the communication, control and power cables.

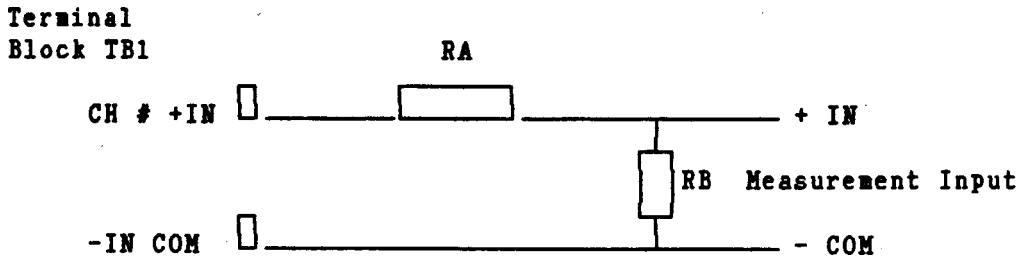
### **3.3.4 SOURCE IMPEDANCE**

Each sensor has a certain output impedance which is effectively connected across the ANAFAZE 12LS input amplifier when a measurement is made. To reach the rated accuracy, the maximum source impedance should not exceed 500 ohms. Consult ANAFAZE for operation with higher source impedance.



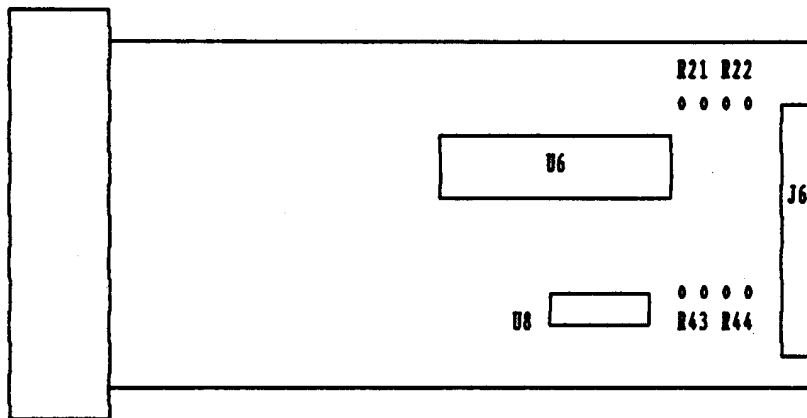
### 3.3.5 INPUT SCALING

The ANAFAZE 12LS contains an area that can be used to install resistors to scale input voltages and convert milliamp inputs to match the -10 to 60mv (-16.7% to 100%) input range. The input circuit is designed to enable connection of current inputs (such as 4 to 20ma), and voltage inputs. ANAFAZE will supply input scaling as needed -- order option 12LS-SI-XX. The input circuit is shown below:



The location of RA and RB for each input is shown on the following table:

Loop #	RA #	RB #	Loop #	RA #	RB #
1	R44	R43	7	R32	R31
2	R42	R41	8	R30	R29
3	R40	R39	9	R28	R27
4	R38	R37	10	R26	R25
5	R36	R35	11	R24	R23
6	R34	R33	12	R22	R21



RA is shorted by a jumper on the PC board, remove this jumper to install RA.

Resistors should be 0.1% metal film, 1/4 watt. Note that the resistors must be stood on end due to the compact size of the unit. Other components such as capacitors can be installed for signal conditioning. Please consult ANAFAZE. The PC board silk screen shows the resistor locations.

### 3.3.6 VOLTAGE INPUTS

DC Voltage inputs should be connected with the positive side to the CH +IN terminal and the negative side to one of the -IN COM terminal. The input range is -10 to +60 mv. Signals greater than 60 mv must be scaled with resistors to match the input full scale to 60 mv. The scaling resistor RA is selected as the voltage dropping and/or current limiting resistor. RB is selected for the 60 mv full scale dropping resistor. It should normally be less than 500  $\Omega$  and should never be greater than 1000  $\Omega$ . Any value above 1000  $\Omega$  for RB will cause error due to the upscale burnout circuit.

Output Voltage Range	RA	RB	Accuracy
0 - 100 mV	499 $\Omega$	750 $\Omega$	+ .1 %
0 - 500 mV	5.49 K $\Omega$	750 $\Omega$	+ .1 %
0 - 1 V	6.91 K $\Omega$	442 $\Omega$	+ .2 %
0 - 5 V	39.2 K $\Omega$	475 $\Omega$	- .2 %
0 - 10 V	49.9 K $\Omega$	301 $\Omega$	- .1 %

The above values are standard metal film values and will give an accuracy of  $\pm 0.25\%$  when using .1% tolerance resistors. Any possible error due to resistor tolerance may be corrected by using the built in linear scaling.

### 3.3.7 MILLIAMP INPUTS

Current inputs from transmitters are accommodated by placing resistors in the input section to convert the current input into a voltage. The input connections are the same as the voltage inputs. Different current input ranges are accommodated by selecting the proper resistor values.

A single 0.1% resistor is used as follows:

4 to 20 ma	0 to 10 ma
RB = 3.000 $\Omega$	RB = 6.000 $\Omega$

### 3.3.8 THERMOCOUPLE INPUTS

All thermocouple types may be directly connected to the ANAFAZE 12LS. Types J,K,T,R, S and B linearization and cold junction compensation are provided standard in the ANAFAZE 12LS. For other thermocouple types, optional input ranges are required. Thermocouples should be connected with the positive lead to the CH +IN terminal and the negative lead to one of the -IN COM analog grounds.

Use 20 gage or smaller T/C Extension wire as there are only four terminals for the common negative input lead for 12 loops.

## WARNING

Use of the grounded T/C, meaning that the T/C junction is at the same potential of the metal protection sheath of the T/C assembly, may cause calibration shifts and/or erratic temperature readings of the input. The use of a grounded T/C in a process using electrical energy for heating, may also cause damage to the 12LS.

The ungrounded T/C, meaning that the T/C junction is electrically isolated from the metal sheath of the T/C assembly is recommended by ANAFAZE for use as the type of T/C to be use with the 12LS.

When updating an existing temperature control system with the ANAFAZE 12LS, it is highly recommended that all grounded T/C in use with the old system be changed to ungrounded types of T/C.

### 3.3.9 RTD INPUTS

RTD's should have external signal conditioning with an isolated 4-20ma output or the equivalent for connection to the 12LS. Please consult ANAFAZE for additional information.

### 3.3.10 INFRARED NON-CONTACT TEMPERATURE SENSORS

The ANAFAZE IRSM (infrared sensing module) is ideally suited for many infrared non-contact temperature applications. It can be supplied by ANAFAZE as a fully integrated system with the 12LS configured to provide power for up to four IRSM modules and for direct connection of the IRSM output. The following connections are required if the IRSM internal ambient sensor is not used:

12LS TB1 TERMINALS	IRSM Wires		
	Pin Nr.	Color	Function
CH # +IN	A	Orange	Signal Out (0-10 mAdc)
-IN COM	B	White	Signal Ground
-IN COM	K		Shield
+5VDC	E	Red	+5 VDC Supply
CTRL COM	C	Black	Power Ground
CTRL COM	J	Brown	No Peak Hold
N/C	D	Green	+15 VDC Supply
N/C	F	Blue	Ambient Sensor
N/C	H	Yellow	Track and Hold

The range of the standard ANAFAZE IRSM is 0-1000<sup>o</sup> F with an output of 0-10mAdc. The input of the ANAFAZE 12LS must be configured for a 0-10mAdc input. See section 3.3.7

To use more than four IRSM's with the 12LS, use an external power supply of 8-15vdc.

If desired, a second input may be used to monitor the internal IRSM ambient temperature. Consult ANAFAZE for more information.

### 3.3.11 SCALING AND CALIBRATION

The ANAFAZE 12LS includes a scaling provision to convert analog inputs into engineering units. Section 4.5.2.3 describes how to set the automatic scaling.

### 3.3.12 DIAGRAMS OF TYPICAL INPUTS

CH # +IN	O---	White	-----	Type J T/C
-IN COM	O---	Red	-----	UNGROUND
Earth GND	O--	T/C Wire Shield	if used-----	
CH # +IN	O---	Yellow	-----	Type K T/C
-IN COM	O---	Red	-----	UNGROUND
Earth GND	O--	T/C Wire Shield	if used-----	
CH # +IN	O-----			4-20mAdc/
-IN COM	O-----			Voltage
Earth GND	O--	Shielded wiring	recommended-----	

### 3.4 CONTROL OUTPUTS

```
+-----+
|                                     |
|           WARNING! -- GROUND LOOP POTENTIAL           |
|-----|
| The ground of every control output is connected to    |
| the ANAFAZE 12LS logic ground. Use caution when      |
| connecting external devices that may have their low  |
| side at voltage other than controller ground, since  |
| potential ground loops can be created. Use isolated  |
| relays or the isolated control device inputs if     |
| possible grounding problems are expected.            |
|-----|
+-----+
```

The ANAFAZE 12LS includes two sets of control outputs for each loop. These are provided on the 50 pin ribbon cable connector and are set for heat/cool whether or not they will be used for each application.

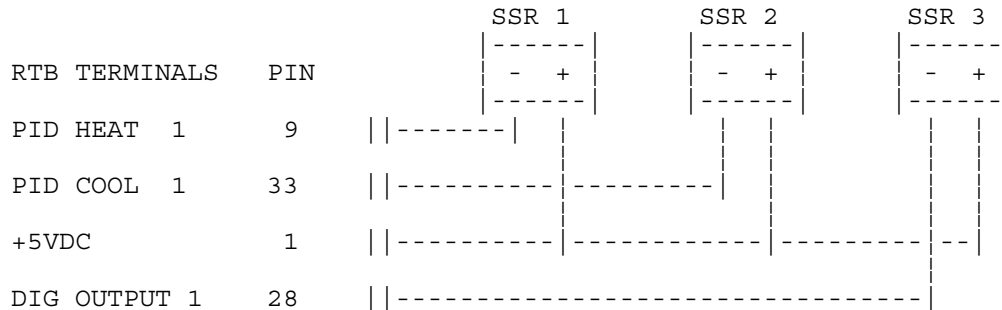
1. Each output may be individually programmed as a different type (on/off, CTP, or DZC).
2. Each output can be individually programmed to be direct or reverse acting [both outputs can be the same].
3. There may be a deadband programmed for heat/cool, and within that deadband both outputs will be off.

### 3.4.1 PID CONTROL AND ALARM OUTPUTS CONNECTIONS

Typical digital control outputs utilize external optically- isolated solid-state relays. These relays use a 3 to 32vdc input for control and can be sized to switch up to 100 amps at 480vac. For larger currents these relays can be used to drive contactors.

-----  
**NOTE: Control outputs are SINK OUTPUTS. They will be low when the output is ON. They should be connected to the minus (-) side of SSRs.**  
 -----

#### Example of Heat/Cool And Alarm Outputs Connections:



### 3.4.2 PID OUTPUT LIMITING

The output from each loop's dual heat/cool output may be limited to a value less than 100%. This level may not be exceeded by the PID control action. This limit on the control output may be limited by a period of time and then returned to full 100% output or it may be a continuous limit until changed by the programming keys.

The limit time delay is restarted whenever:

- a) A new time period is entered.
- b) A loop is switched from MANUAL to AUTO mode.
- c) The controller is restarted (powered up).

The time period is adjustable from 1 to 999 seconds for a maximum period of time of over 16 minutes. A time of 0 seconds will be displayed as C, the same as for Continuous.

The Output Limiting is disabled by setting the value to 100%. The control mode of ON/OFF has no output limiting available.

The output limiting may be used for "Soft Start" type of requirements of different processes. May also be used to restrict the energy into a process, thus tailoring the controller output to the process requirements.

### 3.5 COMPUTER SERIAL COMMUNICATIONS

The ANAFAZE 12LS offers two types of serial communications: RS-232 and RS-485. The RS-232 is used primarily for local communications of up to the recommended RS-232 distance of 50 feet. It can only be used with one ANAFAZE 12LS. More than one unit requires RS-485

The RS-485 is a voltage balanced, 4-wire, long distance, multi-point transmission interface. Up to 32 addresses can be set in the 12LS for one communication line.

Units must be ordered for the RS-485 communications, otherwise the factory standard of RS-232 will be supplied with the ANAFAZE 12LS.

#### 3.5.1 RS-232 CONNECTIONS

The optically-isolated RS-232 interface is connected using the Communications terminal block 1. See **Table 3-3** for connections.

Computer Connector		12 LS TB 1 Pin Nr.
DB 25	DB 9	
RX Pin 3	RX Pin 2	TX Pin 26
TX Pin 2	TX Pin 3	RX Pin 25
GND Pin 7	GND Pin 5	GND Pin 23

The computer pins are for the normal 25 pin RS-232 connector [DB25] and the normal 9 pin connector [DB9]. On some computers transmit TX and receive RX may be reversed. Please check your computer manual for details.

#### 3.5.2 OTHER RS-232 LINES

Some host computers or other RS-232 devices use additional communication lines that are not required by the 12LS. These include:

RTS - Ready to Send      DSR - Data Set Ready  
CTS - Clear To Send      DTR - Data Terminal Ready

If the host computer uses RTS and CTS or DSR and DTR, these lines should be connected together in pairs [or as shown in the computer manual]. Normally this is done in the RS-232 connector hood at the host computer. Alternately, the effect of these lines can be eliminated in software. The ANAFAZE 12LS is ready to receive data; therefore these lines are not required.

### 3.5.3 RS-485 DESCRIPTION

The EIA Standard RS-485 specifies only the electrical characteristics of generators (transmitters) and receivers for use in digital multi-point systems. The specification of transmission lines, signaling rates, protocols, etc. is left entirely up to the user. The transmitters and receivers selected by ANAFAZE also meet the requirements of RS-422.

The following information is intended to make recommendations for the application of the RS-485 interface to ANAFAZE equipment.

The maximum signaling rate used by the ANAFAZE 12LS and associated equipment is 9600 baud. Since this is far below the maximum signaling rate covered by the specification, satisfactory performance may be expected without strict adherence to all of the design rules. ANAFAZE has presented conservative recommendations to insure reliable operation. If deviations are necessary, please contact ANAFAZE.

#### 3.5.3.1 CABLE RECOMMENDATIONS

ANAFAZE recommends twisted shielded pairs for the RS-485 cables. The transmitters and receivers specified in RS-485 are very tolerant of cable characteristics, and some leeway is possible unless distances and signaling rates push the specification limits.

One requirement is very important, as it impacts performance even down to low frequency operation. The loop resistance of the transmission line [wire only -- not terminating resistor] must not exceed 200  $\Omega$  for a properly terminated line with a reasonable margin for noise. Thus the following recommendations for distance and wire gauge should be observed:

Distance	Wire Gauge	Recommended Cable
4000 ft.	24 AWG	Belden 9729/9842
6000 ft.	22 AWG	Belden 9184

See 3.1.3 para. 7 and 3.1.4 for further recommendations.

The use of a shield depends on the noise environment and grounding considerations. The above cables are shielded.

### 3.5.3.2 RS-485 CONNECTIONS

Connection of ANAFAZE controllers to a system computer requires an interface at the computer to convert RS-232 levels to RS-485. Anafaze recommends Black Box Model LD485A for this purpose. The LD485A should be configured for DCE operation, with the RTS/CTS delay jumper in the "on" position. ANAFAZE can supply this converter configured and checked out with the system on request.

Normal Operation LD485A installation setup:

1. DCE operation (Dip shunt in XW1A socket)
2. Normal operation (Front panel switch out)
3. Full Duplex operation (Jumper W8 on Full)
4. RTS/CTS Delay set to ON (Jumper W9 to ON)
5. Unterminated operation (Switch S2 to Unterm)
6. No jumper at position W7

The RS-485 specification is for "balanced line" operation, and is not true differential. Thus a common connection is required between all stations on the communication line. This can be accomplished by either a 5th wire (which could be shield) or a common ground connection.

The ANAFAZE system more conveniently supports the common ground connection, although 5th wire can be supported if required due to common mode voltages generated in a given installation. The 3rd wire connection would be required only if the "common mode" voltage between stations exceeds the RS-485 specification of 7 volts peak.

To make sure the communication system works, the controller chassis must be electrically tied to Earth ground, and the host computer communication must be tied to Earth ground. If the host computer RS-232 communication is not referenced to Earth ground, install the 100 \_ resistor in W7 as recommended by Black Box.

The following diagram shows the recommended system hookup. The transmitter from the host computer connects in parallel to the controller receivers, and the host computer receiver connects in parallel to the controller transmitters. A single "daisy chain" is recommended. Octopus connections or "spurs" are discouraged. A termination resistor is required at each end of the transmission line. This is accomplished by applying a 200 \_ resistor across the line at the farthest point from the computer transmitter. Check with ANAFAZE for setting the Black Box SW2 to the "term" position to terminate the computer receive line.



ANAFAZE 12LS connections for a single unit are as follows:

Black Box		12LS	
LD485A		TB 1	
TXA -----		RX+ #25 ---	
TXB -----		RX- #23 ---	
RXA -----		TX+ #26	
RXB -----		TX- #24	
Shield -----	Earth Ground -----	Shield	<b>Do not Ground</b>

**NOTE: Connect the shields to EARTH ground only at the computer or other 485 interface. No shield connection is required at the 12LS. Connect a 200 terminating resistor between RX- and RX+ at the 12LS**

For multiple units connect the system in parallel as follows:

Black Box	12LS	12LS	
LD485A	[1]	[n]	
TXA -----	RX+ #25 -----	RX+ #25 ---	
TXB -----	RX- #23 -----	RX- #23 ---	
RXA -----	TX+ #26 -----	TX+ #26	
RXB -----	TX- #24 -----	TX- #24	
Ground -----	0-----0-----	Do not Ground	

## 4.0 FRONT PANEL OPERATION AND DISPLAYS

The 12LS front panel provides the operator interface for the controller. The 12LS may be fully programmed and operated by using the eight keys on the front panel.

The 32 character display shows process information and setup displays. The 12LS will power up with the BAR GRAPH display being shown. Press the BACK key to get to the SINGLE LOOP display. Refer to section 4.2 for more detailed information on these and other system displays.

```
-----  
                          WARNING! - BATTERY CHECK  
-----  
On power-up the 12LS checks its memory for valid  
data. If an error is detected the message BATTERY  
DEAD is displayed and default values are assumed.  
Press ANY key to clear the message. Be sure to enter  
valid system data before continuing. Consult ANAFAZE  
about battery replacement.  
-----  
This message may also appear if the internal PROM  
has been changed or the unit has been disassembled.  
-----
```

### PROM CHANGE OR BATTERY DEAD:

It is recommended that upon changing the PROM, that the RAM memory be cleared.

To clear the battery backed RAM and to re-initialize the factory default values into the RAM, PRESS THE NO KEY while turning on the power to the 12LS. Never press the NO key upon power up unless it is necessary to clear the RAM memory as this will replace all customer entered values with the factory default values.

The RAMP SOAK key is used only if the optional RAMP/SOAK package is included in the controller. Information pertaining to programming and operation of ramp and soak profiles is included in Chapter 7 - RAMP AND SOAK OPTION.

The ANAFAZE 12LS displays operate in a sequence that is shown on the following flow chart, **Figure 4-1**. Main menu headings are shown in outlined boxes while the sub-menus under each main heading are listed below it.

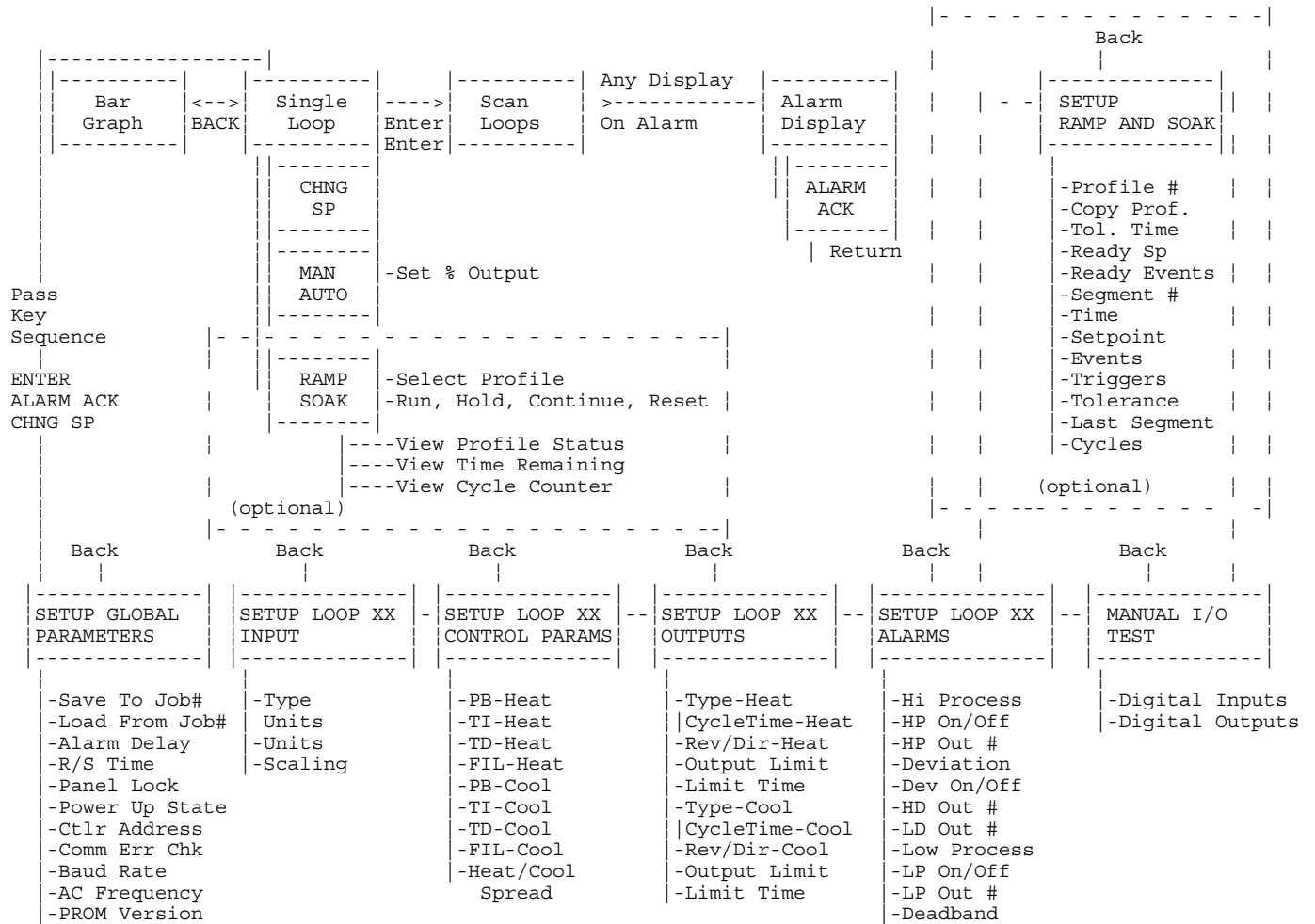


Figure 4-1. DISPLAY FLOWCHART

## 4.1 FRONT PANEL KEYS

The four main function keys on the front panel are used to perform specific operations :

-----    CHNG     SP      -----	o Adjust the setpoint on displayed loop.
-----     MAN     AUTO    -----	o Toggle loop status between MANUAL and AUTO. o Adjust output power level of loops in MANUAL mode.
-----    RAMP     SOAK    -----	o No function if OPTION not installed. o Assign a ramp/soak profile to selected loop. o Perform operations on profile already assigned.
-----    ALARM    ACK     -----	o Acknowledge an alarm condition, reset global alarm digital output.

A panel lock feature within the password-protected global menu can lock out these keys.

The four cursor keys are used to select menus, select data for editing, increment or decrement numerical data and step through choices within menus.

-----    /  \    /YES\<   -----	o Select a menu when prompt is blinking. o Answer YES to YES/NO prompts. o Increment a number or choice being edited.
-----    \ NO/    \  /    -----	o Skip a menu when prompt is blinking. o Answer NO to YES/NO prompts. o Decrement a number or choice being edited.
-----    BACK    -----	o Abort editing. o Return to previous menu.
-----    ENTER   -----	o Store data or menu choice after editing. o Proceed to the next menu.

Changes such as input types, tuning, and control output types are made from DETAILED MENUS after a pass key sequence is pressed.

## 4.2 DISPLAYS

On power-up the controller defaults to the BAR GRAPH display which shows the status of all 12 loops.

From there the user may switch to the SINGLE LOOP display which provides more detailed information about any selected channel. The channel displayed in the SINGLE LOOP display may be changed by using the UP and DOWN ARROW keys.

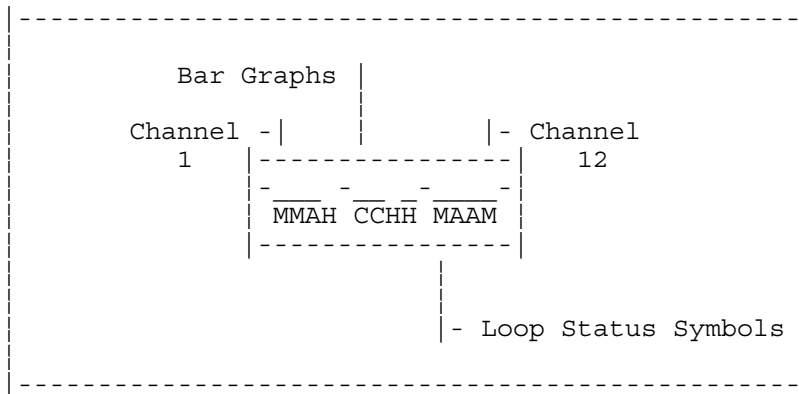
A SCANNING display is also available which automatically increments the channel to be displayed in the SINGLE LOOP fashion continually looping through all active channels of the 12 available, showing each for a short period of time.

If an alarm occurs the ALARM display is shown.

### 4.2.1 BAR GRAPH DISPLAY

This is the default display on power up.

The upper display shows the BAR GRAPH for each loop. The highest and lowest level of the BAR GRAPH display are the upper and lower deviation alarms. If deviation alarms are OFF the display range is  $\pm 5\%$  of setpoint. The intermediate levels are linearly spaced between the upper and lower limits.



**Figure 4-2. BAR GRAPH DISPLAY**

Refer to **Table 4-2** for descriptions of loop status symbols used.

If an acknowledged alarm exists, the BAR GRAPH is replaced by an alarm symbol. Refer to **TABLE 4-2** for a description of alarm symbols used.

## 4.2.2 SINGLE LOOP DISPLAY

The SINGLE LOOP Display shows the detailed information for one loop at a time. The UP/DOWN arrows select the loop number. Press the BACK key to return to the BAR GRAPH display.

FIGURE 4-3 identifies the data shown on the SINGLE LOOP Display.

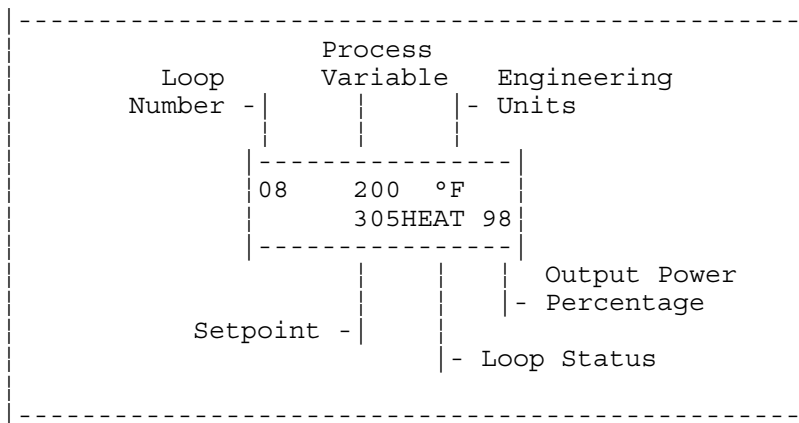


Figure 4-3. SINGLE LOOP DISPLAY

The SINGLE LOOP display shows:

LOOP NUMBER	01 to 12
PROCESS VARIABLE	-999 to 9999 A decimal point may be used where possible if selected by the user.
ENGINEERING UNITS	Up to three alpha characters.
SETPOINT	Same format as process variable.
LOOP STATUS	Refer to <b>TABLE 4-1</b> for definitions of the various loop status displays.
PERCENT OUTPUT	Heat or cool output power percentage, 0 to 100%.

**Table 4-1. LOOP STATUS DEFINITIONS**

Loop Status Symbol		Description
Bar Graph Display	Single Loop Display	
A	AUTO	Single output loop is in automatic control mode. The output power percentage displayed is for the heat output.
H T	HEAT	Dual output loop is in automatic control and the heat output is active. The output power percentage displayed is for the heat output.
C L	COOL	Dual output loop is in automatic control and the cool output is active. The output power percentage displayed is for the cool output.
M	MAN	Loop is in manual control mode. Output power percentage displayed is for the heat output.

### **4.2.3 SCANNING DISPLAY**

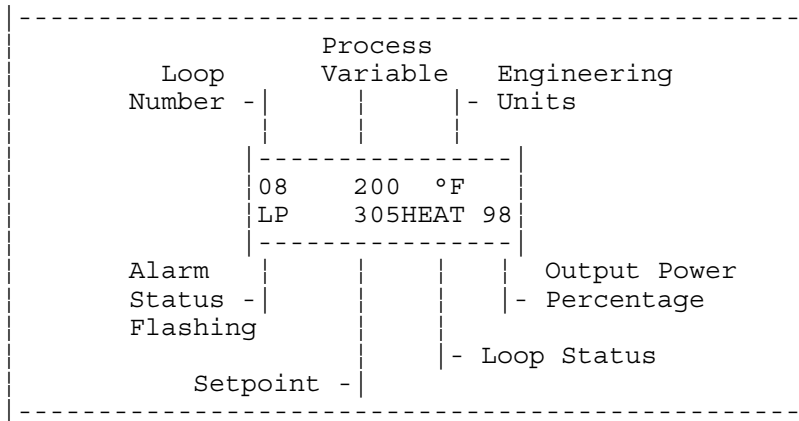
Press the ENTER key twice from the SINGLE LOOP display to enter the SCANNING display.

In this mode the controller will automatically step through the channels, showing the SINGLE LOOP display for each for about a second before advancing.

Press any of the cursor keys (YES, NO, BACK or ENTER) to return to the SINGLE LOOP display.

## 4.2.4 ALARM DISPLAY

The ALARM display interrupts any system display. If more than one alarm is present the first alarm is shown.



**Figure 4-4. ALARM DISPLAY**

The ALARM display is the same as the SINGLE LOOP display except the alarm status is flashing. Refer to **TABLE 4-2** for a list of the various alarm indicator symbols.

Table 4-2. ALARM SYMBOLS		
Alarm Condition	Symbol Displayed	
	Bar Graph Display	Single Loop Display
High Process	HP	>
High Deviation	HD	>
Low Deviation	LD	<
Low Process	LP	<
Tolerance Error (Ramp/Soak Only)	T	T

When the ALARM ACK key is pressed the flashing stops but the alarm indicator remains as long as the alarm condition exists. Pressing ALARM ACK acknowledges ALL alarms on the displayed loop.

If another alarm is present on another loop the display switches the ALARM display to that loop. In general multiple alarms are displayed from the lowest loop to the highest loop.

Multiple alarms on a SINGLE LOOP are acknowledged in the sequence they occurred.

When all alarms are acknowledged the global annunciator digital output is cleared.



## 4.3 GENERAL PROGRAMMING AND EDITING

In general, the 12LS menu structure consists of several main menus each having a group of sub-menus beneath them. The user selects a main heading and then steps through the sub-menus until the desired menu is reached.

Most menus will appear with a prompt denoting the parameter to be edited followed by a blinking question mark (?) and the current value or setting of the parameter.

At this point the operator can press YES to select the menu for editing or press NO to advance to the next logical menu.

When a menu is selected for programming the blinking question mark (?) changes to an equal sign (=). At that point the UP and DOWN keys are used to adjust the value or choices offered. When the adjustment or selection is complete, press ENTER to store the new data and the display changes to the next menu.

The following example illustrates the steps a user would take to program the input type on channel 5 as a type K thermocouple. The default input type is type J.

### EXAMPLE:

- o The INPUTTYPE menu is under the SETUP LOOP INPUT main menu. Press NO until the SETUP LOOP INPUT menu appears.

```
-----  
| SETUP LOOP 05 |  
| INPUT ?      |  
|-----|
```

- o Press YES to enter the SETUP LOOP INPUT group of sub-menus
- o Press NO until the INPUT TYPE menu appears.

```
-----  
| 05 INPUT     |  
| TYPE ? J T/C |  
|-----|
```

- o Press YES to select the menu for editing
- o Use the UP and DOWN keys to change the type until the desired input type is displayed
- o Press ENTER at this point to store the new input type and advance the display to the next menu

Pressing the BACK key before ENTER at any time returns to the previous main menu heading. If a main menu heading is currently displayed, pressing the BACK key returns the display to the SINGLE LOOP display. Pressing the BACK key from the SINGLE LOOP display or the BAR GRAPH display toggles the display between those two.

## 4.4 OPERATIONAL MENUS

All changes must start from the SINGLE LOOP display. The following changes can be made by pressing the associated front panel key:

----- CHNG SP -----	○ Adjust the setpoint on displayed loop.
MAN AUTO ----- -----	○ Change loop status from Manual to Auto or vice-versa.
RAMP SOAK -----	○ If option is installed, this key is used to change status of a Ramp/Soak profile.

-----  
NOTE: Unless otherwise specified, in all examples of menu displays in the following discussions about editing and programming, the question mark (?) would data or choice to be edited. When a menu is selected the x's would show the current data setting and the question mark (?) would become an equal sign (=)  
-----

### 4.4.1 CHANGE SETPOINT

To change the setpoint of the channel being displayed, press this key :

```
-----  
CHNG  
  SP  
-----
```

The display will appear as in the following display using loop 5 as an example. The 1234 represent the current setpoint value.

```
-----  
05 SETPOINT ?  
      1234  
-----
```

Press NO or BACK to return to SINGLE LOOP display.

Press YES to change the setpoint.

Press UP or DOWN keys to change the value and ENTER to store it.

## 4.4.2 SET LOOP TO MANUAL/AUTO

To toggle the current mode from MANUAL to AUTO or from AUTO to MANUAL, press this key :

```
-----  
|  MAN  |  
|  AUTO |  
|-----|
```

Depending on the current loop status the display will appear as in one of the two following examples. The 5 represents channel 5.

```
-----  
| 05 STATUS = MAN |  
|      SET ? AUTO |  
|-----|  
Loop in MANUAL mode.
```

```
-----  
| 05 STATUS = AUTO |  
|      SET ? MAN  |  
|-----|  
Loop in AUTO mode.
```

Press BACK to return to the SINGLE LOOP display or YES to select the menu.

If the loop is in MANUAL, pressing NO skips the mode changing menu and allows for manual setting of both loop control outputs.

If the loop is in AUTO, pressing NO returns to the SINGLE LOOP display.

If YES was pressed use the UP and DOWN keys to toggle the AUTO/MANUAL mode setting and ENTER to store it.

If the loop has been set to AUTO, the display returns to SINGLE LOOP display. If the loop was set into MANUAL mode, however, the display changes to allow setting of the MANUAL OUTPUT POWER.

## 4.4.3 ADJUSTING OUTPUT LEVELS MANUALLY

If a channel is in MANUAL mode both the HEAT and COOL outputs may be set manually. From the SINGLE LOOP display press the MAN AUTO key and then press NO to the SET?AUTO prompt. The display will change to the MANUAL OUTPUT display. The display appears as:

```
-----  
| 05 SET HEAT    |  
|  OUTPUT ?  43  |  
|-----|
```

Here we see loop 5's heat output is currently set to 43% power.

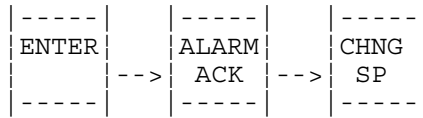
Press NO to advance to the cool output menu or YES to edit the heat output value.

Press BACK to return to the SINGLE LOOP display.

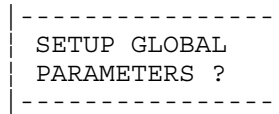
The cool output editing display is identical but with the word COOL substituted for HEAT.

## 4.5 SETUP MENUS

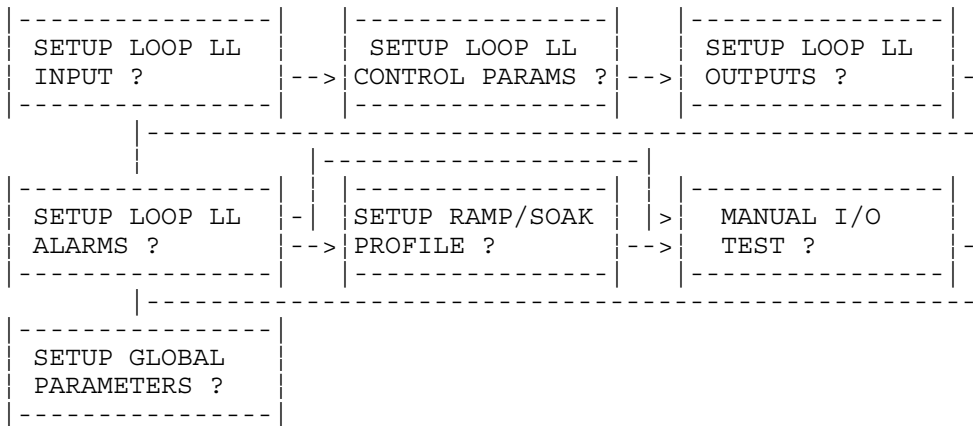
To change any other of the controller settings select the loop desired and from the SINGLE LOOP display enter the password key sequence by pressing these three keys in this order :



In this way, the operational menus can be made available to operators while supervisors and other approved personnel familiar with the password sequence can access the setup menus. The display will initially show:



Press NO to cycle through the detailed menu main headings as follows. After the six other menu headings the display will return to the GLOBAL PARAMETERS menu.



Press YES at any of these main menu headings to enter that menu and gain access to the associated sub-menus to change any parameters as outlined in the following sections. The main menu heading for setting up ramp and soak profiles will not appear unless the RAMP AND SOAK option is installed.

Each loop is set up from the front panel or through the serial interface with the desired operating parameters. The following loop setup diagram may be copied and used to list values prior to entry. This helps in keeping track of data as it is entered.

If an IBM PC or compatible computer is available, ANAFAZE software can be used for parameter entry and storage.

## LOOP SETUP DATA

Date _____			
Controller Number _____		Loop Number _____	
Setpoint _____	Manual/Auto _____	Manual Output 1, HT _____	
Spread _____		Manual Output 2, CL _____	
<b>Input Settings</b>			
Input Type _____	High PV _____	High RDG _____	
Units _____	Low PV _____	Low RDG _____	
<b>Heat Control Output</b>			
Proportional Band (PB) _____		Output Type _____	
Reset (TI) _____		Control Action REV/DIR	
Rate (TD) _____		Cycle Time _____	
Output Filter _____			
<b>Cool Control Output</b>			
Proportional Band (PB) _____		Output Type _____	
Reset (TI) _____		Control Action REV/DIR	
Rate (TD) _____		Cycle Time _____	
Output Filter _____			
<b>Alarm Settings</b>			
High Process Setpoint _____		ON/OFF	Output Nr _____
Deviation	Deviation Band _____	ON/OFF	
	Low Deviation Output Nr _____		
	Hi Deviation Output Nr _____		
Low Process Setpoint _____		ON/OFF	Output Nr _____
Deadband _____			

NOTE: Unless otherwise specified, in all examples of menu displays in the following discussions about editing and programming, the question mark (?) would be blinking and the multiple x's used represent the data or choice to be edited. When a menu is selected the x's would show the current data setting and the question mark (?) would become an equal sign (=)

## 4.5.1 SETUP GLOBAL PARAMETERS?

Answer YES at this prompt to access editing menus for global system parameters. This group of menus includes those that allow the user to :

- o Save memory to a job number
- o Restore a job number to memory
- o Set the alarm delay
- o Select the global time base
- o Lock out panel editing
- o Select output state on power-up
- o Set the controller communications address
- o Set the communications error checking method
- o Set the communications baud rate
- o Set the AC line frequency
- o Check the PROM version and date

### 4.5.1.1 STORING JOB SETUP

The current operating parameters may be stored in battery-backed memory by saving them to one of 8 job files. Information for all 12 channels is saved in each job file and includes :

- o Setpoints
- o Output percentage
  - both heatand cool output values
- o Channel status (auto, manual, etc.)
- o Alarminformation
  - status
  - setpoints
  - output assignments
- o Assigned ramp and soak profile if in ramp/soak mode

The menu appears as:

```
|-----|
|SAVE CURRENT|
|SETUP TO JOB ? x|
|-----|
```

When this menu is first displayed the job number will be the number of the last job file selected, or 1 by default.

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to select the job number.

Press ENTER to store current setup to the selected job file or press BACK to return to the SETUP GLOBAL PARAMETERS main menu heading.

#### 4.5.1.2 RESTORING A JOB SETUP

Any one of 8 saved jobs may be loaded for operation from memory. The parameters loaded into memory when a job is loaded are the same as those listed above under Storing Job Setup. All existing data will be overwritten. The display will appear as :

```
|-----|
|LOAD CURRENT|
|SETUP FM JOB ? x|
|-----|
```

When this menu is first displayed the job number will be the number of the last job selected, or 1 by default.

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to select the job number.

Press ENTER to load the current setup from the selected job file or press BACK to return to the SETUP GLOBAL PARAMETERS main menu heading.

#### 4.5.1.3 SETTING THE ALARM DELAY

This menu is used to set a startup delay for all system alarms. Alarm checking will be delayed for the number of minutes entered [0 to 60]. This is used to avoid nuisance alarms when starting up a system. The display will appear as :

```
|-----|
|ALARM DELAY|
|? xx MINUTE(S)|
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to adjust the number of minutes desired.

Press ENTER to store the new alarm delay setting or press BACK to return to the SETUP GLOBAL PARAMETERS main menu heading.

#### 4.5.1.4 SETTING THE GLOBAL TIME BASE

This menu allows setting of the global ramp and soak time base to units of hours and minutes or minutes and seconds. All time entries in ramp and soak profiles will assume the units of this setting. The default is hours and minutes.

NOTE: This prompt will appear only if the unit has the Ramp and Soak option installed.

The display will appear as :

```
-----  
RAMP/SOAK TIME  
BASE? xxxx/xxx  
-----
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to toggle selection between HOURS/MINS or MINS/SECS.

Press ENTER to store the new time base or press BACK to return to SETUP GLOBAL PARAMETERS main menu heading.

#### 4.5.1.5 KEYBOARD LOCK

This menu allows the front panel function keys

```
----- | ----- | -----  
CHNG   |   MAN   |   RAMP  |  
SP     |   AUTO  |   SOAK  |  
----- | ----- | -----
```

to be disabled (pressing these keys will not cause any action). The default setting is OFF so that these keys are activated. The display will appear as:

```
-----  
KEYBOARD LOCK  
STATUS ? xxx  
-----
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to toggle the selection between OFF and ON.

Press ENTER to store the new panel lock status or press BACK to return to the SETUP GLOBAL PARAMETERS main menu heading.



#### 4.5.1.6 POWER UP OUTPUT STATUS

This menu is used to configure the initial power-up state of the control outputs. The controller will either initialize the outputs to OFF or to the last output state as it was left stored in memory. If OFF is chosen all control outputs are initially set to MANUAL mode at 0% output level. If MEMORY is chosen the outputs are restored to their condition when power was removed.

```
-----  
WARNING! -- SET SAFE START-UP CONDITIONS  
-----  
Do NOT use MEMORY startup if there is any chance  
the process could start in an unsafe state.  
-----
```

The display will appear as:

```
-----  
POWER UP OUTPUT  
STATUS ? xxx  
-----
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to toggle the selection between OFF and MEMORY.

Press ENTER to store the new power up output status or press BACK to return to the SETUP GLOBAL PARAMETERS main menu prompt.

#### 4.5.1.7 CONTROLLER ADDRESS

This menu is used to set the 12LS controller address. This box address is used for communications and each 12LS in a system must have a different address. Begin with address 1 for the first controller and assign each subsequent controller the next higher address. The default address is, of course, 1. The display will appear as :

```
-----  
CONTROLLER  
ADDRESS ? xx  
-----
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to increment or decrement the address from 1 to 32.

Press ENTER to store the controller address or press BACK to return to the SETUP GLOBAL PARAMETERS main menu prompt.

#### 4.5.1.8 COMMUNICATION ERROR CHECKING METHOD

This menu is used to select the checksum algorithm used in the ANAFAZE communications protocol. Either BCC (block check character) or CRC (cyclic redundancy check) may be chosen.

```
-----  
NOTE: If using ANASOFT software to communicate to  
the controller make sure that the ANASOFT INSTALL  
program has been set for the same error checking  
method.  
-----
```

The display will appear as :

```
-----  
COMMUNICATIONS  
ERR CHECK ? xxx  
-----
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to toggle the selection between CRC and BCC.

Press ENTER to store the error checking method or press BACK to return to the SETUP GLOBAL PARAMETERS main menu prompt.

#### 4.5.1.9 COMMUNICATION BAUD RATE

This menu is used to set the communications baud rate. Either 2400 or 9600 baud may be chosen. The controller defaults to the higher rate of 9600.

```
-----  
NOTE: If using ANASOFT software to communicate to  
the controller make sure that the ANASOFT INSTALL  
program has been set for the same baud rate.  
-----
```

The display will appear as :

```
-----  
COMMUNICATIONS  
BAUD RATE ? xxxx  
-----
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to toggle the selection between 9600 and 2400.

Press ENTER to store the baud rate or press BACK to return to the SETUP GLOBAL PARAMETERS main menu prompt.

#### 4.5.1.10 AC LINE FREQUENCY

This menu is used to configure the controller to match the AC line frequency. Since the controller reduces the effect of normal mode noise by integrating the signal over the period of the AC line frequency, that accuracy will be reduced if this is not set correctly. The display will appear as:

```
-----  
| AC LINE FREQ. |  
| ? xx HERTZ   |  
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to toggle the selection between 50 and 60.

Press ENTER to store the AC Line Cycle or press BACK to return to the SETUP GLOBAL PARAMETERS main menu prompt.

#### 4.5.1.11 PROM VERSION

This view-only display shows the controller firmware PROM version and the date the version was released. The display appears as :

```
-----  
| PROM VERSION |  
| xx.xx mmdd 19yy |  
|-----|
```

xx.xx is the version number.

mmdd is the month and day code.

19yy is the release year.

Pressing any key will return to the SETUP GLOBAL PARAMETERS? main menu display.

## 4.5.2 SETUP LOOP INPUT

Press YES at this prompt to access menus to change parameters related to the channel input including :

- o Input type [thermocouple or other]
- o Engineering units to be displayed
- o Scaling

### 4.5.2.1 EDIT INPUT TYPE

This menu allows configuration of the input sensor as either a thermocouple or a LINEAR input. Thermocouple types include J, K, T, S, R and B. Also available is a type called SKIP for unused channels. It is not necessary to program unused channels as SKIP types but the SCANNING display will skip that channel when cycling through the channels. This allows the SCANNING and BAR GRAPH displays to show only those channels that are in use. The display appears as :

```
-----  
| LL INPUT |  
| TYPE ? xx |  
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to cycle through the available input type choices.

Press ENTER to store the input type or press BACK to return to the SETUP LOOP INPUT main menu prompt.

### 4.5.2.2 EDIT ENGINEERING UNITS

This menu allows a three character description of the engineering units to be entered. Thermocouples can only be °F or °C. For linear inputs the user may choose any available character (see **Table 4-3**) for each of the character positions. For example, GPM or PH. Blank spaces appear with a dot (.) for editing purposes only - just to let the user know which character he is editing. Character editing proceeds left to right one character at a time.

TABLE 4-3. CHARACTER SET FOR UNITS	
Thermocouples	°F or °C
Linear	0 through 9 A through Z %, /, °, SPACE

The display appears as :

```
-----  
LL INPUT  
  UNITS ?  xxx  
-----
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to cycle through the available character choices.

Press ENTER to store the character being edited. If the third character has just been entered the display will advance to the next menu. Otherwise, the display will move to the next character for editing and the steps are repeated.

Press BACK before ENTER to return to the SETUP LOOP INPUT main menu prompt.

#### 4.5.2.3 EDIT LINEAR SCALING

For all inputs automatic scaling is provided. To set the scaling enter a high process variable in engineering units and a corresponding high reading. Then enter a low process variable in engineering units and a corresponding reading. Using points as near as possible to zero and full scale is best. After these entries the process variable, the setpoint and alarms will all be in engineering units.

Table 4-4 shows the default values for process variable and process reading points for all input types.

TABLE 4-4. DEFAULT SCALING				
Input Type	High PV	High RDG	Low PV	Low RDG
LINEAR	1000	1000	0	0
J T/C	1400	1400	-350	-350
K T/C	2500	2500	-450	-450
T T/C	750	750	-450	-450
S T/C	3200	3200	0	0
R T/C	3210	3210	0	0
B T/C	3200	3200	150	150

The display for the high process variable will appear as :

```
-----  
| LL INPUT SCALING |  
| HIGH PV ?  xxxx  |  
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to set the high process variable.

Press ENTER to store the high process variable or BACK to return to the SETUP LOOP INPUT main menu prompt.

Enter the corresponding actual high input reading :

```
-----  
| LL INPUT SCALING |  
| HIGH RDG ?  xxxx  |  
|-----|
```

The high input reading is referenced to 60 mV and is calculated using this equation: (see section 3.3.6)

$$\text{HIGH RDG} = (1000) * \frac{(\text{Sensor Output @ High PV})}{(60\text{mV})}$$

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to set the high reading.

Press ENTER to store the value or BACK to return to the SETUP LOOP INPUT main menu prompt.

Enter the low process variable:

```
-----  
| LL INPUT SCALING |  
| LOW PV ?   xxxx  |  
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to set the low process variable.

Press ENTER to store the new value or press BACK to return to the SETUP LOOP INPUT main menu prompt.

Enter the corresponding actual low input reading:

```
-----  
| LL INPUT SCALING |  
| LOW RDG ?   xxxx  |  
|-----|
```

The low input reading is referenced to 60mV and is calculated using this equation: (see section 3.3.6)

$$\text{LOW RDG} = (1000) * \frac{(\text{Sensor Output @ Low PV})}{(60\text{mV})}$$

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to set the low reading.

Press ENTER to store the value or BACK to return to the SETUP LOOP INPUT main menu prompt.

Linear Input Scaling Example:

PROBLEM: We want to connect a pressure sensor to enable us to read pressure directly in PSI. The sensor has an output of 4-20mA over a range of 100-400PSI. The 4-20mA is converted to 12-60mV (see section 3.3.6 and 3.3.7)d. How do we set the input scaling?

SOLUTION: 1. Set the HIGH PV to 400 and enter the units as P, S, and I.

2. Calculate the HIGH RDG and enter it:

$$\begin{aligned} \text{HIGH RDG} &= 1000 * \frac{(60\text{mV}) \quad \text{<--Sensor output @ High PV}}{(60\text{mV}) \quad \text{<--Full scale 8LS input}} \\ &= 1000 \end{aligned}$$

3. Set the LOW PV to 100 and enter the units as P, S, and I.

4. Calculate the LOW RDG and enter it:

$$\begin{aligned} \text{LOW RDG} &= 1000 * \frac{(12\text{mV}) \quad \text{<--Sensor output @ Low PV}}{(60\text{mV}) \quad \text{<--Full scale 8LS input}} \\ &= 200 \end{aligned}$$

#### 4.5.2.4 SOFTWARE CALIBRATION OF INPUTS

The scaling function may be used to calibrate for the inaccuracies of the input signal at a given point. For example, the type J T/C may be up to 4° F high or low from true temperature, when the temperature is below 400° F. When adjusting to correct for linear offset in the input calibration, use only the PV scaling function. Using both the PV and RDG function will not shift the calibration. Adjusting the RDG should never be done as this will effect the overall T/C range.

When the PV readout is reading below the true known PV level, add that amount to the High and Low PV scaling. When the PV readout is reading above the true known PV level, subtract that amount from the High and Low PV scaling.

Example: A J T/C is reading 396 when true temperature is 400.

Set the High PV to 1404 and the Low PV to -346.

Example: A J T/C is reading 302 when true temperature is 300.

Set the High PV to 1398 and the Low PV to -352.

**CAUTION! ADJUSTING THE SCALING VALUES WILL EFFECT THE CALIBRATION OF THE INPUT RANGE. DO NOT ADJUST THE RDG VALUES OF THE T/C RANGES. INCORRECT SCALING VALUES WILL GIVE ERRORS IN READING OF THE PROCESS VARIABLE.**

### 4.5.3 SETUP LOOP CONTROL PARAMETERS

Press YES at this prompt to access menus to change control parameters for both the heat and cool outputs of the selected loop, including :

- o Proportional Band
- o Integral
- o Rate
- o Output Filter
- o Spread between heat and cool outputs

The top line of all displays will appear as one of those shown below, depending on whether the heat or cool control output is being programmed. In all cases the LL represents the loop number displayed in the upper left hand corner.

LL HEAT CONTROL	LL COOL CONTROL
-----------------	-----------------

The heat output parameters are programmed first, then the same parameters for the cool output.

NOTE: If the COOL output PB is set to OFF the loop becomes a single output channel and no longer will function as a heat/cool loop. Further programming of COOL output parameters is skipped and the display returns to the SETUP LOOP CONTROL PARAMS ? prompt.



#### 4.5.3.1 PROPORTIONAL BAND

The first selection for each output allows programming of the proportional band. The display bottom line appears as :

```
-----  
PB ?   xxxx  
-----
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to set the proportional band in engineering units.

Press ENTER to store the value or BACK to return to the SETUP LOOP CONTROL PARAMS main menu prompt.

#### 4.5.3.2 INTEGRAL CONSTANT

This menu allows programming of the integral constant. The bottom line of the display will appear as :

```
-----  
TI ?   xxxx  
-----
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to set the integral constant (or reset) between 0 (OFF) and 1024 seconds.

Press ENTER to store the value or BACK to return to the SETUP LOOP CONTROL PARAMS main menu prompt.

#### 4.5.3.3 DERIVATIVE CONSTANT

This menu allows programming of the derivative constant. The bottom line of the display will appear as :

```
-----  
TD ?   xxx  
-----
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to set the derivative constant between 0 (OFF) and 255 seconds.

Press ENTER to store the value or BACK to return to the SETUP LOOP CONTROL PARAMS main menu prompt.

#### 4.5.3.4 OUTPUT FILTER

This menu allows programming of the output filter. The output filter causes the controller to average multiple output calculations for smoother response. The bottom line of the display will appear as :

```
-----  
| FILTER ? xx |  
-----
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to set the number of readings to average.

Press ENTER to store the value or BACK to return to the SETUP LOOP CONTROL PARAMS main menu prompt.

#### 4.5.3.5 SPREAD

The final control menu allows programming of the spread between the heat and cool output. The display will appear as follows :

```
-----  
| LL HEAT / COOL |  
| SPREAD ? xx   |  
-----
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to set the spread value from 0 to 255 in engineering units.

Press ENTER to store the value or BACK to return to the SETUP LOOP CONTROL PARAMS main menu prompt.

#### 4.5.4 SETUP LOOP OUTPUTS

Press YES at this prompt to edit loop output parameters including:

- o Output type
- o Cycle time
- o Control action
- o Output level limit
- o Output limit duration

The top line of all displays will appear as one of those shown below, depending on whether the heat or cool control output is being programmed. In all cases the LL represents the loop number.

```
-----  
| LL HEAT CONTROL | | LL COOL CONTROL |  
-----
```

The heat output parameters are programmed first, then the same parameters for the cool output.

NOTE: If the channel is operating as a single output loop (ref. 4.5.3) all prompts for the COOL output data are suppressed. When the last HEAT output variable is programmed (OUTPUT LIMIT TIME) the display will return to the SETUP LOOP OUTPUTS? prompt.

#### 4.5.4.1 OUTPUT TYPE

The first menu for either heat or cool outputs is that which allows programming of the output type.

The bottom line of the display will appear as:

```

-----
TYPE ?  xxx
-----

```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to step through the output type choices.

Press ENTER to store the output type or BACK to return to the SETUP LOOP OUTPUTS main menu prompt.

Refer to **Table 4-5** for details of the output types available.

TABLE 4-5. OUTPUT TYPES		
Display Code	Output Type	Definition
TP	Time Proportioning	Percent output is converted to a percent duty cycle over the programmed cycle time. (Ref. section 5.1.10)
DZC	Distributed Zero Crossing	Output on/off state calculated for every AC line cycle. (Ref. section 5.1.11)
ON/OFF	On / Off	Output either full ON or full OFF. (Ref. section 5.1.3)

#### 4.5.4.2 CYCLE TIME

If Time Proportioning is selected as the output type the controller will prompt the user for a cycle time. The lower display will appear as :

```
|-----|
|CYCLE TIME ? xxx|
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to select desired cycle time(1 - 255 seconds).

Press ENTER to store the cycle time or BACK to return to the SETUP LOOP OUTPUTS main menu prompt.

```
|-----|
|NOTE: Cycle Time editing is offered only if the|
|output type was entered as Time Proportioning.|
|-----|
```

#### 4.5.4.3 CONTROL ACTION

The control output action is programmable as either DIRECT or REVERSE for both the heat and cool outputs. The default is REVERSE for heat outputs and DIRECT for cool outputs. The bottom line of the display will appear as:

```
|-----|
|ACTION ? xxxxxxxx|
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to toggle the choice between REVERSE and DIRECT.

Press ENTER to store the control action setting or BACK to return to the SETUP LOOP OUTPUTS main menu prompt.

#### 4.5.4.4 OUTPUT LIMIT

A limit may be placed on the output power percentage for the heat and cool outputs separately. This may be a constant limit or a temporary one subject to the output limit delay (ref. section 4.5.4.5). The lower line of the display will appear as:

```
|-----|
|LIMIT ?   xxx|
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to set the maximum output power percentage from 0 to 100%.

Press ENTER to store the output limit or BACK to return to the SETUP LOOP OUTPUTS main menu prompt.

Entering 100% as the limit effectively disables the limit function.

#### 4.5.4.5 OUTPUT LIMIT TIME

The length of time that a programmed output limit (ref. sec. 4.5.4.4) will be in effect is selectable from 1 to 999 seconds (1 second to over 16 minutes) or CONTINUOUS. The lower line of the display will appear as:

```
-----  
| LIMIT TIME ? xxx |  
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to adjust the limit time in seconds.

Press ENTER to store the output limit time and return to the SETUP LOOP OUTPUTS main menu prompt or press BACK to return to the main menu prompt without storing the data.

#### 4.5.5 SETUP ALARMS

This main menu heading provides access to sub-menus allowing programming of parameters related to the alarm functions for the selected loop. Press YES at this prompt to edit :

- o High process alarm
  - High process alarm ON/OFF
  - High process alarm output assignment
- o Deviation band alarm
  - Deviation alarm ON/OFF
  - High deviation alarm output assignment
  - Low deviation alarm output assignment
- o Low process alarm
  - Low process alarm ON/OFF
  - Low process alarm output assignment
- o Alarm Deadband

```
-----  
| NOTE: For all output assignments to alarm functions  
| it must be remembered that all digital outputs are  
| "OR"ed together. More than one alarm function may  
| be assigned the same output number and that output  
| will be on if any alarm activates it.  
|-----|
```

#### 4.5.5.1 HIGH PROCESS ALARM SETPOINT

This menu is used to set the point within the scaled sensor range at which the high process alarm is activated. The display appears as :

```
-----  
| LL HI PROC ALARM |  
| SETPOINT ? xxxxx |  
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to adjust the high process alarm setpoint.

Press ENTER to store the setpoint or press BACK to return to the SETUP LOOP ALARMS main menu prompt.

#### 4.5.5.2 HIGH PROCESS ALARM STATUS

This menu is used to enable or disable the high process alarm. OFF disables the alarm function, ON enables it. The display appears as:

```
-----  
| LL HI PROC ALARM |  
| STATUS ? xxx |  
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to toggle the selection between OFF and ON.

Press ENTER to store the alarm status or press BACK to return to the SETUP LOOP ALARMS main menu prompt.

#### 4.5.5.3 HIGH PROCESS ALARM OUTPUT ASSIGNMENT

This menu is used to assign a digital output to be used by the high process alarm. Set to OFF to disable the output function or 1-9 for the desired digital output number. The display appears as:

```
-----  
| LL HI PROC ALARM |  
| OUTPUT NR ? xx |  
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to step through the available output numbers (1 through 9) or turn OFF the output function.

Press ENTER to store the output assignment or press BACK to return to the SETUP LOOP ALARMS main menu prompt.

#### 4.5.5.4 DEVIATION BAND ALARM

This menu is used to set the deadband alarm value. The deviation alarm is a plus and minus alarm that is always relative to the setpoint. If the setpoint changes the actual alarm points also change. A separate digital output may be assigned to the high deviation alarm and the low deviation alarm.

To edit the deviation alarm bandwidth the display will appear as:

```
-----  
| LL DEV. ALARM |  
| VALUE ?  xxx  |  
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to adjust the deviation alarm band value from 0 to 255.

Press ENTER to store the setting or press BACK to return to the SETUP LOOP ALARMS main menu prompt.

#### 4.5.5.5 DEVIATION ALARM STATUS

This menu is used to program the deviation alarm status to OFF or ON. Setting the status to OFF disables the alarm function and setting it to ON enables it. The display appears as:

```
-----  
| LL DEV. ALARM |  
| STATUS ?  xxx  |  
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to toggle the choice between OFF and ON.

Press ENTER to store the alarm status or press BACK to return to the SETUP LOOP ALARMS main menu prompt.

#### 4.5.5.6 HIGH DEVIATION ALARM OUTPUT ASSIGNMENT

This menu is used to assign a digital output to be activated in the event of a high deviation alarm. Any of the 9 available digital outputs may be used or the output function may be turned OFF. The display appears as:

```
-----  
| LL HI DEV. ALARM |  
| OUTPUT NR ?  xx  |  
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to step through the output assignment choices.

Press ENTER to store the output assignment or press BACK to return to the SETUP LOOP ALARMS main menu prompt.

#### 4.5.5.7 LOW DEVIATION ALARM OUTPUT ASSIGNMENT

This menu is used to assign a digital output to be activated in the event of a low deviation alarm. Any of the 9 available digital outputs may be used or the output function may be turned OFF. The display appears as:

```
|-----|
| LL LO DEV. ALARM |
| OUTPUT NR ?  xx  |
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to step through the available output assignment choices.

Press ENTER to store the output assignment or press BACK to return to the SETUP LOOP ALARMS main menu prompt.

#### 4.5.5.8 LOW PROCESS ALARM SETPOINT

This menu is used to set the point within the scaled sensor range at which the low process alarm is activated. The display appears as :

```
|-----|
| LL LO PROC ALARM |
| SETPOINT ?  xxxxx |
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to adjust the low process alarm setpoint.

Press ENTER to store the setpoint or press BACK to return to the SETUP LOOP ALARMS main menu prompt.

#### 4.5.5.9 LOW PROCESS ALARM STATUS

This menu is used to enable or disable the low process alarm check. OFF disables the alarm check, ON enables it. The display appears as:

```
|-----|
| LL LO PROC ALARM |
|   STATUS ?  xxx  |
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to toggle the selection between OFF and ON.



Press ENTER to store the status or press BACK to return to the SETUP LOOP ALARMS main menu prompt.

#### 4.5.5.10 LOW PROCESS ALARM OUTPUT ASSIGNMENT

This menu allows assignment of a digital output to be used by the low process alarm. Set to OFF to disable the output function or 1-9 for the desired digital output number. The display appears as:

```
-----  
| LL LO PROC ALARM |  
| OUTPUT NR ?  xx  |  
|-----|
```

Press YES to select the menu or NO to advance to the next menu.

Press UP and DOWN to step through the available output assignment choices.

Press ENTER to store the assignment or press BACK to return to the SETUP LOOP ALARMS main menu prompt.

#### 4.5.5.11 ALARM DEADBAND

This menu allows programming of a hysteresis for the alarm setting and clearing. Once the alarm is set the process variable must return to a point above or below the setpoint plus the deadband value (depending on whether it is a high or low alarm). The display will appear as follows :

```
-----  
| LL ALARM          |  
| DEADBAND ?  xx   |  
|-----|
```

Press YES to select the menu or NO to return to the SETUP LOOP ALARMS main menu heading.

Press UP and DOWN to adjust the alarm deadband value.

Press ENTER to store the deadband or press BACK to return to the SETUP LOOP ALARMS main menu prompt.

#### 4.5.6 MANUAL I/O TEST

Use this menu to access menus which allow the user to test the state of the eight digital inputs or the nine digital outputs.

#### 4.5.6.1 DIGITAL INPUT TESTING

This is a view-only display showing the logic state of the 8 digital inputs as 1's (High) or 0's (Low). The display appears as:

```
          |-----|
          | DIGITAL INPUTS |
          | xxxxxxxxxx |
          |-----|
Input 1  --|           |-- Input 8
```

Press any key to advance to the TEST OUTPUT SELECTION display.

#### 4.5.6.2 TEST OUTPUT SELECTION

This menu allows the user to select one of the 9 digital outputs for manual operation. The display appears as :

```
          |-----|
          | DIGITAL OUTPUTS |
          | TEST OUTPUT?  x |
          |-----|
```

Press YES to select the menu or NO to go on to the OUTPUT TEST display.

Press UP and DOWN to choose the output number for test.

Press ENTER to select the displayed output for test or press BACK to return to the SINGLE LOOP display.

#### 4.5.6.3 DIGITAL OUTPUT TEST

Use this display to manually toggle the state of a digital output between ON or OFF. The display will appear as :

```
          |-----|
          | DIGITAL OUTPUT |
          | NUMBER  yy?  xxx |
          |-----|
```

The lower line of the display shows the selected output number and the current output state, ON or OFF.

Press YES or NO to toggle the output state between OFF and ON.

Press the BACK key to return to the Test Output Selection menu.

## 4.6 RAMP AND SOAK OPTION

The ramp and soak option turns the 12LS into a powerful batch controller. Along with the power comes a certain amount of complexity. In general, the features that are not as likely to be used have been set to default to a non-intrusive condition. For example, if there is not a requirement for digital inputs as triggers, they will be ignored by the profile.

Some planning is required to set up a successful profile and the Profile Setup Guide should be copied and used in configuring ramp and soak profiles. All the loop parameters should be entered before starting on ramp and soak. If possible, test all loops for stability and control before beginning ramp and soak operation.

In the ANAFAZE 12LS the RAMP AND SOAK OPTION allows up to 12 profiles to be specified, each containing a maximum of 20 segments. The 12 profiles are assigned letters A through L and are independent of the loops.

Profiles are set up by their letter name and subsequently assigned to a loop. The same profile can be assigned to any number of loops.

```
-----  
NOTE : Care should be taken with digital inputs and  
outputs since these are specifically assigned to a  
profile. For example, if input 1 is used to start  
profile A, it will start that profile on all loops  
that use profile A.  
-----
```

A channel is put into ramp and soak mode by assigning it a profile letter from A to L. Likewise, a channel is returned to normal manual/auto status by assigning it NONE.

The profiles are edited from the password-protected RAMP & SOAK menu by profile letter. From this menu the user may create a profile from scratch or copy another profile for editing.

Event outputs may be specified as NONE or 1-9, corresponding to the 9 available digital outputs. The ready segment contains an event state (ON or OFF) for each of these 9 output pins. The default for each is OFF. All digital outputs function in an "OR" configuration and may be multiply defined in various profiles. If any profile segment has turned the output on it will be on. Only when all sources set the output off will it be turned off.

Triggers may be specified as NONE or 1 through 8, corresponding to one of 8 available digital inputs.

All times are entered in the same units: either hours and minutes or minutes and seconds. The time format is selected from the GLOBALS menu. All time variables are then understood to be in the same units, although there is no explicit display of such. For either time base, segment times from 000:01 to 999:59 may be entered. If using hours and minutes, this provides a range of 1 minute to over 41 days. Total profile time can stretch up to 2.28 years although profile time remaining can only be displayed up to 999 hours and 59 minutes.

#### 4.6.1 DESCRIPTION

A ramp / soak profile consists of several groups of parameters: those global to the profile as a unit, those defined as the "ready state" for the profile, and those specified for each segment of the profile.

The "ready state" is assigned as segment 0, although it is not an executable segment.

The remaining executable segments each comprise one time period within the profile in which either a change of setpoints occurs or a single setpoint is held.

PARAMETERS GLOBAL TO EACH PROFILE	
Tolerance Time	Maximum allowable time out of tolerance within any single segment. Timer reset at beginning of each new segment.
Last Segment	Specifies which segment is the final segment of the profile.
Cycles	Number of times a profile is to be repeated. Can be set from 1 to 99 or as continuous.
PARAMETERS SPECIFIC TO THE READY STATE	
Ready Setpoint	Setpoint to be loaded before a profile begins running, after a profile ends or when a profile is aborted.
Ready Event States	The outputs to be activated prior to beginning execution of the first segment of a profile. The default is all outputs off.

PARAMETERS SPECIFIC TO EACH SEGMENT	
Setpoint	Specifies setpoint to be reached at the end of the segment. If the setpoint from the previous segment is the same, this setpoint will be held during the segment (soak). If the setpoint is different the setpoint will make a linear change between the two setpoints over the time of the segment (ramp).
Time	Segment duration time. Time units are selected from the GLOBALS menu.
Triggers	Two logic inputs sensed during profile segment execution. There are 2 types, latched and unlatched. The state may be ON or OFF. Default value is OFF
Event States	The outputs of up to four events to be set to the selected ON or OFF state at the end of the segment. The default is for all events to be OFF.

**Triggers:** Triggers are logic inputs sensed during profile execution. There are two types, latched and unlatched. Latched triggers must be TRUE for a segment to begin execution. Once sensed, these triggers are never tested again. Unlatched triggers, however, are tested throughout the execution of a segment. If an unlatched trigger goes FALSE while a segment is executing, the control loop will go into WAIT mode with the segment timer stopped.

Each segment may have up to two triggers specified. Either one being TRUE, whether latched or unlatched, is sufficient for a segment to begin executing.

**Events:** An event takes place at the end of a segment. Each segment may have up to four events assigned. These events can be assigned to a specific logic output. They can be active ON or OFF.

**Tolerance Hold ["Guaranteed Soak"]:** A tolerance can be assigned to each segment of each profile. This tolerance is a deviation from setpoint. If the process variable is beyond the tolerance limit from the (instantaneous) setpoint, then the segment will enter a tolerance hold until the process variable is within tolerance. There is no logic output available to indicate the tolerance hold condition, only a visual indication.

This function may be enabled or disabled per segment via the tolerance parameter. If tolerance is OFF no guarantee of setpoint is made and the tolerance time is disregarded. If tolerance is any value between -99 and 99, other than 0 (OFF), then the total integrated input error time (time that the process variable is out of tolerance) is not allowed to exceed the specified alarm time for the segment.

Disregarding triggers, a segment will run at least as long as the interval time but no longer than the total of the interval time and tolerance time. If the input is out of tolerance for a period greater than the entered tolerance time, the process is discontinued.

**Segment End:** A segment ends successfully when: the interval time period has been achieved, and the time out of tolerance is less than max tolerance time (if a tolerance is specified), and the associated trigger(s) for the next segment occur(s) (if any are specified).

### Profile States

On any channel assigned a ramp and soak profile, the profile will be in one of five states: START, RUN, HOLD, WAIT or TOLERANCE HOLD. Refer to TABLE 4-1 for an explanation of loop states.

### 4.6.2 RAMP/SOAK FRONT PANEL DISPLAY

Press this key.

```
|----|  
| RAMP |  
| SOAK |  
|----|
```

The RAMP/SOAK key provides access to nested displays pertaining to the ramp and soak profile assigned to the current channel.

Pressing the key from the SINGLE LOOP display enters the initial ramp and soak display. If a profile has been assigned to the loop this display will be the PROFILE TIME display. If no profile has yet been assigned this display will be the PROFILE SELECTION menu. After selecting a profile the display will proceed to the PROFILE TIME display.

Pressing RAMP/SOAK from the PROFILE TIME display enters the CYCLE COUNT display.

Pressing RAMP/SOAK from the CYCLE COUNT display will enter the PROFILE OPERATION menu.

### 4.6.3 PROFILE STATUS DISPLAY

Whether in the TIME display, the CYCLE COUNT display or the PROFILE OPERATION menu, the upper line of the display will always show the current PROFILE STATUS. An example of this STATUS display line follows:

```

          Profile Assigned | Current Segment executing
                          | and total profile segments
Loop Number | | | First letter of current
            |-----| loop status
            |05 A SEG01/07 R|
            |-----|
    
```

Refer to TABLE 4-1 for description of the loop status symbols.

Table 4.1 Loop Status Symbols	
Symbol	Description
S	Loop is ready to Start
R	Loop is Running
H	Loop is in Hold
W	Loop is waiting for a trigger input. Time is stopped.
T	Loop has exceeded tolerance limits and time is stopped.

### 4.6.4 PROFILE SELECTION MENU

If no profile is assigned to the loop, pressing the RAMP/SOAK key from the SINGLE LOOP display will change the display to the PROFILE SELECTION menu. An example of this display is:

```

|-----|
|05 ASSIGN R/S|
|PROFILE ? NONE|
|-----|
    
```

The 5 in the upper left corner represents the loop number.

Press NO or BACK to return to SINGLE LOOP display.

Press YES to select a profile for assignment to this loop. The "?" will change to "=".

Use the UP and DOWN keys to change the profile letter. Profile assignment may be 'A' to 'L' for one of the twelve ramp and soak profiles stored in memory, or NONE for no profile.

If, there is a profile assigned to the loop, the selection of a new profile requires stepping through the R/S display menu to get to the selection menu. Use the following steps:

Step #1 Press the R/S key.

The profile time display will be shown.

Step #2 Press the R/S key.

The profile cycle count display will be shown.

Step #3 Press the R/S key.

The profile operation will be shown.

Step #4 Press the NO key.

The profile reset display will be shown.

Step #5 Press the YES key.

Step #6 Press the ENTER key.

The profile Selection Menu will be shown.

Step #7 Press the YES key.

Step #8 Press the YES/UP or NO/DOWN keys to select A-H profiles or 0 for none.

Step #9 Press the ENTER key to enter the new profile selection or the BACK key to return to the single loop display without selecting a new profile.

-----  
| NOTE: Assigning PROFILE = NONE removes the loop |  
from ramp and soak operation.

Press ENTER to assign the chosen profile to this loop.

Press BACK to return to the SINGLE LOOP display without selecting a profile letter.

#### 4.6.5 PROFILE TIME DISPLAY

This display shows the profile status on the top line and the total time remaining in the profile on the bottom line. This is the total of the time remaining in the current segment and all the segments yet to be executed.

Time units are either hours:minutes or minutes:seconds. The time units are selected from the system GLOBALS menu.



An example display follows:

```
|-----|  
| 05 A SEG01/07 R |  
| TIME LEFT= 34:28 |  
|-----|
```

In this example loop 5 is running profile A. The loop is currently executing segment 1 of a total of 7 segments in the profile. The total time remaining in the profile is 34:28. This could be either 34 hours and 28 minutes or 34 minutes and 28 seconds.

#### 4.6.6 CYCLE COUNT DISPLAY

This display shows the profile status on the top line and the current cycle count on the bottom line. The cycle count is incremented automatically each time the profile is repeated. If (C)ontinuous cycling is selected only the current cycle number is displayed. If a specific number of cycles has been specified the current cycle number and the total number to complete will be displayed.

An example of the display when limited cycling has been selected is:

```
|-----|  
| 05 A SEG01/07 R |  
| CYCLE NR=   6/12 |  
|-----|
```

In this example loop 5 is executing profile A for the 6th time. The profile will be repeated 12 times.

An example of the display for (C)ontinuous cycling is :

```
|-----|  
| 05 A SEG01/07 R |  
| CYCLE NR=   123 |  
|-----|
```

In this example loop 5 is executing profile A for the 123rd time.

#### 4.6.7 PROFILE OPERATION MENU

This menu displays the profile status on the top line and allows for selecting certain modes of operation related to executing the ramp and soak profile on the bottom line.

The mode selections available depend on the current status of the loop. The following table describes the possible profile operations that could be performed.

TABLE 4-2 Ramp / Soak Operations		
Current Status	Available Mode	Operation Description
RUN	HOLD	Put loop into HOLD mode. All loop parameters are "frozen" at current settings.
HOLD	CONT	CONTINUE from a hold condition. Profile resumes execution at point where HOLD was selected.
START	RUN	Begin RUNNING profile that has been loaded on this channel.

In all cases the available choice is presented with the "?" blinking.

Press NO to skip the currently offered mode choice and advance to the PROFILE RESET menu.

Press BACK to return to the PROFILE TIME display.

Press YES to select the new mode. The "?" will change to "=".

Press ENTER to force the profile into the newly selected mode.

#### 4.6.8 RESET PROFILE

This menu allows a way of stopping and resetting a profile currently loaded and running on the loop indicated. It returns the display to the PROFILE SELECTION menu so that another profile may be assigned to the loop. In this way a channel can be removed from ramp and soak mode by resetting the current profile and making the PROFILE = NONE assignment.

An example of the RESET PROFILE display follows :

```

|-----|
| 05 A SEG01/07 R |
| SET MODE ? RESET |
|-----|

```

In this example profile A is running on channel 5.

Press BACK to return to the PROFILE TIME display.

Press NO to return to the SINGLE LOOP display.

Press YES to reset the profile assignment. The "?" will become "=". Press ENTER to return to the PROFILE SELECTION menu.

The 12LS R/S program also supports an external contact to reset the R/S program. This function is programmable in the R/S program(See Section 4.7.6 Edit External Reset). The external reset input is programmable to any of the eight digital inputs. Any program that is assigned to that input will be reset when the input is forced low by connecting it to the digital ground. The external reset is disabled when no input is assigned to it.

NOTE: When leaving ramp and soak mode the loop is placed in MANUAL mode and the output is set to 0.

### Example problems and solutions

**PROBLEM:** Length of a segment is unknown and depends solely on a trigger input for conclusion.

**SOLUTION:** Enter the smallest interval possible, define a trigger for the subsequent segment. The first condition for conclusion will be satisfied when the interval period elapses but the next segment will not commence until the trigger occurs.

**PROBLEM:** Separate profiles have different setpoints, triggers and events but the basic timing pattern is identical.

**SOLUTION:** Edit the common variables on one profile (perhaps on an unused profile), copy that profile into each individual ramp and soak profile as a basic template and edit specific details from there.

# PROFILE SETUP GUIDE

## PROFILE SETUP GUIDE

Ch Nr.  Profile 

A	B	C	D	E	F	G	H
---	---	---	---	---	---	---	---

 Date

Time Base 

E/M	M/S
-----	-----

 Max Out-of-Tolerance Time  :

Ready State Setpoint -----  
 Ready Event Output States

01	ON OFF	06	ON OFF	11	ON OFF	16	ON OFF	21	ON OFF	26	ON OFF
02	ON OFF	07	ON OFF	12	ON OFF	17	ON OFF	22	ON OFF	27	ON OFF
03	ON OFF	08	ON OFF	13	ON OFF	18	ON OFF	23	ON OFF	28	ON OFF
04	ON OFF	09	ON OFF	14	ON OFF	19	ON OFF	24	ON OFF	29	ON OFF
05	ON OFF	10	ON OFF	15	ON OFF	20	ON OFF	25	ON OFF	30	ON OFF

Segment Nr -----  
 Time -----:-----  
 Setpt -----  
 Trigger Inputs

1	ON OFF	LATCH
2	ON OFF	LATCH

Event Outputs

1	ON OFF
2	ON OFF
3	ON OFF
4	ON OFF

Tolerance -----

Segment Nr -----  
 Time -----:-----  
 Setpt -----  
 Trigger Inputs

1	ON OFF	LATCH
2	ON OFF	LATCH

Event Outputs

1	ON OFF
2	ON OFF
3	ON OFF
4	ON OFF

Tolerance -----

Segment Nr -----  
 Time -----:-----  
 Setpt -----  
 Trigger Inputs

1	ON OFF	LATCH
2	ON OFF	LATCH

Event Outputs

1	ON OFF
2	ON OFF
3	ON OFF
4	ON OFF

Tolerance -----

Segment Nr -----  
 Time -----:-----  
 Setpt -----  
 Trigger Inputs

1	ON OFF	LATCH
2	ON OFF	LATCH

Event Outputs

1	ON OFF
2	ON OFF
3	ON OFF
4	ON OFF

Tolerance -----

Segment Nr -----  
 Time -----:-----  
 Setpt -----  
 Trigger Inputs

1	ON OFF	LATCH
2	ON OFF	LATCH

Event Outputs

1	ON OFF
2	ON OFF
3	ON OFF
4	ON OFF

Tolerance -----

Segment Nr -----  
 Time -----:-----  
 Setpt -----  
 Trigger Inputs

1	ON OFF	LATCH
2	ON OFF	LATCH

Event Outputs

1	ON OFF
2	ON OFF
3	ON OFF
4	ON OFF

Tolerance -----

# PROFILE SETUP GUIDE

Segment Nr \_\_\_\_\_  
 Time \_\_\_\_\_ : \_\_\_\_\_  
 Setpt \_\_\_\_\_

**Trigger Inputs**

1 _____	ON	OFF	LATCH
2 _____	ON	OFF	LATCH

**Event Outputs**

1 _____	ON	OFF
2 _____	ON	OFF
3 _____	ON	OFF
4 _____	ON	OFF

Tolerance \_\_\_\_\_

Segment Nr \_\_\_\_\_  
 Time \_\_\_\_\_ : \_\_\_\_\_  
 Setpt \_\_\_\_\_

**Trigger Inputs**

1 _____	ON	OFF	LATCH
2 _____	ON	OFF	LATCH

**Event Outputs**

1 _____	ON	OFF
2 _____	ON	OFF
3 _____	ON	OFF
4 _____	ON	OFF

Tolerance \_\_\_\_\_

Segment Nr \_\_\_\_\_  
 Time \_\_\_\_\_ : \_\_\_\_\_  
 Setpt \_\_\_\_\_

**Trigger Inputs**

1 _____	ON	OFF	LATCH
2 _____	ON	OFF	LATCH

**Event Outputs**

1 _____	ON	OFF
2 _____	ON	OFF
3 _____	ON	OFF
4 _____	ON	OFF

Tolerance \_\_\_\_\_

Segment Nr \_\_\_\_\_  
 Time \_\_\_\_\_ : \_\_\_\_\_  
 Setpt \_\_\_\_\_

**Trigger Inputs**

1 _____	ON	OFF	LATCH
2 _____	ON	OFF	LATCH

**Event Outputs**

1 _____	ON	OFF
2 _____	ON	OFF
3 _____	ON	OFF
4 _____	ON	OFF

Tolerance \_\_\_\_\_

Segment Nr \_\_\_\_\_  
 Time \_\_\_\_\_ : \_\_\_\_\_  
 Setpt \_\_\_\_\_

**Trigger Inputs**

1 _____	ON	OFF	LATCH
2 _____	ON	OFF	LATCH

**Event Outputs**

1 _____	ON	OFF
2 _____	ON	OFF
3 _____	ON	OFF
4 _____	ON	OFF

Tolerance \_\_\_\_\_

Segment Nr \_\_\_\_\_  
 Time \_\_\_\_\_ : \_\_\_\_\_  
 Setpt \_\_\_\_\_

**Trigger Inputs**

1 _____	ON	OFF	LATCH
2 _____	ON	OFF	LATCH

**Event Outputs**

1 _____	ON	OFF
2 _____	ON	OFF
3 _____	ON	OFF
4 _____	ON	OFF

Tolerance \_\_\_\_\_

```

-----
NOTE: For RAMP AND SOAK option, if the loop is run-
ning a ramp and soak profile, forcing it into manual
removesthe loop from ramp and soak mode. The user
must reassign and restart the profile to return to
automatic ramp and soak operation.
-----

```

## 4.7 SETUP RAMP/SOAK PROFILE

Press YES at this prompt to setup or edit stored ramp and soak profile data including :

- profile number
- copy one profile to another
- maximum out-of-tolerance time
- ready state setpoint
- ready event (digital output) states
- segment number
- segment time
- segment setpoint
- segment events
- segment triggers
- segment tolerance
- last segment

```

-----
NOTE: When leaving ramp and soak mode the loop is
placed in MANUAL mode and the output is set to 0.
-----

```

**NOTE:** This prompt will appear only if the 12LS has the ramp and soak option installed.

### 4.7.1 SELECT A PROFILE FOR EDITING

This menu allows selection of one of twelve profiles [A-L] for editing. The default profile number displayed in the prompt is either the last profile edited or PROFILE A if none has been edited.

Display:

```

-----
EDIT RAMP & SOAK
PROFILE ?    x
-----

```

The ? flashes.

x is the profile designator [A-L].

YES Select a profile other than the default profile displayed.

Lower display **PROF = x**

UP/DOWN      Select a profile designator [A-L].

- ENTER            Open the selected profile for editing. The display advances to the Copy Profile Menu.
- BACK            Return to SETUP R/S PROFILE ? prompt.
- NO                Select the default profile for editing. The display advances to Copy Another Profile.
- BACK            Return to the SETUP R/S PROFILE ? prompt.

#### 4.7.2 COPY ANOTHER PROFILE

This menu allows copying of another profile into the profile currently selected. This shortcut method is useful when the majority of a profile is similar to one that already exists.

As a default choice the initial prompt offers to copy the profile immediately preceding the current profile (or L if editing profile A) but any of the other profiles may be selected.

```
Display:            |-----|
                   | COPY SETUP |
                   | FROM PROFILE ? |
                   |-----|
```

The ? flashes.  
x is the profile to be copied [A-L].

- YES                Select a profile to copy from.  
Lower display    **COPY = x**
- UP/DOWN           Select profile to copy.
- ENTER             Copy profile contents. Display advances to Edit Tolerance Alarm Time.
- BACK              Return to SETUP R/S PROFILE? prompt.
- NO                Skip profile copying menu. Display advances to Edit Tolerance Alarm Time.
- BACK              Return to SETUP R/S PROFILE? prompt.

#### 4.7.3 EDIT TOLERANCE ALARM TIME

With this menu the maximum out-of-tolerance time for any segment within the profile may be set. Units are either Hours:Minutes or Minutes:Seconds depending on the global time base selected. Values from 00:01 to 99:59 may be entered. The default is 1:00.



When any segment is out of tolerance for a period greater than the Tolerance Time entered, a tolerance alarm is generated. A tolerance alarm activates the global annunciator output and displays a 'T' in the alarm status position on the display.

Display: 

-----
x OUT-OF-TOLRNCE
ALARM TIME: ?hh:mm
-----

x is the profile designator [A-L].  
 The ? flashes.  
 hh:mm is the current out-of-tolerance time limit.

YES Edit the tolerance limit time.

Lower display **T =hh:mm**

UP/DOWN Adjust time.

ENTER Store the new setting. The display advances to Edit Ready Setpoint.

BACK Return to the SETUP R/S PROFILE? prompt.

NO Leave tolerance time value as it is. The display advances to Edit Ready Setpoint.

BACK Return to the SETUP R/S PROFILE? prompt.

#### 4.7.4 EDIT READY SETPOINT

This menu allows editing of the ready state setpoint. This is the setpoint that will be loaded whenever the profile is in the START (or ready) state.

A profile enters START mode whenever it is first assigned to a loop. It also returns to START mode after completing execution.

The ready setpoint provides a starting point at which segment 1 will begin.

Display: 

-----
x READY SEGMENT
SETPOINT ? YYYY
-----

The ? is flashing.  
 x is the profile designator [A-L].  
 yyyy is the current ready setpoint.

YES Change the ready state setpoint.  
 Lower display **SP =yyyy**

UP/DOWN Adjust setpoint.

- ENTER            Store new ready state setpoint. Display will advance to Edit Ready Event States.
- BACK            Return to SETUP R/S PROFILE? prompt.
- NO              Skip edit. Leave ready setpoint as it is. Display will advance to Edit Ready Event States.
- BACK            Return to the SETUP R/S PROFILE? prompt.

#### 4.7.5 EDIT READY EVENT STATES

This menu allows setting of default states for all possible 9 event outputs. These will be the output states whenever the loop is in the (S)TART state. The default for all outputs is OFF.

```
Display:  |-----|
          | x READY SEGMENT |
          | EDIT EVENTS ?  |
          |-----|
```

The ? is flashing.  
x is the profile designator [A-L].

- YES            Edit default output states.  
Lower display **DOxx?yyy**  
The ? is flashing.  
xx is an event output number [1-9].  
yyy is output state, OFF or ON.
- YES            Edit state of output selected.  
Lower display **DOxx=yyy**
- UP/DOWN        Toggles state to ON or OFF.
- ENTER          Sets selected output ready state to ON or OFF. Display advances to next output.
- BACK           Quit editing. Return to READY EVENTS? prompt.
- NO             Select next output.
- BACK           Quit editing. Return to READY EVENTS? prompt.
- NO             Skip ready event editing. Display advances to Edit Segment Number.

#### 4.7.6 EDIT EXTERNAL RESET

From this menu one of the eight digital inputs will be selected to provide an input for a external reset of this profile while in any of the R/S operational modes. A selection of 0 will disable this function. The same input may be assigned to more than one profile.

Display: 

----- x EXTERNAL RESET INPUT NUMBER? d -----
---

The ? is flashing.

x is the profile designator [A-L].

d is the assigned digital input number [1-8], 0 for no assignment-external reset disabled.

YES Change digital input number assigned to this profile.

Lower display **INPUT NUMBER= d**

UP/DOWN Select digital input number.

ENTER Assign digital input number for the external reset function.

BACK Return to Setup Ramp/Soak Profile?

#### 4.7.7 EDIT SEGMENT NUMBER

From this menu one of the twenty profile segments may be selected for editing. The default number will be either the last segment edited or SEGMENT 1 if none has been edited. When entering profile data sequentially the segment number will automatically increment to the next segment each time this menu is entered.

Display: 

----- x EDIT SEGMENT NUMBER ? yy -----
---

The ? flashes.

x is the profile designator [A-L].

yy is the default segment number [1-20].

YES Select a segment other than the default segment for editing.

Lower display **SEG = xx**

UP/DOWN Select segment number.

ENTER Open selected segment for editing. Display advances to Edit Segment Time.

BACK Return to SETUP R/S PROFILE? prompt.

- NO                    Select the default segment for editing. Display advances to Edit Segment Time.
- BACK                Return to the SETUP R/S PROFILE? prompt.

#### 4.7.8 EDIT SEGMENT TIME

Use this menu to edit the segment time. Units are either Hours:Minutes or Minutes:Seconds depending on the global time base selected.

Display:            

```

|-----|
| x SEGMENT yy   |
| SEG TIME ?hhh:mm|
|-----|
```

The ? flashes.  
x is the profile designator [A-L].  
yy is the segment number [1-20].  
hhh:mm is the current segment time [000:00 to 999:59]

YES                Change the current segment time.  
Lower display    **T= hh:mm**

- UP/DOWN           Adjusts time.
- ENTER             Stores new segment time. Display advances to Edit Segment Setpoint.
- BACK              Returns display to Edit Segment Number.
- NO                 Leave segment time as it is. Display advances to Edit Segment Setpoint.
- BACK              Returns display to Edit Segment Number.

#### 4.7.9 EDIT SEGMENT SETPOINT

This menu allows setting of the segment setpoint. This is the setpoint for the end of the segment. Entering a setpoint different from that of the previous segment will initiate a setpoint ramping action over the length of the segment. Entering a setpoint the same as that of the previous segment initiates a setpoint soaking action for the duration of the segment.

Display:            

```

|-----|
| x SEGMENT yy   |
| SEG SETPT ?zzzz|
|-----|
```

The ? flashes.  
x is the profile designator [A-L].  
yy is the segment number [1-20].  
zzzz is the setpoint for end of segment.

YES	Change current setpoint setting. Lower display <b>SP =xxxx</b>
UP/DOWN	Changes setpoint value.
ENTER	Stores new segment setpoint. Display advances to Edit Segment Events.
BACK	Returns to Edit Segment Number.
NO	Leave segment setpoint as it is. Display advances to Edit Segment Events.
BACK	Returns to Edit Segment Number.

#### 4.7.10 EDIT SEGMENT EVENTS

From this menu event outputs for the current segment may be defined. Each segment may have up to four event outputs defined. These outputs are activated when the segment reaches completion. Any number of the four events may be used and the default state for each is NO (no assignment). Each event has an associated output number (all 9 outputs are available for assignment) and an active state (ON or OFF).

```

Display:  |-----|
           | x SEGMENT yy |
           | EDIT SEG EVENTS? |
           |-----|

```

The ? flashes.  
x is the profile designator [A-L].  
yy is the segment number [1-20].

YES	To edit events for the current segment.
NO	Skip event editing. Display advances to Edit Segment Triggers.
BACK	Return to Edit Segment Number.

#### 4.7.11 EDIT EVENT OUTPUT NUMBER

```

Display:  |-----|
           | a SEGbb EVENTc |
           | OUTPUT NR ? dd |
           |-----|

```

The ? flashes.  
a is the profile designator [A-L].  
bb is the segment number [1-20].  
c is the event number [1-4].  
dd is the output number assigned to this event [1-9,  
NO for no assignment]

YES Change the output assigned to this event.  
 Lower display **DOUT= xx**

UP/DOWN Select output number. [1-30, NO].

ENTER Assign output number to this event.  
 Display advances to Edit Event State.

BACK Return to Edit Segment Events.

NO If an output is assigned to the current event the display advances to Edit Event State. If no output number is assigned the display advances to next event number. [1-4 and wraps around].

BACK Return to Edit Segment Events.

#### 4.7.12 EDIT EVENT OUTPUT STATE

Display: 

-----
a SEGbbEVc DOdd
ACTIVE STATE?eee
-----

The ? flashes.  
 a is the profile designator [A-L].  
 bb is the segment number [1-20].  
 c is the event number [1-4].  
 dd is the output number assigned to this event [1-9]  
 eee is the output active state [ON or OFF]

YES Change the active state of this event.  
 Lower display **DOxx=yyy**

UP/DOWN Select output state. [ON, OFF].

ENTER Assign active state to this event. Display returns to Edit Event Output Number for the next event number.

BACK Return to Edit Segment Events.

NO Leave current active state as it is. Display returns to Edit Event Output Number for the next event number. [1-4 and wraps around].

BACK Return to Edit Segment Events.

### 4.7.13 EDIT SEGMENT TRIGGERS

Use this menu to edit the trigger input assignments, their active states and their latching status for the current segment. Each segment may have two associated triggers. If a segment has any triggers defined at least one of them must be true before the segment will begin executing. Triggers may be latched or unlatched. The default assignment for all segment triggers is NO assignment.

Latched triggers are checked only once at the beginning of a segment. Once the segment begins executing these inputs are ignored.

Unlatched triggers are checked constantly while a segment is running. Should any unlatched trigger become FALSE the segment clock will stop and the loop will go into TRIGGER WAIT state. This allows a REMOTE HOLD capability using the assigned trigger input.

Each trigger has an associated input number. All eleven digital inputs are available for assignment. Each trigger also has a specified TRUE state, either ON or OFF.

```
Display:      |-----|
              | x SEGMENT yy |
              | EDIT SEG TRGGRS? |
              |-----|
```

The ? flashes.  
x is the profile designator [A-L].  
yy is the segment number [1-20].

YES Edit trigger assignments for this loop. Display advances to Edit Trigger Input Nr.

NO Skip editing of segment triggers. Display advances to Edit Segment Tolerance.

BACK Return to Edit Segment Triggers.

### 4.7.14 EDIT TRIGGER INPUT NUMBER

```
Display:      |-----|
              | a SEGbbTRIGc |
              | INPUT NR ?dd |
              |-----|
```

The ? flashes.  
a is the profile designator [A-L].  
bb is the segment number [1-20].  
c is the trigger number [1 or 2].  
dd is the assigned input number [1-8, NO for no assignment].

YES	Edit input number assigned to this trigger. Lower display <b>DIN = xx</b>
UP/DOWN	Select input number or delete assignment.
ENTER	Assign input number to current trigger. If a pin number is assigned the display advances to Edit Trigger Active State. If NO is entered, the display advances to the next trigger.
BACK	Return to Edit Segment Triggers.
NO	Leave input assignment for this trigger as it is. If the trigger is assigned the display advances to Edit Trigger Active State. Otherwise the display advances to edit the next trigger.
BACK	Return to Edit Segment Triggers.

#### 4.7.15 EDIT TRIGGER ACTIVE STATE

Display:           |-----|  
                  | a SEGbbTRcDIdd |  
                  | ACTIVE STATE?eee |  
                  |-----|

The ? flashes.  
a is the profile designator [A-L].  
bb is the segment number [1-20].  
c is the trigger number [1 or 2].  
dd is the assigned input number [1-8].  
eee is the True state for the input [ON/OFF]

YES	Change TRUE state of this trigger. Lower display <b>DIxx=yyy</b>
UP/DOWN	Select input state [ON/OFF].
ENTER	Assign TRUE state for this trigger. Display advances to Edit Trigger Latch Status.
BACK	Return to Edit Segment Triggers.
NO	Leave input state assignment for this trigger as it is. Display advances to Edit Trigger Latch Status.
BACK	Return to Edit Segment Triggers.



#### 4.7.16 EDIT TRIGGER LATCH STATUS

Display: 

-----
a SEG TR DI
TRIG? UNLATCH
-----

The ? flashes.

- |         |   |
|---------|---|
| YES     | Change latch state of this trigger.<br>Lower display <b>UNLATCH</b>   |
| UP/DOWN | Select unlatch or latch status.   |
| ENTER   | Assign latch status for this trigger. Display advances to Edit Trigger Input Number for the next trigger.               |
| BACK    | Return to Edit Segment Triggers.  |
| NO      | Leave latch state assignment for this trigger as it is. Display advances to Edit Trigger Input Number for next trigger. |
| BACK    | Return to Edit Segment Triggers.  |

#### 4.7.17 EDIT SEGMENT TOLERANCE

Use this menu to edit the tolerance value assigned to this segment. The tolerance is a value from -99 to 99, or OFF, that specifies a process variable limit for assured soak. If a positive value is entered the process variable is assured to be no higher than setpoint + the tolerance value. If a negative value is entered the process variable is assured to be no lower than setpoint - tolerance. If OFF is specified no tolerance checking is done.

Whenever a loop is out of tolerance the status display will show a 'T' and the segment clock will stop running. When the loop returns to within tolerance the segment clock will resume. If the cumulative time out of tolerance for the entire segment exceeds the maximum out-of-tolerance time specified for this profile, a tolerance alarm is generated.

Display: 

-----
x SEGMENTyy
SEG TOLRANCE?zz
-----

The ? flashes.

x is the profile designator [A-L].

yy is the segment number [1-20].

zz is the tolerance value for assured soak.

YES	Change current tolerance value. Lower display <b>TOL = xx</b>
UP/DOWN	Set value [ <u>+</u> 99]
ENTER	Store new tolerance value. Display advances to Specify the Last Segment.
BACK	Return to Edit Segment Number.
NO	Leave tolerance value as it is. Display advances to Specify the Last Segment.
BACK	Return to Edit Segment Number.

#### 4.7.18 SPECIFY THE LAST SEGMENT

This menu is used to designate the final segment in the current profile by answering YES or NO to the question LAST?. Answering YES terminates segment editing and all data in segments beyond the current segment will be ignored when the profile is executed. Answering NO begins editing of the next segment.

Only one segment can be the last segment and any assignments made in this menu supersede any previous assignment to another segment.

Display: 

-----
x SEGMENTyy
LAST SEGMENT?zzz
-----

The ? flashes.  
x is the profile designator [A-L].  
yy is the segment number [1-20].  
zzz is either YES or NO.

YES	Change current status of this segment. Lower display <b>LAST=xxx</b>
UP/DOWN	Toggle choice of YES or NO.
ENTER	Stores choice. If YES is entered the display advances to Edit Profile Cycles otherwise it advances to Edit Segment Number for the next segment.
BACK	Return to Edit Segment Number.
NO	Leave segment status as it is. If segment is currently assigned as the last segment the display will advance to Edit Profile Cycles. Otherwise, the display will advance to Edit Segment Number for the next segment.
BACK	Return to Edit Segment Number.

#### 4.7.19 EDIT PROFILE CYCLES

This menu is used to enter the desired cycles for this profile. Cycles is the number of times this profile is to be repeated without stopping. Cycles may be entered from 1 to 99 or C for Continuous. The default value is 1.

Display: 

-----
x REPEAT CYCLES
? yy
-----

The ? flashes.

x is the profile designator [A-L].

yy is the current cycle value.

YES Change number of repeat cycles.

Lower display **CYCLE=xx**

UP/DOWN Set cycle count.

ENTER Store new cycle count. Display returns to Select Profile for Editing.

BACK Return to SETUP R/S PROFILE? prompt.

NO Leave repeat cycles as entered. Display returns to Select Profile for Editing.

BACK Return to SETUP R/S PROFILE? prompt.

## **5.0 PID CONTROL**

The information provided in this manual is provided to get the system up and running with a minimum of effort. For further details of the use and tuning of PID control see the ANAFAZE Practical Guide for Process Control.

### **5.1 CONTROL MODES**

The control mode is the form of control function. In the 12LS the choices are: on/off, proportional [P], proportional and integral [PI], and proportional with integral and derivative [PID]. The control mode should not be confused with with the type of control output signal: for example pulsed DC voltage or analog output.

#### **5.1.1 REVERSE-DIRECT ACTION**

The ACTION of the control OUTPUT with RESPECT to the PV is known as REVERSE ACTION, if the OUTPUT INCREASES as the PV DECREASES. If the OUTPUT INCREASES as the PV INCREASES, then it is known as DIRECT ACTION.

Heating applications normally uses REVERSE ACTION and cooling applications normally will use DIRECT ACTION. The selection may also be dependent upon the application of two competing mediums of energy such as in a HEAT/COOL or TEMPERATURE/HUMIDITY applications.

#### **5.1.2 HEAT/COOL DUAL OUTPUTS**

Dual outputs are provided standard in the ANAFAZE 12LS. Each loop control mode, and output signal type, and a spread between the setpoints. The deadband adjustment is not normally possible in many controllers. Three-Position or Two-Position floating control can be implemented by selecting the proper deadband between setpoints of the heating and cooling loops.

#### **5.1.3 CONTROL OUTPUTS**

The 12LS provides a output signal of 5 Vdc for use as PID control outputs. An analog output signal of 0 to 5 Vdc or 4-20 mA<sub>dc</sub> is available using a external module called a DAC from ANAFAZE.

#### **5.1.4 DIGITAL OUTPUT**

PID Digital outputs normally control the process using relays. Three types of control are used: ON/OFF, TIME PROPORTIONING, and DZC.

### **5.1.5 DISTRIBUTED ZERO CROSSING**

Distributed Zero Crossing [DZC] output is the other time proportioning output available from the 12LS. This output is primarily for very fast acting electrical heating loads using SSR's. The open air heater coil is an example of a fast acting load. It should never be used with electro-mechanical relays.

The combination of Distributed Zero Crossing and a solid state relay can approach the effect of analog phase angle fired control at a reduced cost.

The DZC output is a TIME PROPORTIONING output where the controller decides for each cycle of the AC line if the power should be on or off. There is no fixed cycle time since the on/off decision is made for each AC cycle.

For example if the control output is 25% the power would be turned on for 1 AC cycle and off for the next 3 AC cycles. This pattern would repeat until the output level changed, for example to 28%. The power would then be on for 1 AC cycle and off for 3 cycles, then after repeating 1 on and 3 off several times the power would be set on for 2 cycles and off for 2 cycles. The result is after 100 cycles the power will have been on for 28 cycles and off for 72 cycles.

Since the time period for 60Hz power is 16.6ms the switching interval is very short and the power is applied very uniformly. Switching is still only done at the zero crossing of the AC power reducing the generated electrical noise.

## **5.2 TUNING PID LOOPS**

The control loop to be tuned should be placed in auto after tuning. If, the loop is in auto and controlling, to avoid upsetting the process place the control in manual. After the loop is placed in manual, the PID values may be changed without upsetting the output. After tuning, placed the loop back into auto. If, a small upset of the output is not important, than the PID constants may be tuned while in auto.

When tuning, remember that time is a factor in most processes and especially in temperature processes. Along with the dynamics of the process, the results may be slow to see. Allow time between adjustments, before making new ones. 20 minutes is highly recommended for most processes.

### **5.2.1 PROPORTIONAL CONTROL:**

When using single mode PB only for control, set the TI and TD to OFF. The initial PB setting may be obtained from the PID TUNING CONSTANTS Table. Normally using P only for control will require a smaller PB than using PI and PID. A range of 3% to 10% of the SP is a useful range for the PB with P only control.

## **5.2.2 PROPORTIONAL WITH INTEGRAL CONTROL:**

The Two-mode PI is the most common of the control modes in use in industry. It must be tuned by tuning the PB first and then the TI may be tuned. Many times preset values may be used to shorten the time required for tuning.

The initial setting for the PB may be obtained from the PID TUNING CONSTANTS Table. A useful range will be in the 5% to 20% of the SP. The initial TI should be set for 60 with TD set to OFF. Set the Digital Filter to 2.

Use of TI below 30 seconds will most likely cause cycling and is not recommended for most applications. Use of TI above 500 seconds is not recommended as it will give the effect of using manual reset. 500 seconds and above should only be used when manual reset is desired for the control action.

## **5.2.3 PROPORTIONAL W/ INTEGRAL W/ DERIVATIVE CONTROL:**

The Three-mode PID control is used primarily when overshoot of the PV cannot be tolerated as in the Quarter Wave Decay response of two-mode PI control. The PI must be tuned first before attempting to tune the Derivative mode.

Initial setting of the PB may be selected from the PID TUNING CONSTANTS Table. Initial TI setting may be set to 60. Adjust as above in the PI tuning. After tuning PI then a setting of 15% of the TI may be used for the TD setting.

A small amplitude and short time period of the PV cycling is characteristic of a narrow PB. A greater amplitude and longer time period is characteristic of too fast of a TI.

## **5.2.4 OUTPUT DIGITAL FILTER:**

The OUTPUT FILTER used by the ANAFAZE Controllers is a digital filter on the output signal after the PID functions. It has a range of 0-255 levels that gives a time constant of 0-127.5 seconds. It is used to filter out erratic swings of the output due to extremely sensitive input signals, such as open air T/C in a dry air gas oven or a turbine flow signal.

It can be used also to allow the 12LS to function more effectively than with PID alone. Some processes may be very sensitive, requiring a wide PB, such that good control is not possible. By increasing the digital output filter to reduce the high and low output swings due to the process, the PB may be narrowed (lower number -- higher gain) to obtain good control.

The filter can also be used to forgive badly tuned PID loops and poorly designed processes. It may also be used to reduce output noise [control output cycling] when a large amount of derivative action is required.

There is no tuning step for the Output Filter. Adjusting the PID without the Filter(set at 0) will give the fastest output response to a step change. The Filter may be turned on at any time. If, the PV is cycling with the PB at 20% of SP or the output is changing more than 2-3% with good PID values, the Digital Filter may be turned on. Settings of 2, 4, 6, 8, 10, 12, and 15 have been used. Settings of 4, 6, and 10 are common filter settings. Increase filter setting in steps of 2 until output or PV has stabilized. Remember to allow at least 20 minutes between adjustments.

After PID values are selected for proper response of the PV, these values will remain the same in most processes without need of re-tuning. Most heat/cool processes do not have the characteristics that require re-tuning of the PID constants.

The PB is one variable that would change when operating at a very low temperature and than operating at a much higher temperature. For instance controlling at 250° F and 2250° F with the same controller will require different PB values. See the PB Table on the PID Tuning Constants page.

TI and TD will most likely remain the same without need of further tuning. There are two situations that may require a new value for the TI. The first one is when changing process material loads from a very large load to a much lighter load. The second situation is of a changing process load due to exothermic based processes.

When changing TI and the Derivative is in use, the TD should also be changed.

Remember, most likely PID values will not need to be changed after they have been set correctly. Changing PID values to correct for process problems, will normally cause more problems.

Table 6-1 PID Constants for ANAFAZE Systems		
PID Mode	Useful Range	Nominal Setting
Proportional Band (PB)	10 to 200° F	40° F or 10% of SP for any input
Integral (TI) [Reset]	30 to 600 Seconds	60 seconds or [120, 180, 240]
Derivative (TD) [Rate]	3 to 60 Seconds	OFF or 10 seconds [or 15% of TI]
Digital Filter	0 to 25	4

## 5.2.5 PID TUNING CONSTANTS

### PROPORTIONAL BAND SETTINGS

THE FOLLOWING TABLE REPRESENTS AN AVERAGE SETTING FOR THE PB IN RELATIONSHIP TO THE SETPOINT OF THE CONTROLLER WITH A TEMPERATURE INPUT:

TEMPERATURE SETPOINT	PB	TEMPERATURE SETPOINT	PB
-100 TO +100	20	1600 TO 1699	100
+100 TO +199	20	1700 TO 1799	105
200 TO 299	30	1800 TO 1899	110
300 TO 399	35	1900 TO 1999	120
400 TO 499	40	2000 TO 2099	125
500 TO 599	45	2100 TO 2199	130
600 TO 699	50	2200 TO 2299	135
700 TO 799	55	2300 TO 2399	140
800 TO 899	60	2400 TO 2499	145
900 TO 999	65	2500 TO 2599	150
1000 TO 1099	70	2600 TO 2699	155
1100 TO 1199	75	2700 TO 2799	160
1200 TO 1299	80	2800 TO 2899	165
1300 TO 1399	85	2900 TO 2999	170
1400 TO 1499	90	3000 TO 3099	175
1500 TO 1599	95	3100 TO 3199	180

As a general rule use 10% of the SP below 1000 and 5% above 1000 for a starting point in setting the PB.

### INTEGRAL (TI) VERSUS RESET REPEATS/MINUTE (R/M)

$$\text{RESET R/M} = 60/\text{TI}$$

TI (SEC.)	R/M	TI (SEC.)	R/M	TI (SEC.)	R/M
30	2.0	150	.40	300	.20
45	1.3	180	.33	400	.15
60	1.0	210	.28	500	.12
90	.66	240	.25	600	.10
120	.50	270	.22		

As a general rule use 60, 120, 180, or 240 for TI.

### DERIVATIVE (TD) VERSUS RATE MINUTES (RM)

$$\text{RATE} = \text{TD}/60$$

TD (SEC.)	RM	TD (SEC.)	RM	TD (SEC.)	RM	TD (SEC.)	RM
5	.08	20	.33	35	.58	50	.83
10	.16	25	.41	40	.66	55	.91
15	.25	30	.50	45	.75	60	1.0

As a general rule set TD to be 15% of TI.



## 5.2.6 GENERAL PID CONSTANTS BY APPLICATION

PROPORTIONAL BAND ONLY (P)

PB = SET 7% of SP Example: SP = 450 PB = 31

TI = OFF

TD = OFF

Output Filter = 0

P with INTEGRAL (PI)

PB = Set 10% of SP Example: SP = 450 PB = 45

TI = 60

TD = OFF

Output Filter = 2

PI with DERIVATIVE (PID)

PB = Set 10% of SP Example SP = 450 PB = 45

TI = 60

TD = Set 15% of TI Example TI = 60 TD = 9

Output Filter = 2

ABOVE VALUES HAVE BEEN USED FOR MANY APPLICATIONS AND IN GENERAL WILL BE USEFUL IF NOT FOR CONTROL THEN FOR A STARTING POINT FOR TUNING THE PID. NOTE! CONTROL MUST BE IN AUTO.

### GENERAL PID CONSTANTS BY APPLICATION

	PB	TI	TD	FIL	OUTPUT	CT	ACT
ELECTRIC HEAT W/ SOLID STATE RELAYS	50	60	15	4	TP	3	REV
ELECTRIC HEAT W/ MECHANICAL RELAYS	50	60	15	6	TP	20	REV
GAS HEAT WITH MOTORIZED VALVES	60	120	25	8	ANA	NA	REV
GAS HEAT SP>1200	100	240	40	8	ANA	NA	REV
EXTRUDERS W/COOLING HEAT W/SSR SET SPREAD TO 0	50	300	90	8	TP	3	REV
COOLW/SOLENOID VALVE	10	OFF	OFF	4	TP	20	DIR
COOLW/FANS	10	OFF	OFF	4	TP	60	DIR
ELECTRIC HEAT W/ OPEN HEAT COILS	30	20	OFF	4	DZC	NA	REV
ELECTRIC HEAT W/ SCR CONTROLLERS	60	60	15	4	ANA	NA	REV

## **6.0 SOFTWARE**

ANAFAZE offers turnkey software for IBM PC and compatible computers. The present software includes:

ANASOFT-SV Standard Version for 12LS setup

ANASOFT-EV Expanded Version with graphics, data logging, and automatic job selection at start up.

ANASOFT-RS ANASOFT-EV with ramp and soak, requires 12LS-RS

### **6.1 ANASOFT**

ANASOFT is a menu driven program that operates ANAFAZE 12LS controllers using an IBM PC or compatible computer. It provides a summary screen with color graphic displays of system operating conditions. ANASOFT-EV includes graphic plotting, data acquisition, alarm indication, and many other features. Please request the ANASOFT data sheet for more information.

### **6.2 CUSTOM APPLICATION PROGRAMS**

ANAFAZE maintains a staff of engineers that can provide assistance in generating software for custom applications. In addition ANAFAZE will design and implement your entire turn key hardware and software system. Please contact your local representative or ANAFAZE directly for a quotation.

## **7.0 TROUBLE SHOOTING INFORMATION**

### **7.1 Stand Alone Systems**

For stand alone systems the ANAFAZE 12LS should be returned to ANAFAZE when problems occur. If the unit has no display check the input power supply.

Normally there are no components that can be field repaired. The 12LS can be checked at ANAFAZE using a test fixture that checks the different boards.

If a spare unit is inserted set the entered values to the ones of the replaced unit. These values can be stored and entered using a standard IBM PC or compatible computer and ANASOFT software.

#### **7.1.1 Checking Control Outputs**

Control outputs can be checked by setting the loop to manual and the control output to the desired level. An LED with a series 1K resistor can be connected across the output to see if it is pulsing.

#### **7.1.2 Checking Digital I/O**

The digital I/O can be checked from the Test I/O menu. Again the LED with series 1k resistor can be used to see the outputs pulse on and off.

### **7.2 Computer Supervised Systems**

These four items must work together to operate the 12LS:

- The 12LS
- The computer including the RS-232 or other serial interface
- The communications link
- The computer software

If the system does not work on initial start up check the 12LS, the computer, and the serial link. The 12LS first be checked in the stand alone mode. If there is a problem the 12LS should be returned to ANAFAZE for service.

If ANASOFT is running in the system, when a unit is replaced, ANASOFT will detect a controller reset [indicated on initial power up] and automatically reload the current parameters in ANASOFT.

If the system includes multiple ANAFAZE 12LS controllers the address must be set to the correct address. This should be done using a spare housing before plugging the unit into the system housing.

If the address is not changed the unit will probably have the default address 1. If the address must be changed on line, ANASOFT will indicate communication errors as it will probably get responses from two controllers at once. The address should be set as quickly as possible, and the current job reloaded to ensure the correct parameters are at each controller.

### **7.2.1 Computer Problems**

The computer can be checked by running standard programs that use the display and the printer. The serial interface must be functioning. This is harder to test since most programs do not utilize the serial interface. Check any computer problems with the computer supplier.

### **7.2.2 Computer Software**

This can be divided into: ANASOFT and user written software:

### **7.2.3 User Written Software**

For user written software a simple routine that sends and receives a command from the 12LS should be written and tested initially. The ideal routine sends and receives commands displaying both sets on the computer monitor. Since the protocol includes all characters, the display should show the hex numbers of the characters sent in both directions.

Once successful communications is established, this program can be used as a check if problems arise in the operating software.

### **7.2.4 ANASOFT**

ANASOFT is a complete menu driven software program which includes error detection and diagnostic messages. If ANASOFT will not run at all please see the ANASOFT manual for detailed information. The following can be checked:

1. Correct path for files run the install program and check the disk drive and path for the data files.
2. All files present - check that all necessary files are present and on the specified directory.
- 3 Sufficient memory free ANASOFT requires 512K memory free to run. You can use the DOS command CHKDSK to view the free memory. If there is insufficient memory check step 4.
4. Delete any memory resident programs check the AUTOEXEC.BAT to insure no memory resident programs are automatically run on start-up. Some memory resident programs may interfere with ANASOFT.

If ANASOFT runs then the next step is to establish communications with the 12LS. On start up ANASOFT checks communication with the controller. If the 12LS does not answer, a communications error message will appear on the display.

### **7.2.5 Communications Problems**

If the computer is functioning properly then the communication interface, cables and connections must be checked. A number of problems have been traced to bad cables or connections.

### **7.2.6 Serial Interface**

The serial interface must be correctly installed in the computer and set according to the manufacturers directions. ANASOFT communicates using Comm Port 1. Some multi-function interface cards allow setting of the comm port this should be done correctly. In addition be careful that only one communications channel is set as comm port 1. If necessary the communications port can be changed in the install program.

When the communications interface is correctly installed a scope can be used to check the transmit line to insure characters are being sent to the 12LS.

## 8.0 SOFTWARE COMMAND STRUCTURE

The 12LS will respond to commands according to the following format. The commands generally follow the specifications of ANSI X3.28-1976. The structure is outlined below:

### . Commands from Allen Bradley Programmable Controllers (CMD)

The A32PID will respond only to Unprotected Block Read (CMD01) and Unprotected Block Write (CMD 08) commands from the Allen Bradley PLC. Any other command numbers received will return an error status code.

### . Error Checking (BCC / CRC)

Error checking is set on the global menu. The default is BCC and this has proven satisfactory in most applications. CRC is recommended for highest data integrity, BCC provides slightly higher speed.

### . Protocol

Controller protocol is set for full duplex.

### . Status Codes

Four Error Code numbers will be returned in the Status (STS) byte to denote the following error conditions :

Error Code (Hex)	Status/Error Condition
A0	Processor Reset
C0	Command Error
D0	Data Boundary Error
E0	[ Spare ]

#### **Processor Reset**

This Error Code is returned after :

- Power-up reset
- The watchdog timer resets the Master processor
- The Master processor resets the Slave processor

#### **Command Error**

This Error Code is returned when the 12LS receives a command that is not a Block Read or a Block Write.

## Data Boundary Error

This Error Code is returned when:

- A Read command attempts to read beyond the 32 byte boundary of byte-size variables
- A Read command attempts to read beyond the 64 byte boundary of word-size variables
- A Read command is received that specifies the number of bytes to read as 0
- A Write command attempts to write beyond the 32 byte boundary of byte-size variables
- A Write command attempts to write beyond the 64 byte boundary of word-size variables

### . Data Table Addresses

Variable	Number	Size	Addresses	
			Hex Byte Range	Octal Word Range
Prop. Gain	32	Byte	0100 - 011F	200 - 217
Rate	32	Byte	0120 - 013F	220 - 237
Reset	32	Byte	0140 - 015F	240 - 257
Input Type	32	Byte	0160 - 017F	260 - 277
Output Value	32	Byte	0180 - 019F	300 - 317
Output Type	32	Byte	01A0 - 01BF	320 - 337
Output Filter	32	Byte	01C0 - 01DF	340 - 357
Cycle Time	32	Byte	01E0 - 01FF	360 - 377
Alarm Deviation	32	Byte	0200 - 021F	400 - 417
Setpoint	32	Word	0220 - 025F	420 - 457
Measured Value	32	Word	0260 - 029F	460 - 517
Ambients	08	Byte	02A0 - 02A7	520 - 523
Digital I/O's	01	Byte	02A8	524
Alarm Status	08	Byte	02B0 - 02B7	530 - 533
Heater Check	33	Byte	02BC	536
EEROM Save	--	----	02BE	537
DACQ Input Type	64	Byte	02C0 - 02FF	540 - 577
DACQ Meas. Val.	64	Word	0300 - 037F	600 - 677

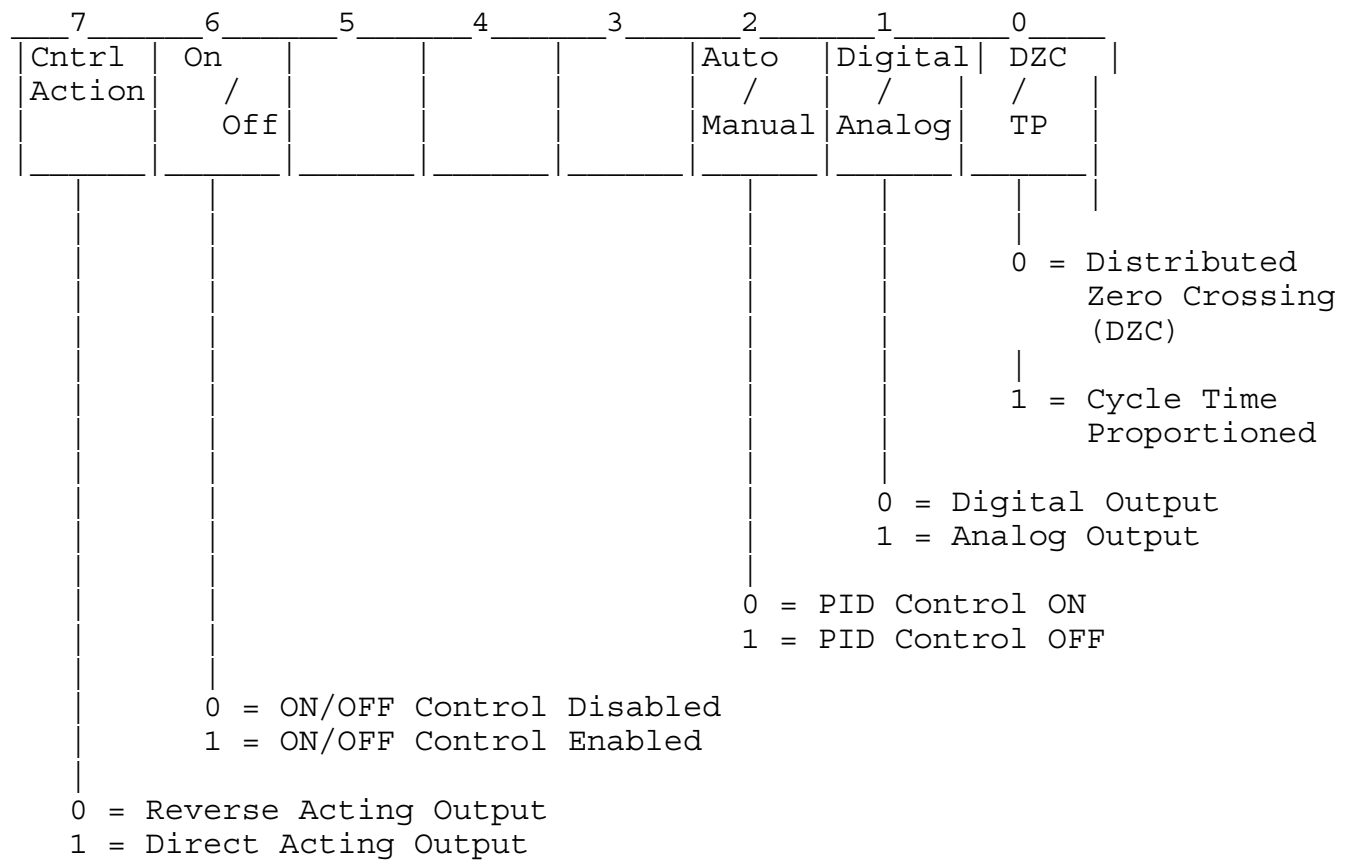
## . Input Types

The following one byte codes designate the various input types accepted by the 12LS:

Code	Input Type
00	Linear (0-60 mV)
01	J Thermocouple
02	K Thermocouple
03	T Thermocouple
04	[ Spare ]
05	[ Spare ]
06	RTD
07	Frequency (Pulse Counter)

## . Output Types

Output type codes are one byte hexadecimal designations formed by setting the individual bits, as explained below, to their proper state.





The following examples show the output code for specific output types:

<b>Output Configuration</b>	<b>Hex Code</b>
DZC Digital Output, Automatic control	00
Time Proportioned Digital Output, Automatic control	01
Analog output, Automatic control	02
DZC Digital Output, Manual Control	04
Time Proportioned Digital Output, Manual control	05
Analog output, Manual control	06
ON/OFF Digital Output, Automatic control	40
ON/OFF Digital Output, Manual control	44
DZC Output, Automatic Control, Inverted Output	80
Time Proportioned Output, Automatic Control, Inverted Output	81
Analog Output, Automatic Control, Inverted Output	82
DZC Output, Manual Control, Inverted Output	84
Time Proportioned Output, Manual Control, Inverted Output	85
Analog Output, Manual Control, Inverted Output	86
ON/OFF Output, Automatic Control, Inverted Output	C0
ON/OFF Output, Manual Control, Inverted Output	C4

## 9.0 GLOSSARY OF TERMS

<b>Address</b>	The ANAFAZE controller address used in computer communications. Each controller must have a separate address beginning with 1. The default is 1.
<b>AC Frequency</b>	The frequency of the power line, 60 Hz or 50 Hz
<b>Control Action</b>	The movement of the control relative to the error between the process variable and the setpoint. For reverse action [heat], as the process decreases below the setpoint the output increases. For direct action [cool], as the process increases above the setpoint the output increases.
<b>Alarm Delay</b>	The time in minutes that alarm functions are delayed when the controller is started (initial powerup).
<b>Alarms</b>	<p>Four alarms are available for each loop. A High Process and a Low Process Alarm with High Deviation and a Low Deviation Band Alarm are assigned to process variables. They remain unchanged from segment to segment during ramp and soak. However, since a deviation alarm is relative to setpoint, and the setpoint varies during ramp and soak the deviation alarm will "track" the setpoint during a ramp and soak cycle.</p> <p>The global alarm output will be active when any alarm condition exists and the alarm has been turned on. Logic outputs can be assigned to any alarm, and in fact one logic output can be assigned to any number of alarms. In this case, the logic output will be active whenever any of its assigned alarms is active.</p> <p>Alarms must be acknowledged before the display annunciation or the global alarm output will be cleared. However, an assigned alarm output will clear when the alarm clears whether or not it has been acknowledged.</p>
<b>Auto Mode</b>	The loop mode in which the PID control output is set by the controller in response to the process variable.
<b>Baud Rate</b>	The serial bit transfer rate for controller to computer communications. May be set at 9600 or 2400 baud. The default is 9600.

**Cycle Time** The time base for the time proportioning outputs entered in seconds. For example with a 10 second cycle time, and 30% output, the output will be on for 3 seconds and off for the balance of 7 seconds. **Deadband** Alarm hysteresis value. A value entered will cause an alarm to remain on or set until the process variable comes out of alarm by at least the value of the deadband. The purpose of the deadband is to avoid nuisance alarms when the process is approximately the alarm value.

**Deviation Alarm** A high and low alarm band that moves with the **Band** setpoint.

**Error Check** The method of communications error checking performed by the communications protocol handler. May be BCC (Block Check Character) or CRC (Cyclic Redundancy Check). Default is BCC.

**High Process Alarm** A fixed alarm level that goes into alarm when the process measurement is higher than it's setting.

**Input Type** The sensor type connected to an input. Thermocouple types are designated by their letter, linear should be used for all other types.

**Job** A set of operating conditions for all 8 loops including setpoints, loop status, output levels, alarm configuration data and (if installed) associated ramp/soak profile assignments. Up to eight jobs can be stored in the 8LS.

**Low Process Alarm** A fixed alarm level that goes into alarm when the process measurement is lower than it's setting.

**ManualMode** The loop mode in which the PID control outputs are set manually by the operator.

**Output Type** PID control output type such as Time Proportioning, Distributed Zero Crossing , ON/OFF or Analog.

**Panel Lock** Feature allowing the function keys on the front panel to be locked out.

**PB** Proportional control band of the PID in the engineering units of the input.

**PROM Version** The release number and date of the PROM inside the ANAFAZE controller.

**Ramp/Soak Time** The time base used in ramp/soak profile segment timing. May be either hours and minutes or minutes and seconds.

**Scaling** Enter two values of unscaled process readings RDG and their corresponding scaled process values PV. Try to have as near as possible to zero and full scale. Once entered the 8LS calculates linear scaling from these values and scales all subsequent measured data. This should be entered prior to any other loop data.

**Setpoint** The desired control setting. This will be in engineering units after scaling.

**Spread** For heat/cool dual output loops, this entry offsets the heat and cool control points from the entered setpoint. The heat will start to control when the process is one half the spread below the setpoint. The cool will start to control when the process is one half the spread above the setpoint. When the process is between the spread values there is no control output.

**TI** Integral or Reset of the PID. The time constant is in seconds.

**TD** Derivative or Rate of the PID. The time constant is in seconds.

**Units** Three characters that will appear in the display next to the process variable.



Congratulations! You have obtained one of the fine products from the ANAFAZE Incorporated line of quality Measurement and Control Systems.

This is your technical, installation and operation manual. Please copy this page and send us your name and address so we can keep you informed of any changes or updates to this manual.

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