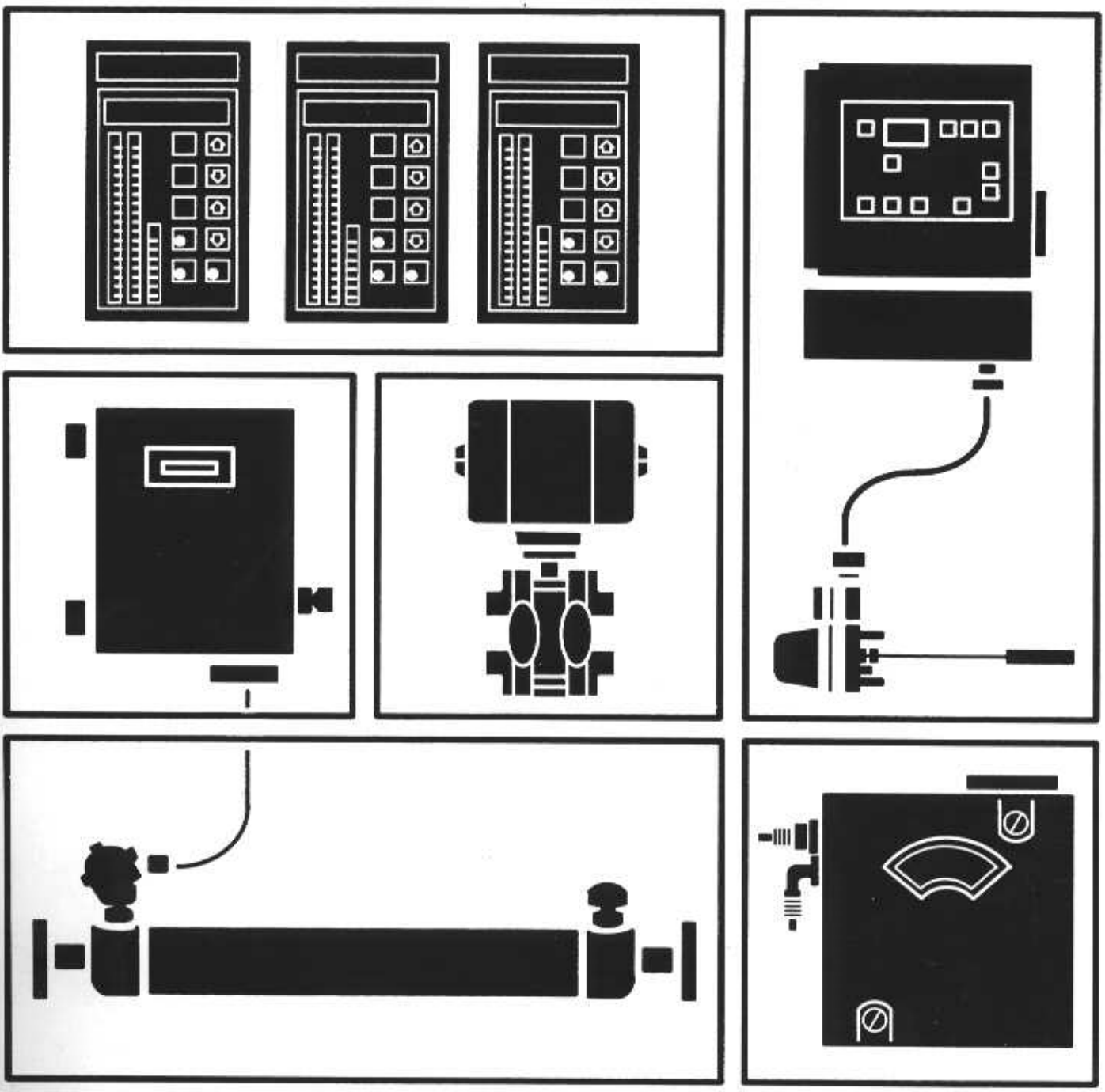
Bailey

PRODUCT INSTRUCTION

E92-530-1

Command Series®

Strategic Loop Controller (Type SLC□1)



BAILEY FISCHER & PORTER

WARNING notices as used in this manual apply to hazards or unsafe practices which could result in personal injury or death.

CAUTION notices apply to hazards or unsafe practices which could result in property damage.

NOTES highlight procedures and contain information which assist the operator in understanding the information contained in this manual.

WARNING

INSTRUCTION MANUALS

DO NOT INSTALL MAINTAIN OR OPERATE THIS EQUIPMENT WITHOUT READING, UNDERSTANDING AND FOLLOWING THE PROPER **Bailey Controls** INSTRUCTIONS AND MANUALS, OTHERWISE INJURY OR DAMAGE MAY RESULT.

RADIO FREQUENCY INTERFERENCE

MOST ELECTRONIC EQUIPMENT IS INFLUENCED BY RADIO FREQUENCY INTERFERENCE (RFI). CAUTION SHOULD BE EXERCISED WITH REGARD TO THE USE OF PORTABLE COMMUNICATIONS EQUIPMENT IN THE AREA AROUND SUCH EQUIPMENT. PRUDENT PRACTICE DICTATES THAT SIGNS SHOULD BE POSTED IN THE VICINITY OF THE EQUIPMENT CAUTIONING AGAINST THE USE OF PORTABLE COMMUNICATIONS EQUIPMENT.

POSSIBLE PROCESS UPSETS

MAINTENANCE MUST BE PERFORMED ONLY BY QUALIFIED PERSONNEL AND ONLY AFTER SECURING EQUIPMENT CONTROLLED BY THIS PRODUCT. ADJUSTING OR REMOVING THIS PRODUCT WHILE IT IS IN THE SYSTEM MAY UPSET THE PROCESS BEING CONTROLLED. SOME PROCESS UPSETS MAY CAUSE INJURY OR DAMAGE.

AVERTISSEMENT

MANUELS D'OPERATION

NE PAS METTRE EN PLACE REPARER OU FAIRE FONCTIONNER CE MATERIEL SANS AVOIR LU, COMPRIS ET SUIVI LES INSTRUCTIONS REGLEMENTAIRES DE **Bailey Controls** TOUTE NEGLIGENCE A CET EGARD POURRAIT ETRE UNE CAUSE D'ACCIDENT OU DE DEFAILLANCE DU MATERIEL.

PERTURBATIONS DE LA FREQUENCE RADIOPHONIQUE

LA PLUPART DES EQUIPEMENTS ELECTRONIQUES SONT SENSIBLES AUX PERTURBATIONS DE LA FREQUENCE RADIO. DES PRECAUTIONS DEVRONT ETRE PRISES LORS DE L'UTILISATION DE MATERIEL DE COMMUNICATION PORTATIF. LA PRUDENCE EXIGE QUE LES PRECAUTIONS A PRENDRE DANS CE CAS SOIENT SIGNALEES AUX ENDROITS VOULUS DANS VOTRE USINE.

PERTES ROCEDE RENVERSEMENTS

L'ENTRETIEN DOIT ETRE ASSURE PAR UN PERSONNE QUALIFIE ET EN CONSIDERATION DE L'ASPECT SECURITAIRE DES EQUIPMENTS CONTROLES PAR CE PRODUIT. L'ADJUSTMENT ET/OU L'EXTRATION DE CE PRODUIT LORSQU'IL EST INSERE A UN SYSTEME ACTIF PEUT OCCASIONNER DES A-COUPS AU PROCEDE CONTROLE. SUR CERTAINS PROCEDES, CES A-COUPS PEUVENT EGALEMENT OCCASIONNER DES DOMMAGES OU BLESSURES.

NOTICE

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Preface

This publication is for the use of technical personnel responsibile for installation, operation and maintenance of the Type SLC_1 Strategic Loop Controller.

This instruction has been revised to include all previous updates and also includes new information on the trend display available.

List of Effective Pages

Total number of pages in this instruction is 169, consisting of the following:

Page No.	Change Date
Preface	Original
List of Effective Pages	Original
iii through xi	Original
1-1 through 1-12	Original
2-1 through 2-21	Original
3-1 through 3-21	Original
4-1 through 4-28	Original
5-1 through 5-22	Original
6-1 through 6-6	Original
7-1 through 7-5	Original
8-1 through 8-9	Original
A-1 through A-15	Original
B-1 through B-3	Original
C-1 through C-4	Original
D-1	Original
E-1 through E-3	Original
F-1 through F-3	Original
Index-1 through Index-5	Original

When an update is received, insert the latest changed pages and dispose of the superseded pages.

NOTE: On an update page, the changed text or table is indicated by a vertical bar in the outer margin of the page adjacent to the changed area. A changed figure is indicated by a vertical bar in the outer margin next to the figure caption. The date the update was prepared will appear beside the page number.

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Safety Summary

GENERAL WARNINGS

Equipment Environment
All components, whether in transportation, operation or storage, must be in a noncorrosive environment.

Electrical Shock Hazard During Maintenance
Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing.

SPECIFIC WARNINGS

Use this equipment only in those classes of hazardous locations listed on the nameplate. Uses in other hazardous locations can lead to unsafe conditions that can injure personnel and damage equipment. (p. 2-3)

Disconnect the AC line cord or power lines from the operating branch circuit coming from the source before attempting electrical connections. Instruments powered by AC line voltage constitute a potential for personnel injury due to electric shock. (p. 2-8)

The analog and digital outputs change to a fixed value during start-up, RESET and for various failure conditions. The analog output values must be selected by the user to insure safe operation when transfer to default condition occurs. (p. 3-20)

Be aware of the effects on the process before pressing the RESET button. Pressing the RESET button causes momentary loss (approximately five seconds) of process control. Some process upsets can injure personnel and damage equipment. (p. 5-20)

The output tests could cause process upsets if the unit is connected to the process while the tests are performed. Some process upsets can lead to injury and equipment damage. The last six tests on the diagnostics screen verify the I/O operation without configuration interaction. (p. 6-4)

System maintenance must be performed only by qualified personnel and only after securing the equipment controlled by the circuit. Altering or removing components from an active circuit may upset the controlled process leading to personnel injury and equipment damage. (p. 7-1)

Wear eye protection when using compressed air to remove cleaning solvents. Eye injury can result from splashing solvent. (p. 7-4)

Do not substitute components that compromise the certifications listed on the nameplate. Invalidating the certifications can lead to unsafe conditions that can injure personnel and damage equipment. (p. 8-1)

Safety Summary (continued)

SPECIFIC WARNINGS *(continued)*	Do not disconnect equipment unless power has been switched off at the source or the area is known to be nonhazardous. Disconnecting equipment in a hazardous location with source power on can produce an ignition capable arc that can injure personnel and damage equipment. (p. 8-2) Replace the fuse with one of the same type and rating. Using an improper fuse can lead to injury to personnel and equipment damage from fire or electrical shock. (p. 8-5)

Sommaire de Sécurité

AVERTISSEMENTS D'ORDRE GÉNÉRAL	**Environnement de l'équipement** Ne pas soumettre les composants à une atmosphère corrosive lors du transport, de l'entreposage ou l'utilisation. **Possibilité de chocs électriques durant l'entretien** Débrancher l'alimentation ou prendre les précautions pour éviter tout contact avec des composants sous tension durant l'entretien.
AVERTISSEMENTS D'ORDRE SPÉCIFIQUE	L'équipement décrit ici ne doit être utilisé que dans les catégories d'emplacement dangereux identifiées sur la plaque signalétique. Son emploi dans tout autre catégorie d'emplacement dangereux pourrait présenter des risques, et provoquer des dommages matériels et des blessures. (p. 2-3) Débranchez le cordon d'alimentation ou les câbles d'alimentation reliés au circuit de distribution avant d'entreprendre des connexions électriques. Les instruments alimentés en courant alternatif comportent un risque de choc électriques pouvant provoquer des blessures. (p. 2-8) Les signaux de sortie analogiques et numériques prennent une valeur fixe au moment du démarrage, d'une remise à l'état initial ou d'une panne. L'utilisateur doit affecter des valeurs implicites qui assureront un fonctionnement sécuritaire. (p. 3-20)

AVERTISSEMENTS D'ORDRE SPÉCIFIQUE *(suite)*	Soyez conscients des conséquences sur le processus avant d'appuyer sur le bouton de remise à l'état initial (RESET). Ceci provoque une perte momentanée (environ cinq secondes) de la commande du processus. Certaines perturbations du processus pourraient provoquer des blessures et des dommages matériels. (p. 5-20) Les tests de sortie pourraient causer des dérangements au procédé si le contrôleur est raccordé au procédé au moment où ces tests sont effectués. Certains dérangements du procédé pourraient causer des blessures ou des dommages à l'équipement. Les six (6) tests indiqués à l'écran des diagnostiques vérifient le fonctionnement des entrées/sorties sans l'interaction de la configuration. (p. 6-4) L'entretien du système ne doit être effectuée que par le personnel qualifié et seulement une fois que l'équipement contrôlé par le circuit est fixé en place. La modification ou le retrait des composants d'un circuit actif pourraient perturber le processus contrôlé et menter à des blessures au personnel et à l'endommagement de l'équipement. (p. 7-1) Il faut porter une protectino pour les yeux pendant qu'on utilise l'air comprimé pour enlever les solvants nettoyants. Une éclaboussure du solvant pourrait causer une blessure aux yeux. (p. 7-4) Ne substituez pas des composantes qui pourraient annuler la conformité aux classes figurant sur la plaque signalétique relativement aux endroits dangereux. Ceci peut entraîner des conditions dangereuses qui risquent de provoquer des blessures et des dommages matériels. (p. 8-1) Ne débranchez l'équipement que si l'alimentation a été interrompue ou si l'environnement est non dangereux. Le débranchement de l'équipement sous tension peut produire une étincelle, ce qui peut mener à une explosion et à des blessures au personnel. (p. 8-2) Remplacer le fusible avec un fusible du même type et de la même capacité. L'utilisation d'une fusible du mauvais type/capacité pourrait causer des blessures au personnel et des dommages à l'équipement résultant d'un incendie ou de choc électrique. (p. 8-5)

SECTION 1 - INTRODUCTION

INSTRUCTION OVERVIEW

The Type SLC_1 Strategic Loop Controller instruction contains eight sections and six appendices.

Introduction Contains an overview of the instruction and Type SLC controller, and a description of the intended user. This section also provides a functional and physical description of the controller and a description of the communication system (how the controller fits into a larger DCS system). It also describes product nomenclature, reference documents and controller specifications.

Installation Contains unpacking and inspection instructions and special handling procedures for boards with semiconductor devices. This section also provides mounting instructions, including special considerations for mounting in hazardous locations. It also contains wiring instructions for AC/DC power wiring, analog and digital I/O wiring and grounding procedures.

Setup Describes the main menu and setup screens and discusses the various options available. It includes procedures to enter the data and provides examples of screen displays.

Configuration Contains required user actions to establish and define the controller configuration. This section also describes factory configurations in which all data can be entered through the faceplate of the controller via menu selections. It also provides custom and modified factory configurations that require use of the Type CTT Configuration and Tuning Terminal or other software configuration tools for entering data.

Operating Procedures Provides descriptions of the start-up, process, main menu, and the first level of screens under the main menu. It also describes routine operator functions that need to be addressed during daily operation of the controller.

Troubleshooting and Diagnostics Describes the diagnostic tools available to aid in service. A troubleshooting guide and flowchart help determine and isolate problems encountered during operation of the controller.

Preventive Maintenance Provides a preventive maintenance program that will help the controller operate at an optimum level.

Repair and Replacement Procedures Describes procedures required to disassemble and assemble the controller to enable parts replacement. It also includes a parts drawing and a recommended spare parts list.

Appendices Contain factory configuration drawings, setup and configuration worksheets, a quick reference of controller switch

settings, screen flowchart and retrofit instructions for a Type CLC controller.

INTENDED USER

It is important for safety and operating reasons that the personnel responsible for the installation, setup, configuration, operation, maintenance, troubleshooting and repair of this unit read and understand the appropriate sections of this instruction. Do not install or complete any tasks or procedures related to operation until doing so.

Installation Personnel Should be an electrician or a person familiar with the National Electrical Code (NEC) and local wiring regulations.

Application Technician Should have a solid background in electronics instrumentation and process control and be familiar with proper grounding and safety procedures for electronic instrumentation.

Operator Should have knowledge of the process and should read and understand this instruction before attempting any procedure pertaining to the operation of the controller.

Maintenance Personnel Should have a background in electricity and be able to recognize shock hazards. Personnel must also be familiar with electronic process control instrumentation and have a good understanding of troubleshooting procedures.

PRODUCT OVERVIEW

This section contains functional, physical and communication characteristics of the controller.

Functional Description

The Type SLC Strategic Loop Controller is intended for small process control applications and easily accommodates simple PID functions to very complex multiloop control strategies. It can be used as a stand-alone product, in conjunction with other Command Series® controllers, or as a component that can interface with Elsag Bailey's powerful INFI 90® Open strategic process management system or the Network 90® distributed control system.

On-board, factory configuration can be set up and tuned from the faceplate.

Custom control strategies can be implemented using an external configuration device such as the handheld Type CTT Configuration and Tuning Terminal or the PC-based Elsag Bailey engineering work station. These devices access a library of control algorithms contained in controller memory called function codes. The function codes are assigned to a block address

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in the user-definable space of controller memory. Assigning a function code to a block address forms a function block. Control configurations are built by forming function blocks and linking them together.

Menu-driven screens provide quick setup and unparalleled process interface. Refer to Figure 1-1 and the following descriptions of the main menu items.

FULL/SPLIT SCRN Full screen process display shows the process variable (PV), set point (SP) and control output (CO) of one loop (either loop can be displayed). The operator can interface to the displayed loop.

Split screen process display shows the PV, SP and CO of both loops simultaneously. The operator can interface to both loops.

MONITOR Numerically displays all I/O and four function block outputs. It also includes a *STATUS* menu item that includes diagnostics and software revision levels.

ALARM SUM Provides clear, concise alarm descriptions.

BYPASS Locks in a manual override capability on both analog outputs.

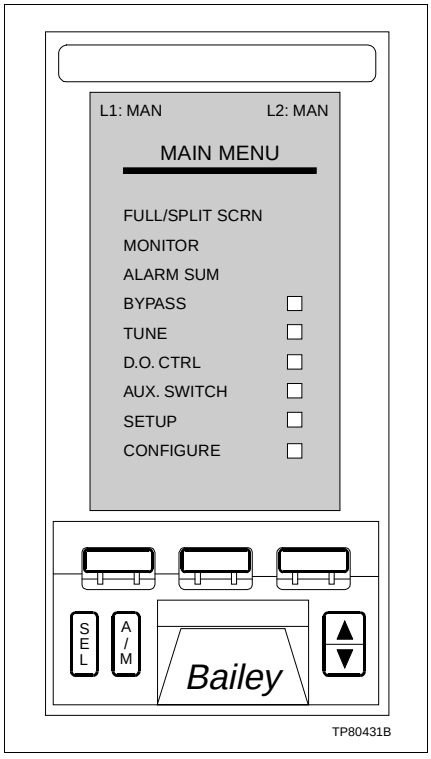

Figure 1-1. Faceplate with Main Menu Display

TUNE Provides quick access to the PID tuning parameters and to adjustable alarm settings.

D.O. CTRL Provides faceplate control of the four digital outputs.

AUX. SWITCH Provides four auxiliary faceplate switches which can be used for troubleshooting or in the control strategy.

SETUP Allows determining:

- Process display screen options.
- Module bus address (0 to 31).
- Password security options.
- Diagnostics to verify hardware.
- Special optional temperature/frequency input board setup.
- Selection of trend screen options.
- Display brightness.

CONFIGURE Provides the menu-driven screens necessary to implement a factory configuration.

Physical

The controller is a panel-mounted, slide-out assembly that conforms to DIN standards. The assembly contains four printed circuit boards (main board, operator interface board, power supply board and termination board) and a faceplate assembly (Fig. 1-2). The operator interface board is attached to the faceplate assembly and is connected to the main board via a 26-pin ribbon cable connector. Both the power supply board and the main board plug into card edge connectors on the termination board. The termination board is assembled to the rear of the housing and provides lugless terminations for ease in making wiring connections. The housing is welded sheet steel and contains card guides that are riveted to the housing for installing the circuit boards. Multiple knockouts at the rear

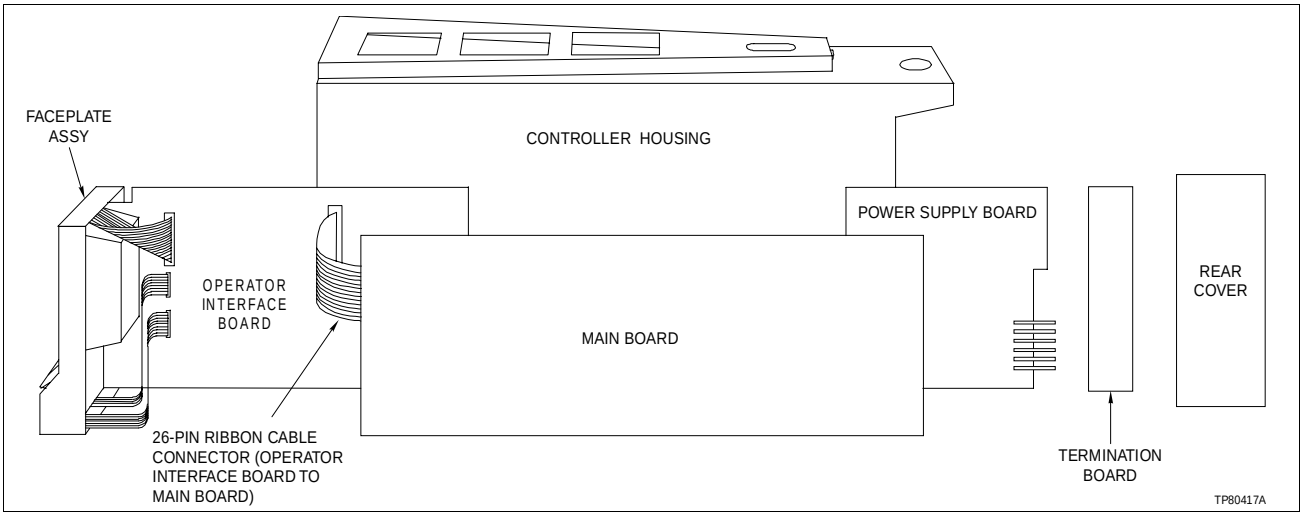

Figure 1-2. Strategic Loop Controller Components

of the housing provide two ½-inch and one ¾-inch conduit entrance facilities for electrical interconnections. The housing also contains multiple holes in the top and bottom primarily for heat dissipation.

Two captive mounting brackets, one for the top and one for the bottom, are supplied with each controller. When in position, the mounting bracket secures the controller to the panel.

A captive locking screw (Fig. 1-3) located behind the door on the faceplate must be loosened to remove the faceplate and operator interface board assembly from the housing. Also located behind the access door is the connector for the Type CTT Configuration and Tuning Terminal and a controller reset button.

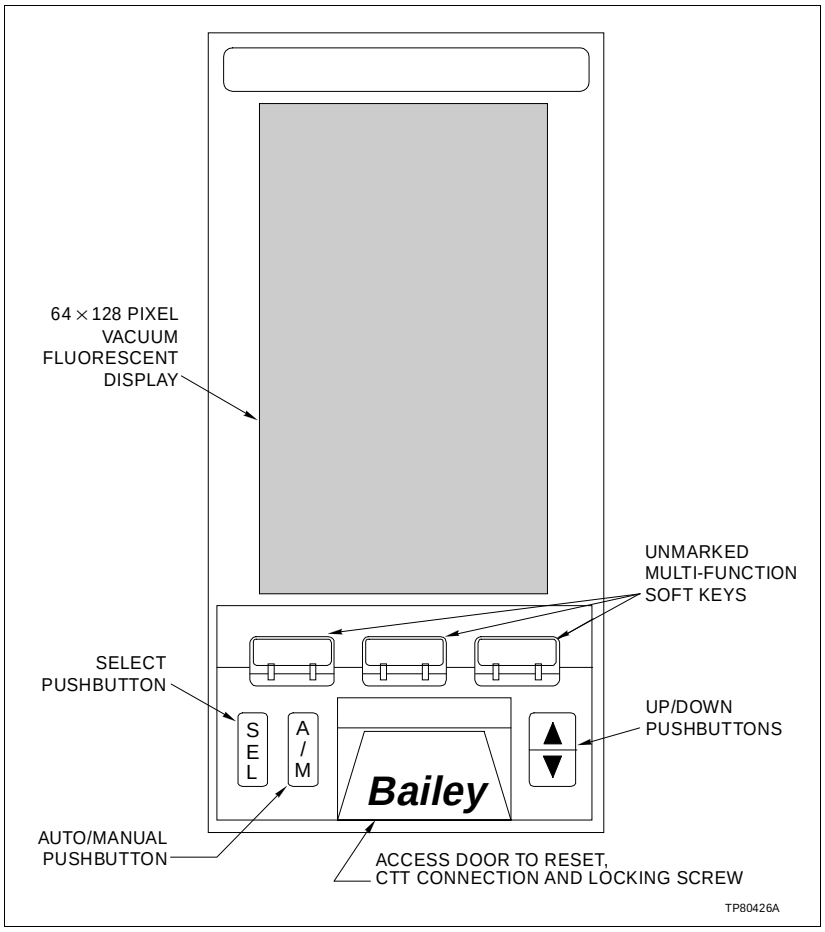

Figure 1-3. Faceplate Assembly

Communication System

The Type SLC_1 Strategic Loop Controller has peer-to-peer communications capability via the Elsag Bailey module bus network. The module bus can transfer approximately 600 to 700 real points (a mix of analog and digital) per second. The

network can contain up to 32 addressable modules/controllers, enabling over 60 loops of control.

Controllers on the network can be linked to a PC through the stand-alone Type CIC01 Computer Interface Command Module (Fig. 1-4). Tools such as the Elsag Bailey engineering work station software and LAN-90® Process Control View (PCV®) can be used.

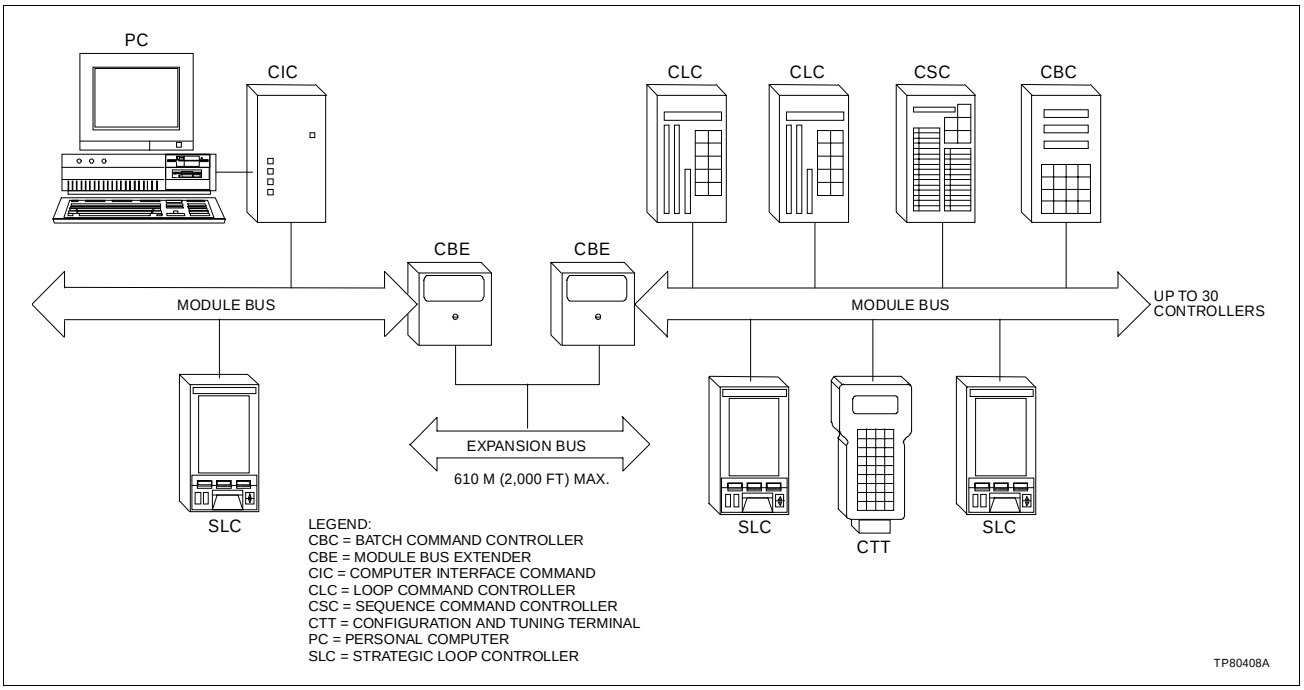

Figure 1-4. Module Bus Network with Type CIC01 Computer Interface Command Module

By adding Elsag Bailey communication modules, the network can be accessed by a plant communications loop for interface to Elsag Bailey's powerful INFI 90 Open strategic process management system or the Network 90 distributed control system (Fig. 1-5).

NOTE: The Type CIC01 module cannot be used on a module bus which is connected to the Plant Loop.

GLOSSARY OF TERMS AND ABBREVIATIONS

Table 1-1 contains those terms and abbreviations that are unique to Bailey-Fischer & Porter or have a definition that is different from standard industry usage.

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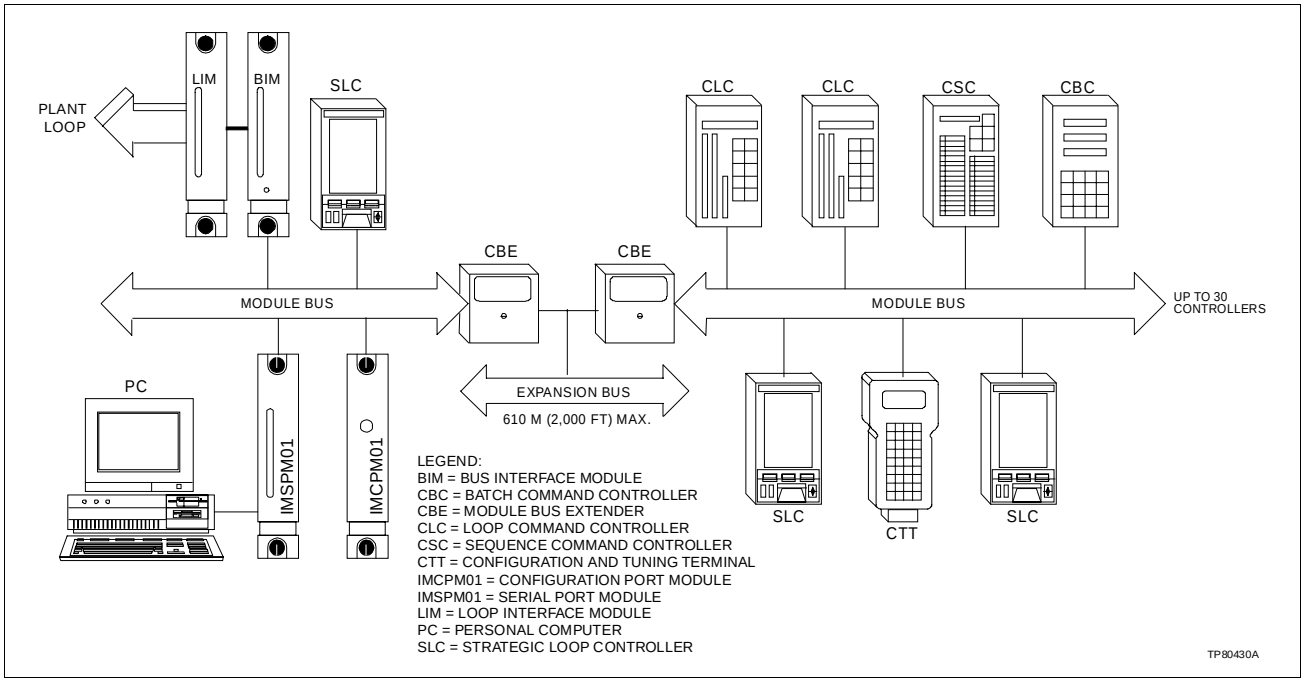


Figure 1-5. Module Bus Network with Plant Loop

Table 1-1. Glossary of Terms and Abbreviations

Term	Description
Cascade Station	An analog control station configuration that allows an externally generated signal, such as the output of an upstream controller, to control the set point. One of three station types available in the normal operating mode.
Fatal Error	An error that causes the device to go into a fail mode and send its output to a defined value.
Function Block	The occurrence of a function code at a block address of a module.
Function Code	An algorithm which manipulates specific functions. These functions are linked together to form the control strategy.
Loop	That portion of an analog process control loop which resides within the controller and typically consists of an analog input measuring the process variable, a manual/auto station generating a set point, a PID control algorithm and an analog output driving a final control element.
Module Bus	Peer-to-peer communication link used to transfer information between intelligent modules within a process control unit.
Ratio Station	An analog control station configuration that maintains a ratio between two variables. The ratio of an externally generated wild variable times the controlled variable becomes the set point that provides regulation of a third variable. One of three station types available in the normal operating mode.
Termination Unit	Provides input/output connection between plant equipment and INFI 90 Open/ Network 90 modules.
Wild Variable	A variable that is used as a reference for a control loop.

REFERENCE DOCUMENTS

Table 1-2. Reference Documents

Document No.	Title
I-E92-500-5	CLB01 Loop Bypass Station
I-E92-500-7	Type CLC Loop Command Controller
I-E92-501-2	CTT_2 Configuration and Tuning Terminal
I-E92-504-1	CBE01 Module Bus Extender
I-E92-504-2	CIC01 Computer Interface Command
I-E96-200	Function Code Application Manual
I-E96-200-1	Function Code Quick Reference Guide
I-E96-500	Site Planning and Preparation
I-E96-717	Computer-Aided Drawing/Text (CAD/TXT) (Release 5.2.2[1])
I-E97-801-1	LAN-90 Process Control View (PCV) (Release 4.3)
P-E21-001	Installing a 4-20 mA Transmitter in a Hazardous Location

NOTE:
1. Release 5.3 is recommended for 100% functionality.

NOMENCLATURE

Table 1-3. Nomenclature

Position	1	2	3	4	5	
Type	**S**	**L**	**C**	**_**	**1**	**Strategic Loop Controller**
				0		Standard inputs, no special input board
				2		Two direct low level inputs in place of AI3 and AI4 (frequency/pulse input included, switch selectable)[1,2]
				1		Base unit

NOTES:
1. An optional input board contains circuitry which allows DI3 to accept a frequency input and 2 temperature modules for direct temperature inputs. Actual use of AI3, AI4 and DI3 remains jumper selectable with the option board installed.
2. Use of the option board does not change the I/O count of the controller. The optional input board contains circuitry for a frequency/pulse input and 2 temperature modules for direct temperature inputs. Hardware jumpers (refer to Appendix D) and menu options permit selecting the function of DI3, AI3 and/or AI4. Digital input DI3 may be used as a digital or frequency input. Analog input AI3 and AI4 are each selectable as a high level or low level input.

SPECIFICATIONS

Table 1-4. Specifications

Property	Characteristic/Value
Inputs	
Analog inputs:	
Quantity available	4
Signal range	1-5 VDC, 4-20 mA
Input type	Isolated, self-calibrating; internally or externally powered
Input accuracy	±0.2% of span
A/D resolution	12 bits
Input impedance	>1 MΩ
Analog inputs *(continued)*:	

Table 1-4. Specifications (continued)

Property	Characteristic/Value
Common mode voltage limit	30 V rms maximum
Common mode noise rejection	-60 dB at 60 Hz, ±120 VAC rms or ±168 VDC
Ambient temperature effect	±0.2% of span/50°C
Digital inputs:	
Quantity available	3
Valid high input range	10-24 VDC
Valid low input range	0-1.7 VDC
Input type	Opto-isolated 0-36 VDC; internally or externally powered
Minimum on/off time	500 msec
Maximum current	4.7 mA at 24 VDC
Optional inputs:	
Direct temperature/mV inputs:	
Quantity available	Up to 2 (in place of standard analog inputs)
Signal ranges	Refer to Figures 1-6 and 1-7
Accuracy	Refer to Figures 1-6 and 1-7
Input type	Isolated, user-calibrated
Linearized input elements:	
Thermocouple	Types J, K, T, S, E, R and Chinese E, S
RTD	100 Ω platinum: European Std. (DIN) (alpha = 0.00385) U.S. Ind. Std. (SAMA) (alpha = 0.00391) 120 Ω Ni Chem Pure (alpha = 0.00672) **NOTE:** RTD input may be affected up to 10% by RFI at 30-45 MHz and 75-85 MHz.
Millivolt	-20 to +80 mV (linear)
Frequency/pulse input:	
Quantity available	1 (in place of standard digital input DI3)
Input type	5 or 24 VDC; opto-isolated 0-36 VDC; internally or externally powered
Valid high input range:	
24 V	14 to 30 V
5 V	3.5 to 8 V
Valid low input range:	
24 V	-50 to 6 V
5 V	-50 to 2.3 V
Maximum frequency	50 kHz (minimum period = 20 µsec)
Minimum pulse width	10 µsec
Outputs	
Analog outputs:	
Quantity available	2
Signal range	1-5 VDC, 4-20 mA
Output accuracy	±0.2% of span
Output load:	
Current mode	<700 Ω
Voltage mode	>250 kΩ
Digital outputs:	
Quantity available	4
Load current	80 mA maximum at 24 VDC
Output type	Opto-isolated, open-collector transistor

Table 1-4. Specifications (continued)

Property	Characteristic/Value
Power supply requirements	
Jumper selectable	24 VDC ±10%
Factory default	90-130 VAC, 50/60 Hz
Jumper selectable	180-260 VAC, 50/60 Hz
Power consumption	
Controller (includes analog outputs and digital inputs)	800 mA at 24 VDC 425 mA at 120 VAC 275 mA at 240 VAC
Analog inputs	80 mA at 24 VDC (4 powered analog inputs)
Digital outputs	320 mA at 24 VDC (4 powered digital outputs)
Accessories: Loop bypass station Module bus extender	 CLB01: 100 mA at 24 VDC CBE01: 112 mA at 24 VDC
Internal power supply limit	Combined current draw from the analog inputs, digital outputs, and accessories is limited to 500 mA
Inrush current	<20 A at 120 VAC (1 cycle at 60 Hz) <12 A at 240 VAC (1 cycle at 60 Hz) <10 A at 24 VDC
Overcurrent protection	
Power supply board fuses	F101, 3 A 250 V (AC power interrupt) F102, 2 A slow blow, 250 V (DC output power interrupt)
Main board fuse	F1, 2.5 A 250 V (external DC power interrupt)
Configuration execution rate	Factory default = 4 scans/sec Faster rates can be selected by the user Execution rate is dependent on configuration size
NVRAM memory	16 kbytes nonvolatile static RAM
Serial communication	
Serial protocol	Elsag Bailey module bus Bi-directional, 2-wire, 83 kbaud
Maximum number of addressable units per bus	32
Peer-to-peer communication	Standard
Communication to PC	Available through CIC01 Computer Interface Command Module or across plant communications loop
Faceplate display	Vacuum fluorescent graphic display, 64 × 128 pixels
Electrical connections	Rear of case Compression type, lugless, 24-14 AWG
Mounting	Flush panel mount
Size	
Faceplate	72 mm × 144 mm (2.82 in. × 5.67 in.)
Depth	245 mm (16.75 in.)
Size standard	Conforms to DIN Standard 43700
Weight	3.6 kg (8 lb.)

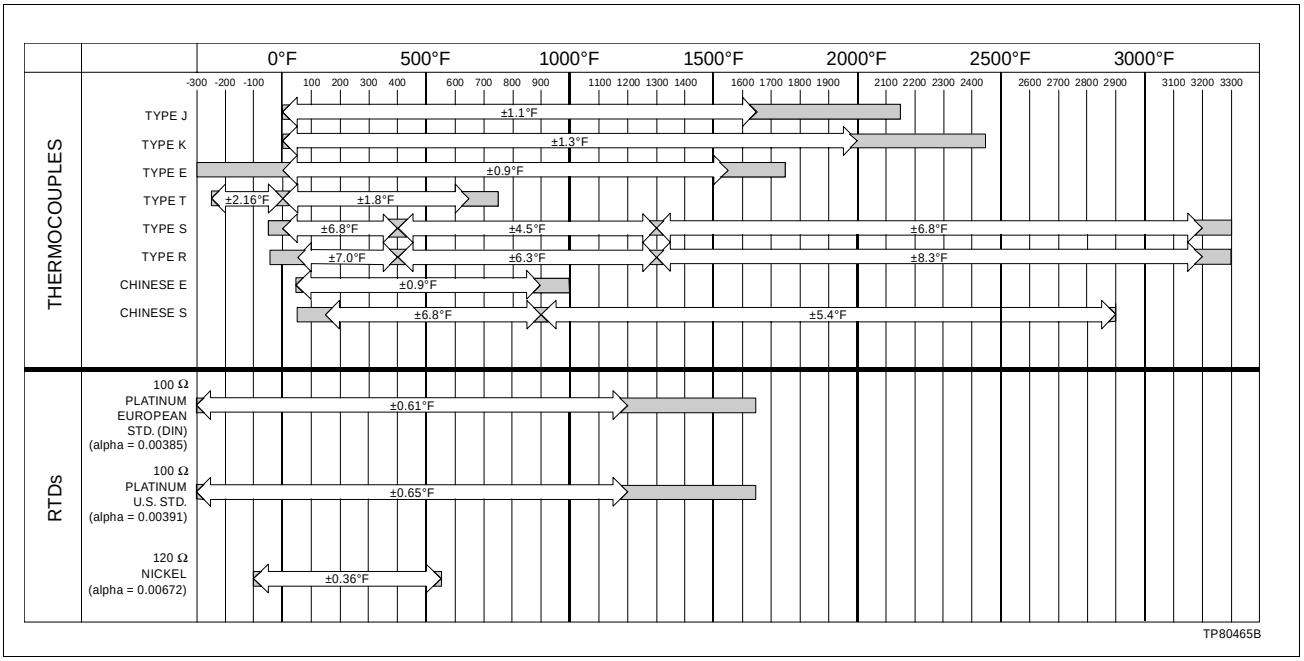
Table 1-4. Specifications (continued)

Property	Characteristic/Value
Environmental constraints	
Temperature: Operating Storage	 0° to 50°C (32° to 122°F) -20° to +70°C (-4° to +158°F)
Relative humidity	10% to 95% noncondensing
RFI effect	<2.5% output effect for 4-1000 MHz at 5 V/m (high level)
Enclosure classification	NEMA 1
Agency certifications[1]	
CSA (Canadian Standards Association)	Certified for ordinary (nonhazardous) locations Certified for Class I, Division 2, Groups A, B, C, D
CSA (NRTL[2])	Certified for Class I, Division 2, Groups A, B, C, D
Type SLC termination unit spacings	<table><tr><th>Circuit</th><th>Max. Volts</th><th>Installation Category[3]</th></tr><tr><td>Mains</td><td>130 rms</td><td>III</td></tr><tr><td></td><td>250 rms</td><td>II</td></tr><tr><td></td><td>26.4 VDC</td><td>III</td></tr><tr><td>I/O</td><td>30 V</td><td>III</td></tr></table>
Accessories	
Configuration and tuning terminal	Handheld unit that provides system configuration, monitoring, tuning and diagnostics. Order by nomenclature: Type CTT_2.
Blank cartridge	Configuration storage cartridge for the Type CTT_2 Configuration and Tuning Terminal. Order by part no.: 6637531_1.
Loop bypass station	Maintenance tool that provides direct manual control of the process. Order by nomenclature: Type CLB01.
Module bus extender	Increases module bus distance from 10 meters to 610 meters (33 ft. to 2,000 ft.). Order by nomenclature: Type CBE01.
ESD field service kit	For personnel working on equipment containing static sensitive devices. Includes static dissipative work mat, ground cord assembly, alligator clip and wrist bands. Order by part no.: 1948385_1.
Retrofit mounting kit	Type CLC case adapter. Contains hardware that allows a Type CLC case to accept a Type SLC faceplate and board assembly. Order by part no.: 258568_1.
Temperature/frequency input board	Permits 2 direct low level inputs in place of AI3 and AI4. Permits 1 frequency/pulse input in place of DI3. Order by part no.: 6640367_1 (requires software rev B_1 or higher).
Frequency input board[4]	Permits 1 frequency/pulse input in place of DI3. Order by part no.: 6640367_2 (requires software rev B_1 or higher).

NOTES:

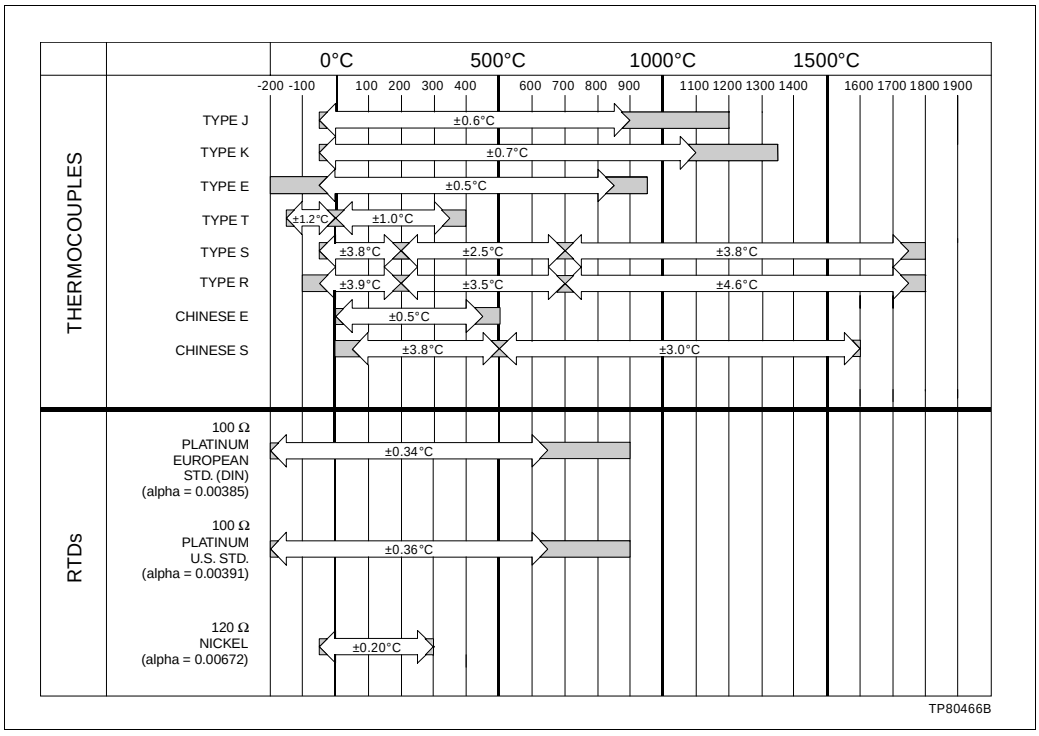
1. Hazardous location approvals are for ambient conditions of 86 to 108 kPa (12.47 to 15.66 psi), 21% O_2 max., and -25° to 40°C (-13° to 104°F). If the normal temperature range of this product is not within these temperature limits, the temperature rating of the product takes precedence.
2. NRTL (Nationally Recognized Test Lab). OSHA designation for approved test lab.
3. Installation category per IEC 1010-1.
4. Optional inputs are hardware/software selectable.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.



NOTE: Temperature accuracy shown does not include mV to degrees conversion accuracy. Testing performed with function code 182, S12 = 7. Shaded area of available measuring range cannot maintain accuracy stated.

Figure 1-6. Instrument Accuracy and Available Measuring Ranges for Direct Temperature Inputs (Fahrenheit Scale)



NOTE: Temperature accuracy shown does not include mV to degrees conversion accuracy. Testing performed with function code 182, S12 = 7. Shaded area of available measuring range cannot maintain accuracy stated.

Figure 1-7. Instrument Accuracy and Available Measuring Ranges for Direct Temperature Inputs (Celsius Scale)

SECTION 2 - INSTALLATION

INTRODUCTION

This section contains special handling procedures for boards with semiconductor devices, inspection instructions for the equipment shipped, special considerations required for mounting the controller in a hazardous location and the physical mounting instructions.

It also provides information on AC/DC power wiring, analog and digital I/O wiring, grounding procedures, peer-to-peer communication connections and applicable switch settings on the termination board.

> **NOTE:** Installation personnel should be an electrician or a person familiar with the National Electrical Code and local wiring regulations.

UNPACKING AND INSPECTION

Upon receipt of the shipment, the equipment should be examined for possible damage in transit. If damage is found or there is evidence of rough handling, a damage claim should be filed with the transportation company responsible. Also, the nearest Bailey-Fischer & Porter sales office should be notified as soon as possible.

Carefully inspect the packing material before discarding it to make certain that all mounting equipment and any special instructions or paperwork have been removed. Careful handling and installation will insure satisfactory performance of your unit.

Use the original packing material and container for storage. The storage environment should be protected and should be free from extremes of temperature and high humidity and fall within the environmental constraints listed in Table 1-4.

SPECIAL HANDLING PROCEDURES

In addition to the normal precautions for storage and handling of electronic equipment, the Type SLC controller has special semiconductor handling requirements. The controller contains electronic components that can be damaged from discharges of static electricity. Therefore, do not touch the components on the circuit board if at all possible. Ordinarily, the circuit will not be damaged if the circuit board is handled by the edges.

Semiconductor devices are subject to damage by static electricity. Therefore, the following techniques should be observed during servicing, troubleshooting and repair.

1. Use antistatic bag. Most assemblies with semiconductor devices are shipped in a special antistatic bag. Keep the assembly in the bag as much as possible whenever the assembly is not in the system.

2. Assemblies containing semiconductor devices should be removed from their antistatic protective containers only under the following conditions:

   a. When at a designated static-free work station or when the bag is grounded at the field site.

   b. Only after the conductive area of container has been neutralized.

   c. Only after firm contact with an antistatic mat and/or firmly gripped by a grounded individual.

3. Personnel handling assemblies with semiconductor devices should be neutralized to a static-free work station by a grounding wrist strap that is connected to the station or to a good ground point at the field site.

4. Do not allow clothing to make contact with static sensitive devices. Most clothing generates static electricity.

5. Avoid touching edge connectors and components.

6. Avoid partial connection of static sensitive device. Static sensitive devices can be damaged by floating leads, especially the power supply connector. If an assembly must be inserted in a live system, it should be done quickly. Do not cut leads or lift circuit paths when troubleshooting.

7. Ground test equipment.

8. Avoid static charges during maintenance. Make sure circuit board is thoroughly clean around its leads but do not rub or clean with an insulating cloth.

   NOTE: An antistatic kit (ESD field service kit part number 1948385é1) is available for personnel working on devices containing semiconductor components. The kit contains a static dissipative work surface (mat), a ground cord assembly, wrist bands and an alligator clip.

9. To avoid contamination of switch contacts that can result in unnecessary circuit board malfunction, do not use a lead pencil to set a dipswitch.

INSTALLATION LOCATION

The Type SLC controller is designed for flush panel mounting. The enclosure must be mounted indoors, preferably in a control room environment.

The installation site should be well lit, dry and vibration free, and conform to the environmental constraints listed in Table 1-4. Careful placement of the controller will insure proper operation as well as overall safety.

> **NOTE:** Temperature is an important consideration. Allow for adequate air flow, especially if the controller is to be installed in an enclosed area.

Care should be taken to avoid installations where conductive contaminants can accumulate on the surface of the printed circuit boards.

The Type SLC controller can be used with a 24 VDC supply or 120, 220 or 240 VAC line service. The proper power source must be made available at the installation site.

Hazardous Locations

WARNING	**Use this equipment only in those classes of hazardous locations listed on the nameplate. Uses in other hazardous locations can lead to unsafe conditions that can injure personnel and damage equipment.**
AVERTISSEMENT	**L'équipement décrit ici ne doit être utilisé que dans les catégories d'emplacement dangereux identifiées sur la plaque signalétique. Son emploi dans tout autre catégorie d'emplacement dangereux pourrait présenter des risques, et provoquer des dommages matériels et des blessures.**

The Type SLC controller is certified by the Canadian Standards Association (CSA) and CSA (NRTL [nationally recognized test lab]). Refer to Table 1-4.

Refer to the ***Installing a 4-20 mA Transmitter in a Hazardous Location*** application guide (Table 1-2) for specific guidelines when using an instrument in a Division 2 hazardous location.

Radio Frequency Interference

Most electronic equipment is influenced by radio frequency interference (RFI). Caution should be exercised with regard to the use of portable communications equipment in the area. Bailey-Fischer & Porter recommends posting appropriate signs

in your plant. Refer to the ***Site Planning and Preparation*** instruction (Table 1-2) for additional information on radio frequency interference.

MOUNTING

The controller can be flush panel mounted, either as a single unit or side-by-side for multiple units. Outline dimensions and panel cutout requirements are shown in Figure 2-1.

> **NOTE:** Temperature is an important consideration. Allow for adequate air flow, especially if the controller is to be installed in an enclosed area.

Use a panel of sufficient thickness and strength for the application. Panel strength must be carefully considered when mounting multiple units. As the panel cutout becomes longer, the panel becomes weaker and it may be necessary to install extra support.

If necessary, additional support can be added by running a piece of angle iron along the bottom of the controller housing.

To install single or multiple mounted units in a prepared panel cutout:

1. Remove the mounting brackets from the top and bottom of the controller housing.

2. Slide the housing through the panel opening. Support the weight of the case and reassemble the mounting brackets on the housing, making certain that the bushing in the mounting bracket assembly is positioned in the mounting hole on the housing (Fig. 2-1). Tighten the bracket screws until the housing is secure in the panel.

3. If installing multiple units, repeat Steps 1 and 2 until all units are installed.

WIRING REQUIREMENTS

Conduit knockouts (½-inch and ¾-inch) are located at the rear of the controller housing. Under ideal conditions, the use of conduit and shielded wire may not be required. However, to avoid noise problems, it is recommended that power, signal and output wiring be enclosed in conduit and separated. Just prior to entering the housing, rigid conduit should be terminated and a short length of flexible conduit should be installed to reduce any stress.

A compression type, lugless connector is provided at the rear of the housing for making wiring connections. Maximum wire gauge for the connector is 14 AWG.

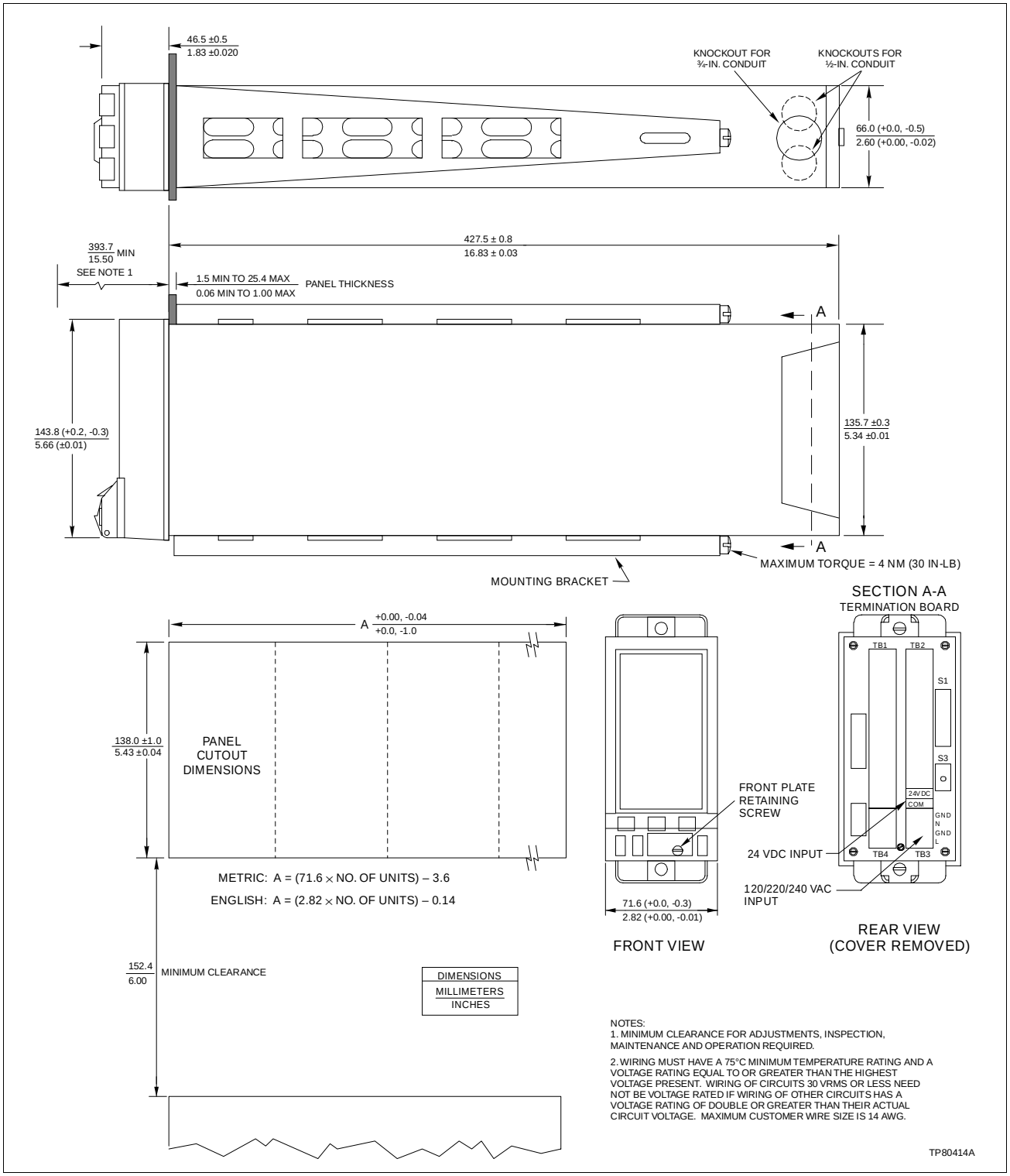


Figure 2-1. External and Mounting Dimensions

The Type SLC controller has the capacity for seven inputs and six outputs. ***For those applications requiring CSA compliance,*** if more than nine two-wire inputs plus outputs are used, then some or all of the wires must be reduced in size. The internal volume of the wiring compartment is about 27 cubic inches. The following volume is required for each conductor.

- 22 AWG 0.50 cubic inches.
- 20 AWG 0.75 cubic inches.
- 18 AWG 1.00 cubic inches.
- 16 AWG 1.25 cubic inches.
- 14 AWG 1.50 cubic inches.

The total number of conductors multiplied by each conductor's volume requirement should not exceed 27 cubic inches. This includes the power conductors. If an interconnecting cable (such as used with the Type CLB Loop Bypass Station) is used, then the total volume should be reduced to 26 cubic inches.

NOTE: Once the wiring is completed, and always during operation, the rear cover of the controller must be in place to maintain system safety and accuracy. The cover prevents operator access to parts which may cause an ignition capable arc, acts as an electrical shield to reduce the effects of EMI/RFI, and helps minimize temperature gradients. It is important that the cover be securely mounted during normal use.

Power Wiring

Use the following procedures to complete the wiring and terminations for the controller.

DC POWER WIRING

When using a DC supply, it must be hard wired by the user. It is recommended that all the power wiring be stranded copper conductor and bear a voltage rating for the highest voltage present (either power or signal) and a 75 degrees Centigrade (167 degrees Fahrenheit) minimum rating.

NOTE: Wiring in extra low voltage circuits (<30 Vrms) need not be voltage rated if wiring on the other circuits has a voltage rating more than double the actual circuit voltage.

1. Connect the specified DC voltage (24 VDC, ±10%) to terminal block TB2-2 (+) and TB2-1 (common) as shown in Figure 2-2.

2. Connect the shield or ground wire to earth ground at TB3-4 (⏚) or TB3-2 (⏚). Connect jumper W110 shown in Figure 2-3 to the E4 position.

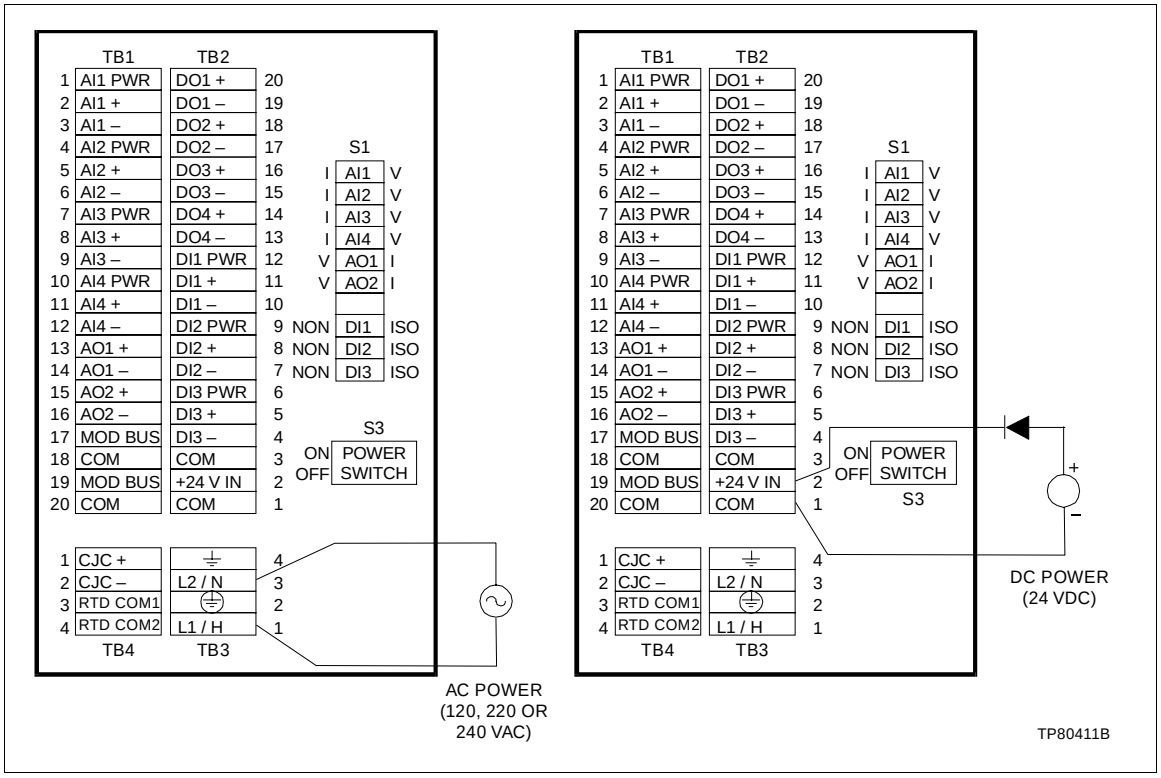


Figure 2-2. DC and AC Power Supply Wiring Connections

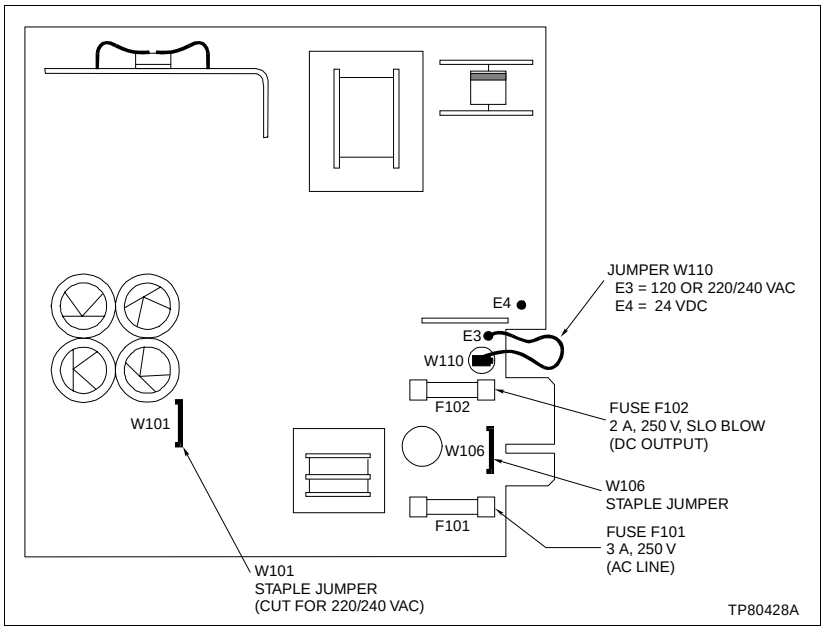


Figure 2-3. Power Supply Board

AC POWER WIRING

The unit is factory set for 120 VAC (nominal). Jumper W110 should be connected to E3 (Fig. 2-3) for 120 VAC service. If 220 or 240 VAC is required, remove the power supply board and cut and remove jumper wire W101 (Fig. 2-3). It is recommended that the jumper wire be cut such that it is completely removed from the circuit.

Either a standard three-prong grounded flexible CSA certified line cord must be supplied by the user for power supply connection or the AC supply must be hard wired.

1. If hard wiring the AC power supply, it is recommended that all power wiring be stranded, copper conductor, No. 14 AWG, and bear a suitable voltage rating for the highest voltage connected to the termination board (either signal or power) and a 75°C (167°F) minimum rating. Wiring must be in accordance with the National Electrical Code.

> **NOTE:** If AC power is used, the system should not be powered from a transformer which also powers large motor loads (over 5 horsepower) or any other type of equipment which will generate line voltage surges and sags.

WARNING	**Disconnect the AC line cord or power lines from the operating branch circuit coming from the source before attempting electrical connections. Instruments powered by AC line voltage constitute a potential for personnel injury due to electric shock.**
AVERTISSEMENT	**Débranchez le cordon d'alimentation ou les câbles d'alimentation reliés au circuit de distribution avant d'entreprendre des connexions électriques. Les instruments alimentés en courant alternatif comportent un risque de choc électriques pouvant provoquer des blessures.**

2. Connect the specified line voltage (120, 220 or 240 VAC, 50 or 60 Hz) to terminal block TB3-1 (L1/H) on the termination board. Neutral to terminal TB3-3 (L2/N) and the ground wire to terminal TB3-2 (⏚) must be completed.

Refer to Figure 2-2 for AC wiring connections.

REDUNDANT POWER SUPPLY WIRING

The Type SLC controller does not require special settings or adjustments if redundancy in power supplies is needed. Both a 24 VDC supply and a 120 VAC (220 or 240 VAC) supply can be wired to the unit as described in ***AC POWER WIRING***, thus providing continuous power to the unit in case a supply fails. Jumper W110 should be set to the E4 position for redundant

power supply wiring. Additionally, a blocking diode should be installed in series with the external DC source to prevent back feeding to the external DC source from the controller's power (Fig. 2-2).

Grounding Procedures

Various grounding procedures for the controller are described in the following sections.

AC SAFETY GROUND

It is the responsibility of the customer and/or their installation/wiring contractor to insure that the controller, other associated control or test equipment and all exposed conductive materials are properly grounded in accordance with local, National Electrical Code or Canadian Electrical Code regulations and are not a hazard, including under fault conditions, to operation and service personnel.

The Type SLC controller provides for a connection of an AC safety grounding conductor (customer supplied) at TB3-4 (⏚) on the termination unit.

> **NOTE:** Because of the prevailing differences in soil conditions throughout the world and differences in acceptable practices, it is not within the scope of this instruction to describe grounding electrode systems. It is the responsibility of the customer to insure that a grounding electrode system which is acceptable to the local building and wiring codes exists at the facility where the Type SLC controller is to be installed.

The NEC, Article 250, Section H, details requirements for grounding electrode systems acceptable in the United States. The CEC, Section 10, paragraphs 700 through 712, details the requirements for grounding electrode systems acceptable in Canada.

> **NOTE:** The structural metal frame of a building shall not be used as the required equipment grounding conductor for the Type SLC controller.

1. To avoid possible misoperation due to multiple grounding connections, the Type SLC controller must not be mounted to structural members which are at a different potential than the grounded circuit of the site's wiring system.

2. Where mounting to structural members cannot be avoided, the structural members should be connected to the grounding circuit of the premise's wiring system in order to equalize any potential differences. This could include customer conduit which is connected to structural steel or grounded at some other location and must be isolated.

3. Preferably, the controller may be isolated from the structural members by the use of suitable insulating materials, provided a potential difference of 30 Vrms or greater does not exist between the structural members and the grounded parts of the equipment.

DC SYSTEM COMMON GROUND

Jumper W106 on the power supply board (Fig. 2-3) provides a connection for the DC system common to the earth ground. Jumper W106 can be cut and removed to isolate system common from earth ground.

For single controller installations (module bus is not connected to any other Type SLC controller or an INFI 90/Network 90 system), single point grounding is obtained by jumper W106 remaining in place on the power supply board.

If several Command Series controllers are connected through the module bus communications link, the system commons are also connected by the module bus. Therefore, read and follow the instructions for single point grounding.

SINGLE POINT GROUNDING

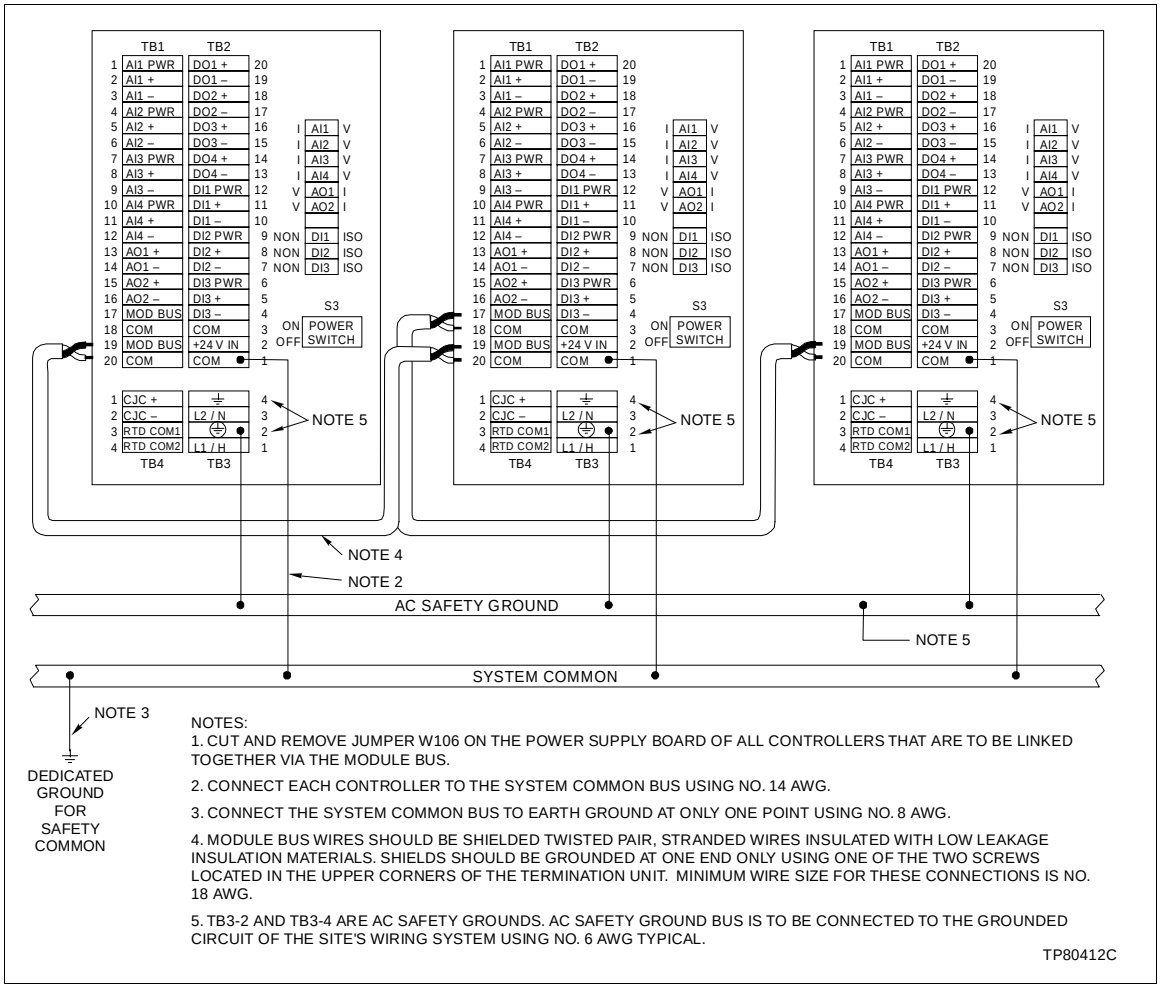
Single Controllers

Single point grounding of the Type SLC controller provides an analog and digital DC grounding system free of circulating currents. Jumper W106 on the power supply board (Fig. 2-3) connects the DC system common to the AC grounding conductor terminal TB3-2 (⏚). Jumper W106 can be cut and removed to isolate DC system common from AC ground.

Multiple Controllers

If several Type SLC controllers are connected through the module bus communication link, then the system commons are also connected. For a single point grounding system, system common must be tied to earth ground only at one point. Cut and remove jumper W106 (Fig. 2-3) on the power supply board of all controllers that are to be linked together via the module bus. Use a separate 14 AWG jumper wire to connect the DC system common (TB2-1) of each controller to an isolated system common bus. From one point on the DC system common, use an eight AWG wire to connect to a dedicated earth ground (Fig. 2-4). This dedicated earth ground should connect to the same grounding point as the AC safety ground (typically the site grounding grid). There should be no more than one-ohm resistance between the DC system grounding conductor and the AC safety conductor.

NOTE: For a single point grounding system, system common of all I/O devices that interface with the Type SLC controllers must be the same potential as the Type SLC controller system common.



NOTES:

1. CUT AND REMOVE JUMPER W106 ON THE POWER SUPPLY BOARD OF ALL CONTROLLERS THAT ARE TO BE LINKED TOGETHER VIA THE MODULE BUS.
2. CONNECT EACH CONTROLLER TO THE SYSTEM COMMON BUS USING NO. 14 AWG.
3. CONNECT THE SYSTEM COMMON BUS TO EARTH GROUND AT ONLY ONE POINT USING NO. 8 AWG.
4. MODULE BUS WIRES SHOULD BE SHIELDED TWISTED PAIR, STRANDED WIRES INSULATED WITH LOW LEAKAGE INSULATION MATERIALS. SHIELDS SHOULD BE GROUNDED AT ONE END ONLY USING ONE OF THE TWO SCREWS LOCATED IN THE UPPER CORNERS OF THE TERMINATION UNIT. MINIMUM WIRE SIZE FOR THESE CONNECTIONS IS NO. 18 AWG.
5. TB3-2 AND TB3-4 ARE AC SAFETY GROUNDS. AC SAFETY GROUND BUS IS TO BE CONNECTED TO THE GROUNDED CIRCUIT OF THE SITE'S WIRING SYSTEM USING NO. 6 AWG TYPICAL.

TP80412C

Figure 2-4. Recommended Single Point Grounding System

The isolated system common bus should be grounded by use of a dedicated grounding electrode, i.e., a grounding electrode separate from the alternating current (safety ground) grounding electrode. There should be no greater than one-ohm resistance between the dedicated grounding electrode for the DC single point grounding system and the alternating current (safety ground) grounding electrode.

NOTE: Where it is not possible to provide a dedicated grounding electrode for system common, then connection to the site's grounding electrode must be by a grounding conductor used for no other purpose (no other equipment may be grounded through the same grounding conductor).

Input/Output Wiring

This section provides instructions for analog and digital I/O wiring.

ANALOG I/O WIRING

Wiring used for analog inputs must be carefully chosen, with consideration for environmental and electrical conditions.

- Shielded (overall or individually) twisted-pair wires for low level signal conduction are recommended to reduce the effects of electromagnetic and electrostatic noise coupling.
- An aluminum Mylar® type with a drain wire has a very good electrostatic coupling shield efficiency.
- All shields must be electrically insulated from other shields. Shields are to be grounded at one of the two screws located in the lower corners of the termination board.

  NOTE: The field end of the shield should not be connected to a ground.
- Conduit is recommended for the field portion of the run. Wherever practical, it is recommended that trays containing analog signals be devoted exclusively to that use. Conduit containing analog signals should cross power lines, etc., at right angles and remain perpendicular for at least ten times the diameter of the crossed element on either side of the crossing joints.
- Maximum wire gauge for the connectors on the rear of the Type SLC controller housing is 14 AWG.
- Connect the analog inputs and outputs using the external wiring label (Fig. 2-5) on the inside of the rear cover as a guideline for terminal block assignments.
- When connecting 2-wire RTDs to AI3/AI4 with the optional temperature input board, connect RTD COM1/RTD COM2 to AI3+/AI4+ respectively. When connecting 3-wire RTDs to AI3/AI4, connect the third wire to RTD COM1/RTD COM2.

Wiring must bear a suitable voltage rating for the highest voltage connected to the termination board (either signal or power) and a 75°C (167°F) minimum rating. Wiring must be in accordance with the National Electrical Code.

Refer to Figures 2-6 through 2-12 for typical analog input/output connection examples.

® Mylar is a registered trademark of E.I. DuPont de Nemours Company, Incorporated.

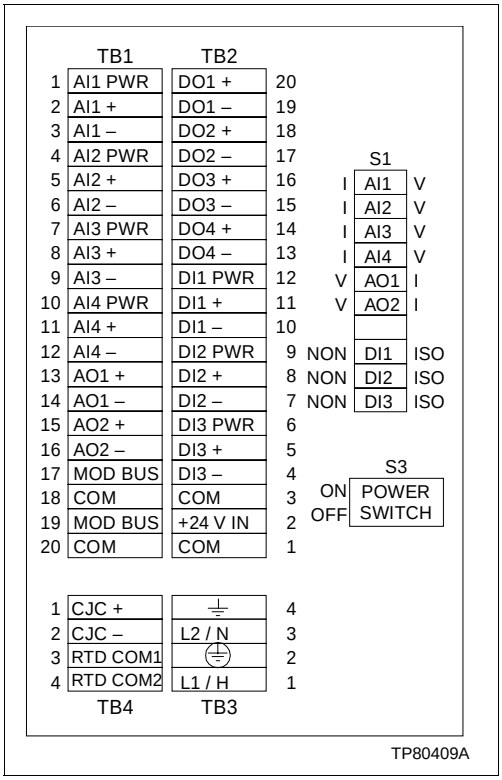


Figure 2-5. External Wiring Label

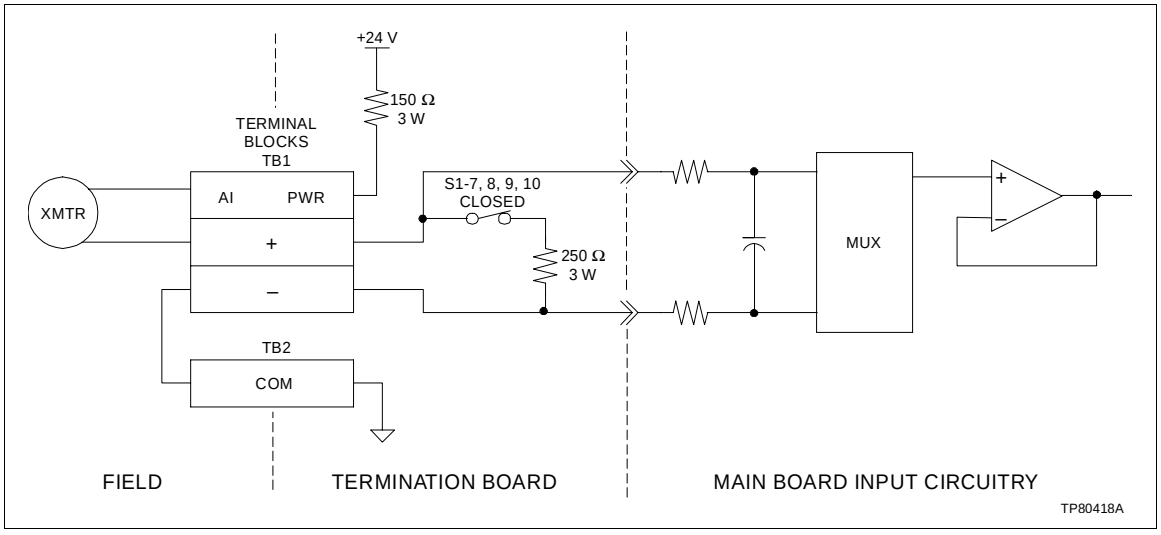


Figure 2-6. Powered Four to 20 Milliamp Analog Input

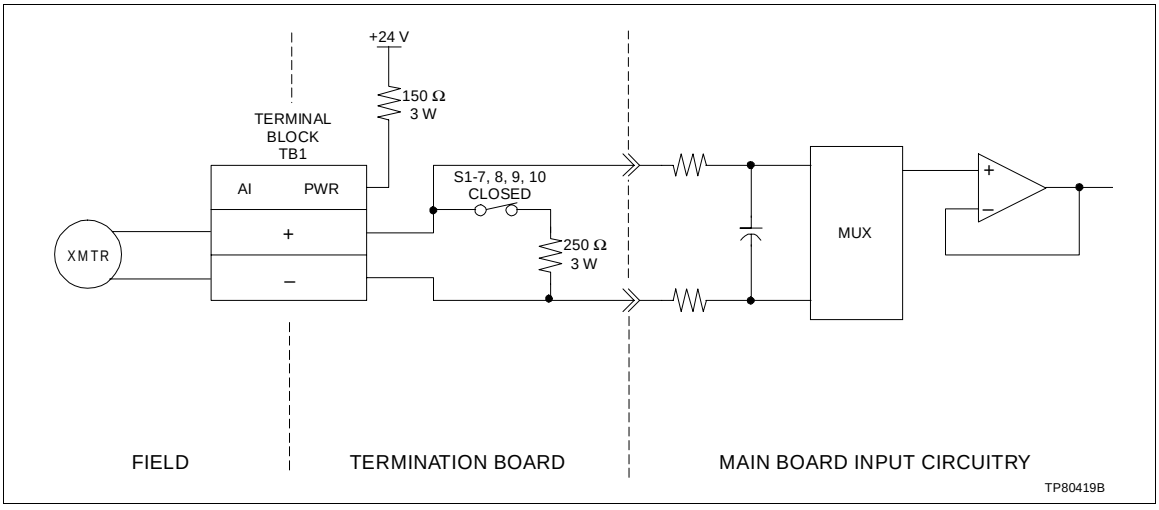


Figure 2-7. Unpowered or Field Powered Four to 20 Milliamp Analog Input

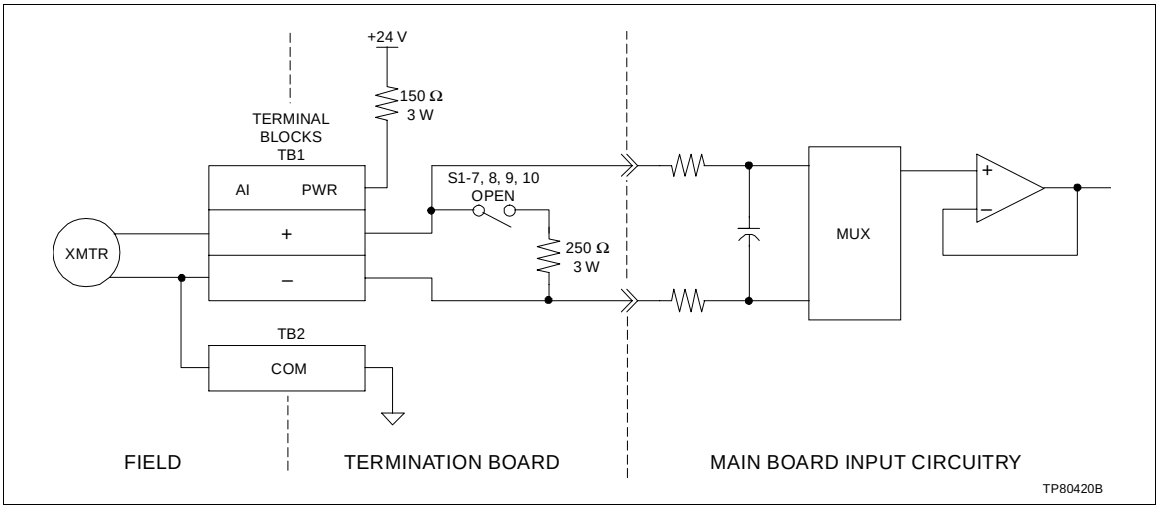


Figure 2-8. Single Ended Voltage Input

DIGITAL I/O WIRING

1. Digital input wires should be twisted-pair, stranded wires insulated with low leakage insulation materials.

2. Individually shielded pairs provide greater protection against noise and crosstalk than nonindividually shielded pairs.

3. Shields are to be grounded at one of the two screws located in the lower corners of the termination board.

> **NOTE:** The field end of the shield should not be connected to a ground.

4. Maximum wire gauge for the connectors on the rear of the Type SLC controller housing is 14 AWG.

Connect digital inputs and outputs using the external wiring label (Fig. 2-5) on the inside of the rear cover as a guideline for terminal block assignments. Refer to Figures 2-13 through 2-15 for typical digital input/output connections examples.

NOTE: Digital inputs are not individually fused. Refer to Table 1-4 for maximum rating.

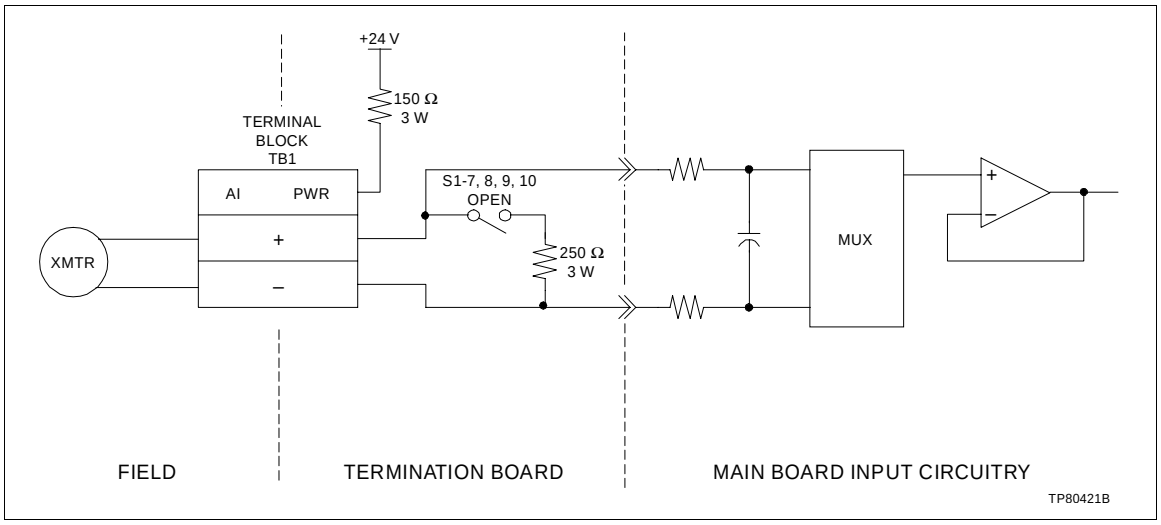


Figure 2-9. Differential Voltage Analog Input

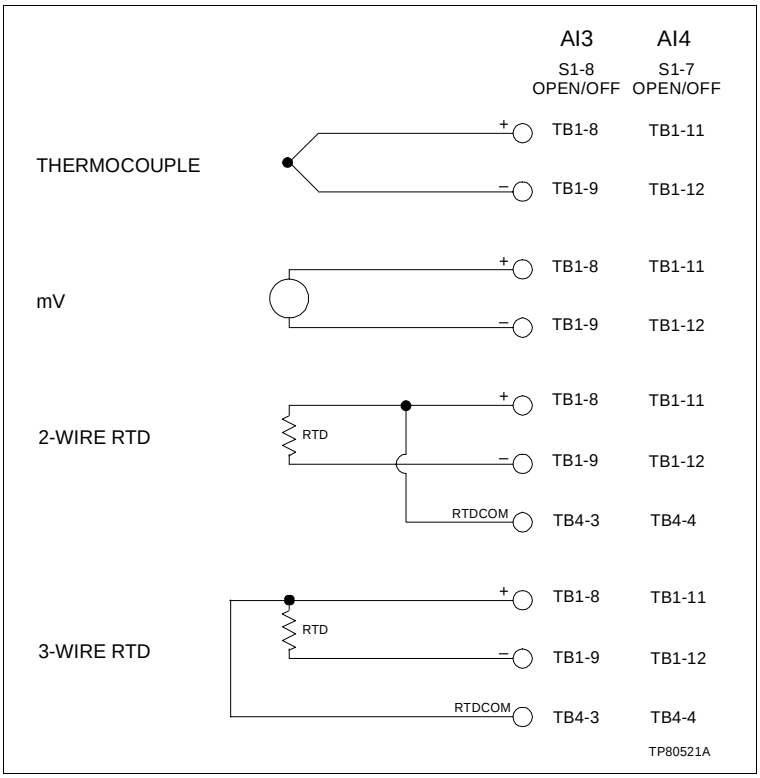


Figure 2-10. Thermocouple, Millivolt and RTD Inputs

Wiring must bear a suitable voltage rating for the highest voltage connected to the termination board (either signal or power) and a 75 degrees Centigrade (167 degrees Fahrenheit) minimum rating. Wiring must be in accordance with the National Electrical Code.

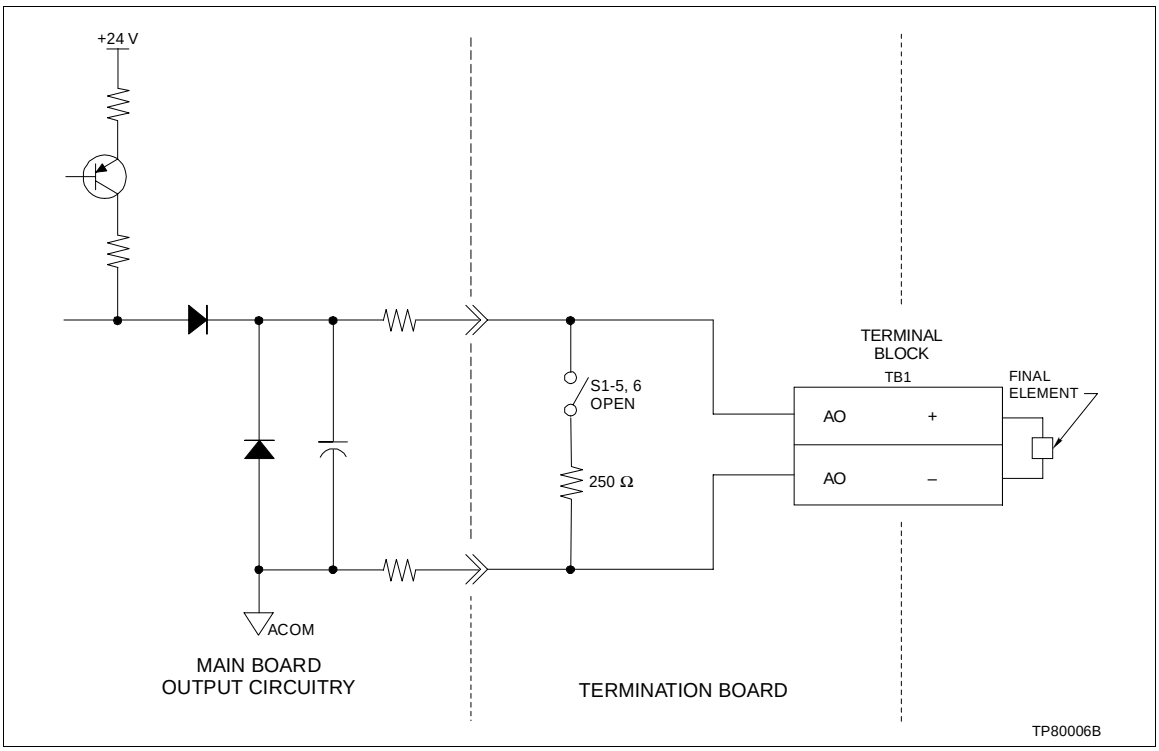


Figure 2-11. Analog Output in Current Mode

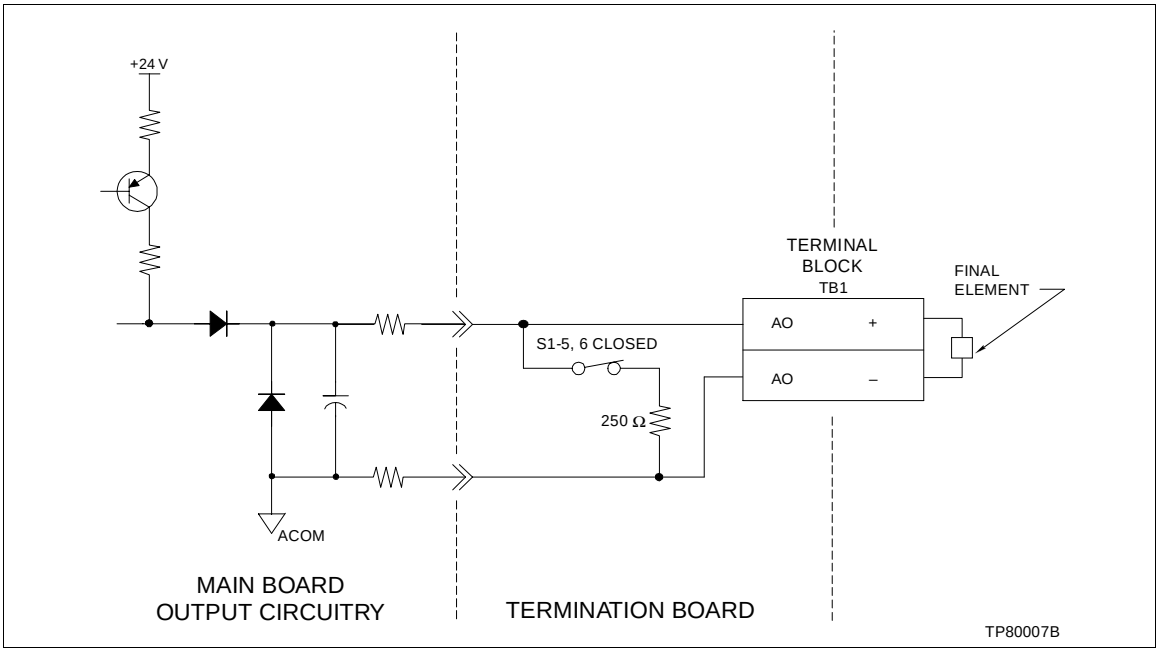


Figure 2-12. Analog Output in Voltage Mode

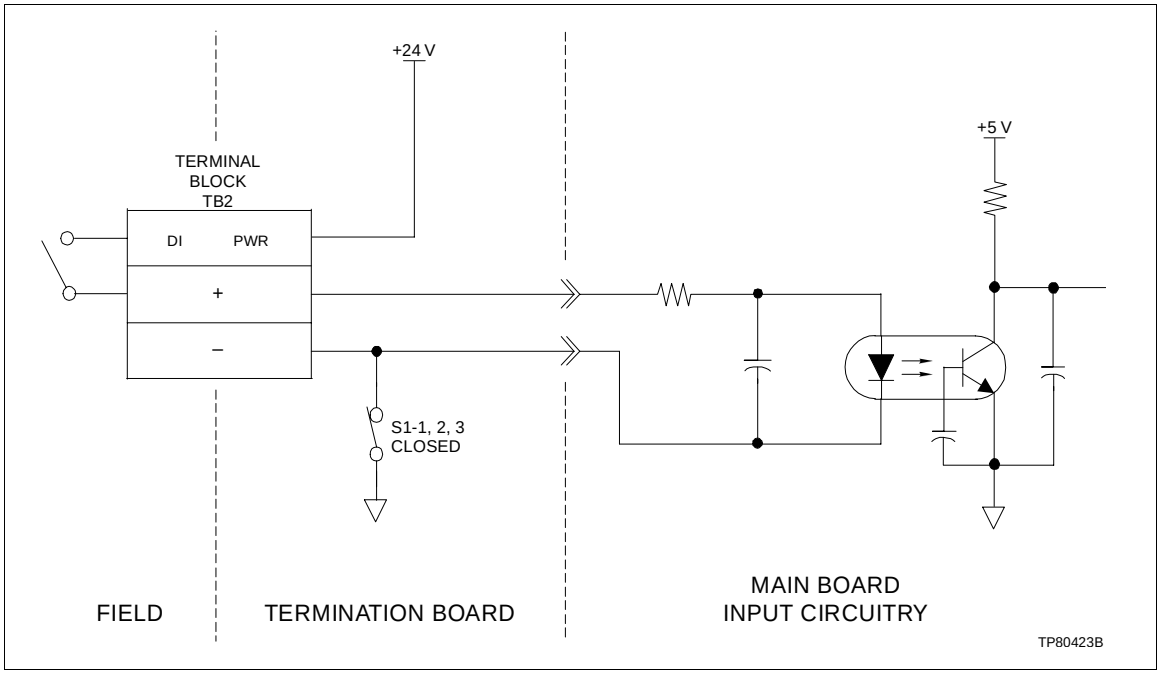


Figure 2-13. Digital Inputs in Nonisolated Mode

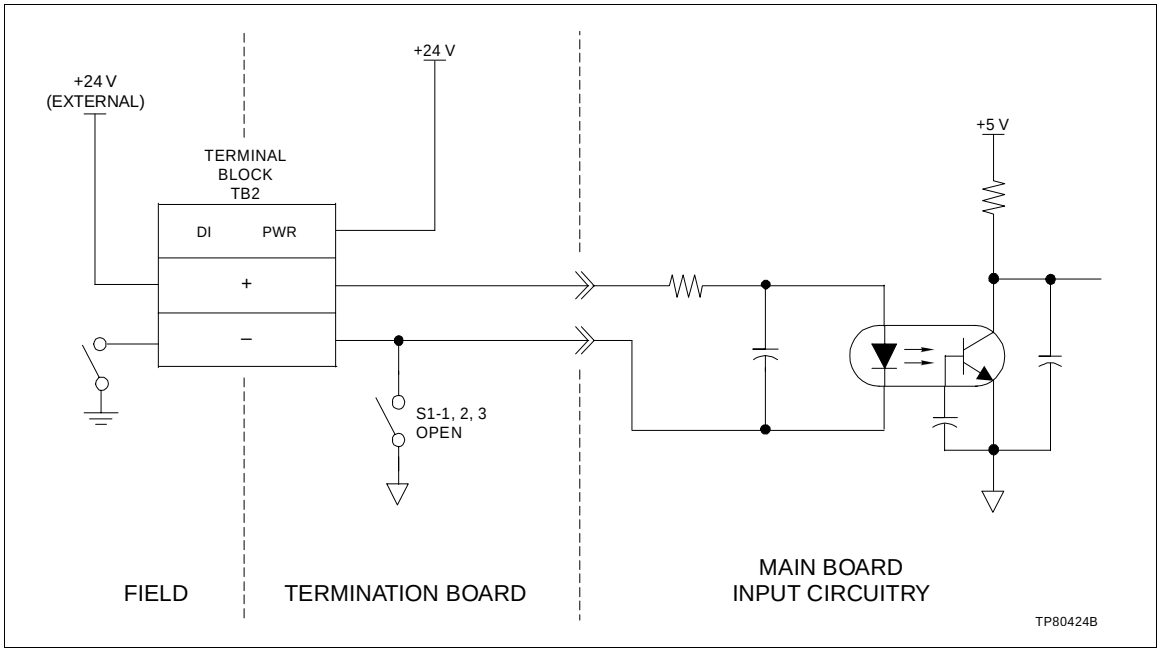


Figure 2-14. Digital Inputs in Isolated Mode

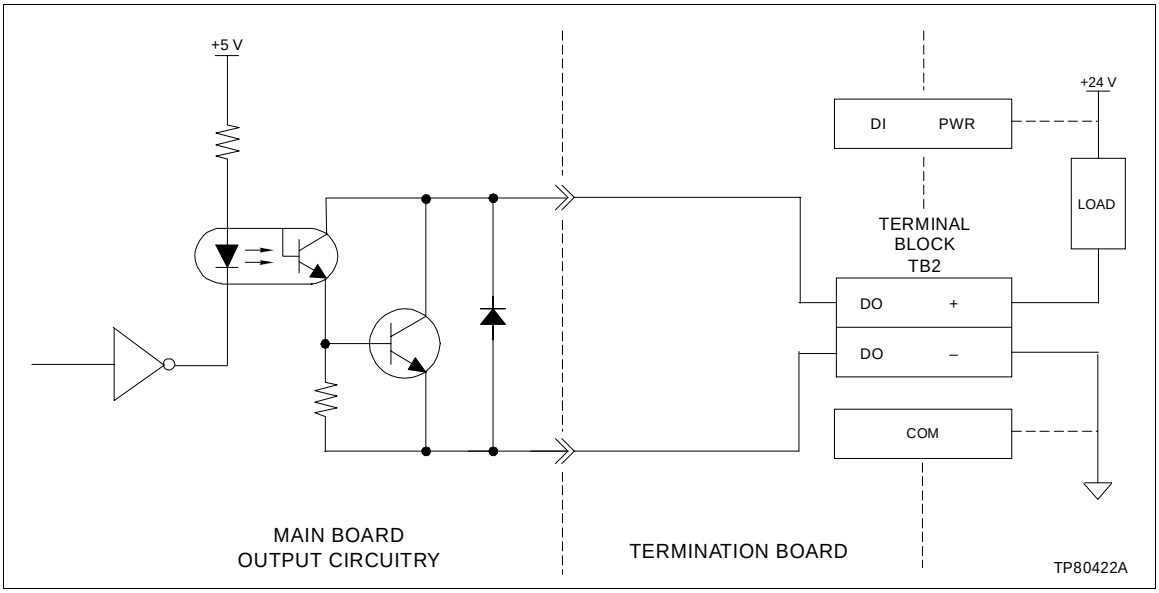


Figure 2-15. Digital Output Circuitry

Peer-to-Peer Communication Wiring

1. The module bus wires for connecting multiple Type SLC controllers should be twisted-pair stranded wires insulated with low leakage insulation materials.

2. Individually shielded pairs are recommended to provide greater protection against noise and crosstalk than nonindividually shielded pairs.

3. For each section of cable, the shield is to be grounded on one end only. To ground the shield, one of the two screws at the lower corners of the termination board or TB3-4 should be used.

4. Maximum wire gauge for the connectors on the rear of the Type SLC controller housing is 14 AWG.

5. Connect multiple Type SLC controllers via the module bus connections using Figure 2-16 as a guideline for terminal block assignments. Type CBE01 Module Bus Extenders must be used if the module bus length is more than 10 meters (32.8 feet) or where ground potentials cannot be avoided. Total maximum module bus distance with the Type CBE01 extender is 610 meters (2,000 feet). Refer to Figures 1-4 and 1-5 for location of the module bus extenders in the communication loop.

NOTE: The 1.8-meter (6-foot) cord of the Type CTT Configuration and Tuning Terminal must be included in the 10-meter distance.

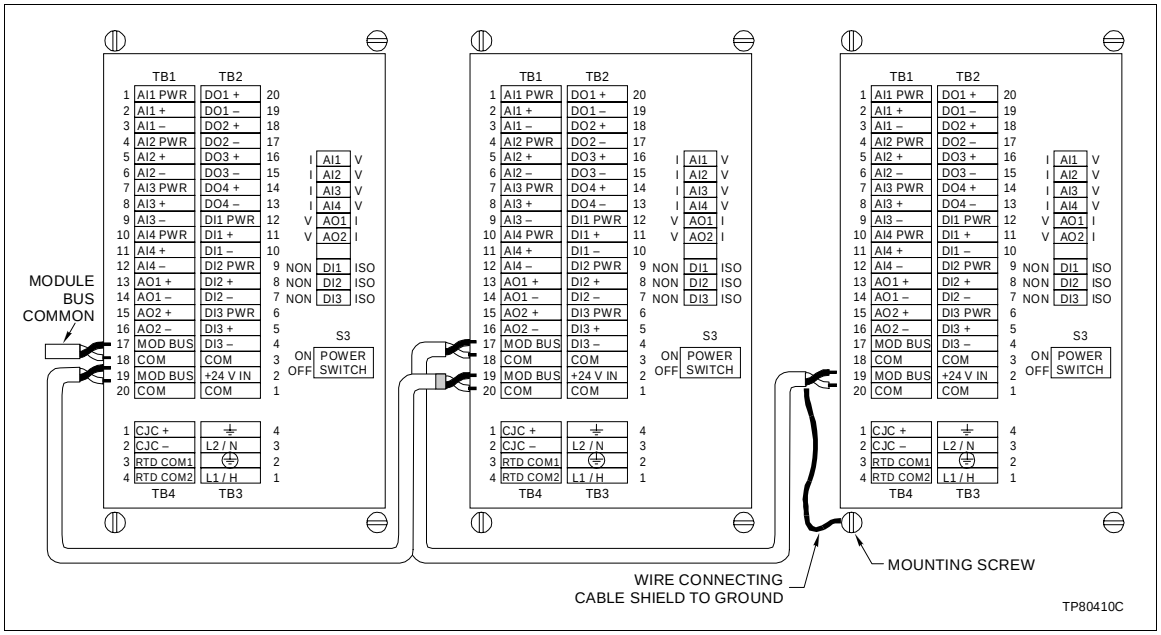


Figure 2-16. Peer-to-Peer Communications Wiring Connections

PREOPERATING SWITCH SETTINGS

Prior to starting the setup and configuration procedures, several switch settings are required on the termination board. Always use proper safety precautions when working near the wiring connections.

> **NOTE:** A power switch, S3 (Fig. 2-16), is located on the termination board to allow the external power supply (AC or DC) to be disconnected from the controller without removing the power supply wiring.

With the rear cover of the controller removed, there is a bank of switches exposed on the right side of the termination board (Fig. 2-17). These switches provide analog I/O options and digital input options.

Analog Inputs

1. Remove power. The four top switches, S1-10 through S1-7, allow either a voltage input or a current input to be applied to the analog inputs. They are factory set for a ***voltage*** input.

> **NOTE:** S1-7 and S1-8 must be in the ***open*** (off) position when using controller as low level inputs.

2. Place the switches in the ***open*** position for the analog inputs to accept a ***voltage*** input.

3. Place the switches in the ***closed*** position for the analog inputs to accept a ***current*** input.

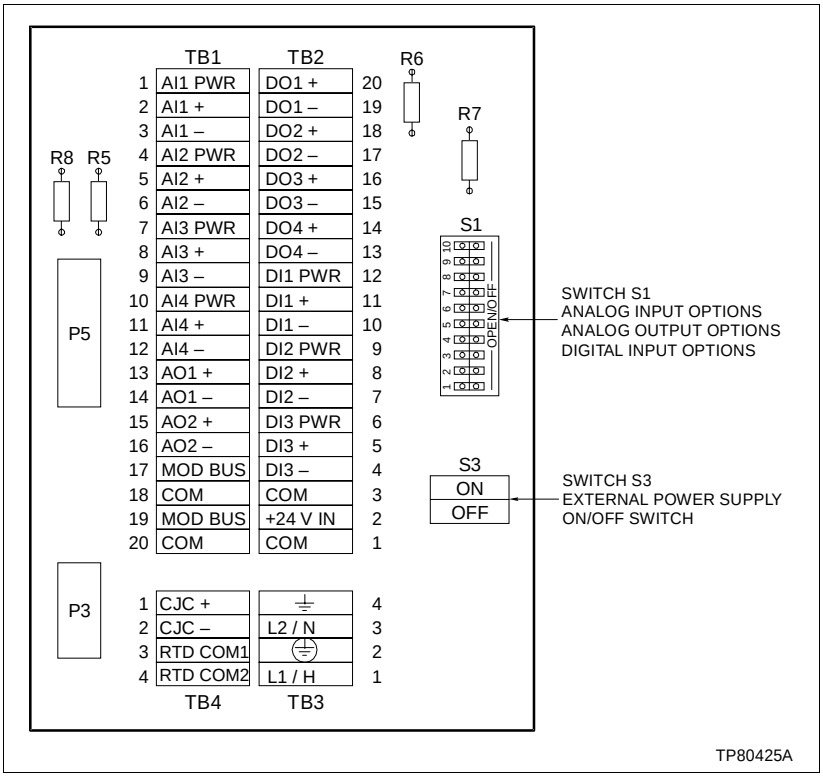


Figure 2-17. Termination Board Switch Locations

Analog Outputs

1. Remove power. Set switch S1-6 (AO1) and S1-5 (AO2) to select either a current or a voltage output. They are factory set for a ***voltage*** output.

2. Place the switch in the ***closed*** position for a ***voltage*** output.

3. Place the switch in the ***open*** position for a ***current*** output.

Digital Inputs

1. Remove power. Switches S1-3 through S1-1 allow selection of isolated or nonisolated inputs for DO1 through DO3. The switches are factory set for ***isolated*** inputs.

2. Place the switch in the ***open*** position to select an ***isolated input***.

3. Place the switch in the ***closed*** position to select a ***nonisolated input***.

Table 2-1 provides a summary of the option settings for the termination board.

Table 2-1. Termination Board Summary of Options Settings[1]

Option	Control	Setting[2]	Description	Sample Switch Configuration Figure No.
Analog input 1	S1-10	Closed	Current input	Figures 2-6 through 2-10
		Open	***Voltage input***	
Analog input 2	S1-9	Closed	Current input	
		Open	***Voltage input***	
Analog input 3	S1-8	Closed	Current input	
		Open	***Voltage input***	
Analog input 4	S1-7	Closed	Current input	
		Open	***Voltage input***	
Analog output 1	S1-6	Closed	***Voltage output***	Figures 2-11 and 2-12
		Open	Current output	
Analog output 2	S1-5	Closed	***Voltage output***	
		Open	Current output	
(None)	S1-4	None	Not used	—
Digital input 1	S1-3	Open	***Isolated input***	Figures 2-13 and 2-14
		Closed	Nonisolated input	
Digital input 2	S1-2	Open	***Isolated input***	
		Closed	Nonisolated input	
Digital input 3	S1-1	Open	***Isolated input***	
		Closed	Non-isolated input	

NOTES:
1. Bold text indicates factory settings.
2. Off = open, on = closed.

SECTION 3 - SETUP

INTRODUCTION

This section provides walk-through procedures for the menu-driven controller setup. Setup worksheets are provided in Appendix B. It is recommended that the worksheets be filled in prior to starting the setup procedures. All the data will then be available to make the entries.

> **NOTE:** Setup personnel should have a solid background in electronics instrumentation and process control and be familiar with proper safety procedures for electronic instrumentation.

SCREEN CONVENTIONS AND PUSHBUTTON FUNCTIONS

The screen displays illustrated in procedural steps throughout this section contain circled numbers. Those numbers reference the step number of the procedure and are not on the actual display.

Whenever there is more than one choice available to the user on a screen display, the choices are bracketed [ ] on the screen illustration or are located in the right margin.

The graphics of the screens presented are close representations, but data may vary in size and position.

Pushbutton functions are shown in Figure 3-1.

Single Function Pushbuttons

The three marked pushbuttons at the bottom of the faceplate are single function keys.

▲, ▼ Controls cursor movement, changes selection choices on screens, and increments or decrements selected parameter values when changing a numeric variable.

A/M Does not perform any action in the setup screens.

SEL Allows selecting a highlighted parameter in a menu. On screens with variables instead of menus, it will cause the unit to enter the change mode on the variable highlighted to change its value.

Multi-Function Soft Keys

Three unmarked soft keys directly below the display are multi-function keys. The specific function of these keys is

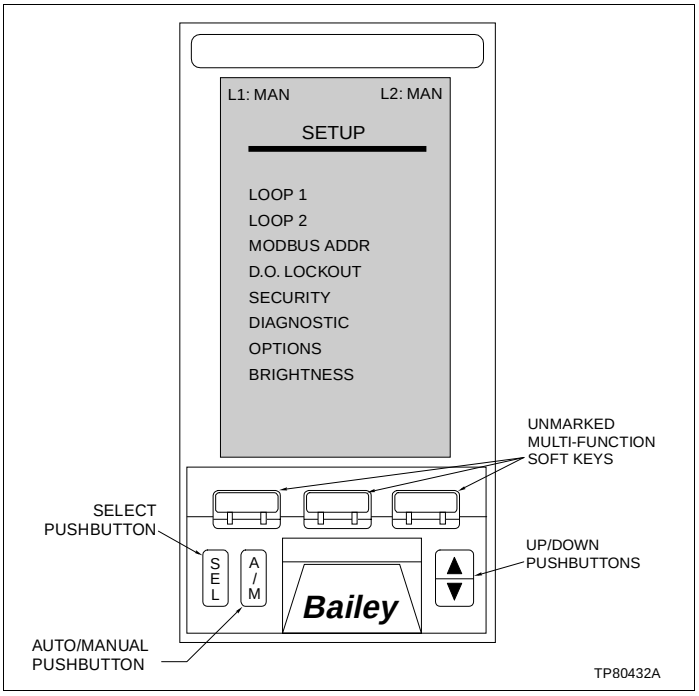


Figure 3-1. Setup Menu

defined by the graphics and will vary depending on the screen displayed. When no soft key menu is displayed directly above the soft keys, touching any of these soft keys will display a soft key menu. Once this soft key menu is displayed, pressing the soft key below the menu item desired will initiate the defined action.

SETUP MENU OPTIONS SUMMARY

From the setup menu, several options are available. Following is a brief description of each option (Fig. 3-1).

LOOP 1 Allows configuration of such items as tag name, process variable and set point engineering units, maximum number of decimal places displayed, control output high and low tag, power up mode, power up level for AO1, fail level for AO1, state of the audible alarm associated with loop 1, bypass direction, and process display type for loop 1.

LOOP 2 Allows changing the same parameters for loop 2.

MODBUS ADDR Gives the option to set the software module bus address. Factory default is 2.

D.O. LOCKOUT Allows individually locking or unlocking each digital output from faceplate control.

SECURITY Allows changing the security passwords and the password level required for several of the main menu options.

DIAGNOSTIC Performs tests to verify the correct functionality of the unit's hardware.

OPTIONS Executes a submenu which contains option board setup, faceplate switch setup for both loop 1 and loop 2, auxiliary switch label settings, ambient temperature entry and trend loop 1 and trend loop 2 screen option.

BRIGHTNESS Allows changing the display to the desired brightness level.

ENTER SETUP

The controller setup is accomplished from the faceplate using the setup menu. This procedure is for all users, i.e., for those selecting or modifying a factory configuration, or developing a custom configuration.

Make certain that your selections provide a process condition that is unlikely to cause injury or equipment damage if a problem occurs.

NOTES:

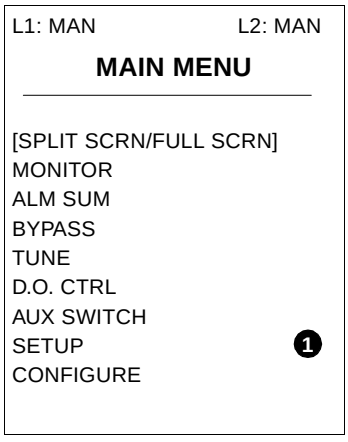
1. A continuous push of ▲ or ▼ will accelerate the ramping function during procedural steps.

2. The following procedure is presented for single loop controllers. Whenever loop 1, AO1, is referenced, repeat the procedure for loop 2, AO2, if required.

3. Setup procedures should be run with the unit off-line.

1. From the main menu, press ▲ or ▼ until *SETUP* is highlighted.

2. Press SEL.

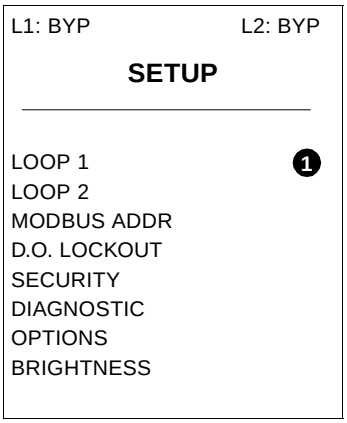


PROCESS LOOP SETUP

Loop Tag Name

1. From the setup menu, press ▲ or ▼ to highlight *LOOP 1*. Press SEL. The loop label menu will appear.

The loop tag name is a user-defined character string depicting the tag name for the selected loop. The maximum number of characters allowed is 14. Tag names less than 11 characters will appear on the display in a larger font. Valid characters are A to Z, 0 to 9, - (hyphen), *, (,), /, ° and '.



Tagname

2. If *Tagname* is not highlighted, press ▲ or ▼ until it is. Press SEL. The cursor will appear on the left side of the screen and the soft key menu will be displayed. Choose the characters for the description. Press ▲ or ▼ until the character appears and then press the soft key below ← or → to move the cursor to the next position. Once the tag name characters have been entered, press SEL.

PV and Set Point Engineering Units

The process variable and set point engineering units are user-defined character strings depicting the name of the units of the values. The maximum number of characters allowed is five. Valid characters are A to Z, 0 to 9, - (hyphen), *, (,), /, ° and '.

PV EU
SP EU

3. Press ▲ or ▼ until *PV EU* is highlighted. Press SEL. Select the process variable engineering units. Press ▲ or ▼ until the character appears and then press the soft key below ← or → to move the cursor to the next position. Once the engineering unit characters have been entered, press SEL. Repeat this step to set the engineering units for the set point (*SP EU*).

Decimal Places

This value controls the maximum number of digits after the decimal point is displayed on process display screens. Setting this number to four allows the value to be displayed with the most number of decimal places. For example, if the process variable has a range of zero to 100, normal display would include a maximum of one decimal place. Changing this number to zero limits the display to zero decimal places. Selecting

one or less decimal places causes the displayed value to be shown in a larger font.

> **NOTE:** Maximum number of decimal places displayed on the trend screen option is two.

DEC PLACES

4. To set the decimal places, press ▲ or ▼ until *DEC PLACES* is highlighted. Press SEL. A selection box will appear. Press ▲ or ▼ until the correct number of decimal places appears (0, 1, 2, 3 or 4), then press SEL.

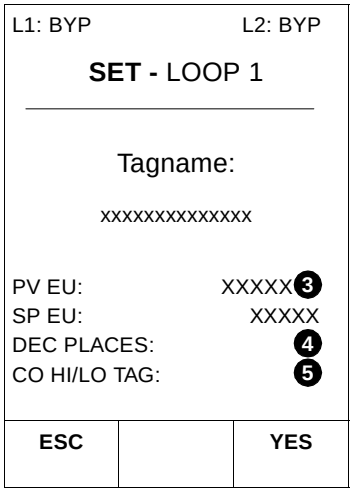
Output Bar Graph High/Low Labels

The control output bar graph on the process display screen has multiple labels from which to choose. Valid choices are zero to 100, 100 to zero, CLS to OPN, and OPN to CLS.

CO HI/LO TAG

5. Press ▲ or ▼ until *CO HI/LO TAG* is highlighted. Press SEL. A selection box will appear. Select the bar graph control output tag (*0/100, 100/0, CLS/OPN* or *OPN/CLS*) using ▲ or ▼. Press SEL.

6. To continue, press the soft key below *NEXT SCRN* and the loop options menu will appear.



0, 1, 2, 3, 4

0/100,100/0, CLS/OPN, OPN/CLS

LOOP OPTIONS

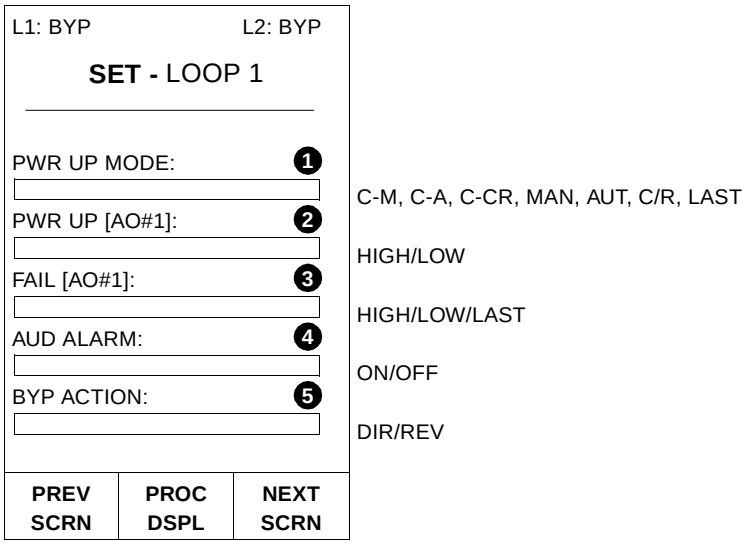
Station Power Up

This specification is the initial mode of the control loop after start-up. The station will be in bypass mode for the configurable start-up period after power up/reset/switch-to-execute mode. After the start-up period expires, the mode is as indicated by this specification unless overridden. When configuring a loop to last mode, the actual mode will be the last mode prior to power up/reset/switch-to-execute until modified by the operator or logic. When selecting local cascade/ratio, cascade or ratio, control will be implemented depending upon the

station type. Valid selections are C-M, C-A, C-CR, manual, auto, cascade/ratio or last.

PWR UP MODE

1. Press ▲ or ▼ until *PWR UP MODE* is highlighted. Press SEL. Select the mode desired upon power up of the controller [*C-M* (computer-manual), *C-A* (computer-auto), *C-CR* (computer-cascade/ratio), *MAN*, *AUT*, *C/R* (cascade/ratio) and *LAST*]. Press ▲ or ▼ until the desired mode is highlighted. Press SEL.



Analog Output Power Up Level

This option determines what value the analog output is set to while the unit is powering up. Valid selections are *HIGH* and *LOW*. The high value is 5.25 VDC or 21 milliamps, while the low value is 0.75 VDC or three milliamps. This value will remain in effect for the configurable start-up period after power up. After the start-up period expires, the output will be determined by the mode or operator setting.

PWR UP [AO#1]

2. Press ▲ or ▼ until *PWR UP [AO#1]* is highlighted. Press SEL. A selection box appears. Press ▲ or ▼ to select *HIGH* (5.25 VDC/21 mA) or *LOW* (0.75 VDC/3 mA). Press SEL.

Analog Output Default

This option determines what value the analog output is set to when the unit has failed. If a failure should occur, the controller will go into bypass mode. Valid selections are *HIGH*, *LOW* and *LAST*. The high value is 5.25 VDC or 21 milliamps, while the low value is 0.75 VDC or three milliamps. Selecting *LAST* maintains the last valid analog output value until the unit is powered down/reset/switch-to-execute.

FAIL [AO#1]

3. Press ▲ or ▼ until *FAIL [AO#1]* is highlighted. Press SEL. A selection box will appear. Press ▲ or ▼ to select *HIGH*, *LOW* or *LAST*, then press SEL. For additional information, refer to ***Analog Output Default Settings***.

Audible Alarm

This option allows enabling or disabling the audible alarm located inside the unit. The audible alarm will sound when there is an unacknowledged alarm associated with the loop.

> **NOTE:** Disabling loop specific alarms also disables non-loop specific alarms.

AUD ALARM

4. Press ▲ or ▼ until *AUD ALARM* is highlighted. Press SEL. A selection box will appear. Press ▲ or ▼ to select *ON* or *OFF*, then press SEL.

Direct/Reverse Bypass Operation

When the unit enters bypass mode, this option determines direction of the control output action of the analog signal with respect to changes in the control output percentage. Direct action is analogous to fail close or air-to-open (ATO); reverse action is analogous to fail open or air-to-close (ATC).

For example, if direct is chosen and the displayed output percentage was 25%, 2 V (8 mA) will appear on the analog output and increasing percent drives the output to 5 V (20 mA). If reverse is chosen with a 25% displayed output, 4 V (16 mA) will appear at the analog output, and decreasing percent drives the output to 5 V (20 mA). This option must be consistent with the configuration to support ATC/ATO final control element in the main board. Refer to ***Reverse Acting Final Control Elements*** in Section 4 for supporting logic.

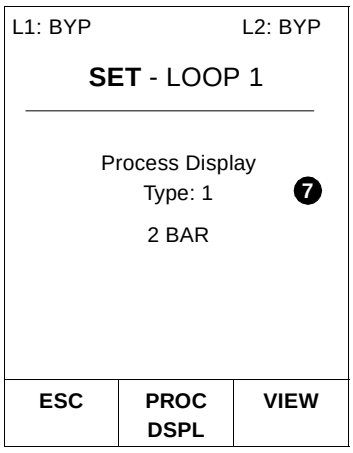
BYP ACTION

5. Press ▲ or ▼ until *BYP ACTION* is highlighted. Press SEL. To select the action when the controller is in bypass mode, press ▲ or ▼ to select *DIR* or *REV*. Press SEL.

6. Press the soft key below *NEXT SCRN* to continue.

Process Display Type

7. The select *Process Display Type* screen will appear. This option allows selecting the type of process display. There are four selections as shown (Fig. 3-2). Press ▲ or ▼ to scroll the types. If the soft key below *VIEW* is pressed, a view of that type process display screen will appear. Once the selection has been made, press SEL to return to the setup menu.



Choose 1 of 4 types:
1 = 2 bar
2 = 3 vertical bar
3 = 2 vertical bar (horizontal CO)
4 = 2 vertical bar (reverse SP and PV) with horizontal CO

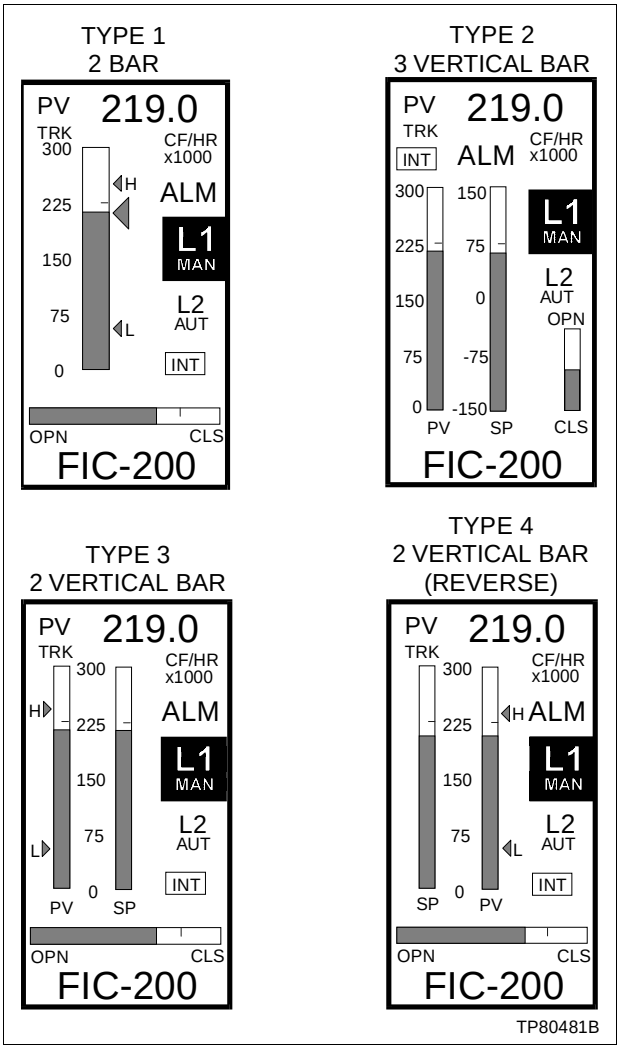


Figure 3-2. Process Display Selections

MODULE BUS ADDRESS

This option determines which software address is used to communicate to this device via the module bus (such as with a Type CTT02 Configuration and Tuning Terminal). The range of this value is zero through 31. Addresses zero and one are typically reserved for loop communication modules and should be used with caution.

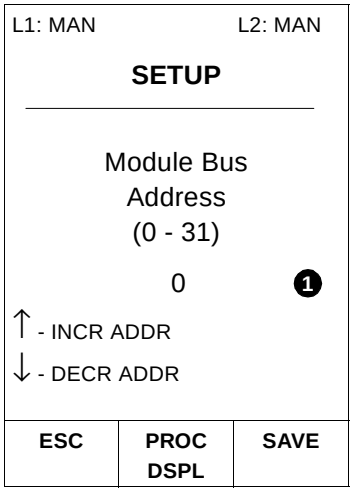
> **NOTE:** It is recommended that module bus address two be left vacant so it can be used for installations when more than one Type SLC controller will be on the same module bus.

MODBUS ADDR

1. From the setup menu, press ▲ or ▼ until *MODBUS ADDR* is highlighted. Press SEL. Set the module bus address for the controller by pressing ▲ or ▼ until the correct value appears.

2. Press the soft key below *ESC* to leave this screen or below *SAVE* to confirm the entry. Either soft key selection returns to the setup menu.

NOTE: The module bus address default is two.

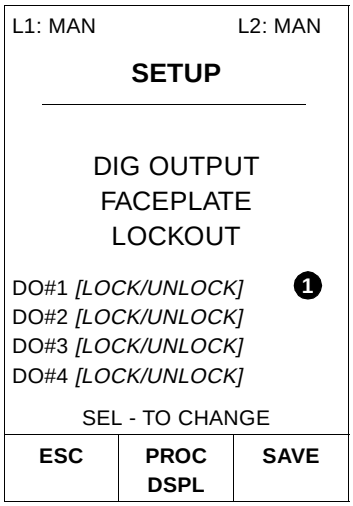


DIGITAL OUTPUTS LOCKOUT

The digital output lockout is a security function that prevents manual changing of the digital outputs from the faceplate. The digital outputs may also be locked out from the configuration. When viewing the digital output control screen, **LOCK* is used to designate that the digital output has been locked by this option, while *LOCK* designates that it has been locked by the configuration.

D.O. LOCKOUT

1. From the setup menu, press ▲ or ▼ until *D.O. LOCKOUT* is highlighted. Press SEL. Press ▲ or ▼ until *DO#1* is highlighted. Press SEL to toggle between *LOCK* and *UNLOCK*. Repeat this step to set all the digital outputs. Press one of the soft keys and the soft key menu will appear.



2. Press the soft key below *ESC* to leave this screen or below *SAVE* to confirm the entry. Either soft key selection returns to the setup menu.

Refer to ***Digital Output Control*** for additional information.

SECURITY LEVELS

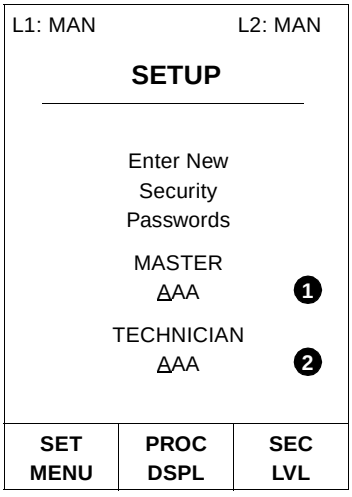
The security environment allows setting a password consisting of three alphanumerics to two levels, technician and master. The master password can be used to enter any of the environments, as it overrides the technician password. Security levels are intended to provide a way to prevent unauthorized changes to the controller.

NOTES:
1. The security feature is optional and is not required for operation of the unit.

2. A master password is required to set or change security levels.

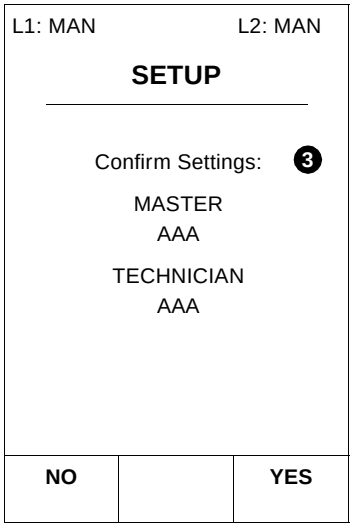
1. From the setup menu, press ▲ or ▼ until *SECURITY* is highlighted. Press SEL. The security password screen will appear. If it is desired to set up a security function, determine a password for both master and technician. *MASTER* should be highlighted. Press SEL again. The soft key menu will appear and a cursor will appear on the left side of the password to be entered.

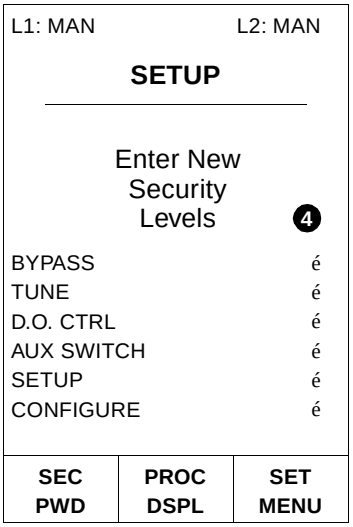
2. Choose any ASCII character for the password. Maximum characters for the password are three. Press ▲ or ▼ until the character appears and then press the soft key below ← or → to move the cursor to the next position. Once the master password characters have been entered, press SEL and then ▲ or ▼ to highlight *TECHNICIAN*. When the passwords have been entered, press SEL.



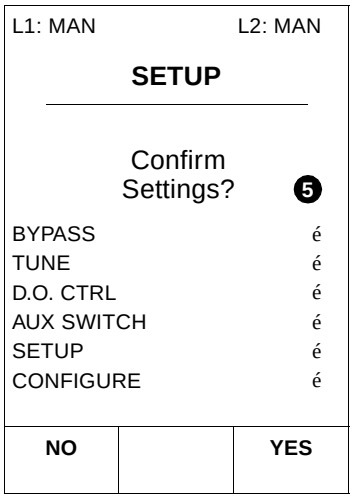
3. Press any soft key. When the soft key menu appears, press the soft key below *SEC LVL*. A *Confirm Settings:* screen will appear. Press the soft key below *YES* to confirm or *NO* to not confirm.

4. Once the passwords are confirmed, the security level screen will appear automatically. Security levels can only be entered for *BYPASS, TUNE, D.O. CTRL, AUX SWITCH, SETUP* and *CONFIGURE* functions. With *BYPASS* highlighted, continue to press SEL to enter the choice: *T* for technician, *M* for master and blank for none.





5. To continue, press ▲ or ▼ to the next function. Press SEL until the level is correct. Repeat this step to assign the security levels for the rest of the functions. Once complete, press any soft key and the soft key menu will appear. Press *SET MENU* and the *Confirm Settings?* screen will appear. Press the soft key below *YES* or *NO*. Return to the setup menu and continue.



DIAGNOSTICS

Refer to ***SECTION 6 - TROUBLESHOOTING AND DIAGNOSTICS***.

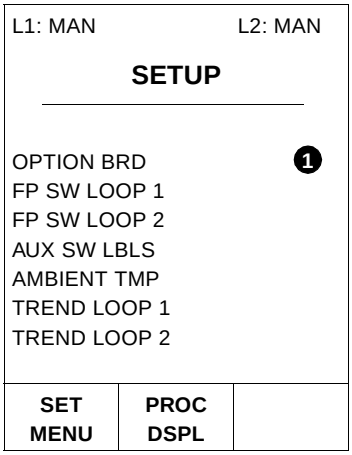
OPTIONS

Optional Temperature/ Frequency Input Board

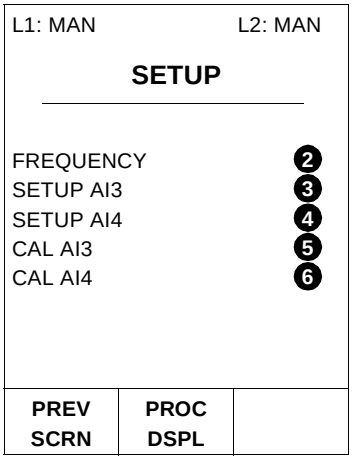
1. To continue from the setup/options menu, press ▲ or ▼ until *OPTION BRD* is highlighted. Press SEL (option board is installed at the factory on Type SLC2 controllers). If no option board is installed, a message appears:

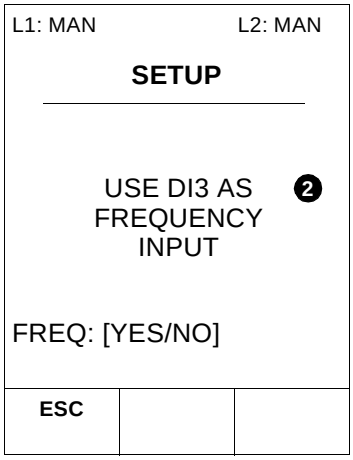
OPTION BRD NOT INSTALLED
PRESS ANY KEY TO CONTINUE

If an option board is installed, the option board screen will appear and *FREQUENCY* is highlighted. Press SEL.



FREQUENCY This option determines whether digital input three is to be used as a frequency input. This feature is only available if the option board is installed and the main board jumpers have been properly positioned.



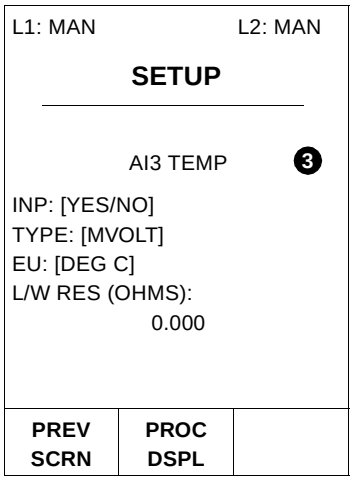


2. For controllers with the optional frequency input, press SEL when *FREQUENCY* is highlighted and the DI3 setup screen appears. Press SEL and a *NO/YES* box will appear on the screen. Press ▲ or ▼ to select. When the correct input is highlighted, press SEL to confirm the entry. Press the soft key below *PREV SCRN* to return to the setup/option board menu.

SETUP AI3

This option allows defining analog input three as a temperature input. An option board must be installed with the main board jumpers set in order for a temperature input to be used (Fig. D-1). Function code 182 N output (mV) must be referenced to S3 of function code 230 at block 100 (Fig. A-2).

3. For controllers with the optional temperature input that replaces the standard AI3 input, press SEL when *SETUP AI3* is highlighted. An *AI3 TEMP* setup screen appears. Press SEL and a *NO/YES* box will appear on the screen across from *INP:*. Press ▲ or ▼ to select *YES*, then press SEL. Press ▲ or ▼ to select *TYPE*. Press SEL and a box will appear with an input selection list. Press ▲ or ▼ to scroll through the input list. When the correct input is highlighted, press SEL.



Input Selection List

UNDEFINED	CH S T/C
MVOLT	2/100 LAB
S T/C	2/100 IND
R T/C	2/100 EUR
E T/C	2/PURE NI
J T/C	3/100 LAB
K T/C	3/100 IND
T T/C	3/100 EUR
CH E T/C	3/PURE NI

Set the engineering units (*EU*) in degrees Celsius or Fahrenheit. To set the resistance (*L/W RES [OHMS]*), press SEL. A new soft key menu will appear and a cursor will be under the first zero to the right of the decimal. Use the soft keys below ← and → to position the cursor and press ▲ or ▼ to establish the correct value. When complete, press SEL. Press the soft key under *PREV SCRN*. A warning will appear.

NOTES:

1. Whenever the *ESC* soft key menu option is shown, pressing the soft key directly below it deletes the entered information for that function and the correct information can be entered.

2. For controllers with optional temperature inputs, in addition to completing Step 3, also complete a calibration procedure for temperature inputs. These screens are listed as *CAL AI3* and *CAL AI4*.

WARNING		
Unit will be placed in Bypass to update SETUP DATA ❸ SAVE DATA?		
NO		**YES**

SETUP AI4

This option allows defining analog input four as a temperature input. An option board must be installed with the main board jumpers set in order for a temperature input to be used and function code 182 N (mV) output must be referenced to S4 of function code 230 at block 100 (Fig. A-2).

4. For controllers with two optional temperature inputs that replace the standard AI3 and AI4 inputs, press SEL when *SETUP AI4* is highlighted. Repeat Step 3 for the *SETUP AI4* procedure.

Calibrate AI3/AI4

This option allows calibrating analog input three and/or analog input four when being used as a temperature input.

NOTE: A 0 to 60 mV source, accurate to 0.01%, is required for calibration if mV or thermocouple was selected in setup. If RTD was selected in setup, calibration requires a precision 300-ohm resistor with 0.1% accuracy or better. The screens in the following CAL AI3 and CAL AI4 text are for millivolt or thermocouples. The values and text on the screens will automatically change if RTD has been chosen. Refer to Figure 3-3 for calibration connections.

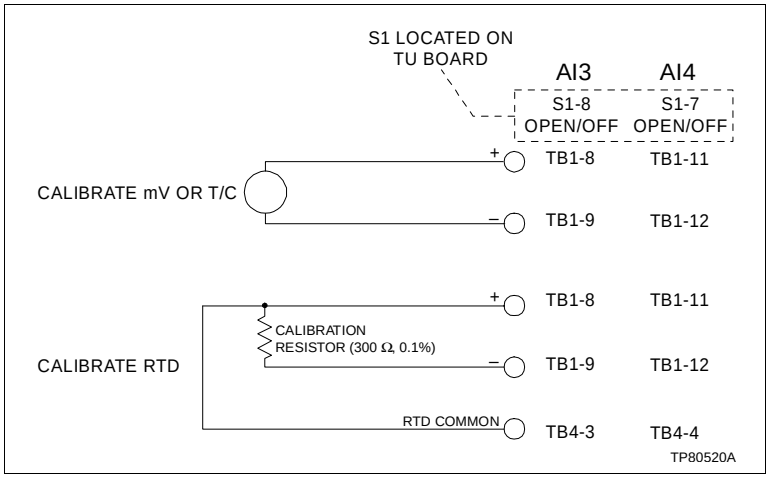
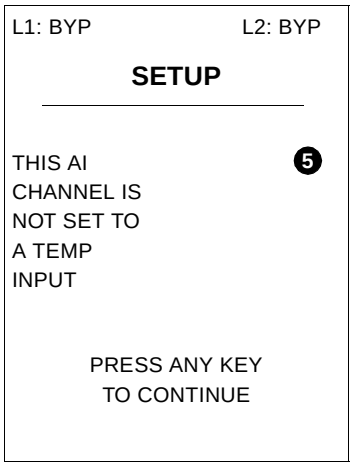
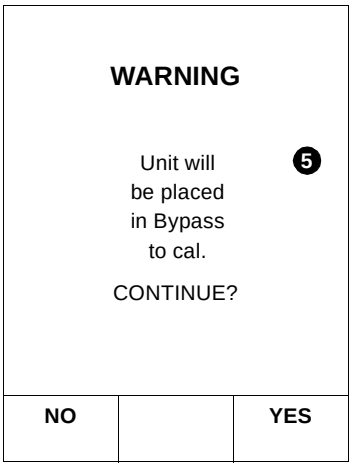


Figure 3-3. AI3 and AI4 Calibration Connections

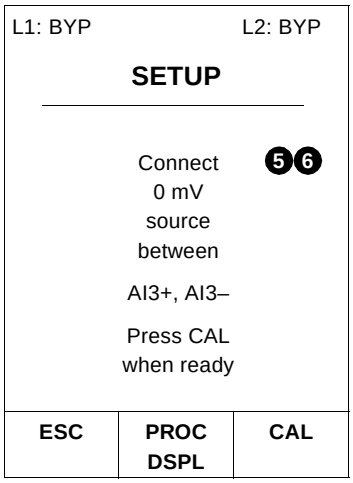
CAL AI3

5. From the options/setup menu, press ▲ or ▼ to highlight *CAL AI3*. Press SEL. If AI3 has not been set as a temperature input from the *OPTION BRD* screen, the message shown in the following screen on the left will appear. Press any key to return to the options menu and follow Step 3. If AI3 has been selected as a temperature input, the following warning message and then a calibration screen will appear. Connect an external 0 to 60 mV source that has an accuracy of 0.01% and follow the instructions on the screen.





6. When the soft key below *CAL* is pressed, the controller will take a reading of the 0 mV source. Once the reading is taken, the screen will change to say connect 60 mV between AI3+ and AI3–. Press the soft key below *CAL*. Once the reading is complete, the controller will return to the options menu.



CAL AI4

Repeat Steps 5 and 6 for AI4 if required. After calibration is complete, a short message will appear:

CHANNEL CAL. OK! PRESS ANY KEY TO CONTINUE

The setup menu will appear. Press the soft key below *PREV SCRN* and the main setup/options screen appears.

7. If channel calibration fails, a message appears:

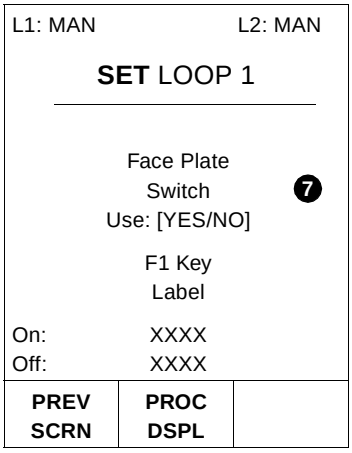
CHANNEL CAL FAIL: PRESS ANY KEY TO CONTINUE

Repeat Steps 5 and 6. If calibration fails again, check jumper settings on the main and option boards.

User-Defined Faceplate Switch

The faceplate can be used to tie a boolean value in the configuration to a switch on the faceplate. This allows changing the state of the switch from the process display screen as well as viewing the current state.

NOTE: This switch is not available when a cascade or ratio configuration is used.



FP SW LOOP 1

8. To continue, press ▲ or ▼ to highlight *FP SW LOOP 1*. Press SEL. This option allows making the left unmarked soft key (named F1) a user-defined switch, and labeling the switch. Normally, the soft key menu item in that position displays *PREV SCRN*. Selecting this option disables the *PREV SCRN* function for this particular loop. With the highlight on *Use:* press SEL and a *YES/NO* box will appear. By selecting *YES* with ▲ or ▼, this soft key menu display can be changed to designate a switch. Two four-character tags can be designated to show the switch as being on or off. This option is available for either loop 1 or loop 2 or both.

9. If this option is not desired, select *NO* by pressing ▲ or ▼. Press SEL and go to Step 11.

10. If this option is desired, select *YES* by pressing ▲ or ▼. Press SEL. Press ▲ or ▼ until *ON:* is highlighted. Press SEL. The cursor and a soft key menu will appear. Press ▲ or ▼ to select the character. Use the soft keys below ← and → to move the cursor. Press SEL.

11. Press ▲ or ▼ until *OFF:* is highlighted. Press SEL. The cursor and a soft key menu will appear. Press ▲ or ▼ to select the character. Use the soft keys below ← and → to move the

cursor. Press SEL. Press any soft key. Press the soft key below *PREV SCRN* to return to the setup menu.

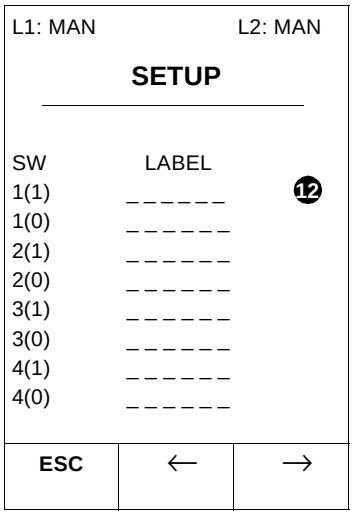
> **NOTE:** Whenever the *ESC* soft key menu option is shown, pressing the soft key directly below it deletes the entered information for that function, and the correct information can be entered.

Auxiliary Switch Labels

Four general purpose switches are available. Most frequent use of these switches is to access digital outputs for alarms, etc. This selection allows defining a six-character label for the logic states of the switch.

AUX SW LBLS

12. From the options menu, press ▲ or ▼ to highlight *AUX SW LBLS*. Press SEL. Press ▲ or ▼ to highlight the switch. Press SEL. Use the soft keys below ← and → to move the cursor. Press ▲ or ▼ to select the characters. Changes to this switch state after setup is complete are done from the main menu under *AUX SWITCH*. Refer to Section 5 for additional information. Press SEL to confirm. Press the soft key below *PREV SCRN* to continue and return to the options/setup menu.

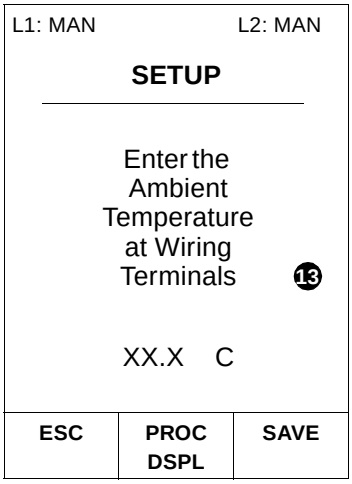


Ambient Temperature

This option allows entering the ambient temperature at the terminals to set the cold junction compensation conversion factor. This procedure is usually performed at the factory. It must be done in the field when the following circumstances exist: the main board, termination unit or cold junction compensator is replaced; a cold junction error exists; or when an optional temperature input is used.

AMBIENT TMP

13. From the options menu, press ▲ or ▼ to highlight *AMBIENT TMP*. Press SEL. Enter the ambient temperature at the wiring terminals by pressing ▲ or ▼. Once the correct temperature is entered, press the soft key below *SAVE* to confirm.



Trend Loop 1/ Trend Loop 2

The trend screen option allows monitoring any combination of the process variable, set point and control output over a tunable time period. This feature is useful when fine tuning PID constants to monitor process responses to step changes. In these situations, the user can define the trend to update as fast as twice per second or as slow as once per hour. This provides a trend range of 24 seconds to 48 hours. The trend screen display area is 24 pixels wide by 82 pixels high.

While at the trend screen, the control features are fully active. The operator may change set point, control output or change control modes with the auto/manual key. Note that the trend values are not stored, so historical data is lost when departing the trend screen. The screen provides numeric readout of all three values, as well as mode and alarm indications. These trend screen features allow maintaining complete process control while graphically viewing the dynamics of the process over time.

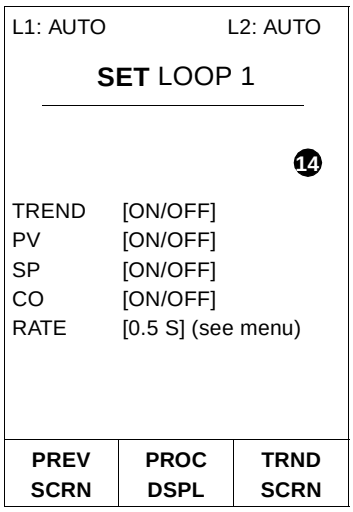
TREND LOOP 1
TREND LOOP 2

14. From the setup/options menu, press ▲ or ▼ to highlight *TREND LOOP 1* or *TREND LOOP 2*. Press SEL. The *SET LOOP* screen appears.

15. Press ▲ or ▼ to highlight the function. Press SEL. The *ON/OFF* box appears. Press ▲ or ▼ to turn on or turn off the function. Press SEL again and then ▼ to move to the next function. When *RATE* is highlighted, press SEL. A pull down menu will appear that lists the trend time values available.

> **NOTE:** Whenever the *ESC* soft key menu option is shown, pressing the soft key directly below it deletes the entered information for that function, and the correct information can be entered.

16. Press the soft key below *PREV SCRN* to return to the options/setup menu.



Rate Pull-Down Menu

0.5 S	10 S
1.0 S	↓
1.5 S	180 S
2.0 S	4 M
2.5 S	5 M
3.0 S	6 M
3.5 S	7 M
4.0 S	8 M
4.5 S	↓
5 S	29 M
6 S	30 M
7 S	40 M
8 S	50 M
9 S	60 M

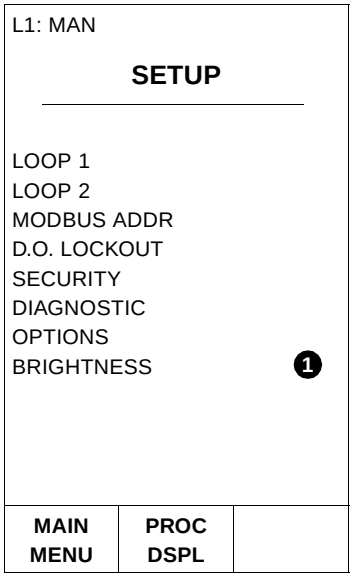
DISPLAY BRIGHTNESS

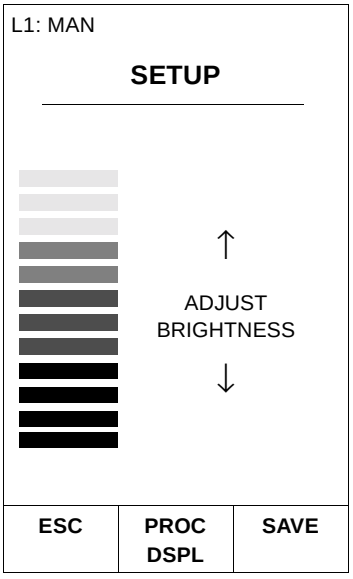
The display brightness may be user-controlled by selecting this menu option. There are 15 levels of screen brightness allowed. A lower setting will prolong the life of the display.

BRIGHTNESS

1. From the main setup menu, press ▲ or ▼ to highlight *BRIGHTNESS*. Press SEL.

2. Press ▲ or ▼ to select the desired contrast. Once adjustment is complete, press the soft key below *SAVE*. The setup menu appears.





ANALOG/DIGITAL OUTPUTS

WARNING	**The analog and digital outputs change to a fixed value during start-up, RESET and for various failure conditions. The analog output values must be selected by the user to insure safe operation when transfer to default condition occurs.**
AVERTISSEMENT	**Les signaux de sortie analogiques et numériques prennent une valeur fixe au moment du démarrage, d'une remise à l'état initial ou d'une panne. L'utilisateur doit affecter des valeurs implicites qui assureront un fonctionnement sécuritaire.**

This section contains information on setting the analog output default settings to insure safe operation of the controller and the process. It also includes information of how to issue digital output control from the faceplate and use of operator alarms for noisy or remote locations.

Analog Output Default Settings

Both analog outputs go into bypass should a failure condition occur. The Type SLC controller allows defining a set of default values for both outputs should some type of failure occur with the main board.

This will occur under the following conditions:

- If the RESET button is pressed.
- If a fatal error occurs in the controller.
- A process failure occurs for which a trip block (function code 32) has been selected. This might be specified for critical inputs or interlocks or violations of critical cross-limits.
- If the main board (CPU) enters into the error mode.
- During certain diagnostic operations.
- Communications with the main board lost.

These default settings should be set such that a safe operating state is obtained if a controller fault occurs.

The default values for the analog outputs are selected from the faceplate at the setup menu loop option screen, *FAIL AO#1*. The selection is *HIGH* (5.25 VDC, 105%), *LOW* (0.75 VDC, -5%), or *LAST* (for hold last value).

Digital Output Control

Direct digital output control may be issued from the faceplate directly (when in execute mode only) or from the configuration.

Access to changing the digital outputs from the faceplate may be accepted or denied through the lock and unlock selections available in security features or at the setup menu at the *D.O. LOCKOUT* screen. Setting any digital output to the lock mode will disable faceplate control from the main menu *D.O. CONTROL* screen.

For those users with custom or modified factory configuration, direct digital output control can be issued through the configuration procedures. Refer to ***D.O. LOCK*** in Section 4 for additional information. Refer also to function code 231, S12 through S16 in the ***Function Code Application Manual***.

> **NOTE:** On power down and main board reset, the digital outputs go to zero until the controller returns to execute mode. Once the main board goes into execute mode, the digital outputs go to the state determined by the configuration, and the faceplate digital output control mode will return to auto. On a main board failure condition, digital outputs maintain the last known value.

Operator Alarms

In noisy environments or when operators may not be close by the controller, it may be necessary to use one of the digital outputs to control a signaling device to signal alarm conditions.

SECTION 4 - CONFIGURATION

INTRODUCTION

NOTE: Configuration personnel should have a solid background in electronics instrumentation and process control and be familiar with proper safety procedures for electronic instrumentation.

This section provides the required actions to establish and define the Type SLC Strategic Loop Controller configuration. The section is divided into two procedures: using a factory configuration and entering data via the faceplate; or using a factory configuration with modifications or developing a custom configuration using Bailey-Fischer & Porter tools such as the handheld Type CTT Configuration and Tuning Terminal. For developing a custom configuration or modifying the standard configuration, information is provided on block addresses, function codes and specification lists and various configuration data.

Complete the procedures in Section 3 before entering a configuration.

Configuration worksheets are provided in Appendix C. It is recommended to fill in the worksheets prior to starting a configuration procedure. All the data will then be available to make the entries.

Common PID configurations that will cover most applications can be directly entered from the controller faceplate (refer to ***FACTORY CONFIGURATION***).

If a complex or customized configuration is required for your application, refer to ***CUSTOM CONFIGURATION***. To use a factory configuration as a base configuration but modify it for a particular application, refer to ***MODIFYING A FACTORY CONFIGURATION***. Either of these choices requires the use of a Type CTT terminal or other Bailey-Fischer & Porter configuration tools.

SCREEN CONVENTIONS AND PUSHBUTTON FUNCTIONS

The screen displays illustrated in procedural steps throughout this section contain circled numbers. Those numbers reference the step number of the procedure and are not on the actual display.

Whenever there is more than one choice available on a screen display, the choices are bracketed [ ] on the screen illustration or are located in the right margin.

The graphics of the screens presented are close representations, but data may vary in size and position.

Pushbutton functions are shown in Figure 4-1.

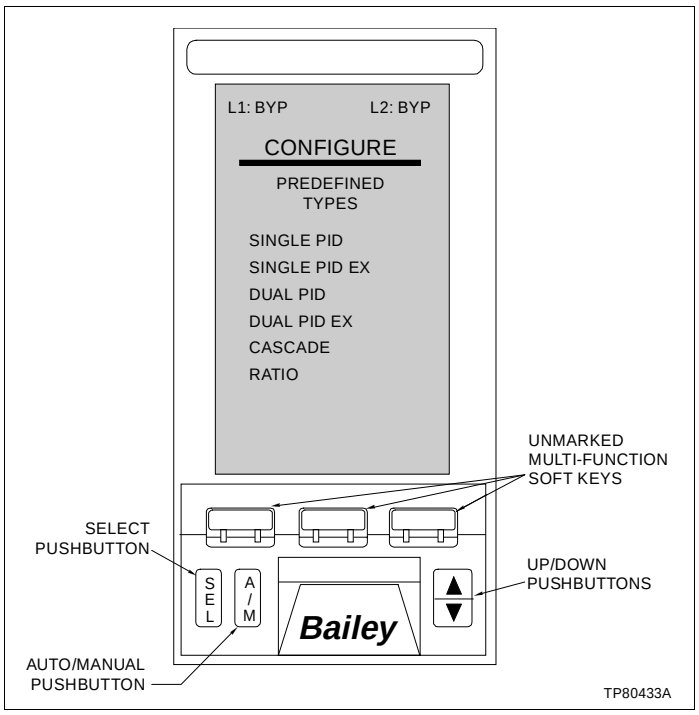


Figure 4-1. Configuration Menu

Single Function Pushbuttons

The three marked pushbuttons at the bottom of the faceplate are single function keys.

▲, ▼ Controls the cursor movement, changes selection choices on screens, and increments or decrements selected parameter values when changing a numeric variable.

A/M Does not perform any action in the configure screens.

SEL Allows selecting a highlighted parameter in a menu. On screens with variables instead of menus, it will cause the unit to enter the change mode on the variable highlighted to change its values.

Multi-Function Soft Keys

Three unmarked soft keys directly below the display are multi-function keys. Their specific function is defined by the graphics and will vary depending on the screen displayed. When no soft key menu is displayed directly above the soft keys, touching any of these soft keys will display a soft key

menu. Once this soft key menu is displayed, pressing the soft key below the menu item desired will initiate the defined action.

CONFIGURATION MENU OPTIONS SUMMARY

From the configuration menu, several control loop options are available (Fig. 4-1). Following is a brief description of each option:

SINGLE PID Single analog input, single analog output, PID controller.

SINGLE PID EX Two analog input, single analog output, PID controller.

DUAL PID Two separate and independent single loop configurations. Each configuration is a single analog input, single analog output, PID controller.

DUAL PID EX Two separate and independent single loop configurations. Each configuration is a two analog input, single analog output, PID controller.

CASCADE Two analog input, single analog output, two PID controller.

RATIO Two analog input, single analog output, PID controller.

FACTORY CONFIGURATION

Appendix A contains typical configuration diagrams for the six different standard factory configurations:

- Single loop PID internal set point.
- Single loop PID external set point.
- Dual loop PID internal set point.
- Dual loop PID external set point.
- Cascade.
- Ratio.

These drawings will provide an insight as to how the six factory configurations are developed.

Entering a Factory Configuration

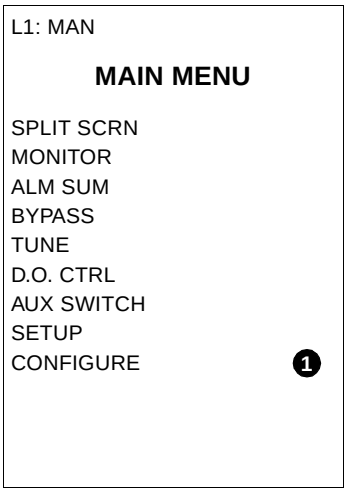
NOTE: It is not required to initialize before entering a configuration.

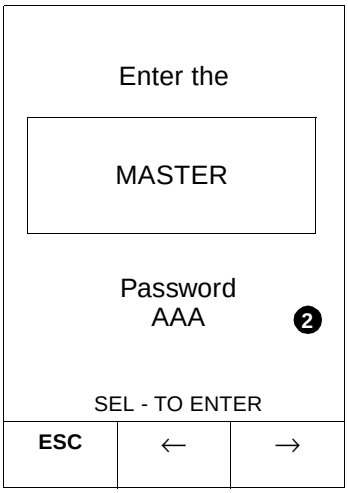
A series of user-friendly display screens prompt for specific parameters associated with the chosen configuration. The following procedure is based on entering a configuration in a new controller using a single loop PID internal set point configuration.

1. From the main menu display, press ▲ or ▼ until *CONFIGURE* is highlighted. Press SEL. The security password screen will appear (if security has been assigned during setup).

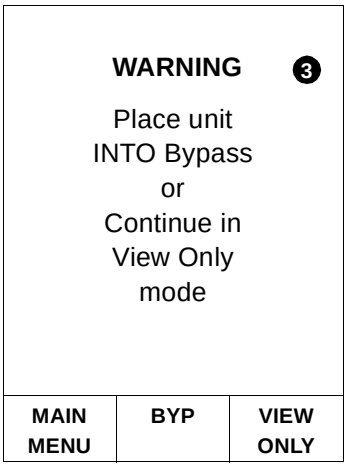
2. If security has been assigned, the security level (*MASTER or TECHNICIAN*) will be shown in the box above *Password*. If necessary, enter the correct password. Remember that the master password will override the technician password. Using the soft key menu, press the soft key below ← or → to move the character cursor left or right. To increment or decrement the password character to enter, press ▲ or ▼ accordingly. Once the correct password has been entered, press SEL. Press the *ESC* soft key to return to the main menu.

> **NOTE:** To add a password if security has not been assigned, refer to ***SECURITY LEVELS*** in Section 3. If no password is desired, the default is AAA to continue.





3. Once the password is entered and approved, one of two screens will appear. If the controller is not in bypass mode, a warning screen will appear. If the controller is already in the bypass mode, the *ADD/MODIFY* screen will appear.



4. To start on the configuration process, the controller must be in the bypass mode. Press the soft key below *BYP* to place

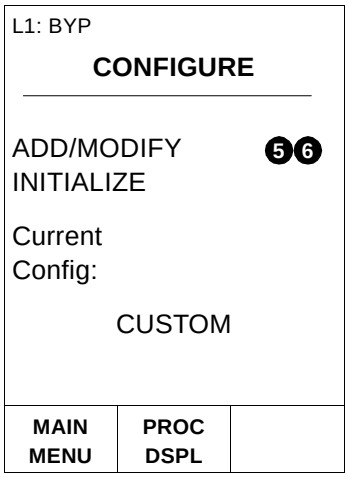
the controller into the bypass mode. To view the screens, press the soft key below *VIEW ONLY* (to read only).

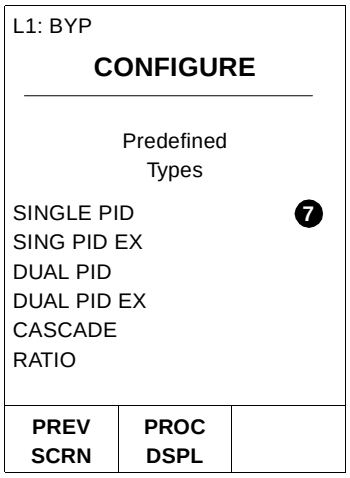
NOTE: In view mode, default values will appear for custom configurations.

5. Once in bypass, the *ADD/MODIFY* or *INITIALIZE* screen will appear. On new controllers, the box below *Current Config:* should say *CUSTOM*.

6. To enter a new configuration, press ▲ or ▼ to choose *ADD/MODIFY*. Press SEL. The configuration type selection screen will appear.

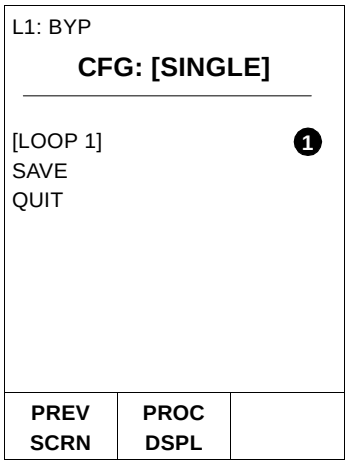
7. Press ▲ or ▼ to highlight *SINGLE PID*, *SING PID EX*, *DUAL PID*, *DUAL PID EX*, *CASCADE* or *RATIO*. Press SEL.





Control Loop Selection

1. Once the selection has been made, a control loop screen will appear. The screen display is dependent on the selection made in Step 7 of ***Entering a Factory Configuration***.



LOOP 1

LOOP 1, LOOP 2

PRIMARY, SECONDARY

WILD VAR, CTRL LOOP

For *SINGLE PID* and *SING PID EX*: *LOOP 1*
For *DUAL PID* and *DUAL PID EX*: *LOOP 1* and *LOOP 2*
For *CASCADE*: *PRIMARY* and *SECONDARY*
For *RATIO*: *WILD VAR* and *CTRL LOOP*

2. Press ▲ or ▼ to select the control loop. Press SEL. Select *SAVE* or *QUIT*.

Analog Input Values

Refer to Table 4-1 for a functional description of the analog inputs for each predefined configuration.

Table 4-1. Analog Input Functions for Predefined Configurations

Predefined Configuration Name	Loop	Analog Input Meaning[1]
Single PID	Loop 1	AI1 = PV1
Single PID External SP	Loop 1	AI1 = PV1 AI2 = ESP1
Dual PID	Loop 1	AI1 = PV1
	Loop 2	AI2 = PV2
Dual PID External SP	Loop 1	AI1 = PV1 AI2 = ESP1
	Loop 2	AI3 = PV2 AI4 = ESP2
Cascade	Primary	AI1 = PV1
	Secondary	AI2 = PV2
Ratio	Wild	AI2 = WV1
	Control	AI1 = CV1

NOTE:
1. PV = process variable, ESP = external set point, WV = wild variable, CV = control variable.

The analog input range and type are determined by the AI ZERO, AI SPAN and SQUARE ROOT function.

AI ZERO This zero value corresponds to a one-volt or four-milliamp input when using the high level input type. With the selection of the millivolt input, this value corresponds to a -20 millivolt input. The span value is equal to the difference between the engineering units value at maximum (five volts or 20 milliamps) and the zero value. The default value for AI ZERO is 0.00, the range is -100,000.00 to +100,000.00 engineering units (EU). Thermocouple and RTD inputs do not require the zero specification.

1. The analog input screen will appear. To set *AI ZERO*, press ▲ or ▼. When highlighted, press SEL. Use ▲ or ▼ to enter the correct value for *AI ZERO*. The default value is 0.00. The range

is -100,000.00 to +100,000.00 engineering units (EU). Press SEL.

AI SPAN

The span value is equal to the difference between the engineering units value at maximum (5 V or 20 mA) and the zero value. The default value for AI SPAN is 100.00; the range is -100,000.00 to +100,000.00 engineering units (EU). Thermocouple and RTD inputs do not require the span specification.

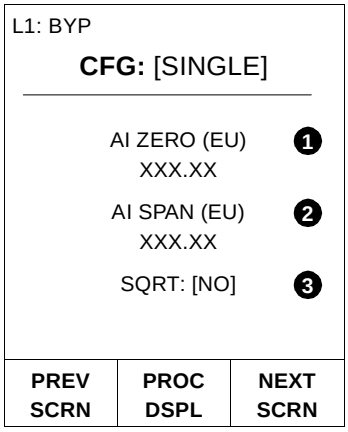
> **NOTE:** For proper controller operation, the AI span value entered must be greater (more positive) than the AI zero value.

2. Press ▼ to proceed to *AI SPAN*. Press SEL. Use ▲ or ▼ to enter the correct value for *AI SPAN*. The default value is 100.00. The range is -100,000.00 to +100,000.00 engineering units (EU). Press SEL.

> **NOTE:** During the configuration procedures, *ESC* appears in the soft key menu as the change mode is entered. Press *ESC* to reset the value to the original or default value if an error has been made and it needs to be entered again.

SQRT

3. Press ▼ to proceed to *SQRT* (square root). Square root is used to convert differential pressure into flow units. A square root of the input before engineering units (EU) conversion is performed when *YES* is selected. Press SEL. A *NO/YES* box will appear. Use ▲ or ▼ to select the choice, then press SEL.



4. Press the soft key below *NEXT SCRN* to proceed.

PID Constants

CONV FACTOR

The conversion factor is also known as the gain multiplier *K*. The purpose of the conversion factor is to convert the difference signal from engineering units (EU) to percent for use in the PID algorithm.

1. The PID screen will appear. If *CONV FACTOR* (conversion factor) is not highlighted, press ▲ or ▼ until it is. Press SEL. Use ▲ or ▼ to enter the correct conversion factor value. The

default value is 1.000. The range is 0.00 to +1,000.00. Press SEL.

KP, KI and KD

These are terms used in the PID calculation. *KP* is proportional gain. *KI* is integral, the number of resets per minute. *KD* is the derivative rate action, used to reduce lag.

2. To enter the values for *KP, KI* and *KD,* follow the procedure listed in Step 1.

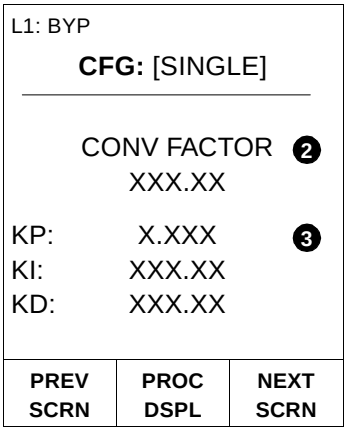
The default values are:

KP = 1.00
KI = 0.00 resets/minute
KD = 0.00 minutes

The ranges are:

KP = 0.00 to +1,000.00
KI = 0.00 to +1,000.00 resets/minute
KD = 0.00 to +1,000.00 minutes

Once the last value is entered and SEL is pressed, press the soft key below *NEXT SCRN* to proceed.



Output Bar Graph High/Low Labels

HI CO LIM %

1. The control output screen will appear. If *HI CO LIM %* is not highlighted, press ▲ or ▼ until it is. Press SEL. Use ▲ or ▼ to enter the correct value. The default value for HI CO LIM% is 105%; the range is -5.0% to +105.0% in all factory configurations except in the primary loop of the cascade factory configuration. The range then becomes -100,000.00 to +100,000.00 engineering units (EU) in the primary loop.

LO CO LIM %

2. Press SEL to confirm the selection. Repeat this step for *LO CO LIM %*. The default value for LO CO LIM % is -5.0%; the range is -5.0% to +105.0% in all factory configurations except in the primary loop of the cascade factory configuration. The

range then becomes -100,000.00 to +100,000.00 engineering units (EU) in the primary loop.

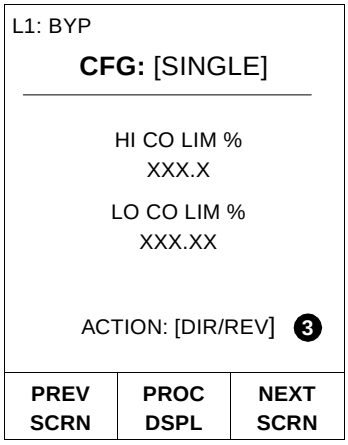
ACTION This is the direction switch. This input defines the direction the control output must move to compensate for an error between the process variable and the set point.

Direct - an ***increase*** in the control output results in a ***decrease*** in the process variable.

Reverse - (default) an ***increase*** in the control output results in an ***increase*** in the process variable.

3. Press ▼ to proceed to *ACTION*. Press SEL. A *DIR/REV* box will appear. Use ▲ or ▼ to enter the choice, then press SEL.

4. Press the soft key below *NEXT SCRN* to proceed.



These first two items do not appear for cascade, primary.

Process Variable and Set Point Values

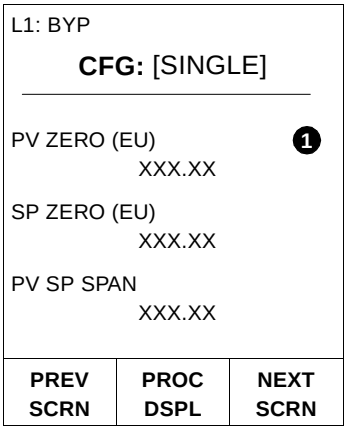
These options set the signal zero, zero value of set point in engineering units, and signal span for both process variable and set point, respectively.

PV ZERO
SP ZERO
PV SP SPAN

1. The process variable and set point screen will appear. If *PV ZERO* is not highlighted, press ▲ or ▼ until it is. Press SEL. Use ▲ or ▼ to enter the correct value. The default value for PV ZERO and SP ZERO is 0.0; the range is -100,000.00 to +100,000.00 engineering units (EU). The default value for PV SP SPAN is 100.0; the range is -100,000.00 to +100,000.00 engineering units (EU). Press SEL. Repeat this step for SP ZERO and PV SP SPAN.

NOTE: For proper controller operation, the PV span value entered must be greater (more positive) than the PV zero value.

2. Press the soft key below *NEXT SCRN* to proceed.



PV Alarm Values

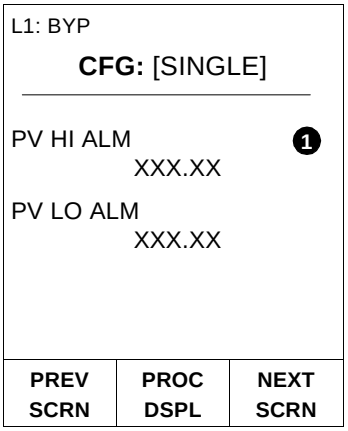
Alarms can be set to occur when the process variable changes above the PV HI alarm value or below the PV LO alarm value.

> **NOTE:** Set the alarm values to within the signal's operating range to enable the alarm function.

PV HI/LO ALM

1. The alarms screen will appear. If *PV HI ALM* is not highlighted, press ▲ or ▼ until it is. Press SEL. Use ▲ or ▼ to enter the correct value for the high alarm. The default value for PV HI ALM is +100,000 and for PV LO ALM is -100,000; the range is -100,000.00 to +100,000.00 engineering units (EU). Press SEL. Repeat this step for *PV LO ALM*.

2. Once the alarm values have been set, press the soft key below *NEXT SCRN* to continue. The bad quality screen will appear.

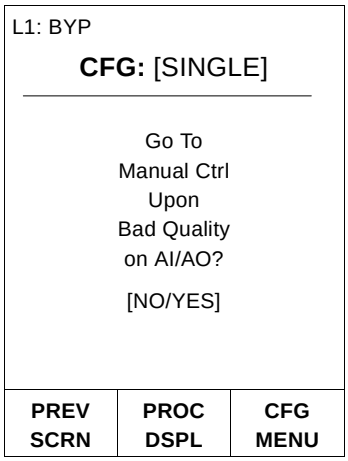


Manual Control Upon Bad Quality of the Analog Inputs/Outputs

A parameter termed ***quality*** is associated with all I/O points in the Type SLC controllers. Good quality status is the normal operating values when all required communications have been established with the I/O sources and the I/O is within allowed

ranges. Bad quality results from an open circuit, or faulty operation of the input/output circuits.

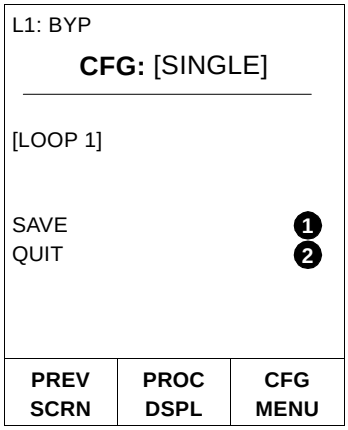
Press SEL when the bad quality screen appears. A selection box will appear. To select whether the controller should go to manual control when bad quality analog inputs/outputs are detected, use ▲ or ▼ to choose *YES* or *NO*. Once the selection has been made, press SEL. Press the soft key below *CFG MENU* to return to the save/quit menu.

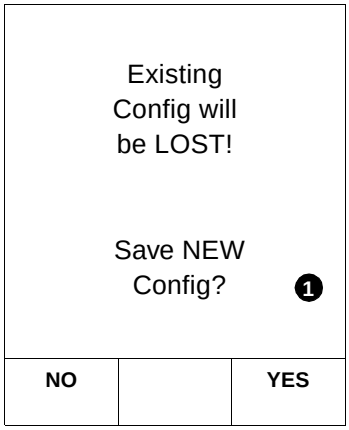


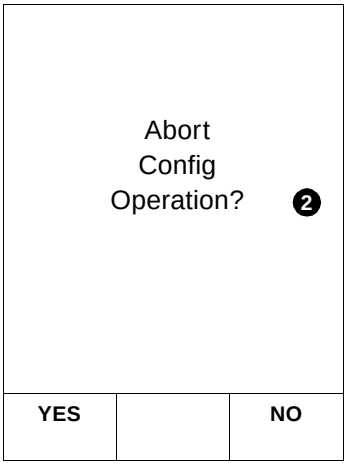
Save or Abort Configuration

1. To save the configuration, press ▲ or ▼ to highlight *SAVE*. Press SEL. The following save screen will appear. Press the soft key below *YES* to save the configuration. A message will appear that the configuration has been saved. To not save the configuration, press the soft key below *NO*. The save/quit (previous) screen will appear.

2. To stop the configuration process, press ▲ or ▼ to highlight *QUIT*, then press SEL. The abort configuration screen will appear. To abort the configuration, press the soft key below *YES*; the main menu will appear. To not abort the configuration, press the soft key below *NO*; the configure menu will appear.







CUSTOM CONFIGURATION

It is recommended that the procedures in Section 3 be completed before starting.

NOTE: To start fresh, initialize the controller (Fig. A-12).

Configuration of custom control strategies can be accomplished by a number of devices. The Type CTT Configuration and Tuning Terminal operates through a connector on the faceplate of the Type SLC controller and is used to design, modify, tune, simulate, troubleshoot and document a given control strategy. Refer to Table 1-2 for the Type CTT instruction number.

Other configuration software tools operate via a PC over the module bus, assigning function codes to function blocks. The first of these, LAN-90, contains configuration loading system (CLS), which is used to configure the Type SLC controller. LAN-90 Process Control View software revision 4.3 or later is the minimum requirement for 100 percent compatibility with the Type SLC controller. The CLS system can download a configuration to a printer for hard copy documentation.

Another Elsag Bailey software tool, CAD/TXT (Computer Aided Drawing/Text), contains two configuration programs. CAD/TXT software revision 5.2.2 or later is the minimum requirement for compatibility with the Type SLC controller. Software revision 5.3 is recommended for 100 percent functionality. CAD/TXT contains TXT, a DOS-based software tool used to configure the controller much like the Type CTT terminal does. CAD/TXT also contains CADEWS, a CAD-based system used to design, modify, tune, trend, simulate, troubleshoot and document a given control strategy. Once a control strategy is configured, it can be directly downloaded to the controller or sent to a plotter or printer. Once a CADEWS configuration is compiled, it is downloaded to the controller over the Plant Loop or over the module bus, provided that the

controller is in the configure mode. Refer to Table 1-2 for instruction numbers of software tools.

When downloading a custom configuration from a Type CTT Configuration and Tuning Terminal or other device over the module bus, the controller display should be on the main menu or on a process display. Downloading a custom configuration will overwrite any existing configuration; therefore, some setup parameters are redefined. Once the configuration is downloaded, the setup menu should be accessed to verify or modify loop-specific and option card information.

NOTES:

1. The *SETUP-OPTIONS-OPTION BRD* menu will reflect the existence of the option board and specifications set by a custom configuration.

2. If the faceplate switch is used, the *SETUP-OPTIONS-FP SW LOOP #* must be configured to use the faceplate switch. The loop-specific faceplate switch is overridden if a cascade or ratio station is detected for that loop.

Custom control configuration is accomplished by assigning function codes to function blocks. The function codes are operations such as PID control, sum, limit, square root, etc. The function blocks are addressable memory locations saved in the NVRAM and copied to RAM for execution. The operator interface board communicates with the main board and displays information such as process variable, set point and control output.

To configure a function block, define the following parameters:

- Block address.
- Function code.
- Specification list.

The selected software tool allows entering and defining these parameters. Function blocks can be added, modified or deleted. The controller stores the configuration in the NVRAM.

The Type SLC controller can operate in configure, execute and error modes. The controller must be in the configure mode to add, modify or delete a function. When the controller is in the execute mode, all configured functions will be executed. Certain parameters, labeled ***tunable*** in the function code specifications tables, can be altered while the controller is in the execute mode.

Block Address

The block address (or block number) is a reference number for a function block and is assigned during configuration. The output values from a function block may be referenced as

inputs to other function blocks by using the block address. For functions that have more than one output, each one is referenced by a sequential block address starting with the block address assigned during configuration. Note that these consecutive block addresses must not be assigned to other function blocks in the controller.

The Type SLC controller is designed to process the function blocks in ascending numerical order beginning with the lowest numbered one. For this reason, the lowest block addresses should be assigned to the function blocks closest to the inputs. This must be done to minimize ***loopbacks***. A loopback occurs when the output of a higher numbered block is used as an input to a lower numbered block. This situation requires the controller to process all of the function blocks (a cycle) more than once before the correct inputs and outputs can be obtained from blocks that have loopbacks.

NOTE: Function code 82, S15, autosequencing, can be used to minimize the effects of loopbacks.

Function Codes

Table 4-2 lists function codes that support the Type SLC controller. The ***Function Code Application Manual*** provides the specification lists, block output definitions, and a detailed explanation of the operation of each function code. The function code manual should be used in conjunction with this instruction when designing a customized configuration.

Table 4-2. Control Functions

Function Block Type	No.	Description	Function Block Type	No.	Description
Station	80	Control station (MFC)[1]	Advanced functions *(continued)*	166	Integrator
	231	SLC station[1,2]		167	Polynomial
Control function	4	Pulse positioner		168	Matrix addition
	24	Adapt		169	Matrix addition
	156	Advanced PID		170	Matrix multiplication
	160	Inferential smith		171	Trigonometric
Batch function	123	Device driver		172	Exponential
	161	Sequence generator		173	Power
Advanced functions	140	Restore		174	Logarithm
	152	Model parameter estimator	Computing	1	Function generator
	153	ISC parameter converter		2	Manual set constant
	154	Adaptive parameter scheduler		3	Lead/lag
	162	Digital segment buffer		5	Pulse rate
	163	Analog segment buffer		6	High/low limiter
	165	Moving average		7	Square root

Table 4-2. Control Functions (continued)

Function Block Type	No.	Description	Function Block Type	No.	Description
Computing *(continued)*	8	Rate limiter	Logic *(continued)*	110	5-input rung
	14	4-input summer		111	10-input rung
	15	2-input summer		112	20-input rung
	16	Multiply	I/O field	96	Redundant analog input
	17	Divide		97	Redundant digital input
	51	Manual set constant		102	Pulse input/period[3]
	52	Manual set integer		103	Pulse input/frequency[4]
	58	Time delay (analog)		104	Pulse input/totalization[5]
	65	Digital sum with gain (4-input)		182	Analog input definition[6]
Signal select	9	Analog transfer		230	SLC input/output[1,2]
	10	High select	Controlway/ module bus I/O	25	Analog input (same PCU)
	11	Low select		28	Analog output (same PCU)
	13	Integer transfer		41	Digital input/Controlway/ module bus
	59	Digital transfer		63	Analog input list (same PCU)
Signal status	12	High/low compare		64	Digital input list (same PCU)
	31	Test quality		95	Module status monitor
	69	Test alarm	Plant Loop I/O	26	Analog input/loop
Logic	33	NOT		30	Analog exception report
	34	Memory		42	Digital input/loop
	35	Timer		45	Digital exception report
	36	Qualified OR (8-input)		66	Analog trend
	37	AND (2-input)	Exception report	62	Remote control memory
	38	AND (4-input)		68	Remote manual set constant
	39	OR (2-input)	Executive	81	Executive[2]
	40	OR (4-input)		82	Segment control[2]
	50	Manual set switch		89	Last block[2]
	61	Blink		90	Extended executive[2]
	85	Up/down counter	Trip	32	Trip
	86	Elapsed timer	ASCII	113	ASCII string descriptor[7]
	101	Exclusive OR			

NOTES:

1. May not be restored properly using function code 140.
2. Only one permitted per controller in fixed block addresses.
3. S1, S2 and S4 of function code 102 are not used in the Type SLC controller and should be left at default values. The user range is preset at 0.001 to 50 secs.
4. S1, S2 and S4 of function code 103 are not used in the Type SLC controller and should be left at default values. The user range is preset at 0.1 to 50,000 Hz.
5. S1 and S2 of function code 104 are not used in the Type SLC controller and should be left at default values.
6. S3, S7, S8, S10 and S13 of function code 182 are not used in the Type SLC controller and should be left at default values.
7. Refer to the ***Function Code Application Manual***, function code 231, for additional information to be used with function code 113.

Specification List

The specification list for each function code includes the inputs and parameters needed to implement the function. The specifications that are needed depend on the requirements of the particular function. Each function code has a list of initial (or default) values when it is first selected. These values may be changed as needed for the particular application. Any specification not modified will remain at its initial (default) value.

Each specification in the function code is identified as being tunable or nontunable. A tunable specification may be changed either when the controller is being configured or while it is in the execute mode. The tunable adjustment can be made using the TUNE function of the Type CTT terminal. A specification identified as nontunable can only be changed when the controller is in the configure mode.

Refer to the ***Function Code Application Manual*** for a listing of function codes and specifications.

Function Blocks

The Type SLC controller has two types of function blocks: fixed and user-defined.

FIXED BLOCKS

The fixed blocks consist of executive blocks, extended executive blocks, segment control blocks, SLC I/O blocks, SLC station blocks and ASCII string descriptor blocks.

The Type SLC controller uses the executive block (function code 81), the segment control block (function code 82), and the extended executive block (function code 90) to set up overall controller operations.

In addition to the fixed SLC I/O block (function code 230), the controller also has three built-in ASCII string descriptor blocks (function code 113), one SLC station (function code 231), and four analog input definition blocks (function code 182).

These blocks have fixed addresses (i.e., an address cannot be assigned to them). Table 4-3 is a summary of fixed block locations.

USER-DEFINED BLOCKS

Blocks 30 to 49, 58 to 99, 117 to 899 and 914 to 1019 are user-definable. The user-defined blocks are not pre-assigned and function codes can be added to perform a wide variety of

functions to implement control logic. The total number of blocks that can be defined within this range is dependent on the function codes required. Table 4-3 lists user-defined block locations.

Table 4-3. Fixed and User-Defined Block Address Summary

Block Address	Description	Function Code
0 - 14	Executive block	81[1]
15 - 19	Segment control block	82[1]
20 - 29	Extended executive block	90[1]
30 - 49	—	User configurable
50 - 57	Analog input definition	182
58 - 99	—	User configurable
100 - 116	SLC I/O	230[1]
117 - 899	—	User configurable
900 - 913	SLC station	231[1]
914 - 1019	—	User configurable
1020 -1022	ASCII string descriptor	113
1023	Last block	89[1]

NOTE:
1. Only one permitted per controller.

CONFIGURATION UTILIZATION FACTORS

Each function code has a utilization factor associated with it. The factor represents the amount of memory occupied by the function. When planning control strategy, it is important to note the utilization factor associated with the functions used, so as not to exceed 100 percent. This tends not to be a concern except when very large control sequences are used.

Refer to Appendix C of the ***Function Code Application Manual*** for a complete listing of function code execution times. These times will help keep the configuration within the range of the Type SLC controller capacity.

CONFIGURATION DATA REQUIRED

The custom configuration worksheets in Appendix C are provided to prompt the user for the basic information needed to generate the configuration. The worksheets also help organize the data in a usable format prior to entering the configuration with the selected configuration software tool.

Station Functions

Three types of station functions are available: basic, cascade or ratio. The principal difference between the three station functions is the method in which the set point is generated. Refer to the ***Function Code Application Manual***.

> **NOTE:** The station functions linked to the Type SLC controller faceplate must be configured as a passive station with station address equal to 254 (S16 of function code 80).

BASIC STATION

A basic station generates a set point (SP) and provides manual/automatic transfers, control output adjustment in manual control mode, and set point adjustments in automatic control mode.

CASCADE STATION

A cascade station provides the same functions as a basic station plus an additional mode that allows the set point to be controlled by an external process variable while in the cascade mode.

RATIO STATION

An analog control station configuration that maintains a ratio between two variables. A wild variable multiplied by a ratio adjustment factor (ratio index) determines the set point output. The initial ratio index value is calculated by the station to maintain the current set point output value when the station is placed into the ratio mode.

The initial ratio index value is determined internally when the station mode is transferred to ratio mode. Valid ratio index values range from 0.01 to 10.0.

Dual Loop Operation

The faceplate of the Type SLC controller can display the data associated with two different M/A stations within the configuration. Both loops can be displayed on the faceplate at the same time by selecting the split screen display from the main menu.

When developing the configuration, note the following.

Loop 1

1. Specification S16 within function code 80 defines the M/A station as a passive station when set to an address of 254.

2. Specification S23 within function code 80 defines the M/A station as a basic control station when set to station type 0.

3. Specification S1 (strategic loop controller station, function code 231, fixed block address 900) must be the block address of the M/A station (function code 80) control output associated with loop 1. It allows the SLC station block to get loop information from the M/A station, and it enables the M/A station faceplate to be placed in automatic or manual control mode.

4. Specification S5 of function code 230 (strategic loop controller I/O, fixed block address 100) is analog output one (AO1), and must therefore be associated with the M/A station for loop 1. Manual control of this output is maintained when the unit enters bypass mode.

Loop 2

1. Specification S16 within function code 80 defines the M/A station as a passive station when set to an address of 254.

2. Specification S23 within function code 80 defines the M/A station as a basic control station when set to station type 0.

3. Specification S2 (strategic loop controller station, function code 231, fixed block address 900) must be the block address of the M/A station (function code 80) control output associated with loop 2. It allows the SLC station block to get loop information from the M/A station, and it enables the M/A station faceplate to be placed in automatic or manual control mode.

4. Specification S6 of function code 230 (strategic loop controller I/O, fixed block address 100) is analog output 2 (AO2), and must therefore be associated with the M/A station for loop 2. Manual control of this output is maintained when the unit enters bypass mode.

Both Loops

On power up, initialization, or return from bypass, loop 1 is the default loop that is displayed on the faceplate. Loop 2 cannot be activated unless:

1. It is configured properly (function code 231, S1 = block address of function code 80, loop 1; S2 = block address of function code 80, loop 2).

and

2. The *CHNG LOOP* soft function key is pressed.

Cascade Operation

The dual loop capability can also be used to display a single output cascade loop configuration by following these guidelines.

Loop 1 is the primary loop and has no control output. Its PID output is the external set point to loop 2. The primary loop is

also known as the master or outer loop. There is no control output associated with this loop.

1. Specification S16 within function code 80 defines the M/A station as a passive station when set to an address of 254.

2. Specification S23 within function code 80 defines the M/A station as a basic control station when set to an address of zero.

3. Specification S1 (strategic loop controller station, function code 231, fixed block address 900) is the block address of the M/A station (function code 80) control output associated with loop 1. It allows the SLC station block to get loop information from the M/A station, and it enables the M/A station faceplate to be placed in automatic or manual control mode.

4. There is no control output associated with the primary loop, therefore S5 of function code 230 (strategic loop controller I/O, fixed block address 100) is left at a default address of 2.

Loop 2 is the cascade loop, and has a control output associated with AO2. In manual or automatic control modes, the set point is derived from the faceplate. In cascade control mode, the set point originates from the primary control loop. Loop 2 is also known as the cascade, secondary or inner loop.

1. Specification S16 within function code 80 defines the M/A station as a passive station when set to an address of 254.

2. Specification S23 within function code 80 defines the M/A station as a cascade control station when set to station type 4.

3. Specification S2 within function code 80 is the set point originating from the primary control loop. This set point is output from the M/A station when cascade control is selected from the faceplate.

4. Specification S2 (strategic loop controller station, function code 231, fixed block address 900) is the block address of the M/A station (function code 80) control output associated with the cascade loop. It allows the SLC station block to get loop information from the M/A station, and it enables the M/A station faceplate to be placed in manual, automatic or cascade control mode.

5. Specification S6 of function code 230 (strategic loop controller I/O, fixed block address 100) is analog output 2 (AO2); therefore it must be associated with the M/A station for loop 2. Manual control of this output is maintained when the unit enters bypass mode.

The cascade station uses an external set point. Normally the engineering units for the external set point would be set the

same as the set point engineering units defined for the cascade loop. If special tag or engineering units for the external set point are desired, they can be defined by the *SETUP - LOOP 1* menu option.

Configuration Lock

The configuration lock is a security feature that prevents unauthorized altering of the configuration by not allowing transfer of the SLC controller from the execute mode to the configure mode.

Specification S1 of function code 90 (extended executive block) controls this function. Setting S1 to block one permanently locks the configuration; the default is S1 to zero (configure mode allowed).

NOTES:

1. Once locked permanently, to gain access to logic in this segment it is necessary to initialize NVRAM under the *INITIALIZE* option at the configure menu.

2. An engineering lock action may be implemented by using a tunable block as the input to S1. The configuration could then be unlocked by authorized persons through tuning the appropriate block. In critical or hazardous applications, it may be safer to use logic that defines safe periods (i.e., normal shutdown periods) to unlock the configuration.

3. This feature overrides the *SECURITY* option in the setup menu.

Tune/Modify Lock

The configuration TUNE/MODIFY lock is a security feature that prevents unauthorized altering of the configuration in the current segment. The tune lock insures that tunable parameters in a critical segment cannot be changed while the controller is on-line to the process. The modify lock prohibits modifying or deleting blocks within the segment.

NOTES:

1. To gain access to logic under modify/lock, it is necessary to initialize NVRAM under the *INITIALIZE* option at the configure menu.

2. This feature overrides the *SECURITY* option in the setup menu.

Specification S1 of function code 82 (segment control block), in the tens digit, controls this function. Setting:

S1 = 01, 02 – tune and modify allowed.
S1 = 11, 12 – tuning not allowed.
S1 = 21, 22 – modify lock.
S1 = 31, 32 – tune and modify lock.

EXECUTION CYCLE TIME S1, S2 FUNCTION CODE 82 BLOCK 15

Specification S1 of function code 82 (segment control block), in the ones digit, determines the base execution time units. Setting:

S1 = 01, 11, 21, 31 = seconds.
S1 = 02, 12, 22, 32 = minutes.

Specification S2 determines the execution cycle time in time units selected with S1.

START-UP TIME S4 FUNCTION CODE 90 BLOCK 20

Specification S4 (tunable) of function code 90 is the controller start-up time in seconds. Whenever power is cycled or the unit is placed in execute mode, fixed block ten in the module has an output of logic one for the length of time specified by S4. This shows that the start-up has been initiated and is proceeding correctly.

D.O. LOCK

Function code 231, S12 through S16, provides the configuration for digital outputs. Each of these specifications represents the configuration control mode (lock or unlock) of the corresponding digital output. Refer to Table 4-4 and function code 231 for additional information.

Table 4-4. Digital Output State

Main Menu D.O. Control	Main Menu D.O. Control Mode	Setup Menu D.O. Lockout	Configuration BLK 900 FC 231 S12-S16
Configuration[1]	*Lock[2]	Locked	0 or 1
	Lock	Unlocked	0
	AUT	Unlocked	1
Faceplate	MAN	Unlocked	1

NOTES:
1. OIS remote control is available with the use of function code 123. Refer to the ***Function Code Application Manual*** for operation.
2. Refer to ***D.O. CONTROL*** in Section 5.

Trip Blocks/Test Quality Blocks

Incorporating trip blocks and test quality blocks provide safety related procedures during loss of the input. The following information provides the data necessary to include these trip and quality test blocks in the system.

GOOD/BAD SIGNAL QUALITY STATUS

A parameter termed ***quality*** is associated with all I/O points in the Type SLC controllers.

Good quality status is the normal operating value when all required communications have been established with the I/O sources and the I/O is within allowed ranges.

Bad quality status results from an out-of-range signal, or a signal not getting through from the module bus or Plant Loop. The normal operation of the controllers is to mark ***bad*** inputs as bad quality and then use the last good value of the input for further control. This assumes that suitable control can be maintained without the input and that the input problem will be corrected in a timely manner. However, a safety related input should be alarmed so that operators can take immediate action to correct the problem. Personnel injury or severe equipment damage may occur if a trip or interlock does not function properly because of the loss of the input. In these cases, loss of the input should cause the controller to go to a safe default condition. To internally alarm for a broken analog input, the analog input status from function code 182 is brought in as either S3, S4, S5 or S6 of function code 231. This displays general purpose alarms of bad quality inputs on the faceplate (Fig. 4-2).

A test quality block (function code 31) can be configured to transfer the associated operator manual/auto station to manual, shut down the process or send a warning to an annunciator (Fig. 4-2).

> **NOTE:** Configuration of a test quality block requires the use of a Type CTT Configuration and Tuning Terminal or other software configuration tool.

Only process I/O, module bus inputs, and Plant Loop inputs can be tested for quality. Quality is not propagated through the controller function blocks. All internal points will have good quality.

ANALOG OUTPUT QUALITY

A broken analog output current loop may or may not cause the controller to go into the bypass operation depending on how it is configured. A test quality block (function code 31) can monitor analog output quality. When the current loop is broken, a bad quality is registered (Fig. 4-3).

Specification S18 within function code 80 is the transfer to manual mode input. If S18 is set to the block address of the test quality block associated with the analog output, the controller will transfer into manual control mode.

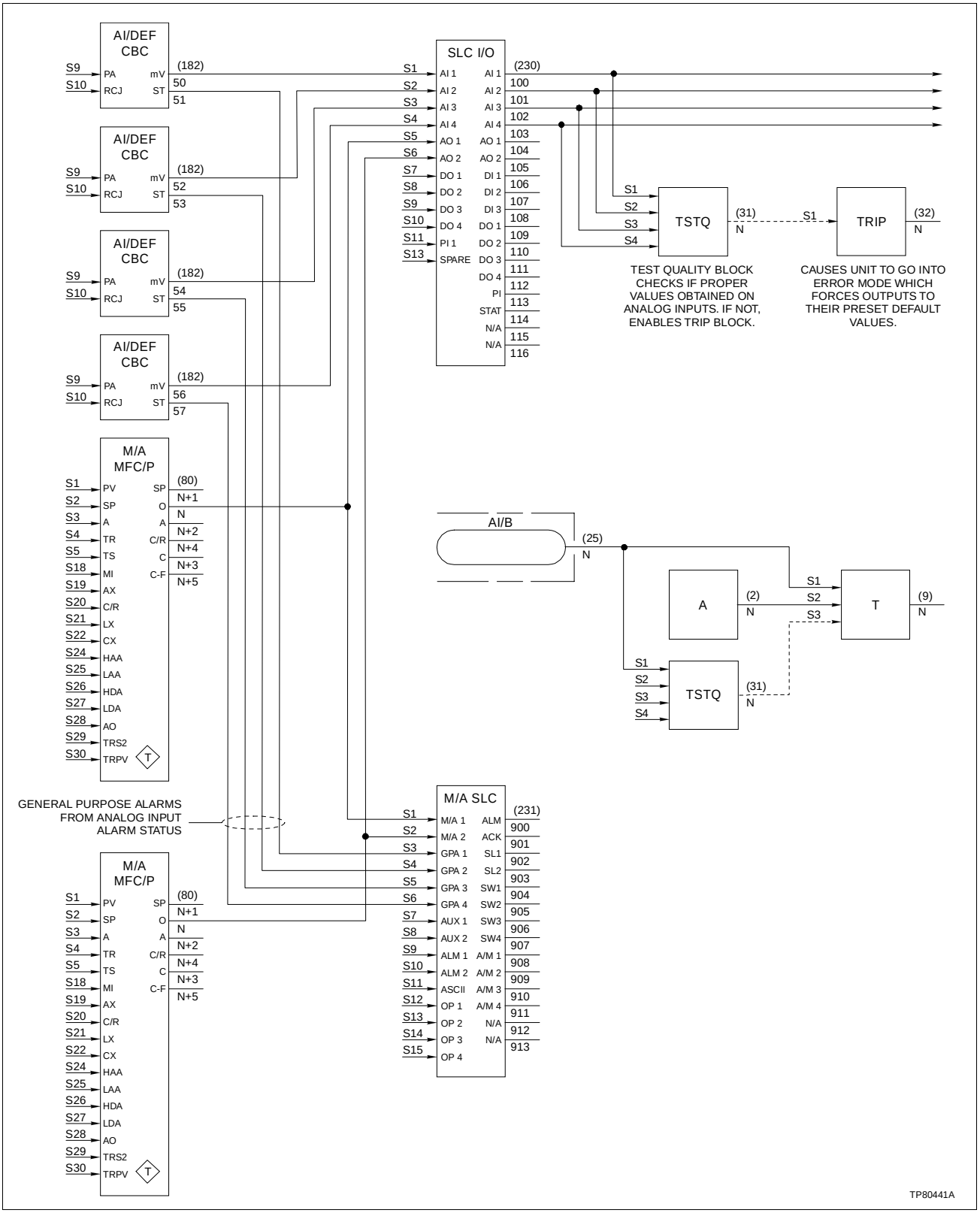


Figure 4-2. Test Quality/Trip Block Configuration

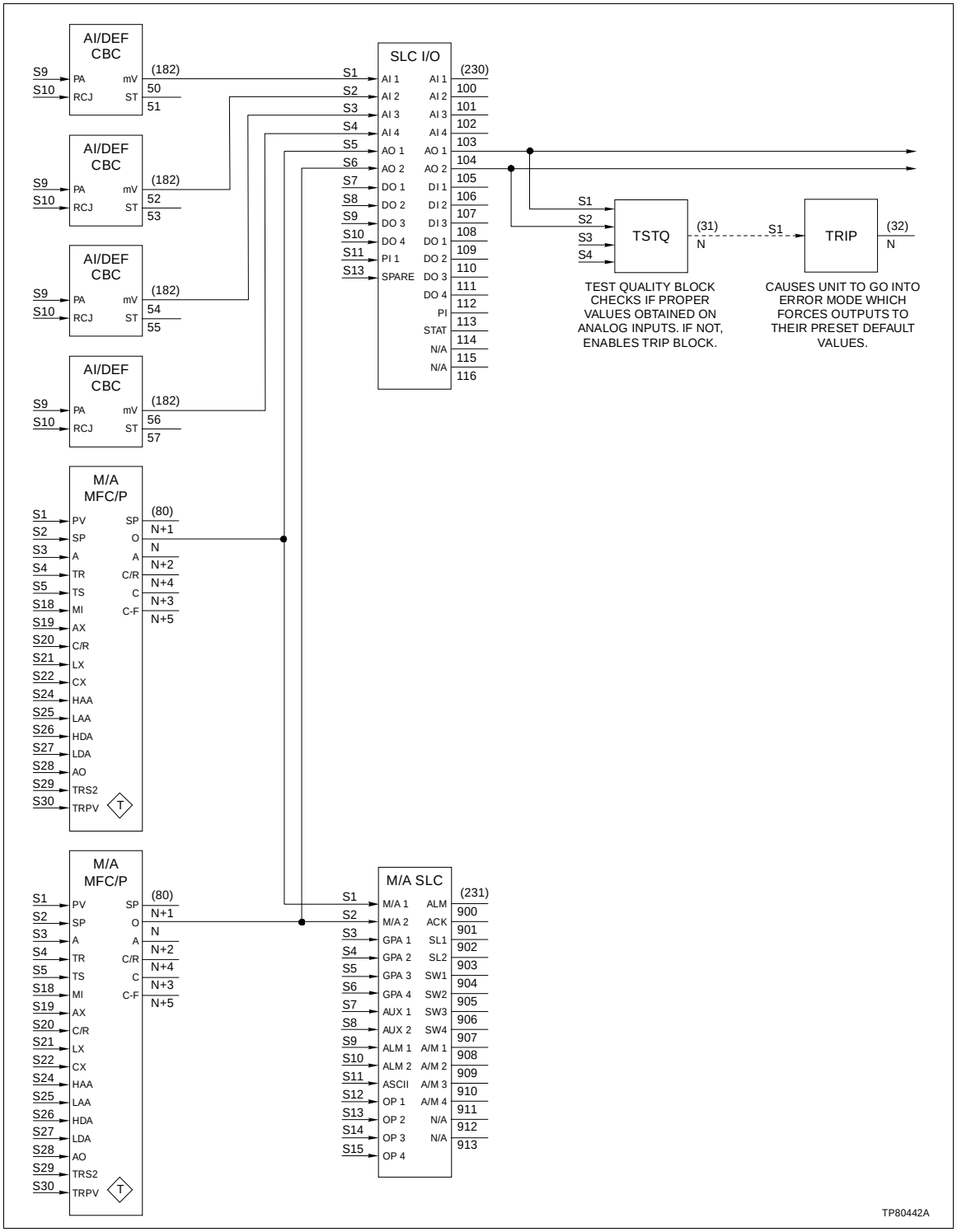


Figure 4-3. Analog Output Quality

Depending on the application, it may be desirable to configure a trip block (function code 32), which would place the controller into bypass mode (registers as ERROR mode on the Type CTT terminal) if a break in the analog output current loop is detected (Fig. 4-3). If, and only if, a trip block is activated, will the controller go into bypass operation when the analog output current is broken. Specification S1 of the trip block is the block address of the test quality block associated with the analog output. Note that all configured control loops are placed in bypass mode when a trip is activated.

Reverse Acting Final Control Elements

When a reverse acting final control element (air-to-close (ATC)) is in use, the control output of the Type SLC controller must be inverted. Two operating modes will be affected: bypass mode and execute mode. In bypass mode, the operator interface board controls each analog output in the manner described in ***Direct/Reverse Bypass Operation*** in Section 3.

To make the selection, use the *SETUP-LOOP#-BYPASS DIRECTION* menu. In execute mode, the main board (with the configuration) executes function codes and controls the outputs. Each ATC final control element (reverse acting output) must be configured to add a two-input summer (function code 15) between the M/A station output (function code 80) and the corresponding analog output of function code 230 (strategic loop controller I/O, fixed block address 100). Refer to Figure 4-4.

Entering Data

Entering data into the controller requires the Type CTT Configuration and Tuning Terminal. Refer to the handheld terminal instruction for detailed procedures on entering the information.

1. Enter the Type SLC controller module address.

2. Place the controller in bypass.

3. Place the target unit in the configure mode.

4. Determine the block address at which to place the function code.

5. Add the block.

6. Select required function code.

7. Set the specifications to the required values, linking them to other function blocks as required to carry out the desired control scheme.

8. Send the block to the Type SLC controller.

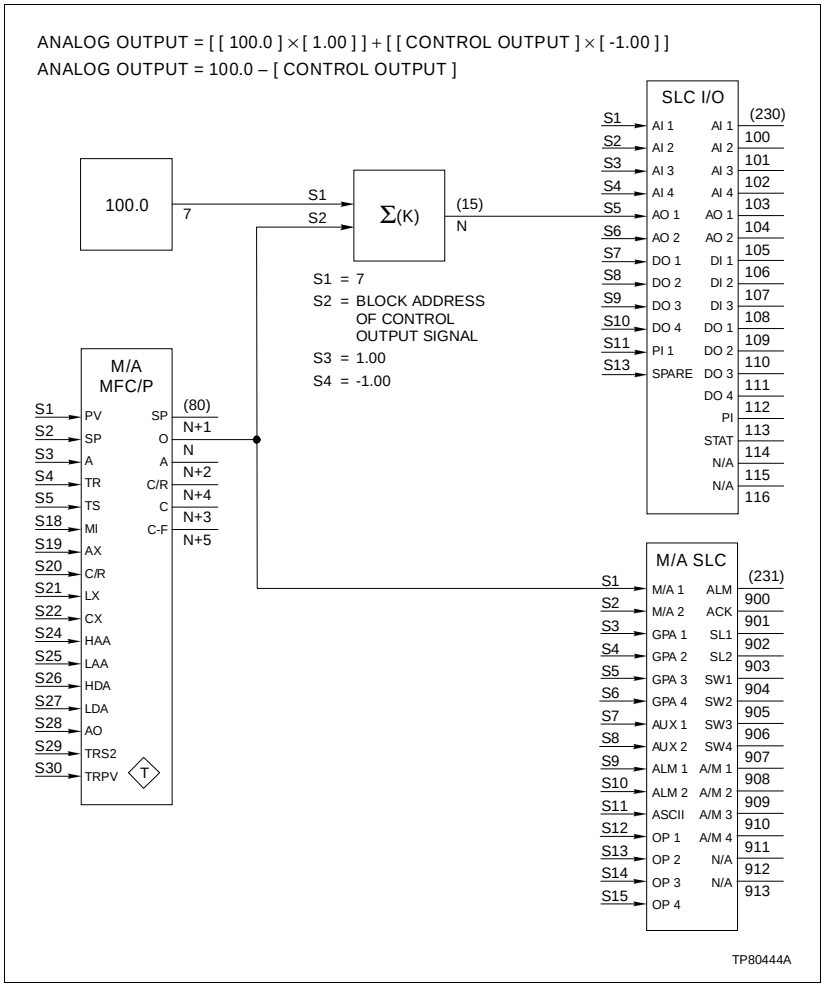


Figure 4-4. Reverse Acting Controllers

MODIFYING A FACTORY CONFIGURATION

To use a factory configuration as a base configuration and then modify certain portions of it:

1. Follow the procedures listed under ***FACTORY CONFIGURATION***. Once the configuration is saved, open the access door on the front of the controller and plug in the Type CTT Configuration and Tuning Terminal. Enter the module address for the Type SLC controller.

2. Press *CONFIG* and then *F2* on the handheld terminal.

3. Refer to Table 4-2 and note the function code number of the function to modify or delete. To add a function code, refer to the ***Function Code Application Manual***.

4. Refer to the configuration section of the ***CTT_2 Configuration and Tuning Terminal*** instruction. Follow the procedures for adding, modifying or deleting function blocks.

5. After each change per function code, press *SEND* and then *F2*.

6. After all changes have been completed, press *EXECUTE* and then *F2*.

7. The display on the handheld terminal will show execute mode.

NOTE: Selecting the add/modify option after entering a custom configuration will overwrite the custom configuration.

CUSTOM CONFIGURATION AIDS

Refer to Appendix A for skeleton function block drawings to aid when developing a custom configuration.

SECTION 5 - OPERATING PROCEDURES

INTRODUCTION

This section provides a description of the single function pushbuttons and multi-function soft keys. It also describes the various screens encountered during everyday operation, i.e., the process screen, the main menu and all of the primary submenus of the main menu. Alarm displays, along with steps for acknowledging those alarms, are given. This section also describes routine operator functions such as changing the set point and control output values, changing modes, bypass operation, changing the loop display on dual loop controllers, tuning the PID constants and PV alarms, and monitoring the process.

> **NOTE:** The operator should have knowledge of the process and should read and understand this instruction before attempting any procedure pertaining to the operation of the controller. The operator should also be thoroughly educated in procedures for handling alarm conditions.

SINGLE FUNCTION PUSHBUTTONS

The three marked pushbuttons at the bottom of the faceplate are single function keys.

▲, ▼ Controls cursor movement, changes selection choices on screens, and increments or decrements selected parameter values (SP, CO).

A/M Allows choosing automatic or manual operation only at the process display screen. After switching from manual to automatic, the process will be under automatic control in response to the adjustment of a local set point in the controller.

SEL Allows selecting a highlighted parameter in a submenu. On screens where no submenu exists, it will enter the displayed selection environment. It is also used to move between PV, SP, CO display/control in the process display.

MULTI-FUNCTION SOFT KEYS

Three unmarked soft keys directly below the display are multi-function keys (Fig. 5-1). The specific function of these keys is defined by the graphics and will vary depending on the screen displayed. When no soft key menu is displayed directly above the soft keys, touching any of these soft keys will display a soft key menu. Once this soft key menu is displayed, pressing the soft key below the menu item desired will initiate the defined action.

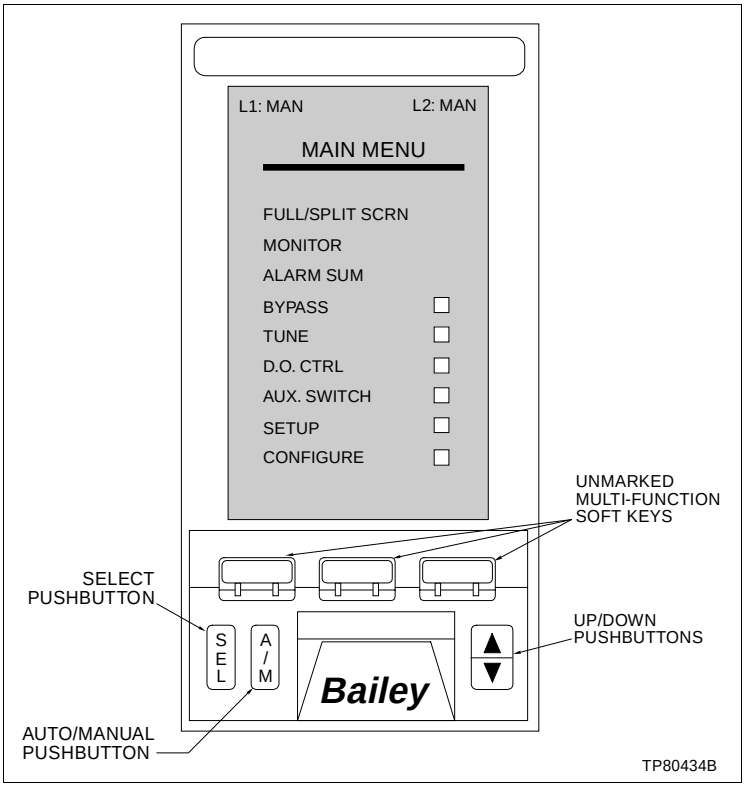


Figure 5-1. Operator Interface Controls

NORMAL OPERATION

Normal operation occurs when communication has been established between all the components within the Type SLC controller and everything is operating properly. During normal operation:

1. The set point, process variable and control output will appear on the front panel display.

2. The controller operates as a basic (single or dual loop PID), cascade or ratio station, depending upon the configuration entered.

POWER UP

Power up the unit. When the controller is first powered up, the following screen appears for a short time and then the process display screen appears if a configuration is entered. If no configuration is entered, the main menu screen appears.

During start-up, the controller is performing some self-diagnostics. If one of the tests fails, a message will appear. Refer to Section 6.

PROCESS DISPLAY

The process display screen is the default screen upon power up when a configuration does exist. The process screen displays information relative to the process: process variable, set points, control output, tag name, mode, and if alarms exist. This screen can be entered into from the main menu and other screens. No security level can be placed on this environment. This screen can always be reached from any other environment by pressing the middle multi-function soft key. Refer to Table 5-1 and Figure 5-2 for a description of all items encountered on the process display screen. From the process display screen, several options are available if the controller is set up for dual loop operation.

Table 5-1. Process Display Screen Descriptions

Item	Description	Function
1	Displayed variable indicator	Indicates the variable being displayed, either PV, SP, CO, A1 or A2.
2	Variable tracking indicator	Indicates when either CO or SP tracking is enabled. Will display *TRK* when tracking is enabled, and nothing otherwise.
3	Selected variable analog value	Analog value in EU of the selected variable, either PV, SP or CO for a basic or cascade station, the multiplier for a ratio station, and A1/A2 the auxiliary variables.
4	Selected variable EU	5-character EU of the selected variable. An *X* will be displayed when in ratio mode.
5	Value multiplier	Indicates that the value being displayed is $^{1}/_{1000}$ of the actual value.
6	Loop 1 mode indicator	Indicates the mode of loop 1: **Local:** AUT - automatic MAN - manual CAS - cascade RAT - ratio BYP - bypass **Computer:** C-A - computer automatic C-M - computer manual C-C - computer cascade C-R - computer ratio
7	Loop 2 mode indicator	Indicates the mode of loop 2. Same as item 6.
8	Alarm indicator	Indicates there is currently an alarm condition. A flashing *ALM* indicates an unacknowledged alarm.

Table 5-1. Process Display Screen Descriptions (continued)

Item	Description	Function
9	Active loop's faceplate switch indicator	3-character label indicates the state of the active loop faceplate switch. The ON and OFF labels are defined by the user in setup.
10	Active loop's tag name	14-character tag name of the active loop. For tag names of 10 characters or less, a larger font is used to display the name.
11	PV high and low alarms	High and low alarm limits of the process variable as defined by the user.
12	CO bar graph	Bar graph representation of the control output value.
13	PV bar graph	Bar graph representation of the process variable value.
14	SP bar graph	Bar graph representation of the set point value.
15	SP arrow	Indicates the value of the set point using the same scale as the process variable.
16	CO high and low tag	CO high and low bar graph labels defined by the user in setup.
17	PV zero and span	PV bar graph scale auto-calculated based on the PV zero and span defined by the user.
18	SP zero and span	SP bar graph scale auto-calculated based on the SP zero and span defined by the user.

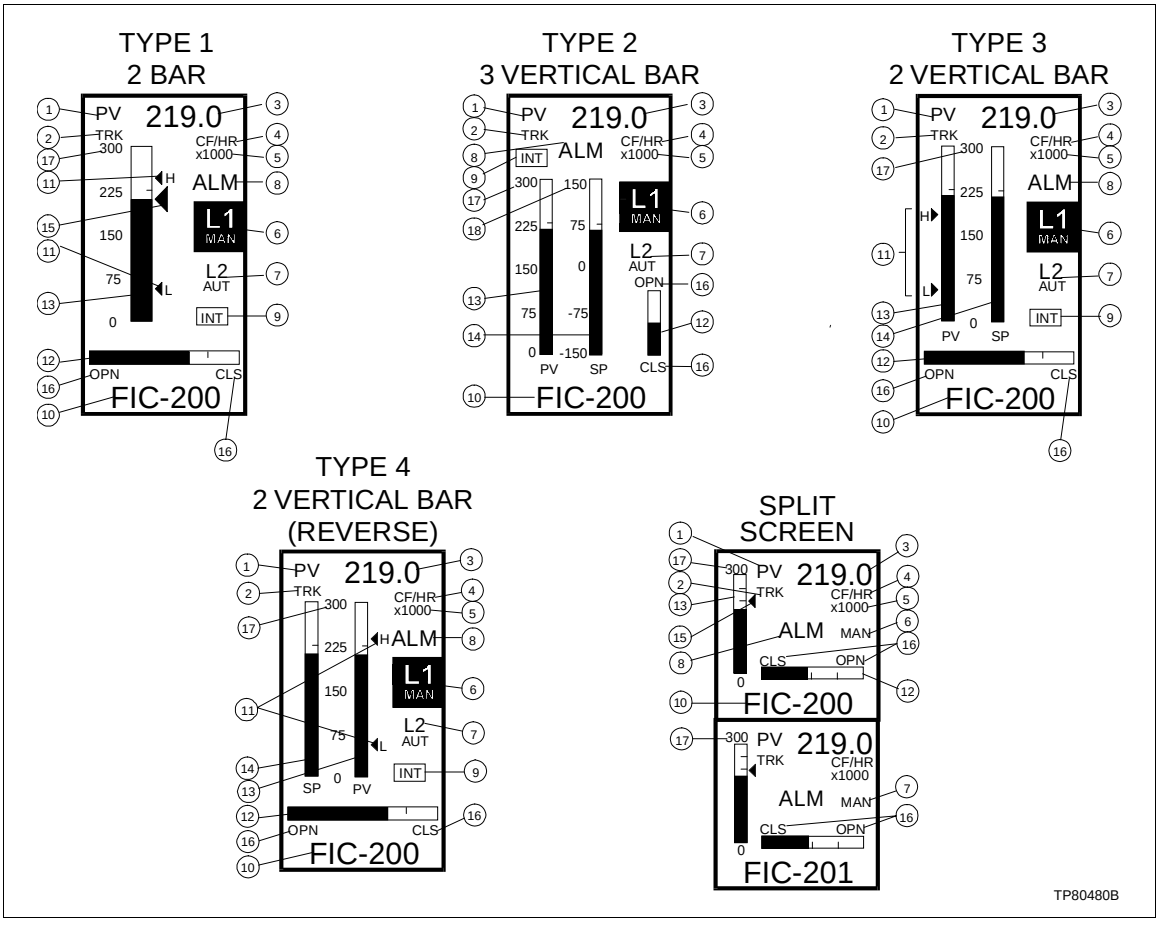


Figure 5-2. Process Display Screen

Full Screen or Split Screen

For single loop controllers, the process display screen is full size. For dual loop controllers, the process display can be full size or split screen, showing both loop one and loop two.

1. To change to split screen, press any unmarked soft key. At the soft key menu, press the soft key below *MAIN MENU*.

2. At the main menu, the other available choice will be highlighted. If presently using a full screen display, *SPLIT SCRN* will appear on the menu, or vice versa.

3. Press SEL when the correct selection is highlighted.

Change Loop

From the process display screen, it is possible to move from loop one to loop two in full screen or split screen mode on dual loop controllers.

1. Press any soft key and the soft key menu will appear.

2. Press the soft key below *CHNG LOOP*.

Set Point, Control Output and Changing Modes

The Type SLC controller has three types of station functions: basic, cascade or ratio. The principal difference between the three station functions is the method in which the set point is generated.

The procedures for adjusting the set point and control output are dependent on the type of station for which the controller is configured and the operating mode (auto, manual or bypass) of the controller. To complete operator adjustments, locate the station type and follow the procedures listed.

In some instances, the controller mode has to be changed before an adjustment can be made.

BASIC STATION

If the controller is configured as a basic station (single or dual PID configuration, internal set point), use the following procedures to set or change the set point, control output, and to change the controller mode if required. Table 5-2 explains what mode the controller needs to be in to effect a change in set point or control output through the faceplate.

> **NOTE:** For ***external*** set point basic stations, the set point *TRK* (track) indicator is displayed and the set point cannot be modified.

Table 5-2. Basic Station - Adjusting SP and CO from the Faceplate

Mode	Adjust Set Point (SP)	Adjust Control Output (CO)
Manual	Yes	Yes
Auto	Yes	No (change to MAN or BYP)
Bypass	Yes	Yes

Set Point - Basic Station

To adjust the set point on a controller configured for single or dual loop PID, refer to Table 5-2 to check mode and use the following procedures.

1. The controller can be in manual, auto or bypass mode to change the set point at the faceplate. If in *AUTO* and at the process display screen, press ▲ and ▼. The *SP* display will appear immediately in the upper left hand corner of the display. If in *MAN* or *BYP*, press SEL until *SP* appears.

2. Use ▲ and ▼ to select the new set point. The value in the upper right hand corner of the display will show the values ramping up or down and the arrow to the right of the scale will move to follow the new value.

3. To control the set point of the other loop in a dual loop controller, from the full screen or split screen process display, press one of the three unmarked soft keys and a soft key menu will appear. Press the soft key below *CHNG LOOP*. Repeat Steps 1 and 2 to adjust the set point.

Control Output - Basic Station

1. To adjust the control output at the faceplate in the loop displayed, the controller must be in manual or bypass mode (Table 5-2). If in auto, refer to ***Changing Modes - Basic Station***. Press SEL until *CO* appears in the upper left corner of the display.

2. Use ▲ and ▼ to select the new control output. The value in the upper right hand corner of the display will show the values ramping up or down and the CO bar graph will move right or left (up or down on Type 2 display).

3. To control the output of the other loop in a dual loop controller, from the full screen or split screen process display, press one of the three unmarked soft keys and a soft key menu will appear.

4. Press the key below *CHNG LOOP* to switch loops. Adjust the control output of that loop by repeating Steps 1 and 2.

Changing Modes - Basic Station

1. To move from *AUTO* to *MAN*, press A/M.

2. To move from *MAN* to *AUTO*, press A/M.

CASCADE STATION

If the controller is configured as a cascade station (cascade configuration), it is similar to a basic station, but receives an input from an external source during automatic control. That input is the remote set point to the controller.

To adjust the internal set point and the control output on a controller configured for cascade, use the following procedures. Table 5-3 explains the controller mode selections required to effect a change in set point or control output through the faceplate.

Table 5-3. Cascade Station - Adjusting SP and CO from the Faceplate

Mode	Adjust Set Point (SP)	Adjust Control Output (CO)
Manual	Yes	Yes
Auto	Yes	No (change to MAN or BYP)
Cascade	No (change to AUTO, MAN or BYP)	
Bypass	Yes	Yes

Set Point - Cascade Station

1. The controller can be in manual, auto or bypass mode to change the set point at the faceplate. If in *AUTO* and at the process display screen, press ▲ and ▼. The *SP* display will appear immediately in the upper left hand corner of the display. If in *MAN* or *BYP* and *PV* or *CO* is displayed, press SEL until *SP* appears.

2. Use ▲ and ▼ to select the new set point. The value in the upper right hand corner of the display will show the values ramping up or down and the arrow to the right of the scale will move to follow the new value.

Changing the Control Output - Cascade Station

1. To adjust the control output at the faceplate, the controller must be in manual or bypass mode (Table 5-3). If in auto, refer to ***Changing Modes - Cascade Station***. Press SEL until *CO* appears in the upper left corner of the display.

2. Use ▲ and ▼ to select the new control output. The value in the upper right hand corner of the display will show the values ramping up or down and the CO bar graph will move right or left (up or down on Type 2 display).

Changing Modes - Cascade Station

To change modes, perform the following procedures and refer to Figure 5-3.

Controller in AUTO

1. To change to *MAN*, press A/M.

2. To change to *CASCADE*, press the left soft key (*F1*) .

Controller in MAN

1. To change to *AUTO*, press A/M.

2. To change to *CAS*, press A/M to change to *AUTO*, then press the left soft key (*F1*).

Controller in CAS

1. To change to *MAN*, press A/M.

2. To change to *AUTO*, press the left soft key (*F1*).

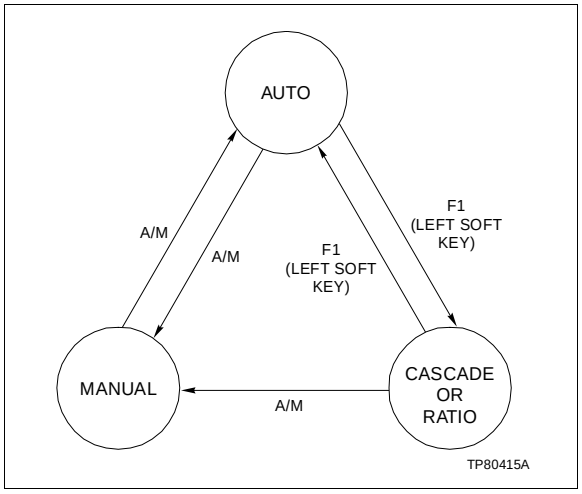


Figure 5-3. Changing Controller Modes

RATIO STATION

If the controller is configured as a ratio station, it differs from a basic and cascade station in that the set point is determined by a ***wild*** or uncontrolled variable. The set point is calculated by multiplying the uncontrolled variable by a predetermined multiplier. During ratio operation, the multiplication constant for the process can be modified through the set point raise/lower pushbuttons. Ratio multipliers can range from 0.01 to 10.0. To adjust the set point (ratio index) and the control output on a controller configured for ratio, use the following procedures. Table 5-4 explains in which mode the controller

needs to be to effect a change in set point or control output through the faceplate.

Table 5-4. Ratio Station - Adjusting SP and CO from the Faceplate

Mode	Adjust Set Point (SP)	Adjust Control Output (CO)
Manual	Yes	Yes
Auto	Yes	No (change to MAN or BYP)
Ratio	No[1] (change to AUTO, MAN or BYP)	
Bypass	Yes	Yes

NOTE:
1. For custom configuration users, the set point can be adjusted from the faceplate if the ratio N+1 of S2 in function code 80 is adjusted.

Changing the Set Point - Ratio Station

If the controller is operating as a ratio station, the operations are the same as a basic station.

1. The controller can be in manual, auto or bypass mode to change the set point at the faceplate. If in *AUTO* and at the process display screen, press ▲ and ▼. The *SP* display will appear immediately in the upper left hand corner of the display. If in *MAN* or *BYP* and *PV* or *CO* is displayed, press SEL until *SP* appears.

2. Use ▲ and ▼ to select the new set point. The value in the upper right hand corner of the display will show the values ramping up or down and the arrow to the right of the scale will move to follow the new value.

During ratio operation, the multiplication constant for the process can be modified by pressing ▲ and ▼.

Changing the Control Output - Ratio Station

1. To adjust the control output at the faceplate, the controller must be in manual or bypass mode (Table 5-4). If in auto, refer to ***Changing Modes - Ratio Station***. Press SEL until *CO* appears in the upper left corner of the display.

2. Use ▲ and ▼ to select the new control output. The value in the upper right hand corner of the display will show the values ramping up or down and the CO bar graph will move right or left (up or down on Type 2 display).

Changing Modes - Ratio Station

To change modes, perform the following procedures (Fig. 5-3).

Controller in AUTO

1. To change to *MAN*, press A/M.

2. To change to *RATIO*, press the left soft key (*F1*).

Controller in MAN

1. To change to *AUTO*, press A/M.

2. To change to *RAT*, press A/M to change to *AUTO*, then press the left soft key (*F1*).

Controller in RATIO

1. To change to *MAN*, press A/M.

2. To change to *AUTO*, press the left soft key (*F1*).

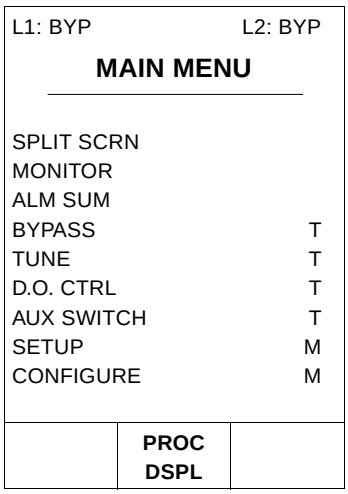
MAIN MENU

The main menu is the starting point to all other functions that need to be completed. From the process display screen, press any soft key and the soft key submenu will appear. Press the soft key under *MAIN MENU* to enter this environment.

Availability of operator adjustments is dependent on the security assigned during the setup procedures. Looking at the main menu, there are five environments which can have security assigned. Security levels and passwords are not mandatory; the controller operates without them. The type of adjustments that can be made will depend on the current type of security assigned and the security status.

The main menu is the default screen upon power up when the unit is not configured. It can also be entered into from other screens via the multi-function soft keys. This screen is the gateway to all of the other environments except for the process display screen. The security levels of the different environments are displayed on the main menu and are represented by a *T* (technician), *M* (master) or blank (none). The security passwords and security levels are set during the setup procedures. To move the highlight from one function to another, press ▲ and ▼. Press SEL when the choice has been highlighted.

Pressing any of the three soft keys below the faceplate will bring up the soft key submenu. Press the soft key below the display to return to the process display.



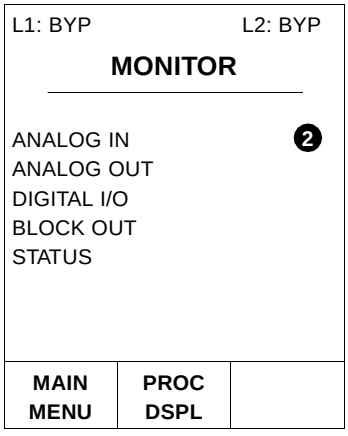
MONITOR

The monitor environment allows observing the controller I/O in a grouped fashion, i.e., all of the analog inputs together, all the analog outputs together, the digital I/O and block outputs, etc.

This environment is for monitoring and diagnostic purposes and can be entered from the main menu. The first four menu items are for monitoring; the status menu item is for diagnostics. No security level can be placed on this environment.

1. From the process display screen, press any soft key to bring up the soft key menu. Press the key below *MAIN MENU*.

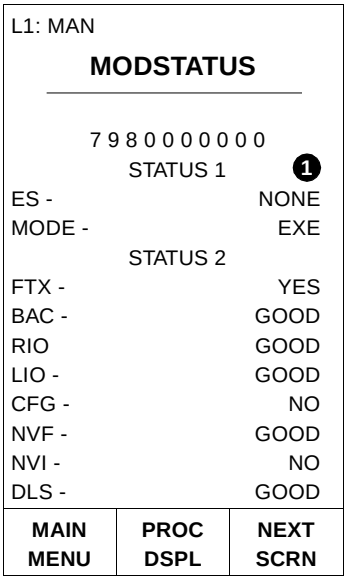
2. From the main menu, use ▲ and ▼ to highlight *MONITOR*. Press SEL. Use ▲ and ▼ to highlight *ANALOG IN*, *ANALOG OUT*, *DIGITAL I/O*, or *BLOCK OUT*, then press SEL.



3. To continue the monitor function, the next monitor subject that can be viewed is shown on the soft key menu (far right side). Press the soft key below that function to continue to the *STATUS* menu item, or return to the monitor menu or the process display.

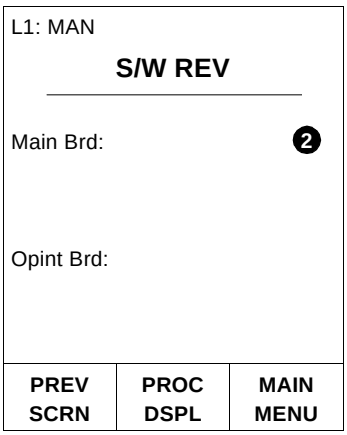
The status function provides the operator with diagnostic information and firmware revision levels.

1. Use ▲ or ▼ to highlight *STATUS*. The status screen provides status bytes 1 through 5 in hexadecimal. These bytes are located directly below the *MODSTATUS* display. The first two status bytes have common meaning for all control units. The last three status bytes contain specific error information. If a problem occurs, this information can be useful when talking to a service representative. To obtain the status information, the hexadecimal bytes must be converted to binary format. Refer to the CTT_2 Configuration and Tuning Terminal instruction. Reference the information in the ***Operating Status Display*** section and the hexadecimal conversion table. Refer also to Table G-10 in the ***Function Code Application Manual*** for an explanation of the abbreviated tests listed on the *MODSTATUS* screen.



NOTE: The status screen shows all 5 status bytes under *MODSTATUS*. Descriptions of status bytes 1 and 2 are displayed on this screen. Refer to the ***CTT_2 Configuration and Tuning Terminal*** instruction for a complete description of status bytes 3, 4 and 5.

2. To check the revision level of the main and operator interface boards, press the soft key below *NEXT SCRN*.



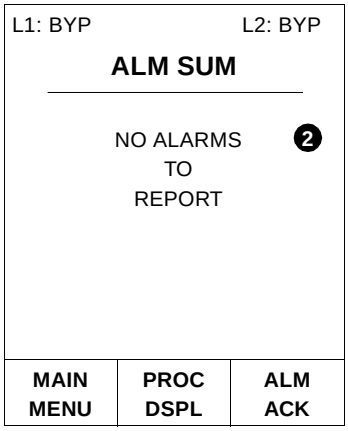
ALARM SUMMARY

When an alarm occurs, an alarm indication will be displayed. The type of alarm indicator may vary depending on the current screen and the type of alarm. A blinking alarm indicator indicates that one of more alarms have occurred and have not been acknowledged.

The alarm summary selection allows viewing all active alarms, both loop specific as well as general purpose and also displays if the controller is in bypass. Bypass alarm states include BYP TRANS, BYP ERROR, BYP LOCK, BYP CFG and BYP NO STATION. Alarms are listed in the order that they occur. A blinking alarm indicates that the alarm has not been acknowledged.

1. Press any of the three soft keys to bring up the soft key submenu.

2. Press the soft key below the display to initiate the action required. If the display is full and additional alarms are indicated, press ▲ or ▼.



An alarm condition can be acknowledged from the process display screen or from the alarm summary screen off the main menu. In addition to the alarm indication, a soft key menu will appear. Depending on the screen displayed at the time of the alarm, some of the following functions will be available to the user from the soft key menu.

- *ALM ACK* - acknowledge any alarms for the active loop.
- *ALM SUM* - go to the alarm summary screen.
- *CHNG LOOP* - change the active loop.
- *CONT* - continue working and ignore the current alarm.
- *PROC DSPL* - go to the process display screen.

Table 5-5 lists alarm types, screen displays being viewed when alarm condition occurs, and the various soft key menus available.

Table 5-5. Acknowledging Alarms

Screen Type (Active Loop)	Alarm	Soft Key		
		Left	Middle	Right
Process/trend display (L1)	Loop 1	ALM SUM	CHNG LOOP	ALM ACK
Process/trend display (L2)	Loop 1	ALM SUM	CHNG LOOP	—
Process/trend display (L1)	General	ALM SUM	CHNG LOOP	—
	Loop 1, loop 2	ALM SUM	CHNG LOOP	ALM ACK
	Loop 1, loop 2, general			
Non process display	Loop	ALM SUM	PROC DSPL	CONT
	General			
	Loop, general			

ACKNOWLEDGING ALARM FROM THE MAIN MENU

1. From the main menu, use ▲ or ▼ to highlight *ALM SUM*. The alarm summary screen allows viewing all active alarms, both loop specific as well as general purpose. The blinking alarm indicates the alarm has not been acknowledged.

2. To acknowledge the alarm, press the soft key below *ALM ACK*. The blinking will discontinue. Follow the necessary procedures to eliminate the alarm indication from the screen.

Return to normal operating conditions once the alarm condition has been corrected.

BYPASS

Bypass operation is a condition in which the operator interface board takes control of analog outputs one and two. The output associated with the active loop can be modified.

This mode is useful if the main board fails or if the communications link between boards is lost. The controller will be in bypass whenever the unit is entered into the configure mode. The *BYP* mode indicator on the faceplate indicates the unit is in bypass. The controller will alarm when bypass mode is entered.

To control analog output one, the controller must be on loop one. To control analog output two, the controller must be on loop two.

The bypass environment allows placing the bypass lock on or off depending on the current state of the controller. If the unit is placed into bypass mode, an alarm condition will occur.

Press the soft key below the display to initiate the action required.

When the controller enters a bypass mode ***automatically***, it should return to normal operation once the error condition is corrected and the controller is returned to manual or automatic control.

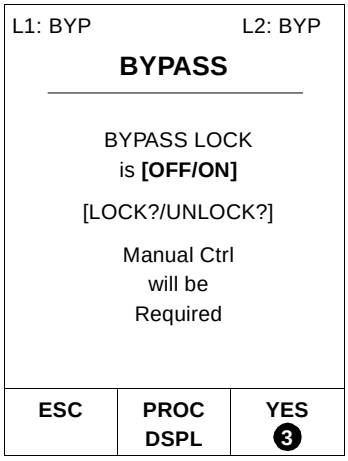
If bypass is entered ***manually***, it will override the automatic operation until manually changed back.

To manually initiate bypass operation:

1. Use the soft keys to enter the main menu.

2. From the main menu, use ▲ or ▼ to highlight *BYPASS*. Press SEL.

3. The bypass screen will appear. Press the soft key below *YES* to place the bypass lock *ON*. The controller will be in bypass mode.



4. When the operator interface makes a transition from normal operation to bypass, the board generates analog outputs that correspond to the last output values when in normal operation.

Refer to ***FAIL [AO#1]*** under ***LOOP OPTIONS*** in Section 3 for additional information.

TUNE

There are two tune functions available: tuning the PID constants and tuning the PV alarms. Entry to the tune environment is from the main menu.

PID Constants

The tune environment allows examining the configuration and modifying some tunable PID constants that affect controller response.

The tune feature can identify up to two PID loops to tune. Tune associates the first PID block (numerically lowest block address) with loop one, and the second PID block with loop two. The block address of the function code is the primary key.

The tunable parameters are documented in the worksheets in Appendix B. This environment can only be entered from the main menu. From the main menu, use ▲ or ▼ to highlight *TUNE*. Press SEL.

NOTE: Whenever SEL is pressed in the following steps, a soft key menu appears.

ESC	←	→

Use ← and → to position the cursor; use ▲ or ▼ to change the parameter values. *ESC* (escape) returns an entry to its original value.

Press the soft key below the display to initiate the action required.

NOTE: Pressing the soft key below *TUNE ALM* makes the PV alarm screen appear.

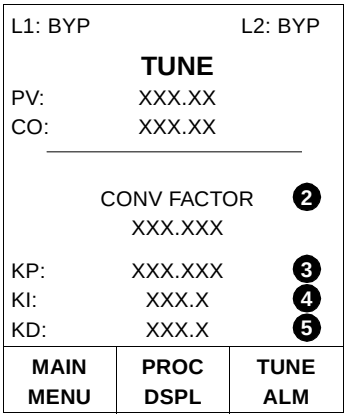
1. From the main menu, use ▲ or ▼ to highlight *TUNE*. Press SEL.

2. *CONV FACTOR* should be highlighted. Press SEL. Use ▲ or ▼ to enter the new conversion factor. Press SEL.

3. Use ▲ or ▼ to highlight *KP*. Press SEL. Use ▲ or ▼ to enter the new KP factor. Press SEL.

4. Use ▲ or ▼ to highlight *KI*. Press SEL. Use ▲ or ▼ to enter the new KI factor. Press SEL.

5. Use ▲ or ▼ to highlight *KD*. Press SEL. Use ▲ or ▼ to enter the new KD factor. Press SEL.



6. Press the soft key below the soft key menu display to go to *MAIN MENU, PROC DSPL* or *TUNE ALM*.

Process Variable (PV) Alarms

This is a tune function and access is gained through the main menu. The tune environment allows examining the configuration and modifying some tunable PV alarm constants that affect controller response.

The tune alarms function allows setting the process variable high and low alarms. The alarm settings must be within the value of the process variable span.

Press the soft key below the display to initiate the action required.

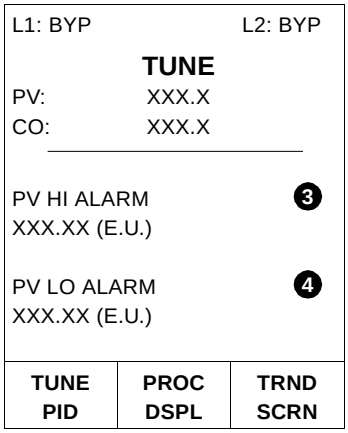
1. From the main menu, use ▲ or ▼ to highlight *TUNE*. Press SEL.

2. When the tune PID screen comes up, press the soft key below *TUNE ALM* to get to the correct screen.

3. With *PV HI ALM* highlighted, press SEL and then ▲ or ▼ to set the process variable high alarm. When the correct value is reached, press SEL.

4. Press ▼ to highlight *PV LO ALM*. Press SEL and then ▲ or ▼ to set the process variable high alarm. When the correct value is reached, press SEL.

NOTE: When SEL is pressed to change a selection, *ESC* appears on the soft key menu. Press the soft key below to return an entry to its original value.



5. Press the soft key below *TUNE PID, PROC DSPL* or *TRND SCRN*.

6. If *TRND SCRN* is chosen, the trend screen will appear (Fig. 5-4). The following functions are available:

a. Change controller mode between manual and auto by pressing A/M.

b. Change the set point (SP) or control output (CO). Press SEL. Press ▲ or ▼ to change the value.

c. Change set point in auto or manual. Change control output only in manual.

NOTE: The trend values are not stored. Historical data is lost when departing the trend screen.

7. To leave this environment, press any soft key and a soft key menu will appear. Select *PREV SCRN*, *PROC DSPL* or *MAIN MENU*.

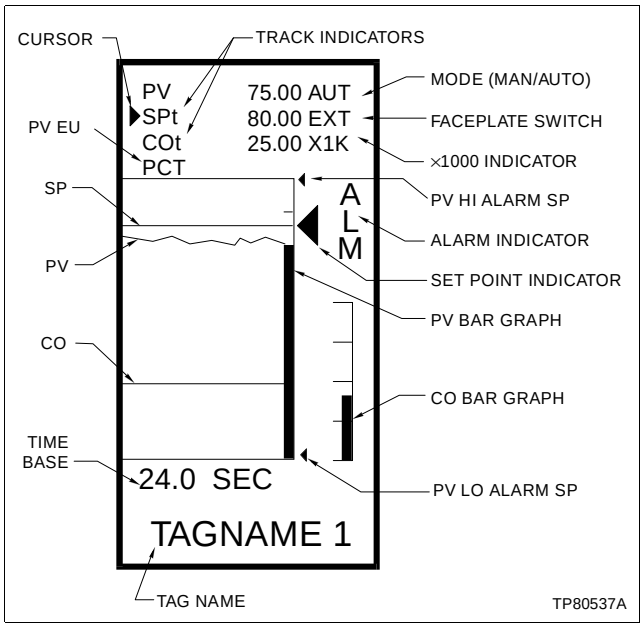


Figure 5-4. Trend Screen Description

D.O. CONTROL

Digital output control allows manually controlling each digital output provided each digital output is ***unlocked***.

Factory Configuration Users

When **LOCK* appears, the digital output is locked out through the setup procedures.

Custom or Modified Factory Configuration Users

When *LOCK* appears (without asterisk), the digital output is locked out through the configuration procedures. Refer to function code 231, specifications S12 through S16.

Press the soft key below the display to initiate the action required. To change the state of the digital outputs that are not locked:

1. From the main menu, press ▲ or ▼ to select *D.O. CTRL*. Press SEL. The DIG CTRL screen will appear.

2. Press ▲ or ▼ to choose the D.O. number to be changed. Place the D.O. in *MAN* mode by pressing the soft key below *AUT/MAN* until the display reads *MAN*. Press SEL to change the state of the digital output.

3. When changes have been completed, press the soft key below *MAIN MENU* or *PROC DSPL* to return to those environments.

L1: BYP		L2: BYP
DIG CTRL		
D.O.	ST	MODE
#1	0	LOCK
#2	0	*LOCK
#3	0	MAN
#4	0	AUT
[SEL - TO CHANGE]		
MAIN MENU	**PROC DSPL**	**AUT/ MAN**

SEL - TO CHANGE only appears if the current digital output is in MAN mode. AUT is the default.

AUXILIARY SWITCH OUTPUTS

This screen is ***only*** applicable for custom or modified factory configurations. This function provides Boolean outputs from the M/A-SLC function block during execute mode. These are reset in bypass mode.

The Boolean value (change state) of the four auxiliary switch outputs on loop station, function code 231, outputs 904 through 907 (one through four respectively) can be individually adjusted.

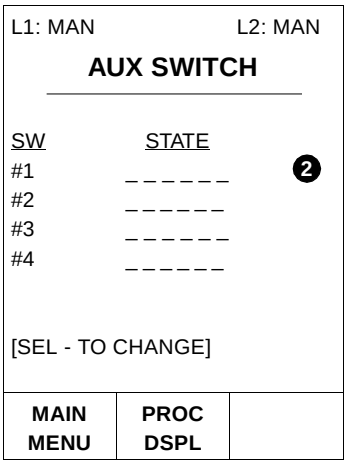
These are general purpose switches that are user-defined. The labels for the switches are assigned during the setup procedures. Most frequent usage is to access digital outputs for alarms, etc.

Press the soft key below the display to initiate the action required.

To change the state of an auxiliary switch:

1. From the main menu, press ▲ or ▼ to select *AUX SWITCH*. Press SEL. The AUX SWTCH screen will appear.

2. Press ▲ or ▼ to choose the switch number. Press SEL to change the state of the auxiliary switch. The new switch label will appear.



3. When changes have been completed, press the soft key below *MAIN MENU* or *PROC DSPL* to return to those environments.

CONTROLLER RESET

WARNING	**Be aware of the effects on the process before pressing the *RESET* button. Pressing the *RESET* button causes momentary loss (approximately five seconds) of process control. Some process upsets can injure personnel and damage equipment.**
AVERTISSEMENT	**Soyez conscients des conséquences sur le processus avant d'appuyer sur le bouton de remise à l'état initial (*RESET*). Ceci provoque une perte momentanée (environ cinq secondes) de la commande du processus. Certaines perturbations du processus pourraient provoquer des blessures et des dommages matériels.**

NOTE: For custom or modified factory configurations, this warning lists a five-second loss of automatic process control when the reset button is pressed. This loss of time could be more depending on the module start-up time configured. Refer to function code 90, block 20, S4.

The controller reset button is located behind the access door below the display area. This button may be used when the

main board times-out or goes into an error mode. Pressing the reset button causes the I/O to go through:

- Fail state.
- Power up state.
- Start-up.
- Execute.

When the reset button is pushed, the controller will go to bypass mode for one or both loops and will display an alarm condition. This bypass mode is indicated on the process display screens.

MODES OF OPERATION WHEN USING TYPE CTT TERMINAL

NOTE: This information applies only to users of a Type CTT Configuration and Tuning Terminal.

The Type SLC controller has three modes of operation when used with a Type CTT terminal: execute, configure and error. The five modes of operation indicated on the faceplate of a Type SLC controller are automatic, manual, bypass, cascade and ratio. Table 5-6 shows how these modes compare to one another.

Table 5-6. Modes of Operation Comparison

Type SLC Controller	Modes of Operation		
When using Type CTT terminal	Execute	Configuration	Error
When Type CTT terminal is not used (corresponding mode on faceplate)	Manual Auto Cascade Ratio	Bypass	Bypass

Execute

The ***execute*** mode is the normal mode of operation for the Type SLC controller. The controller reads the configuration, monitors and updates outputs, computes the algorithms, and performs self-diagnostic routines. The configuration cannot be changed, but parameters may be tuned and block outputs can be monitored.

Configure

The ***configure*** mode is used to enter new configuration data, and delete or modify an existing configuration. When bypass mode is entered, the analog outputs are held at their present value, the digital outputs are de-energized, and the algorithms are not computed. Existing parameters can be modified, blocks can be deleted or added, and all parameters can be adjusted using the Type CTT Configuration and Tuning Terminal.

Error

When transferring to the execute mode, the Type SLC controller may enter the ***error*** mode if a configuration error is detected. If this occurs, refer to the CTT_2 Configuration and Tuning Terminal instruction to determine the cause of the error. Also refer to the status information under ***MONITOR***. The controller must then be placed into ***configure*** mode to correct the problem before placing the unit into ***execute*** mode. Depending on the configuration, the ***error*** mode may also be entered from the ***execute*** mode by the occurrence of one of the following:

- The trip block is activated.
- A self-diagnostic failure occurs.

If either condition occurs, the Type SLC controller will enter the bypass mode. The Type CTT terminal will, when addressing the controller, report *VACANT*. Refer to Appendix D of the ***Function Code Application Manual*** for byte information.

1. Press *RESET* on the controller to receive the error message. Refer to the CTT_2 Configuration and Tuning Terminal instruction to determine the cause of the error.

2. After the error has been corrected, place the Type SLC controller into configure mode first and then into execute mode. As Figure 5-5 indicates, the execute mode is only accessible through the configure mode.

When in the error mode, both analog outputs are in bypass mode and the digital outputs are de-energized.

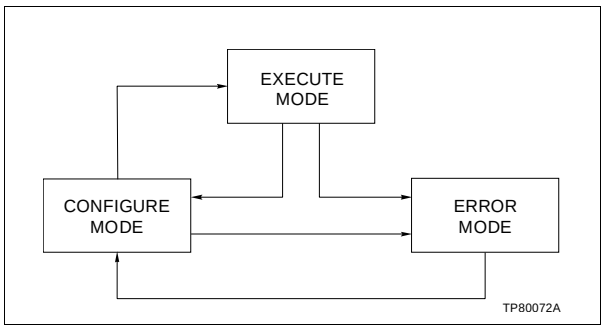


Figure 5-5. Entering the Execute Mode

SECTION 6 - TROUBLESHOOTING AND DIAGNOSTICS

INTRODUCTION

NOTE: Troubleshooting and diagnostic personnel should be qualified electrical technicians or engineers that know the proper use of test equipment and have a good understanding of troubleshooting procedures. They should also be familiar with the equipment, have experience working with process control systems, and know what precautions to take when working on live AC systems.

This section provides several checking procedures of problems that could be encountered during troubleshooting. The Type SLC controller has on-line diagnostics to help determine and isolate problems encountered. The diagnostics can be accessed through the monitor menu under *STATUS* and also through the setup menu under *DIAGNOSTICS*. Also included in this section is a troubleshooting flowchart.

If a Type CTT handheld terminal is being used, information through error messages is available to help identify the problem. Refer to the diagnostics section of the ***CTT_2 Configuration and Tuning Terminal*** instruction.

If the Type SLC controller is inoperative or operation is faulty, refer to the troubleshooting flowchart (Fig. 6-1).

NOTE: The troubleshooting flowchart contains sections pertaining to the Type CTT terminal. For factory configurations, ignore those blocks and proceed to the next applicable block.

CHECKING PROCESS CONTROL INTEGRITY

Hardware and software security functions help minimize the impact of errors on the controlled process.

The Type SLC controller performs on-line diagnostic tests to insure process control integrity. If an error is detected:

- Execution of algorithms ceases.
- The controller enters into the bypass mode and the analog outputs go to their user-selected default state determined during the setup procedures.
- Digital outputs de-energize.
- NVRAM is inhibited (cannot be erased or written).
- The module bus and internal communications cease. The controller may indicate VACANT when addressed.

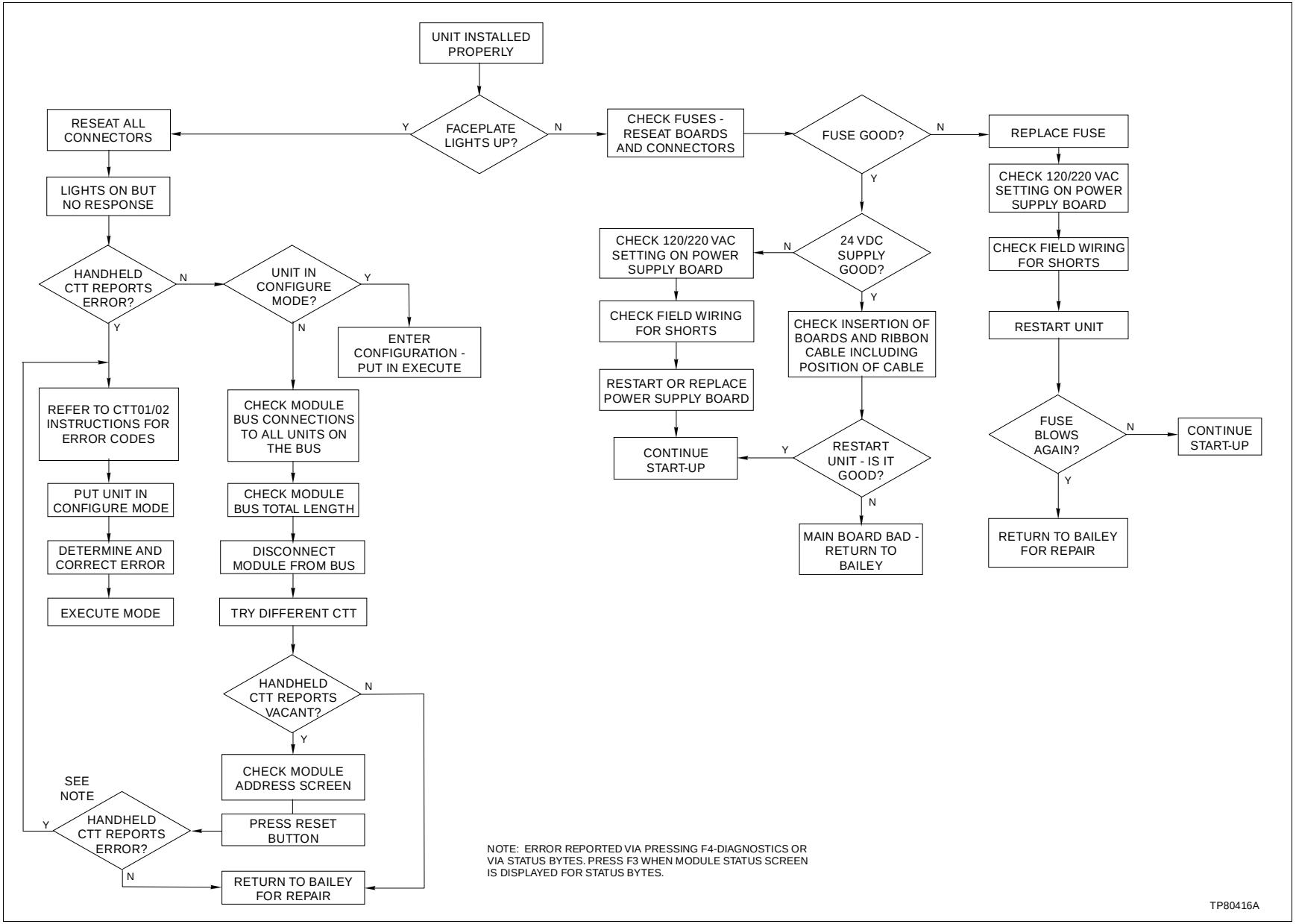


Figure 6-1. Troubleshooting Flowchart

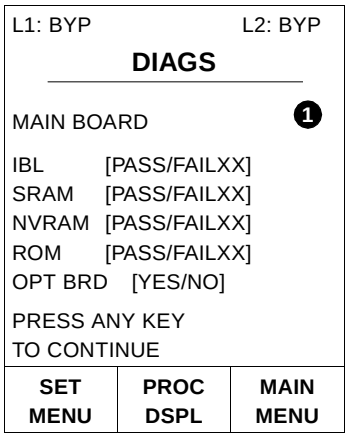
DIAGNOSTICS

There are two diagnostic tools available. The first tool provides a series of self-tests the controller automatically runs at start-up. The *DIAGNOSTICS* menu selection from the setup menu also provides those self-tests plus an additional group of tests. The second tool is the *STATUS* menu selection from the monitor menu. It provides specific error information through a display of status bytes.

If no security level was assigned to the setup function, a master password is required to enter the diagnostics screen. The tests on the first and second diagnostic screen are for the main board and operator interface board, respectively. These tests run automatically when the diagnostics screen is entered. The third diagnostics screen contains I/O and keyboard tests.

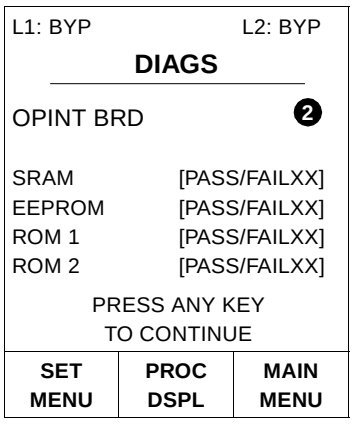
1. From the setup menu, press ▲ or ▼ until *DIAGNOSTICS* is highlighted. Press SEL. A warning screen notes the output may change and the unit is to be placed in bypass. Press any key; the first diagnostics screen (main board tests) appears. If any of the tests show *FAIL*, refer to Table 6-1 for corrective action.

2. Press any key to continue. The second diagnostics screen (operator interface board) will be displayed. If any of the tests show *FAIL*, refer to Table 6-1 for corrective action.



Main Board Tests

Interboard communications link.
Static RAM.
Nonvolatile RAM.
Read only memory firmware.
Is option board installed?

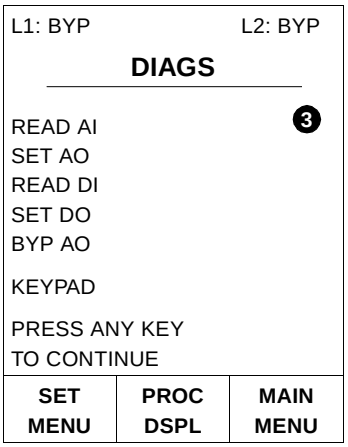


Operator Interface Board Tests

Static RAM.
Programmable read only memory firmware.
Read only memory firmware.
Read only memory firmware.

WARNING	**The output tests could cause process upsets if the unit is connected to the process while the tests are performed. Some process upsets can lead to injury and equipment damage. The last six tests on the diagnostics screen verify the I/O operation without configuration interaction.**
AVERTISSEMENT	**Les tests de sortie pourraient causer des dérangements au procédé si le contrôleur est raccordé au procédé au moment où ces tests sont effectués. Certains dérangements du procédé pourraient causer des blessures ou des dommages à l'équipement. Les six (6) tests indiqués à l'écran des diagnostiques vérifient le fonctionnement des entrées/sorties sans l'interaction de la configuration.**

3. When main board and operator interface board tests are completed, press any key to continue. The third diagnostics screen (I/O tests) will appear. The *READ AI* test will be highlighted. From this point, choose to run any, all, or none of the remaining six tests. To run any of the remaining tests, press ▲ or ▼ until the test desired is highlighted. Press SEL. If any of the tests show *FAIL*, refer to Table 6-1 for corrective action.



Input/Output Tests

Read analog input. Same as a monitor function.
User can set AO, 0 to 100%.
Read digital input. Same as monitor function.
User can set DO, 0 or 1.
Tests operator interface board. User can set AO, 0 to 100%.
Checks functions of all pushbuttons and keys.

4. Once tests are completed, press any soft key and a soft key submenu appears. Press the key below your selection.

Table 6-1. Diagnostic Tests

Board or Test	Display Description	Checking Procedures	Corrective Action
Main board	IBL [FAIL]	Check ribbon connector cable connections between operator interface board and main board.	If cable connections are bad, replace ribbon connector (refer to Section 8).
	SRAM [FAIL]	None.	Replace main board (refer to Section 8).
	NVRAM [FAIL]	Replace NVRAM (U10, U11).	If test still fails, replace main board. Refer to Section 8 for board and NVRAM or ROM replacement instructions.
	ROM [FAIL]	Replace ROM (U12).	

Table 6-1. Diagnostic Tests (continued)

Board or Test	Display Description	Checking Procedures	Corrective Action
Main board *(continued)*	OPT BRD	Checks to see if option board is installed.	None.
Operator interface board	SRAM [FAIL]	None.	Replace operator interface board (refer to Section 8).
	EEPROM [FAIL]		
	ROM 1 [FAIL]	Replace ROM (XU18).	If test still fails, replace operator interface board (refer to Section 8).
	ROM 2 [FAIL]	Replace ROM (XU6).	
I/O tests	READ AI	Enter and verify the values on screen display are correct.	If not correct, refer to Section 8.
		Set from 0 to 100%. Verify reading at termination unit terminal block.	
	READ DI	Enter and verify that values on screen display are correct.	
	SET DO	Set digital outputs to 0 or 1. Verify reading at termination unit terminal block.	
	BYP AO	Check ribbon connector cable between operator interface board and main board.	Replace operator interface board (refer to Section 8).
Keypad test	KEYPAD	Press each key on the controller faceplate. Screen display will echo key depressed.	Replace faceplate assembly (refer to Section 8).

ERROR MESSAGES

Error messages appear on the faceplate display of the Type SLC controller through menu selections. *DIAGNOSTICS* in the setup menu and *STATUS* in the monitor menu both provide error information.

If the Type CTT terminal is being used with the controller, refer to the ***CTT_2 Configuration and Tuning Terminal*** instruction for error messages and recovery actions.

BROKEN ANALOG OUTPUT CURRENT LOOP

1. To detect a break in the analog output current loop, go to the *MONITOR AO* screen.

2. If a break has occurred, check the termination unit connections for a break.

3. Repair or replace any broken connections. If no break is evident, refer to Section 8 for instructions on removing the circuit boards and replace the main board.

During the start-up routine, the controller remains in bypass. The operator has control of the analog outputs from the process display faceplate.

REFERENCE OR OVERRANGE ERROR

If an error code is displayed on the Type CTT terminal that indicates a reference or overrange error, the analog input may be overranged. To isolate the problem:

1. Measure the common mode voltage on each input (+/–) to earth ground (Fig. 6-2).

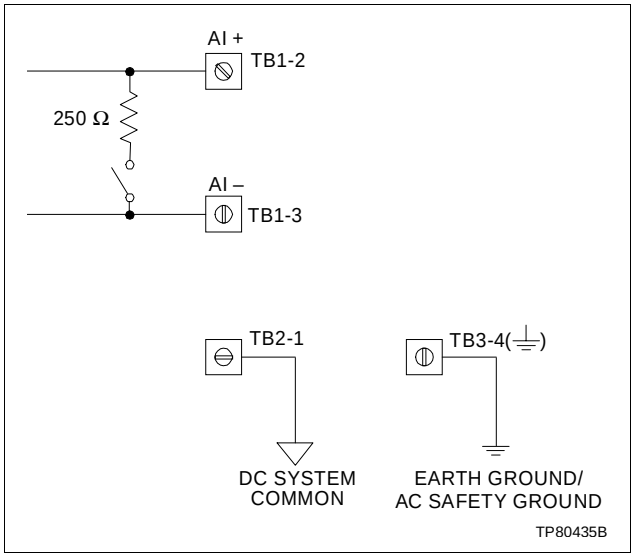


Figure 6-2. Checking Common Mode Voltage

2. In an ideal single point grounding system, there will be no potential difference between DC system common and earth ground.

3. The voltage between the analog input (+) and earth ground can be between -5 V and +10 VDC or AC peak maximum.

4. The voltage between the analog input (–) and earth ground can be between -10 V and +5 VDC or AC peak maximum.

5. If the analog input exceeds these limits, the controller is properly sensing an overranged input. The installation must be corrected.

6. Check for single point grounding, the need for input isolators, signal wiring which is improperly routed with power wiring, inadequate shielding, etc.

7. Function code 230, S12 = 0, will trip the controller on a reference voltage error. The alarm summary screen will indicate bypass error mode.

8. Refer to the status information under ***MONITOR*** in Section 5 and reference status byte information.

SECTION 7 - PREVENTIVE MAINTENANCE

INTRODUCTION

WARNING	**System maintenance must be performed only by qualified personnel and only after securing the equipment controlled by the circuit. Altering or removing components from an active circuit may upset the controlled process leading to personnel injury and equipment damage.**
AVERTISSEMENT	**L'entretien du système ne doit être effectuée que par le personnel qualifié et seulement une fois que l'équipement contrôlé par le circuit est fixé en place. La modification ou le retrait des composants d'un circuit actif pourraient perturber le processus contrôlé et menter à des blessures au personnel et à l'endommagement de l'équipement.**

The reliability of any stand-alone product or control system is affected by the maintenance of the equipment. Bailey-Fischer & Porter strongly recommends that all equipment users practice a preventive maintenance program that will keep the equipment operating at an optimum level.

NOTE: Maintenance personnel should be qualified electrical technicians or engineers that know the proper use of test equipment. They should also be familiar with the Type SLC controller, have experience working with process control systems, and know what precautions to take when working on live AC systems.

USING THE LOOP BYPASS STATION

The Type CLB01 Loop Bypass Station is available as an accessory from Bailey-Fisher & Porter. It is a tool for maintenance personnel that allows the interface and/or the main board to be removed for service or replacement while maintaining direct manual control of the process. Refer to the ***CLB01 Loop Bypass Station*** instruction for detailed information of operation before continuing.

The following procedures outline use of the loop bypass station.

1. Transfer control to the bypass mode from the main menu.

2. Connect the loop bypass cable to connector P3 (Fig. 2-17) on the controller termination board and transfer analog output control to the loop bypass station.

3. Refer to Section 8 for procedures for removing the operator interface board.

4. Reverse these procedures to return output control to the controller.

NOTE: It is not necessary to reset the Type SLC controller when returning from Type CLB bypass control.

PREVENTIVE MAINTENANCE SCHEDULE

Table 7-1 is the preventive maintenance schedule for the Type SLC controller. The table lists the preventive maintenance tasks in groups according to their specified maintenance interval. Some tasks in Table 7-1 are self explanatory. Instruction for tasks that require further explanation are covered under ***PREVENTIVE MAINTENANCE PROCEDURES***.

Table 7-1. Preventive Maintenance Schedule

Task	Frequency
Clean faceplate. Operating conditions may require more frequent cleaning. See procedure.	3 months
Check and tighten all wiring connections, including power and ground connections.	6 months
Check and tighten all conduit connections.	
Calibrate the temperature inputs. See procedure.	
Inspect circuit boards and edge connectors for contamination and clean if necessary. See procedure.	12 months
Complete all the procedures listed in this table unless procedure lists a replacement time. Follow timetable for replacement.	Shutdown

PREVENTIVE MAINTENANCE PROCEDURES

This section covers tasks from Table 7-1 that require specific instructions or further explanation:

- Cleaning the faceplate.
- Calibrating the temperature inputs.
- Cleaning printed circuit boards and edge connectors.

Cleaning the Faceplate

Equipment required:

- Window cleaning solution.
- Soft, lint-free cloth.

1. Use a soft, lint-free cloth and gentle window cleaning solution to clean the faceplate.

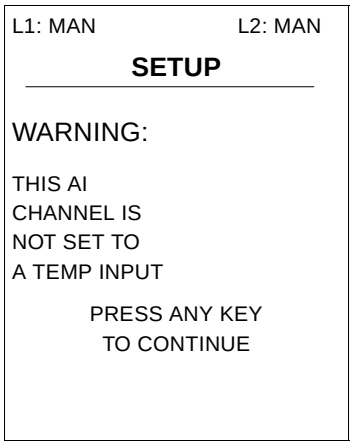
2. Spray the solution on the cloth and apply to faceplate. Do not directly spray the faceplate area.

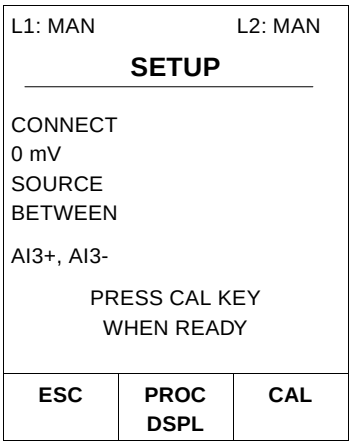
Calibrating the Temperature Inputs

Equipment required:

- Thermocouples: 0 to 60 mV source, 0.01 percent accuracy.
- RTDs: 300 ohm, 0.1 percent accuracy.

1. From the main menu, press ▲ or ▼ to highlight *SETUP*. Press SEL. From the setup menu, press ▲ or ▼ to highlight *OPTIONS*. Press SEL. From the options menu, press ▲ or ▼ to highlight *CAL AI3*. Press SEL. If AI3 has not been set as a temperature input from the *OPTION BRD* screen, the warning screen on the left will appear. Press any key to return to the options menu. If AI3 has been selected as a temperature input, the calibration screen on the right will appear. Connect an external 0 to 60 mV source that has an accuracy of 0.01% and follow the instructions on the screen.





2. When the soft key below *CAL* is pressed, the controller will take a reading of the 0 mV source. Once the reading is taken, the screen will prompt to connect 60 mV between AI3+ and AI3-. Press the soft key below *CAL*. Once the reading is complete, the controller will return to the options menu. Repeat Steps 1 and 2 for AI4 if required. After calibration is complete, the setup menu will appear. Press the soft key below *PROC DSPL* to return to the process display.

Cleaning Printed Circuit Boards

NOTE: Before handling circuit boards, refer to ***SPECIAL HANDLING PROCEDURES*** in Section 2.

Equipment required:

- Antistatic vacuum.
- ESD field service kit.
- Isopropyl alcohol, 99.5 percent electronic grade.

WARNING	**Wear eye protection when using compressed air to remove cleaning solvents. Eye injury can result from splashing solvent.**
AVERTISSEMENT	**Il faut porter une protectino pour les yeux pendant qu'on utilise l'air comprimé pour enlever les solvants nettoyants. Une éclaboussure du solvant pourrait causer une blessure aux yeux.**

Refer to Section 8 for procedures to remove circuit boards.

If the printed circuit board needs minor cleaning, remove dust and residue from board surfaces using clean, dry, filtered compressed air or an antistatic field service vacuum cleaner.

Do not wash printed circuit boards.

Another method of cleaning the printed circuit board is:

1. Spray or wipe the board with isopropyl alcohol (99.5% electronic grade). Use a foam tipped swab to wipe the circuit board.

2. When the circuit board is clean, remove excess solvent by using compressed air to blow it free of the circuit board.

Bailey-Fischer & Porter does not recommend the repair of printed circuit boards in the field. Equipment requiring repair should be returned to the factory or the nearest Bailey-Fischer & Porter service center.

Cleaning Edge Connectors

Equipment required:

- Isopropyl alcohol, 99.5 percent electronic grade.
- Distilled water.
- Eberhard Faber (400A) pink pearl eraser.

To clean edge connector contacts:

1. Use a solvent mixture of 80% isopropyl alcohol (99.5% electronic grade) and 20% distilled water.

2. Soak a lint-free cloth with the solvent mixture.

3. Work the cloth back and forth parallel to the end connector contacts.

4. Repeat with a clean cloth that is soaked with the solvent mixture.

5. Dry the edge connector contact area by wiping with a clean lint-free cloth.

To clean tarnished or deeply stained edge connector contacts:

1. Use an Eberhard Faber (400A) pink pearl eraser or equivalent to remove tarnish or stains. Fiberglass or nylon burnishing brushes may also be used.

2. Minimize electrostatic discharge by using the 80/20 isopropyl alcohol/water solution during burnishing.

3. Use no more than five wipes of the eraser back and forth to clean the edge connector contacts.

SECTION 8 - REPAIR AND REPLACEMENT PROCEDURES

INTRODUCTION

WARNING	**Do not substitute components that compromise the certifications listed on the nameplate. Invalidating the certifications can lead to unsafe conditions that can injure personnel and damage equipment.**
AVERTISSEMENT	**Ne substituez pas des composantes qui pourraient annuler la conformité aux classes figurant sur la plaque signalétique relativement aux endroits dangereux. Ceci peut entraîner des conditions dangereuses qui risquent de provoquer des blessures et des dommages matériels.**

This section provides disassembly and assembly procedures for replacement of the faceplate/operator interface assembly, main board, power supply board, termination board and fuse replacement.

Also included is an assembly drawing of the controller and recommended spare parts.

> **NOTE:** Repair/replacement personnel should be qualified technicians, experienced in disassembly and assembly of electronic equipment.

USING THE LOOP BYPASS STATION

If the operator interface board or the main board must be removed for servicing, a Type CLB01 Loop Bypass Station is available as an accessory. The Type CLB01 station is a maintenance tool for maintenance or repair/replacement personnel. When properly installed and adjusted, the loop bypass station overrides two analog outputs of the Type SLC controller and permits direct manual control of the process. Refer to the ***CLB01 Loop Bypass Station*** instruction for detailed information of operation before continuing.

The following procedures outline use of the loop bypass station.

1. Transfer control to the bypass mode from the main menu.

2. Connect the loop bypass cable to connector P3 (Fig. 2-17) on the controller termination unit and transfer analog output control to the loop bypass station.

WARNING	**Do not disconnect equipment unless power has been switched off at the source or the area is known to be nonhazardous. Disconnecting equipment in a hazardous location with source power on can produce an ignition capable arc that can injure personnel and damage equipment.**
AVERTISSEMENT	**Ne débranchez l'équipement que si l'alimentation a été interrompue ou si l'environnement est non dangereux. Le débranchement de l'équipement sous tension peut produire une étincelle, ce qui peut mener à une explosion et à des blessures au personnel.**

3. Refer to the procedures for removing the operator interface board.

NOTE: The main board and the interface board contain semiconductor devices and are subject to damage by static electricity. Refer to ***SPECIAL HANDLING PROCEDURES*** in Section 2.

Reverse these procedures to return output control to the controller.

REPLACING THE FACEPLATE/OPERATOR INTERFACE ASSEMBLY

NOTE: When replacing any components, verify the firmware revision level. Make certain that replacement parts match firmware revision level of components being removed.

Remove power from the controller if the Type CLB01 loop bypass station is not in use.

1. Pull down on the small access door below the display area on the controller faceplate. Loosen the captive locking screw until the faceplate and operator interface board assembly can be pulled forward.

2. Disconnect the ribbon connector between the main board and the interface board. Remove the faceplate/operator interface assembly from the controller housing.

3. If just replacing ROM 1 or ROM 2, refer to Figure 8-1 for the locations.

4. Assemble the new faceplate/operator interface assembly into the controller housing. While inserting, attach the ribbon cable connector on the new assembly to the main board.

NOTE: The contrast of the display has been preset at the factory. If adjustment is required, refer to Section 3 and make the brightness adjustment.

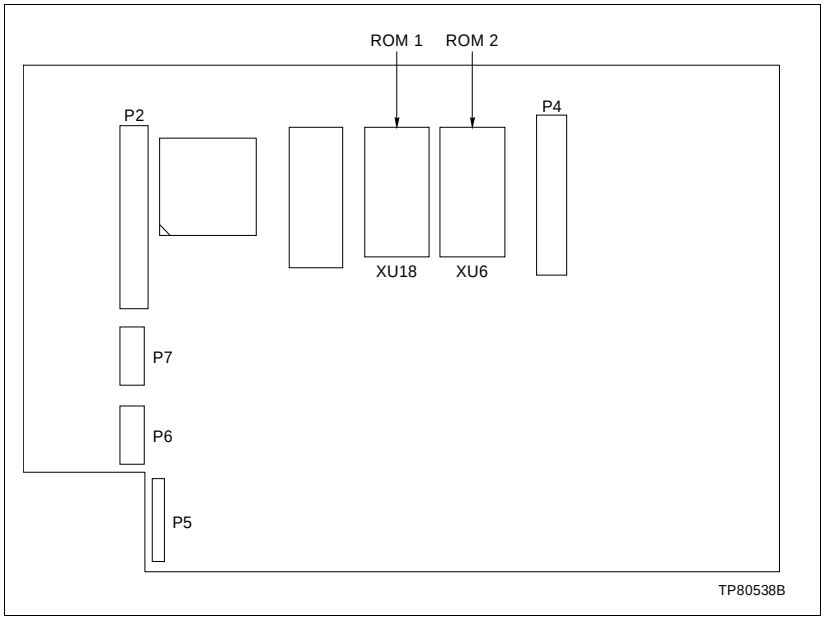


Figure 8-1. Location of ROMs on Operator Interface Board

REPLACING THE POWER SUPPLY BOARD

1. Remove power from the controller.

2. Loosen the captive screw and remove the faceplate/operator interface assembly as described in Steps 1 through 3 of ***REPLACING THE FACEPLATE/OPERATOR INTERFACE ASSEMBLY***.

3. Loosen screw and remove the card retainer. Use the handle (pull tab) and remove the main board from the controller housing (Fig. 8-2).

> **NOTE:** If the controller is to be used with 220/240 VAC supply, or the controller has to be set for single point grounding, jumpers must be removed from the power supply board prior to entering into service. Refer to Figure 2-4 and ***DC SYSTEM COMMON GROUND*** in Section 2. Refer to Figure 8-3 for location of jumpers.

4. Slide the power supply board out of the housing. Note jumper settings. Set jumpers on new power supply board and slide the board into the controller housing. Press board into position making certain that the card edge is seated in the termination board connector.

5. Assemble the main board and the faceplate/operator interface assembly into the controller housing. Install card retainer and tighten screw. While inserting the operator interface assembly, reconnect the ribbon connector. Tighten the captive locking screw under the door to secure the faceplate assembly to the controller housing.

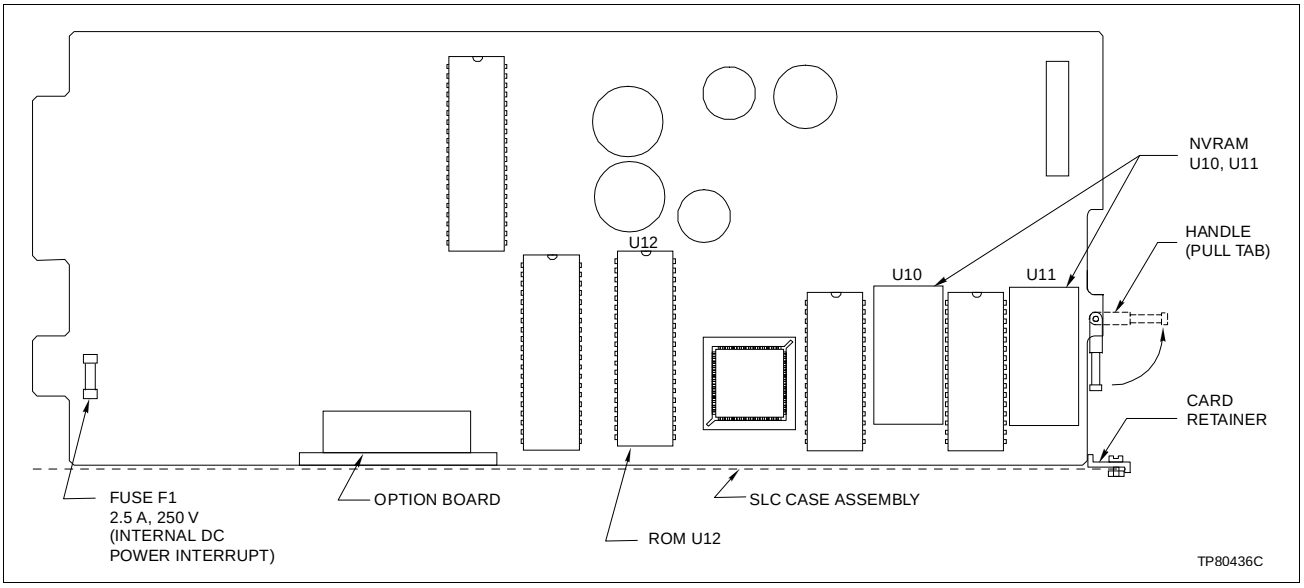


Figure 8-2. Removing the Main Board

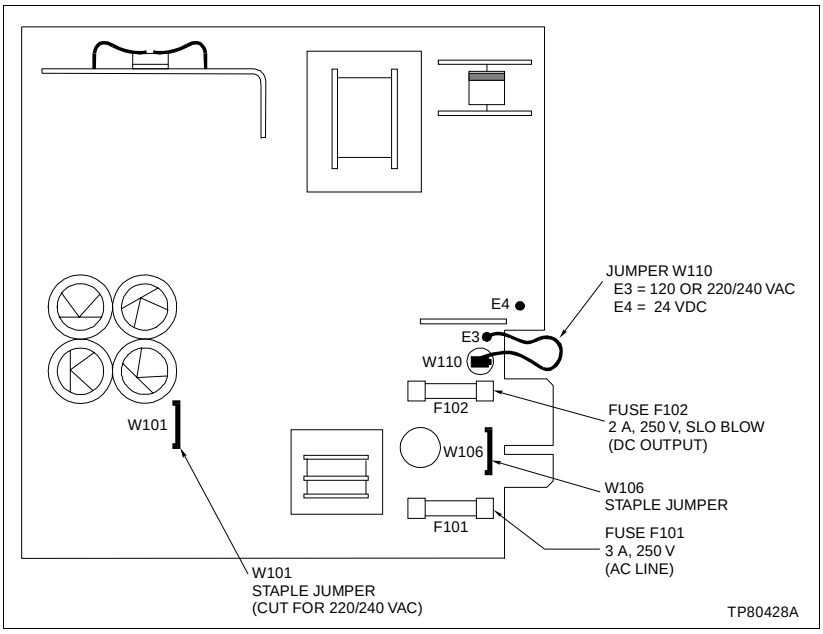


Figure 8-3. Replacing Power Supply Board Fuses

REPLACING FUSES

1. Remove power from the controller.

2. Remove the faceplate assembly and interface board as described in Steps 1 through 3 of ***REPLACING THE FACEPLATE/OPERATOR INTERFACE ASSEMBLY***.

WARNING	**Replace the fuse with one of the same type and rating. Using an improper fuse can lead to injury to personnel and equipment damage from fire or electrical shock.**
AVERTISSEMENT	**Remplacer le fusible avec un fusible du même type et de la même capacité. L'utilisation d'une fusible du mauvais type/ capacité pourrait causer des blessures au personnel et des dommages à l'équipement résultant d'un incendie ou de choc électrique.**

3. Loosen screw and remove the card retainer. Use the handle (pull tab) to remove the main board assembly from the housing (Fig. 8-2).

4. If necessary, replace F1 on the main board (Fig. 8-2) with a 2.5 A, 250 V fuse.

5. Reach in the housing and pull the power supply board to remove. Examine the two fuses, F101 and F102 (Fig. 8-3) on the power supply board.

6. If necessary, replace F101 with a 3 A, 250 V fuse or F102 with a 2 A (slo blow), 250 V fuse. Slide the power supply board into the housing and make certain it is firmly seated in the termination board connector.

7. Slide the main board assembly back into the housing. Make certain it is firmly seated in the termination board connector. Install card retainer and tighten screw.

8. Connect the ribbon cable connector from the main board to the faceplate/operator interface assembly and slide the interface board into the housing.

9. Tighten the captive locking screw.

REPLACING THE MAIN BOARD AND OPTION BOARD

NOTE: When replacing any component, verify the firmware revision level. Make certain that replacement parts match the firmware revision level of the component being removed.

1. Remove power from the controller if not using the Type CLB01 loop bypass station.

2. Remove the faceplate assembly and interface board as described in Steps 1 through 3 of ***REPLACING THE FACEPLATE/OPERATOR INTERFACE ASSEMBLY***.

3. Loosen screw and remove the card retainer. Using the handle (pull tab), remove the main board from the controller housing (Fig. 8-2).

NOTES:

1. The NVRAM (Fig. 8-2) from the faulty main board can be removed and installed on the new main board. This eliminates the need to configure the new board, providing main board failure is not due to or has not caused NVRAM corruption. If the NVRAM is replaced, refer to ***Ambient Temperature*** in Section 3 and enter the ambient temperature at the wiring terminals.

2. If necessary to replace ROM U12, refer to Figure 8-2 for the location.

4. To replace the option board, remove it from the main board connector P6. Set all jumpers on the new option board to the same positions as on the old option board (Fig. D-1). Seat the new option board in the main board connector P6.

5. Assemble by reversing Steps 2 and 3.

6. Replacement of the main board requires entering the ambient temperature at the wiring terminals (refer to ***OPTIONS*** in Section 3).

REPLACING THE TERMINATION BOARD

1. Remove power from the controller.

2. Disconnect all the wiring terminations on the termination board at terminal blocks TB1, TB2, TB3 and TB4. Tag each wire removed to aid in reconnecting.

3. Remove the faceplate assembly and interface board as described in Steps 1 through 3 of ***REPLACING THE FACEPLATE/OPERATOR INTERFACE ASSEMBLY***.

4. Remove the power supply board and the main board from the controller housing (refer to ***REPLACING THE POWER SUPPLY BOARD***).

5. Remove the four screws securing the termination board to the controller housing. Note the S1 switch settings before discarding the board.

6. Install new termination board in rear of controller housing. Insert four screws and tighten. Set switch S1 on the new board. If necessary, refer to Table 2-1.

7. Install the power supply board and then the main board into the housing and gently push in position until the card edge of each board is firmly seated in the termination board connector. Install the card retainer and tighten the screw.

8. Assemble the main board ribbon connector to the interface board. Insert the faceplate/operator interface assembly into the controller housing. Tighten the captive locking screw.

9. Reconnect the wiring to TB1, TB2 and TB3 of the termination board using the tags (Step 2) for identification of location. Refer to the external wiring label on the inside of the rear cover for additional help. Connect wiring to TB4.

10. Replacement of the termination unit requires entering the ambient temperature at the wiring terminals (refer to ***OPTIONS*** in Section 3).

PARTS LIST

Bailey Controls Company is ready to assist in the use and repair of its products at any time. Requests should be made to the nearest sales or service office. Table 8-1 is the parts list for Figure 8-4.

Table 8-1. Parts List (Figure 8-4)

Item	Part No.	Description
1	6639054é1	Faceplate and operator interface PCB assembly[1]
2	6639049é1	Main PCB assembly[1]
3	1948118é1	Power supply PCB assembly
4	6640350é1	Case assembly
5	6639199é1	Termination unit PCB assembly
6	6636612é1	Rear cover
7	6640713é1	Wiring label
8	MP405-789	Rear cover label
9	5311428-10	O-ring
10	6636615é1	Slide nut, 2 required
11	1963660éé	Nameplate
12	MP295-1087	Caution label
13	6636735A1	Mounting bracket assembly
14	6637171é2	Cable assembly
15	6636733é2	Card guide, 2 required
16	1951781é1	Panel gasket
17	1964053é1	Service legend, 3 required
18	6640367é1	Optional temperature/frequency input board: SLC01 – omit SLC21 – 1 required
19	6641189é1	Spring spacer
20	NBZHA16005	0.190-32 × 0.312 pan head slotted machine screw
21	NIDAC09004	0.112-40 × 0.250 slotted pan head machine screw, sems external, 4 required

Table 8-1. Parts List (Figure 8-4) (continued)

Item	Part No.	Description
22	NBTHA23040	0.312-18 × 0.250 slotted fillister head machine screw, 2 required
23	NPMHA08010	Rivet, 4 required
24	6641379é1	Card retainer
25	341816é5118	O-ring
26	NBZAC09006	Pan head screw
27	NTLAC11000	External lockwasher

NOTE:
1. Specify firmware level of board being replaced.

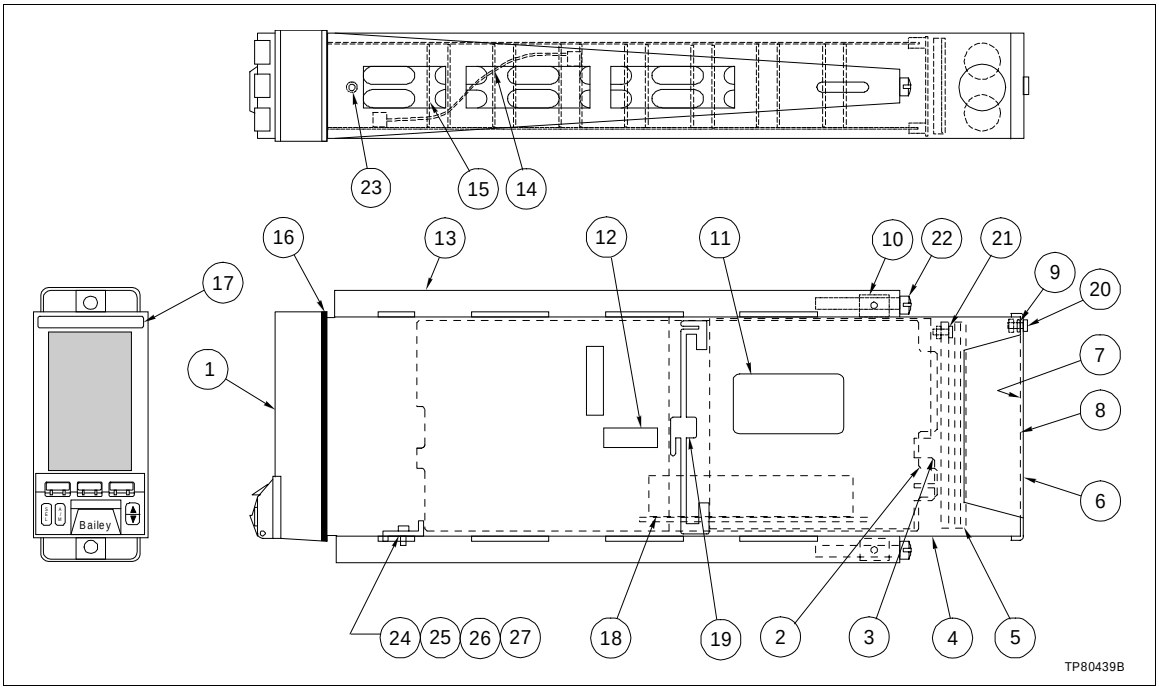


Figure 8-4. Parts Drawing

REPLACEMENT PARTS AVAILABLE

Table 8-2. Recommended Spare Parts

Item[1]	Part No.	Description
1	6639054é1	Faceplate and operator interface PCB assembly
Note 2	6639055é1	Faceplate assembly only
2	6639049é1	Main PCB assembly
3	1948118é1	Power supply PCB assembly
5	6639199é1	Termination unit PCB assembly
Note 3	1946987é1	Cold junction compensator

Table 8-2. Recommended Spare Parts (continued)

Item[1]	Part No.	Description
18	6640367é1	Optional temperature/frequency input board
Note 4	1948182é23001	Fuse, 3 A, fast acting, 250 V (F101) AC line
	1948182é32001	Fuse, 2 A, slo blow, 250 V (F102) DC output
Note 5	1948266é25	Fuse, 2.5 A, 250 V (F1) internal DC power interrupt

NOTES:
1. Refer to Figure 8-4 for item no.
2. Faceplate assembly part of item 1 assembly.
3. CJC part of item 5 assembly.
4. Fuses located on power supply board (item 3).
5. Fuse located on main board (item 2).

APPENDIX A - CONFIGURATION DRAWINGS

INTRODUCTION

The following information provides a brief description of the six predefined factory configurations.

CONFIGURATION DRAWINGS

Figures A-1 through A-11 show how the predefined factory configurations are organized and what the supporting function codes are.

Single Loop PID with Internal Set Point

This configuration is a single analog input, single analog output, PID controller (Fig. A-1). HI/LO alarm digital outputs are provided for the analog input process variable in the loop. The

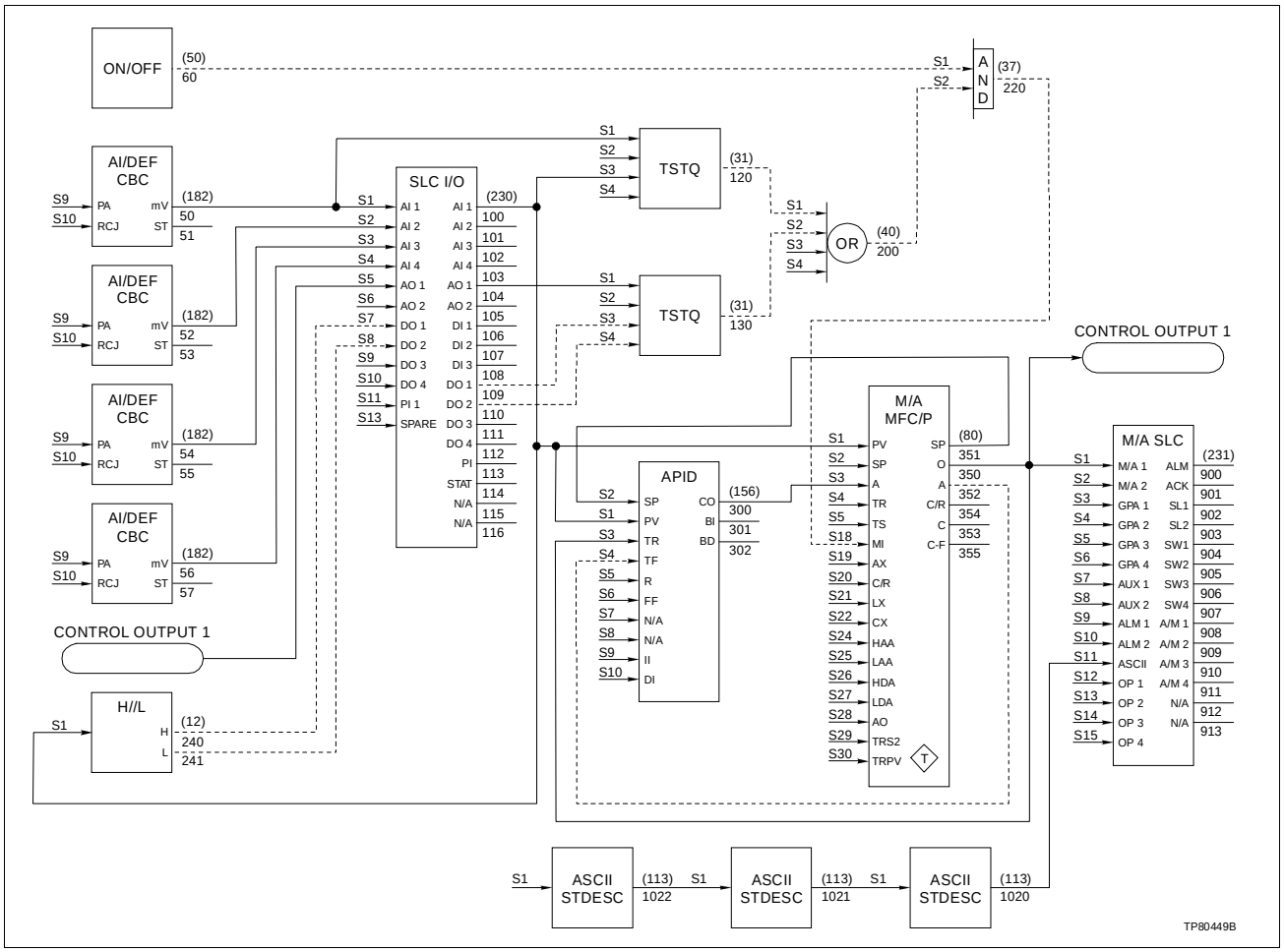


Figure A-1. Single Loop Control, Internal Set Point

PV HI/LO alarm menu is used to set each alarm limit. The analog input is AI1; the analog output is AO1. Replacing AI1 with one temperature input requires a modified configuration. Figure A-2 represents the configuration using AI3 as a single temperature analog input. Note that the option card is required, and the temperature input type must be selected from the *SETUP-OPTIONS-OPTION BOARD* menu. The single loop PID configuration is applicable to any control task having a single input and the process variable, and requiring a single analog output. The set point is manipulated from the faceplate on the process display screen.

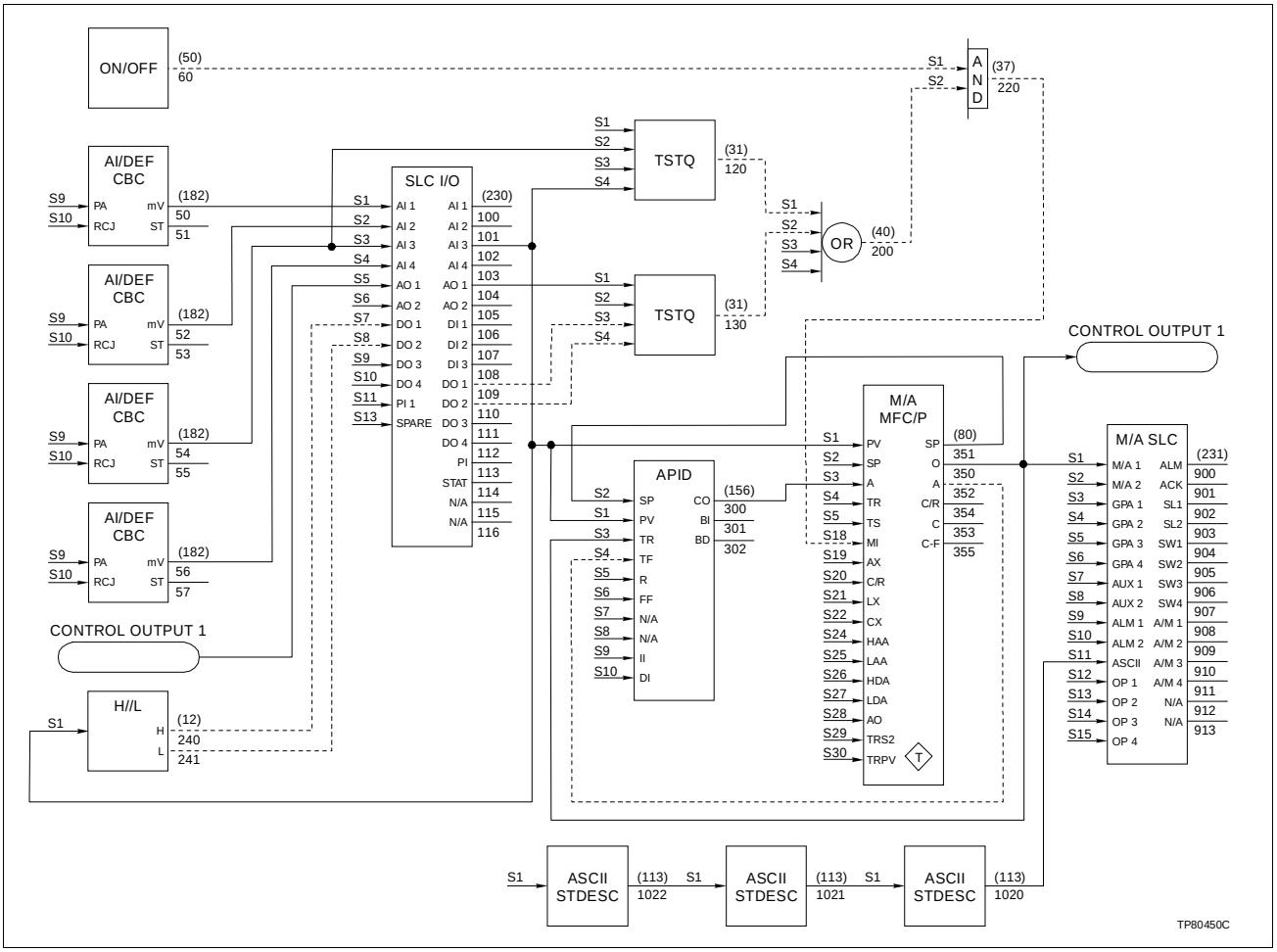


Figure A-2. Single Loop Control, Internal Set Point, with Temperature Input

Single Loop PID with External Set Point

This configuration is a two analog input, single analog output, PID controller (Fig. A-3). The process variable is associated with AI1, external set point with AI2, and analog output with AO1. The process variable and external set point are set to the same zero and span values. When the option card is installed

and the temperature inputs are configured in the *SETUP-OPTIONS-OPTION BOARD* menu, the process variable is associated with AO3 and external set point is associated with AI4. The analog output remains AO1. Figure A-4 represents this two temperature input configuration.

The single loop PID configuration is applicable to any control task having a single process variable input and supervisory set point input, and requiring a single analog output. Select either the external set point input or the faceplate set point as the input to the PID controller. Both analog inputs have HI/LO alarm digital outputs associated with them. The PV HI/LO alarm menu sets both alarm limits.

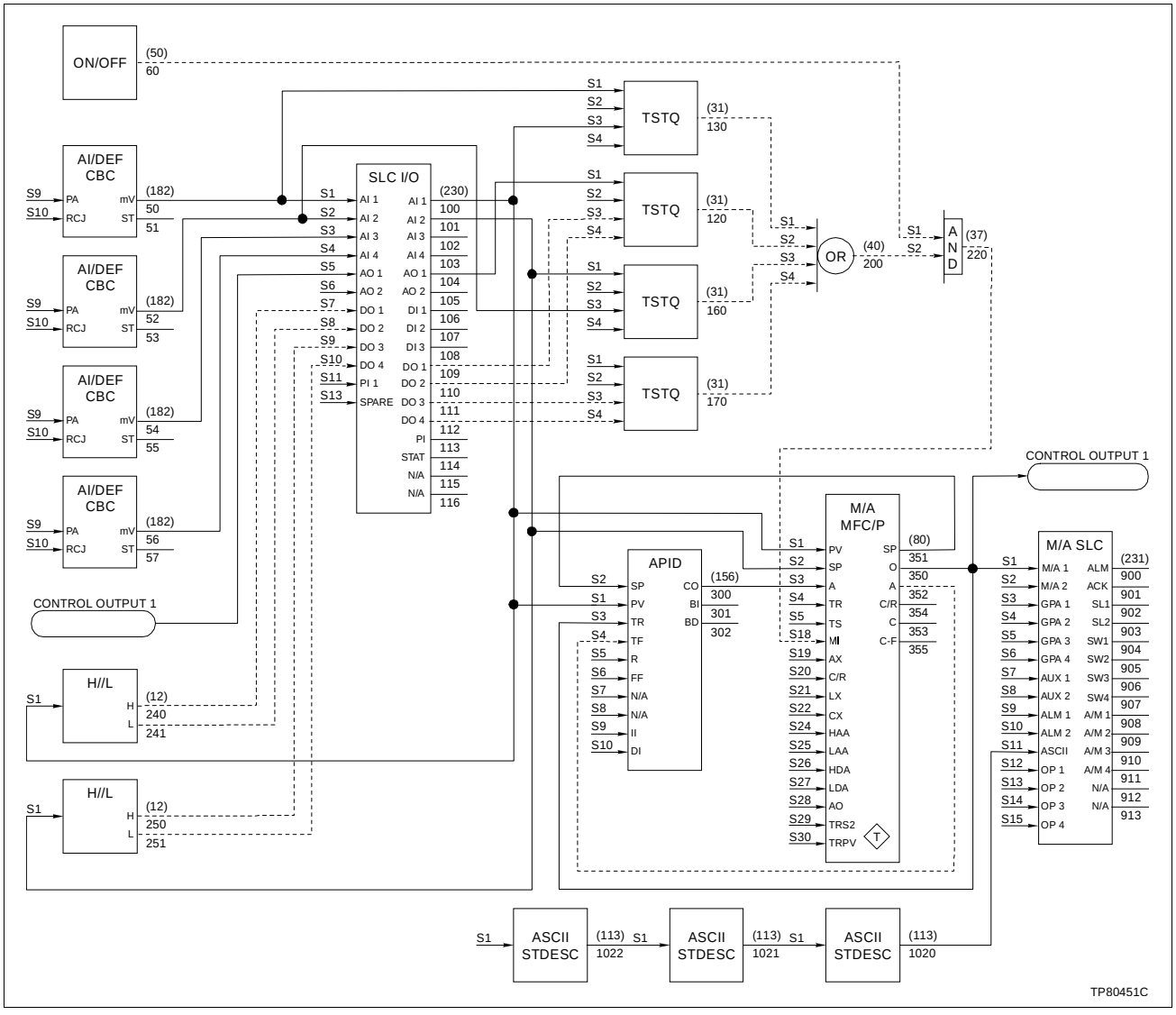


Figure A-3. Single Loop Control, External Set Point

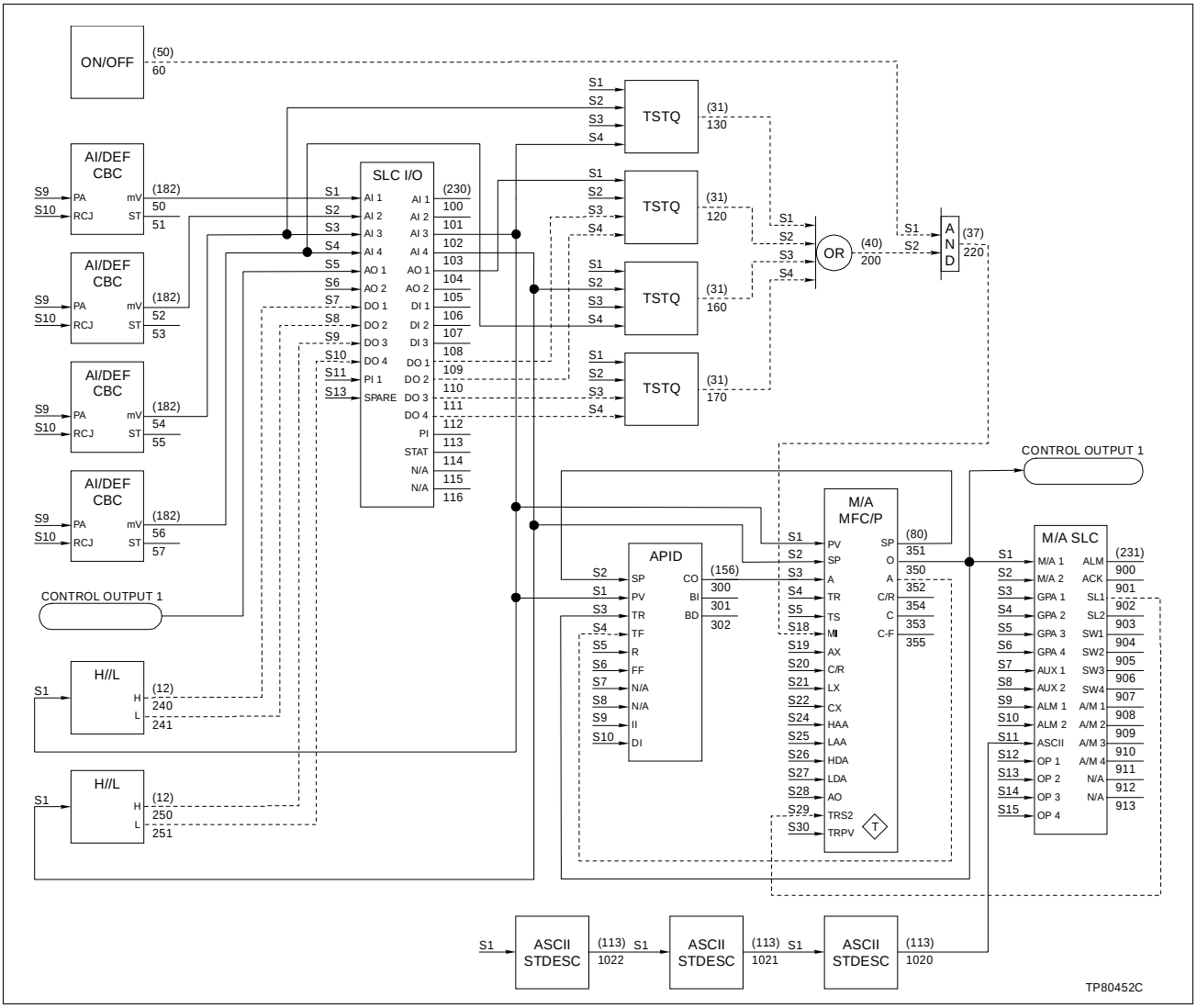


Figure A-4. Single Loop Control, External Set Point, with Two Temperature Inputs

Dual Loop Controller with Internal Set Point

This configuration contains two separate and independent single loop controller configurations (Fig. A-5). Each configuration is a single analog input, single analog output, PID controller. HI/LO alarm digital outputs are provided for the analog input process variable in each loop. The PV HI/LO alarm menu is used to set each alarm limit. For loop 1, the analog input is AI1 and the analog output is AO1. For loop 2, the analog input is AI2 and the analog output is AO2.

When two temperature inputs are required, the option card must be installed and the temperature input type selected from the *SETUP-OPTIONS-OPTION BOARD* menu. The high level AI1 is replaced by AI3 as the loop 1 process variable temperature

input. In loop 2, AI4 replaces AI2 as the process variable temperature input. Figure A-6 represents the configuration using AI3 and AI4 as the process variable temperature inputs.

This configuration can be applied to any process having two controllable process variables and requiring two analog outputs.

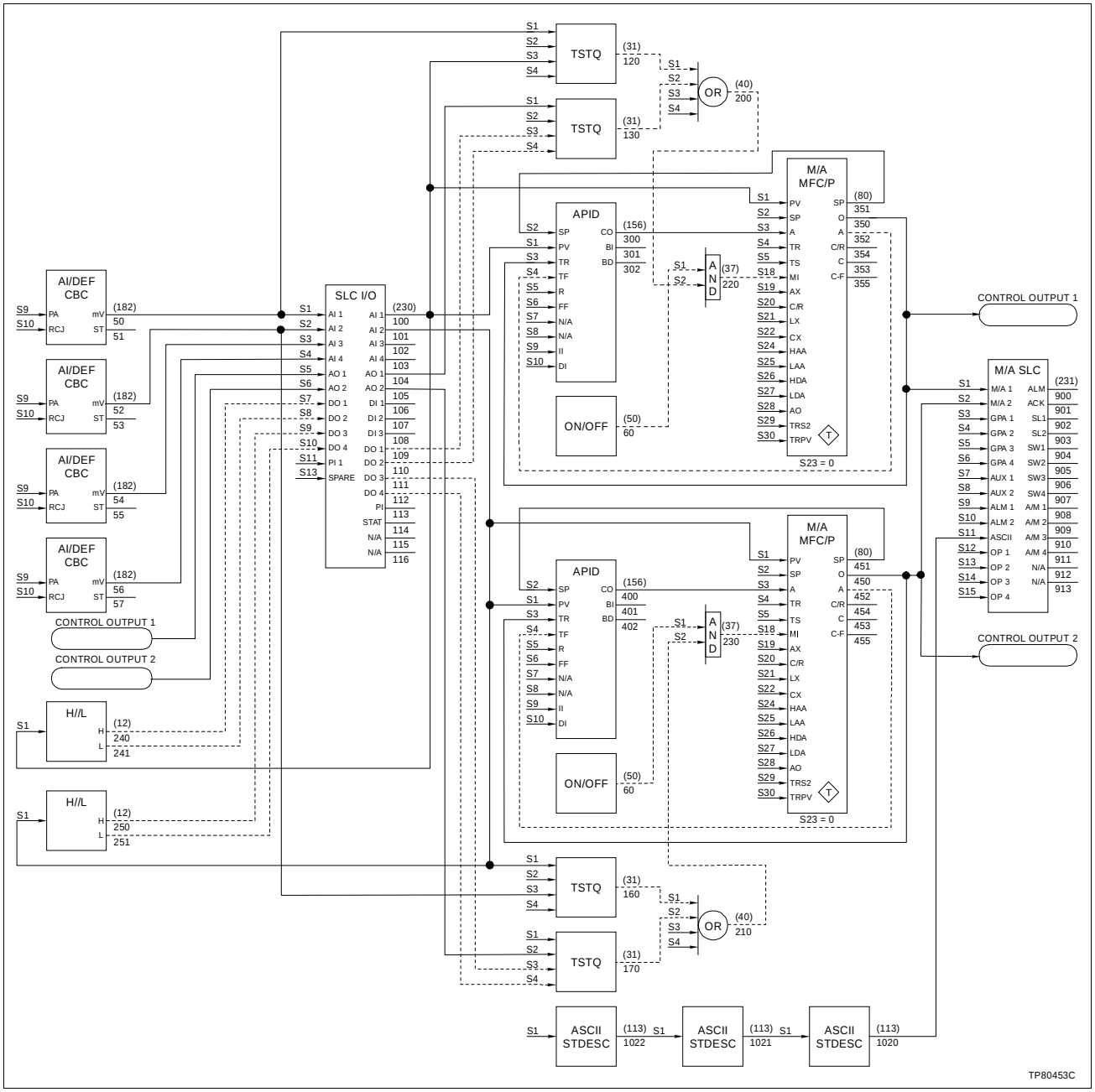


Figure A-5. Dual Loop Control, Internal Set Point

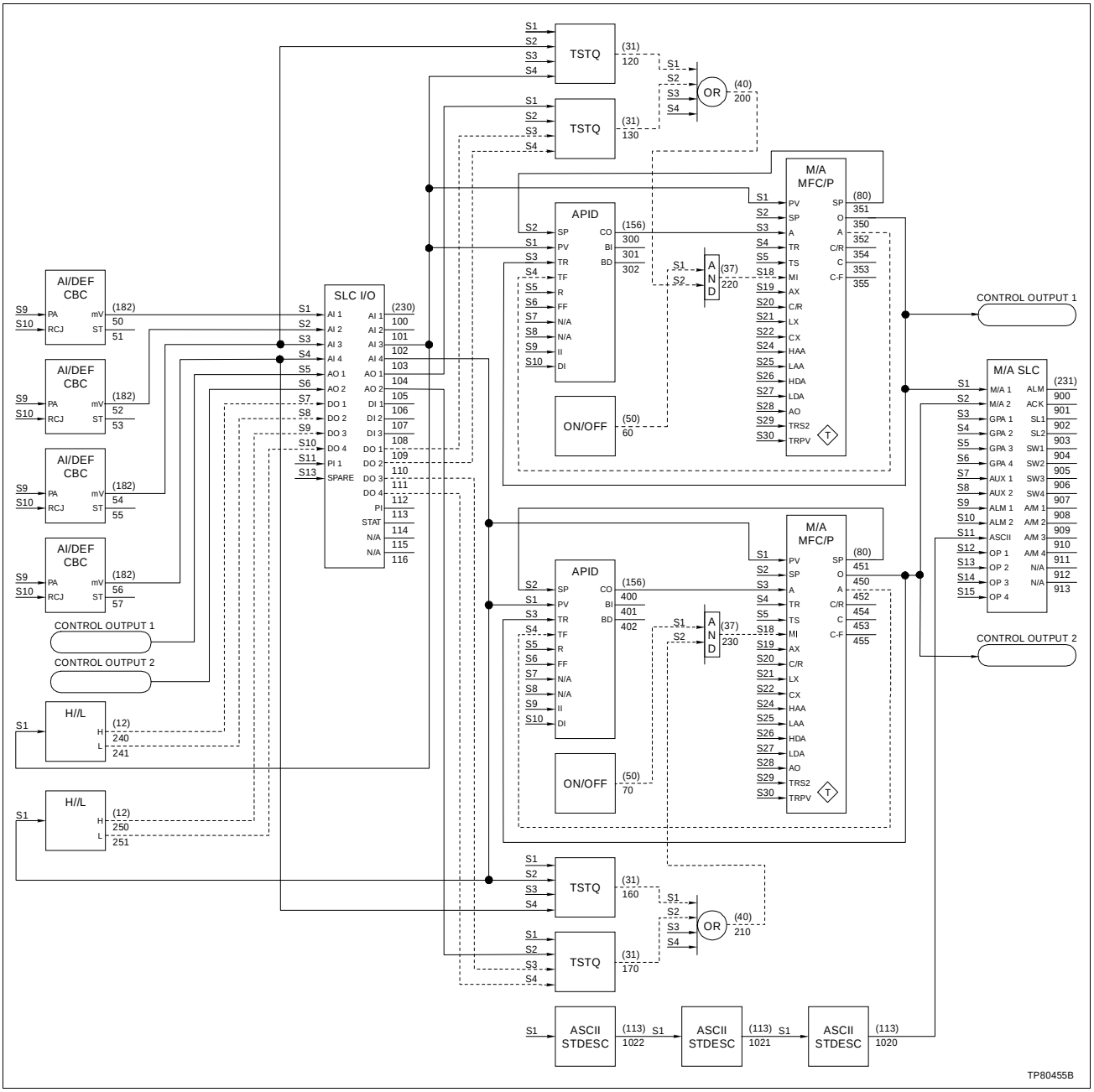


Figure A-6. Dual Loop Control, Internal Set Points, Two Temperature Inputs

Dual Loop Controller with External Set Point

This configuration contains two separate and independent single loop configurations (Fig. A-7). Each configuration is a two analog input, single analog output, PID controller. HI/LO alarm digital outputs are also provided for the analog input process variable in each loop. The PV HI/LO alarm menu is used to set each alarm limit. For loop 1, the analog input is AI1 and the external set point is AI2. The control output is AO1. For loop 2, the process variable is AI3 and the external set point is AI4. The

control output is AO2. When two temperature inputs are required, the option card must be installed, and the temperature input type selected from the *SETUP-OPTIONS-OPTION BOARD* menu. These temperature inputs only affect loop 2. AI3 and AI4 are reconfigured as temperature inputs in S1 and S2 of function code 182 at block numbers 54 and 56, respectively.

The dual loop configuration can be applied to any process having two controllable process variable inputs and two external supervisory set point inputs, and requiring two analog outputs.

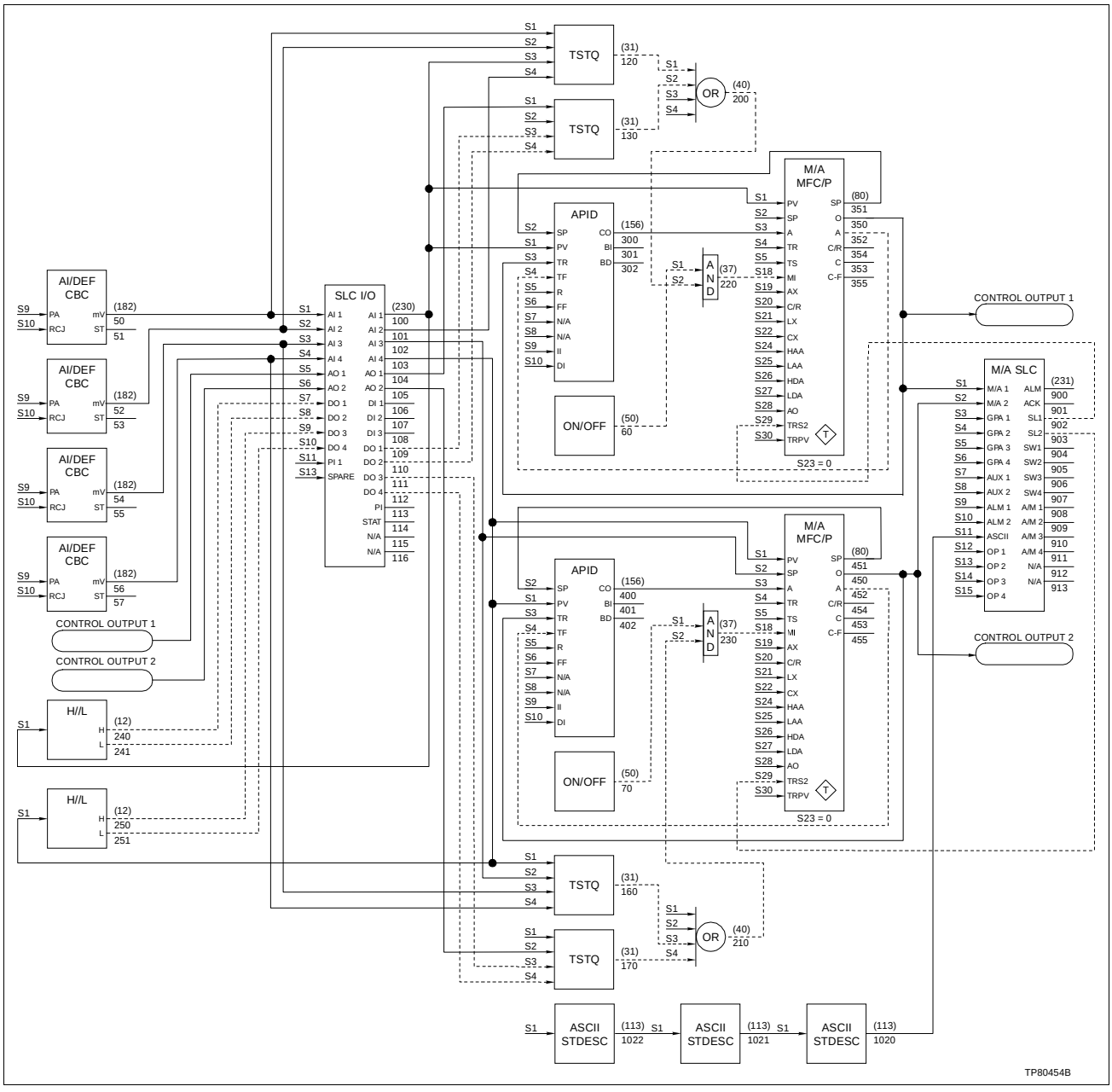


Figure A-7. Dual Loop Control, External Set Points (with or without Temperature Inputs)

Cascade Control

This configuration is a two analog input, single analog output, two PID controller (Fig. A-8). Both analog inputs have HI/LO alarms digital outputs associated with them. The PV HI/LO alarm menu is used to set each alarm limit. The primary PID controller is tuned as loop 1; the secondary PID controller is tuned as loop 2.

A cascade controller is applicable to a process with an intermediate variable that affects the controlled variable. The controller requires a primary and secondary analog input and

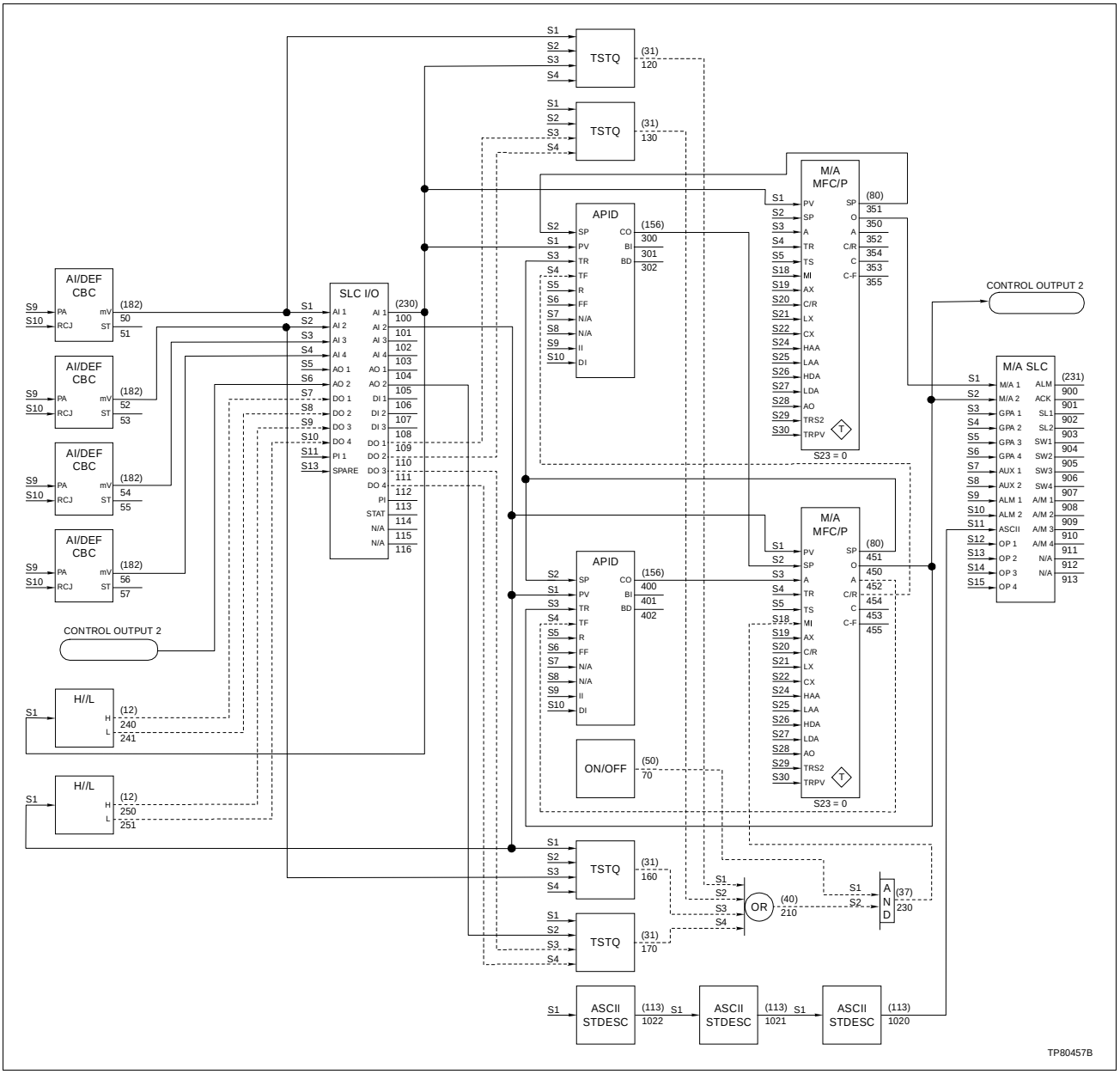


Figure A-8. Cascade Control

provides a single analog output. The primary process variable is AI1 and the secondary process variable is AI2. The output of the primary PID controller becomes the set point for the secondary PID controller. The output of the secondary control loop is AO2.

When two temperature inputs are required, the option card must be installed and the temperature input type selected from the *SETUP-OPTIONS-OPTION BOARD* menu. The primary temperature input becomes AI3 and AI4 is the secondary temperature input. This configuration is shown in Figure A-9.

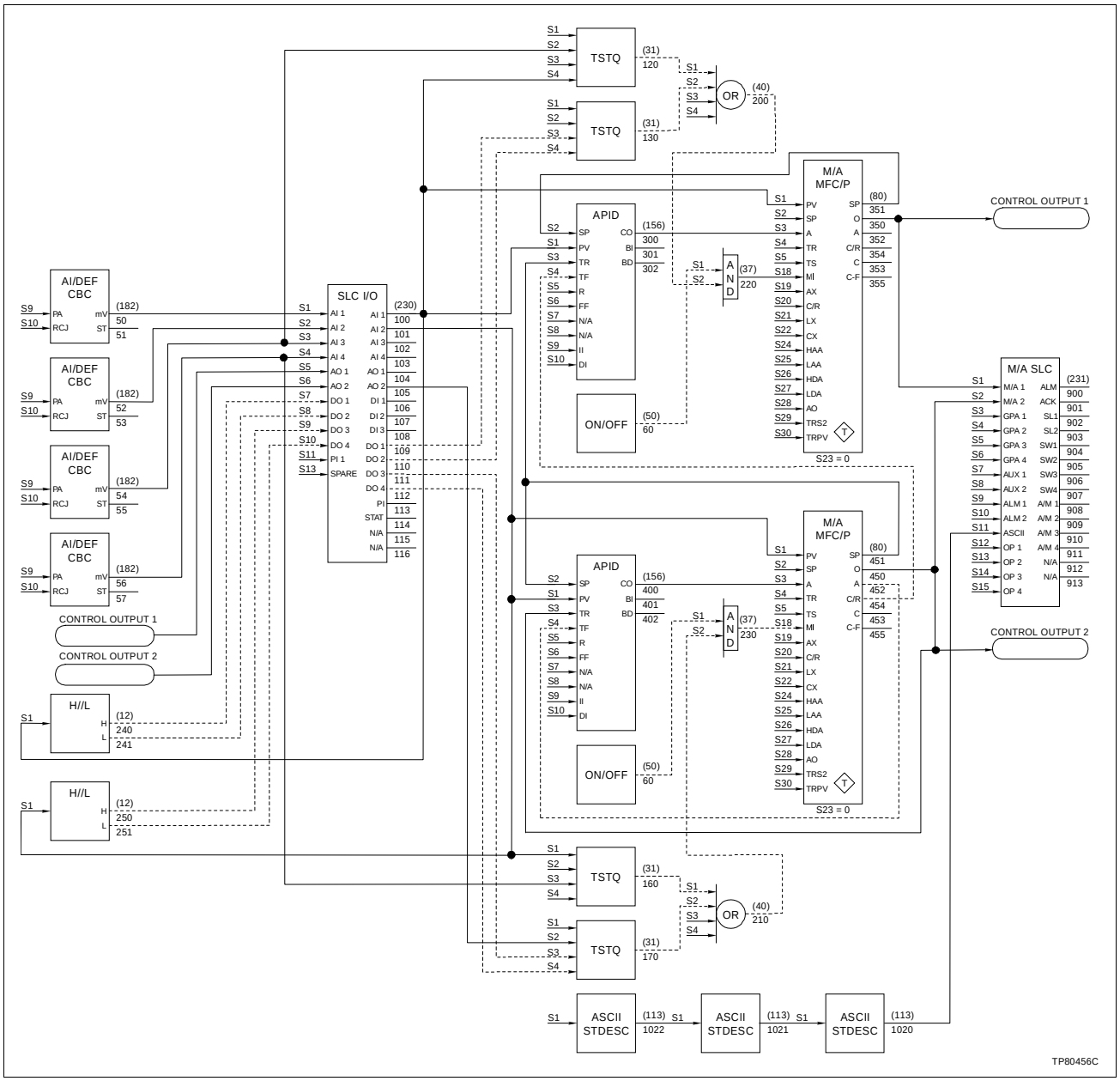


Figure A-9. Cascade Control with Two Temperature Inputs

Ratio Controller

This configuration is a two analog input, single analog output, single PID controller (Fig. A-10). The control variable is AI1, the wild variable is AI2 and the analog output is AO1. Both analog inputs have HI/LO alarm digital outputs associated with them. The PV HI/LO alarms menu is used to set both alarm limits.

When two temperature inputs are required, the option card must be installed and the temperature input type selected from the *SETUP-OPTIONS-OPTION BOARD* menu. The control variable is associated with AI3 and the wild variable is associated

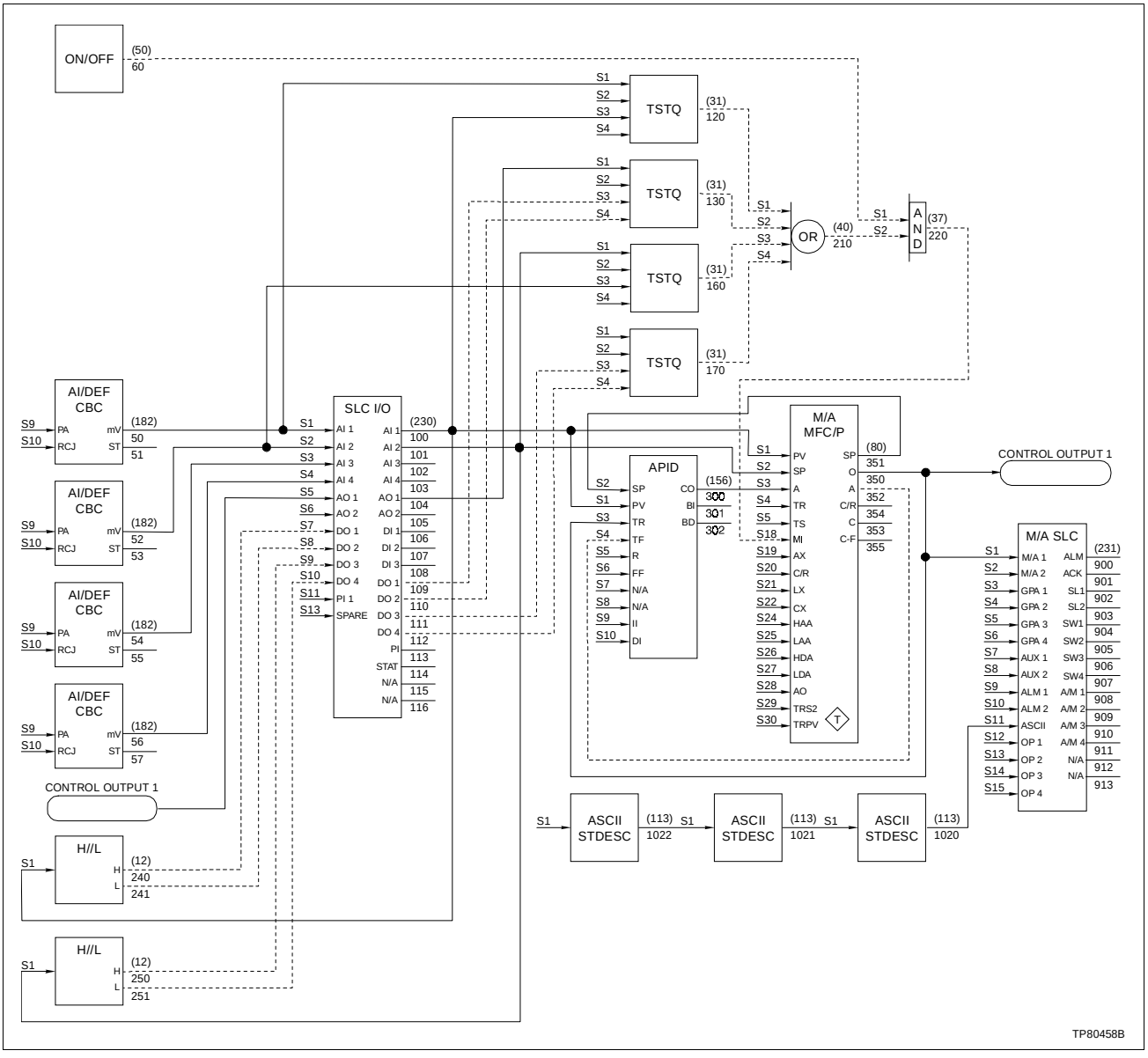


Figure A-10. Ratio Control

with AI4. The analog output remains AO1. Figure A-11 represents this two temperature input configuration.

The ratio control configuration is applicable to any control task having two inputs, one of which must be maintained in a constant proportion to the other, and requiring a single analog output. Ratio multipliers can range from 0.01 to 10.0.

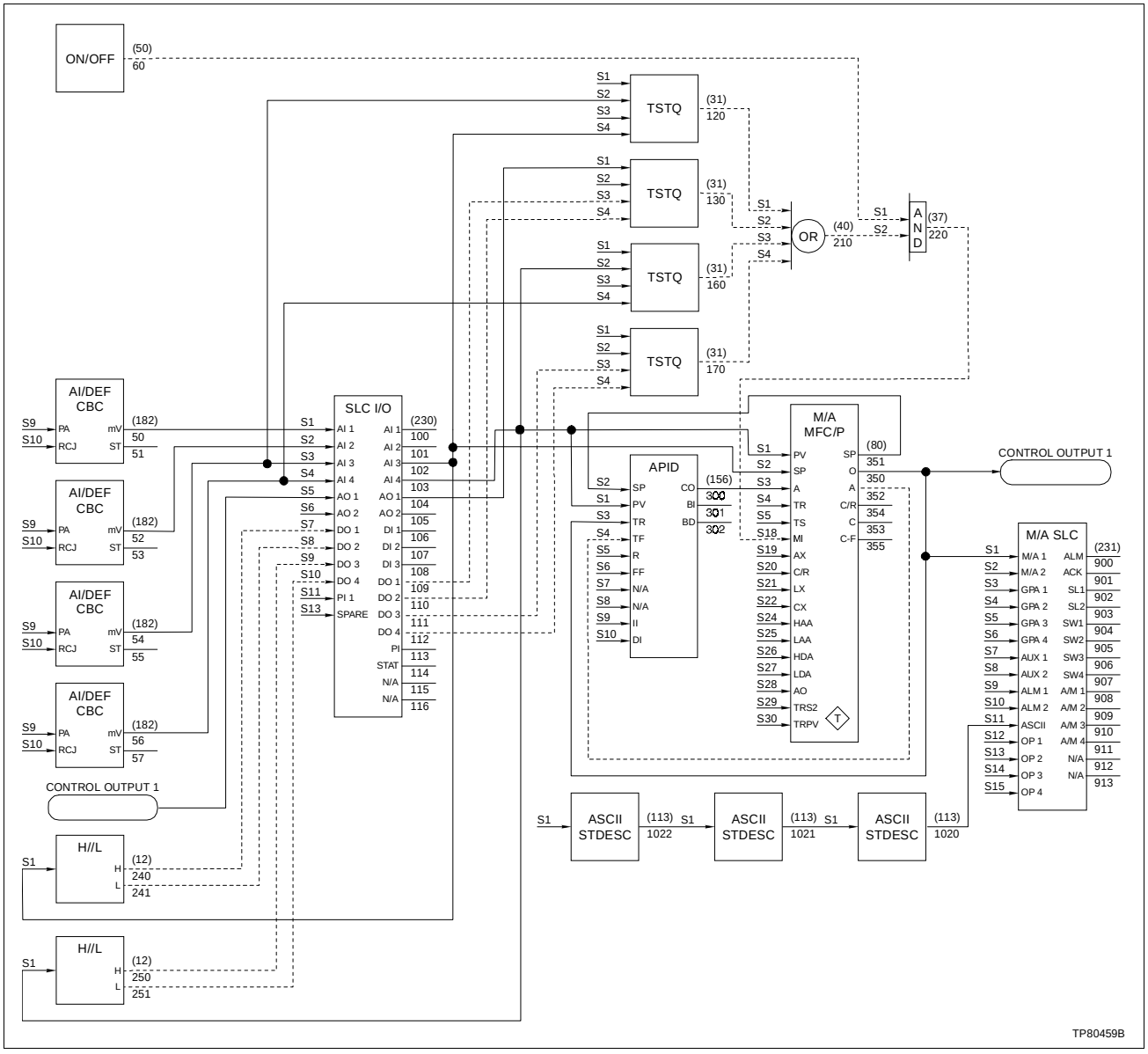


Figure A-11. Ratio Control with Two Temperature Inputs

Fixed Block Locations

Figure A-12 illustrates the fixed block locations of function codes after reinitialization with the configure menu. Any block address between 30 and 1019 can be configured except those occupied by these fixed block function codes.

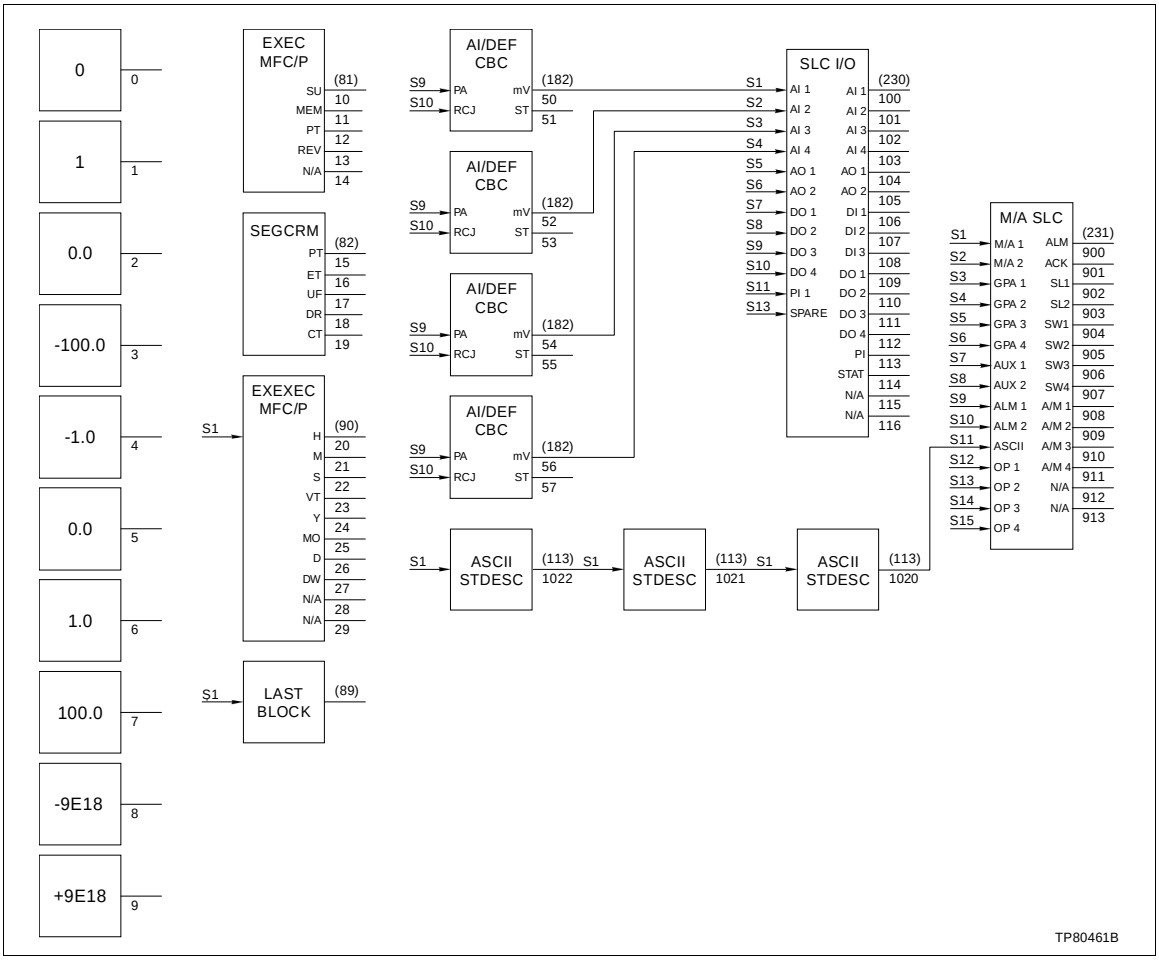


Figure A-12. Fixed Block Locations of Function Codes After Initialization

Figure A-13 illustrates the fixed block locations of the controller I/O and station function codes (function codes 230 and 231). These blocks are required for every configuration. Function code 230 occupies blocks 100 through 116; function code 231 occupies blocks 900 through 913. For ease of use, the analog input definition (function code 182), representing the four analog inputs, is also downloaded to blocks 50 through 57. These may be moved to any other free block location using an external programming device. Loop specific information is stored in the ASCII string description function code (function code 113). These are located at blocks 1020 through 1022. These function codes are inserted when the unit is reinitialized from the configure menu.

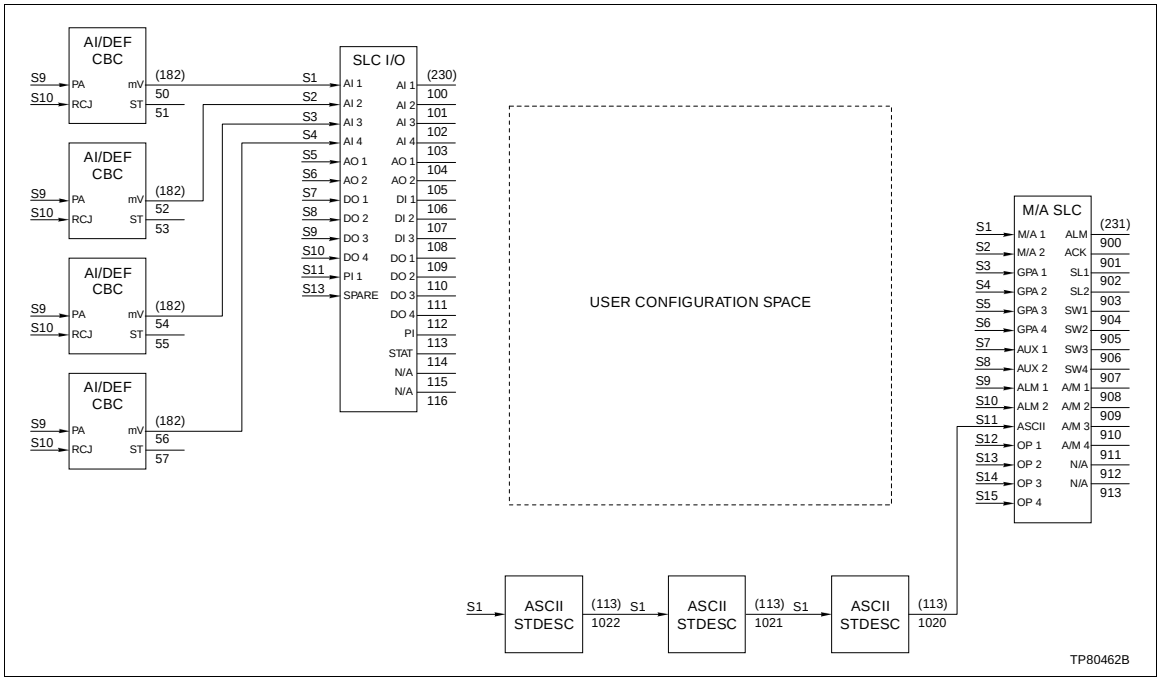


Figure A-13. Fixed Block Locations for Function Codes 113, 230 and 231

Figure A-14 represents the fixed block locations of the executive function codes and the last block location. These blocks are required for every configuration, and are inserted after reinitialization from the configure menu.

Figures A-13 and A-14 are good starting points for custom configurations. Use Figure A-15 as a template for custom configurations. Start with a reinitialized configuration space, select a factory configuration or customize one of the factory configurations to suit specific requirements.

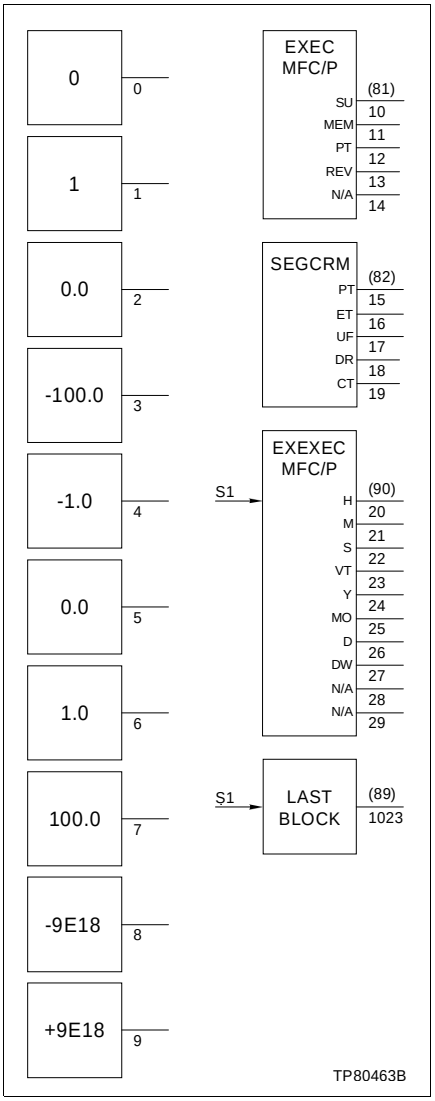


Figure A-14. Fixed Block Locations for Function Codes 81, 82, 89 and 90

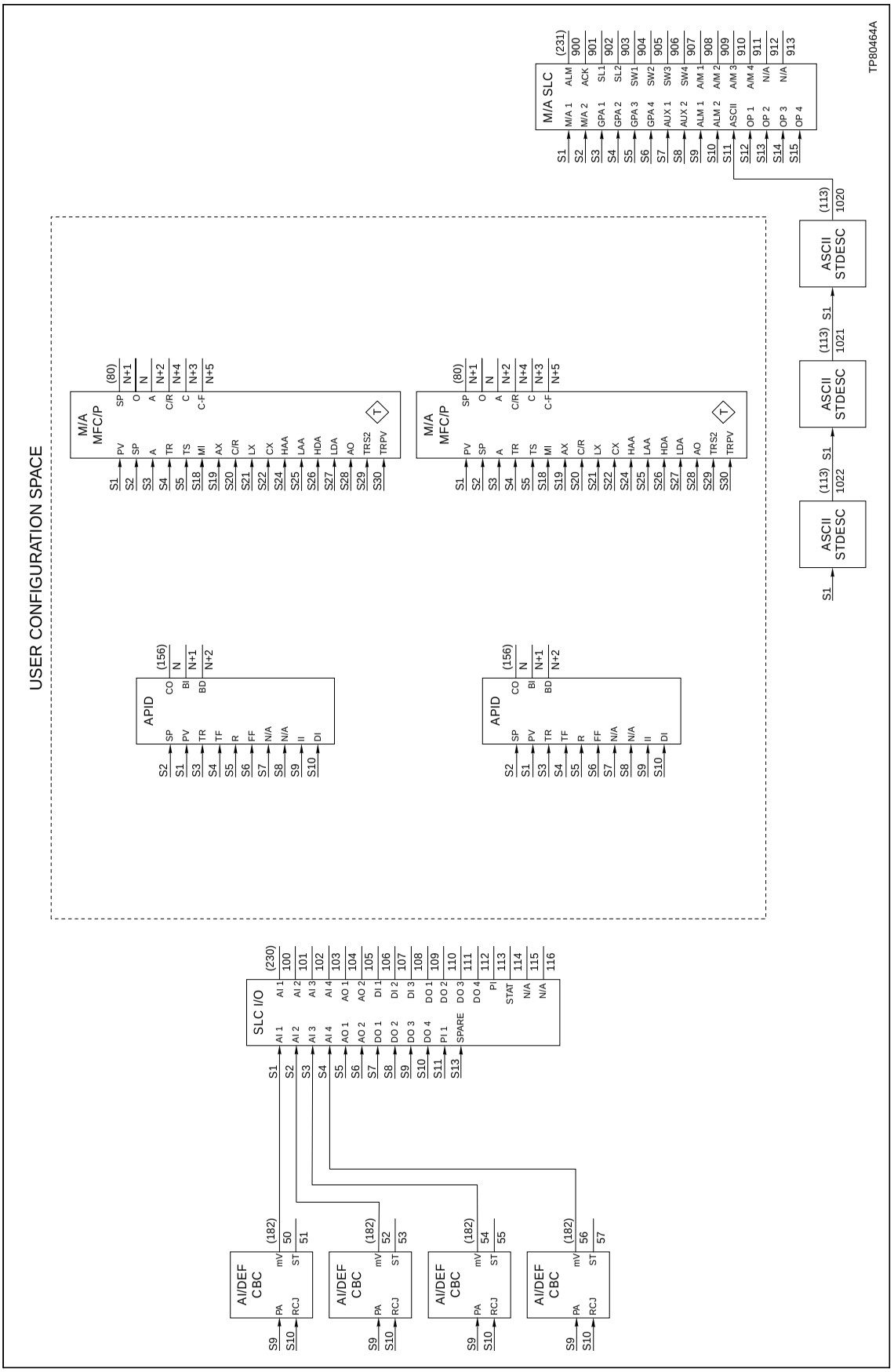


Figure A-15. User Configuration Space

APPENDIX B - TYPE SLC SETUP WORKSHEET

INTRODUCTION

This appendix contains the Type SLC setup worksheet. Remove and reproduce this worksheet as necessary.

SLC SETUP WORKSHEET

Loop Tag Name: _____ (14 characters max.)

Process Variable Engineering Units (EU): _____ (5 characters max.)

Set Point Engineering Units (EU): _____ (5 characters max.)

Decimal Places: _ 0 _ 1 _ 2 _ 3 _ 4

Control Output Hi Tag: _ 100/0 _ 0/100 _ OPN/CLS _ CLS/OPN

Control Output Lo Tag: _ 100/0 _ 0/100 _ OPN/CLS _ CLS/OPN

Power Up Mode: _ MAN _ AUT _ LAS _ CAS _ RAT

Power Up AO1: _ High _ Low

Fail AO1: _ High _ Low

Audible Alarm: _ On _ Off

Bypass Action: _ Dir _ Rev

Process Display Type: _ 2 Bar _ 3 Vertical Bar _ 2 Vertical Bar (Horizontal CO) _ 2 Vertical Bar (Reverse)

Module Bus Address: _____ (select 0 - 31)

Digital Output Faceplate Lockout:

DO1:	_ Lock	_ Unlock
DO2:	_ Lock	_ Unlock
DO3:	_ Lock	_ Unlock
DO4:	_ Lock	_ Unlock

Security Levels and Passwords:

Environment:	Master	Technician	Password (3 characters max.)
Bypass	_	_	_____
Tune	_	_	_____
D.O. Control	_	_	_____
Aux. Switch	_	_	_____
Setup	_	_	_____
Configure	_	_	_____

APPENDIX C - TYPE SLC CONFIGURATION WORKSHEETS

INTRODUCTION

This appendix contains the Type SLC configuration worksheets. Remove and reproduce them as necessary.

Optional Inputs (Temperature/Frequency)

Optional Analog Input List

Thermocouple	RTD	Millivolt
S	2-wire 100 Ω Lab	-20 to +80 mV
R	2-wire 100 Ω Ind	
E	2-wire 100 Ω Eur	
J	2-wire 100 Ω Pure Ni Chem	
K	3-wire 100 Ω Lab	
T	3-wire 100 Ω Ind	
Ch E	3-wire 100 Ω Eur	
Ch S	3-wire 100 Ω Pure Ni Chem	

Type SL21:

DI3 - Frequency Input _ No _ Yes _____

AI3 - Temperature Input _ No _ Yes _____
(select from ***Optional Analog Input List***)

AI4 - Temperature Inputs _ No _ Yes _____
(select from ***Optional Analog Input List***)

Faceplate Switch:

Loop 1 _ No _ Yes On Tag _____ (4 characters max.)
Off Tag _____ (4 characters max.)

Loop 2 _ No _ Yes On Tag _____ (4 characters max.)
Off Tag _____ (4 characters max.)

Auxiliary Switch Labels:

Switch 1 0 State Tag _____ (6 characters max.)
1 State Tag _____ (6 characters max.)

Switch 2 0 State Tag _____ (6 characters max.)
1 State Tag _____ (6 characters max.)

Switch 3 0 State Tag _____ (6 characters max.)
1 State Tag _____ (6 characters max.)

Switch 4 0 State Tag _____ (6 characters max.)
1 State Tag _____ (6 characters max.)

Ambient Temperature at Wiring Terminals Entered? _ No _ Yes _____ °C
(only required after replacement of main board, termination unit or NVRAM, or firmware change)

Document Firmware Revision Level: Main Board: _____ Op Int Board: _____
(select *MONITOR* from the main menu, then select *STATUS* for correct revision level)

STANDARD CONFIGURATION

Configuration Type: _ Single PID _ Single PID EX _ Dual PID _ Dual PID EX
_ Cascade _ Ratio

Engineering Units: _____ Analog Input Zero (-100,000.00 to +100,000.00) _____ EU
_____ Analog Input Span (-100,000.00 to +100,000.00) _____ EU

Square Root: _ Yes _ No

PID Constants: _____ Conv. Factor _____ KP _____ KI _____ KD
(0.000 to 100.00)

Control Output: _____ Hi CO Limit% _____ Lo CO Limit%
(-5.0% to 105.0%)

Action: _ Direct _ Reverse

Process Variable Zero: _____ (-100,000.00 to +100,000.00)

Set Point Zero: _____ (-100,000.00 to +100,000.00)

PV SP Span: _____ (-100,000.00 to +100,000.00)

PV Alarm Values: _____ High _____ Low
(-100,000.00 to +100,000.00)

Go to manual control upon bad quality of analog loop I/O? _ Yes _ No

CUSTOM CONFIGURATION

Analog Inputs/Outputs

Unit Tag: _____

Module Bus Address: _____

AI1 (FC 182, BLK 50):	_ 4-20 mA	_ 1-5 VDC	_____ Zero	_____ Span
AI2 (FC 182, BLK 52):	_ 4-20 mA	_ 1-5 VDC	_____ Zero	_____ Span
AI3 (FC 182, BLK 54):	_ 4-20 mA	_ 1-5 VDC	_____ Zero	_____ Span
(With optional input board)	_ mV (-20 to +80)	_ Thermocouple _ RTD	Type _____ Type _____	(refer to ***Optional Analog Input List)***
AI4 (FC 182, BLK 56):	_ 4-20 mA	_ 1-5 VDC	_____ Zero	_____ Span
(With optional input board)	_ mV (-20 to +80)	_ Thermocouple _ RTD	Type _____ Type _____	(refer to ***Optional Analog Input List)***

Optional Analog Input List (Function Code 182, Spec 1)

Input Type	Spec 1	Input Type	Spec 1
Undefined	0	**RTDs[1]:**	
Thermocouples:		U.S. Lab Std 100 Ω Platinum	[X]20
S	001	U. S. Ind Std 100 Ω Platinum	[X]21
R	002	EUR Std 100 Ω Platinum	[X]22
E	003	120 Ω Chemically Pure Nickel	[X]23
J	004	**Millivolts:**	
K	005	-20 to +80	064
T	006		
Ch E	007		
Ch S	008		

NOTE:
1. [X] = 0 for 2-wire RTD, [X] = 1 for 3-wire RTD.

AO1 (switch S1-6 on TU):	_ 4-20 mA	_ 1-5 VDC	(refer to Table 2-1)
AO2 (switch S1-5 on TU):	_ 4-20 mA	_ 1-5 VDC	(refer to Table 2-1)

Digital Inputs/Outputs

Unit Tag: _____

Module Bus Address: _____

DI1 (FC 230, BLK 106): _ Isolated _ Non-Isolated

DI2 (FC 230, BLK 107): _ Isolated _ Non-Isolated

DI3 (FC 230, BLK 108): _ Isolated _ Non-Isolated _ Pulse Input Option Board

DO1 (FC 230, BLK 109): _____ Input Block Address (S7)

DO2 (FC 230, BLK 110): _____ Input Block Address (S8)

DO3 (FC 230, BLK, 111): _____ Input Block Address (S9)

DO4 (FC 230, BLK 112): _____ Input Block Address (S10)

APPENDIX D - QUICK REFERENCE

INTRODUCTION

Figure D-1 provides a quick reference of switch and jumper settings and fuses for the Type SLC controller.

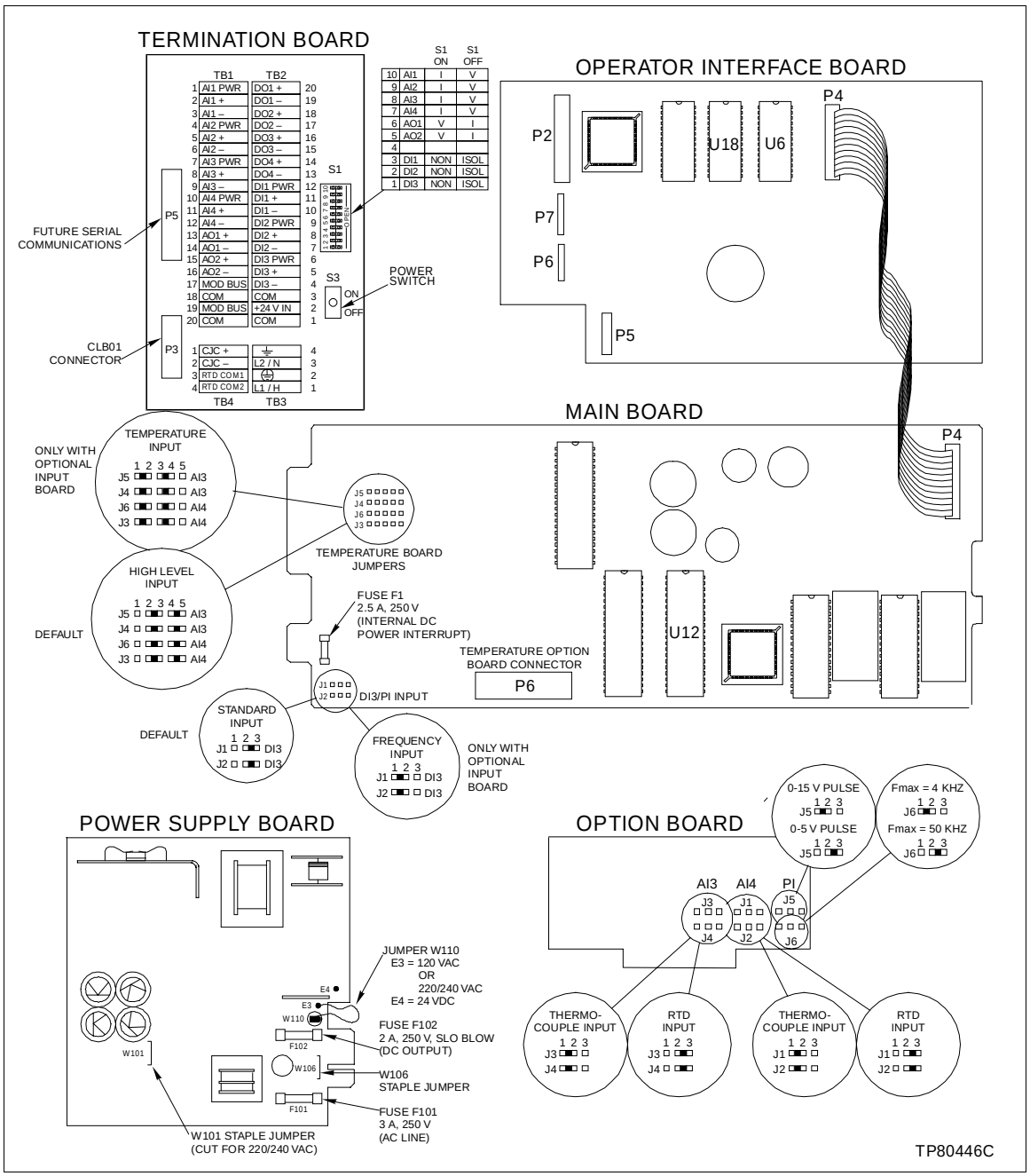


Figure D-1. Switch and Jumper Settings, Fuse Location and Type

APPENDIX E - SCREEN FLOWCHART

INTRODUCTION

Figure E-1 is a summary flowchart of the menus available for the Type SLC controller.

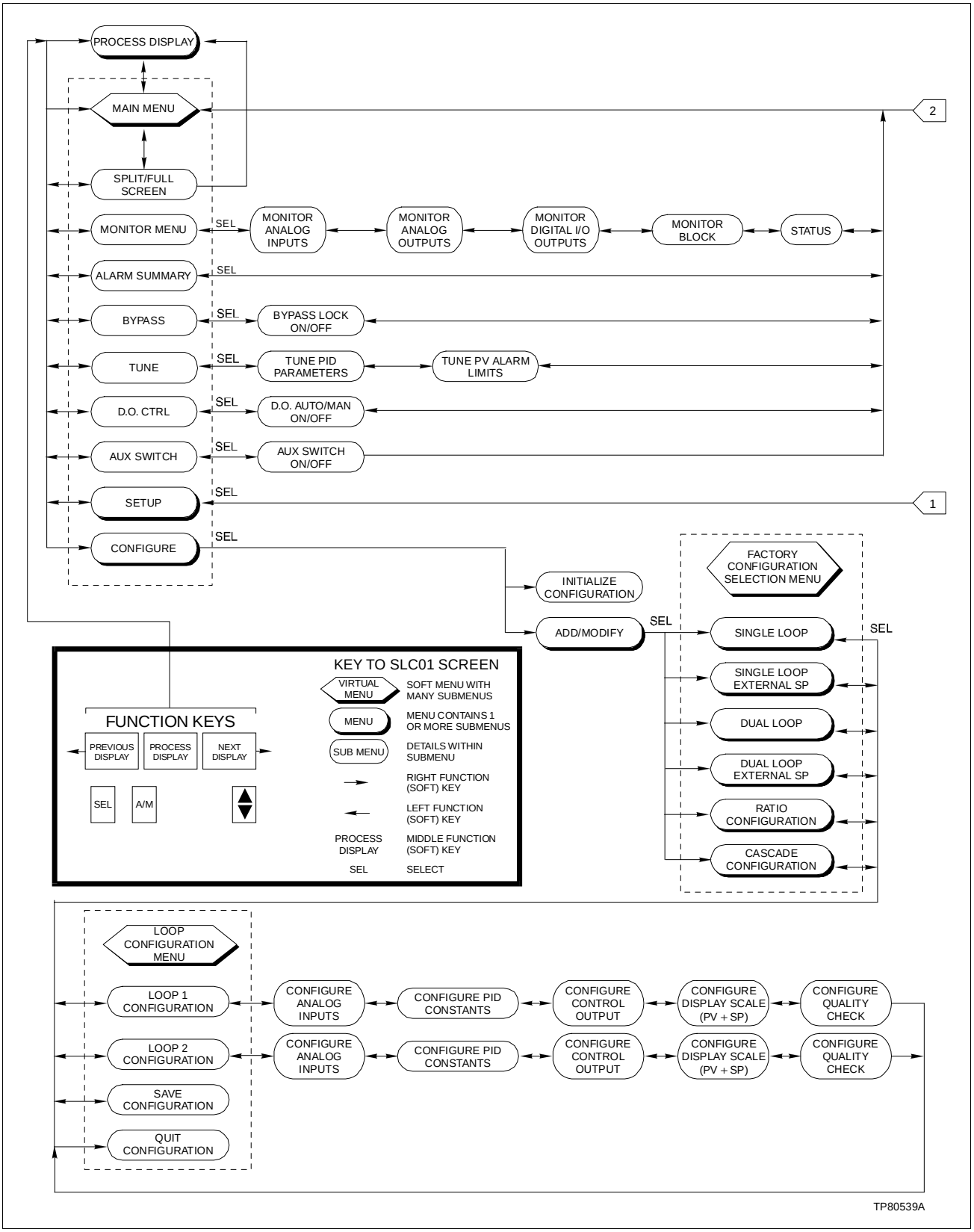


Figure E-1. Screen Flowchart (Page 1 of 2)

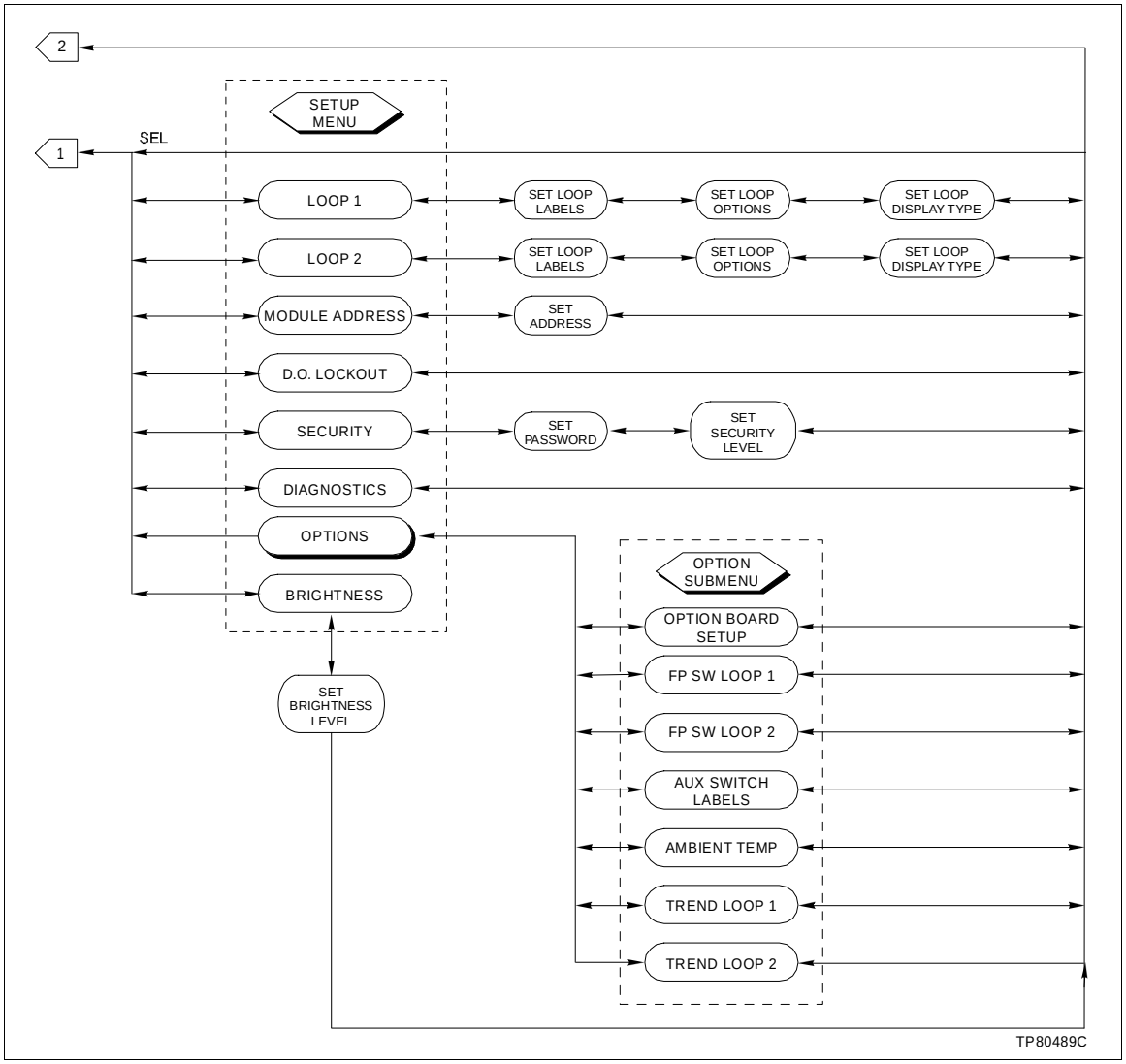


Figure E-1. Screen Flowchart (Page 2 of 2)

APPENDIX F - RETROFIT INSTRUCTIONS FOR TYPE CLC CONTROLLER

INTRODUCTION

NOTE: Although this retrofit is possible, Bailey-Fisher & Porter reserves the right to waive any guarantees of functionality. Installation environment and existing condition of the case may affect noise and accuracy of the instrument.

When retrofitting the Type CLC controller using Type SLC controller boards and faceplate assembly, the following functions are not available and some performance specifications may be affected.

- Power supply auctioneering between 120 VAC and 24 VDC cannot be done.
- Optional temperature inputs will not be functional.
- NDCS03 and IISAC01 second stations will not be functional.
- Current/voltage switches for analog inputs and analog outputs, as well as the isolation switches for the digital inputs, are on the Type CLC termination unit board locations called out in the Type CLC instruction (Table 1-2).
- No surge protection will be available for the analog inputs and digital inputs and outputs.
- Not all Type CLC termination boards include a power switch.
- The module bus address and other important settings of the Type SLC controller are not switch selectable. They must be set through the faceplate setup menu.
- Analog input/output accuracy will be ±0.25%.

Retrofit Instructions

Parts required to complete this retrofit include:

- Type SLCé1 controller.
- Adapter kit part number 258568é1.

1. Remove power from the Type CLC controller.

2. Open the legend access door on the Type CLC controller faceplate. Loosen the captive locking screw until the faceplate and operator interface board assembly can be pulled forward.

3. Disconnect the ribbon connector from the main board to the interface board. Remove the faceplate/operator interface assembly from the Type CLC controller housing.

4. Using the handle (pull tab), remove the main board from the housing.

> **NOTE:** It is not necessary to remove the power supply board if it is operating correctly. The power supply board in the Type SLC controller will then become a spare board.

5. On the Type SLC controller, pull down on the small access door below the display area on the controller faceplate. Loosen the captive locking screw until the faceplate and operator interface board assembly can be pulled forward. Remove the assembly from the controller housing.

6. Loosen screw and remove the card retainer. Use the handle (pull tab) and remove the main board from the Type SLC controller housing (Fig. 8-2).

7. If the power supply board is going to be installed in the Type CLC controller, remove it from the Type SLC controller now.

Assembling the Retrofit Unit

There are several items to be aware of while completing this retrofit procedure.

1. The housing for the Type CLC controller is approximately 25.4 millimeters (1 inch) longer than the housing for the Type SLC controller. When seating the new boards, make certain that good contact is made with the mating connectors. These boards will sit further back into the housing.

2. The Type CLC controller faceplate is held in position with a locking screw at the top of the faceplate beneath the legend/access door. The locking screw that secures the faceplate for the Type SLC controller is located under a small access door below the faceplate display. To accommodate this locking screw location change between the two units, an adapter kit (part number 258568é1) provides all the hardware necessary to complete the change and assembly instructions. Mount this hardware on the Type CLC controller housing now.

3. The configuration of the Type CLC controller will be lost. After retrofit, the controller will require setup and configuration procedures. For simple PID functions and custom configurations, refer to Section 4. Because of function code differences between the Types CLC and SLC controllers, exact conversions of the present Type CLC configuration would be very difficult. Contact Bailey Controls Company for additional information.

To assemble the Type SLC controller boards into the Type CLC housing:

1. If installing a new power supply board, insert it now. Make certain the card edge is seated in the termination board connector.

2. Install the main board partially into the Type CLC housing. While installing the faceplate/operator interface board, connect the ribbon connector to the main board. Push the board assemblies into the housing. Make certain the main board is seated in the termination board connector.

3. Tighten the captive locking screw to secure the faceplate assembly to the controller housing.

4. After all assembly is complete, the new controller will have to be configured. Refer to Sections 3 and 4.

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