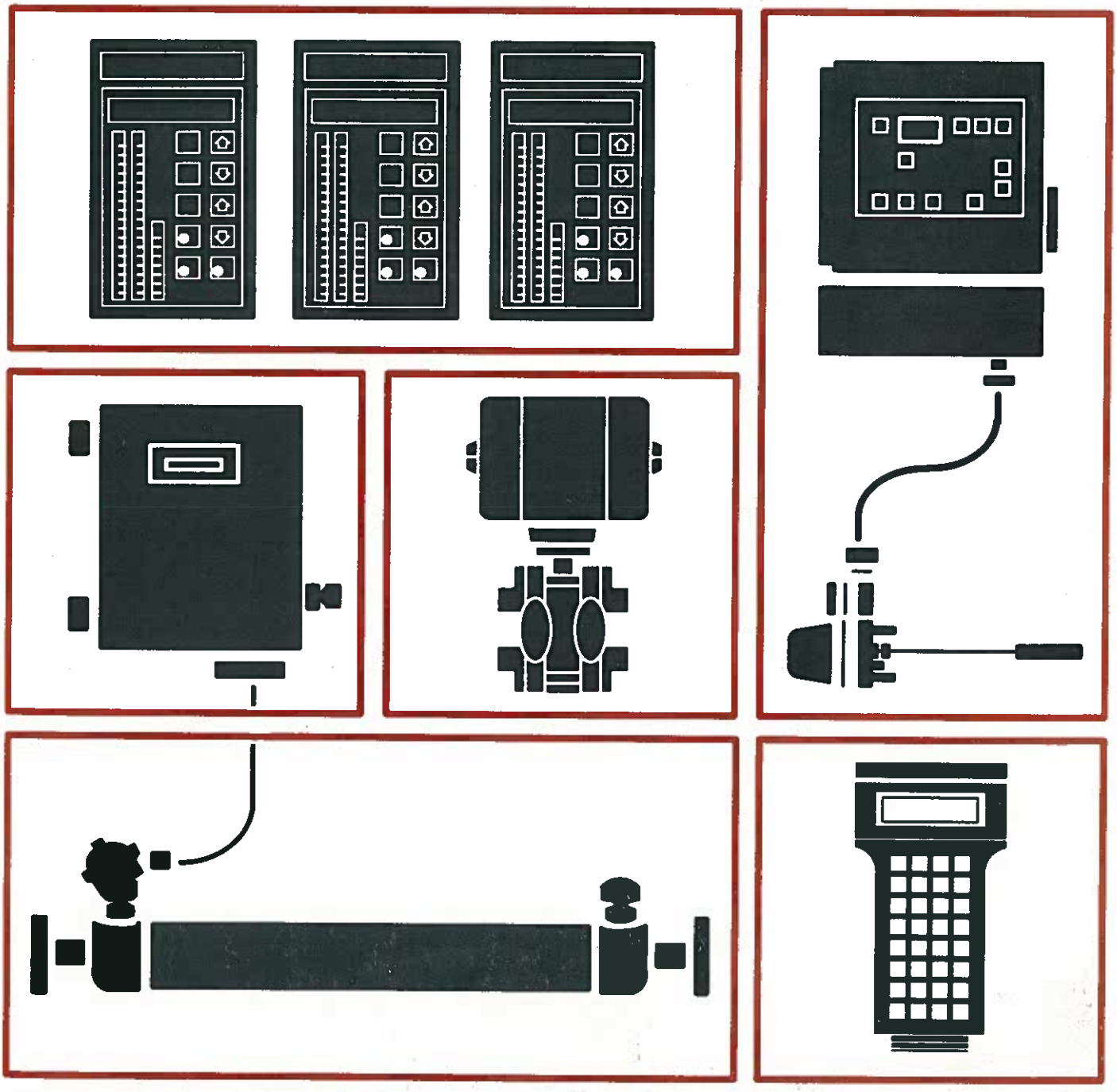
Bailey

PRODUCT INSTRUCTION

E92-500-4

Sequence Command Controller, CSC01



Bailey Process Control and Automation Solutions from Elsag Bailey Group

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.

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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.

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Preface

This publication is for the use of technical personnel responsible for installation, operation and maintenance of the Bailey Sequence Command Controller, Type CSC01.

List of Effective Pages

Total number of pages in this manual is 151, consisting of the following:

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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

Hazardous Locations
The equipment described herein may be used only in those classes of hazardous locations identified on the nameplate.

Substitution of Components
Substitution of components may impair suitability for Class I, Division 2 Hazardous Locations.

Nameplate Ratings
Do not at any time exceed the ratings listed on the nameplate.

System Maintenance
System maintenance must be performed by qualified personnel and only after securing equipment controlled by the circuit. Altering or removing components from an active circuit may upset the process being controlled.

SPECIFIC WARNINGS

The equipment described may be used only in those classes of hazardous locations identified on the nameplate. (p. 2-3)

Instruments that are powered from AC line voltage constitute a potential for an electrical shock hazard to the user. Make certain the AC line cord or power lines from the operating branch circuit are disconnected from the source before attempting electrical connections. (p. 2-8)

When using the non-isolated digital outputs with AC voltage, care must be taken that voltage phases are not mixed. Phase to phase shorts could result if improperly wired. (p. 2-11)

The digital outputs change to a fixed value during start-up, operator-selected E-STOP, RESET or STOP, and for various failure conditions. (p. 2-19)

Shock hazard exists. Remove power before extracting or inserting the I/O unit. (p. 2-22, 2-23)

The following test causes the digital outputs to change state. Field devices driven by the outputs must be disabled or disconnected before running this test. (p. 2-27)

Safety Summary (continued)

SPECIFIC WARNINGS (continued)

The CSC01 is factory programmed to trip the outputs to the OFF or de-energized state during the initialization period and when internal errors are detected that create a loss of communications with the CPU board. In some applications, energized outputs could create a situation that could cause personal injury, equipment damage or damage to the product. Make certain these manual control board switches are properly set to the state that will least likely cause injury or damage upon loss of communications. (p. 2-36)

The STOP pushbutton causes a hardware shutdown and results in loss of automatic control. Outputs go to their user-defined hardware setting. It is to be used when removing the Sequence Command Controller from service - not for process control. Use the HOLD and E-STOP functions for process control stops. (p. 4-8)

Pushing the RESET button can cause momentary loss of automatic process control while the controller goes through a power-up condition. Outputs go to user-defined hardware settings. The sequencer may or may not be reset depending on whether RESTORE function codes are used. (p. 4-10)

EXPLOSION HAZARD

Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous. (p. 7-1)

Disconnecting or reconnecting wiring, removing or inserting printed circuit boards, or operating the ON/OFF switch are not considered normal operation. Operator access to these connections and to the switch is prevented by a cover which requires a tool to remove it. These operations should only be done if power has been removed from all wiring or if the flammable atmosphere is known not to be present. (p. B-2)

Sommaire de Securite

AVERTISSEMENT D'ORDER GENERAL

Hazardous Locations
L'equipment descrit par cette notice ne pieu etre installed que dans les emplacements specifies sul la plaque signalitique de l'appariel.

Substitution of Components
La substitution de tout composant peut rendre le systeme inapproprie a un emplacement dangereux de classe I et de division 2.

Nameplate Ratings
On no doit en aucune circonstance depasses les valeurs nominales figurant sur le plaque d'identification.

System Maintenance
L'entretien du systeme doit etre effective par des personnes competentes et uniquement a patir du moment ou les elements controles par le circuit ont ete isoles. Le fait d'enlever ou d'alterer les composants d'une circuit sous tension peut perturber le processus controle.

AVERTISSEMENT D'ORDER SPECIFIQUE

L'equipment descsrit par cette notice ne peut etre installe que dans les emplacements specifies sur la plaque signalitique le l'appareil. (p. 2-3)

Les appariels alimentes par le reseau de distribution de courant alternatif conportent des resques de chocs electriques. S'assurer que l'appariel soit completement debranche du circuit de distribution avant de proceder aux diverses connections electriques. (p. 2-8)

Lorsqu'on se sert des sorties numeriques non-isolees sur alimenation C.A., il faut s'assurer que les phases de l'alimentation no soient pas melees. Des courts-circuits de pahse a phase pourraient resulter d'un filage inadequat. (p. 2-11)

Les signaux desortie numeriques prennent une valeur fixe au moment du demarrage, d'un arret E-STOP defini per l'utilisateur, d'une remise a zero ou d'un arret, et lors de certaines pannes. (p. 2-19)

Risque de choc. Assurez-vous d'interrompre l'alimentation avant de retirer ou d'inserer l'unite d'E/S. (p. 2-22, 2-23)

Sommaire de Securite (continued)

AVERTISSEMENT D'ORDER SPECIFIQUE
(continued)

Les tests suivants provoquent un changement d'etat des sorties numeriques. Les appareils en chantier qui sont commandes par ces sorties doivent etre mis hors fonction ou debranches avant que ces tests ne soient executes. (p. 2-27)

Le poste CSC01 est programme en usine pour declencher ses sorties numbriques a l'etat zero ou etat desoncite (de-energized) durant la periende d'initialization, de meme lorsque des erreurs internes sont detectees qui causant une perte de communication avec le circuit du CPU. Dans certaines applications, des porties excitees pourraient creer une situation causant des blessures corporelles, des dommanges a l'equipement ou des dommages au produit. Veuillez vour assurer que les interrupteurs manuels du circuit imprime sont places un position la moins susceptible de causer des blessures ou des dommages lors d'une perte de communication. (p. 2-36)

Le bouton-poussoir d'arret (STOP) provoque l'arret du materiel et peut provoquer la perte de la command automatique. Les signaux de sortie prennent alors la valeur definie au prealable par l'utilisateur. On doit l'utiliser au moment du retrait du Sequence Command Controller, et non a des fins d'interruption du controle de processus. Pour interrompre le controle du processus, utilisez les fonctions HOLD et E-STOP. (p. 4-8)

Une pression du bouton RESET provoque une interruption du controle du processus pendant que le module procede a son cycle de redemarrage. Les signaux de sortie prennent alors la valeur definie au prealable par l'utilisateur. Le sequenceur peut etre soumis a une remise a zero, selon que des codes fonctionnels RESTORE ont ete utilisee ou non. (p. 4-10)

RISQUE D'EXPLOSION
Avant de deconnecter o'equipment, couper le courant ou s'assurer que l'emplacement est designe non dangereux. (p. 7-1)

Les operations de connexion et de deconnexion de cables, l'installation et la depose de cartes de circuits imprimes et la manoeuvre de l'interrupteur marche/arret ne font pas partie de l'utilisation normale. Pour interdire a l'utilisateur l'acces a ces pieces, un couvercle non amovible sans l'aide d'outils est installe. Les manipulations mentionnees ci-dessus ne devraient etre entreprises qu'apres mise hors tension complete du cablage, a moins que l'on ne sit certain que l'atmosphere ne contient aucune matiere inflammable. (p. B-2)

SECTION 1 – INTRODUCTION

INSTRUCTION CONTENT

Introduction Provides the user with a description of the instruction manual sections, a product overview, a physical description of the product and possible applications. This section also contains a glossary of terms and/or abbreviations, a list of reference documents on related equipment, the product identification (nomenclature), and a comprehensive list of hardware performance specifications including accessories and applicable certification information.

Installation Contains special handling procedures for boards with MOS devices, inspection instructions for the equipment shipped, special considerations required for mounting the controller in a hazardous location and the physical mounting instructions. Safety related information, including hardware default and configuration default conditions are discussed. Instructions are provided for AC/DC power wiring, digital I/O wiring, grounding procedures, connection of multiple Command Series Controllers, expansion bus cabling, redundancy link cabling, RS-232 port cabling and connection of the optional CBE01 Bus Extender.

A detailed subsection is provided for pre-operation adjustments and option settings of the various boards.

Configuration This section provides the required user actions to establish and define the Sequence Command Controller's™ configuration. It provides information on block addresses, function codes and specification lists. It also addresses pre-configuration data required, configuration data for performing specific tasks, and the procedures for converting the initial data into a configuration.

Operating Procedures This section contains a functional description of the faceplate indicators and pushbuttons that are used as operator interface controls. It also describes normal and manual operation. EXECUTE, CONFIGURE and ERROR modes are defined.

Troubleshooting This section provides the user with a listing of faceplate error messages and the corrective action to be taken. A logic flow diagram is also included to help determine and isolate problems encountered.

Maintenance No periodic maintenance is necessary for the Sequence Command Controller.

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Repair/Replacement Provides the user with disassembly and assembly procedures for the replacement of faceplate/CPU assembly, input board, output board, power supply board, manual control board, termination board, and fuse replacement.

Support Services Contains replacement parts drawings and parts lists and recommended spare parts.

Appendix A Contains safety circuit information on redundant inputs and outputs.

Appendix B Contains information on applications in flammable atmospheres.

Worksheets Provides the user with worksheets for I/O Data, Step Mask Data, Device Driver Data, and Step Logic.

INTENDED USER

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. The application technician or engineer should have adequate familiarity with the process to determine and select the default values for process equipment that will cause the least damage or injury should a problem occur.

Operator Should have knowledge of the process and should read and understand this instruction book before attempting any procedure pertaining to the operation of the Sequence Command Controller. Must understand proper actions to take for every alarm condition.

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

PRODUCT OVERVIEW

The Sequence Command Controller is a microprocessor based instrument intended for small digital process control applications.

The Sequence Command Controller may be configured to suit many process control applications. The control functions performed by the Sequence Command Controller are produced by the CPU (Central Processing Unit) circuit board executing a set of control functions that are defined by the user. Refer to Table 1-1 for a list of available control functions for the Sequence Command Controller. The selection

Table 1-1. User-Defined Blocks

NOTE: Refer to Bailey Function Code Application Manual, I-E93-900-20 for a complete description of the Function Codes.

Function	Code No.
Station	
Sequence Station (CSC)	176
Control	
Sequence Generator	161
Device Driver	123
Sequence Monitor	124
Device Monitor	125
Sequence Master	141
Sequence Slave	142
Sequence Manager	135
Multi-State Device Driver	129
Multi-Sequence Monitor	134
Remote Motor Control	136
Computing	
Integrator	166
Matrix Addition	169
Matrix Multiplication	170
Digital Sum with Gain	65
2-Input Sum	15
Multiply	16
Divide	17
Signal Select	
Boolean Signal Multiplexer	119
Real Signal Multiplexer	120
Real Signal Demultiplexer	126
Analog Transfer	9
Signal Status	
High/Low Compare	12
Test Quality	31
Slave Select	98
Digital Readback Check	100
Test Alarm	69
Logic	
Trip	32
NOT	33
Memory	34
Timer	35
Qualified OR	36
AND - 2 Inputs	37
AND - 4 Inputs	38
OR - 2 Inputs	39
OR - 4 Inputs	40
Manual Set Switch	50

Function	Code No.
Logic (continued)	
Digital Transfer	59
Up/Down Counter	85
Elapsed Timer	86
Exclusive OR	101
5 Input Rung	110
10 Input Rung	111
20 Input Rung	112
Jump/Master Control Relay	116
Module Bus I/O	
Analog Input/PCU*	25
Digital Input/PCU	41
Analog Input List	63
Digital Input List	64
Module Status Monitor	95
Plant Loop I/O	
Analog Input/Loop	26
Digital Input/Loop	42
Digital Output Exception Report	45
Analog Exception Report	30
Remote Control Memory	62
Field I/O	
Redundant Digital Input	97
Digital Output Group	83
Digital Input Group	84
BCD Input	114
BCD Output	115
Executive	
Sequence Executive (CSC)	175
Extended Executive	90
Other	
Boolean Recipe Table	117
Real Recipe Table	118
Segment	82
Restore	140
Manual Set Constant (Tunable)	2
Manual Set Constant (Non-Tunable)	51
Adapt	24
Manual Set Integer	52
Blink	61
Boolean Buffer	162
Real Buffer	163

* PCU - Process Control Unit; a group of modules communicating via a module bus performing a control strategy.

and interaction of these control functions is accomplished by configuring ***function blocks***. A function block is merely an input or output, or an operation on an input or output. These function blocks are generic software control algorithms that are used to perform the specific tasks required for your application. The process of defining controller operations with function blocks is called configuration. The configuration process is discussed in the section titled, ***CONFIGURATION***.

The Sequence Command Controller is fully configurable using the Bailey CTT0□ Configuration and Tuning Terminal. This handheld device allows the user to perform system configuration, monitoring, tuning and diagnostic functions. The user-friendly, menu-driven terminal provides a ***walk-through*** procedure for the user. A large alphanumeric LCD readout with four lines, 16 characters per line, offers easy operator interface. This equipment has a separate instruction manual, Bailey number I-E92-501-1 (CTT01) or I-E92-501-2 (CTT□2), and should be included with the shipment if the handheld terminal was ordered as an accessory.

COMMUNICATIONS SYSTEM

The Sequence Command Controller receives and transmits signals by way of the module bus. This system of communication allows the unit to act as a ***stand-alone product*** or as part of a larger system.

Module Bus

The module bus is the local level communication bus and is required only when using multiple Command Series Controllers. It is the bidirectional communication link between each unit. The maximum module bus distance is 33 ft. (10 m) total with twisted pair. To increase the module bus distance up to 2,000 feet maximum, a module bus extender (CBE01) is available as an accessory item. A maximum of 32 active (or addressable) modules can be grouped together on a module bus. Each must have a valid address. Address values range from 2 through 30. Address 31 is reserved for the CTT0□ Configuration and Tuning Terminal.

If the Sequence Command Controller is to be interfaced to Bailey's INFI 90 Strategic Process Management System or the Network 90 Distributed Digital Control System, additional communication modules are required. It is recommended that addresses 0 and 1 be reserved for these additional communication devices. If interface is not necessary or required, addresses 0 and 1 can be used for controllers. Figure 1-1 shows the relationship of the plant loop and module bus.

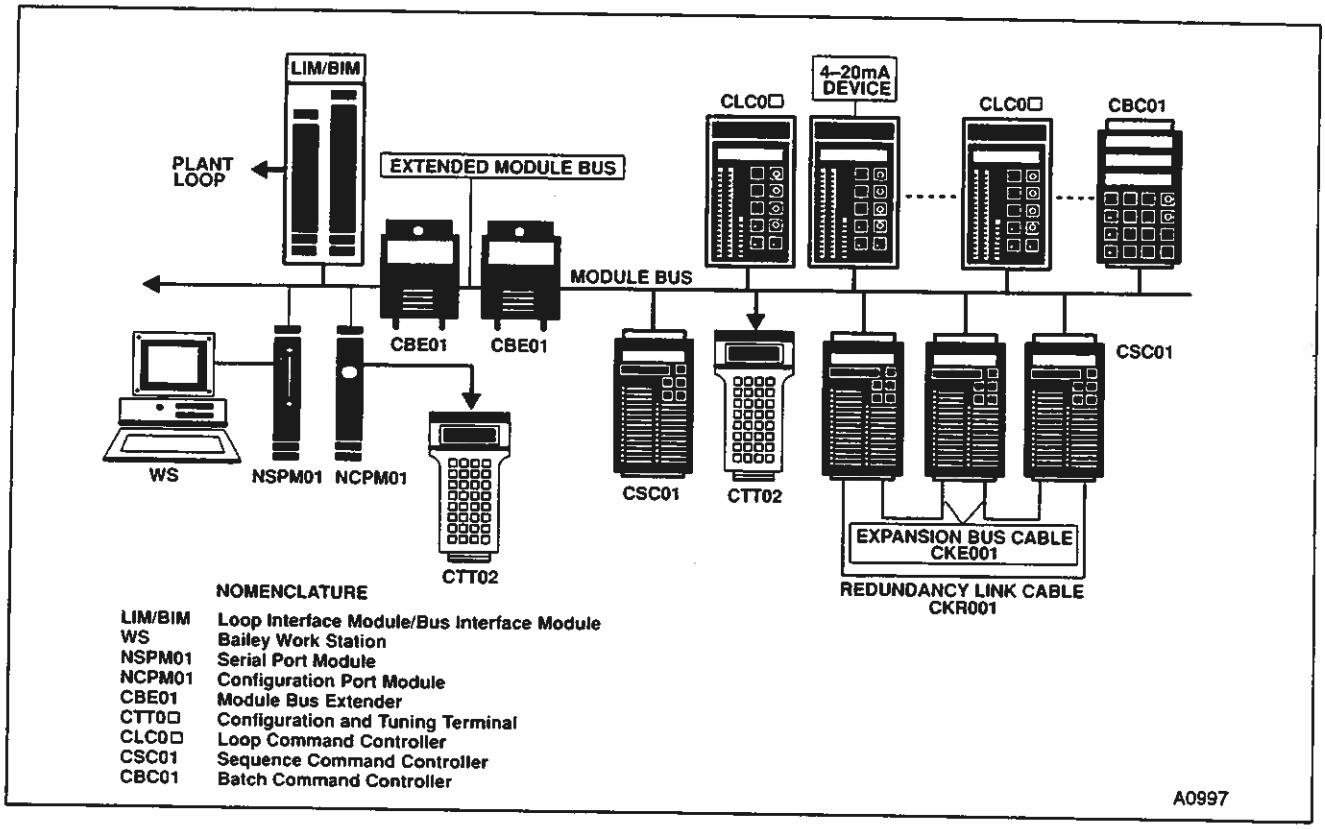

Figure 1-1. Communication Loop Block Diagram

Plant Communication Loop

The plant communication loop is the system level of communication if the Sequence Command Controller is going to interface with Bailey's INFI 90 or Network 90 system. It is a unidirectional redundant system of connected Process Control Units (PCU's). A PCU is a group of modules communicating via a module bus.

Expansion Bus

The expansion bus is a local level of communication which is usually internal to the Sequence Command Controller. It is a bidirectional/parallel bus used for communications between the Central Processing Unit (CPU) board and the input and output boards. External wiring of this bus between units is required when: 1) a redundant Sequence Command Controller is needed, or 2) a master Sequence Command Controller is controlling slave Sequence Command Controllers. A maximum of four active (addressable) units can be linked on the expansion bus (i.e., one master and three slaves). Each I/O unit within a controller must have two valid addresses, one each for the input board and output board, with address values ranging from 2 through 31. The maximum total length of the expansion bus is 4.5 ft. (1.4 m) and by using cable CKE001, proper distance is assured. Figure 1-2 shows the relationship of the expansion bus and the redundancy link.

Redundancy Link

The redundancy link is another local level of communication which is only required when a second Sequence Command Controller's CPU is being used as a backup for a primary Sequence Command Controller's CPU. This is a differential serial bus linking both units. The maximum total distance of the redundancy link is 5 ft. (1.5 m) and cable CKR001 assures this proper length.

NOTE: A redundant Sequence Command Controller can only back up the CPU portion of the primary controller. The I/O cannot be redundant between the two units.

Only two units can be connected on this link. One controller must be set up as the primary and the other as the backup (Figure 1-2). The primary controller executes the control configuration while the backup controller waits in ***standby*** mode and continuously monitors the primary. If an error situation occurs that shuts down the primary controller, the backup assumes control within milliseconds. This feature greatly reduces the chance of a critical process being impacted by a failure. Configuration information is located in the configuration section.

Station Link

The station link is yet another local level of communication used by the master controller to communicate with the faceplates of slave controllers (Figure 1-2). This is a differential serial bus. It is connected between units by the same CKE001 cable containing the expansion bus.

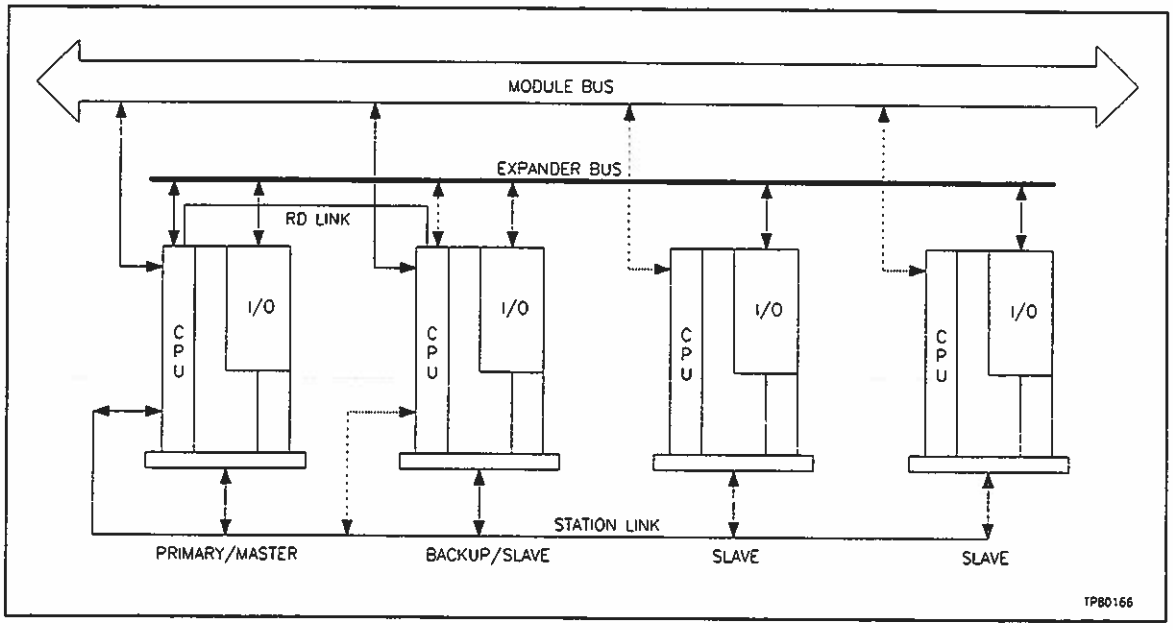

Figure 1-2. Master/Slave Communications

RS-232 Port

The RS-232 port provides a communication Data Terminal Equipment (DTE) link between the controller and a serial output device such as a printer for data logging purposes. The controller can communicate with only one device over this link. The maximum distance of the RS-232 link is 25 ft. (7.6 m). Two cables are available, CKC001-010 (10 ft. [3 m]) or CKC001-025 (25 ft. [7.6 m]), which convert the 9-pin connector port to a standard DB 25-pin male connector.

EQUIPMENT DESCRIPTION

The Sequence Command Controller is a panel-mounted, slide-out assembly that conforms to DIN standards (DIN 43700). The standard assembly contains five printed circuit boards (CPU board, power supply board, input board, output board and termination board) and a faceplate assembly which is attached to the CPU board (Figure 1-3). A sixth board, the manual control board, is mounted on a bracket which supports the power supply board. The power supply board plugs into a connector on the output board. The output board, input board and CPU board, plug into card edge connectors on the termination board. The termination board is attached to the rear of the housing and provides lugless terminations for ease in making wiring connections and reducing installation time. A power switch is located on the termination board to provide a means of disconnecting external power from the unit during maintenance without disconnecting the power wiring.

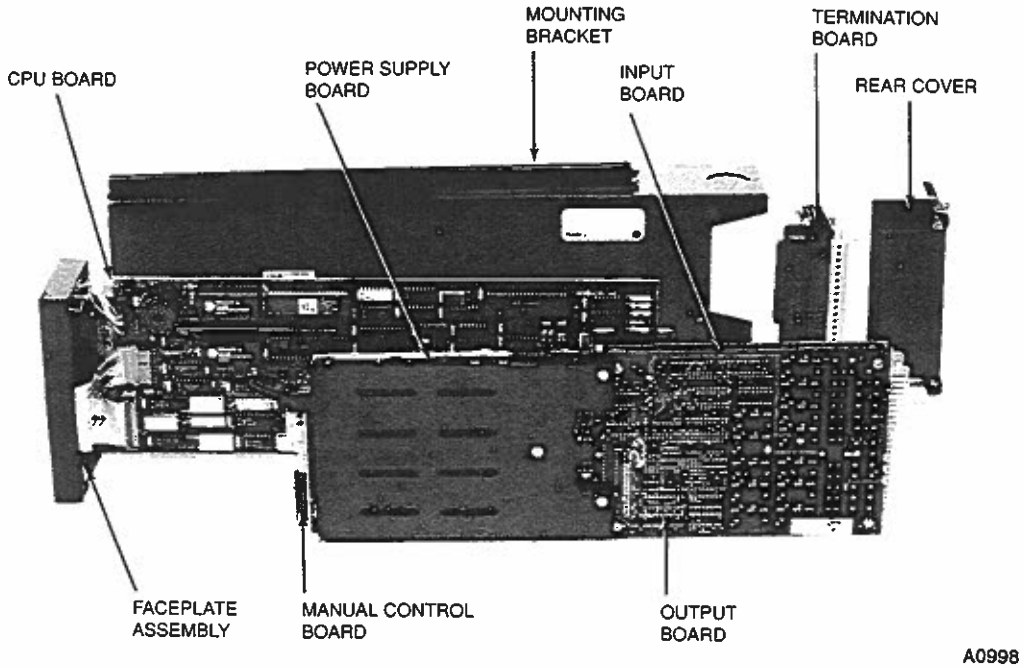

Figure 1-3. Sequence Command Controller (CSC01) Components

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 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 for heat dissipation.

Two captive mounting brackets, one for the top and one for the bottom, are supplied with each controller. When in position on the controller, they act as a dust shield and cover for the heat dissipation holes in the housing. The brackets have cutouts on both sides to allow for air flow.

A captive locking screw located behind the legend/access door (Figure 1-4) on the front faceplate assembly must be loosened to remove the faceplate assembly and CPU board from the housing. Also located behind the legend/access door is the connector for the CTT0□ Configuration and Tuning Terminal, a **STOP** pushbutton and a hardware **RESET** button.

The **STOP** pushbutton allows removal of the controller from service by providing an orderly shutdown of the CPU board. This button should be used before power is removed from the controller (e.g., during maintenance).

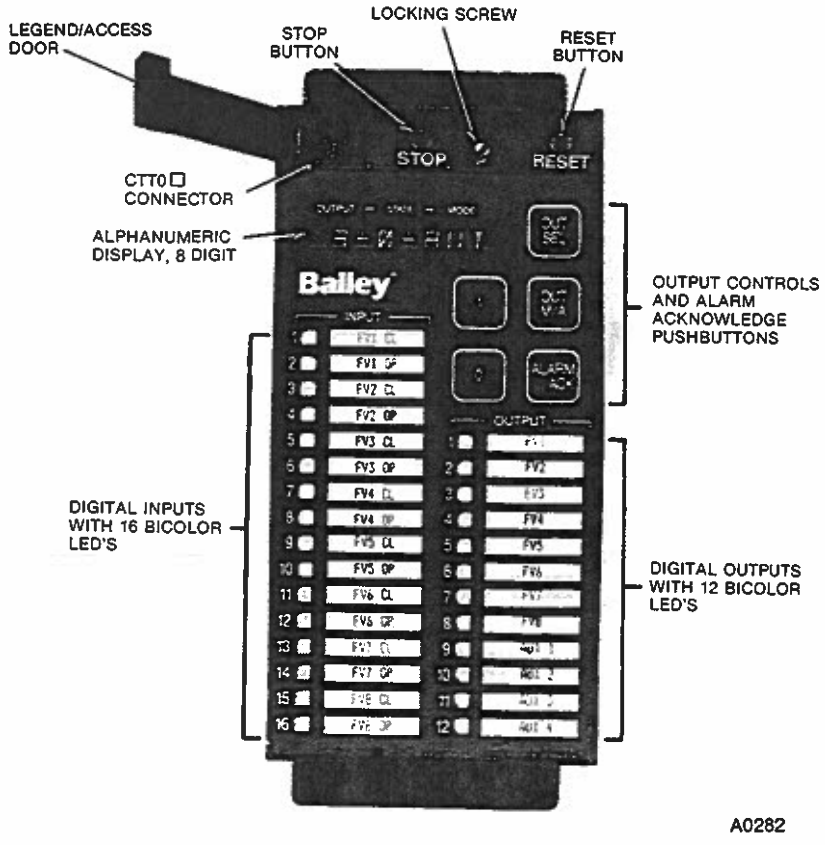

Figure 1-4. CSC01 Faceplate Assembly

The hardware **RESET** button generates a ***power up*** condition for the CPU board. This button may be used when the CPU board times-out, goes into an error mode or after an operator-initiated stop.

The faceplate assembly contains those operator controls necessary for manual and automatic operation. There is a bicolor (red/green) light emitting diode (LED) for each of the 16 inputs and 12 outputs. Five pushbuttons and an 8-digit alphanumeric display provide easy operator interface. An alarm LED is located on the alarm acknowledge (**ALARM ACK**) pushbutton.

Faceplate Displays

The digital alphanumeric display at the top of the unit consists of eight characters and provides the status of the digital outputs during automatic and manual control. It is also used for displaying the controller's mode (EXECUTE, CONFIGURE, ERROR) and the process control status (RUN, HOLD, E-STOP, START, DONE and RESTART). The controller's diagnostic error codes and other related messages are also shown on this display.

Two columns of indicating LED's display the status of all digital inputs and outputs of the controller. Refer to operation section for a more detailed functional description.

Slide-in tags are provided for use in identifying each input and output LED indicator.

Faceplate Pushbuttons

Five pushbuttons are located on the upper right side of the faceplate. For further information on each pushbutton's function, refer to the operation section.

EQUIPMENT APPLICATION

The Sequence Command Controller can be used as either a ***stand-alone*** product, or in conjunction with other sequence commands, or to complement Bailey's Loop Command and Batch Command Controllers for applications requiring analog and digital I/O capabilities. The Sequence Command Controller can also interface with Bailey's powerful INFI 90 Strategic Process Management System or the Network 90 Distributed Control System.

Some typical applications for the Bailey Sequence Command Controller are burner control, pump and valve sequencing, palletizer control, interlock systems, compressor control and motor control.

GLOSSARY OF TERMS AND ABBREVIATIONS

Term	Definition
Checksum	The bytewise sum of all bytes in a command except for the checksum byte and the command terminator. This sum is used in software security checks.
Configuration	The process of defining controller operations with function blocks.
CPU	Central Processing Unit. Section of controller which performs the computations and control functions.
DDB	Device Driver Block, Function Code 123.
DTE	Data Terminal Equipment. This is equipment which sends and receives data over an RS232 link and uses this data to perform particular functions. Examples include computers and printers.
E-STOP	EXECUTED STOP. An operator or configuration induced shutdown state defined as Step 0.
EASY STEP PLUS™	A simplified configuration method for developing sequencer applications. EASY STEP PLUS is the enhanced version of EASY STEP and is used with the CBC01 Batch Command Controller.
Exception Reports	A Command Series message that is generated as a result of an alarm, or a significant change in the output value of a Command Series function block. Exception reports are also generated at maximum reporting intervals, even if no change in value has occurred.
Expansion Bus (Expander Bus)	Parallel data bus used by the CPU to communicate with the I/O units.
Faceplate	Area of the controller containing the operator accessible indicators and controls.
Fatal Error	An error that causes the controller to no longer control the process.
Function Blocks	Software control algorithms that can be used to perform specific tasks.
I/O Unit	Input/Output Unit. Section of controller which directly interfaces with the field I/O devices.
Logic 0 (low)	Contact OPEN, output OFF.
Logic 1 (high)	Contact CLOSED, output ON.
Module Bus	Serial data bus used by the CPU to communicate with other CPU's for the purpose of passing process and configuration data.
N.C.	Normally CLOSED relay contact.
N.O.	Normally OPEN relay contact.
Nonfatal Error	A problem exists but the controller maintains control of the process (i.e., an I/O point has bad quality).
Normal Operation	The operation of a Sequence Command Controller in which the controller is executing the stored configuration.

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GLOSSARY OF TERMS AND ABBREVIATIONS *(continued)*

Term	Definition
PCU	Process Control Unit is a group of instruments communicating via a module bus performing a control strategy.
Quality	Status associated with an I/O value indicating whether the required communications has been established with the I/O source and that the I/O is within allowed range.
NVRAM	Non-Volatile Random Access Memory.
RAM	Random Access Memory.
Redundancy Link	Serial data link used by the primary CPU to communicate with the CPU in the backup unit for the purpose of creating a redundant copy of the control configuration and current process data.
ROM	Read Only Memory.
Sequencer	A configuration in which the function codes are organized to perform a specified sequence of discrete steps.
Station Link	Serial data link used by the slave Sequence Command Controller faceplates to communicate with the master.
Step	One of a series of events which occurs in a batch recipe (i.e., heat to 200°C or mix for 10 minutes).
Tag	Name given to a particular I/O point or control loop.
TU	Termination Unit. Section of controller where field wiring is connected.

ASSOCIATED DOCUMENTS

Number	Title
I-E92-501-1	Type CTT01 Configuration and Tuning Terminal
I-E92-501-2	Type CTT□2 Configuration and Tuning Terminal
I-E93-900-20	Function Code Application Manual
I-E92-504-1	CBE01 Module Bus Extender

NOMENCLATURE

The appropriate nomenclature for the Sequence Command Controller and related equipment is as follows:

CSC01	Sequence Command Controller
CTT01/CTT□2	Configuration and Tuning Terminal
CKR001-5	Redundancy Cable
CKE001-2	Expansion Bus Cable
CKC001-10	Serial Port Cable, RS-232, 10 ft. (3 m)
CKC001-25	Serial Port Cable, RS-232, 25 ft. (7.6 m)

SPECIFICATIONS

Inputs	
16 Digital:	24 VDC or 120 VAC, 4 mA (nominal) 2 mA (minimum) All optically isolated, 12 with common bus
Digital Input Logic Levels	
Valid High:	18-26 VDC 80-130 VAC
Valid Low:	0-6 VDC 0-10 VAC
Outputs	
12 Digital:	24 VDC or 120 VAC @ 2 A (contact outputs: electromechanical relay) 6 isolated, 6 common bus[1] Individually fused @ 2.5 A [1]Total common bus current not to exceed 9 A.
Relay Characteristics:	
Operate time:	5 msec nominal
Release time:	3 msec nominal
Contact Life:	500,000 operations (Rated load of 2 A resistive)
I/O Scan Rate	2 msec minimum for 16 inputs/12 outputs. **NOTE:** Time will increase as Function Codes are added to the control configuration.
Input/Output Capabilities (via CSC01 as Digital Slave)	24 VDC, 120 VAC 64 digital inputs (max.) 48 digital outputs (max.) **NOTE:** A maximum of 3 CSC01's can be used as slaves.
Manual Control	Provided for all outputs
Power Supply Requirements	24 VDC (±10%), or 90 to 130 VAC, or 180 to 260 VAC, 47 to 63 Hz
Maximum Power Consumption	
24 VDC:	14 W
120 VAC:	18 W
240 VAC:	18 W
Maximum Power Supply Inrush Current (Cold)	
120 VAC:	14 A
240 VAC:	18 A
Microprocessor	68HC000 @ 8 MHz
Memory	128 kbytes of ROM 128 kbytes of RAM 16 kbytes of NVRAM
Function Blocks	2048 maximum 30 reserved 2018 user-defined
Input/Output Ports	RS-232 (Serial) or RS-422 (Redundancy Link) plus RS-422 (Station Link).

SPECIFICATIONS (continued)

Electrical Connections	Rear of case. Compression type, lugless connections, 14-24 AWG.
Faceplate	
Indicators:	28 bicolor (red/green) LED indicators for each input and output. User selection of color to correspond to logic state. Mono or bicolor displays are user selectable.
Pushbuttons:	5
Digital Display:	Alphanumeric, 8 characters.
Environmental Constraints	
Temperature:	0° to 50°C (32° to 122°F)
Relative Humidity:	0-95% non-condensing
RFI Effect	Controller operates within specifications when rear cover is in place and earth ground is connected for: 20 MHz -150 MHz @ 20 V/m 150 MHz - 500 MHz @ 10 V/m
Agency Approvals	CSA (Canadian Standards Association) certified for Class I, Division 2, Groups A - D. FM (Factory Mutual) approved for Class I, Division 2, Groups A - D. **NOTE:** Hazardous location approvals are for ambient conditions of 86 to 108 kPa (12.47 to 15.66 psi), 21% oxygen maximum, and -25° to 40°C (-13° to 104°F).
Enclosure Classification	NEMA 1.
Weight	10 lbs. (4.5 kg)
Accessories	
Configuration and Tuning Terminal	Handheld unit that provides system configuration, monitoring, tuning and diagnostics. Order by nomenclature: CTT□2
Blank Configuration Storage Cartridge	Cartridge for the CTT□2 Configuration and Tuning Terminal. Provides storage capability for up to 32 configurations. Order by part no.: 6637531-1
Bus Extender	Increases the module bus distance from 33 feet to 2,000 feet. Order by nomenclature: CBE01
ESD Field Service Kit	For personnel working on equipment containing MOS devices. Includes static-dissipative work mat, a ground cord assembly, alligator clip and wrist bands. Order by part no.: 1948385-1
RS-232 Adapter Cable	Provides a communication (DTE) link between the controller and a serial output device. Order by nomenclature: CKC001-10 (10 ft.), CKC001-25 (25 ft.).
Redundancy Cable	Differential serial bus linking the primary controller to a backup Sequence Command Controller's CPU. Order by nomenclature: CKR001-5.
Expansion Bus Cable	Parallel and differential serial bus linking the master controller to a slave controller. Order by nomenclature: CKE001-2.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

SECTION 2 – INSTALLATION

SPECIAL HANDLING PROCEDURES FOR MOS DEVICES

In addition to the normal precautions for storage and handling of electronic equipment, the Sequence Command Controller has special MOS (Metal Oxide Semiconductor) handling requirements. The Sequence Command 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.

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

1. Use anti-static bag. Most assemblies with MOS devices are shipped in a special anti-static bag. Keep the assembly in the bag as much as possible whenever the assembly is not in the system.

2. Assemblies containing MOS devices should be removed from their anti-static protective containers only under the following conditions:

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

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

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

3. Personnel handling assemblies with MOS devices should be neutralized to a static-free workstation 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 MOS devices. Most clothing generates static electricity.

5. Avoid touching edge connectors and components.

6. Avoid partial connection of MOS devices. MOS devices can be damaged by floating leads, especially the power supply connection. If an assembly must be inserted into 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 the circuit board is thoroughly clean around its leads, but do not rub or clean with an insulating cloth.

NOTE: An anti-static kit (ESD Field Service Kit, Bailey Part No. 1948385-1) is available for personnel working on devices containing MOS components. The kit contains a static-dissipative work surface (mat), a ground cord assembly, wrist bands and alligator clip.

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 responsible transportation company. Also, the nearest Bailey 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. Inside the rear cover are three blank legend tags (unless a legend was specified at time of ordering), three blank sets of I/O tags and two spare 2.5 A fuses. One of the legend tags should be filled in by the user and mounted on the legend/access door on the faceplate. The other two are spares. One set of I/O tags should also be filled in by the user and slipped into the appropriate pockets on the faceplate assembly. Careful handling and installation will ensure 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 the ***SPECIFICATIONS*** section.

LOCATION

The Sequence Command 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 lighted, dry and vibration free and conform to the environmental constraints listed in the ***SPECIFICATIONS*** section. Careful placement of the controller will ensure 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 contaminates can accumulate on the surface of the printed circuit boards.

The Sequence Command Controller can be powered with a 24 VDC supply and/or 120, 220 or 240 VAC line service. The proper power source must be made available at the installation site.

Hazardous Locations

The Sequence Command Controller has Factory Mutual Research (FM) approval and Canadian Standards Association (CSA) certification for use in the following categories:

Class I, Division 2, Groups A-D

Refer to Appendix B for guidelines on using the controller in hazardous locations.

WARNING	**The equipment described may be used only in those classes of hazardous locations identified on the nameplate.**
AVERTISSEMENT	**L'equipment descsrit par cette notice ne peut etre installe que dans les emplacements specifies sur la plaque signalitique le l'appareil.**

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. Prudent practice dictates that cautioning against the use of portable communications equipment be taken by posting appropriate signs in your plant.

SAFETY CIRCUIT APPLICATIONS

If the Sequence Command Controller is to be used in a safety circuit application, some form of redundant I/O connections and configuration must be used to ensure detection of a failure. Refer to Appendix A at the end of the instruction book.

MOUNTING

The Sequence Command 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.

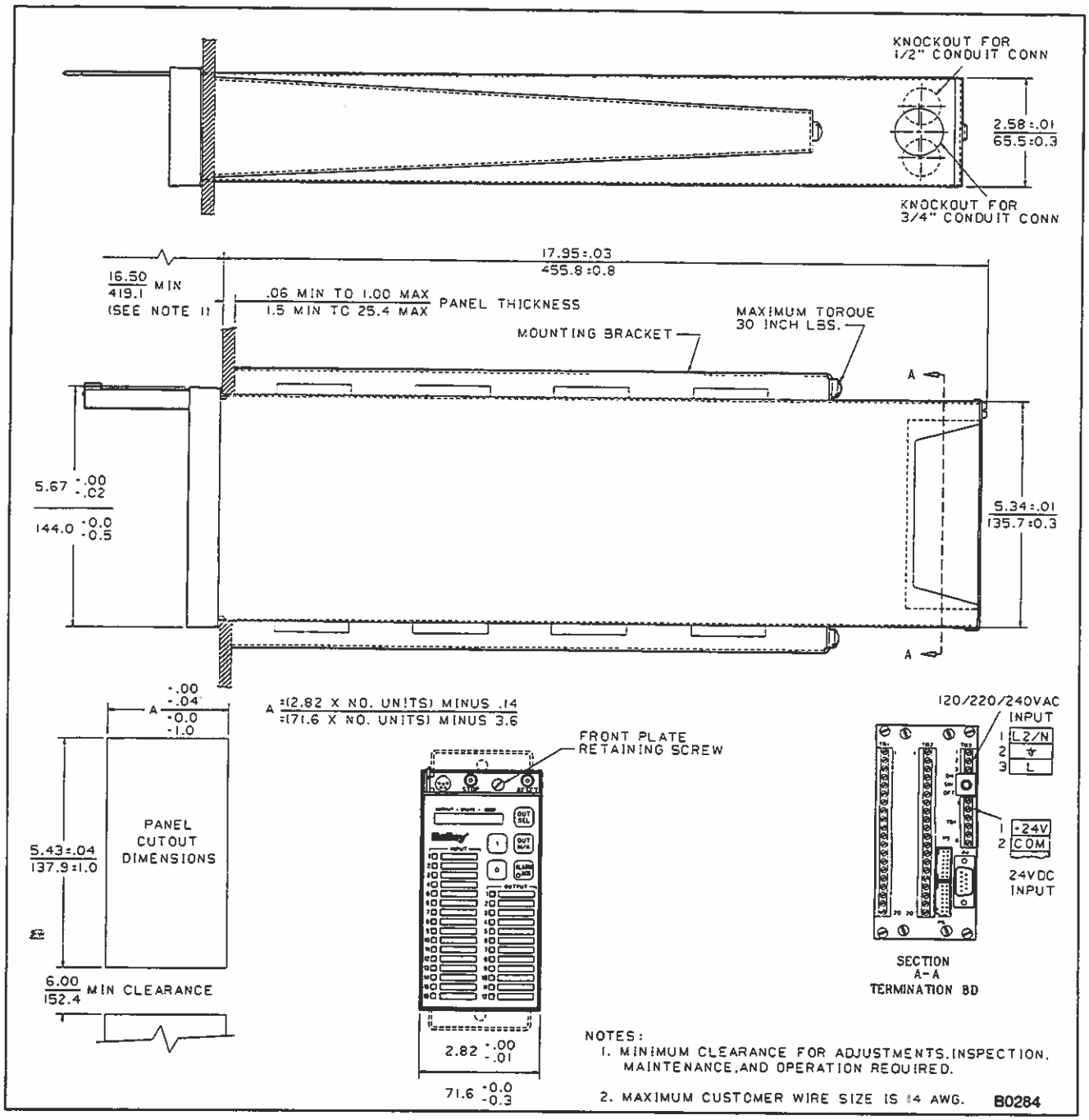


Figure 2-1. External and Mounting Dimensions, Type CSC01

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.

Mounting Procedure

To install single or multiple mounted units in a prepared panel cutout, proceed as follows:

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. Tighten the bracket screws until the housing is secure in the panel.

3. If assembling multiple units, follow Steps 1 and 2 above until all units are installed.

WIRING CONNECTIONS/CABLING

General

Conduit knockouts (½-inch and ¾-inch) are located at the rear of the Sequence Command 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. Wire size for the connector is 14 AWG to 24 AWG.

The CSC Controller has the capacity for 16 inputs and 12 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 interconnecting cables (CKC, CKR or CKE) are 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 live parts, prevents operator access to parts which may cause an ignition capable arc, acts as an electrical shield to reduce the affects of EMI/RFI, and helps minimize temperature gradients. It is important that the cover be securely mounted during normal use.

A power switch, SW1, is located at the rear of the housing to allow the external power supply (AC or DC) to be disconnected from the unit without removing the power supply wiring. See Figure 2-2 for location of the power switch.

DC Power Wiring

If a DC supply is used, 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°C 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.

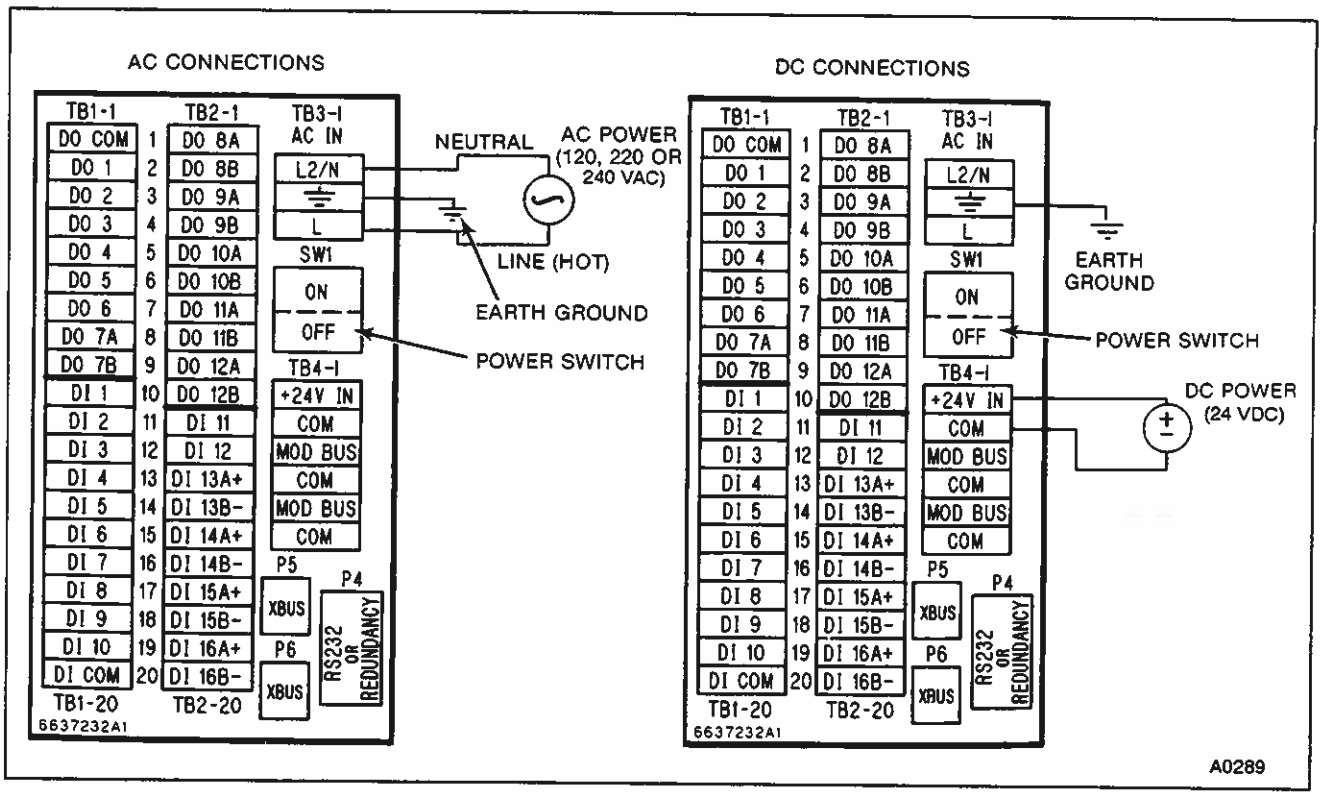


Figure 2-2. DC and AC Power Supply Wiring Connections

Connect the specified DC voltage (24 VDC ±10%) to terminal block TB4-1 (+) and TB4-2 (common) as shown in Figure 2-2. A ground wire should be connected to TB3-2 (earth ground).

AC Power Wiring

The unit is factory set for 120 VAC (nominal). If 220 or 240 VAC is required, remove the power supply board and cut the jumper wire W100 or W101 (Figure 2-3). It is recommended that the jumper wire be cut such that it is completely removed from the circuit.

Either a standard 3-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.

If hard wiring the AC power supply, it is recommended that all power wiring be stranded, copper conductor, No. 14 AWG,

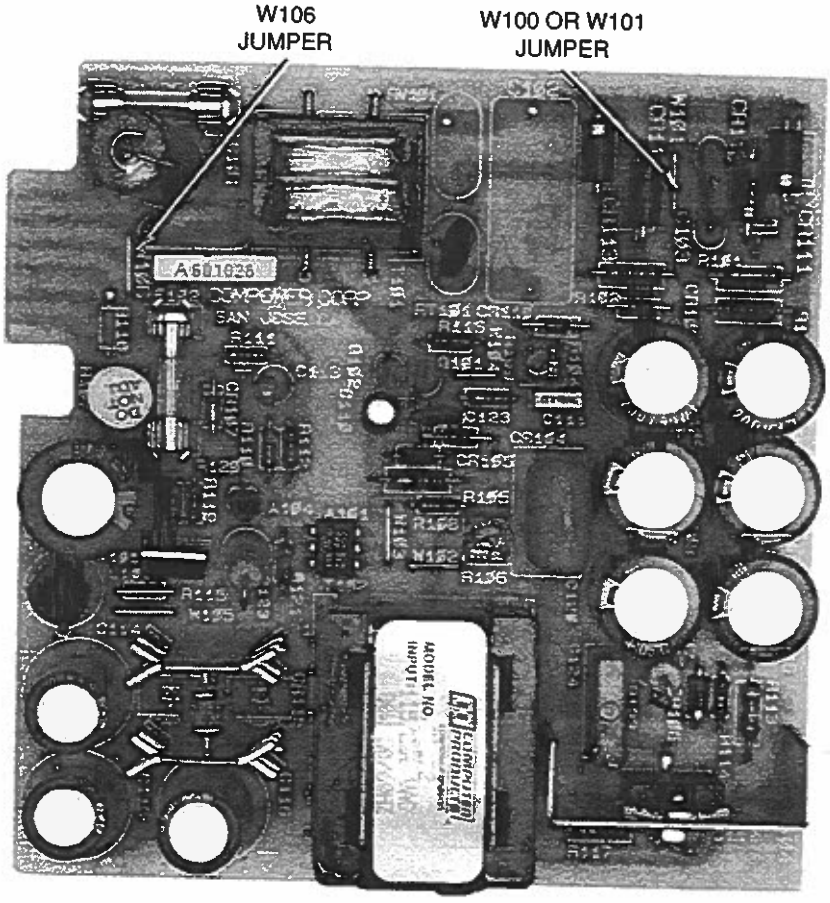


Figure 2-3. Jumper Removal for 220 or 240 VAC Service and Single Point Grounding

and bear a suitable voltage rating for the highest voltage present (either signal or power) and a 75°C 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.

The U.S. and Canadian Electrical Codes specify that neutral (current carrying ground) conductors be white or natural gray and that earth grounding conductors be green or green with yellow stripes. Common practice is to use black or red for ***hot*** leads.

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	**Instruments that are powered from AC line voltage constitute a potential for an electrical shock hazard to the user. Make certain the AC line cord or power lines from the operating branch circuit are disconnected from the source before attempting electrical connections.**
AVERTISSEMENT	**Les appariels alimentes par le reseau de distribution de courant alternatif conportent des resques de chocs electriques. S'assurer que l'appariel soit completement debranche du circuit de distribution avant de proceder aux diverses connections electriques.**

Connect the specified line voltage (120, 220 or 240 VAC, 50 or 60 Hz) to terminal block TB3 on the termination board. The hot lead to terminal ***L*** (TB3-3); neutral to terminal ***L2/N*** (TB3-1); and the ground wire to terminal marked with the ground sign (⏚) (TB3-2).

Refer to Figure 2-2 for AC wiring connections.

Redundant Power Supply Wiring

The Sequence Command 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 above, thus providing continuous power to the unit in case a supply fails.

AC Safety Ground

It is the responsibility of the user to ensure that all exposed conductive materials are properly grounded in accordance with local, National Electrical Code and Canadian Electrical Code regulations and are not a hazard, including under fault conditions, to operation and service personnel.

The Sequence Command Controller provides for a connection of a grounding conductor (user supplied) at terminal block TB3-2 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 ensure that a grounding electrode system which is acceptable to the local building and wiring codes exists at the facility where the Sequence Command 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 Sequence Command Controller.

To avoid possible misoperation due to multiple grounding connections, the Sequence Command Controller must not be mounted to structural members which are at a different potential than the grounded circuit of the site's wiring system. Where mounting to structural members cannot be avoided, the structural members should be connected to the grounding circuit of the site'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. Preferably, the Sequence Command 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 (Figure 2-3) connects the DC system common to the earth ground. Cut jumper W106 to isolate system common from earth ground.

For single controller installations (module bus is not connected to any other sequence command 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.

SINGLE POINT GROUNDING

For single controllers - Single point grounding of the command series controllers provides an analog and digital DC grounding system free of circulating currents. Jumper W106 on the power supply board (Figure 2-3) connects the DC system common to the earth ground. Cut jumper W106 to isolate system common from earth ground if needed. Otherwise, jumper W106 should remain intact for a single controller.

For multiple controllers - If several command series controllers are connected through the module bus communication link, then the system commons are also connected. For a single point grounding system, system common should be tied to earth ground only at one point. Therefore, cut jumper W106 (Figure 2-3) on the power supply board of each controller. Use a separate 14 AWG jumper wire to connect the DC system common of the CSC to an isolated system common bus. From one point on the system common bus, use 8 AWG wire to connect to a dedicated ground (Figure 2-4).

NOTE: For a single point grounding system, system common of all I/O devices that interface with the Sequence Command Controllers must be the same potential as the Sequence Command's system common.

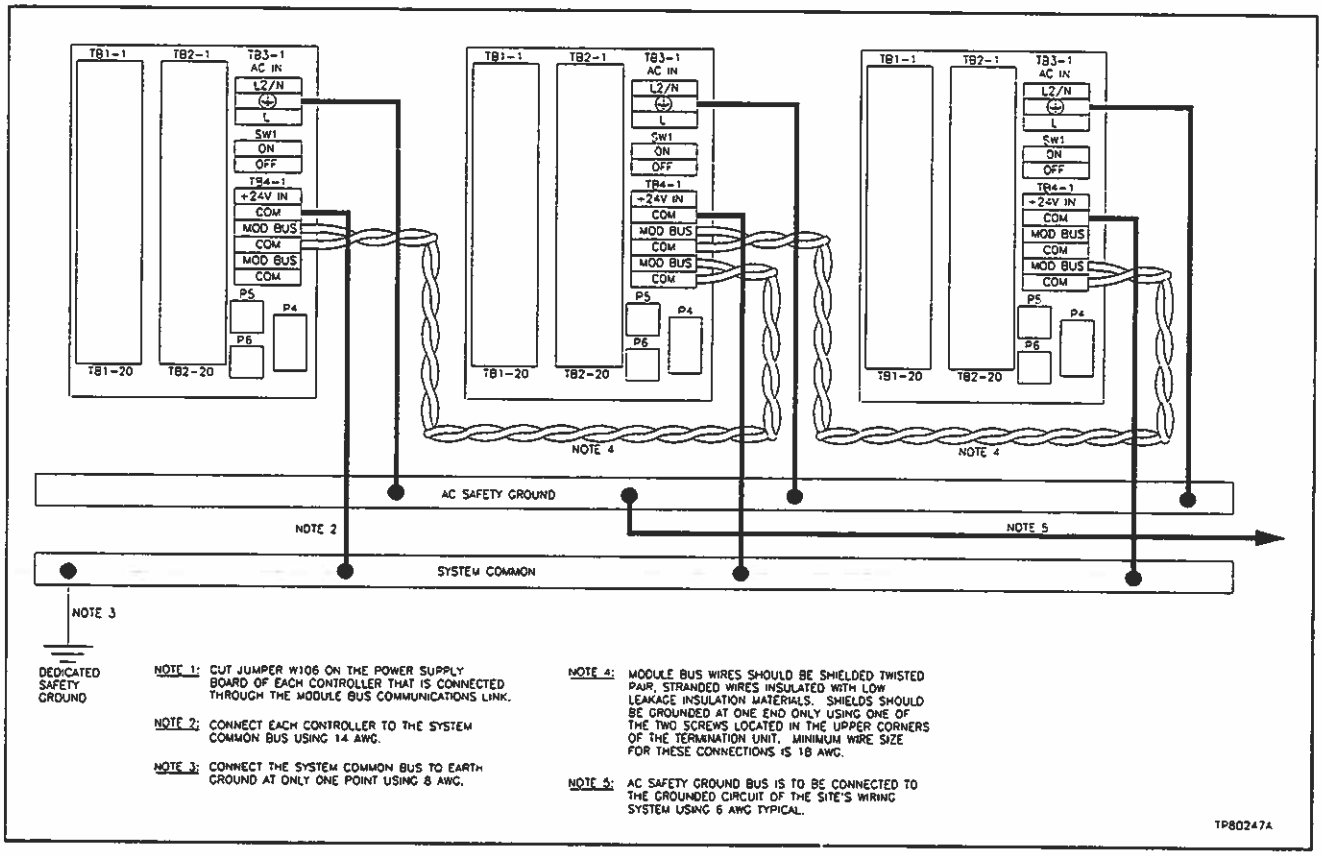


Figure 2-4. Recommended Single Point Grounding System

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 five ohms 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 must be grounded through the same grounding conductor).

Digital Input/Output Connections

Low level (24 VDC) digital input and output wires should be twisted pair, stranded wires insulated with low leakage insulation materials and bear a voltage rating for the highest voltage present (either power or signal) and a 75°C (167°F) minimum rating. An alternative is that non-voltage rated wire can be used for the 24 VDC circuits if the high level circuits (power and signal) are insulated for twice the actual circuit voltage. Individually shielded pairs provide greater protection against noise and crosstalk than nonindividually shielded pairs. Shields are to be grounded at one of the two screws located on the bottom of the termination board. Higher level (120 VAC) digital input and output wiring should be stranded copper conductors and bear a voltage rating for the highest voltage present (either power or signal) and a 75°C minimum rating.

Maximum wire gauge for the connectors on the rear of the Sequence Command housing is No. 14 AWG and minimum is No. 24 AWG.

WARNING	**When using the non-isolated digital outputs with AC voltage, care must be taken that voltage phases are not mixed. Phase to phase shorts could result if improperly wired.**
AVERTISSEMENT	**Lorsqu'on se sert des sorties numeriques non-isolees sur alimenation C.A., il faut s'assurer que les phases de l'alimentation no soient pas melees. Des courts-circuits de pahse a phase pourraient resulter d'un filage inadequat.**

Connect the digital inputs and outputs using the external wiring label (Figure 2-5 on the inside rear housing cover) as a guideline for terminal block assignments.

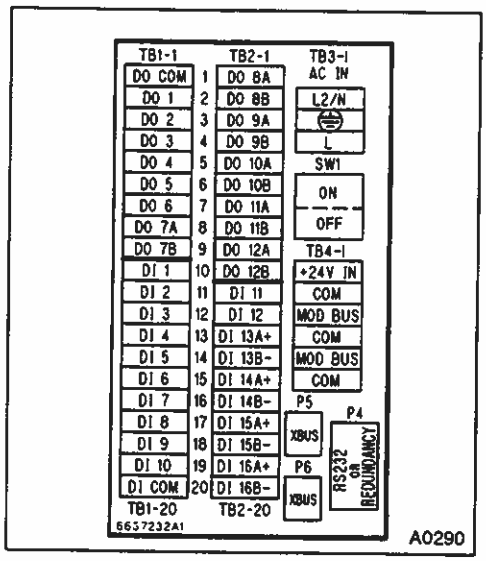


Figure 2-5. External Wiring Label

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 live parts, 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.

Refer also to Figures 2-6 through 2-12 for typical digital input/output, isolated and non-isolated connection examples.

NOTE: Refer to Appendices A and B at the back of this instruction book for safety circuit diagrams and hazardous location information.

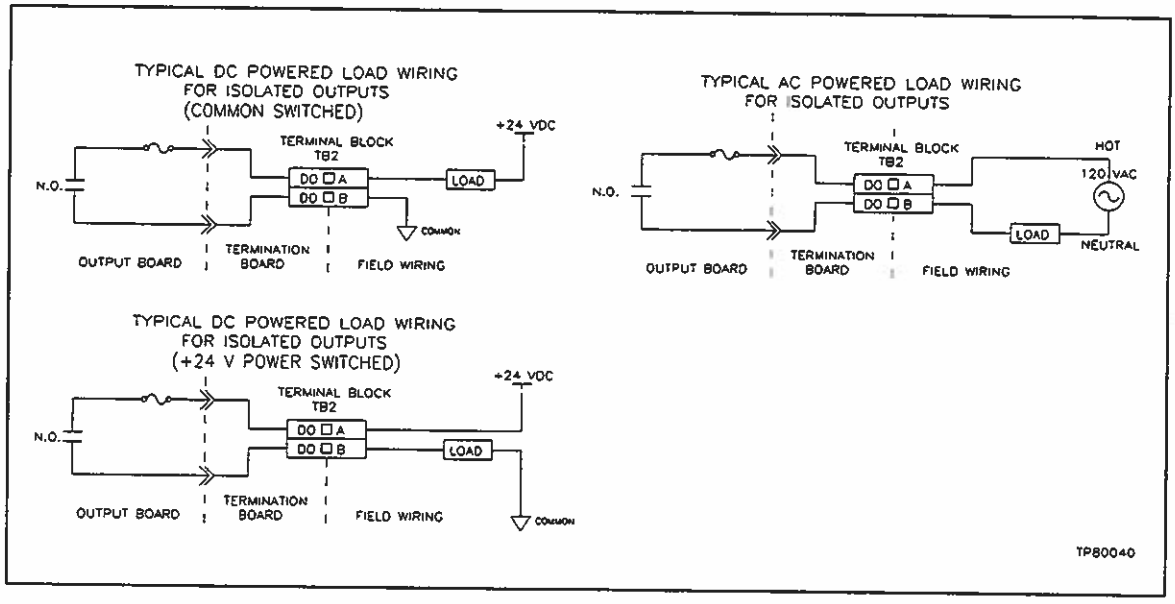


Figure 2-6. Connection of Isolated Digital Outputs, AC/DC Powered Load Wiring

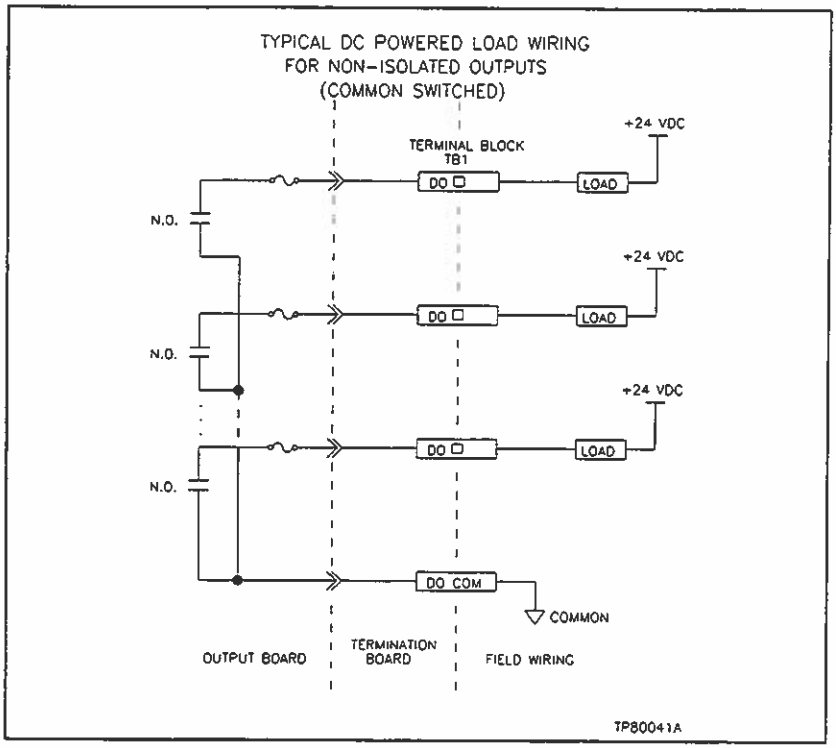


Figure 2-7. Connection of Non-Isolated Digital Outputs, DC Powered Load Wiring (Common Switched)

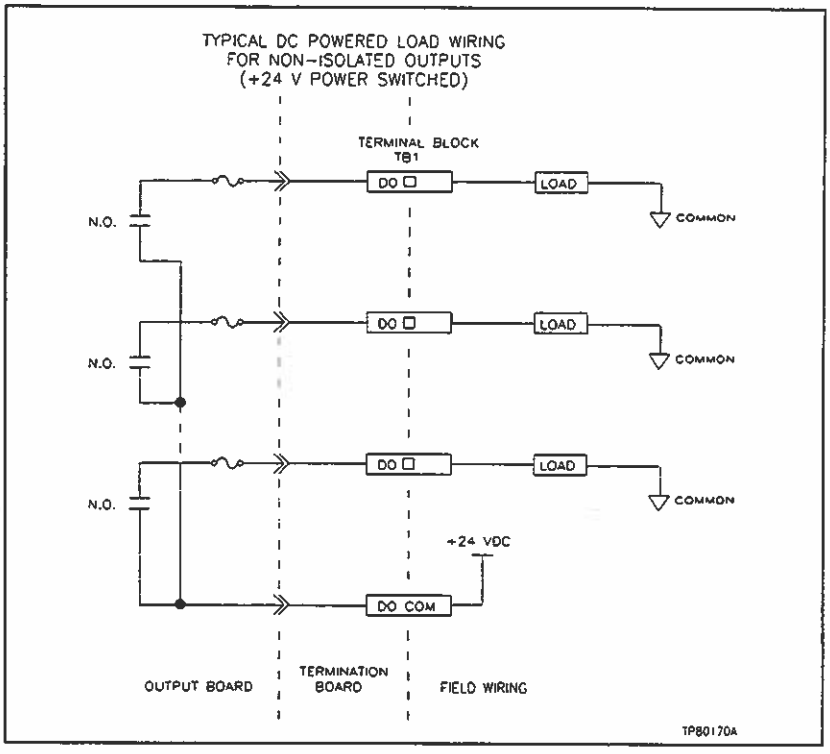


Figure 2-8. Connection of Non-Isolated Digital Outputs, DC Powered Load Wiring (+24 V Power Switched)

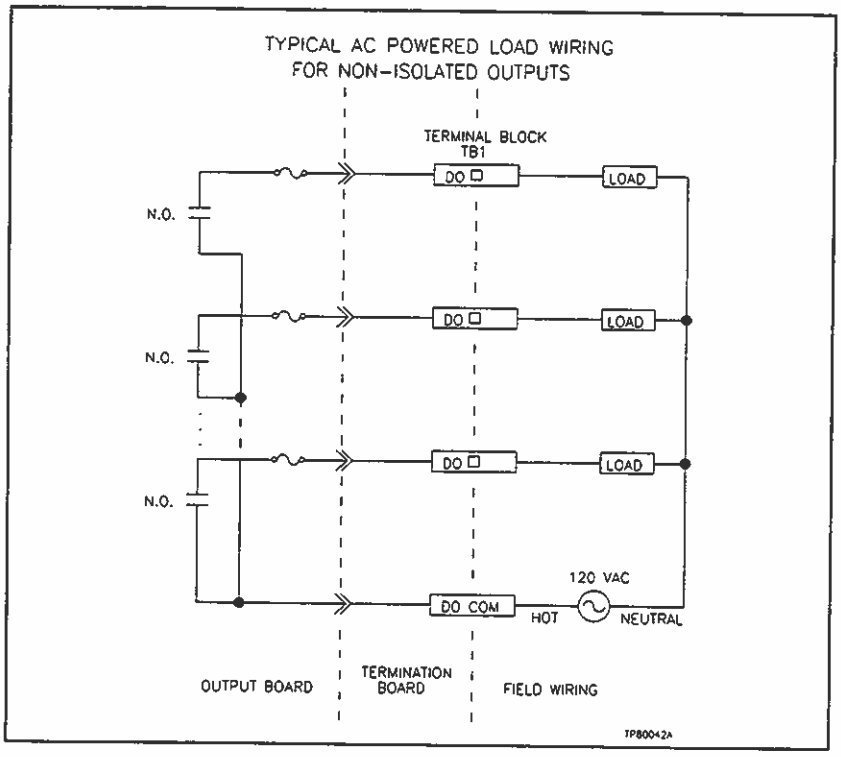


Figure 2-9. Connection of Non-Isolated Digital Outputs, AC Powered Load Wiring

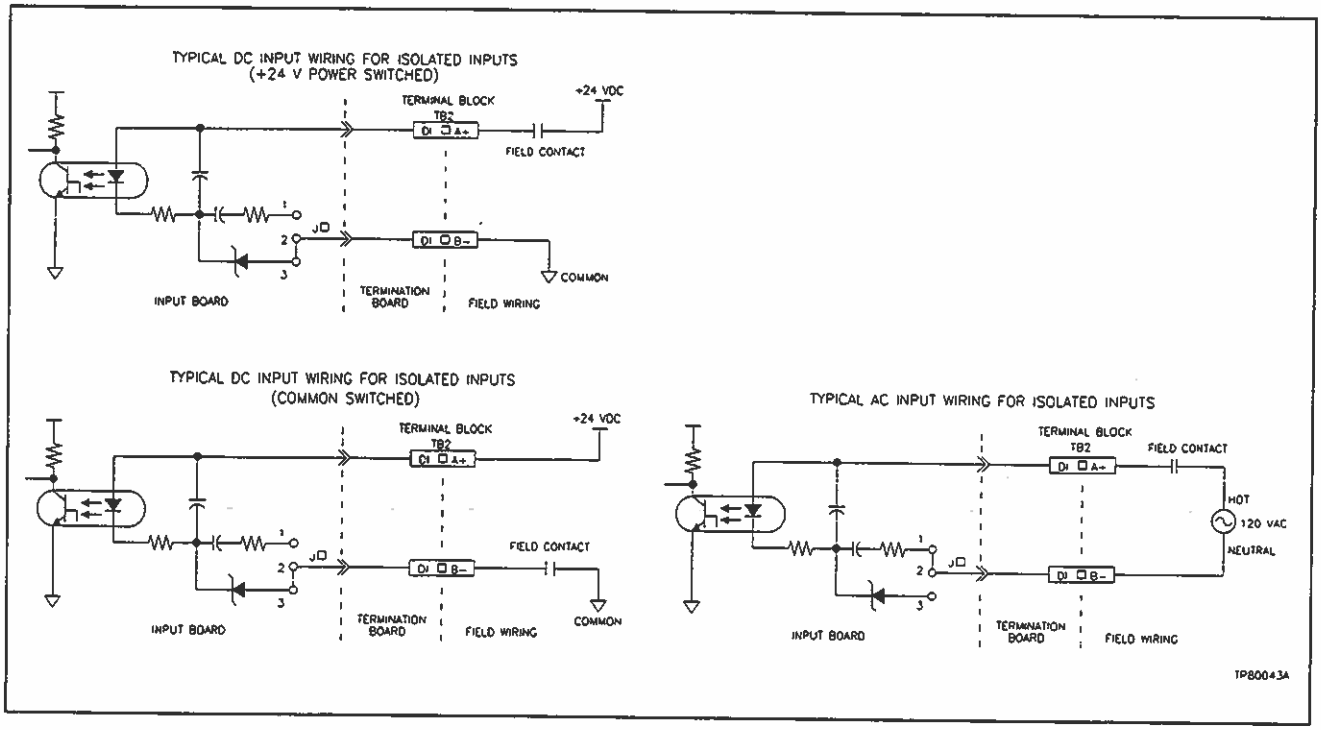


Figure 2-10. Connection of Isolated Digital Inputs, AC/DC Powered Load Wiring

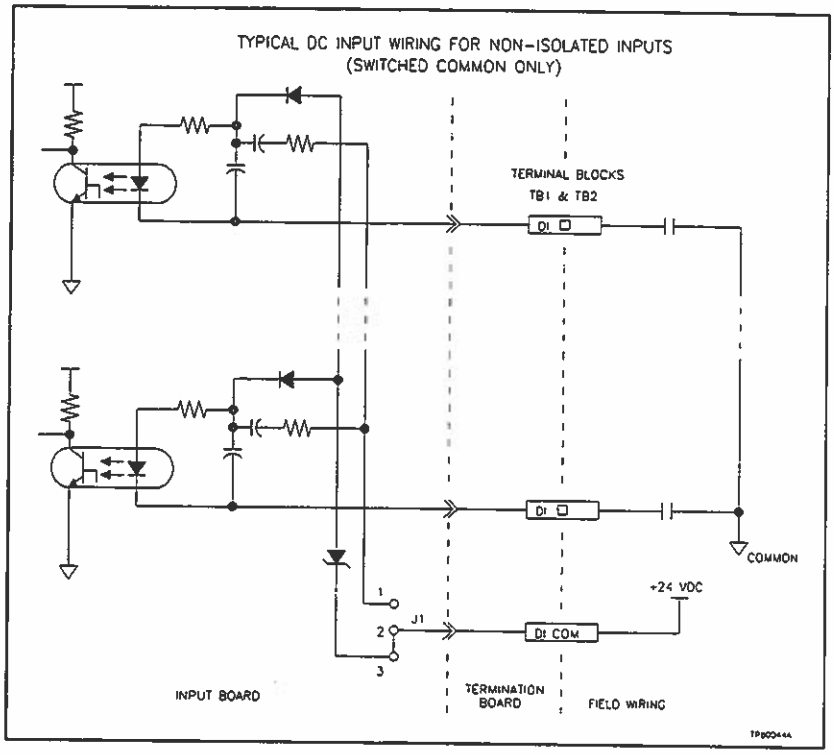


Figure 2-11. Connection of Non-Isolated Digital Inputs, DC Input Wiring

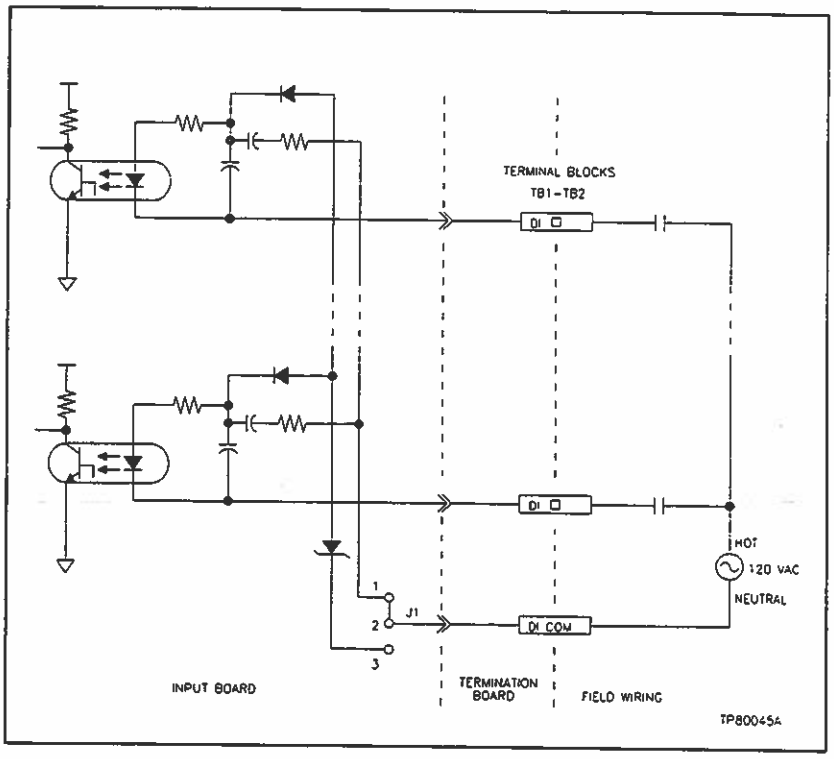


Figure 2-12. Connection of Non-Isolated Digital Inputs, AC Input Wiring

Connecting Multiple Command Series Controllers

MODULE BUS CONNECTIONS

The module bus wires for connecting multiple Command Series Controllers should be twisted pair stranded wires insulated with low leakage insulation materials. Individually shielded pairs provide greater protection against noise and crosstalk than non individually shielded pairs. Shields are to be grounded on one end. To ground the shields, one of the two screws at the bottom of the termination board should be used.

Maximum wire gauge for the connectors on the rear of the Sequence Command housing is 14 AWG. Refer to Figure 2-13 for module bus wiring when connecting multiple controllers.

EXPANSION BUS CABLING

The expansion bus can be connected between units via cable CKE001-2 which plugs into connectors P5 or P6 on the controller's termination board (Figure 2-14). The two connectors are provided to allow daisy chaining between four units maximum.

REDUNDANCY LINK CABLING

The redundancy link can be connected between two units by using cable CKR001-5. This cable plugs into connector P4 on the controller's termination board (Figure 2-15).

NOTE: For redundancy, the expansion bus of the backup controller must be connected to the expansion bus of the primary controller.

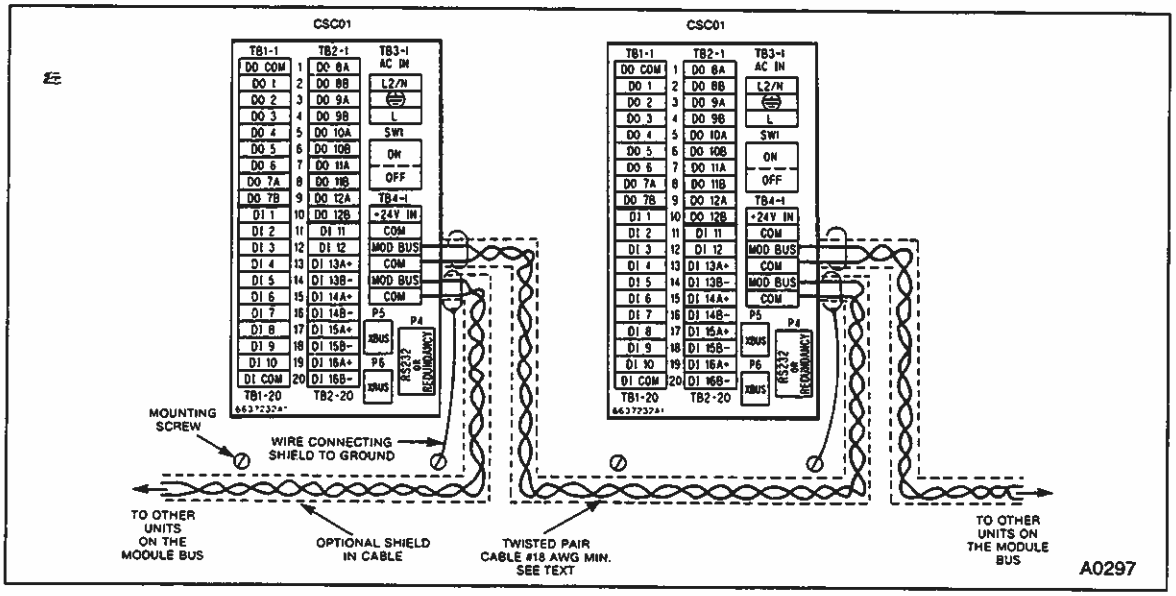


Figure 2-13. Module Bus Line - Connecting Multiple Controllers

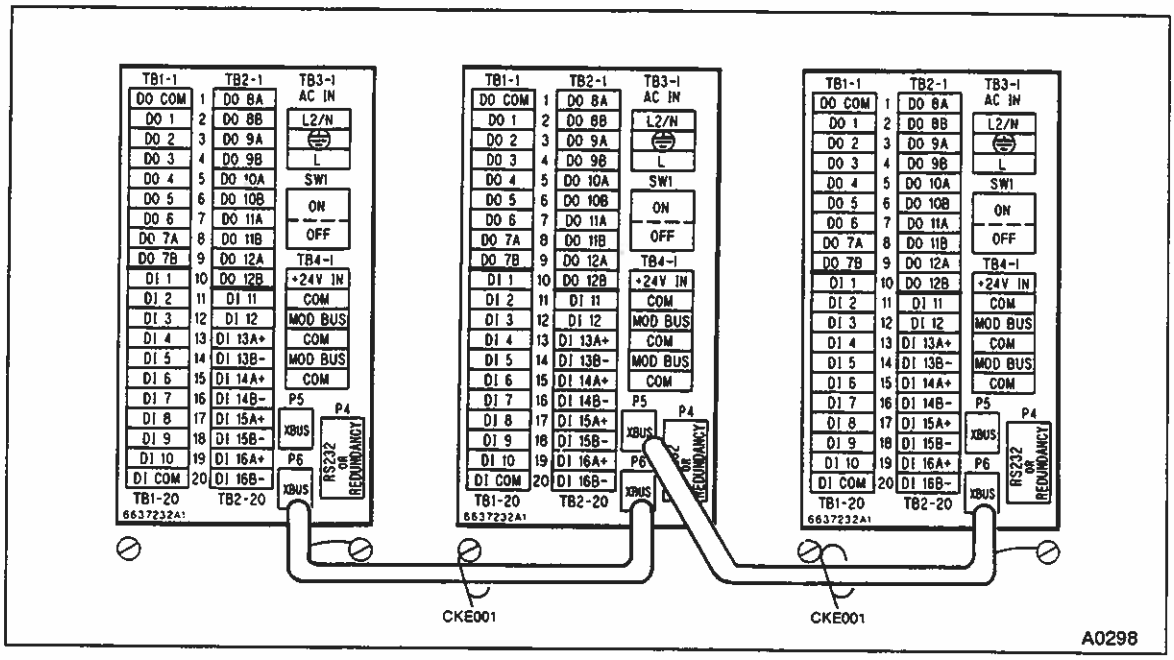


Figure 2-14. Expansion Bus - Connecting Multiple Controllers

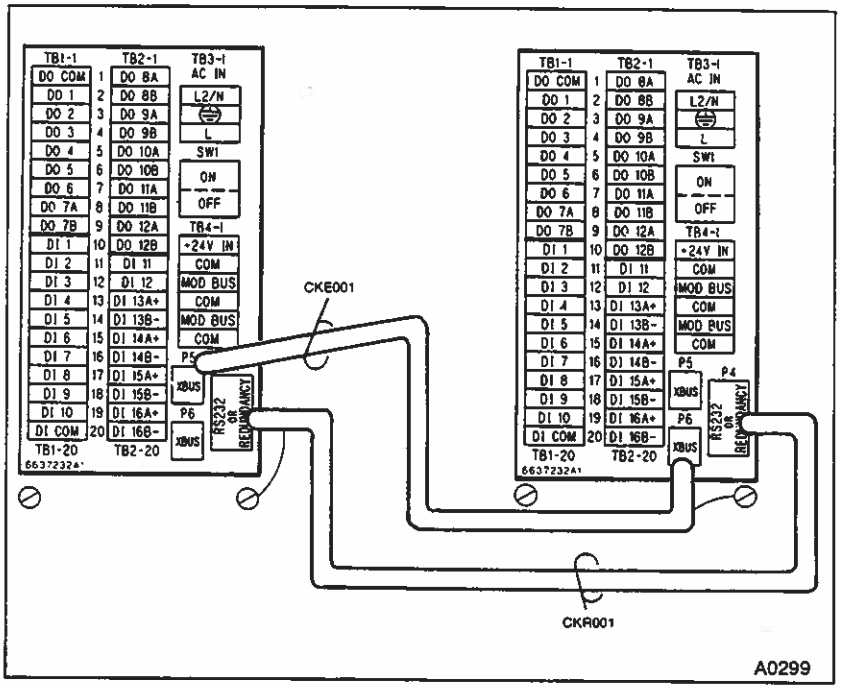
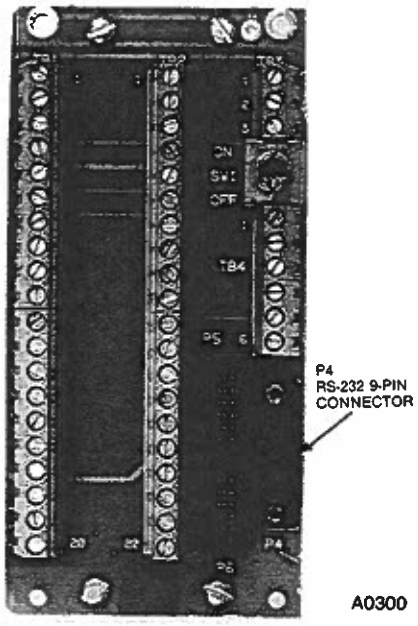


Figure 2-15. Redundancy Link - Connecting Multiple Controllers

Two cables are available which allow the controller to be connected to EIA RS-232 Serial I/O equipment such as a printer. These cables, CKC001-10 (10 ft.) and CKC001-25 (25 ft.) plug into the 9-pin connector, P4, on the termination board (Figure 2-16). The other end of the cable has a 25-pin male connector.



SIGNAL	CSC01 9-PIN CONNECTOR (P4 ON T.U.)	CKC001-CBE 25-PIN CONNECTOR
TXD (Transmit Data)	2	2
RXD (Receive Data)	3	3
RTS (Request to Send)	4	4
CTS (Clear to Send)	5	5
DSR (Data Set Ready)	6	6
SG (Signal Ground)	7	7
DCD (Data Carrier Detected)	8	8
DTR (Data Terminal Ready)	9	20

Figure 2-16. RS-232 Port Connections and Pin Out Designations

Connecting the CBE01 Bus Extender

Four wires are required to connect a CBE01 module bus extender to the Sequence Command Controller: module bus, module bus common, +24 VDC, and common. The +24 VDC power can be obtained for the CBE01 at TB4-1 even if the Sequence Command Controller is not being powered from a +24 VDC power source. Connections between the CBE01 and the Sequence Command Controller are indicated in Figure 2-17.

NOTE: The +24 VDC power available from TB4-1 is not to be used for digital I/O power.

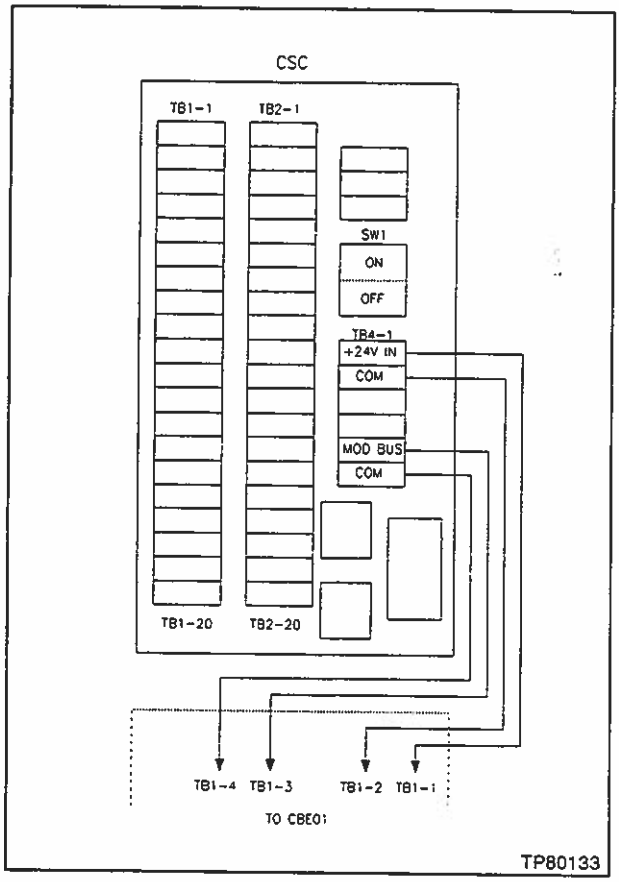


Figure 2-17. Connection of the CBE01 Module Bus Extender to a CSC01 Controller

SAFETY RELATED INFORMATION

Part of the required installation of the CSC01 Controller is the proper selection of 1) hardware output default conditions, and 2) configuration output default conditions. Typically, the hardware and configuration default settings will be identical. However, they must be defined separately. The hardware settings are done through switches on the I/O assembly. The configuration settings are done through the logic defined by function codes within the configuration. These default values must be selected as to provide a process condition that is least likely to cause injury or equipment damage.

WARNING	**The digital outputs change to a fixed value during start-up, operator-selected E-STOP, RESET or STOP, and for various failure conditions.**
AVERTISSEMENT	**Les signaux desortie numeriques prennent une valeur fixe au moment du demarrage, d'un arret E-STOP defini per l'utilisateur, d'une remise a zero ou d'un arret, et lors de certaines pannes.**

Hardware Output Default Settings

The Sequence Command Controller allows the user to define a set of default hardware settings for the digital outputs should some type of failure occur with the CPU board. The outputs will be forced to these hardware settings if communications with the CPU board is lost. This will occur under the following conditions:

1. If the **STOP** or **RESET** button is pressed by the operator.

2. If a fatal error occurs in the controller. A fatal error occurs for all error codes listed in Table 5-1 except for 05 and 06.

3. A process failure occurs for which a trip block (Function Code 32) has been selected by the user. This block, when enabled, forces the CPU in the ERROR mode, at which time the outputs switch to their default settings. This might be specified for critical inputs or interlocks or violations of critical cross-limits.

4. If a hardware failure occurs with the expansion bus (such as CKE001-2 cable being disconnected when additional units are being used as slaves). This case is only applicable when specification S3 of Function Codes 83 (DO Group) and 84 (DI Group) is set to a 0 so the CSC Controller will trip upon loss of communications. Otherwise, if spec S3 is set to a 1, the controller will mark the inputs and outputs as having BAD quality and continue to operate using the last valid values it had for the I/O.

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

The default values for the digital outputs are selected on the manual control board, Table 2-9. The selection is ON, OFF or HOLD LAST VALUE.

Configuration Output Default Settings

These configuration default settings should not be confused with the hardware default settings. Refer to the configuration section, ***Configuration Output Default Settings*** for data required to make the necessary default settings.

Output Values When in the CONFIGURE Mode

When the controller powers up in the CONFIGURE mode, the digital outputs will be driven to the OFF or de-energized state if the output board (Pt. No. 6637163-1) is revision D or greater. When it is transferred to the CONFIGURE mode from the EXECUTE or ERROR modes, the digital outputs hold their last values. These values may be the default values specified by the switch settings indicated in Table 2-9 or, if

the controller was executing a configuration, the last values outputted before transferring to the CONFIGURE mode.

NOTE: The option to hold last value outputted before transferring modes should only be used if the output board is revision D or greater.

Safety Related Inputs

A parameter termed QUALITY is associated with all I/O points in the Command Series 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, loss of communication with the I/O unit, or a signal not getting through from the module bus or plant loop. The normal operation of the Command Series 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. Personal 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. A TEST QUALITY block can be configured to transfer the associated operator manual/auto station to MANUAL, shut down the process or send a warning to an annunciator. Refer to the configuration section, ***Configuring a Test Quality Block for Safety Related Inputs***.

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 Klaxon or other signaling device to notify the operator of alarm conditions.

FACTORY SWITCH SETTINGS

The switches on the CPU, output and manual control boards along with the jumpers on the input board have been preset at the factory. To change the factory settings and customize the controller for your application, refer to the section titled ***SELECTING OPTIONS***. The highlighted or screened switch settings in Tables 2-1 through 2-9 designate the factory settings. A column has been included in each table for you to record the final switch settings.

Removing the Circuit Boards

NOTE: The circuit boards contain MOS devices and are subject to damage by static electricity. Refer to section titled ***Special Handling Procedures for MOS Devices.***

WARNING	**Shock hazard exists. Remove power before extracting or inserting the I/O unit.**
AVERTISSEMENT	**Risque de choc. Assurez-vous d'interrompre l'alimentation avant de retirer ou d'inserer l'unite d'E/S.**

1. Remove power from the controller.

2. At the top of the faceplate is a legend/access door. Part of the door protrudes above the top of the faceplate. Pull the door and swing it to the left to open. A locking screw is located between the **RESET** pushbutton and the **STOP** pushbutton (Figure 2-18).

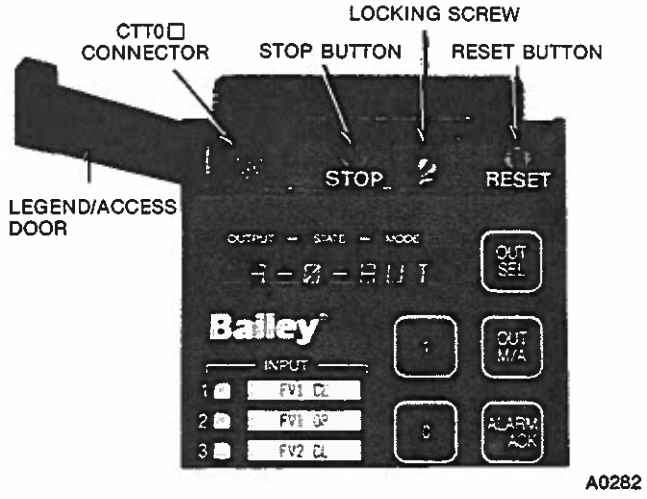


Figure 2-18. Locking Screw Location

3. The locking screw is captive and does not require complete removal. Back off the screw and pull the faceplate/CPU board assembly forward to remove from the housing. Switch settings for the various options available can be made to the CPU board once removed.

4. The input/output assembly consists of the input board, output board, power supply board, manual control board and the power supply mounting bracket. To remove this assembly, insert a screwdriver into the slot from the bottom of the integral tab on the power supply mounting bracket and carefully pry against the case. The entire assembly can be removed from the housing. Once removed, the necessary jumper and switch settings for the various options can be made.

5. Refer to section titled ***SELECTING OPTIONS*** for procedures to check and/or set the necessary switches and jumpers prior to placing the unit in service.

6. Once the switch and/or jumper settings have been made, reassemble the input/output assembly and faceplate/CPU board assembly into the housing.

SELECTING OPTIONS

The options of the Sequence Command Controller allow variations in performance to be selected according to the requirements of a particular application. The switch and jumper settings should be made prior to placing the controller in service. Refer to section titled ***REMOVING AND INSTALLING THE CIRCUIT BOARDS*** for the procedure to gain access to the circuit boards and make the necessary adjustments.

WARNING	**Shock hazard exists. Remove power before extracting or inserting the I/O unit.**
AVERTISSEMENT	**Risque de choc. Assurez-vous d'interrompre l'alimentation avant de retirer ou d'inserer l'unite d'E/S.**

Central Processing Unit (CPU) Board

The various options available and the switch settings required on the CPU board for those options are described in the following sections. Refer to Figure 2-19 for location of the switch settings and to Table 2-6 for a summary of the following described options.

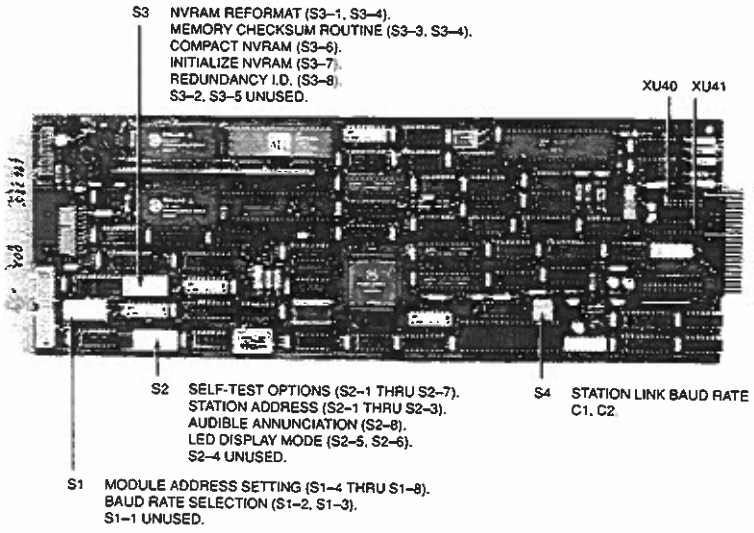


Figure 2-19. CPU Board Switch Settings

MODULE ADDRESS

When using multiple Command Series Controllers or when interfacing with the Bailey INFI 90 or Network 90 system, each controller unit or module must have a unique address assigned for communication purposes. Switch S1, positions 4 through 8 on the CPU board are used to set the module address and are listed in Table 2-1.

Table 2-1. S1 Module Address Settings

Switch S1 Positions[1] CPU Board							
MSB S1-4	S1-5	S1-6	S1-7	LSB S1-8	Address		Customer Setting
					Binary	Decimal	
Closed	Closed	Closed	Closed	Closed	00000	0[2]	
Closed	Closed	Closed	Closed	Open	00001	1[2]	
Closed	Closed	Closed	Open	Closed	00010	2	
Closed	**Closed**	**Closed**	**Open**	**Open**	**00011**	**3[3]**	
Closed	Closed	Open	Closed	Closed	00100	4	
Closed	Closed	Open	Closed	Open	00101	5	
Closed	Closed	Open	Open	Closed	00110	6	
Closed	Closed	Open	Open	Open	00111	7	
Closed	Open	Closed	Closed	Closed	01000	8	
Closed	Open	Closed	Closed	Open	01001	9	
Closed	Open	Closed	Open	Closed	01010	10	
Closed	Open	Closed	Open	Open	01011	11	
Closed	Open	Open	Closed	Closed	01100	12	
Closed	Open	Open	Closed	Open	01101	13	
Closed	Open	Open	Open	Closed	01110	14	
Closed	Open	Open	Open	Open	01111	15	
Open	Closed	Closed	Closed	Closed	10000	16	
Open	Closed	Closed	Closed	Open	10001	17	
Open	Closed	Closed	Open	Closed	10010	18	
Open	Closed	Closed	Open	Open	10011	19	
Open	Closed	Open	Closed	Closed	10100	20	
Open	Closed	Open	Closed	Open	10101	21	
Open	Closed	Open	Open	Closed	10110	22	
Open	Closed	Open	Open	Open	10111	23	
Open	Open	Closed	Closed	Closed	11000	24	
Open	Open	Closed	Closed	Open	11001	25	
Open	Open	Closed	Open	Closed	11010	26	
Open	Open	Closed	Open	Open	11011	27	
Open	Open	Open	Closed	Closed	11100	28	
Open	Open	Open	Closed	Open	11101	29	
Open	Open	Open	Open	Closed	11110	30	
Open	Open	Open	Open	Open	11111	31[4]	

NOTES:
1. OFF = OPEN; ON = CLOSED
2. Reserved for communications pair.
3. Shaded information indicates factory setting.
4. Recommended for CTT0□ Configuration and Tuning Terminal

RS-232 LINK BAUD RATE SETTING

When using the RS-232 link to interface with a device such as a printer, a baud rate at which the data is transmitted must be selected. Switch S1, positions 2 and 3 on the CPU board can be used to set one of the following baud rates: 300, 1200, 2400 or 9600. Refer to Table 2-6 for a listing of the switch settings which correspond to the baud rates.

SELF-TEST OPTION

Note switch positions prior to changing switches for self-test. The six tests described in the following paragraphs can be used for troubleshooting or general checkout of the CPU board and faceplate. By closing switch S2-7, the CPU board goes into the self-test mode and switch S2, positions 1 through 6, can be used to select the desired test. When switch S2-7 is open, switch bank S2 has its normal function of being the faceplate option switches. Refer to Table 2-2 for the self-test option settings and Figure 2-19 for location of the switches.

1. Display Test Option - This test is part of the self-test option and is not normally selected. By closing switches S2-7 and S2-1 on the CPU board and powering up the unit, the test will begin.

   a. The alphanumeric display will show an @ in all eight positions. The display will then start to sequence through the alphabet displaying the letters on all eight positions simultaneously.

   b. The indicating LED's will be RED and turned on in banks of four starting at the top of the input column and cycling through that column and the output column. Once the last four LED's are lit on the output column, all the LED's will turn on and then off. Then the same sequence starts again with the LED's being GREEN.

   c. The alphanumerics will continue through the alphabet, graphic characters and numbers using all eight positions simultaneously. Once complete, it will cycle an asterisk across from left to right and start the sequence again.

   d. The alarm LED will start blinking and the buzzer will start beeping. If the **ALARM ACK** key on the faceplate is pressed, the alarm LED goes solid and the audible alarm stops.

To end the test, power down the controller and open switches S2-7 and S2-1 on the CPU board. If problems are encountered and the faceplate does not pass this test, refer to the Troubleshooting Flow Chart, Figure 5-1, for further action to be taken.

1a. Display Intensity Adjustment - This adjustment can only be done when the controller is in the ***Display Test Option*** mode. The brightness of the alphanumeric display may be adjusted for optimum viewing intensity. Normally, the intensity is preset at the factory, but it may be changed at any time by the user. Once the controller is in the Display Test Option mode, proceed as follows:

a. To increase intensity, press the **1** key on the faceplate. Holding this pushbutton will ramp up the intensity to full brightness.

b. To decrease intensity, press the **0** key on the faceplate. Holding this pushbutton will ramp down the intensity to minimum brightness.

NOTES:

1. The other indicating LED's have a fixed intensity. No adjustment is permitted. The display's intensity level is stored in NVRAM and must be reset if the NVRAM's are replaced or reformatted.

2. This display intensity adjustment is only functional in Sequence Command Controllers which have an eight-character dot matrix display. Some of the early production models do not support this option.

2. Module Bus Communications Test - This option is not normally selected. By disconnecting any external module bus connections and closing S2-7 and S2-2, the module bus communications on the CPU board are tested when the board is powered up. If the test is successful, the alphanumeric display shows *MBUS OK*. If the test fails, the display shows *MBUS BAD* which indicates circuitry failure on the CPU board and board replacement is necessary. To end the test, power down the unit and open S2-7 and S2-2.

3. Station Link Communications Test - This test is part of the self-test option and is normally disabled. To test the station link communications on the CPU board, close switch S2-7 and S2-3 and disconnect cables from P5 and P6 on the termination board. If the test is successful, the alphanumeric display on the faceplate will show *STLK OK*. An *STLK BAD* display indicates that the test has failed and the circuitry on the CPU board has failed and the board must be replaced. To end this test, power down the controller and open S2-7 and S2-3.

4. Memory Test - This test is another part of the self-test option and is normally disabled. To perform a RAM test and a checksum of the EPROM and NVRAM, close switches S2-7 and S2-4. During the running of these test, the faceplate's alphanumeric display will show *MEM TEST*. If the RAM test passes and the checksums are correct, the display will show *MEM OK*. If not, the display will show *NVR BAD* (NVRAM

BAD), *ROM BAD* (UVPROM BAD) or *RAM BAD* to indicate which memory device failed the test. Replace the CPU board if any of these components fail. Power down the controller and open S2-7 and S2-4 to end the test.

WARNING	**The following test causes the digital outputs to change state. Field devices driven by the outputs must be disabled or disconnected before running this test.**
AVERTISSEMENT	**Les tests suivants provoquent un changement d'etat des sorties numeriques. Les appareils en chantier qui sont commandes par ces sorties doivent etre mis hors fonction ou debranches avant que ces tests ne soient executes.**

5. Expansion Bus/Bypass Bus Communications Test - This test is normally disabled since it is part of the self test option. By closing S2-7 and S2-5 and having a dipshunt in socket XU47, the communications on the expansion bus and the bypass bus of the CPU board are checked. If the communication is good, the faceplate's alphanumeric display will read *EXB OK*. If the test fails, the display will show *EXB BAD*. Refer to the repair/replacement section. Replace the output board and redo test. If failure still occurs, replace the CPU board. To end this test, power down the controller and open S2-7 and S2-5.

6. Keyboard Test - This test is normally disabled. To test the keyboard on the faceplate, close switches S2-7 and S2-6. Power up the controller and depress each pushbutton on the faceplate. On power up, the alphanumeric display will show *KB TEST*. If the keyboard is operational, the alphanumeric display will show the following messages which correspond to the pushbutton depressed: *OUT SEL*, *OUT M/A*, *ALM ACK*, *1* and *0*. If a pushbutton is depressed and the keyboard or CPU board is not functional, the alphanumeric display will not be affected. If this happens, check and reseat the cables connecting the faceplate to the CPU board. Run another self test (e.g., display test) to determine if the CPU board is at fault. If the test passes, replace the faceplate. If it does not pass, replace the CPU board. To end this test, power down the unit and open switches S2-7 and S2-6.

Table 2-2. Summary of Self-Test Option Settings

S2 Switch Positions CPU Board								
S2-1	S2-2	S2-3	S2-4	S2-5	S2-6	S2-7	S2-8	Option Description
Closed	Open	Open	Open	Open	Open	Closed	Open	DISPLAY TEST - Controller front display will sequence through a group of initial test displays.
Open	Closed	Open	Open	Open	Open	Closed	Open	MODULE BUS COMMUNICATIONS TEST - Controller runs a routine which verifies communications on the CPU board's module bus hardware.
Open	Open	Closed	Open	Open	Open	Closed	Open	STATION LINK COMMUNICATIONS TEST - Controller runs a routine which verifies communications on the CPU board's station link hardware.
Open	Open	Open	Closed	Open	Open	Closed	Open	MEMORY TEST - Controller runs a RAM test and checksum test of the NVRAM and EPROM.
Open	Open	Open	Open	Closed	Open	Closed	Open	EXPANSION BUS/BYPASS COMMUNICATIONS TEST -Controller runs a routine which verifies communications on the unit's expansion bus and bypass bus hardware.
Open	Open	Open	Open	Open	Closed	Closed	Open	KEYBOARD TEST - By depressing faceplate pushbuttons, the Controller verifies keyboard operation.
X	X	X	X	X	X	Open	X	**ALL SELF-TEST OPTIONS DISABLED. Switch S2 functions normally. X = Return to desired settings. Refer to Tables 2-3 and 2-6.**

NOTES:
Shaded information indicates factory switch settings.
Open = OFF Closed - ON

STATION ADDRESS

When using multiple Command Series Controllers, each Controller must have a unique station address assigned to its faceplate for communication purposes. Switch S2, positions 1 through 3 on the CPU board are used to set the station address. Table 2-3 lists the switch settings and addresses and Figure 2-19 shows the location of the switches.

DISPLAY LED COLOR DEFINITION

The 28 indicating LED's on the faceplate can be configured for either RED indicating an ***OFF*** (Logic 0) status of the I/O and GREEN indicating ***ON*** (Logic 1), or vice versa. To select RED to indicate ***ON***, open switch S2-5.

Table 2-3. S2 Station Address Settings

Switch S2 Positions CPU Board			Address		
MSB S2-3	S2-2	LSB S2-1	Binary	Decimal	Customer Setting
Closed	**Closed**	**Closed**	**0000**	**0**	
Closed	Closed	Open	0001	1	
Closed	Open	Closed	0010	2	
Closed	Open	Open	0011	3	
Open	Closed	Closed	0100	4	
Open	Closed	Open	0101	5	
Open	Open	Closed	0110	6	
Open	Open	Open	0111	7	

NOTE: Shaded information indicates factory switch settings.

DISPLAY LED BICOLOR OR MONOCOLOR SELECT

When S2-6 is open, bicolor is selected. When in the bicolor mode, the I/O LED's use one of the two colors (RED or GREEN) to indicate a logic high state and the other color to indicate a logic low state. The colors are set using switch S2-5 described in the previous paragraph, ***Display LED Color Definition***. Refer also to Table 2-4, Bicolor Operation.

When S2-6 is closed, monocolor mode is selected. When in the monocolor mode, the I/O LED's use one of the two colors (RED or GREEN) to indicate a logic high state and an LED OFF (not lit) to indicate a logic low state. The color used is set with S2-5 described in the ***Display LED Color Definition*** paragraph. Refer also to Table 2-5, Monocolor Operation.

Table 2-4. Bicolor Operation

Switch S2-6 Position	Switch S2-5 Position	Logic 1 Color	Logic 0 Color	Flashing Alarm Colors per I/O State		Customer Setting
				Logic 1	Logic 0	
Open	Closed	Green	Red	Green	Red	
Open	Open	Red	Green	Red	Green	

Table 2-5. Monocolor Operation

Switch S2-6 Position	Switch S2-5 Position	Logic 1 Color	Logic 0 Color	Flashing Alarm Colors per I/O State		Customer Setting
				Logic 1	Logic 0	
Closed	Closed	Green	Off	Green	Red	
Closed	Open	Red	Off	Red	Green	

AUDIBLE ANNUNCIATION OPTION

The controller has a transducer that provides audible annunciation whenever an alarm condition exists. When an alarm condition becomes active, the transducer will beep until the alarm is acknowledged using the **ALARM ACK** pushbutton. The beeping can be disabled by placing S2-8 on the CPU board in the closed position. If in the open position, the transducer will beep whenever an alarm condition becomes active.

REFORMAT NVRAM OPTION

After the controller has been installed, wired and is operational, this option is only used to recover the controller when an NVRAM checksum error is detected. These switches are normally closed. Refer to Table 2-6 and the ***NVRAM Reformat Procedure*** described in the troubleshooting section.

MEMORY CHECKSUM ROUTINE OPTION

Switches S3-3 and S3-4 on the CPU board are used if the controller is to perform checksum routines for the NVRAM and the EPROM. These switches are normally closed (the controller normally performs checksum routines). Setting either of these switches in the open position prevents the controller from performing the associated checksums. (For engineering use.)

COMPACT NVRAM CONFIGURATION OPTION

This option ***compacts*** the configuration in the NVRAM by moving the configured function blocks to the top of the NVRAM and the unused memory (free space) to the bottom of the NVRAM. To use this option, open switch S3-6 on the CPU board and power the unit up. After a short run period, the controller's faceplate display will change from *COMPACT* to *CONFIGURE*. The controller will go into the CONFIGURE mode upon power up and will compact the configuration data as it is entered. This is useful if a large number of configuration changes have been made. It frees up more NVRAM space and improves execution speed.

INITIALIZE NVRAM OPTION

NOTE: Any existing configuration will be lost once the NVRAM is initialized.

To initialize the NVRAM for configuration, set switch S3-7 on the CPU board in the open position.

Apply power to the unit. It will run for a short period and then the controller's faceplate display will change from *INITIAL* to *READY*. Remove power and close switch S3-7. With the switch in the closed position, the controller is in normal

operating mode and it will go into CONFIGURE mode on power up.

NOTE: This switch remains closed for normal operation.

REDUNDANCY IDENTIFICATION OPTION

This switch defines the primary controller in redundancy configuration. When switch S3-8 is closed, it signifies the primary (master) controller. When S3-8 is open, it signifies the backup (redundant) controller.

STATION LINK BAUD RATE OPTION

When Command Series Controllers are used as slave and/or Network 90/INFI 90 Stations are connected on the station link, one of two different baud rates at which the data is transmitted must be chosen. Switch S4, positions C1 and C2, on the CPU board can be used to select either a baud rate of 5,000 or 40,000. Refer to Table 2-6 for baud rate switch setting options. All stations must be set at the same baud rate.

NOTE: Early production units of the Sequence Command Controller and all Network 90 digital control stations (NDCS03 and earlier) and digital indicator stations (NDIS02 and earlier) operate only at the lower baud rate of 5,000. The Sequence Command Controllers with switch S4 located on the CPU board and future INFI 90 stations will operate at both baud rates.

RS-232 PORT/REDUNDANCY LINK OPTION

The controller can be configured for either an RS-232 port or a redundancy link, but not both. If redundancy is required, a dipshunt should be placed in socket XU41. All contacts should remain intact (unbroken). If the RS-232 port is needed, the dipshunt should be placed in socket XU40 with all contacts unbroken. Dipshunts cannot be placed in both sockets or an error will occur. See Figure 2-19 for location of these sockets.

MASTER/SLAVE OPTION

When applications require more digital I/O than can be provided by a single controller, three additional Sequence Command Controllers can be used as I/O slave units. If a controller is used as a slave unit, the CPU board must be disabled from controlling its I/O. A socket, XU47, along with a dipshunt provides the master/slave selection. When a dipshunt is placed in the socket, the controller acts as a master. When the dipshunt is removed, the control of the unit's I/O is disabled and it acts as a slave unit.

Table 2-6. CPU Board Summary of Option Settings

Option	Control	Setting	Description	Customer Setting
Module Bus Address	Refer to Table 2-1 for description.			
Self-Test	Refer to Table 2-2 for description.			
Station Address	Refer to Table 2-3 for description.			
Unused	S1-1	— — —		
RS-232 Port Baud Rate Selection	**S1-2 S1-3**	**Closed Closed**	**300 Baud**	
	S1-2 S1-3	Open Closed	1200 Baud	
	S1-2 S1-3	Closed Open	2400 Baud	
	S1-2 S1-3	Open Open	9600 Baud	
Unused	S2-4	— — —		
Display LED Color Definition	**S2-5**	**Closed**	**Faceplate indicating LED's are GREEN for ON condition of I/O.**	
		Open	Faceplate indicating LED's are RED for ON condition of I/O.	
Display LED Bi-color or Monocolor Select	**S2-6**	**Open**	**Faceplate indicating LED's are bicolor for I/O status.**	
		Closed	Faceplate indicating LED's are monocolor for I/O status.	
Audible Annunciator	**S2-8**	**Open**	**Audible annunciation (beep) present when alarm condition exists.**	
		Closed	Disables audible annunciator (beep).	
NVRAM Reformat	**S3-1 S3-4**	**Closed Closed**	**NVRAM reformat disabled.**	
	S3-1 S3-4	Open Open	NVRAM reformat enabled.	
Memory Checksum Routine	**S3-3 S3-4**	**Closed Closed**	**NVRAM checksum test enabled. EPROM checksum test enabled.**	
	S3-3 S3-4	Open Open	NVRAM checksum test disabled. EPROM checksum test disabled.	
Unused	S3-2, S3-5	— — — —		
Compact NVRAM Configuration	**S3-6**	**Closed**	**Normally does not compact configuration in NVRAM.**	
		Open	Enables compact feature (**NOTE:** Must close switch before entering CONFIGURATION mode.)	

Table 2-6. CPU Board Summary of Option Settings (continued)

Option	Control	Setting	Description	Customer Setting
Initialize NVRAM	**S3-7**	**Closed**	**Normal operation of NVRAM.**	
		Open	Initializes NVRAM (**NOTE:** Must close switch before entering CONFIGURATION mode).	
Redundancy I.D.	**S3-8**	**Closed**	**Controller acts as a primary unit.**	
		Open	Controller acts as a backup unit.	
Station Link Baud Rate Selection	**S4**	**C1**	**5000 Baud**	
	S4	C2	40,000 Baud	
[1]RS-232 Port or Redundancy Link	**XU40 socket**	**Dipshunt installed**	**All contacts unbroken.**	
	XU41 socket	Dipshunt installed	All contacts unbroken.	
Master/Slave	**XU47 socket**	**Dipshunt installed**	**All contacts unbroken. Controller acts as Master unit, controlling I/O on expansion bus and faceplates (stations) on the station link.**	
		Dipshunt not installed	Controller acts as Slave with no direct control over its I/O or faceplate.	

NOTES: (Shaded information indicates factory switch settings. Off = Open On = Closed)
1. Controller can be configured for either an RS-232 port or redundancy link, but not both.

Input Board

Refer to section ***Removing the Circuit Boards***. The only settings on the input board are five jumpers which select either DC or AC operation for the inputs. See Figure 2-20 for location of the jumpers and Table 2-7 for the option settings.

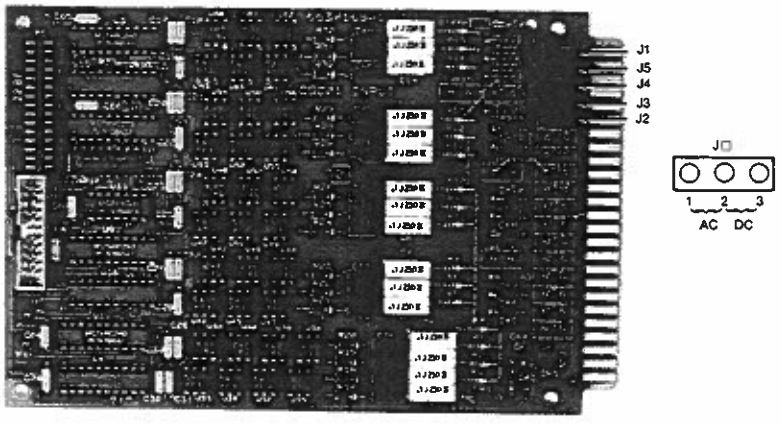


Figure 2-20. Input Board Jumper Settings

Table 2-7. Input Board Summary of Option Settings

Jumper	Position	Description	Customer Setting
J1	**1-2**	**Configures DI1-DI12 for 120 VAC operation.**	
	2-3	Configures isolated digital inputs 1 through 12 (DI1-DI12) for DC operation.	
J2	**1-2**	**Configures DI13 for 120 VAC operation.**	
	2-3	Configures isolated digital input 13 (DI13) for DC operation.	
J3	**1-2**	**Configures DI14 for 120 VAC operation.**	
	2-3	Configures isolated digital input 14 (DI14) for DC operation.	
J4	**1-2**	**Configures DI15 for 120 VAC operation.**	
	2-3	Configures isolated digital input 15 (DI15) for DC operation.	
J5	**1-2**	**Configures DI16 for 120 VAC operation.**	
	2-3	Configures isolated digital input 16 (DI16) for DC operation.	

NOTE: Shaded information indicates factory jumper settings.

Output Board

Refer to ***Removing the Circuit Boards***. Once the output board is removed, the following options can then be set.

Input/Output Address Selection

Each controller must have its own unique addresses assigned to the input and output boards for I/O communication purposes. Switch S1, position 1 through 4, on the output board is used to set the address for both the input and output boards. Since one switch is used to assign both addresses, one bit of the address is preset via hardware for each board. The input board is set such that it always has an even address and the output board is set so it always has an odd address. Valid addresses for these boards are 2/3 through 30/31. Addresses 0 and 1 are invalid; therefore, at least one switch position should always be open. See Figure 2-21 for the location of the switch and Table 2-8 for switch settings and corresponding addresses.

NOTE: The higher the address for the I/O boards, the higher priority the boards have as far as being serviced by the controller. Addresses 00 and 01 are reserved. Therefore, addresses 02 and 03 would have the lowest priority; 30 and 31 would have the highest priority.

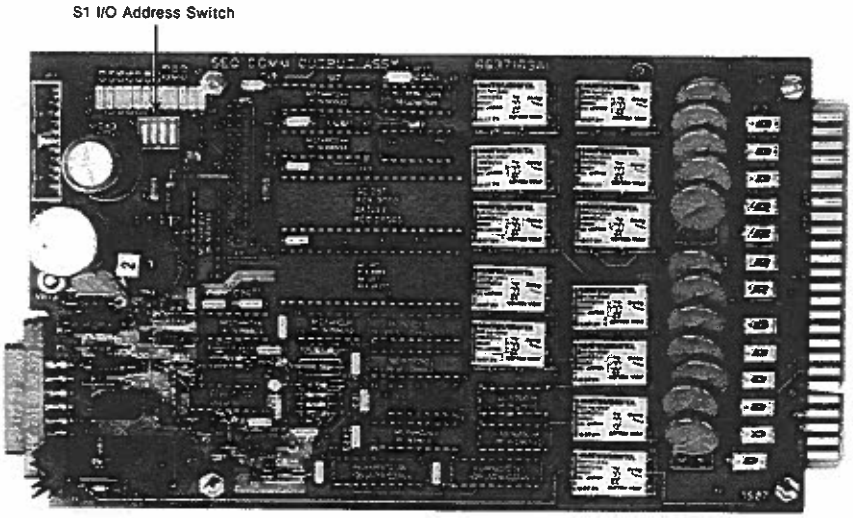


Figure 2-21. Output Board Switch Settings

Table 2-8. Output Board I/O Address Switch Settings

Switch S1 Settings				I/O Addresses		
S1-4	S1-3	S1-2	S1-1	Input Board	Output Board	Customer Setting
C	C	C	C	0[1]	1[1]	
C	C	C	O	2	3	
C	C	O	C	4	5	
C	C	O	O	6	7	
C	O	C	C	8	9	
C	O	C	O	10	11	
C	O	O	C	12	13	
C	O	O	O	14	15	
O	C	C	C	16	17	
O	C	C	O	18	19	
O	C	O	C	20	21	
O	C	O	O	22	23	
O	O	C	C	24	25	
O	O	C	O	26	27	
O	O	O	C	28	29	
O	O	O	O	30	31	

NOTES: (Shaded information indicates factory switch settings. C = Closed O = Open)
1. This address is not to be used - invalid.

Manual Control Board

The manual control board is mounted on the power supply mounting bracket and is accessible by removing the face-plate/CPU board assembly. This board has two functions. The first is to permit the user to have manual control of the digital outputs when the CPU board is removed. The second is to allow the user to set up certain default states that the outputs would go to if there is a loss of communications with the CPU board.

WARNING	**The CSC01 is factory programmed to trip the outputs to the OFF or de-energized state during the initialization period and when internal errors are detected that create a loss of communications with the CPU board. In some applications, energized outputs could create a situation that could cause personal injury, equipment damage or damage to the product. Make certain these manual control board switches are properly set to the state that will least likely cause injury or damage upon loss of communications.**
AVERTISSEMENT	**Le poste CSC01 est programme en usine pour declencher ses sorties numbriques a l'etat zero ou etat desoncite (de-energized) durant la periende d'initialization, de meme lorsque des erreurs internes sont detectees qui causant une perte de communication avec le circuit du CPU. Dans certaines applications, des porties excitees pourraient creer une situation causant des blessures corporelles, des dommanges a l'equipement ou des dommages au produit. Veuillez vour assurer que les interrupteurs manuels du circuit imprime sont places un position la moins susceptible de causer des blessures ou des dommages lors d'une perte de communication.**

When S2-1 is CLOSED, the outputs can be manually controlled by opening or closing the corresponding S1 switch position on the manual control board. Most applications have the OFF or de-energized state as the least likely to cause injury or damage upon loss of communications. If the ON state is the least likely to cause injury or damage, set the appropriate S1 switch to the CLOSED position. See Figure 2-22 for the location of these switches. Table 2-9 lists the switches and their functions.

NOTE: If the output board (Part No. 6637163-1) is a revision D or greater, then the option for the digital outputs to hold their last value upon communications failure may be chosen by opening switch S2-1. This option should only be used if this condition is the least likely to cause damage or injury upon a loss of communications.

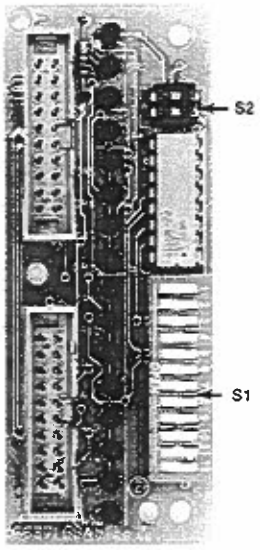


Figure 2-22. Manual Control Board Switch Settings

Table 2-9. Manual Control Board Summary of Switch Settings

Option	Control	Setting	Description	Customer Setting
Digital Output Manual Control Select	S2-1	Open	Outputs hold last value upon CPU failure or removal.	
		Closed	**Outputs can be controlled by default switches (S1) upon CPU failure or removal.**	
Unused	S2-2	— — —		
Digital Output Control (with S2-1 CLOSED)	**S1-1**	**Open**	**Digital Output 1 is OFF.**	
	S1-1	Closed	Digital Output 1 is ON.	
	S1-2	**Open**	**Digital Output 2 is OFF.**	
	S1-2	Closed	Digital Output 2 is ON.	
	S1-3	**Open**	**Digital Output 3 is OFF.**	
	S1-3	Closed	Digital Output 3 is ON.	
	S1-4	**Open**	**Digital Output 4 is OFF.**	
	S1-4	Closed	Digital Output 4 is ON.	
	S1-5	**Open**	**Digital Output 5 is OFF.**	
	S1-5	Closed	Digital Output 5 is ON.	
	S1-6	**Open**	**Digital Output 6 is OFF.**	
	S1-6	Closed	Digital Output 6 is ON.	
	S1-7	**Open**	**Digital Output 7 is OFF.**	
	S1-7	Closed	Digital Output 7 is ON.	
	S1-8	**Open**	**Digital Output 8 is OFF.**	
	S1-8	Closed	Digital Output 8 is ON.	
	S1-9	**Open**	**Digital Output 9 is OFF.**	
	S1-9	Closed	Digital Output 9 is ON.	

Table 2-9. Manual Control Board Summary of Switch Settings (continued)

Option	Control	Setting	Description	Customer Setting
	S1-10	**Open**	**Digital Output 10 is OFF.**	
	S1-10	Closed	Digital Output 10 is ON.	
	S1-11	**Open**	**Digital Output 11 is OFF.**	
	S1-11	Closed	Digital Output 11 is ON.	
	S1-12	**Open**	**Digital Output 12 is OFF.**	
	S1-12	Closed	Digital Output 12 is ON.	

NOTES: Shaded information indicates factory settings. Off = Open On = Closed

SECTION 3 – CONFIGURATION

INTRODUCTION

This section provides the required user actions to establish and define the Sequence Command Controller's configuration. It provides the user with information on block addresses, function codes and specification lists and control input security. Pre-configuration data required, the procedures for converting the initial data into a configuration and the NVRAM initialization procedure are also described.

NVRAM CONFIGURATION

The user must perform the following sequence on a new unconfigured controller prior to configuration. The NVRAM (Non-Volatile Random Access Memory) holds the user's configuration data (Function Blocks). This type of memory is used because it can be written to electrically, but will retain data in the event of a power failure.

NOTE: THIS PROCEDURE ERASES ANY EXISTING CONFIGURATION DATA.

1. If the power to the controller is on, remove the power. Open the legend/access door on the target unit. Loosen the locking screw.

2. Pull the faceplate forward to gain access to the CPU board adjustments.

3. Set DIP Switch S3-7 on the CPU board to the OFF (open) position (Figure 3-1).

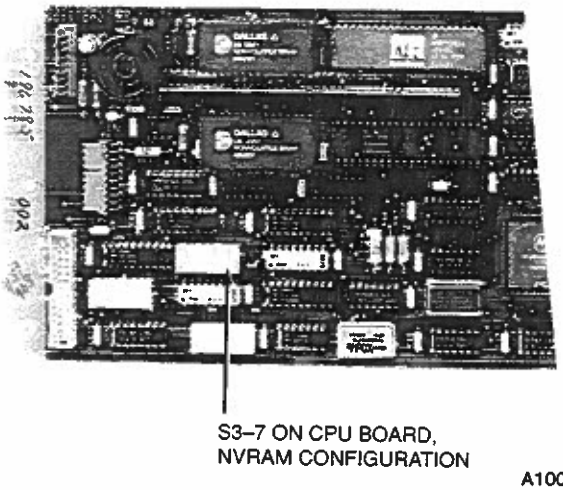


Figure 3-1. NVRAM Configuration Switch S3

4. Reinsert the CPU board into the controller. Power up and allow the controller to initialize for up to 60 seconds. The faceplate will change from ***INITIAL*** to ***READY*** when the initialization is complete.

5. Power down and remove the CPU board from the controller.

6. Set DIP switch S3-7 to the ON (closed) position.

7. Reinsert the CPU board into the controller. Push the faceplate back and tighten the locking screw.

8. Power up the controller and proceed with the configuration functions.

To enter the configuration, the CTT handheld Configuration and Tuning Terminal is generally used, although other Bailey devices can be used. Refer to instruction I-E92-501-1 (CTT01) or I-E92-501-2 (CTT□2) for detailed information on entry procedures.

GENERAL

As part of the Command Series line of control products, the Sequence Command Controller enables an operator to monitor and control a process either automatically or manually. The faceplate area of the controller allows for operator interface to the process; while the CPU board allows the user's control configuration to be programmed and stored. 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 CPU board communicates with the I/O assembly and displays information such as digital I/O logic states and sequencer status.

The process of defining controller operations with function blocks is called configuration. To configure a function block, you must define the following parameters:

1. Block Address.
2. Function Code.
3. Specification List.

The CTT Configuration and Tuning Terminal allows the user to enter and define these parameters. With the CTT, the user can ADD a function block to the controller, MODIFY a function block that is currently defined, or DELETE a function block. The controller stores the configuration in the NVRAM.

The Sequence Command Controller can be operated in two modes, ***CONFIGURE*** and ***EXECUTE***. The controller must be in the ***CONFIGURE*** mode for the user 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.

Assigning Block Addresses

The Sequence Command 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. That 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.

FUNCTION CODES

Table 3-5 lists the function codes available in the Sequence Command Controller. Bailey Controls ***Function Code Application Manual, I-E93-900-20***, provides the specification tables, block output definitions, and a detailed explanation of the operation of each function code.

SPECIFICATION LIST

The specification (spec) list for each function code includes the inputs and parameters needed to implement the function. The specs 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. The user may change these values as needed for the particular application. Any spec not modified by the user will remain at its initial (default) value.

Each spec in the function code is identified as being tunable or non-tunable. A tunable spec may be changed either when

the controller is being configured or while it is in the ***EXECUTE*** mode. This latter adjustment can be made using the TUNE function of the CTT or when using adaptive control functions (Function Code 24). A spec identified as non-tunable can only be changed when the controller is in the ***CONFIGURE*** mode.

FUNCTION BLOCKS

The Sequence Command Controller has two types of function blocks; fixed and user-defined.

Fixed Blocks

The fixed blocks consist of System Constant Blocks and Executive Blocks. The fixed blocks are values and module characteristics that cannot be changed.

SYSTEM CONSTANT BLOCKS

Blocks 0 through 9 are constant values. These blocks contain analog and digital values that can be used as inputs to other blocks anywhere in the configuration. These blocks have fixed addresses (that is, the user cannot assign an address to them). Refer to Table 3-1 for a system constant block summary.

Table 3-1. System Constant Block Summary

Block Number	Description	Output
0	CSC01 Executive Block (F.C. 175)	Logic 0.
1		Logic 1.
2		Logic 0, or Real 0.0.
3		Real -100.0.
4		Real -1.0.
5		Real 0.0.
6		Real 1.0.
7		Real 100.0.
8		-9 x 10E18 (maximum negative value).
9		9 x 10E18 (maximum positive value).
10		Start-up in process (0 = no; 1 = yes).
11		Unused.
12		System free time in %.
13		Firmware revision level.
14		Reserved.
15	CSC Segment Control Block (F.C. 82)	Task 1 elapsed time of previous cycle (seconds or minutes).
16		Task 1 elapsed time of current cycle (seconds or minutes).
17		Task 1 processor utilization %.
18		Task 1 checkpoint overrun count.
19		Task 1 cycle time overrun (seconds or minutes).

Table 3-1. System Constant Block Summary (continued)

Block Number	Description	Output
20	CSC Extended Executive Block (F.C. 90)	Time of day (hours).
21		Time of day (minutes).
22		Time of day (seconds).
23		Time sync flag: 0 = Time/date invalid. 1 = Time/day valid.
24		Calendar year (0-99).
25		Calendar month (1-12).
26		Calendar day (1-31).
27		Calendar day of week: 1 = Sunday. 7 = Saturday.
28		Reserved.
29		Reserved.

EXECUTIVE BLOCKS

These blocks are fixed blocks also. They are responsible for overall module execution and operations. These blocks control the scan rate and priority, and operating characteristics of the Sequence Command Controller. Function Codes 175, 82 and 90 are executive block functions.

Function Code 175

This function resides at block 0 and occupies the next 14 consecutive blocks. It is used to control the RS-232 port operation and contains EASY STEP configuration parameters. The following specifications apply.

Table 3-2. Function Code 175 Specifications

Spec No.	Tune[1]	Default Value	Data Type	Range Min.	Range Max.	Description
S1	Yes	0	Boolean	0	1	1 = Exception report data sent to RS-232 port in EXECUTE mode. 0 = Disables exception report logging via the RS-232 port.
S2	No	0	Int (2)	0	3	EASY STEP status. 0 = EASY STEP not invoked. 1 = EASY STEP invoked. 3 = EASY STEP invoked and AUTO RESTORE chosen.
S3[2]	No	0	Int (2)	0	32	EASY STEP configuration number of steps.
S4	No	0	Int (2)	0	64	EASY STEP configuration number of inputs.
S5	No	0	Int (2)	0	48	EASY STEP configuration number of outputs.

Table 3-2. Function Code 175 Specifications (continued)

Spec No.	Tune[1]	Default Value	Data Type	Range Min. Max.	Description
S6	Yes	0.000	Real (3)	Full	Unused.
S7	Yes	0.000	Real (3)	Full	Unused.
S8	Yes	0	Int (2)	Full	Unused.

NOTES: Utilization Factors: NVRAM = 56; CSC RAM = 20
1. Tune means that these specifications can be altered during execution.
2. To use the START XX function during the step select procedure, refer to section ***RUN, HOLD, RESTART, START and E-STOP***. Spec S3 at block address 0 must be set equal to the number of steps in the application. (This is set automatically if EASY STEP PLUS is used to develop the configuration.) The START XX function can be locked out by setting Spec S3 in Function Code 175 equal to 0.

Function Code 82 (Segment Control Block)

This function resides at block 15 and occupies the next four consecutive blocks. This function groups blocks into a scan cycle that is executed at the user-specified rate and priority. This block can be used elsewhere in the configuration as well. A maximum of eight segment blocks can be configured into one CSC01. The following specifications apply.

Table 3-3. Function Code 82 Specifications

Spec. No.	Tune	Default Value	Data Type	Range Min. Max.	Description
S1	No	1	Int(2)	1 to 2	Time units of segment period: 1 = Seconds. 2 = Minutes.
S2	Yes	0.250	Real(3)	Full	Target period (seconds/minutes).
S3	No	0	Int(2)	0 to 32,767	Segment priority (0 = lowest).
S4	No	1	Int(2)	0 to 32,767	Checkpoint period (number of cycles per checkpoint).
S5	No	0	Int(1)	0 to 1	Not applicable.
S6	No	10.000	Real(3)	Full	Not applicable.
S7	No	1.000	Real(3)	0.0 to 9.2E18	Minimum report time for all exception reports in this segment (in seconds).
S8	No	60.000	Real(3)	0.0 to 9.2E18	Maximum report time for all exception reports in this segment (in seconds).
S9	No	2.000	Real(3)	0.0 to 9.2E18	Not applicable.
S10	No	1.000	Real(3)	0.0 to 9.2E18	Not applicable.
S11	No	1.000	Real(3)	0.0 to 9.2E18	Not applicable.
S12	No	0.0	Real(3)	Full	Reserved.
S13	No	1.000	Real(3)	0.0 to 9.2E18	Module Bus I/O period for this period (seconds). This should be a multiple of the Extended CSC01 Executive Block 20, Spec. 2.

Table 3-3. Function Code 82 Specifications (continued)

Spec. No.	Tune	Default Value	Data Type	Range Min. Max.	Description
S14	Yes	9.2E18	Real (3)	0.0 to 9.2E18	Segment cycle time alarm limit (in seconds).
S15	No	0.0	Int (2)	0 to 1	Block sequencing mode: 0 = No auto sequencing. 1 = Auto sequencing.

Function Code 90 (Extended Executive)

This function is used to select CSC01 operating characteristics such as poll rate, start-up time, etc. It has a fixed block address of Block 20 and occupies the next nine consecutive blocks.

Table 3-4. Function Code 90 Specifications

Spec. No.	Tune	Default Value	Data Type	Range Min. Max.	Description
S1	No	0	Int(2)	0 to 2,046	Block address of CONFIGURE mode lockout flag: 0 = CONFIGURE mode allowed. 1 = CONFIGURE mode locked out.
S2	No	0.250	Real(3)	0.0	Base Module Bus I/O period for CSC01 (in seconds).
S3	Yes	0	Int(2)	0 to 1	Redundant CSC01 configuration flag: 0 = No redundancy. 1 = Redundancy.
S4	Yes	15.000	Real(3)	0.0	Module start-up time (in seconds).
S5	No	0.250	Real(3)	0.0	Not applicable.
S6	No	0	Int(1)	0 to 1	Not applicable.

User-Defined Blocks

Blocks 30 through 2046. These blocks contain the control and mathematical functions the Sequence Command Controller performs. There are 11 types of user-defined blocks, which are briefly described in the following paragraphs. Refer to Table 3-5 for a complete list.

Station Block Provides the interfacing for the CSC01 Controller's faceplate.

Control Block Uses function codes such as a sequence master and a device driver.

Computing Block Performs all of the mathematical functions; e.g., multiplication, division.

Signal Select Block Allows the user to select such things as ***recipe*** values.

Signal Status Block These blocks provide for alarms and test quality.

Logic Block Performs the logical functions, e.g., Exclusive OR, AND, OR and NOT.

Module Bus I/O Block Allows inputs from other modules in the same process control unit to be applied.

Plant Loop I/O Block Provides for inputs from other process control units on the loop to be applied. Also provides exception report.

Field I/O Block Prepares the CSC01 Controller to interface to its internal I/O and that of its I/O slaves.

Executive Block Provides fixed values, processor utilization, cycle time and overall operating characteristics.

Miscellaneous Blocks Provides recipe tables and other ladder logic control.

CONFIGURATION CALCULATIONS

Each function block consumes bytes of NVRAM, RAM and a certain amount of ***processor time***. Table 3-5 lists these values and is intended to help the user keep the configuration within the range of the Sequence Command Controller's capacity. The total capacity is 15 kilobytes (15,334 bytes) of NVRAM and 82 kilobytes (83,840 bytes) of RAM.

Add up the bytes used (for both NVRAM and RAM) by the function codes selected for your configuration. As long as the results are less than the total capacity, the configuration will fit.

Add up the execution times and if they are longer than the cycle time (Spec S2, Function Code 82), the cycle time is no longer valid.

Refer to the Bailey ***Function Code Application Manual, I-E93-900-20*** for complete details of the function codes listed in the following table.

NOTE: All execution times listed are engineering estimates.

Table 3-5. Function Code, NVRAM, RAM Usage

Function Code	Description	Bytes of NVRAM	Bytes of RAM	Execution Time (microseconds)	Comments
02	Manual Set Constant (Tunable)	12	40	45	
09	Analog Transfer	20	76	140	
12	High/Low Compare	16	48	90	
15	2-Input Summer	18	52	215	
16	Multiply	14	48	170	

Table 3-5. Function Code, NVRAM, RAM Usage (continued)

Function Code	Description	Bytes of NVRAM	Bytes of RAM	Execution Time (microseconds)	Comments
17	Divide	14	48	210	
24	Adapt	12	64	300	
25	Analog Input/Bus (Same PCU)	10	100	150	
26	Analog Input/Loop (Different PCU)	12	54	850	
30	Analog Exception Report	26	102	220	
31	Test Quality	16	52	100	
32	Trip	12	36	45	
33	NOT	12	36	45	
34	Memory	14	46	60	
35	Timer	14	58	65	
36	Qualified OR	26	68	130	
37	AND - 2 Inputs	12	40	45	
38	AND - 4 Inputs	16	48	65	
39	OR - 2 Inputs	12	40	50	
40	OR - 4 Inputs	16	48	70	
41	Digital Input/Bus	12	88	155	
42	Digital Input/Loop	12	42	75	
45	Digital Output Exception Report	12	66	160	
50	Manual Set Switch	12	36	40	
51	Manual Set Constant (Non-Tunable)	12	40	50	
52	Manual Set Integer	12	36	40	
59	Digital Transfer	14	44	60	
61	Blink	12	48	50	
62	Remote Control Memory	28	78	150	
63	Analog Input List	28	286	500	
64	Digital Input List	28	190	410	
65	Digital Sum With Gain	28	68	140	
69	Test Alarm	12	44	75	
82	Segment	64	260	0	
83	Digital Output Group	32	90	438	
84	Digital Input Group	16	114	420	
85	Up/Down Counter	24	76	130	
86	Elapsed Timer	20	84	95	
90	Extended Executive	52	152	0	
95	Module Status Monitor	22	108	100	
97	Redundant Digital Input	14	58	120	
98	Slave Select	26	84	130	
100	Digital Readback Check	40	144	370	
101	Exclusive OR	12	40	55	
110	5 Input Rung	24	74	111	
111	10 Input Rung	38	104	165	
112	20 Input Rung	68	164	280	
114	BCD Input	20	72	600	
115	BCD Output	22	72	600	
116	Jump/Master Control Relay	12	52	1500	
117	Boolean Recipe Table	28	68	130	
118	Real Recipe Table	48	102	140	
119	Boolean Signal Multiplexer	32	86	111	

Table 3-5. Function Code, NVRAM, RAM Usage (continued)

Function Code	Description	Bytes of NVRAM	Bytes of RAM	Execution Time (microseconds)	Comments
120	Real Signal Multiplexer	32	90	130	
123	Device Driver	30	100	180	
124	Sequence Monitor	80	162	100	
125	Device Monitor	40	102	690	
126	Real Signal Demultiplexer	12	92	370	
129	Multi-State Device Driver	60	168	273	
134	Multi-Sequence Monitor	96	268	400	
135	Sequence Manager	82	208	300	
136	Remote Motor Control	52	168	330	
140	Restore[1]	46	88	1100	
141	Sequence Master	80	142	300	
142	Sequence Slave	74	104	0	
161	Sequence Generator	74	212	170	
162	Digital Segment Buffer	16	78	120	
163	Analog Segment Buffer	16	94	140	
166	Integrator	28	92	360	
169	Matrix Addition	44	172	450	
170	Matrix Multiplication	44	172	2520	
175	CSC01 Executive	24	160	0	
176	Sequence Station	80	304	618	

NOTE:
1. Refer to *I-E93-900-20, Function Code 140*, Table 1.

PRE-CONFIGURATION DATA REQUIRED

Before a configuration can be entered, the user must define the following:

1. Input/output assignments and required parameters.
2. Control actions required for each process step.
3. Step masks.
4. Step done logic.
5. Alarms.
6. Interlocks.

The configuration worksheets at the back of this instruction 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 CTT Configuration and Tuning Terminal.

CONVERTING THE INITIAL DATA INTO A CONFIGURATION

The Sequence Command Controller provides two means of creating a configuration:

1. Manual Entry.
2. EASY STEP or EASY STEP PLUS.

Manual Entry

Refer to the CTT Configuration and Tuning Terminal Instruction Manual I-E92-501-1 (CTT01) or I-E92-501-2 (CTT□2) for details on entering the configuration.

Manual entry requires the user to select and perform the following functions through the CTT Configuration and Tuning Terminal:

1. Enter the Sequence Command Controller module address.

2. Place the controller in the CONFIGURE mode.

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

4. Select required function code.

5. Add the block.

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

7. Send the block to the CSC.

EASY STEP Entry

Refer to the CTT Configuration and Tuning Terminal Instruction Manual I-E92-501-1 (CTT01) or I-E92-501-2 (CTT□2) for details on entering the configuration.

For most sequencing applications, a standard basic structure of function blocks will meet two-thirds of the control needs. Because of this, a simplified configuration method called EASY STEP PLUS is provided with the Sequence Command Controller. EASY STEP PLUS prompts the user, through the CTT Configuration and Tuning Terminal, for various parameters which define the basic control needs. These parameters include:

Number of process steps.
Number of digital inputs.
Number of digital outputs.
Module addresses of Sequence Command Controller slaves.
Station addresses of Sequence Command Controller slaves.
I/O addresses of Sequence Command Controller slaves.
Automatic Restore function requirements.

Once the required data has been inputted, EASY STEP PLUS constructs a configuration ***shell*** of function blocks needed to perform the control functions (Figure 3-2). A standard table of block address assignments (Tables 3-12 and 3-13, EASY STEP PLUS Block Address Map) is used to locate the function

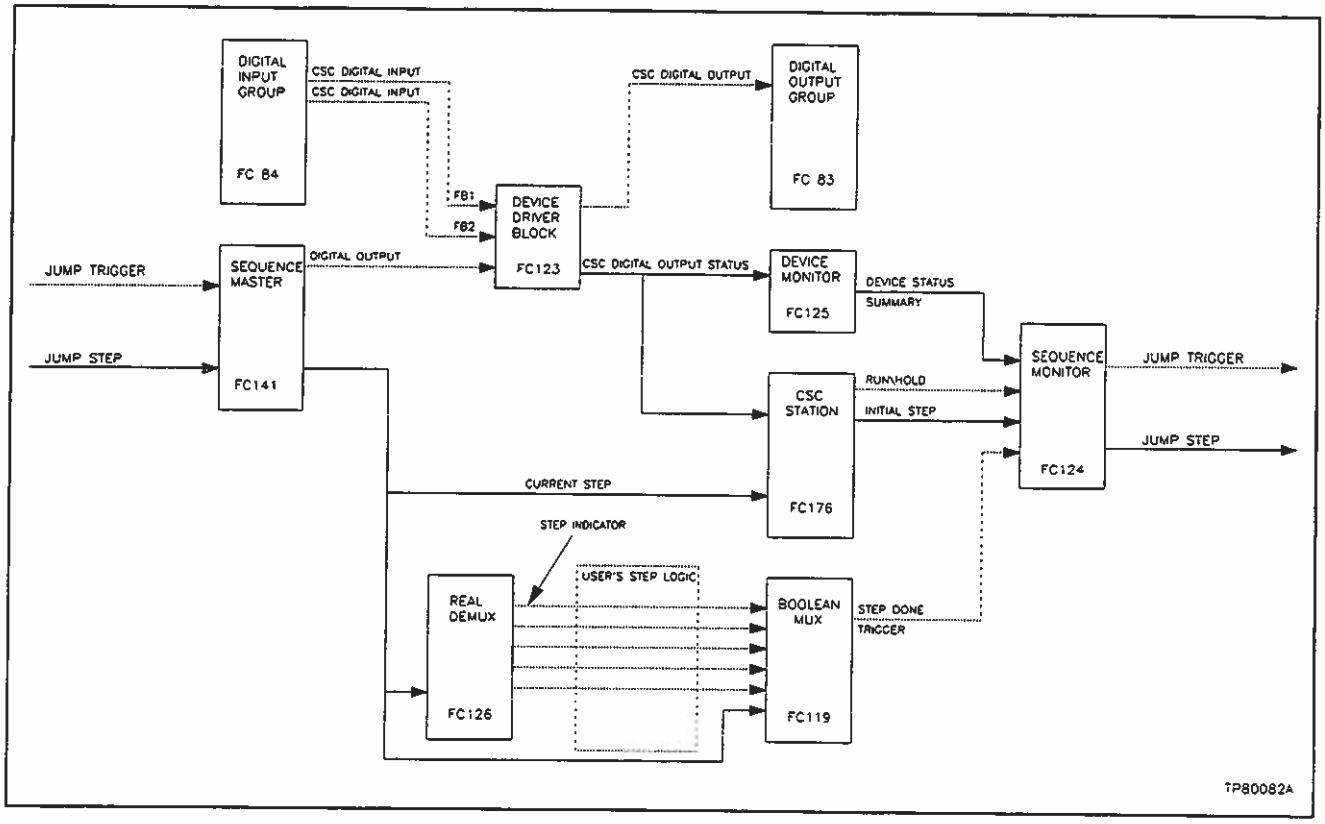


Figure 3-2. EASY STEP PLUS Configuration Shell

blocks. Function blocks are automatically assigned to provide the following control functions:

1. Input/output hardware interface.

2. Operator interface through the faceplate.

3. Sequencing operation for the number of steps specified.

4. ***Hooks*** for inserting required step logic.

5. Restore blocks for the appropriate functions when desired.

EASY STEP PLUS then allows the user to select various configuration subroutines displayed on the CTT to fill in many of the details still needed to complete the control actions. These subroutines consist of:

1. Define step masks.
2. Enter step logic.
3. Set up device driver blocks for the digital outputs.

These subroutines reduce the amount of manual entry required to develop a configuration to perform the desired control functions. They do not, however, completely eliminate

the need for manual entry of configuration data by the user. EASY STEP PLUS does not cover all the configuration needs for a particular control application. It eliminates the need to enter that part of a configuration which will be required for the majority of control applications. The user must still enter function blocks for interlocking and alarms, adjust linking between function blocks as required, change function code specs as needed, etc.

Notes on Using EASY STEP or EASY STEP PLUS

1. Always specify a reasonable amount of additional steps than what you will need. Once the number of steps is inputted into EASY STEP, change can be difficult.

2. Any unused inputs and outputs are set to an off light condition by EASY STEP. This means that unused input and output lights are neither red nor green, but off. Again, once the number of inputs and outputs are entered into EASY STEP, it is difficult to make changes.

3. Block addresses at 1395 and above are available to the user. Blocks are entered here manually, not through EASY STEP.

4. EASY STEP assumes the following when linking function blocks:

   a. Assumes that the digital inputs will be used as status feedbacks to the device driver blocks. It assumes two digital inputs will be used per DDB. The order of linking is as follows: For the DDB for output 1, EASY STEP links the first two digital inputs to the DDB's feedback specs. It then goes on to the next DDB and links the next two digital inputs. This continues until digital output 9 DDB is reached or there are no more digital outputs or digital inputs configured. There is no feedback linking implemented on the DDB's for digital outputs 9 through 12 (or 21 through 24 or 33 through 36 or 45 through 48). When a slave unit is used, the linking will resume with digital output 13 DDB having its feedback inputs linked to the digital inputs 17 and 18. The process continues in a similar manner. If the user does not want the DDB feedbacks linked in this manner, the DDB specs must be manually changed to the desired linking.

   b. Assumes that if no step logic is entered, then it is all right to proceed to the next step as soon as the digital outputs reach their proper states for the current step. This is accomplished by linking the step indicator signal directly to the step done trigger multiplexer. If the user wishes to change this, either EASY STEP must be used to add step logic or function blocks can be manually linked to the step done trigger.

c. Assumes that the user wants the sequencer to start up in the HOLD mode with the outputs driven to their E-STOP (Step 0) values. Also that the DDB's for the outputs should be in the AUTOMATIC mode with manual control available to the operator. If the user wishes to change the start-up parameters, the appropriate specs in the sequence station Function Code 176 must be manually changed.

d. Assumes that the steps will be executed in ascending numerical order and that, once the last step is reached, the sequence will start over again at Step 1. If the user wishes to change this, specifications 17 through 24 in the sequence monitor blocks (Function Code 124) must be manually changed. For single cycle operation, specification 35 in the sequence station block (Function Code 176) must be manually set.

INPUT/OUTPUT INTERFACE

Two function codes are used to interface the configuration with the input/output hardware:

Digital Input Group (Function Code 84)

Digital Output Group (Function Code 83)

See Figure 3-3 for typical use of the digital input and digital output group function codes in the sequence command.

The Digital Input Group Function Code reads a group of eight inputs from a CSC01 I/O unit. Refer to Tables 3-6 and 3-7. The Digital Output Group Function Code writes a group of eight outputs to a CSC01 I/O unit. Refer to Tables 3-8 and 3-9.

Table 3-6. Function Code 84 Outputs

Block Number	Data Type	Description
N	Boolean	Input 1/9
N + 1	Boolean	Input 2/10
N + 2	Boolean	Input 3/11
N + 3	Boolean	Input 4/12
N + 4	Boolean	Input 5/13
N + 5	Boolean	Input 6/14
N + 6	Boolean	Input 7/15
N + 7	Boolean	Input 8/16

Table 3-7. Function Code 84 Specifications

Spec No.	Tune	Default Value	Data Type	Range Min. Max.	Description
S1	No	0	Int(2)	2 to 30	Expander bus address of CSC01.
S2	No	0	Int(1)	0 to 1	Input group: 0 = Inputs 1-8. 1 = Inputs 9-16.
S3	No	0	Int(1)	0 to 1	Action on I/O failure: 0 = Trip CSC. 1 = Continue to operate.

Table 3-8. Function Code 83 Outputs

Block Number	Data Type	Description
N	Boolean	Group status: 0 = Ok. 1 = Bad.

Table 3-9. Function Code 83 Specifications

Spec No.	Tune	Default Value	Data Type	Range Min. Max.	Description
S1	No	0	Int(2)	3 to 31	Expander bus address of CSC01.
S2	No	0	Int(1)	0 to 1	Output Group: 0 = Output 1-8. 1 = Outputs 9-12 (13-16 unused).
S3	No	0	Int(1)	0 to 1	Action on I/O failure: 0 = Trip CSC. 1 = Continue to operate.
S4	No	0	Int(2)	0 to 2046	Block address for value of 1st output/(9th)
S5	No	0	Int(2)	0 to 2046	Block address for value of 2nd output/(10th)
S6	No	0	Int(2)	0 to 2046	Block address for value of 3rd output/(11th)
S7	No	0	Int(2)	0 to 2046	Block address for value of 4th output/(12th)
S8	No	0	Int(2)	0 to 2046	Block address for value of 5th output/(N/A)
S9	No	0	Int(2)	0 to 2046	Block address for value of 6th output/(N/A)
S10	No	0	Int(2)	0 to 2046	Block address for value of 7th output/(N/A)
S11	No	0	Int(2)	0 to 2046	Block address for value of 8th output/(N/A)

CONTROLLER/OPERATOR INTERFACE

The faceplate of the Sequence Command Controller is the interface between the operator and the control configuration running in the unit and is referred to as a control station. The sequence station block (Function Code 176) is used in the configuration to drive the faceplate. The sequence station collects data from the device driver blocks and the I/O hardware as well as other user-defined blocks. It also performs various control actions as requested by operator inputs through the five pushbuttons on the faceplate.

The data available on the faceplate is:
1. The value of all hardware input and output points.
2. Step number.
3. Device driver block mode and logic output value.
4. I/O alarm status.
5. Error codes.

The following control actions are available to the operator:
1. Digital output AUTO/MANUAL select with output control.
2. Selection of step number.
3. Process run and hold control with ability to put process in E-STOP step for a safe shutdown.

Figure 3-3 shows the linking of the various blocks to the Sequence Station block in a typical application.

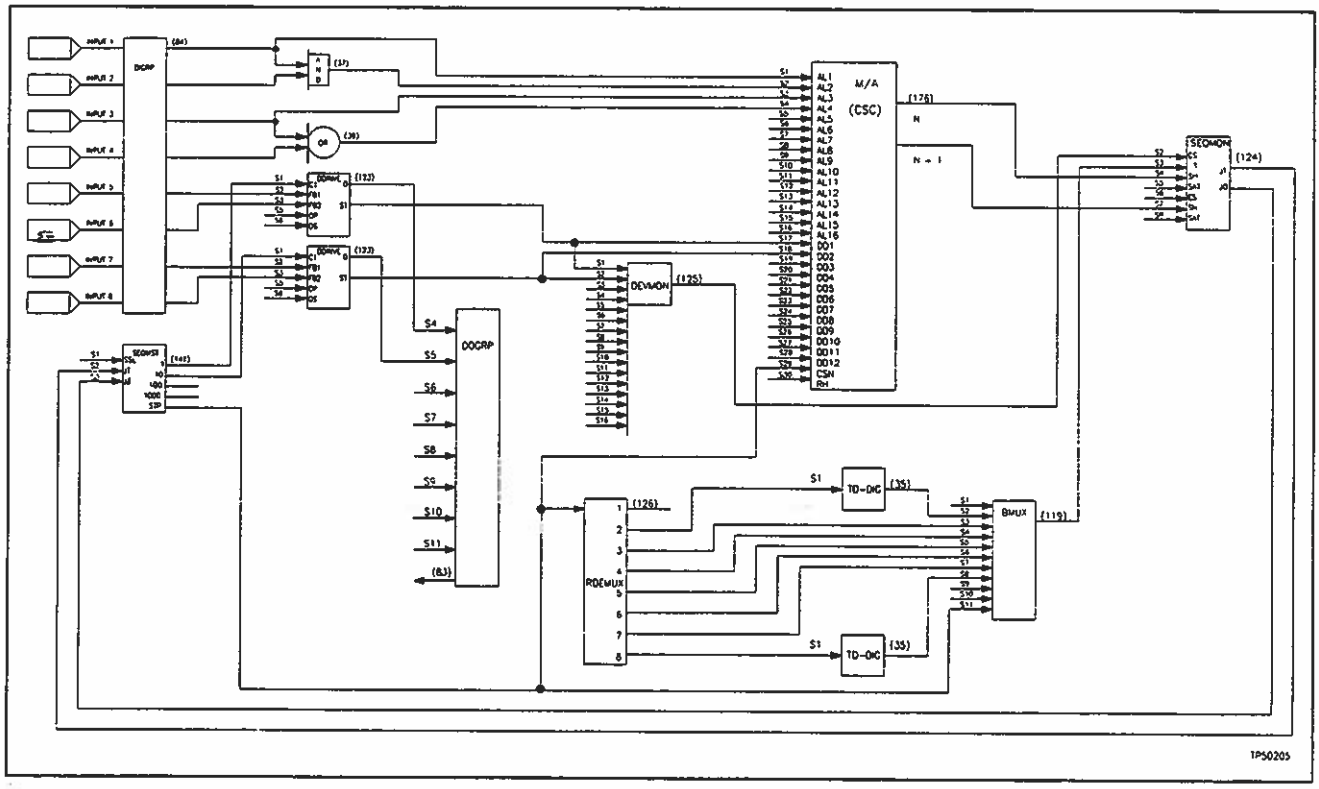


Figure 3-3. Typical Sequence Station Block Linking (Simplified)

Table 3-10. Function Code 176 Outputs

Block Number	Data Type	Description
N	Boolean	Hold/initialize output.
N + 1	Real	Initial step number.
N + 2	Real	Unused.
N + 3	Boolean	Alarm acknowledge key indicator.

Table 3-11. Function Code 176 Specifications

Spec No.	Tune	Default Value	Data Type	Range Min. Max.	Description
S1	No	0	Int(2)	0 to 2046	Block address of input No. 1 alarm signal: 0 = Normal. 1 = Alarm.
S2	No	0	Int(2)	0 to 2046	Block address of input 2 alarm signal.
S3	No	0	Int(2)	0 to 2046	Block address of input 3 alarm signal.
S4	No	0	Int(2)	0 to 2046	Block address of input 4 alarm signal.
S5	No	0	Int(2)	0 to 2046	Block address of input 5 alarm signal.
S6	No	0	Int(2)	0 to 2046	Block address of input 6 alarm signal.
S7	No	0	Int(2)	0 to 2046	Block address of input 7 alarm signal.
S8	No	0	Int(2)	0 to 2046	Block address of input 8 alarm signal.
S9	No	0	Int(2)	0 to 2046	Block address of input 9 alarm signal.
S10	No	0	Int(2)	0 to 2046	Block address of input 10 alarm signal.
S11	No	0	Int(2)	0 to 2046	Block address of input 11 alarm signal.
S12	No	0	Int(2)	0 to 2046	Block address of input 12 alarm signal.
S13	No	0	Int(2)	0 to 2046	Block address of input 13 alarm signal.
S14	No	0	Int(2)	0 to 2046	Block address of input 14 alarm signal.
S15	No	0	Int(2)	0 to 2046	Block address of input 15 alarm signal.
S16	No	0	Int(2)	0 to 2046	Block address of input 16 alarm signal.
S17	No	2	Int(2)	0 to 2046	Block address of output 1 DDB control output status (device driver block F.C. 123).
S18	No	2	Int(2)	0 to 2046	Block address of output 2 DDB control output status.
S19	No	2	Int(2)	0 to 2046	Block address of output 3 DDB control output status.
S20	No	2	Int(2)	0 to 2046	Block address of output 4 DDB control output status.
S21	No	2	Int(2)	0 to 2046	Block address of output 5 DDB control output status.

Table 3-11. Function Code 176 Specifications (continued)

Spec No.	Tune	Default Value	Data Type	Range Min. Max.	Description
S22	No	2	Int(2)	0 to 2046	Block address of output 6 DDB control output status.
S23	No	2	Int(2)	0 to 2046	Block address of output 7 DDB control output status.
S24	No	2	Int(2)	0 to 2046	Block address of output 8 DDB control output status.
S25	No	2	Int(2)	0 to 2046	Block address of output 9 DDB control output status.
S26	No	2	Int(2)	0 to 2046	Block address of output 10 DDB control output status.
S27	No	2	Int(2)	0 to 2046	Block address of output 11 DDB control output status.
S28	No	2	Int(2)	0 to 2046	Block address of output 12 DDB control output status.
S29	No	2	Int(2)	0 to 2046	Block address of current step number.
S30	No	2	Int(2)	0 to 7	Station address.
S31	No	2	Int(2)	0 to 2046	Block address of RUN/HOLD signal (Boolean value): 0 = HOLD state. 1 = RUN state.
S32	No	1612	Int(2)	0 to 1612	I/O utilization (number of inputs used)*100 + (number of outputs used).
S33	Yes	0	Int(1)	0 to 21	Manual override lockout: X Y Y: 0 = Normal; 1 = Lockout. X: 0 = Faceplate has RUN priority; 1 = Configuration has RUN priority; 2 = No RUN priority.
S34	No	1	Int(1)	0 or 1	Default mode of outputs after start-up: 0 = MANUAL. 1 = AUTO.
S35	Yes	9.2E18	Real(3)	Full	Last step number (done step number).
S36	Yes	0	Real(3)	Full	Unused.

Specifications 1 - 16, Function Code 176

Specifications 1 through 16 of the sequence station block provide two different options for the INPUT indicators on the faceplate.

Alarm Mode

When the spec value is made positive, the faceplate indicator will display the logic state of the associated hardware input.

If the associated block input value (indicated by the Function Code spec) is a logic 0, the indicator will be in its normal operating state. If the associated block input value is a logic 1, the indicator will flash, the audible alarm will sound and the alarm LED will flash. By pressing the **ALARM ACK** pushbutton, the audible alarm will silence, the alarm LED will be on continuously, and the indicator will continue to flash as long as there is a logic 1 present.

Internal Logic State Mode

If the spec value is made negative, the indicator will display the boolean value of block output indicated by the Function Code spec. No alarm conditions will exist for a logic 1. Reference Figure 3-4 for examples of these different operations.

Specifications 17 - 28, Function Code 176

Specifications 17 through 28 of the sequence station block are to be the block addresses of the device driver (function code 123) block's status output. When this block is linked to the sequence station block, it serves two purposes:

1. It tells the station where the device driver block for a particular output is located so that the station can pass faceplate commands to it allowing for manual control of the output.

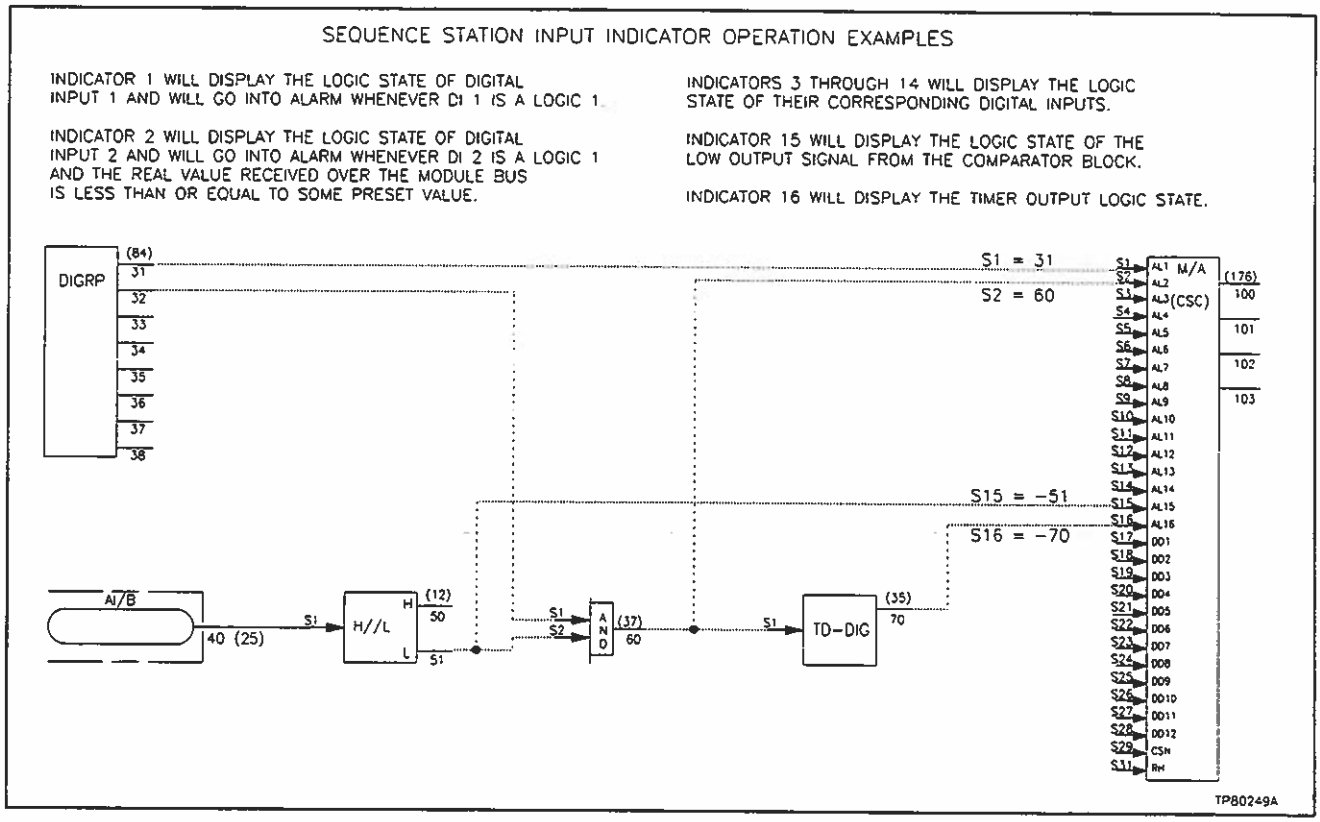


Figure 3-4. Sequence Station Input Indicator Operation Examples

2. It also allows the station to monitor the output's status and therefore provide alarm indication for each associated output. Reference Figure 3-5 for examples of different control options for the digital outputs.

Specification 31, Function Code 176

Specification 31 of the sequence station block serves two purposes.

1. If the input to Spec 31 is equal to 1 on entering the EXECUTE mode, then the sequence station (Function Code 176) causes the sequencer to begin running at Step 1. If the input to Spec 31 is equal to 0 on entering the EXECUTE mode, then the sequence station causes the sequencer to go to the executed stop (E-STOP) step (Step 0) which causes the following conditions to exist:

   a. Sequencer is not running.

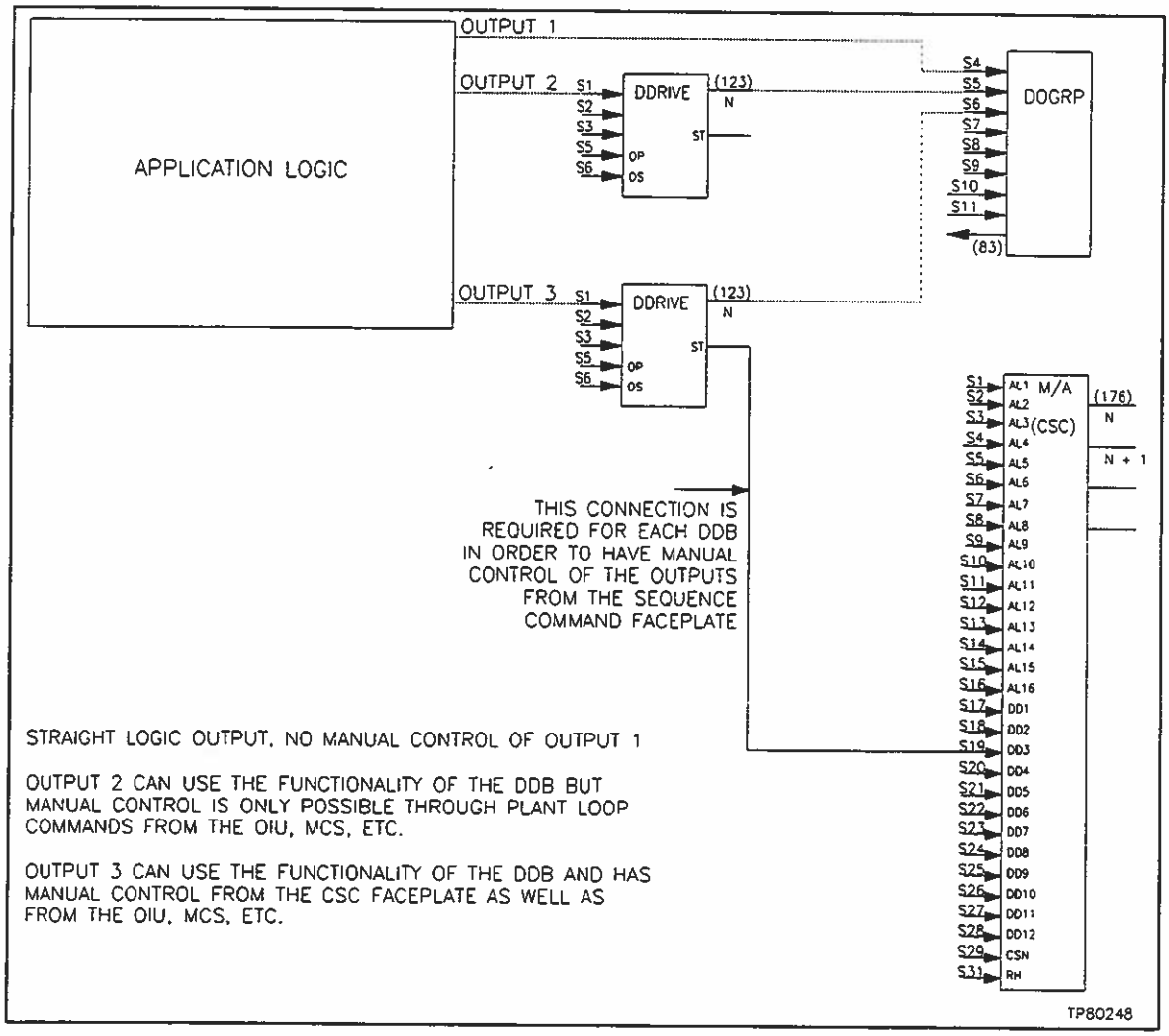


Figure 3-5. Digital Output Control Options

b. The **OUT SEL** pushbutton cycles the alphanumeric display through *E-STOP?*, *RESTART?*, the digital outputs, and back to *E-STOP*.

c. The RESTART or START functions must be used to start the sequencer running.

d. The digital outputs will be driven to the values determined by the configuration for Step 0. Refer to ***Configuration Output Default Settings***.

2. Spec 31 also allows external control of the RUN/HOLD mode after start-up is complete. If this input goes from 1 to a 0 and the sequence is running, the sequence station puts the sequence in HOLD mode. If this input goes from a 0 to a 1 and the sequence is in the HOLD mode, the sequence station puts the sequence in RUN mode depending on the priority set by Spec 33.

Table 3-12. Sequence Command EASY STEP Block Address Map

Block Address		Control Function	Func	Memory Usage		I/O	Comments and
Start	End		Code	NVRAM	RAM	Loc.	Default Settings
0	29	Reserved					
30	30	Unused					
31	38	DI Group Inputs: 1-8	84	16	114	Master	Digital input groups are
39	46	DI Group Inputs: 9-16	84	16	114	Master	the interface to the
47	54	DI Group Inputs: 17-24	84	16	114	Slave 1	hardware inputs.
55	62	DI Group Inputs: 25-32	84	16	114	Slave 1	
63	70	DI Group Inputs: 33-40	84	16	114	Slave 2	
71	78	DI Group Inputs: 41-48	84	16	114	Slave 2	
79	86	DI Group Inputs: 49-56	84	16	114	Slave 3	
87	94	DI Group Inputs: 57-64	84	16	114	Slave 3	
95	96	CSC Station Master	176	80	304		Sequence station blocks
97	98	CSC Station Slave 1	176	80	304		are the interface to the
99	100	CSC Station Slave 2	176	80	304		faceplate.
101	102	CSC Station Slave 3	176	80	304		
103	110	Unused					
111	112	Device Driver Output: 1	123	30	100	Master	Feedback Inputs = 1,2
113	114	Device Driver Output: 2	123	30	100	Master	Feedback Inputs = 3,4
115	116	Device Driver Output: 3	123	30	100	Master	Feedback Inputs = 5,6
117	118	Device Driver Output: 4	123	30	100	Master	Feedback Inputs = 7,8
119	120	Device Driver Output: 5	123	30	100	Master	Feedback Inputs = 9,10
121	122	Device Driver Output: 6	123	30	100	Master	Feedback Inputs = 11,12
123	124	Device Driver Output: 7	123	30	100	Master	Feedback Inputs = 13,14
125	126	Device Driver Output: 8	123	30	100	Master	Feedback Inputs = 15,16
127	128	Device Driver Output: 9	123	30	100	Master	No Inputs.
129	130	Device Driver Output: 10	123	30	100	Master	No Inputs.
131	132	Device Driver Output: 11	123	30	100	Master	No Inputs.
133	134	Device Driver Output: 12	123	30	100	Master	No Inputs.

Table 3-12. Sequence Command EASY STEP Block Address Map (continued)

Block Address		Control Function	Func. Code	Memory Usage		I/O Loc.	Comments and Default Settings
Start	End			NVRAM	RAM		
135	136	Device Driver Output: 13	123	30	100	Slave 1	Feedback Inputs = 17,18
137	138	Device Driver Output: 14	123	30	100	Slave 1	Feedback Inputs = 19,20
139	140	Device Driver Output: 15	123	30	100	Slave 1	Feedback Inputs = 21,22
141	142	Device Driver Output: 16	123	30	100	Slave 1	Feedback Inputs = 23,24
143	144	Device Driver Output: 17	123	30	100	Slave 1	Feedback Inputs = 25,26
145	146	Device Driver Output: 18	123	30	100	Slave 1	Feedback Inputs = 27,28
147	148	Device Driver Output: 19	123	30	100	Slave 1	Feedback Inputs = 29,30
149	150	Device Driver Output: 20	123	30	100	Slave 1	Feedback Inputs = 31,32
151	152	Device Driver Output: 21	123	30	100	Slave 1	No Inputs.
153	154	Device Driver Output: 22	123	30	100	Slave 1	No Inputs.
155	156	Device Driver Output: 23	123	30	100	Slave 1	No Inputs.
157	158	Device Driver Output: 24	123	30	100	Slave 1	No Inputs.
159	160	Device Driver Output: 25	123	30	100	Slave 2	Feedback Inputs = 33,34
161	162	Device Driver Output: 26	123	30	100	Slave 2	Feedback Inputs = 35,36
163	164	Device Driver Output: 27	123	30	100	Slave 2	Feedback Inputs = 37,38
165	166	Device Driver Output: 28	123	30	100	Slave 2	Feedback Inputs = 39,40
167	168	Device Driver Output: 29	123	30	100	Slave 2	Feedback Inputs = 41,42
169	170	Device Driver Output: 30	123	30	100	Slave 2	Feedback Inputs = 43,44
171	172	Device Driver Output: 31	123	30	100	Slave 2	Feedback Inputs = 45,46
173	174	Device Driver Output: 32	123	30	100	Slave 2	Feedback Inputs = 47,48
175	176	Device Driver Output: 33	123	30	100	Slave 2	No Inputs.
177	178	Device Driver Output: 34	123	30	100	Slave 2	No Inputs.
179	180	Device Driver Output: 35	123	30	100	Slave 2	No Inputs.
181	182	Device Driver Output: 36	123	30	100	Slave 2	No Inputs.
183	184	Device Driver Output: 37	123	30	100	Slave 3	Feedback Inputs = 49,50
185	186	Device Driver Output: 38	123	30	100	Slave 3	Feedback Inputs = 51,52
187	188	Device Driver Output: 39	123	30	100	Slave 3	Feedback Inputs = 53,54
189	190	Device Driver Output: 40	123	30	100	Slave 3	Feedback Inputs = 55,56
191	192	Device Driver Output: 41	123	30	100	Slave 3	Feedback Inputs = 57,58
193	194	Device Driver Output: 42	123	30	100	Slave 3	Feedback Inputs = 59,60
195	196	Device Driver Output: 43	123	30	100	Slave 3	Feedback Inputs = 61,62
197	198	Device Driver Output: 44	123	30	100	Slave 3	Feedback Inputs = 63,64
199	200	Device Driver Output: 45	123	30	100	Slave 3	No Inputs.
201	202	Device Driver Output: 46	123	30	100	Slave 3	No Inputs.
203	204	Device Driver Output: 47	123	30	100	Slave 3	No Inputs.
205	206	Device Driver Output: 48	123	30	100	Slave 3	No Inputs.
207	207	DO Group Outputs: 1-8	83	32	90	Master	
208	208	DO Group Outputs: 9-12	83	32	90	Master	Digital output groups
209	209	DO Group Outputs: 13-20	83	32	90	Slave 1	are the interface
210	210	DO Group Outputs: 21-24	83	32	90	Slave 1	to the hardware outputs.
211	211	DO Group Outputs: 25-32	83	32	90	Slave 2	
212	212	DO Group Outputs: 33-36	83	32	90	Slave 2	
213	213	DO Group Outputs: 37-44	83	32	90	Slave 3	
214	214	DO Group Outputs: 45-48	83	32	90	Slave 3	

Table 3-12. Sequence Command EASY STEP Block Address Map (continued)

Block Address Start	Block Address End	Control Function	Func. Code	Memory Usage NVRAM	Memory Usage RAM	I/O Loc.	Comments and Default Settings
215	215	Device Monitor Outputs: 1-12	125	40	102		Device monitors logically or the control status of all the device driver blocks.
216	216	Device Monitor Outputs: 13-24	125	40	102		
217	217	Device Monitor Outputs: 25-36	125	40	102		
218	218	Device Monitor Outputs: 37-48	125	40	102		
219	219	Unused					
220	227	RDEMUX Steps: 0-7	126	12	92		Outputs of the real demultiplexer blocks are the step indicators.
228	235	RDEMUX Steps: 8-15	126	12	92		
236	243	RDEMUX Steps: 16-23	126	12	92		
244	251	RDEMUX Steps: 24-31	126	12	92		
252	259	RDEMUX Steps: 32-39	126	12	92		
260	274	Step 1 Logic					Step Indicator = 221
275	289	Step 2 Logic					Step Indicator = 222
290	304	Step 3 Logic					Step Indicator = 223
305	319	Step 4 Logic					Step Indicator = 224
320	334	Step 5 Logic					Step Indicator = 225
335	349	Step 6 Logic					Step Indicator = 226
350	364	Step 7 Logic					Step Indicator = 227
365	379	Step 8 Logic					Step Indicator = 228
380	394	Step 9 Logic					Step Indicator = 229
395	409	Step 10 Logic					Step Indicator = 230
410	424	Step 11 Logic					Step Indicator = 231
425	439	Step 12 Logic					Step Indicator = 232
440	454	Step 13 Logic					Step Indicator = 233
455	469	Step 14 Logic					Step Indicator = 234
470	484	Step 15 Logic					Step Indicator = 235
485	499	Step 16 Logic					Step Indicator = 236
500	514	Step 17 Logic					Step Indicator = 237
515	529	Step 18 Logic					Step Indicator = 238
530	544	Step 19 Logic					Step Indicator = 239
545	559	Step 20 Logic					Step Indicator = 240
560	574	Step 21 Logic					Step Indicator = 241
575	589	Step 22 Logic					Step Indicator = 242
590	604	Step 23 Logic					Step Indicator = 243
605	619	Step 24 Logic					Step Indicator = 244
620	634	Step 25 Logic					Step Indicator = 245
635	649	Step 26 Logic					Step Indicator = 246
650	664	Step 27 Logic					Step Indicator = 247
665	679	Step 28 Logic					Step Indicator = 248
680	694	Step 29 Logic					Step Indicator = 249
695	709	Step 30 Logic					Step Indicator = 250
710	724	Step 31 Logic					Step Indicator = 251
725	739	Step 32 Logic					Step Indicator = 252
740	740	BMUX Steps: 0-9	119	32	86		Step Triggers 1 - 9
741	741	BMUX Steps: 10-19	119	32	86		Step Triggers 10 - 19
742	742	BMUX Steps: 20-29	119	32	86		Step Triggers 20 - 29
743	743	BMUX Steps: 30-39	119	32	86		Step Triggers 30 - 32

Table 3-12. Sequence Command EASY STEP Block Address Map (continued)

Block Address Start	Block Address End	Control Function	Func. Code	Memory Usage NVRAM	Memory Usage RAM	I/O Loc.	Comments and Default Settings
744	745	Seq Monitor Steps: 1-8	124	80	162		Next and fault steps for each step are configured in the sequence monitors.
746	747	Seq Monitor Steps: 9-16	124	80	162		
748	749	Seq Monitor Steps: 17-24	124	80	162		
750	751	Seq Monitor Steps: 25-32	124	80	162		
752	754	Unused					
755	759	Seq Master Outputs:1-4	141	80	142	Master	Step masks are configured in the sequence master function blocks.
760	764	Seq Master Outputs:5-8	141	80	142	Master	
765	769	Seq Master Outputs:9-12	141	80	142	Master	
770	774	Seq Master Outputs:13-16	141	80	142	Slave 1	
775	779	Seq Master Outputs:17-20	141	80	142	Slave 1	
780	784	Seq Master Outputs:21-24	141	80	142	Slave 1	
785	789	Seq Master Outputs:25-28	141	80	142	Slave 2	
790	794	Seq Master Outputs:29-32	141	80	142	Slave 2	
795	799	Seq Master Outputs:33-36	141	80	142	Slave 2	
800	804	Seq Master Outputs:37-40	141	80	142	Slave 3	
805	809	Seq Master Outputs:41-44	141	80	142	Slave 3	
810	814	Seq Master Outputs:45-48	141	80	142	Slave 3	
815	1394	Reserved For Automatic Restore					
1395	2046	FREE USER AREA					For user defined blocks.

Table 3-13. Sequence Command Controller EASY STEP Block Structure for Automatic Restore Option

Restore F.C. 140 Block Address Start	Restore F.C. 140 Block Address End	Functions To Be Restored	Func Code	Memory Usage Extra NVRAM	Memory Usage Total NVRAM	RAM
815	822	DI Groups	84	34	640	704
823	826	CSC Stations	176	70	464	352
827	874	Device Drivers	123	20	3168	4224
875	882	DO Groups	83	2	384	704
883	886	Device Monitors	125	4	200	352
887	891	RDEMUX	126	16	310	440
892	895	BMUX	119	2	196	352
896	899	Sequence Monitors	124	12	232	352
900	911	Sequence Masters	141	16	744	1056
913	913	Segment Control	82	20	66	88
914	914	Extended Executive	90	52	98	88
915	1394	Step Logic		*	*	*

* Varies with type and amount of Function Codes added by the user.

CONFIGURATION DATA FOR COMMUNICATING WITH OTHER COMMAND SERIES CONTROLLERS

Many control applications involve analog control as well as sequential control. The CLC0□ Loop Command Controller or the CBC01 Batch Command Controller can provide analog control capability. The Sequence Command Controller can communicate with either of these controllers via the module bus. If the two controllers are linked together via the module bus, then there are a series of function codes that allow the two controllers to pass information. These function codes are:

1. AI/B - Analog Input Bus command (Function Code 25). This allows one module to read a specific real block output from another module. This block output is an analog signal. For example, a Sequence Command Controller could read a level transmitter signal hardwired to a Loop Command Controller. (Analog Input List (Function Code 63) - receives 8 analog values.)

2. DI/B - Digital Input Bus command (Function Code 41). This allows one controller to read a specific logical block output from another controller. This block output is a digital signal. For example, a Loop Command Controller could be reading a digital signal from the Sequence Command Controller to tell it to change the setpoint of the controller. (Digital Input List (Function Code 64) - receives 8 digital values).

The analog and digital signals passed over the module bus can be both actual real world I/O values or the result of internal logic and/or calculations.

CONFIGURATION DATA FOR SETTING UP REDUNDANT CONTROLLERS

Some considerations to keep in mind when setting up a redundant pair of controllers include:

1. Both units must have the *same* module bus address.

2. The station address and the I/O address of each unit must be ***different*** from each other.

3. When entering the configuration into the unit, ***only one*** of the CSC station blocks (Function Code 176) can have a value for Spec 29 different than the default value of 2.

4. ***Both*** of the units must have dipshunt XU47 installed and all switch settings on the CPU board must be the same except for S3-8 Table 2-6.

CONFIGURATION DATA FOR FAILURE HANDLING AND DETECTION

EASY STEP PLUS configures a device driver (Function Code 123) for every output specified in the setup menu. These devices have status associated with them. This means that if the feedbacks do not confirm the output within the feedback waiting period, then a BAD status is generated. This will cause an output alarm to be generated which causes the associated output light to blink and an audible sound to be generated. All device status signals are fed to the sequence monitor (through device monitors). A sequence monitor (Function Code 124) normally controls the order in which steps are processed. The normal next step is whatever the specification for NEXTX. However, there is also a FAULTX specification. This means that if a device generates a fault and is in AUTO, then the sequence monitor will cause the step number indicated by FAULTX to be executed rather than NEXTX. In the default configuration of EASY STEP PLUS, a sequence monitor will have a 0 configured for its FAULTX values. This means that if a fault is detected, Step 0 (or Executed Stop) will be executed.

It should be noted that the specifications of the sequence monitor can be changed, allowing the user to program separate fault steps. A shutdown procedure that is different from the executed stop could be constructed and could involve many steps if necessary. Refer to the Bailey ***Function Code Application Manual I-E93-900-20*** for a detailed explanation of the sequence monitor and device driver function codes.

CONFIGURATION OUTPUT DEFAULT SETTINGS

The configuration default settings are outputted when an operator or configuration induced E-STOP occurs. The CPU continues to execute the configuration and communicate with the I/O. When the configuration defaults are enabled, control of the process is still maintained and various outputs can still be manipulated by the operator. The configuration output default settings are done through the logic defined by function codes within the configuration.

NOTE: The E-STOP function is used to force the sequencer to execute default output states that have been defined by the user. These outputs should be defined to minimize possible equipment damage and prevent injury. The E-STOP function should not be used as a substitute for an emergency stop switch. Emergency stop switches should de-energize power from a circuit to prevent or mitigate injury or equipment damage. Such switches should be located so as to be easily used by operators close to equipment that may cause injury.

When the controller is executing a configuration and a sequence station (Function Code 176) is configured, requesting the E-STOP step from the faceplate causes the step number

output of the station block to go to a value of 0. This will occur whether or not there is a redundant controller. The station block also causes the hold/initialize output of the block to toggle from a logic 0 to a logic 1 and then back to a logic 0. Typical sequencer configurations have a sequence monitor (Function Code 124) connected to these outputs of the sequence station block. Pressing the E-STOP selection button causes the sequence monitor to go to Step 0, the default or safe shut down step. If sequence master blocks (Function Code 141) are tied to the sequence monitor, they will output the digital values associated with their default output mask. If any other type of function codes are used, additional logic will be required to detect when the step number output of the sequence station goes to a value of 0, indicating that a safe shutdown condition is required. Additional logic is always required to force the analog signals to the desired value when an E-STOP condition is detected. Figure 3-6 is an example of how to force digital and analog outputs to a safe condition when an E-STOP condition is detected.

CONFIGURE A TEST QUALITY BLOCK FOR SAFETY RELATED INPUTS/CONTROL INPUT SECURITY

All input points to the Sequence Command Controller have either a GOOD or BAD quality status. GOOD quality status is the normal operation of the controller within the parameters

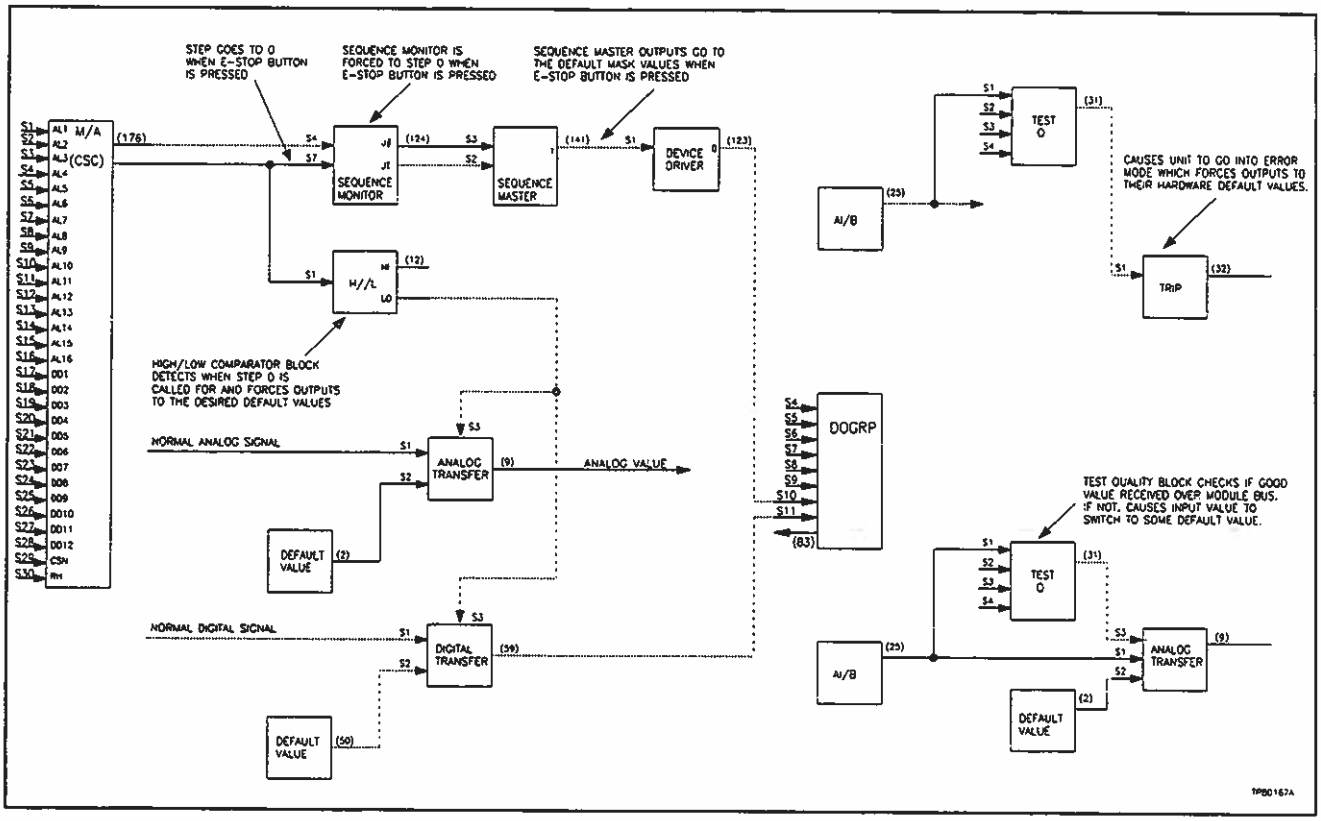


Figure 3-6. Example Method of Forcing Outputs to Default Values During E-STOP

of the system. BAD quality status results from an out-of-range signal or a signal not getting through from the module bus or plant loop. The function block TEST QUALITY (Function Code 31) is used to test the input quality. Depending on the importance of the input, a TEST QUALITY block can be configured.

Safety related inputs should be alarmed so that operators can take immediate action to correct a problem. Personal 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. A TEST QUALITY block can be configured to transfer the associated operator M/A station to MANUAL, shut down the process or send a warning to an annunciator. Refer to Figure 3-6.

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

NOTE: It is also highly recommended that when the unit is used in safety related applications that the configuration lock be enabled to prevent changes from being made once the system has been checked out and operational. The ***lock*** is enabled by setting specification S1 of Function Code 90 at fixed block address 20 to a 1.

CONFIGURATION DATA FOR DIGITAL OUTPUT INDICATION

The alphanumeric display shows the logic state of the associated device driver block (Function Code 123) output when a particular digital output is selected using the **OUT SEL** pushbutton. The OUTPUT LED on the faceplate shows the logic state of the digital output hardware. Generally, the two logic states (alphanumeric display and LED) will match. However, if interlock logic is added between the DDB output and the DOGRP (Function Code 83), then the two logic states may not match because the interlock logic may override the DDB output signal. Refer to Figure 3-7.

CONFIGURATION DATA FOR SINGLE CYCLE OPERATION

Continuous cycling is the default mode of operation for the Sequence Command Controller. If, however, a sequence is to be executed only once, then Spec 35 of the sequence station block (Function Code 176) must be set to the last step number to be executed. The sequence monitor block (Function Code 124) should be set up so that the next step to execute after the last step is that same step. Thus the sequencer cannot get out of the last step without operator intervention.

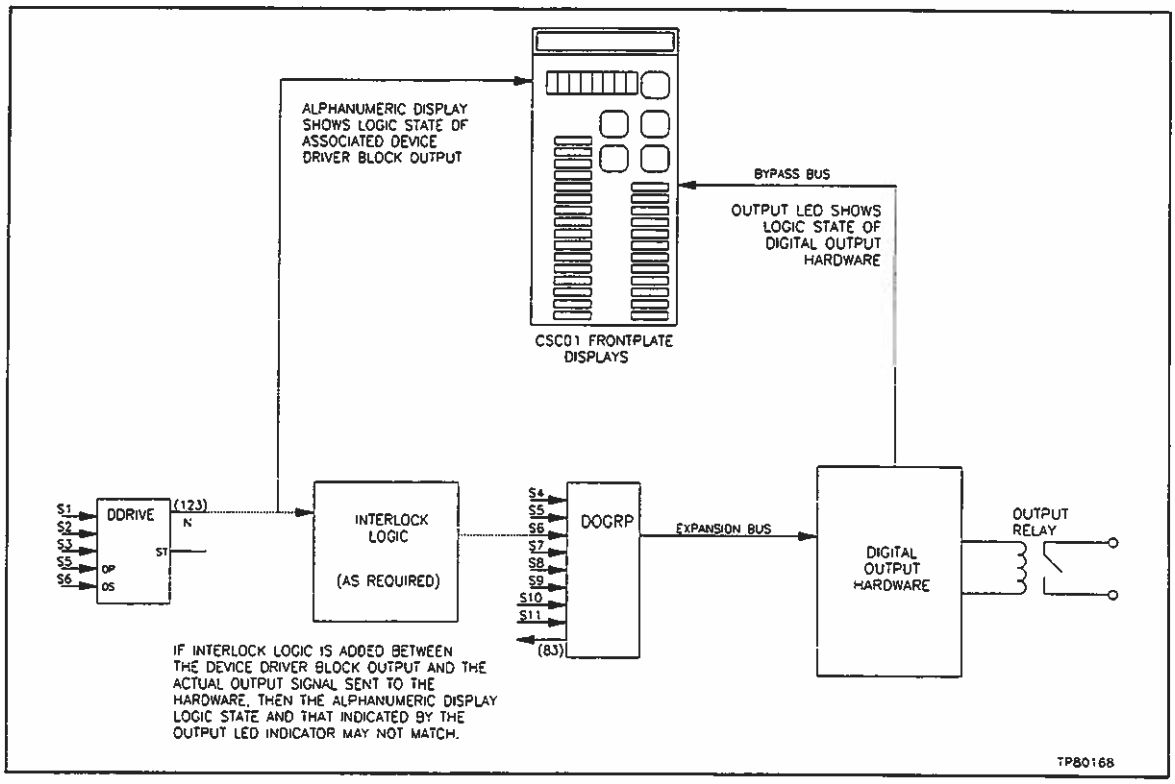


Figure 3-7. Digital Output Indications

CONFIGURATION INFORMATION ON DATA AND ALARM LOGGING

This option is controlled by Spec S1 in the CSC Sequence Executive Block (Function Code 175). When Spec S1 is set to a value of 1, the exception reports generated by Function Codes 30 and 45 are sent out through the RS-232 port. When Spec S1 is set to a value of 0, the reports are generated by Function Codes 30 and 45 and sent out over the module bus to an INFI 90/Network 90 communication module.

CONFIGURATION DRAWING CONVENTIONS

Refer to Figure 3-8 for an example of the drawing conventions used in configuration drawings.

CONFIGURATION EXAMPLE

Figure 3-9 is a simplified process diagram of a filter with backwash cycle. The basic operation consists of a material being pumped through one of two filtering stages, while the other filter is being regenerated. The process runs for a fixed time period and is then switched so that the regenerated filter is used and the other filter is regenerated. Figure 3-10 is a configuration drawing that represents the functions required to complete this operational sequence. Refer to the CTI□2 Configuration and Tuning Terminal instruction book, I-E92-501-2, for additional details of this configuration example.

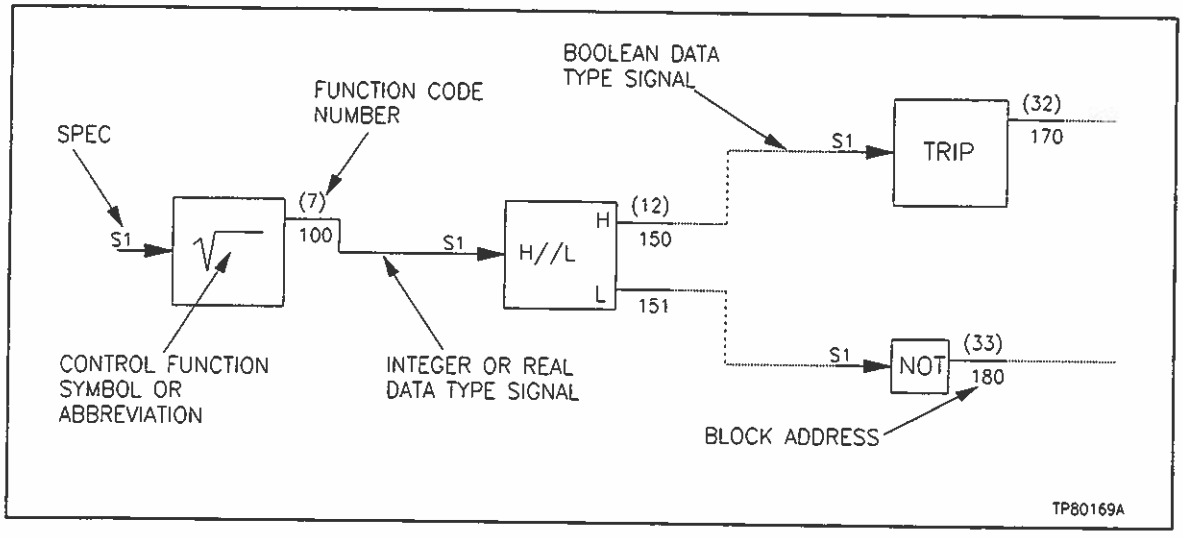


Figure 3-8. Configuration Drawing Conventions

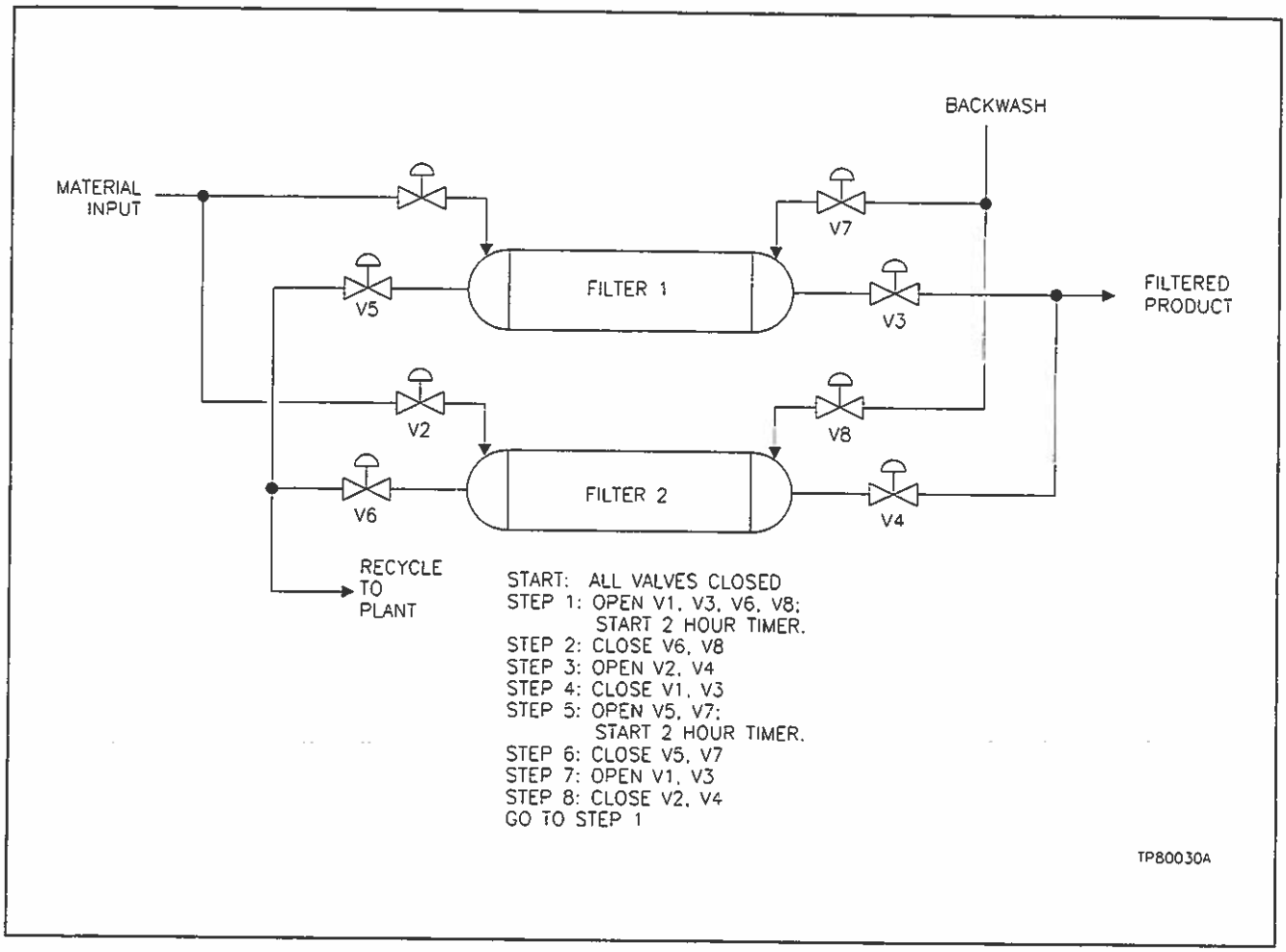


Figure 3-9. Simplified Process Schematic, Filter with Backwash

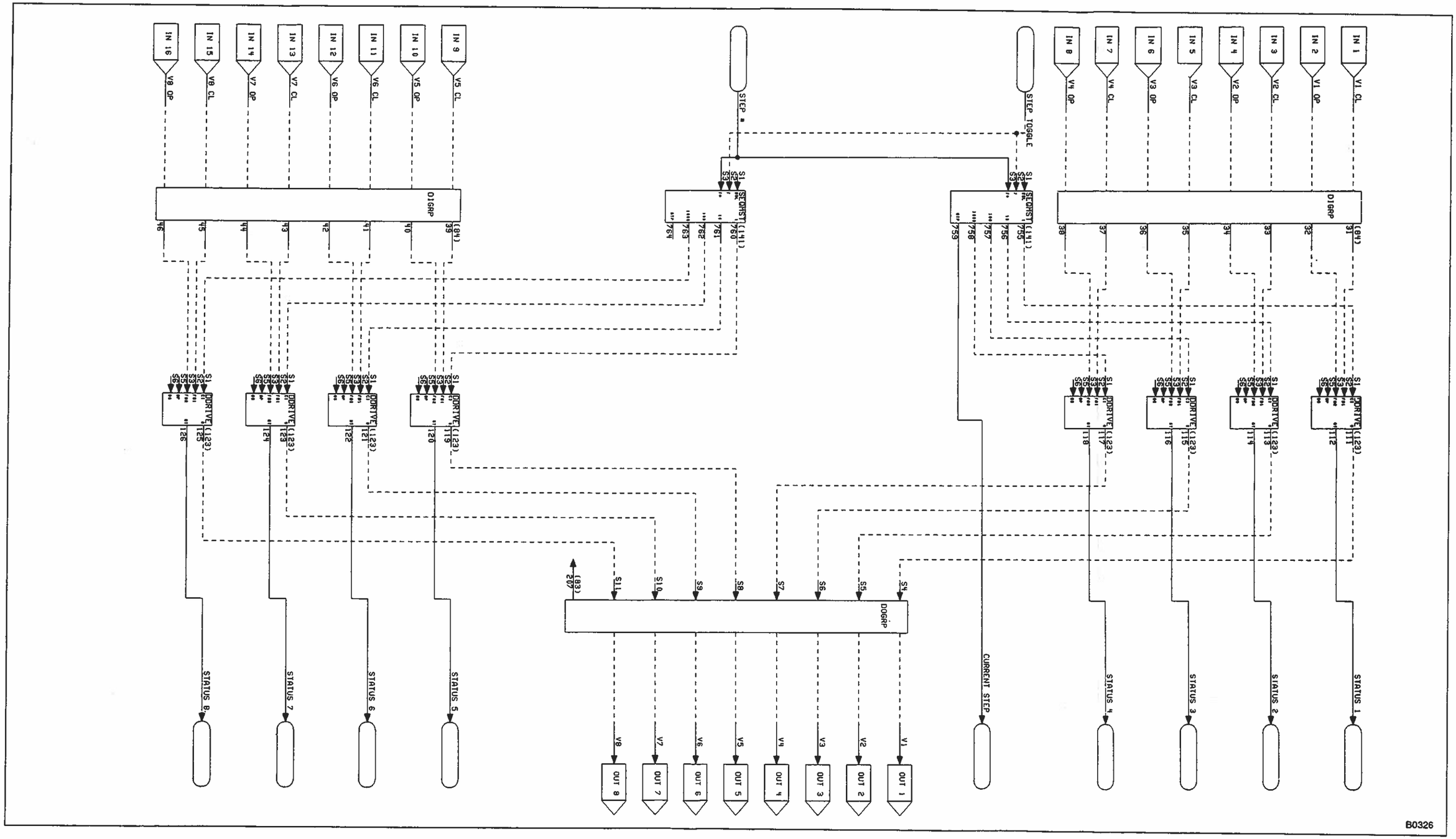


Figure 3-10. Configuration Diagram, Filter with Backwash

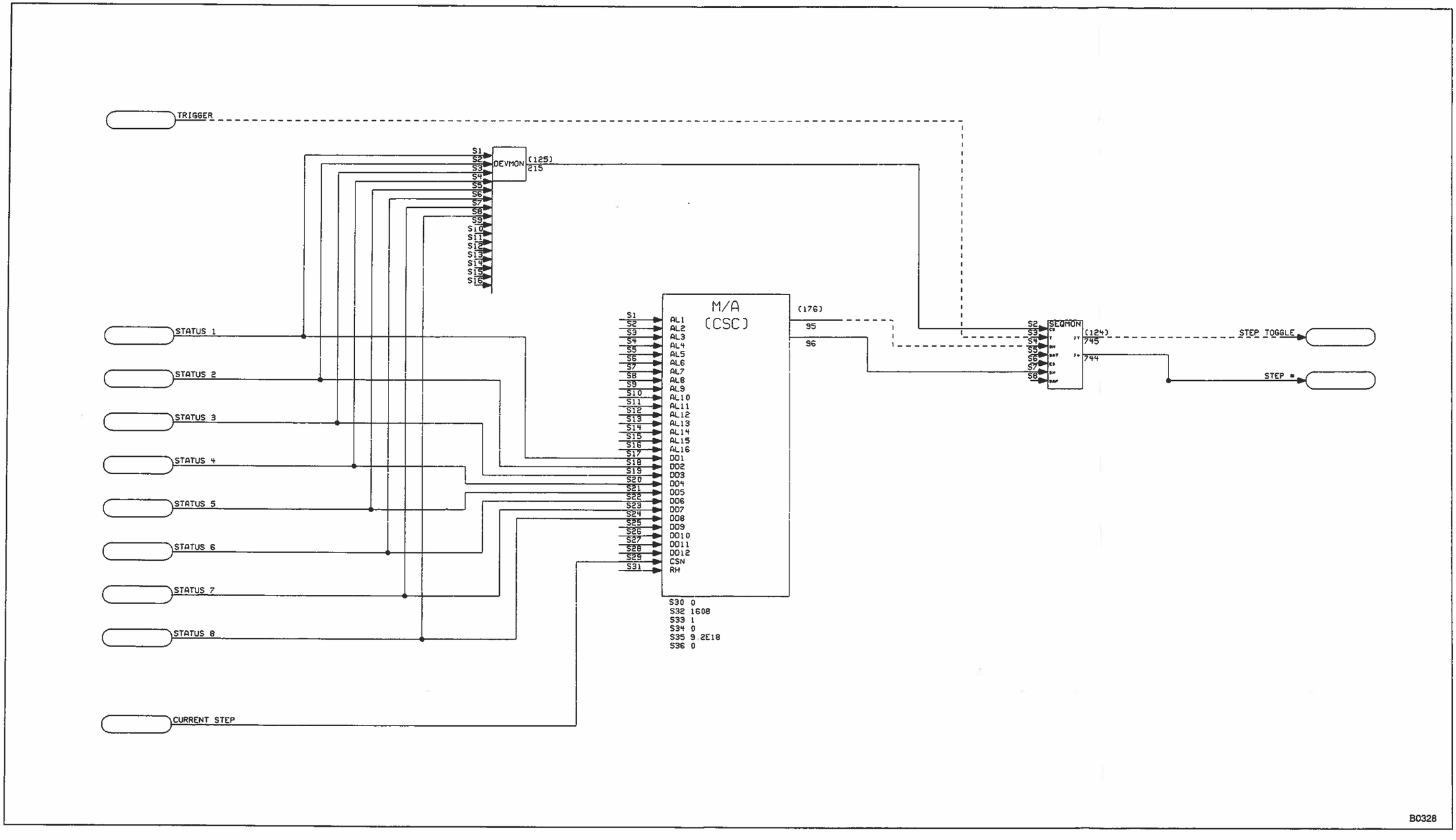


Figure 3-10. Configuration Diagram, Filter with Backwash (continued)

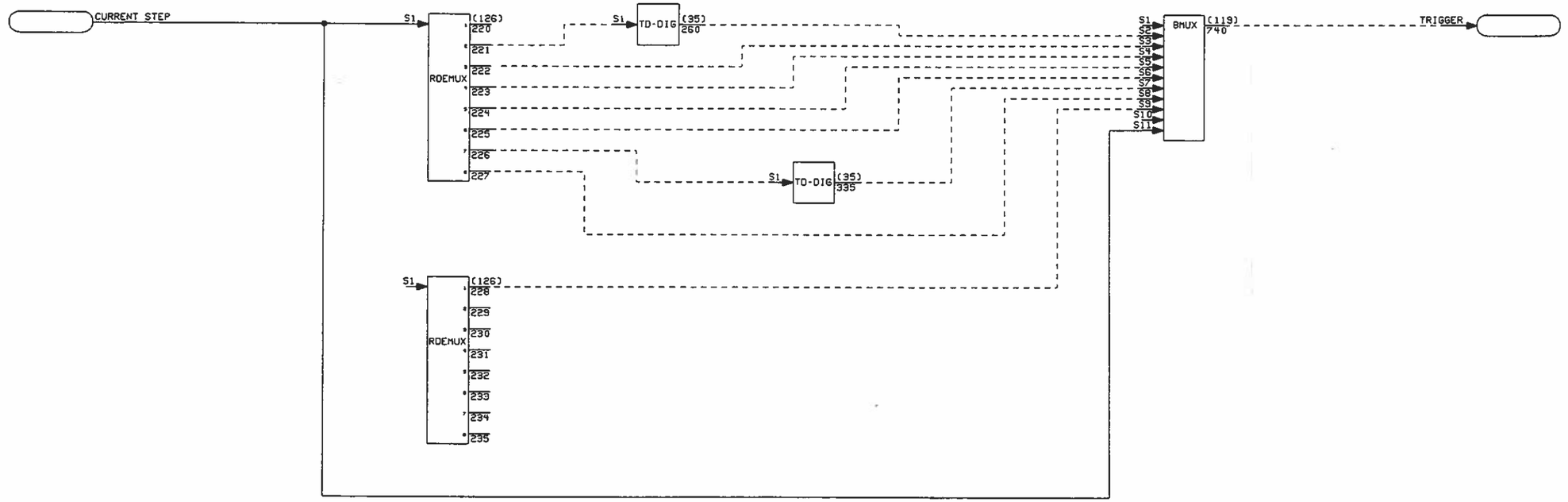


Figure 3-10. Configuration Diagram, Filter with Backwash (continued)

SECTION 4 – OPERATION

INTRODUCTION

This section provides 1) information on the faceplate indicators and controls, and 2) a description of the various operating modes of the controller.

INITIALIZATION

When the Sequence Command Controller is powered on, the alphanumeric display shows *POWER UP* and an initialization procedure is executed within the controller. This procedure first performs various self-checks of the controller. If everything is operating properly, the controller continues the initialization procedure which requires approximately 10 seconds to complete. If an error is found, the message *ERROR XX* will appear on the alphanumeric display where XX indicates a particular error code. Refer to Table 5-1 for a list and description of the error codes.

FACEPLATE INDICATORS AND CONTROLS

Alphanumeric Display

During normal operation, the alphanumeric display shows the controller mode (*EXECUTE, CONFIGURE, ERROR*) or the control process status (*RUN, HOLD, START, RESTART, E-STOP, DONE*) or the logic state (*0/1*) and operating mode (*automatic or manual*) of a selected output (Figure 4-1).

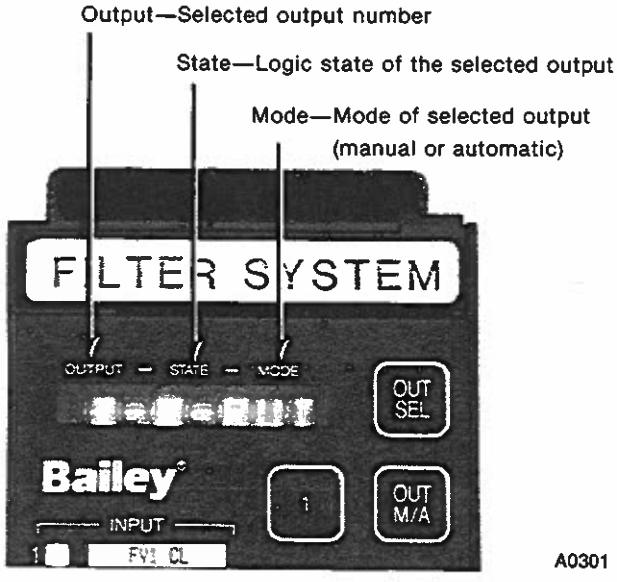


Figure 4-1. Alphanumeric Display

The alphanumeric display is also used to indicate any error conditions which exist. When the controller changes modes, the alphanumeric display will show *CONFIGURE* for configuration mode, *EXECUTE* for the execute mode and *ERROR XX* for the error mode. If an error is detected, the alphanumeric display shows an error message such as *LINK ERR* or *ERROR 01*. These messages remain on the display until the mode changes or the **OUT SEL** or **ALARM ACK** pushbuttons are pressed.

Refer to Table 4-1 for a summary of the various displays and to Table 5-1 in the troubleshooting section for a listing and description of possible error messages.

Table 4-1. Summary of Alphanumeric Displays

Display	Description
0	The **0** button was pressed during keyboard test.
1	The **1** button was pressed during keyboard test.
03 - 0 - AUT	DDB output specified is at a logic 0 state and is in AUTOMATIC mode.
03 - 1 - AUT	DDB output specified is at a logic 1 state and is in AUTOMATIC mode.
03 - 0 - MAN	DDB output specified is at a logic 0 state and is in MANUAL mode.
03 - 1 - MAN	DDB output specified is at a logic 1 state and is in MANUAL mode.
ALM ACK	The **ALARM ACK** button was pressed during keyboard test.
BACKUP	Backup ready.
COMPACT	The unit is compacting the NVRAM.
CONFIGURE	Unit is in the CONFIGURE mode.
DONE XX	The control sequencer has finished a single cycle and halted at Step XX.
ERROR XX	An error has occurred. Refer to Table 5-1 in the troubleshooting section for a listing and description of possible error messages.
E-STOP?	The control sequencer may be put into the EXECUTED STOP step by pressing the **1** key.
EXB BAD	Expansion Bus/Bypass Bus self test failed.
EXB OK	Expansion Bus/Bypass Bus self test passed.
EXB TEST	Expansion Bus/Bypass Bus self test is running.
EXECUTE	Unit is in the EXECUTE mode.
HOLD XX	The control sequencer has been halted. XX indicates the current step number.
I BACKUP (flashing)	Backup (configuration OK, dynamic data not initialized).
INITIAL	The unit is initializing its NVRAM.
KB TEST	Keyboard test has been activated.

Table 4-1. Summary of Alphanumeric Displays (continued)

Display	Description
LINK ERR	Station link communication error. The slave unit is not able to establish communications with the master unit over the station link and, therefore, the faceplate is inoperative.
MBUS BAD	Module Bus self test has failed.
MBUS OK	Module Bus self test has passed.
MB TEST	Module Bus self test is running.
MEM OK	Memory self test has passed.
MEM TEST	Memory self test is running.
NVR BAD	Non-volatile RAM failed the memory self test.
OUT M/A	The **OUT M/A** button was pressed during keyboard test.
OUT SEL	The **OUT SEL** button was pressed during keyboard test.
POWER UP	Unit has just been turned on or the **RESET** button has just been pushed.
RAM BAD	Random Access Memory failed the memory self test.
READY	The unit has completed the requested function and may be reset.
RESTART?	The control sequencer may be restarted at the first step by pressing the 1 key.
ROM BAD	Read Only Memory failed the memory self test.
RUN XX	The sequencer run signal has been set. XX indicates the current step number of the sequencer.
START XX	The control sequence may be started at Step XX by pressing the 1 key.
STOPPED	Unit has performed an orderly shutdown and halted due to the depression of the STOP button or undervoltage detection on the +24 V power supply.
STL TEST	Station Link self test is running.
STLK BAD	Station Link self test has failed.
STLK OK	Station Link self test has passed.
U BACKUP (flashing)	Backup (configuration not initialized).

I/O Indicating LEDs

The 16 input and 12 output bicolor LEDs on the faceplate are used to indicate the logic state of the corresponding I/O point. The I/O LEDs are programmable as pertains to color associated with a logic level and whether the bicolor or monocolor mode is used. Refer to the ***Selecting Options*** section for a description of switch settings.

When an I/O alarm condition occurs, the LED corresponding to the I/O points in alarm will flash. The color of the LED flashing will correspond to the current logic state of the I/O

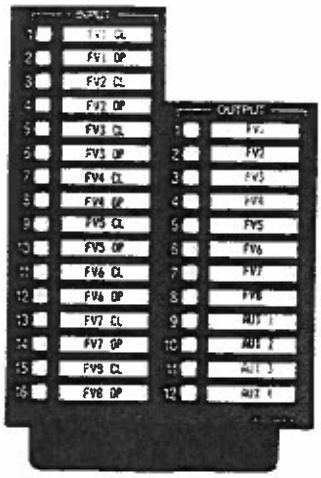


Figure 4-2. I/O Indicating LED s

point. Refer to Tables 2-4 and 2-5 for the alarm state LED colors.

NOTE: The OUTPUT LEDs always indicate the logic state of the digital output hardware. The INPUT LED's indicate either the digital input hardware logic state or the logic state of a digital signal within the configuration. This is determined by Specs 1-16 of Function Code 176.

Alarm LED

The alarm LED is located in the lower left corner of the alarm acknowledge **ALARM ACK** pushbutton. When the alarm LED is flashing, it indicates that an alarm condition exists which has not been acknowledged by the operator. When the alarm LED is on solid, it indicates that the operator has acknowledged the alarm conditions and the alarm conditions still exist.

Pushbuttons

OUT SEL The Output Select pushbutton is used to select one of the following messages to be displayed on the alphanumeric display: the controller mode *CONFIGURE*, *ERROR*, control process status *RUN*, *HOLD*, *E-STOP*, *RESTART*, *DONE* or one of the 12 digital outputs. Pressing the button causes the alphanumeric display to step through the controller mode, control process status, and then the 12 outputs in ascending order. Once output 12 is reached, pressing the button again causes the display to reset to the controller mode display. If the button is held down, the display will automatically step through the messages, stopping at the control process status display.

NOTE: If the alphanumeric display contains information other than the controller mode, control configuration status or the output status display (e.g., alarm messages), pushing the **OUT SEL** pushbutton will cause the previous display to appear.

OUT M/A The Output Manual/Automatic Select pushbutton is used to change the operating mode of the output selected on the alphanumeric display. Pushing the button causes the output mode

to toggle between MANUAL (MAN) and AUTOMATIC (AUT). If an output is not selected on the display, the button is ignored.

NOTE: Automatic mode is locked out when the controller is in the CONFIGURE mode. Manual mode can be locked out when the controller is in the EXECUTE mode by setting Spec S33 of Function Code 176 to logic 1.

ALARM ACK The Alarm Acknowledge pushbutton is used to acknowledge that an alarm condition exists. When an alarm condition occurs, the alarm LED located on the **Alarm Ack** pushbutton will flash and an audible beep will sound. Once the button is pressed, the audible beep will be silenced and the alarm LED will stay on solid. The appropriate alarm message will be shown on the alphanumeric display. Pressing the button again will step through any additional alarm messages. Once all the alarm messages have been viewed, pressing the button again will return the alphanumeric display to the beginning of the alarm list. To return to the alphanumeric display prior to the alarm condition, press the **OUT SEL** pushbutton.

If the **ALARM ACK** pushbutton is pressed when no alarm condition exists, the request is ignored.

If the button is pressed when alarm conditions exist but have already been acknowledged, it causes the alphanumeric display to step through the existing alarm conditions.

1 When the alphanumeric display shows an output status, the logic state 1 pushbutton sets the state of the selected output to a logic high (1) if the output is in MANUAL mode, otherwise it is ignored.

When the alphanumeric display shows the control configuration status, the button causes one of the following functions to occur: RUN, RESTART, START, E-STOP.

0 When the alphanumeric display shows an output status, the logic state 0 pushbutton sets the state of the selected output to a logic low (0) if the output is in MANUAL mode, otherwise it is ignored.

When the alphanumeric display shows *RUN XX*, the button causes the controller to hold the sequence at the current step. If the alphanumeric display shows *RESTART ?*, pressing the button calls up the step select option. If *START XX* is displayed, the button increments the step number.

RUN, HOLD, RESTART, START and E-STOP

When a Sequence Station Function Code 176 is configured, control of a multi-step sequencer may be run, held, restarted to the first step, started at a selected step, or put in the E-STOP step (default step).

In order to control the sequencer, the alphanumeric display must be set to show the desired sequencer action. This display is selected by depressing and holding the **OUT SEL** pushbutton until the desired display is shown.

The possible modes which will be displayed are listed in Table 4-2.

Table 4-2. Sequencer Control Modes

Display	Description
RESTART ?	Pressing the **1** pushbutton will cause the sequencer to begin running at step 1. Pressing the **0** pushbutton calls for the step select option (START XX).
START XX	Pressing the **1** pushbutton will cause the sequencer to begin running at step XX. Pressing the **0** pushbutton increments the step number.
RUN XX	Sequencer is running and currently on step XX. Pressing the **0** pushbutton will cause the sequencer to hold at step XX.
HOLD XX	Sequencer is being held at step XX, pressing the **1** pushbutton will cause the sequencer to begin running at step XX.
E-STOP ?	Pressing the **1** pushbutton will cause the sequencer to go to the E-stop step (step 0, default step). Refer to section titled, **Safety Related Information** for more information on E-STOP.

If the **0** pushbutton is pressed while the sequencer is running and the alphanumeric display is showing *RUN XX*, the sequencer operation will be held at the current step XX and the alphanumeric display will now show:

HOLD XX where XX is the step number.

Pressing the **OUT SEL** pushbutton causes the alphanumeric display to show:

RESTART ?

Continued pressing of the **OUT SEL** pushbutton causes the alphanumeric display to cycle through the digital outputs, *E-STOP ?* and back to *HOLD XX* and repeat the cycle.

If the **1** pushbutton is pressed while the alphanumeric display is showing *HOLD XX*, the sequencer will begin running at the current Step XX. The display will show:

RUN XX where XX is the step number.

Pressing the **OUT SEL** pushbutton again causes the alphanumeric display to cycle through the digital outputs, and *E-STOP ?*.

If the **1** pushbutton is pressed while the alphanumeric display is showing *E-STOP ?*, the sequencer will go to the E-STOP step (default step, Step 0). The display will show:

HOLD 00

NOTE: The E-STOP function is used to force the sequencer to execute default output states that have been defined by the user. These outputs should be defined to minimize possible equipment damage and prevent injury. The E-STOP function should not be used as a substitute for an ***emergency stop*** switch. Emergency stop switch(es) should de-energize power from a circuit to prevent or mitigate injury or equipment damage. Such switch(es) should be located so as to be easily used by operators close to equipment that may cause injury.

Pressing the **OUT SEL** pushbutton causes the alphanumeric display to cycle through the digital outputs, *RESTART ?*, *E-STOP?* and back to *HOLD 00*.

If the **1** pushbutton is pressed while the alphanumeric display is showing *RESTART ?*, the sequencer will begin running at Step 1. The display will show:

RUN 01

Pressing the **OUT SEL** pushbutton causes the alphanumeric display to cycle through the digital outputs, *E-STOP ?*, and back to *RUN XX*.

If the **0** pushbutton is pressed while the alphanumeric display is showing *RESTART ?*, the display will change to:

START 01

This is the step select option. In this mode, the operator may select a particular step to start at. Pressing the **0** pushbutton increments the step number until the number of steps specified during configuration in the sequence executive block, Spec 3, is reached. The step number will then cycle back to 01.

If the **1** pushbutton is pressed when *START XX* is displayed, the sequencer will begin running at Step XX. If the **OUT SEL** key is pressed, the display will go back to *RESTART ?*.

NOTES:

1. The START XX display is a timed display. If no pushbutton activity is detected for 15 seconds, the display switches back to *RESTART ?*.

2. The START XX function must be user-configured. Refer to the configuration section, **Function Code 175**.

Single Cycle Operation

During normal operation, the sequence station block checks to see if the step that was specified during configuration in Spec 35 of the sequence station block (Function Code 176) has been reached. If it has, the sequencer is halted and the alphanumeric display shows:

DONE XX where XX is the step number where the sequencer halted.

Pressing the **OUT SEL** pushbutton causes the alphanumeric display to cycle through *RESTART ?*, the digital outputs, *E-STOP ?*, and back to *DONE XX*.

Pressing any button while *DONE XX* is displayed has no effect on the sequencer operation. The operator must perform the *RESTART* or *START* functions to start the cycle over.

Refer to Figure 4-3 for a summary of the control actions and the alphanumeric display loop.

STOP Button

WARNING	**The STOP pushbutton causes a hardware shutdown and results in loss of automatic control. Outputs go to their user-defined hardware setting. It is to be used when removing the Sequence Command Controller from service - not for process control. Use the HOLD and E-STOP functions for process control stops.**
AVERTISSEMENT	**Le bouton-poussoir d'arret (STOP) provoque l'arret du materiel et peut provoquer la perte de la command automatique. Les signaux de sortie prennent alors la valeur definie au prealable par l'utilisateur. On doit l'utiliser au moment du retrait du Sequence Command Controller, et non a des fins d'interruption du controle de processus. Pour interrompre le controle du processus, utilisez les fonctions HOLD et E-STOP.**

The **STOP** button is located behind the legend/access door on the faceplate assembly (Figure 4-4) and performs the following functions:

1. Forces the Sequence Command Controller to finish writing data to its NVRAM.

2. Completes the data transfers over the expansion and module busses.

3. In redundant configuration, sends a complete primary configuration to a backup Sequence Command Controller.

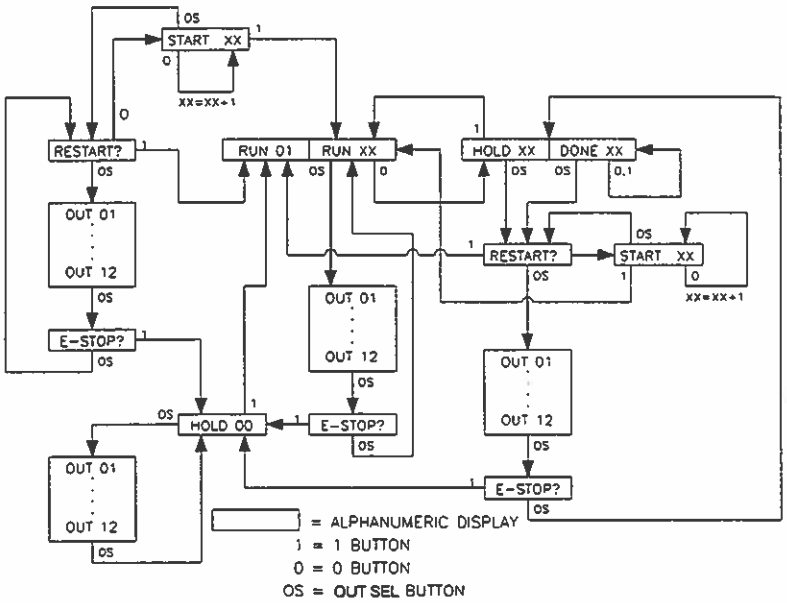


FIGURE A – MASTER/PRIMARY UNIT SEQUENCER CONTROLS AND DISPLAYS (EXECUTE MODE ONLY)

MASTER/PRIMARY UNIT

NORMAL RUN MODE	NORMAL HOLD/DONE MODE	E-STOP MODE	HOLD ON POWER-UP/RESET	CONFIGURE/ERROR MODE
E-STOP?	E-STOP?	HOLD 00	E-STOP?	CONFIGURE/ERROR
RUN XX	HOLD XX/DONE XX	OUT 01	RESTART?	OUT 01
OUT 01	RESTART?	OUT 02	OUT 01	OUT 02
OUT 02	OUT 01	OUT 03	OUT 02	OUT 03
OUT 03	OUT 02	OUT 04	OUT 03	OUT 04
OUT 04	OUT 03	OUT 05	OUT 04	OUT 05
OUT 05	OUT 04	OUT 06	OUT 05	OUT 06
OUT 06	OUT 05	OUT 07	OUT 06	OUT 07
OUT 07	OUT 06	OUT 08	OUT 07	OUT 08
OUT 08	OUT 07	OUT 09	OUT 08	OUT 09
OUT 09	OUT 08	OUT 10	OUT 09	OUT 10
OUT 10	OUT 09	OUT 11	OUT 10	OUT 11
OUT 11	OUT 10	OUT 12	OUT 11	OUT 12
OUT 12	OUT 11		OUT 12	
	OUT 12			

FIGURE B – ALPHANUMERIC DISPLAY LOOPS PER CONTROL MODE FOR A MASTER/PRIMARY UNIT

SLAVE UNIT	BACKUP UNIT
CONFIGURE OR EXECUTE OR ERROR MODE	ALL MODES
CONFIGURE/EXECUTE/ERROR XX	BACKUP/U BACKUP/I BACKUP
SLAVE	OUT 01
OUT 01	OUT 02
OUT 02	OUT 03
OUT 03	OUT 04
OUT 04	OUT 05
OUT 05	OUT 06
OUT 06	OUT 07
OUT 07	OUT 08
OUT 08	OUT 09
OUT 09	OUT 10
OUT 10	OUT 11
OUT 11	OUT 12
OUT 12	

FIGURE C – ALPHANUMERIC DISPLAY LOOPS FOR SLAVE AND BACKUP UNITS

TP80051A

Figure 4-3. Sequencer Control State Diagram

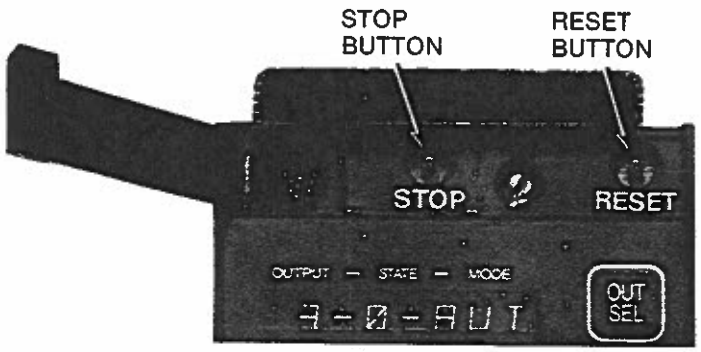


Figure 4-4. Location of STOP and RESET Buttons

4. In redundant configuration, it forces control from a primary to a backup Sequence Command Controller.

Push the **STOP** button before removing the Sequence Command Controller from service.

NOTE: Wait until the faceplate display indicates *STOPPED* before removing the unit from service.

RESET Button

WARNING	**Pushing the RESET button can cause momentary loss of automatic process control while the controller goes through a power-up condition. Outputs go to user-defined hardware settings. The sequencer may or may not be reset depending on whether RESTORE function codes are used.**
AVERTISSEMENT	**Une pression du bouton RESET provoque une interruption du controle du processus pendant que le module procede a son cycle de redemarrage. Les signaux de sortie prennent alors la valeur definie au prealable par l'utilisateur. Le sequenceur peut etre soumis a une remise a zero, selon que des codes fonctionnels RESTORE ont ete utilisee ou non.**

The **RESET** button is located behind the legend/access door on the faceplate assembly (Figure 4-4) and is used to:

1. Reset the Sequence Command Controller to power-up state after a STOP.

2. Recover from a Sequence Command Controller timeout due to a fault condition.

NORMAL OPERATION

During normal operation, the Sequence Command Controller is executing the control configuration stored in its NVRAM. The controller can be in one of two modes: Master or Slave.

The mode is determined by either installing or not installing a dipshunt in socket XU47 on the CPU board.

Master Mode

The master mode is selected by installing a dipshunt in socket XU47 on the CPU board. In the master mode, the Sequence Command Controller is permitted to access all slave I/O units and Sequence Stations connected to its expansion bus and station link. The controller's internal configuration drives the I/O and faceplate assemblies of other controllers connected to it as slaves.

If multiple Command Series Controllers are connected via the expansion bus, only one controller is permitted to be the master; the others must be the slaves. The exception to this is when a redundant backup controller is used. In this configuration, the backup controller is set up to be a master also.

Slave Mode

The slave mode is selected by NOT installing a dipshunt in socket XU47 on the CPU board. In the slave mode, the Sequence Command Controller is not permitted to use the expansion bus to access any I/O units. Its internal I/O is controlled by the master unit via the external expansion bus connection. The main purpose of the slave controller is to act as a display station, receiving its information from the master controller via the station link. The slave unit can still communicate over the module bus and execute a configuration stored in its NVRAM. However, the configuration cannot use any function codes which access I/O via the expansion bus or communicate over the station link.

MANUAL OPERATION

The Sequence Command Controller provides two methods for manual control of the 12 digital outputs.

1. Using the pushbuttons on the faceplate when the CPU is operational, and

2. Using the manual control board when maintenance or servicing of the controller is required.

CPU Controlled

When the Sequence Command Controller is operational and in the EXECUTE or CONFIGURE mode, the 12 digital outputs can be controlled manually using the following procedure:

NOTE: In EXECUTE mode, device driver blocks must be configured and properly linked for each output for which manual control is desired. Refer to section ***Control Operator Interface, Specifications 17-28, Function Code 176.***

1. Select the output to be controlled by pushing the **OUT SEL** pushbutton until the desired output is displayed on the alphanumeric display.

2. If the output is in automatic (AUT) mode instead of manual (MAN) mode, press the **OUT M/A** pushbutton to switch to the manual mode.

3. Press the **1** pushbutton to set the output to a logic 1 state (output contact closed) or press the **0** pushbutton to set the output to a logic 0 state (output contact open).

NOTE: At this point, another output may be selected and manually set to the desired logic state using the same procedure.

To return to automatic (AUT) control when the controller is in the EXECUTE mode:

1. Select the desired output using the **OUT SEL** pushbutton.

2. Press the **OUT M/A** pushbutton to switch the mode from manual (MAN) to automatic (AUT).

Manual Control Board Controlled

The manual control board (Figure 4-5) is located behind the faceplate assembly of the Sequence Command Controller. It provides a means for manual control of the digital outputs and visual indication of the digital input states when the faceplate/CPU board assembly is removed for maintenance or servicing.

The manual control board has 16 LEDs labeled CR1 through CR16 which correspond to digital inputs 1 through 16. If an LED is ON, it indicates that a logic high voltage level is applied to the input associated with that LED. If an LED is OFF, it indicates that a logic low voltage level is applied to that input.

OUTPUT SWITCHES

There are two sets of switches on the manual control board labeled S1 and S2. The 12 switches of S1 correspond to the 12 digital outputs. S2-1 CLOSED is the factory (default) setting. When switch S2-1 is in the ***Manual/Default*** position (CLOSED), switches S1-1 through S1-12 can be used to control the digital outputs. When a switch is in the ON position, the output is a logic 1 (contact closed). When a switch is in the OFF position, the output is a logic 0 (contact open).

If switch S2-1 is in the ***Hold*** position (OPEN), the digital outputs are driven to the logic state last set by the controller and switches S1-1 through S1-12 are inoperative. This option should only be chosen if the output board (Part No.

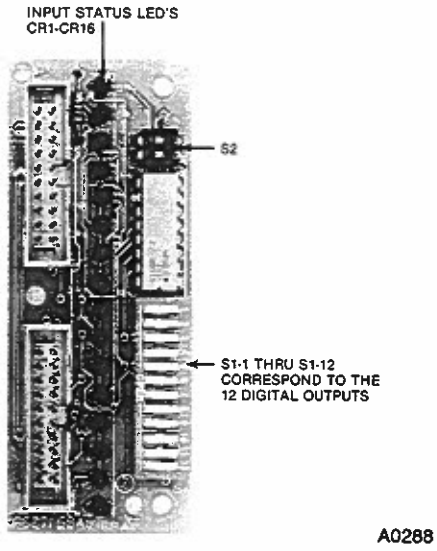


Figure 4-5. Manual Control Board

6637163-1) is revision D or greater; and if this condition is the least likely to cause damage or injury upon a loss of communications. Refer to ***Manual Control Board*** in the installation section.

Switch S2-1 is factory set in the ***Hold*** position (OPEN) so that when the faceplate/CPU board assembly is removed, the outputs hold the last value set by the controller.

If necessary, refer to Table 2-9 for a summary of the switch settings on the manual control board.

OPERATING MODES

The Sequence Command Controller has three modes of operation. They are: EXECUTE, CONFIGURE and ERROR. In the EXECUTE mode, the alphanumeric display shows *EXECUTE* or control process status (*RUN, HOLD, E-STOP, START, RESTART, DONE*) or output status, and the module performs the user-conFigured block operations. If certain non-fatal error conditions occur, the audible alarm sounds in this mode, but the Sequence Command Controller continues to execute. In the CONFIGURE mode, the alphanumeric display shows *CONFIGUR* or the output status and configuration data is entered or modified. In the ERROR mode, the alphanumeric display shows *ERROR XX*, the controller is not executing the function codes, and the unit will only respond to status and change mode commands from the Configuration and Tuning Terminal (CTT).

Execute Mode

This is the Sequence Command Controller's normal operating mode. In this mode, the Sequence Command Controller computes algorithms, performs functions, updates outputs,

and communicates with the module and expansion bus as well as the station and redundancy links. Certain function block parameters can be tuned (adjusted) but configurations cannot be modified in this mode. Refer to the configuration section for further details.

Configure Mode

The CONFIGURE mode enables the user to set up or change the Sequence Command Controller's operating scheme. While in this mode, function blocks can be added, modified or deleted via the Configuration and Tuning Terminal (CTT0□), an Operator Interface Unit (OIU), Management Command System (MCS), or a Computer Interface Unit (CIU). In the CONFIGURE mode:

1. The Sequence Command Controller's digital outputs are in Manual mode and can be controlled from the faceplate.

2. Function algorithms are not computed.

3. The Sequence Command Controller responds only to the CONFIGURE messages.

Error Mode

The ERROR mode occurs:

1. When the I/O fails and the associated Digital Input Group or Output Group (Function Code 84 or Function Code 83) Spec 3 is set to trip.

2. When transferring to the EXECUTE mode if a configuration error is detected.

3. After resetting due to an error condition as a result of a hardware problem such as NVRAM or EPROM checksum error.

4. If a trip block is activated.

The Sequence Command Controller can be configured to halt on an I/O error; and if an error occurs, the Sequence Command Controller stops executing and the alphanumeric display shows *ERROR XX*. The Sequence Command Controller outputs either hold their present value or go to a user-selected predetermined state. If the Sequence Command Controller is configured to continue executing upon I/O failure, it marks the I/O data of the failed CSC01 as having ***BAD Quality***. If the CSC01 is being used with an INFI 90/Network 90 system, the OIU and other INFI 90/Network 90 modules detect I/O failure when they read the CSC01 status. Any fatal error causes the alphanumeric display to show ERROR and the CSC01 stops executing. Press the **RESET** button and place the CSC01 in the CONFIGURE mode

to exit from the ERROR mode after correcting the problem. Refer to Figure 4-6.

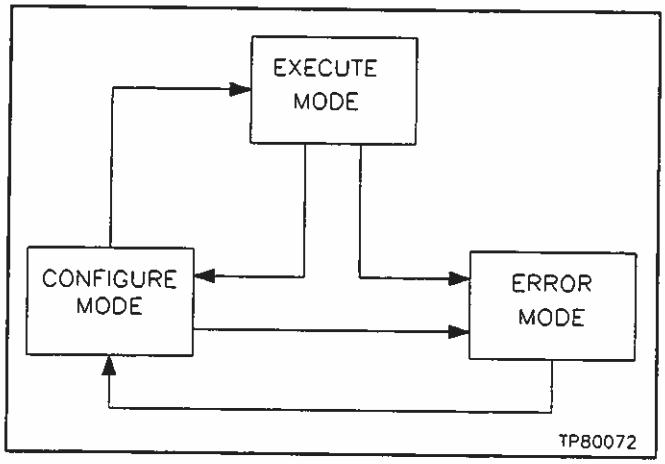


Figure 4-6. Entering the EXECUTE Mode after Error Correction

RS-232 PORT FUNCTIONS

The Sequence Command Controller's RS-232 port can be used for two functions: Data/Alarm Logging and Configuration Dump. Refer to section ***RS-232 Port Cabling*** for details on enabling and connecting the RS-232 port. The baud rate of the RS-232 interface is set by dip switches S1-2 and S1-3 on the CPU board. Refer to Table 2-6 for the switch settings. There are four baud rates which may be used: 300, 1200, 2400 and 9600. The factory setting is 300 baud.

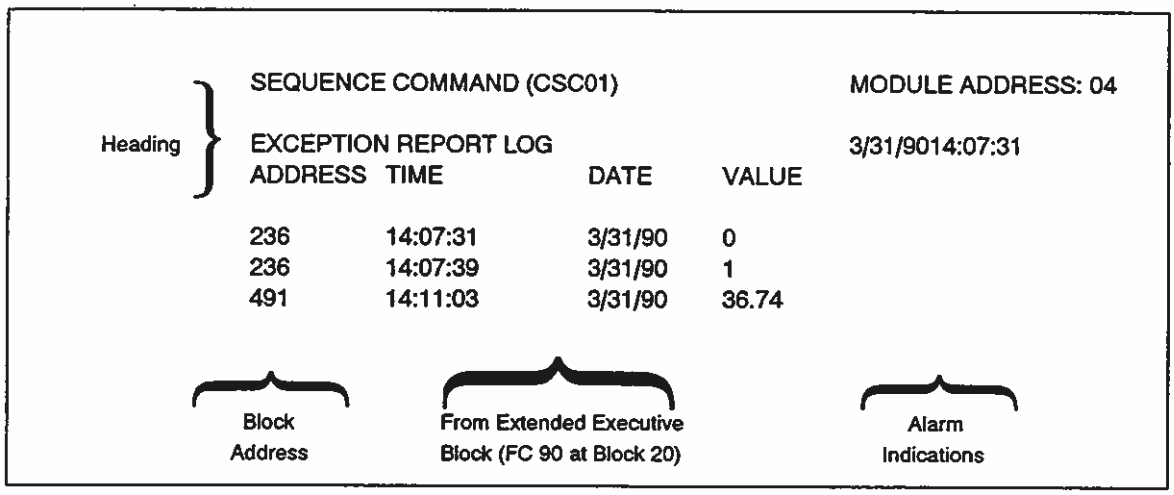
Table 4-3. RS-232 Interface Protocol

Data Bits:	8
Start Bits:	1
Stop Bits:	1
Parity:	None
Handshaking:	CTS
Equipment Type:	DTE

Data and Alarm Logging

When the Sequence Command Controller is in the EXECUTE mode, reports generated by Exception Report function codes (F.C. 30 and F.C. 45) in the control configuration can be sent out through the RS-232 port. These reports include changes of state and alarm conditions.

The report format is designed for an 80 column printer. New headers are printed at the top of each page. The data is sent out in the following format using ASCII characters.



Configuration Dump

When the Sequence Command Controller is in the CONFIGURE mode, a listing of the entire control configuration stored in the controller's NVRAM can be ***dumped*** to the RS-232 port. The listing is sent out in the following format using ASCII characters:

```
    SEQUENCE COMMAND (CSC01)                    MODULE ADDRESS:  04

    CONFIGURATION DUMP
BLOCK ADDRESS:  0                               FUNCTION CODE:  175
        S1:  1
        S2:  1
        S3:  10
        S4:  8
        S5:  12
        S6:  0.000
        S7:  0.000
        S8:  0

BLOCK ADDRESS:  15                              FUNCTION CODE:  82

        S1:  1
        S2:  0.250
        S3:  0
        S4:  1
        S5:  0
        S6:  10.000
```

This option is controlled by the Configuration and Tuning Terminal CTT. Refer to Product Instruction I-E92-501-1 (CTT01) or I-E92-501-2 (CTT□2) for details on initiating a configuration dump.

The time required for a configuration dump varies with the size of the configuration and the speed of the device connected to the RS-232 port.

SECTION 5 – TROUBLESHOOTING

GENERAL

This section provides the user with a listing of the CSC Controller faceplate error codes and the corrective action to be taken. It also includes several checking procedures and recovery actions that could be encountered during troubleshooting.

Table 5-1 is a listing of the faceplate alphanumeric display error messages, what they mean, and what action should be taken. Figure 5-1 is a troubleshooting flow chart and Figure 5-2 is an interconnect diagram of the Sequence Command Controller.

Table 5-1. CSC01 Faceplate Alphanumeric Error Displays/User Action

Error Code	Meaning	Action
01	NVRAM checksum error has occurred.	Set switch S3-7 on the CPU board. Refer to Table 2-6. If error still exists, reformat the NVRAM. Refer to procedure in this section. All configuration will be lost.
03	***BAD*** status message has been transmitted on the expansion bus.	Check switch settings on I/O units. Also, check specs of applicable I/O function codes. If slaves are used, check CKE001 cable. If error is still present, replace the output board with a known good board. Refer to repair/replacement for replacement procedures.
05	Undefined function block in configuration.	Change mode to CONFIGURE. Check configuration. Modify function codes/blocks.
06	Undefined or incorrectly defined data type in configuration.	Change mode to CONFIGURE. Check specs of function codes in the configuration. Correct any discrepancies.
08	Trip block activated.	Check configuration logic which activated the trip block.
10	Primary CSC01 has failed and data in backup CSC01's dynamic RAM is not correct.	Reconfigure the primary CSC01.
11	Error occurred while CSC01 was writing to NVRAM.	Set switch S3-7 on the CPU board. (**NOTE:** All configurations will be lost.)
12	NVRAM checksum error detected.	Reformat the NVRAM. Refer to NVRAM reformat procedures in this section. All configurations will be lost.
18	Backup CSC module bus address is not the same as the primary CSC.	Set module bus address switches the same as settings on the primary CSC.

Table 5-1. CSC01 Faceplate Alphanumeric Error Displays/User Action (continued)

Error Code	Meaning	Action
20	Switches S3-6 and S3-7 are set to 1. CSC01 is in the INITIALIZE and CONFIGURATION COMPACT mode.	Reset switches S3-6 and S3-7. Refer to Table 2-6.
22	Communication error between primary and backup CSC01's.	Check the CKR001 cable between the primary and backup CSC01's. Check that dipshunt is installed in XU41 on CPU board of both units.
23	Duplicate CSC01's with same module bus address have the same ID (switch S3-8 on both CSC01's is same).	Change S3-8 on the CPU board of one of the CSC01's. Make one CSC01 a backup. Refer to Table 2-6.
24	Primary CSC01 has failed and configuration in the backup CSC01 is not correct.	Reconfigure the primary CSC01, reset the backup.
30	The system tried to force control to the backup CSC01 while the primary CSC01 was still functioning.	Press RESET switch on the primary CSC01. The primary should come up as secondary CSC01.
31	Fault exists on the CPU board.	Replace the CPU board with a known good one. Refer to repair/replacement for replacement procedures.
32	Address bus error.	Power down CSC01. Wait for 5 seconds and then power CSC01 back up. If error still present, replace CPU board with known good CPU board. Refer to repair/replacement for replacement procedures.
33	Attempt to execute illegal instruction.	Press **RESET** button on CSC01. If error still present, replace CPU board with known good CPU board. Refer to repair/replacement for replacement procedures.
34	The microprocessor has detected a trace/privilege violation.	Press RESET button on CSC01. If error still present, replace CPU board with known good CPU board. Refer to repair/replacement for replacement procedures.
35	The CSC01 is generating inaccurate exception reports.	Press RESET button on CSC01. If error still present, replace CPU board with known good CPU board. Refer to repair/replacement for replacement procedures.
36	A divide by 0 or CHK (check) instruction was encountered in the configuration.	Check configuration, then press **RESET** button on CSC01. If error still present, replace CPU board with known good CPU board. Refer to repair/replacement for replacement procedures.

Table 5-1. CSC01 Faceplate Alphanumeric Error Displays/User Action (continued)

Error Code	Meaning	Action
37	A ***trap*** instruction was encountered in the configuration.	Check configuration. Press **RESET** button on CSC01. If error still present, replace CPU board with known good CPU board. Refer to repair/replacement for replacement procedures.
39	Redundancy link and RS-232 both selected simultaneously.	Power down CSC01. Select one. Controller can be configured for RS-232 or redundancy link, but not both.
LINK ERR	The controller cannot communicate over the serial station link with the control station(s) configured.	Check configuration, wiring (CKE001-2 cable), and station link baud rate setting (S4 on CPU board). Refer to Table 2-6.

CHECKING PROCESS CONTROL INTEGRITY

The controller performs both hardware and software security checks to ensure unit integrity.

Hardware Checks

Illegal Address Detect If an illegal address is detected, a BUS ERROR is generated and the controller stops.

Machine Fault Timer The microprocessor periodically updates this timer. If at any time, due to hardware or software error, the timer is not updated, the controller stops. Refer to Table 5-1.

Software Checks

Unit Diagnostics These tests are performed when the system is powered up. If any test fails, faceplate display indicates the error condition.

Unit Status Check This test checks the checksums of the NVRAM and EPROM. Discrepancies cause the faceplate display to show ERROR (refer to Table 5-1 for interpretation) and the controller to shut down.

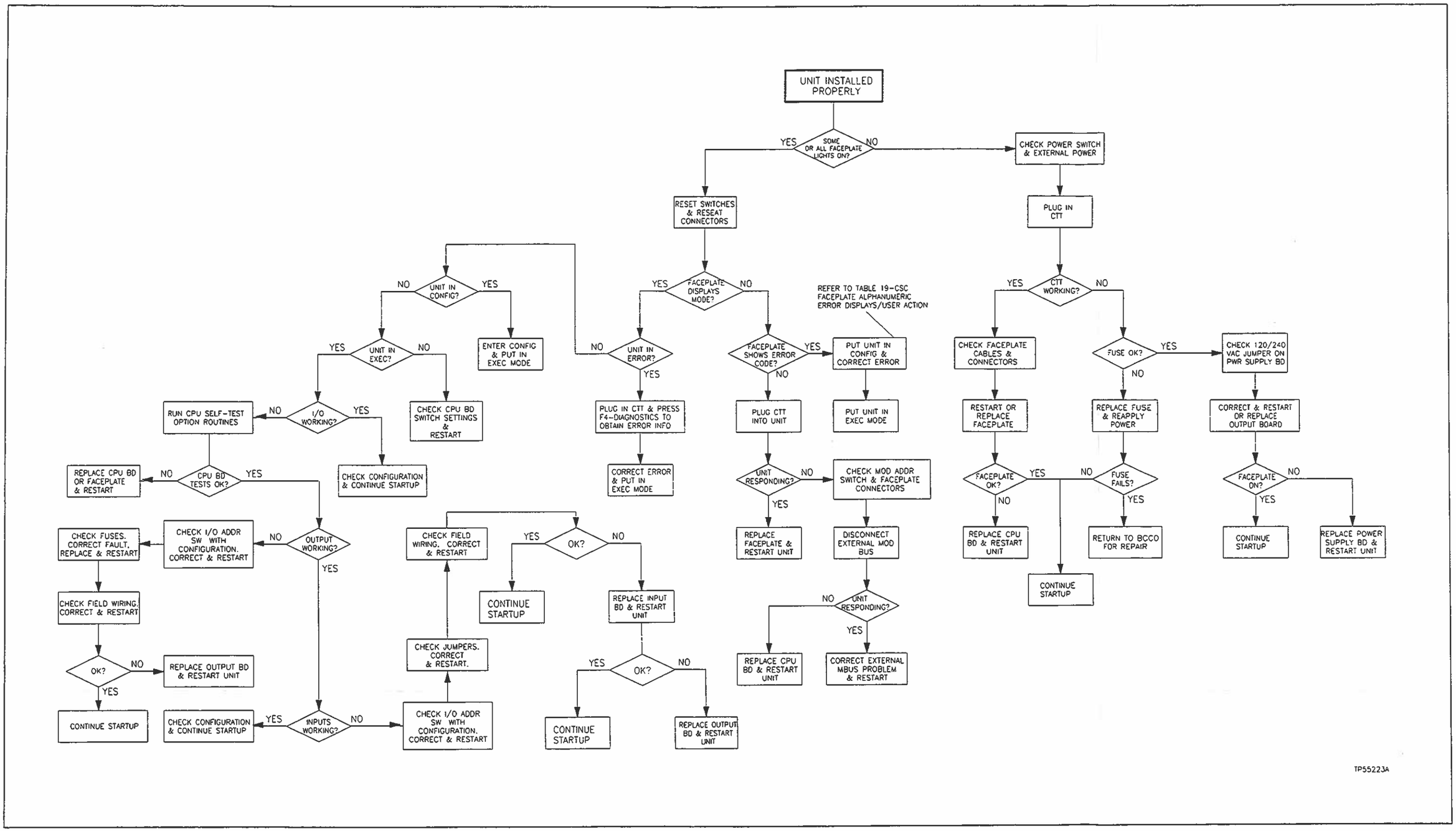


Figure 5-1. Troubleshooting Flow Chart

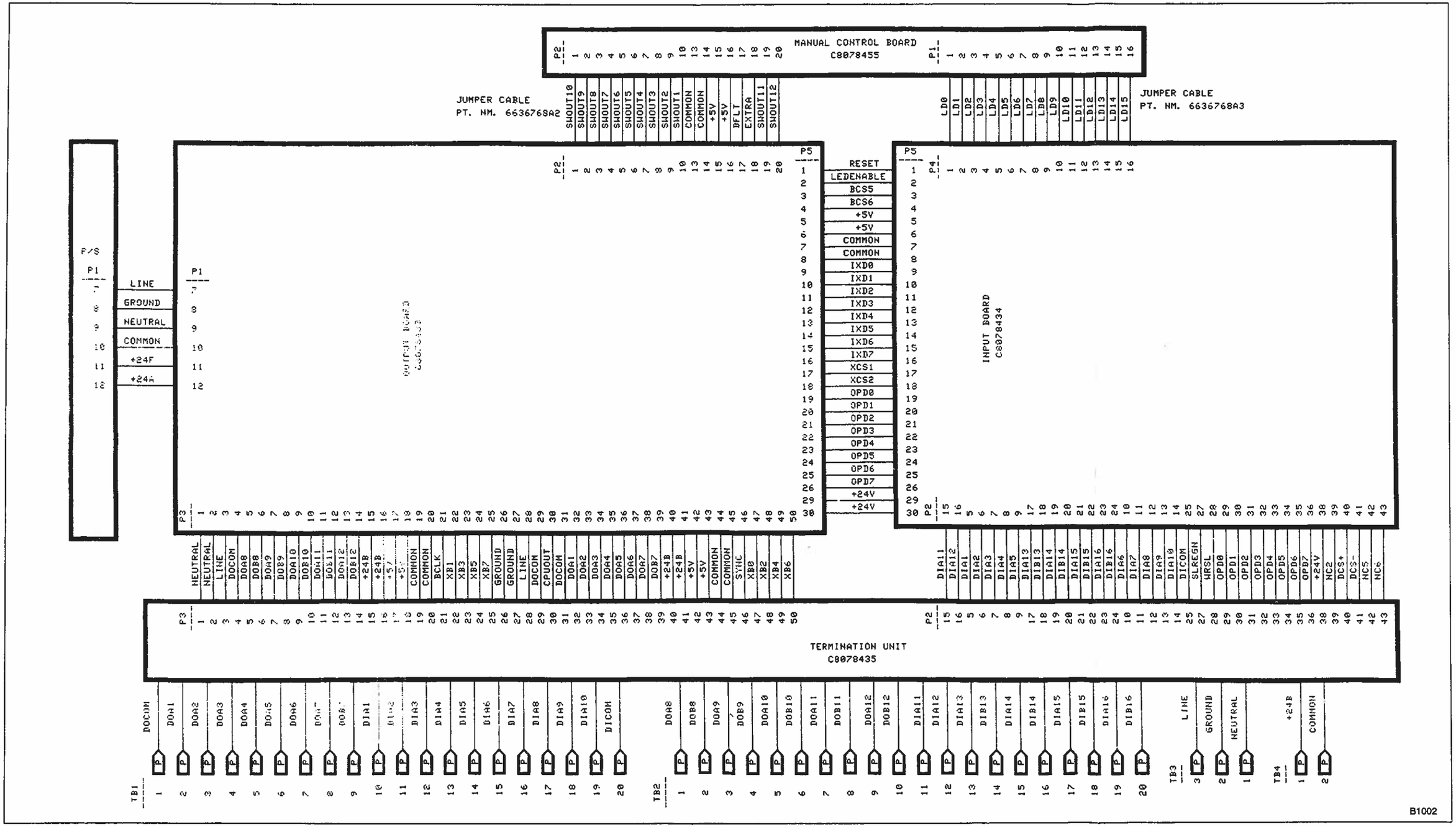


Figure 5-2. CSC01 Interconnect Diagram

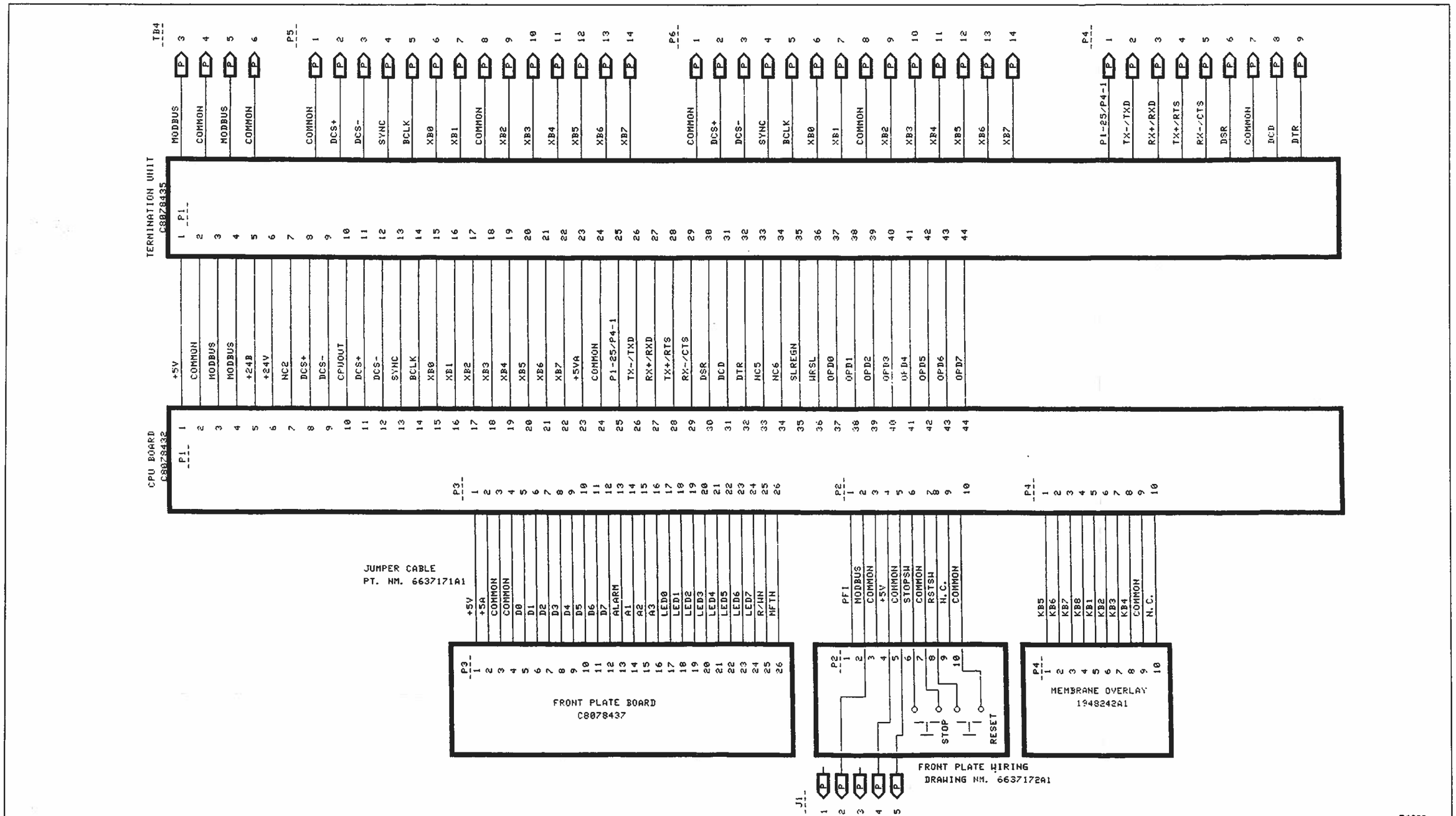


Figure 5-2. CSC01 Interconnect Diagram (continued)

SECTION 6 – MAINTENANCE

INTRODUCTION

No periodic maintenance is necessary for the Sequence Command Controller.

SECTION 7 – REPAIR/REPLACEMENT

GENERAL

Provides the user with disassembly and assembly procedures for replacement of the faceplate/CPU assembly, input board, output board, power supply board, manual control board and termination board. It also outlines information on replacing fuses and the I/O tags.

Bailey Controls Company does not recommend the repair of printed circuit boards in the field. Equipment requiring repair should be returned to the factory or your nearest Bailey Service Center.

WARNING	**EXPLOSION HAZARD** **Substitution of components may impair suitability for Class I, Division 2 Hazardous Locations.**
AVERTISSEMENT	**RISQUE D'EXPLOSION** **La substitution de tout composant peut rendre le system inapproprie a un emplacement dangereux de Class 1 et de Division 2.**

NOTES:

1. The faceplate assembly, CPU board and input/output boards contain MOS (metal oxide semiconductor) devices and are subject to damage by static electricity. Refer to section titled **Special Handling Procedure for MOS Devices** in this instruction book.

2. After any repair/replacement procedures and prior to returning the controller to service, make certain that the rear cover of the controller is in place to maintain system safety and accuracy. The cover prevents operator access to live 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.

REPLACEMENT PROCEDURES

WARNING	**EXPLOSION HAZARD** **Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.**
AVERTISSEMENT	**RISQUE D'EXPLOSION** **vant de deconnecter o'equipment, couper le courant ou s'assurer que l'emplacement est designe non dangereux.**

Replacing the Faceplate Assembly or CPU Board

NOTES:

1. The faceplate assembly and CPU board will be removed from the housing as one assembly.

2. The manual control board will allow the user to maintain manual control of the digital outputs and monitor the digital inputs while servicing or replacing the faceplate/CPU assembly. Refer to the operation section, ***Manual Control Board Controlled*** for the procedures.

1. Remove power from the controller.

2. Open the legend/access door on the controller faceplate. loosen the captive locking screw until the faceplate assembly can be pulled forward.

3. Carefully pull the faceplate and CPU board assembly from the housing.

4. Place the faceplate/CPU board assembly on an anti-static surface. Avoid touching the circuitry. Handle the assembly by the edges.

5. Unplug the three connectors on the CPU board that are used to connect the faceplate assembly.

6. Remove the three screws securing the faceplate assembly to the CPU board.

NOTE: If replacing the CPU board, note the switch settings before discarding the board.

7. Discard the faceplate assembly or the CPU board.

8. If the CPU board assembly is being replaced, set the switches and proceed with reassembly by reversing the above procedures.

NOTE: When reassembling the faceplate assembly/CPU board into the housing, make certain the CPU board is firmly seated in the termination board connector.

Replacing the Input Board, Output Board, Power Supply Board or Manual Control Board

NOTE: To replace any of these boards, it is necessary to remove the entire input/output assembly from the housing. This assembly consists of the input board, the output board, the AC/DC power supply board, the manual control board and the power supply mounting bracket.

1. Remove the faceplate/CPU board assembly from the housing as described under ***Replacing the Faceplate Assembly or CPU Board***, Steps 1 through 4.

2. To remove the input/output assembly, insert a screwdriver into the slot in the tab located at the top of the power supply bracket and carefully pry against the case, pulling forward (Figure 7-1). Slide the assembly out of the housing.

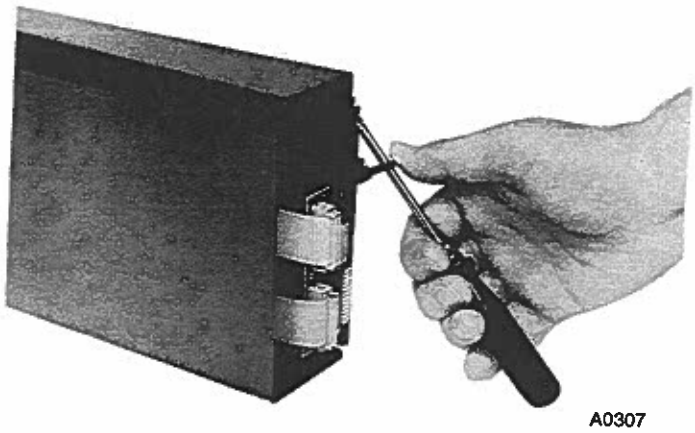


Figure 7-1. Removing the Input/Output Assembly

3. Place the input/output assembly on an anti-static surface. Avoid touching the circuitry. Handle the assembly by the edges.

4. To remove the manual control board, unplug the ribbon connectors; one at the input board, the other at the output board. Unplug the two ribbon connectors at the manual control board.

5. Remove the three screws securing the manual control board to the power supply mounting bracket.

   a. Remove the manual control board and note the switch settings.

   b. Set the switches on the new manual control board and reverse Steps 1 through 5 to reassemble.

6. Remove the three screws securing the power supply mounting bracket to the output board.

7. Secure the power supply board with one hand and with the other, pull on the input/output board assembly until it disconnects from the power supply board and power supply mounting bracket.

8. If replacing the power supply board, carefully remove the power supply board from the power supply board mounting bracket.

   a. Note the jumper settings before discarding the board.

   b. Set jumpers on new power supply board.

   NOTE: If the controller is to be used with 220/240 VAC supply, a jumper must be removed from the power supply board prior to entering into service. Refer to section titled ***AC Power Wiring*** and Figure 2-3.

   c. Reassemble by reversing Steps 1 through 8, omitting Step 5.

9. If replacing the input or output board, remove the four screws (and standoffs if the output board is to be replaced) securing the input board to the output board.

   a. Carefully unplug the input board from the output board by pulling the boards straight apart.

   NOTE: If just the input board is being replaced, check the fuses on the output board while it is removed. Visually inspect output fuses F1 through F12 and 24 V fuse F13. Replace fuses if needed. If the output board is being replaced, check the fuses on the new board before reassembling.

   b. Note the jumper/switch settings on the board being replaced before discarding it.

   c. Set the jumpers/switches on the new board.

   d. Reassemble by reversing Steps 1 through 9, omitting Steps 5 and 8.

10. Make certain during the reassembly procedures that the CPU, input and output boards are firmly seated in the termination board connectors.

Replacing the Termination Board

NOTE: To replace the termination board, it is necessary to remove the faceplate/CPU assembly and the input/output assembly from the housing.

1. Remove the faceplate/CPU assembly by loosening the locking screw under the legend/access door and sliding the assembly out of the housing.

2. Remove the input/output assembly by inserting a screwdriver into the bottom of the slot in the tab located at the top of the power supply bracket and carefully prying against the case (Figure 7-1). Slide the assembly out of the housing.

3. 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.

4. Disconnect all cables connected to the termination board at P4, P5 and P6.

5. Remove the four screws securing the termination board to the controller housing.

6. Remove and discard old termination board.

7. Install new termination board by reversing Steps 1 through 6 above.

NOTE: Make certain when reassembling the CPU board and the input and output boards that they are firmly seated in the termination board connectors.

Replacing the Input and Output Tags

1. There are two small openings (pockets) at the bottom of the faceplate housing just below the tags that are used for removing or installing the tags. The tags are installed behind a very thin transparent covering. Grasp the bottom of the tags and pull to remove.

NOTES:
1. To gain easier access to the tag openings, the bottom of the faceplate may be popped out slightly by inserting a small screwdriver in one of the bottom slots of the plastic support plate and gently prying up.

2. A very small pair of needle nose pliers or tweezers may aid in removal.

2. Start the new tags into the small opening and slide up and into position.

3. Tear off bottom portion of the tags at the perforation line.

Replacing the Fuses

NOTE: To replace any fuses, it is necessary to remove the faceplate/CPU assembly and the input/output assembly from the housing.

1. Remove the faceplate/CPU board assembly from the housing as described under ***Replacing the Faceplate Assembly or CPU Board***, Steps 1 through 4.

2. To remove the input/output assembly, insert a screwdriver into the bottom of the slot in the tab located at the top of the power supply bracket and carefully pry against the case, pulling forward (Figure 7-1). Slide the assembly out of the housing.

3. Place the input/output assembly on an anti-static surface. Avoid touching the circuitry. Handle the assembly by the edges.

4. If replacing a power supply board fuse, remove the fuse in the socket designated F101 or F102. Replace F101 with a 3A, 250 V fuse. Replace F102 with a 2 A, 250 V fuse. Reverse Steps 1 through 3 to reassemble. Refer to Figure 7-2 for location.

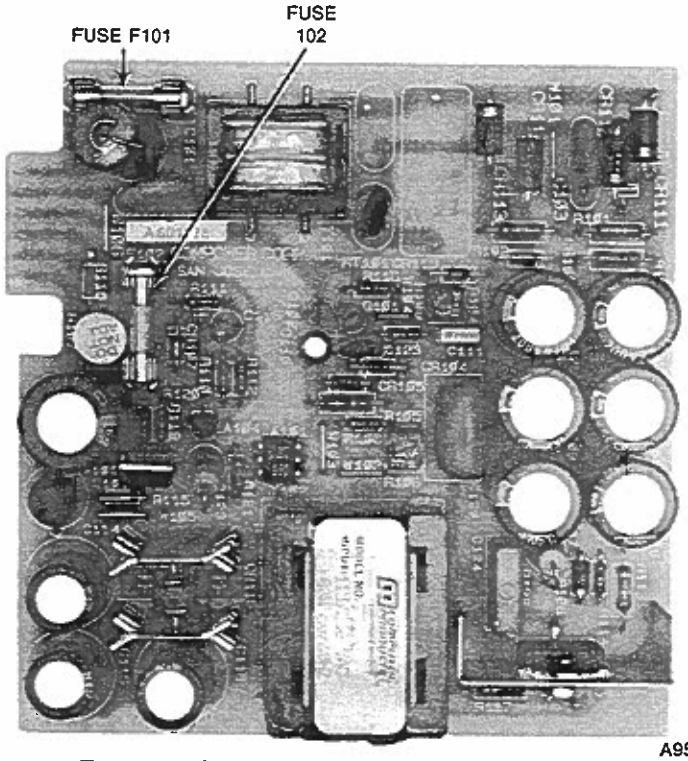


Figure 7-2. Power Supply Board Fuses

5. If replacing the output board fuses, remove the four screws securing the input board to the output board. Refer to Figure 7-3 for location of the fuses.

a. Carefully unplug the input board from the output board by pulling the boards straight apart.

b. Replace any bad fuses with the 2.5 A spare fuses supplied with each controller.

c. Reassemble by reversing Steps 1 through 5, omitting Step 4.

NOTE: Make certain during the reassembly procedures that the CPU, input and output boards are firmly seated in the termination board connectors.

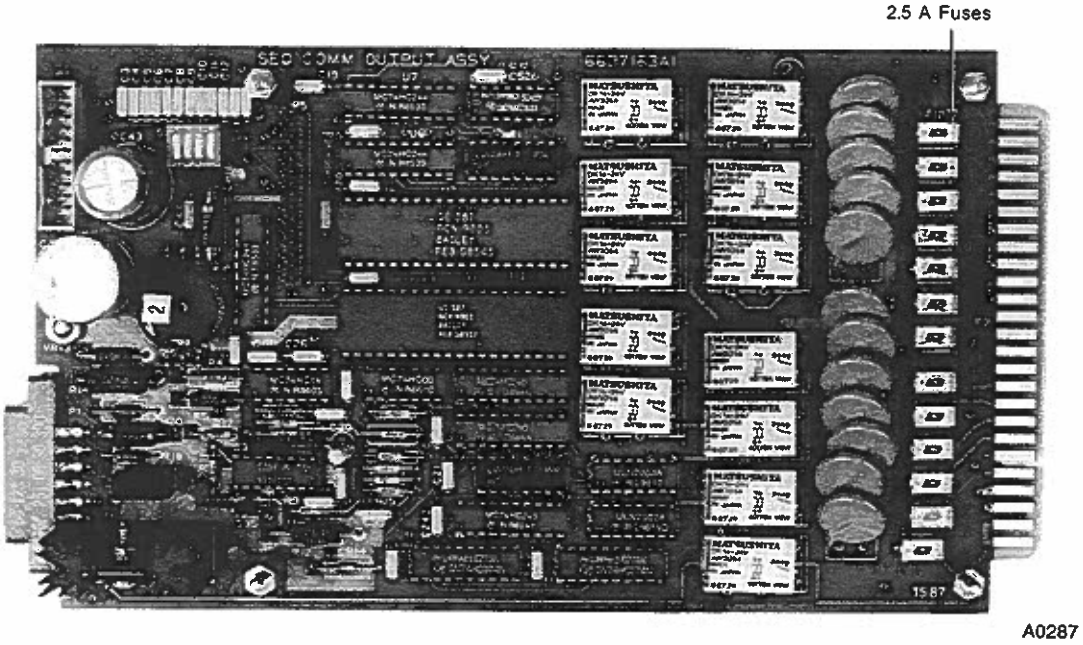


Figure 7-3. Replacing Output Board Fuses

SECTION 8 – REPLACEMENT PARTS

INTRODUCTION

Bailey Controls Company is ready to assist in the use and repair of its products at any time. Requests for sales and/or application service should be made to the nearest sales or service office.

Refer to Figure 8-1 for an assembly drawing of the CSC01 and a list of spare parts available.

Parts List For Figure 8-1		
Item	Part No.	Description
1	6637112-1	CPU BOARD ASSY
2	6637168-1	I/O ASSY (INCLUDES ITEMS 3-7)
3	6637165-1	INPUT BOARD ASSEMBLY
4	6637163-1	OUTPUT BOARD ASSEMBLY
5	1948118-1	POWER SUPPLY BOARD ASSEMBLY (INCLUDES ITEMS 6 AND 7)
6	1948182-23001	FUSE, 3 A, FAST ACTING, 250 V
7	1948182-32001	FUSE, 2 A, SLO BLOW, 250 V
8	6637169-1	TU BD ASSY
9	1963660-1	NAMEPLATE
10	1963673-1	SERVICE LEGEND
11	5311428-10	O-RING
12	6636612-1	REAR COVER
13	6636615-1	SLIDE NUT, 2 REQD
14	6636733-1	CARD GUIDE, 2 REQD
15	6637232-1	TU WIRING LABEL
16	NBZHA16006	.190-32X.312 PAN HD SLTD MACH SCR
17	NBTHA23040	.312-18X2.50 FILL HD SLTD MACH SCR, 2 REQD
18	NIDAC09004	.112-40X.250 PAN HD SLTD SEMS EXT MACH SCR, 4 REQD
19	NPMHA08010	R-3801, .156 LG. SEMI-TUB RD HD RIVET, 4 REQD
20	6636735-1	MOUNTING BRKT, 2 REQD
21	A199394	MP 295-483 CAUTION LABEL, 2 REQD
22	6636610-1	CASE
23	NGJAC09006	.112-24X.375 PAN HD SLTD THD CUTG SCR, TYPE 25, 3 REQD
24	1948445-1	LABEL, 3 REQD
25	6637622-1	FRONTPLATE ASSY
26	1900155-□1□	CSC ROM (□1□ REFERS TO LATEST REVISION LEVEL)
27	1948266-25	FUSE, 2.5 A, 2 REQD
28	6637411-1	MANUAL CONTROL BD
29		FM LABEL
30	1948445-2	LABEL, 3 REQD
31	1948335-1	POLARIZING KEY

Spare Parts Kit - Part No. 258435A1			
Item	Part No.	Description	Qty
10	1963673A1	SERVICE LEGEND	1
23	NGJAC09006	0.112-24x0.375 PAN HD SLTD THD CUTG SCR	3
24	1948445A1	LABEL	3
25	6637622A1	FRONTPLATE ASSY	1
30	1948445A2	LABEL	3

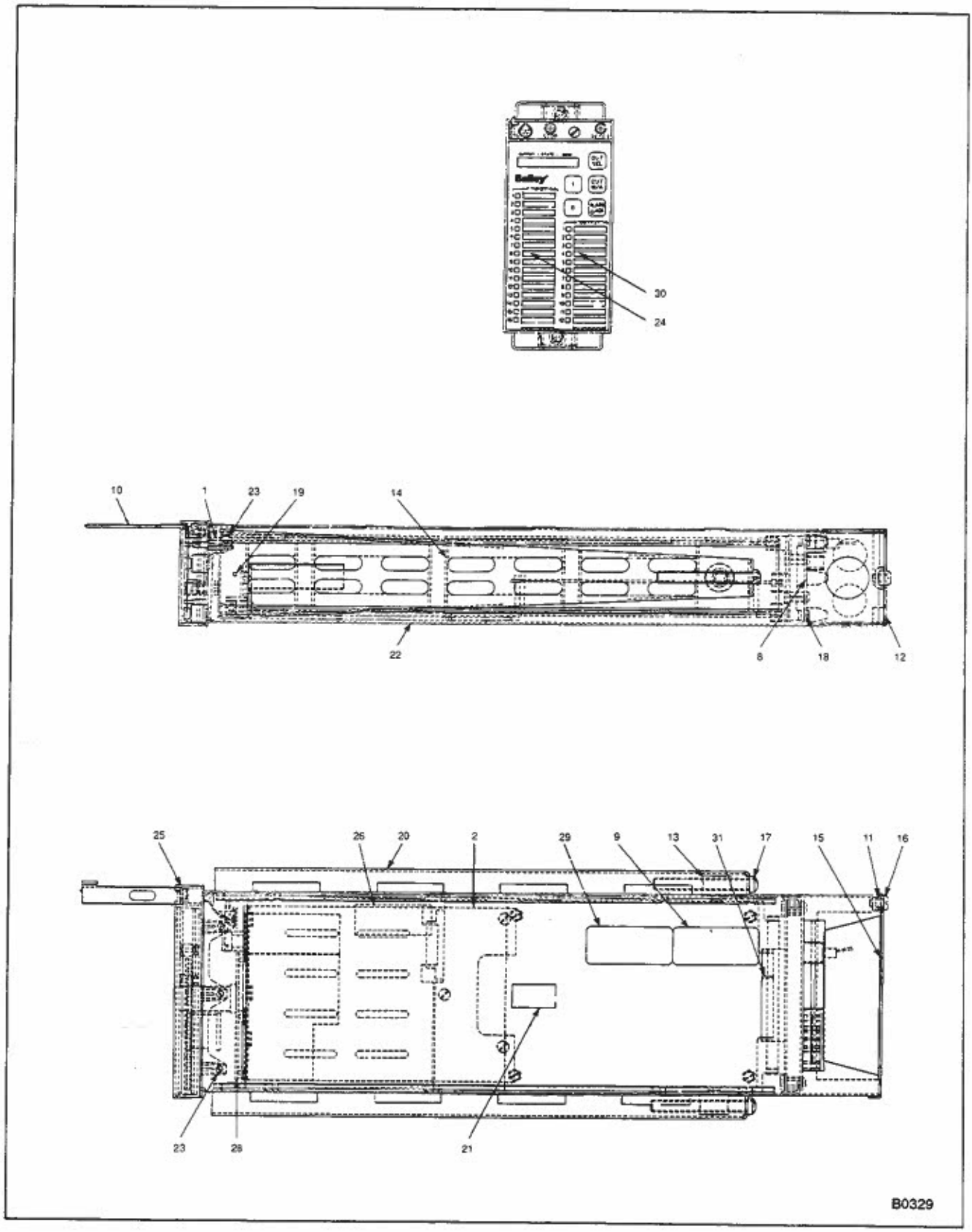


Figure 8-1. Assembly Drawing, Type CSC01

APPENDIX A – SAFETY CIRCUITS

The Sequence Command Controller CSC01 contains many error checking and self-test features. However, the controller has no means for detecting if an input or output circuit is functioning correctly. Therefore, if the Sequence Command Controller is to be used in a safety related application, some form of redundant I/O connections and configuration must be used to ensure detection of a failure. Refer to Figures A-1 and A-2 for redundant I/O circuits.

The configuration for input circuits not only provides a trip if either input shows a ***trip*** input, but it also provides error detection to alert the operator if the inputs do not agree (e.g. one input circuit has failed).

The configuration shown for the output circuit only provides for opening the circuit even if one of the two outputs fails shorted. The configuration does not provide for alarming if one of the output circuits fails. It is up to the user to ensure that each safety application provides the additional configuration or hardware to verify that both output circuits are properly functioning.

Verification could be accomplished by periodically setting one output at a time to the open condition. The outputs could then be monitored with a separate input to verify that the circuit opened. If the circuit does not open, then an alarm would be set to alert the operator. Other techniques that

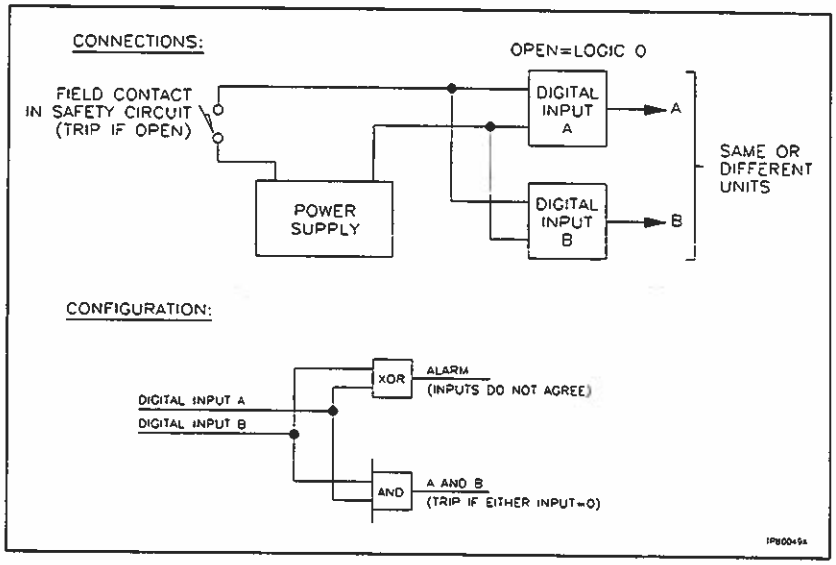


Figure A-1. Safety Circuit Applications, Redundant Inputs

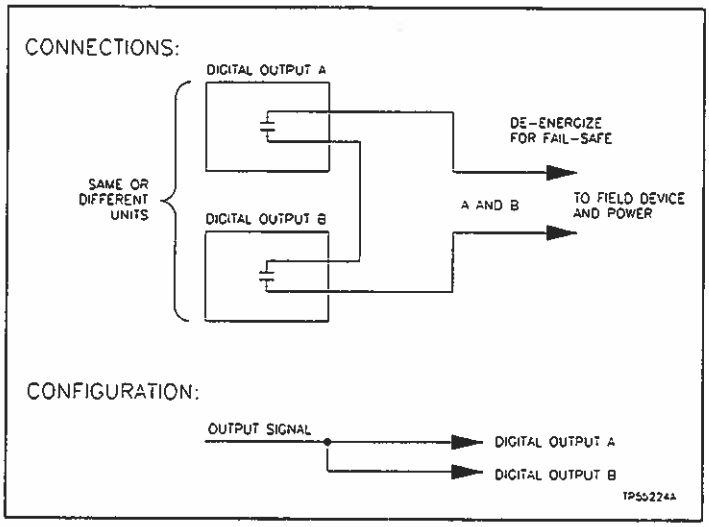


Figure A-2. Safety Circuit Applications, Redundant Outputs

accomplish the same objective of alarming the operator if either output circuit is not functioning properly should also be acceptable.

Refer to ***Safety Related Information*** in the installation section and ***Configuring a Test Quality Block for Safety Related Inputs*** and ***Control Input Security*** in the configuration section for additional information.

NOTE: It is also highly recommended that when the unit is used in safety related applications that the configuration lock be enabled to prevent changes from being made once the system has been checked out and operational. The ***lock*** is enabled by setting specification S1 of Function Code 90 at fixed block address 20 to a 1.

Applicable Standards

The following standards are available for reference when installing and designing safe systems:

Canadian Standards Association C22.2 No. 0.8M1986 "Safety Functions Incorporating Electronic Technology."

Factory Mutual Engineering Corp. "Loss Prevention Data 5-27/14-27."

Industrial Risk Insurers IRInformation P.3 3 "Programmable Logic Controllers for Use with Burner Management Systems," dated April 3, 1987.

National Fire Protection Association NFPA85A "Single Burner Boiler Furnaces" and NFPA85C "Prevention of Furnace Explosions/Implosions in Multiple Burner Boiler Furnaces," 1991.

Addresses for each organization can be found in Appendix B.

APPENDIX B – FLAMMABLE ATMOSPHERES

APPLICATIONS IN FLAMMABLE ATMOSPHERES CLASS I, DIVISION 2 HAZARDOUS LOCATIONS

NOTE: The equipment described within this instruction may only be used in those classes of hazardous locations identified on the nameplate.

Hazardous Locations

The CSC01 Controller is certified and approved for use in a Class I, Division 2 Hazardous Location as defined in the National Electrical Code and the Canadian Electrical Code. These locations are made hazardous by the potential presence of a flammable gas or vapor in air mixture.

A Division 2 classification assumes that the flammable substance is normally adequately contained or is normally adequately diluted by ventilation. Flammable or explosive concentrations would exist rarely and for short periods of time. Guidelines for area classification are found in ANSI/NFPA 497A, "Classification of Class I Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas".

The T3A temperature code means that the CSC01 Controller cannot be used with gases that have an autoignition temperature (AIT) less than 180°C (356°F). Autoignition temperatures for many common gases and vapors can be found in ANSI/NFPA 497M, "Classification of Gases, Vapors and Dusts for Electrical Equipment in Hazardous (Classified) Locations".

NOTE: Hazardous location approvals are for ambient conditions of 86 to 108 kPa (12.47 to 15.66 psi), 21% oxygen maximum, and -25° to 40°C (-13° to 104°F).

Nonincendive Equipment Rating

The nonincendive rating for the controller means that the unit has been evaluated to FM Class Number 3611 and CSA C22.2 No. 213 and has been found that under normal operation will not create a spark capable of igniting a specified test gas.

WARNING	**Disconnecting or reconnecting wiring, removing or inserting printed circuit boards, or operating the ON/OFF switch are not considered normal operation. Operator access to these connections and to the switch is prevented by a cover which requires a tool to remove it. These operations should only be done if power has been removed from all wiring or if the flammable atmosphere is known not to be present.**
AVERTISSEMENT	**Les operations de connexion et de deconnexion de cables, l'installation et la depose de cartes de circuits imprimes et la manoeuvre de l'interrupteur marche/arret ne font pas partie de l'utilisation normale. Pour interdire a l'utilisateur l'acces a ces pieces, un couvercle non amovible sans l'aide d'outils est installe. Les manipulations mentionnees ci-dessus ne devraient etre entreprises qu'apres mise hors tension complete du cablage, a moins que l'on ne sit certain que l'atmosphere ne contient aucune matiere inflammable.**

Disconnecting the signal wiring connected to field equipment may be permitted if the circuit is a Nonincendive Circuit (NEC). Guidelines are provided for making this determination under the section titled ***Nonincendive Circuit (NEC)***. Such circuits may use any wiring method and may be installed and tested while powered. Care must be taken to ensure that only one circuit is worked on at a time and that separate circuits are not shorted. Shorting of separate circuits is not part of the evaluation and could result in ignition capable arcs.

Wiring Requirements

Power and signal wiring to and from the controller is normally assumed to be at ignition capable levels. Therefore, this wiring must be suitable for use in Class I, Division 2, hazardous locations. The National Electrical Code requires the use of rigid metal conduit or non-metallic cable (Types MV, PLTC, SNM, TC) or metallic cable (Types MI, MC). The Canadian Electrical Code requires metal conduit or non-metallic cable certified as ***HL***.

PLTC cable is rated 300 V and can be obtained in wire sizes 22 AWG to 16 AWG at various temperature ratings. This would be the recommended wiring for both power and signal circuits in the United States.

Digital Output Load

The load must be limited such that an ignition capable arc is not created when the relay makes or breaks the circuit. The open circuit voltage, short circuit current, circuit capacitance and circuit inductance must be limited to values below the ignition curves found in the documents listed at the end

of this appendix. As a reference, the following table is provided for a 24 VDC supply.

Group	V_{max}	I_{max}	C_{max}	L_{max}
A or B	28 VDC	150 mA	0.4 µFd	3.5 mH*
C	28 VDC	400 mA	1.2 µFd	2.0 mH*
D	28 VDC	540 mA	3.2 µFd	2.0 mH*

*The inductance may be larger if the current is less than Imax.

In addition, the load cannot be one that would overload during normal operation, such as motor loads where stalling is likely. This restriction is due to the type of fuse used in the CSC01.

Nonincendive Field Circuits

The CSC01 Controller has digital inputs and outputs. If it is desired to use ordinary location wiring for these circuits, then the power source must be voltage and current limited such that opening, shorting or grounding of the circuit will not cause an ignition capable arc. The documents listed at the end of this appendix provide ignition cures to provide guidelines for limiting voltage and current. In general there are three criteria:

1. For a given open circuit voltage, adequate series resistance must be provided at the power source to limit the short circuit current.

2. For a given open circuit voltage, the capacitance of the field equipment including cable must not exceed a specific value.

3. For a given short circuit current, the inductance of the field equipment including cable must not exceed a specific value.

Any wiring type may be used for nonincendive field circuits per the exception in NEC Article 501-4(b) and CEC Article 18-066(2).

DIGITAL INPUTS

The power source for the digital inputs is externally provided and must be evaluated for energy limiting. Ignition curves for various gases can be found in the documents shown at the end of this appendix.

DIGITAL OUTPUTS

The controller provides a relay contact closure. The load and the power source for the load are external and must be evaluated for energy limiting. Although the load must limit

the current to nonincendive levels so that the relay is not an ignition source, the power supply itself must be energy limited if the external circuit is to be considered nonincendive. The CSC01 does not add any capacitance or inductance to the circuit.

Applicable Standards

The following standards are available for designing and installing nonincendive circuits and equipment:

ANSI/ISA RP12.6-1988, "Installation of Intrinsically Safe systems for Hazardous (Classified) Locations."

ANSI/ISA S12.12-1984, "Electrical Equipment for use in Class I, Division 2 Hazardous (Classified) Locations."

Instrument Society of America
67 Alexander Drive
P.O. Box 12277
Research Triangle Park, NC 27709

CSA C22.2 No. 213-M1987, "Nonincendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations."

Canadian Standards Association
178 Rexdale Boulevard
Rexdale (Toronto), Ontario, Canada M9W 1R3

UL 1604 (1982), "Electrical Equipment for Use in Hazardous Locations."

Underwriters Laboratories
333 Pfingsten Road
Northbrook, IL 60062

FM Class Number 3611 (1986), "Electrical Equipment for Use in Class I, II, Division 2; Class III, Division 1 and 2 Hazardous Locations."

Factory Mutual Research
1151 Boston-Providence Turnpike
Norwood, Mass 02062

CONFIGURATION WORKSHEETS

The worksheets have been placed on individual pages so they can be removed from this instruction book and easily reproduced.

Configuration Data

Unit's Tag	
Master	Primary
Slave	Slave
Module Address	Number of Steps (32 Max.)
Station Address	Number of Inputs (64 Max)
Input Board Address	Number of Outputs (48 Max.)
Output Board Address	

I/O Data

Inputs		
Tag	Voltage	No.
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		12
		13
		14
		15
		16

Outputs			
No.	Voltage	Wait Time (Sec.)	Tag
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

Device Driver Data

Device Driver Number:

Function Code 123 Spec Number	Easy Step Default Values	User Values	Comments
S1	(1)		
S2	(2)		
S3	(3)		
S4	0		
S5	1		
S6	0		
S7	0		
S8	0		
S9	0.000		
S10	0		

Device Driver Number:

Function Code 123 Spec Number	Easy Step Default Values	User Values	Comments
S1	(1)		
S2	(2)		
S3	(3)		
S4	0		
S5	1		
S6	0		
S7	0		
S8	0		
S9	0.000		
S10	0		

NOTES:

1. Sequence master output block address for output number _____
2. Block address of signal indicating output _____ = 0.
3. Block address of signal indicating output _____ = 1.

Device Driver Data

Device Driver Number:

Function Code 123 Spec Number	Easy Step Default Values	User Values	Comments
S1	(1)		
S2	(2)		
S3	(3)		
S4	0		
S5	1		
S6	0		
S7	0		
S8	0		
S9	0.000		
S10	0		

Device Driver Number:

Function Code 123 Spec Number	Easy Step Default Values	User Values	Comments
S1	(1)		
S2	(2)		
S3	(3)		
S4	0		
S5	1		
S6	0		
S7	0		
S8	0		
S9	0.000		
S10	0		

NOTES:

1. Sequence master output block address for output number _____
2. Block address of signal indicating output _____ = 0.
3. Block address of signal indicating output _____ = 1.

Step Mask Data

Step Name																																
Step No.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Tag	Outputs																																
	1																																
	2																																
	3																																
	4																																
	5																																
	6																																
	7																																
	8																																
	9																																
	10																																
	11																																
	12																																

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	6																																
	7																																
	8																																
	9																																
	10																																
	11																																
	12																																

CPU BOARD

Switch S1 Positions[1] CPU Board						
MSB S1-4	S1-5	S1-6	S1-7	LSB S1-8	Address Binary	Address Decimal
Closed	Closed	Closed	Closed	Closed	00000	0[2]
Closed	Closed	Closed	Closed	Open	00001	1[2]
Closed	Closed	Closed	Open	Closed	00010	2
Closed	**Closed**	**Closed**	**Open**	**Open**	**00011**	**3[3]**
Closed	Closed	Open	Closed	Closed	00100	4
Closed	Closed	Open	Closed	Open	00101	5
Closed	Closed	Open	Open	Closed	00110	6
Closed	Closed	Open	Open	Open	00111	7
Closed	Open	Closed	Closed	Closed	01000	8
Closed	Open	Closed	Closed	Open	01001	9
Closed	Open	Closed	Open	Closed	01010	10
Closed	Open	Closed	Open	Open	01011	11
Closed	Open	Open	Closed	Closed	01100	12
Closed	Open	Open	Closed	Open	01101	13
Closed	Open	Open	Open	Closed	01110	14
Closed	Open	Open	Open	Open	01111	15
Open	Closed	Closed	Closed	Closed	10000	16
Open	Closed	Closed	Closed	Open	10001	17
Open	Closed	Closed	Open	Closed	10010	18
Open	Closed	Closed	Open	Open	10011	19
Open	Closed	Open	Closed	Closed	10100	20
Open	Closed	Open	Closed	Open	10101	21
Open	Closed	Open	Open	Closed	10110	22
Open	Closed	Open	Open	Open	10111	23
Open	Open	Closed	Closed	Closed	11000	24
Open	Open	Closed	Closed	Open	11001	25
Open	Open	Closed	Open	Closed	11010	26
Open	Open	Closed	Open	Open	11011	27
Open	Open	Open	Closed	Closed	11100	28
Open	Open	Open	Closed	Open	11101	29
Open	Open	Open	Open	Closed	11110	30
Open	Open	Open	Open	Open	11111	31[4]

NOTES:
1. OFF = OPEN; ON = CLOSED
2. Reserved for communications pair.
3. Shaded information indicates factory setting.
4. Recommended for CTTO□ Configuration and Tuning Terminal

Switch S2 Positions CPU Board			Station Address	
MSB S2-3	S2-2	LSB S2-1	Binary	Decimal
Closed	**Closed**	**Closed**	**0000**	**0**
Closed	Closed	Open	0001	1
Closed	Open	Closed	0010	2
Closed	Open	Open	0011	3
Open	Closed	Closed	0100	4
Open	Closed	Open	0101	5
Open	Open	Closed	0110	6
Open	Open	Open	0111	7

NOTE: Shaded information indicates factory switch settings.

MONOCOLOR

Switch S2-6 Position	Switch S2-5 Position	Logic 1 Color	Logic 0 Color	Flashing Alarm Colors per I/O State: Logic 1	Logic 0
Closed	Closed	Green	Off	Green	Red
Closed	Open	Red	Off	Red	Green

BICOLOR

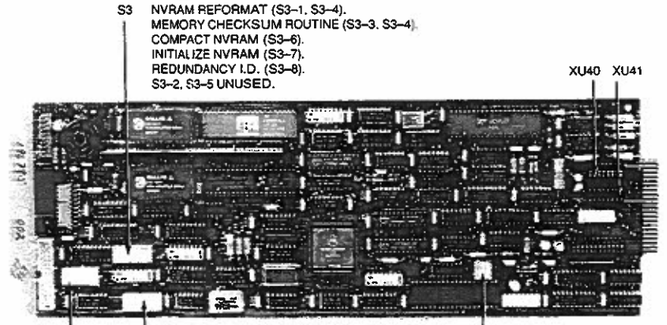
Switch S2-6 Position	Switch S2-5 Position	Logic 1 Color	Logic 0 Color	Flashing Alarm Colors per I/O State: Logic 1	Logic 0
Open	Closed	Green	Red	Green	Red
Open	Open	Red	Green	Red	Green

Option	Control	Setting	Description
Module Bus Address	Refer to Table 2-1 for description.		
Self-Test	Refer to Table 2-2 for description.		
Station Address	Refer to Table 2-3 for description.		
Unused	S1-1	— — —	
RS-232 Port Baud Rate Selection	**S1-2** **S1-3**	**Closed** **Closed**	**300 Baud**
	S1-2 Open S1-3 Closed		1200 Baud
	S1-2 Closed S1-3 Open		2400 Baud
	S1-2 Open S1-3 Open		9600 Baud
Unused	S2-4	— — —	
Display LED Color Definition	**S2-5**	**Closed**	**Faceplate indicating LED's are GREEN for ON condition of I/O.**
		Open	Faceplate indicating LED's are RED for ON condition of I/O.
Display LED Bi-color or Monocolor Select	**S2-6**	**Open**	**Faceplate indicating LED's are bicolor for I/O status.**
		Closed	Faceplate indicating LED's are monocolor for I/O status.
Audible Annunciator	**S2-8**	**Open**	**Audible annunciation (beep) present when alarm condition exists.**
		Closed	Disables audible annunciator (beep).
NVRAM Reformat	**S3-1** **S3-4**	**Closed** **Closed**	**NVRAM reformat disabled.**
	S3-1 Open S3-4 Open		NVRAM reformat enabled.
Memory Checksum Routine	**S3-3** **S3-4**	**Closed** **Closed**	**NVRAM checksum test enabled.** **EPROM checksum test enabled.**
	S3-3 Open S3-4 Open		NVRAM checksum test disabled. EPROM checksum test disabled.
Unused	S3-2, S3-5	— — — —	
Compact NVRAM Configuration	**S3-6**	**Closed**	**Normally does not compact configuration in NVRAM.**
		Open	Enables compact feature (NOTE: Must close switch before entering CONFIGURATION mode.)
Initialize NVRAM	**S3-7**	**Closed**	**Normal operation of NVRAM.**
		Open	Initializes NVRAM (NOTE: Must close switch before entering CONFIGURATION mode).
Redundancy I.D.	**S3-8**	**Closed**	**Controller acts as a primary unit.**
		Open	Controller acts as a backup unit.
Station Link Baud Rate Selection	**S4**	**C1**	**5000 Baud**
	S4	C2	40,000 Baud
[1]RS-232 Port or Redundancy Link	**XU40 socket**	**Dipshunt installed**	**All contacts unbroken.**
	XU41 socket	Dipshunt installed	All contacts unbroken.
Master/Slave	**XU47 socket**	**Dipshunt installed**	**All contacts unbroken. Controller acts as Master unit, controlling I/O on expansion bus and faceplates (stations) on the station link.**
		Dipshunt not installed	Controller acts as Slave with no direct control over its I/O or faceplate.

NOTES: (Shaded information indicates factory switch settings. Off = Open On = Closed)
1. Controller can be configured for either an RS-232 port or redundancy link, but not both.

S2 Switch Positions CPU Board								
S2-1	S2-2	S2-3	S2-4	S2-5	S2-6	S2-7	S2-8	Option Description
Closed	Open	Open	Open	Open	Open	Closed	Open	DISPLAY TEST - Controller front display will sequence through a group of initial test displays.
Open	Closed	Open	Open	Open	Open	Closed	Open	MODULE BUS COMMUNICATIONS TEST - Controller runs a routine which verifies communications on the CPU board's module bus hardware.
Open	Open	Closed	Open	Open	Open	Closed	Open	STATION LINK COMMUNICATIONS TEST - Controller runs a routine which verifies communications on the CPU board's station link hardware.
Open	Open	Open	Closed	Open	Open	Closed	Open	MEMORY TEST - Controller runs a RAM test and checksum test of the NVRAM and EPROM.
Open	Open	Open	Open	Closed	Open	Closed	Open	EXPANSION BUS/BYPASS COMMUNICATIONS TEST - Controller runs a routine which verifies communications on the unit's expansion bus and bypass bus hardware.
Open	Open	Open	Open	Open	Closed	Closed	Open	KEYBOARD TEST - By depressing faceplate pushbuttons, the Controller verifies keyboard operation.
X	X	X	X	X	X	**Open**	X	**ALL SELF-TEST OPTIONS DISABLED. Switch S2 functions normally. X = Return to desired settings. Refer to Tables 2-3 and 2-6.**

NOTES:
Shaded information indicates factory switch settings.
Open = OFF Closed = ON

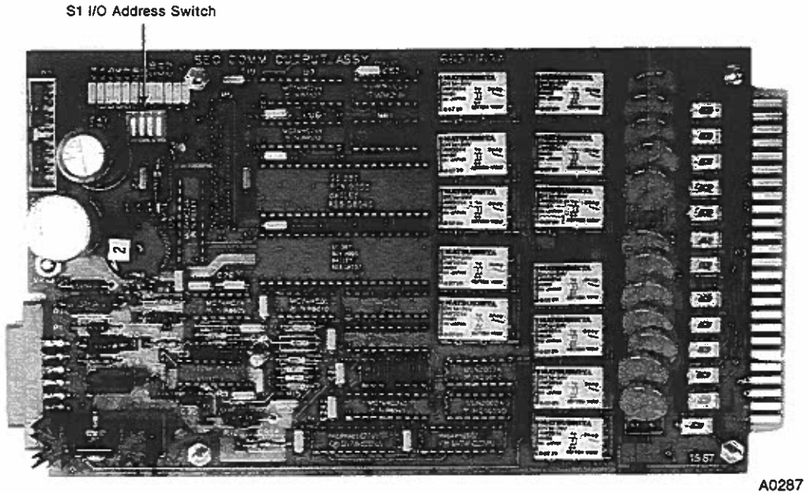


A1000

OUTPUT BOARD

Switch S1 Settings				I/O Addresses	
S1-4	S1-3	S1-2	S1-1	Input Board	Output Board
C	C	C	C	0[1]	1[1]
C	C	C	O	2	3
C	C	O	C	4	5
C	C	O	O	6	7
C	O	C	C	8	9
C	O	C	O	10	11
C	O	O	C	12	13
C	O	O	O	14	15
O	C	C	C	16	17
O	C	C	O	18	19
O	C	O	C	20	21
O	C	O	O	22	23
O	O	C	C	24	25
O	O	C	O	26	27
O	O	O	C	28	29
O	O	O	O	30	31

NOTES: (Shaded information indicates factory switch settings.
C = Closed O = Open)
1. This address is not to be used - invalid.

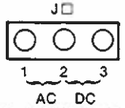


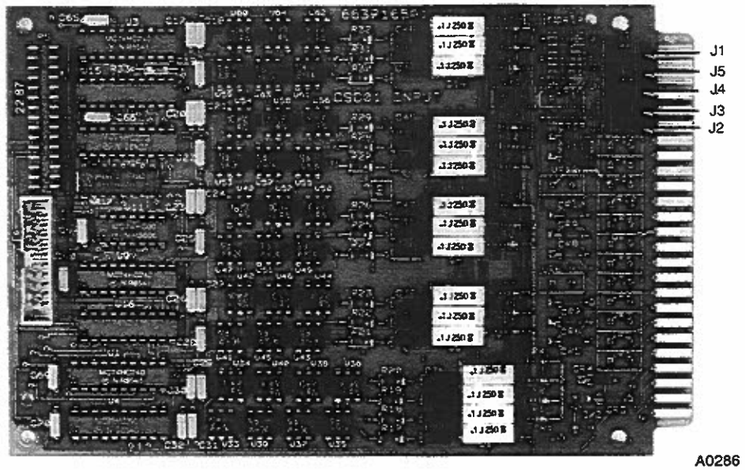
A0287

INPUT BOARD

Jumper	Position	Description
J1	1-2	Configures DI1-DI12 for 120 VAC operation.
	2-3	Configures isolated digital inputs 1 through 12 (DI1-DI12) for DC operation.
J2	1-2	Configures DI13 for 120 VAC operation.
	2-3	Configures isolated digital input 13 (DI13) for DC operation.
J3	1-2	Configures DI14 for 120 VAC operation.
	2-3	Configures isolated digital input 14 (DI14) for DC operation.
J4	1-2	Configures DI15 for 120 VAC operation.
	2-3	Configures isolated digital input 15 (DI15) for DC operation.
J5	1-2	Configures DI16 for 120 VAC operation.
	2-3	Configures isolated digital input 16 (DI16) for DC operation.

NOTE: Shaded information indicates factory jumper settings.





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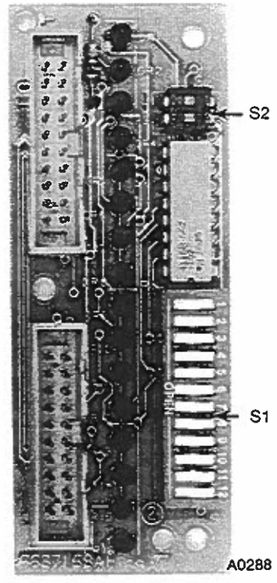
MANUAL CONTROL BOARD

CPU Board Switch S1 Positions[1]						
MSB S1-4	S1-5	S1-6	S1-7	LSB S1-8	Address Binary	Address Decimal
Closed	Closed	Closed	Closed	Closed	00000	0[2]
Closed	Closed	Closed	Closed	Open	00001	1[2]
Closed	Closed	Closed	Open	Closed	00010	2
Closed	Closed	Closed	Open	Open	00011	3[3]
Closed	Closed	Open	Closed	Closed	00100	4
Closed	Closed	Open	Closed	Open	00101	5
Closed	Closed	Open	Open	Closed	00110	6
Closed	Closed	Open	Open	Open	00111	7
Closed	Open	Closed	Closed	Closed	01000	8
Closed	Open	Closed	Closed	Open	01001	9
Closed	Open	Closed	Open	Closed	01010	10
Closed	Open	Closed	Open	Open	01011	11
Closed	Open	Open	Closed	Closed	01100	12
Closed	Open	Open	Closed	Open	01101	13
Closed	Open	Open	Open	Closed	01110	14
Closed	Open	Open	Open	Open	01111	15
Open	Closed	Closed	Closed	Closed	10000	16
Open	Closed	Closed	Closed	Open	10001	17
Open	Closed	Closed	Open	Closed	10010	18
Open	Closed	Closed	Open	Open	10011	19
Open	Closed	Open	Closed	Closed	10100	20
Open	Closed	Open	Closed	Open	10101	21
Open	Closed	Open	Open	Closed	10110	22
Open	Closed	Open	Open	Open	10111	23
Open	Open	Closed	Closed	Closed	11000	24
Open	Open	Closed	Closed	Open	11001	25
Open	Open	Closed	Open	Closed	11010	26
Open	Open	Closed	Open	Open	11011	27
Open	Open	Open	Closed	Closed	11100	28
Open	Open	Open	Closed	Open	11101	29
Open	Open	Open	Open	Closed	11110	30
Open	Open	Open	Open	Open	11111	31[4]

NOTES:
1. OFF = OPEN; ON = CLOSED
2. Reserved for communications pair.
3. Shaded information indicates factory setting.
4. Recommended for CTT0□ Configuration and Tuning Terminal



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