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Bill Benito

INSTALLATION INSTRUCTIONS for SLO-SYN® SS2000I PROGRAMMABLE MOTION CONTROL

Manufactured under an ISO 9002 compliant manufacturing system

DANA WARNER ELECTRIC
LINEAR AND ELECTRONIC DIVISION
SUPERIOR ELECTRIC

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Codes added or modified by Revision B

New Codes Per Revision B

G19 Branch On Result
G21 Register Control
G55 Error Trapping
H44 Transfer Register Contents

Modified Codes Per Revision B

L01 Message #1
L02 Message #2
L03 Message #3
L04 Message #4
L05 Message #5
L20 System Configuration
G20 Branch On Input Condition
G22 Wait For Input Condition
G29 Set Designated L Code
G38 Read Feedrate
G47 Set Outputs
G51 Branch On Flag Condition
G52 Select External Data Source
G53 Select S2000 Interface I/O Port
G54 Register Execution
G60 Enable Continuous Execution Mode

Codes added or modified by Revision C

New Codes Per Revision C

G06 Hcode execution

Modified Codes Per Revision C

L20 System Configuration
G21 Register Control

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USING THIS MANUAL

INTRODUCTION

PRODUCT FEATURES

The SLO-SYN SS2000I is a high-performance programmable motion control (indexer) designed specifically for use with SLO-SYN SS2000D6 step motor drives. It will also work with most standard "pulse and direction" type drives, including digital servo drives. The unit can control one or two drives operating one at a time. This feature is useful in many applications, such as x-y tables for pin insertion or pick-and-place operations. Closed-loop operation is available as an easily-installed option via a front-panel plug-in card. This card also provides the user of open- or closed-loop systems with a way to store programs, via battery-backed memory.

Programming is accomplished via either of the two serial interfaces. Both RS-232 and RS-485 connectors are provided on the front panel. The programming language is a sub-set of the RS-274 CNC language standard (X, F, and G codes). Up to 99 SLO-SYN 2000I motion controls can be easily daisy-chained using their serial ports.

The SLO-SYN SS2000I inputs and outputs (I/O) feature:

- Single-point I/O with removable terminal strips
- Optical isolation, with built-in 24 Vdc 0.75 A power supply
- Sinking or sourcing (switch selectable)
- Software select for positive or negative logic
- Inputs: 13 programmable, 3 dedicated (high-level interrupt)
- Outputs: 8 programmable, with short-circuit protection
- Optional BCD switches (2 seven-bit and sign) for move data accessible via top-mounted 25-pin "D" connector
- Optional remote I/O expansion: 8 inputs and 8 outputs of "OPTO 22" type accessed via the BCD connector

Among the other high-performance capabilities of the SLO-SYN SS2000I programmable motion control are such features as:

- Mark registration ("index from run") repeatable to ± one pulse
- Breakpoint programming that allows changing velocity as a function of position, time, or the state of an input
- Outputs can be set and inputs can be read as a function of velocity, position, or time
- Subroutines and loops nestable to four levels
- Message display capability to user display via serial port
- Fast mechanical homing cycle
- Optional closed loop (factory supplied or field installed)

In addition the SLO-SYN SS2000I incorporates a Fault LED, on the front panel, which indicates when fault conditions exist. The conditions which are indicated by the Fault LED are as follows:

- Drive not ready
- IFR limit exceeded
- CW software limit active
- CCW software limit active
- CW hardware limit active
- CCW hardware limit active
- Program error encountered
- Closed loop error

CAUTIONS AND WARNINGS

- High voltages are present inside this unit. An electrical shock hazard exists that may cause serious injury or death if this unit is operated without its protective covers in place.

- Do not exceed the voltage or current ratings of the various inputs and outputs. Please read the electrical specifications.

- The 24-volt dc power supply is limited to a total current output of 0.7 amperes. Do not exceed this level or the Control may shut down or work erratically as the power supply's current limit operates to protect the unit from overload.

- Be sure to mount the unit so there is adequate space around it for proper cooling airflow.

- Please follow good wiring practices and keep low-level signal lines away from power and motor wiring; this will help to avoid electrical noise interference problems.

LOGIC AND VOLTAGE CONVENTIONS

- Motor rotation direction (CW and CCW) is properly oriented when viewing the motor from the end opposite the mounting flange.

- Please refer to the Glossary section of this manual for detailed descriptions of terms such as "sink and source I/O", and "positive and negative logic".

ASSUMPTIONS

What the user needs to know to properly apply this product.

This instruction manual is written in a simple and easy-to-follow format that should be suitable for both new and experienced motion control users. In order to get the most out of your Slo-Syn 2000 Programmable Motion Control, we assume the user will be knowledgeable in the following areas:

1. Basic electrical and electronic skills, including preparing and following an equipment wiring diagram.

2. The basics of motion control system application, such as torque, speed, move distances, and how to structure a motion task into move segments and input/output control.

3. Some familiarity with elementary computer programming, including defining the problem to be solved and coding it in a computer language.

QUICK STARTUP GUIDE

We strongly recommend that the user read and understand the details and specifications found in later sections of this manual before applying this product. However, listed below are the minimum steps necessary to get up and running, with references to the appropriate instruction manual sections where further details can be found.

1. Set the switch settings for the serial communications parameters and the input/output polarity (sinking - sourcing). Refer to page 2-1.

2. Mount the unit in the location where it will be used.

3. Make all the appropriate electrical connections - wire the signal lines first, and finish by connecting the appropriate ac power. Refer to pages 2-2 through 2-15.

4. Program the unit for the application, then debug, troubleshoot, and correct any problems found.

Complete specifications are found on pages 9-2 through 9-5, and a software reference guide is also provided (see Contents for specific page numbers).

Superior Electric also provides a programming aid, MS-2000, that runs on personal computers to assist in developing motion programs for this Slo-Syn product.

NOTE: The Slo-Syn 2000 Programmable Motion Control **is not** compatible with the Superior Electric Micro Series programming pendant SSP-525, nor with the MS-1 Application Generator Program for personal computers.

SETUP AND INSTALLATION

SWITCH SETTINGS

Before mounting and installing the Programmable Motion Control, it is best to set the top-mounted switches that govern various operating features.

SERIAL COMMUNICATIONS PARAMETER SWITCHES

1. The DIP switch needs to be set to match the Control's baud rate and parity with that of the host computer or terminal to which it is connected. The factory default is 9600 baud, and no parity.

2. The DIP switch needs to be set to match the type of host (RS-232 or RS-485) to which the Control is connected. The factory default is for RS-232.

3. The Control is capable of being "daisy-chained", with up to 99 units connected to a single host. This is described in further detail on pages 2-4 and 2-5. Each unit in such a chain needs a unique identification number (ID #). This value is entered via the pair of ID # select switches on top of the unit. The unit is shipped with a factory default ID # of 01.

If needed, set the ID # select switches to a different value. Set the pointers on the two switches to the desired value of ID #, from 01 to 99.

INSTALLATION GUIDELINES

GENERAL WIRING GUIDELINES

SLO-SYN SS2000I controls use modern solid-state electronics to provide the features needed for advanced motion control applications. In some cases, these applications produce electromagnetic interference (EMI, or electrical "noise").

In general, any equipment that causes arcs or sparks or that switches voltage or current at high frequencies can cause interference. In addition, ac utility lines are often "polluted" with electrical noise from sources outside a user's control (such as equipment in the factory next door). Some of the more common causes of electrical interference are:

- power from the utility ac line
- relays, contactors and solenoids
- light dimmers
- arc welders
- motors and motor starters
- induction heaters
- radio controls or transmitters
- switch-mode power supplies
- computer-based equipment
- high frequency lighting equipment
- dc servo and stepper motors and drives

The following wiring practices should be used to reduce possible noise interference.

- Solid grounding of the system is essential. Be sure that there is a solid connection to the ac system earth ground. Bond the drive case to the system enclosure. Use a single-point grounding system for all related components of a system (a "hub and spokes" arrangement). Keep the ground connection short and direct.

- Even though the control has a built-in line filter, be sure to use a "clean" ac input line. Particularly bad ac lines may need to be conditioned with a ferroresonant type isolation transformer to provide "clean" power to the control.

- Keep signal and power wiring well separated. If possible, use separate conduit or ducts for each. If the wires must cross, they should do so at right angles to minimize coupling.

  Note: Power wiring includes ac wiring, motor wiring, etc. and signal wiring includes inputs and outputs (I/O), serial communications (RS232 lines), etc.

- Use shielded, twisted-pair cables for Control I/O lines. BE SURE TO GROUND SHIELDS ONLY AT ONE END.

Suppress all relays not connected to the control to prevent noise generation (the control's outputs have built-in relay suppression). Typical suppressors are capacitors or MOV's. (See manufacturer's literature for complete information). Whenever possible, use solid-state relays instead of mechanical contact types to minimize noise generation.

If you are experiencing problems which might be related to EMI, refer to the Troubleshooting section for pointers.

INPUT/OUTPUT POLARITY SWITCH

Your Programmable Motion Control offers the optimum in flexibility of using the inputs and outputs (I/O). A top-mounted switch allows selection of either "sinking" or "sourcing" modes for the I/O. In addition, a software command allows the I/O states to be interpreted by the Control program using either "positive logic" or "negative logic" conventions. (Note: All these terms are described in detail in the Glossary at the back of this Manual.)

WIRING THE CONTROL FOR OPERATION

The following pages show how wiring connections are made to the various connectors on the control. All of the terminal strip connectors have their terminals clearly labeled. Please see the SPECIFICATION section for the pin-outs of the "D" connectors for the RS-232, BCD/OPTO-22, and optional Encoder interfaces.

Also included in this section are equivalent circuits for the inputs and outputs, operating in both sinking and sourcing modes.

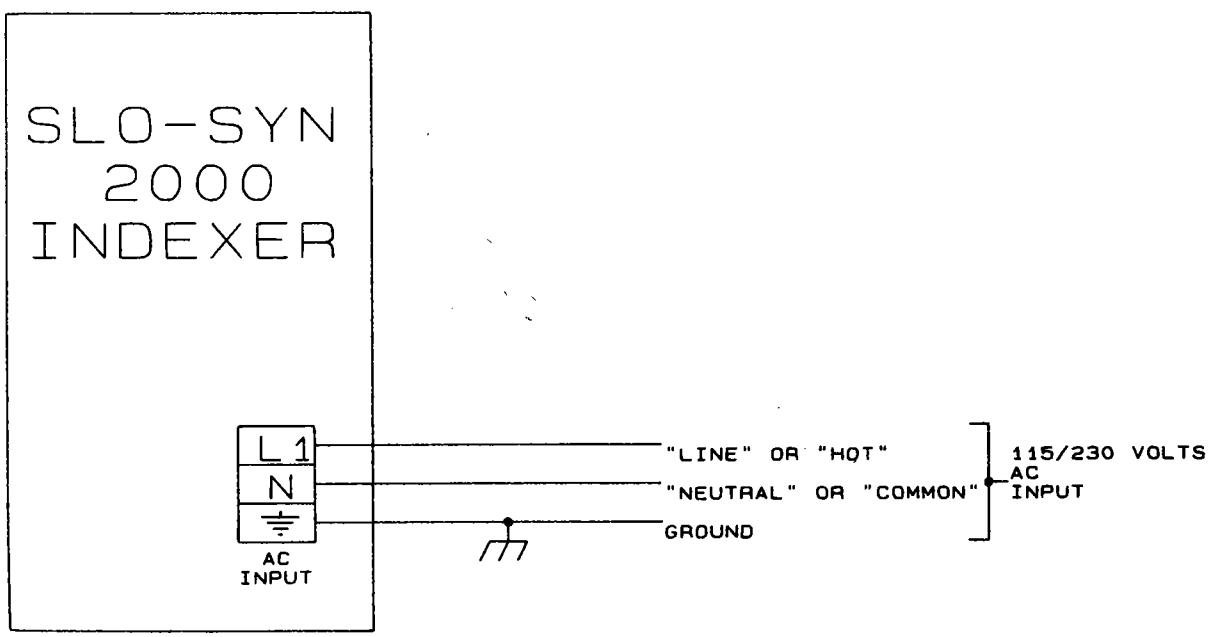
Further details on the use of the programmable inputs and outputs (IN1-IN13 and OUT1-OUT8) can be found in the Programming and Operating section and the Software Reference section of this manual.

Please observe the ratings of the ac input and the various I/O circuits as listed in the Specification section of this manual. This will ensure proper and reliable operation of your control.

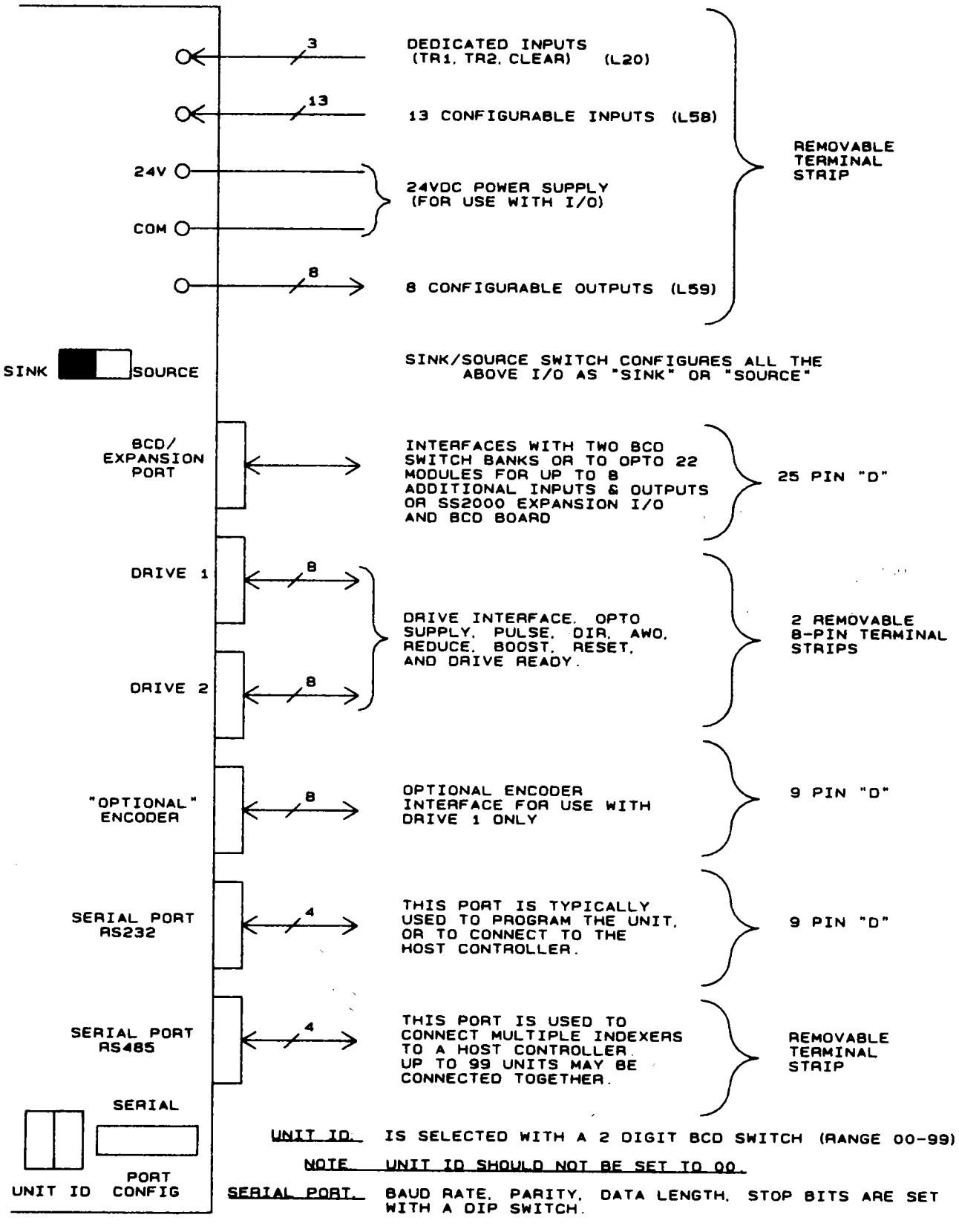
Power Input

The ac input is connected to a 3-screw terminal strip. The terminals are labeled as follows:

Terminal	Lead Color, North American Standard	Lead Color, European Standard (CEE)
"L1" for line or "Hot"	Black	Brown
"N" for Common or Neutral	White	Blue
"⊥" for Ground	Green	Green with Yellow Stripe

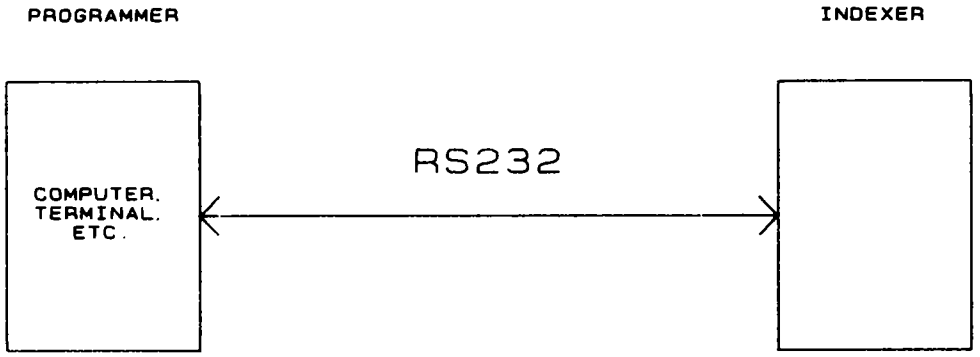


CONTROL I/O CONNECTIONS

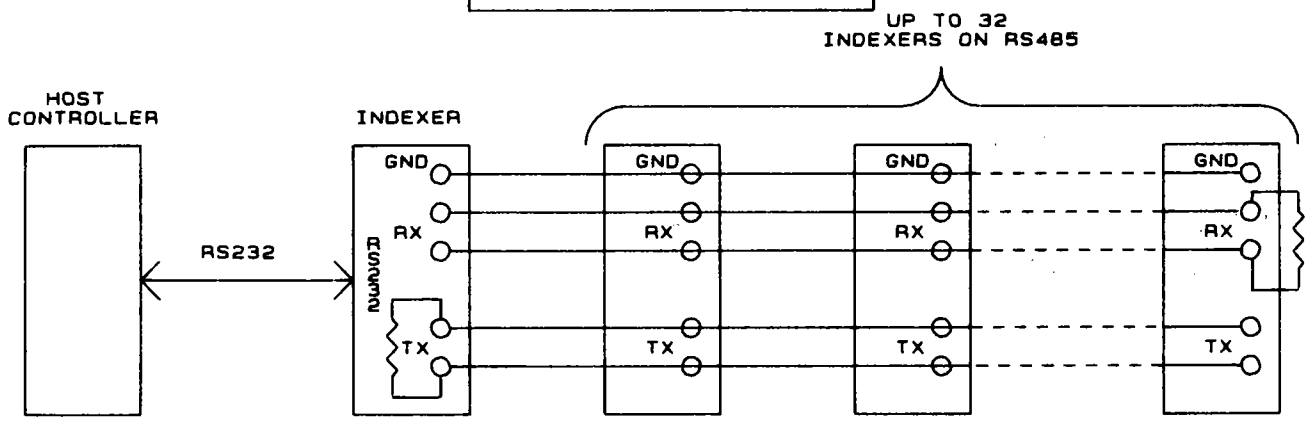


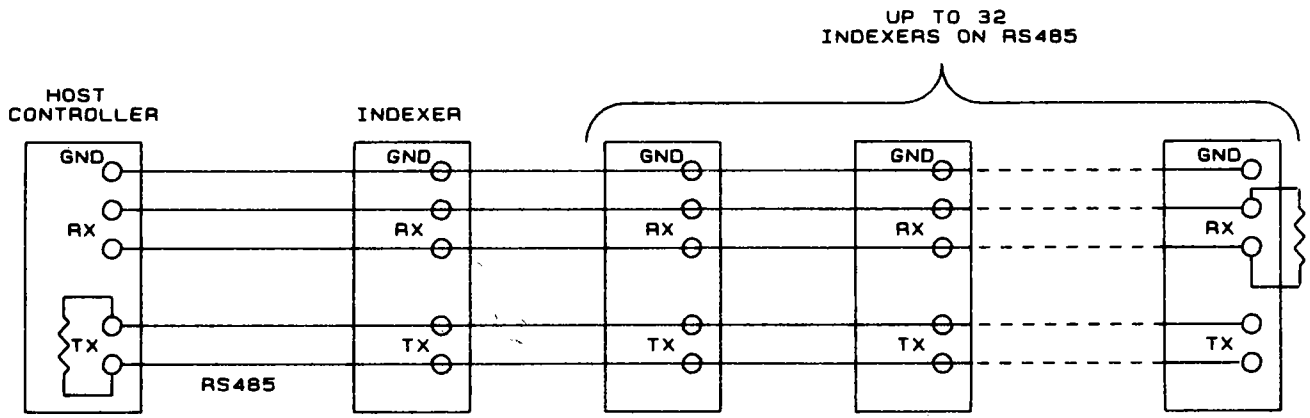
SERIAL PORT

PROGRAMMING



HOST CONTROL



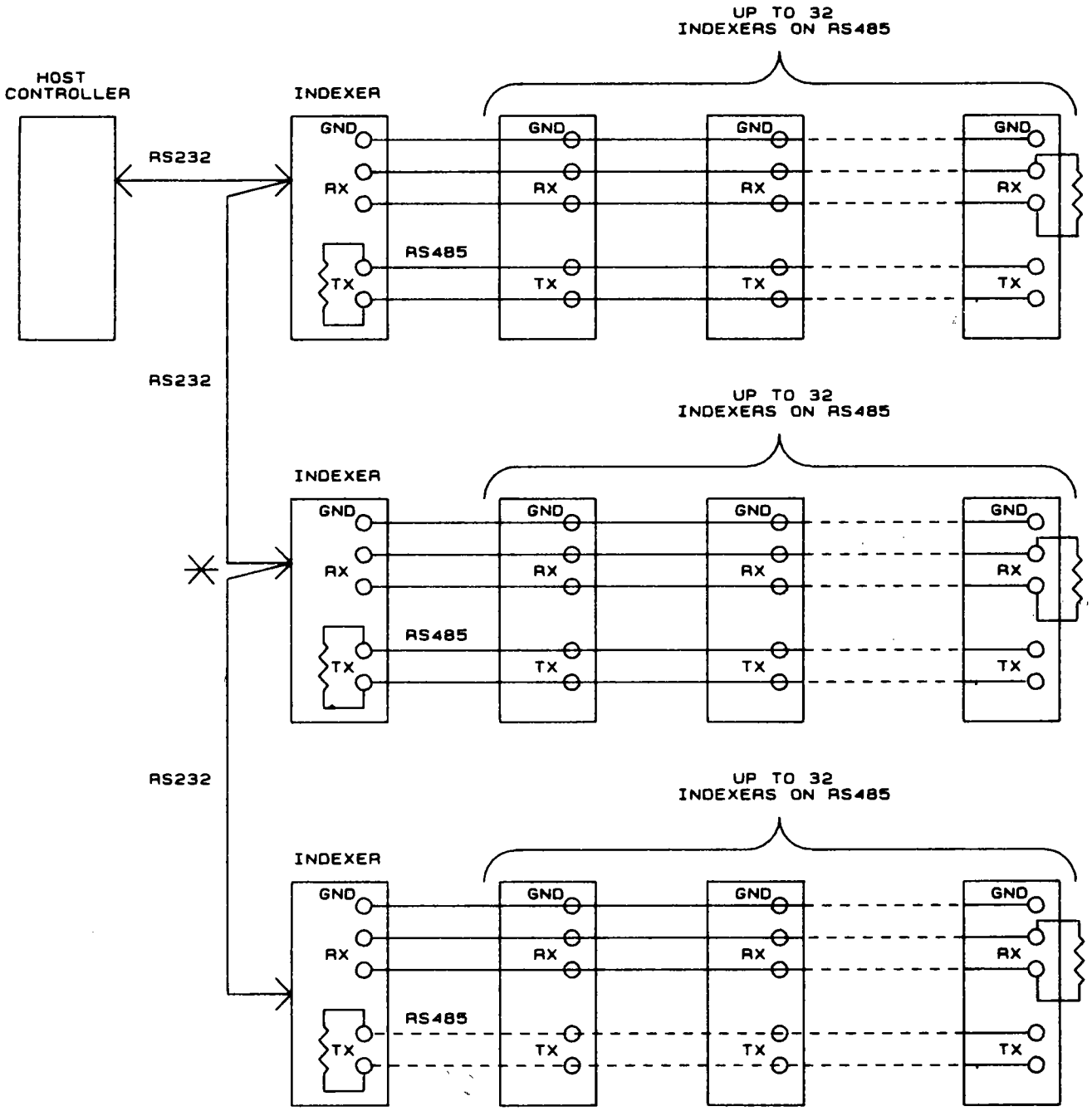


NOTES:

1. HOST COMMUNICATIONS TO FIRST INDEXER USE RS232.
2. REMAINING UNITS COMMUNICATE VIA RS485.
3. ALL UNITS MUST HAVE DISTINCT IDS.
4. AT THE LAST UNIT IN A CHAIN, USER MUST SUPPLY A 120 OHM 1/4 WATT TERMINATION RESISTOR.

HOST CONTROL

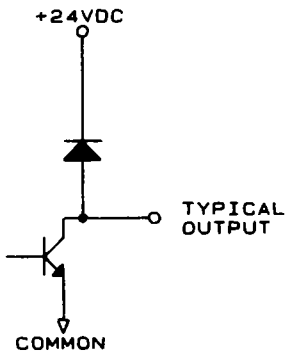
(UP TO 99 INDEXERS)



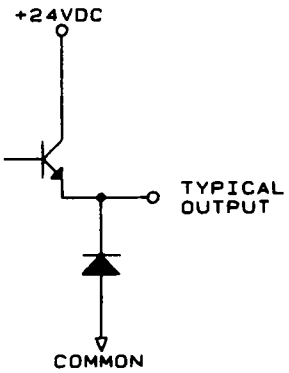
NOTES
1. HOST COMMUNICATIONS TO THREE LEFTMOST INDEXERS USE RS232. REMAINING UNITS COMMUNICATE VIA RS485.
2. ALL INDEXER IDS MUST BE DISTINCT.
3. AT THE LAST UNIT IN A CHAIN, USER MUST SUPPLY A 120 OHM 1/4 WATT TERMINATION RESISTOR, CONNECTED AS SHOWN ABOVE.

✳ USE RS232 ADAPTER "Y" CABLE, S.E., P/N 216298-002

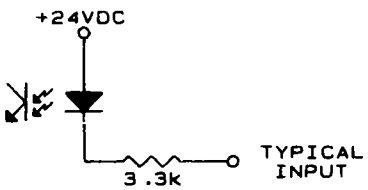
INPUT/OUTPUT EQUIVALENT CIRCUITS



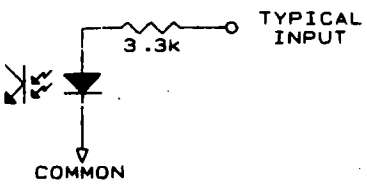
SINK OUTPUT



SOURCE OUTPUT



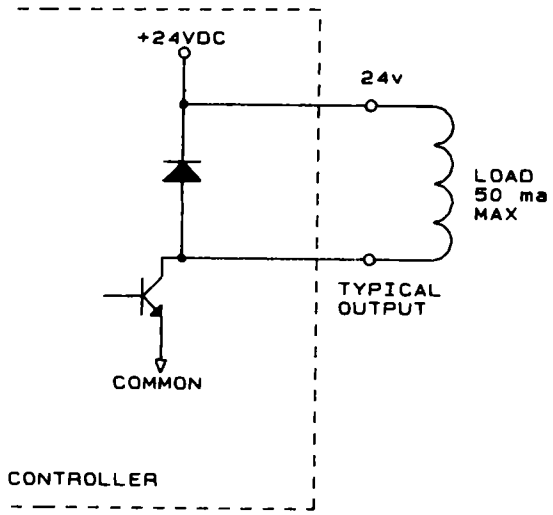
SINK INPUT



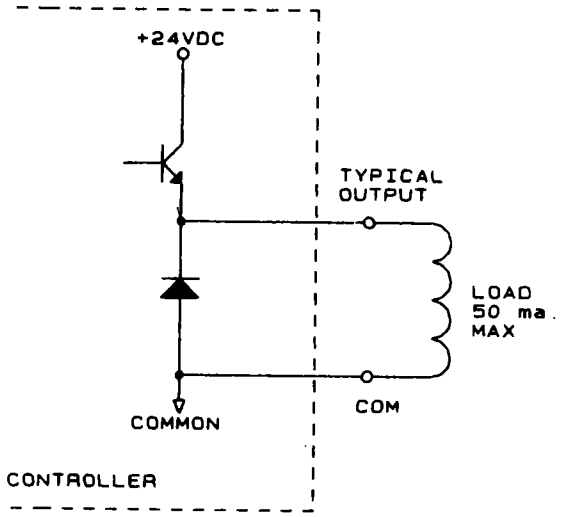
SOURCE INPUT

NOTE ALL INPUTS AND OUTPUTS ARE CONFIGURED TOGETHER FOR SINK OR SOURCE VIA THE SELECTOR SWITCH LABELED "I/O (SINK-SOURCE)" ON TOP OF THE CONTROLLER

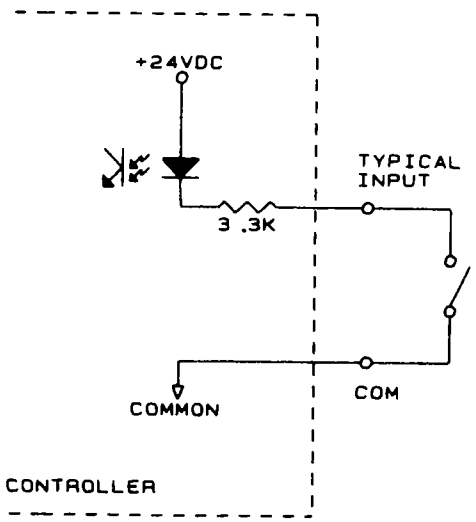
TYPICAL I/O CONNECTIONS



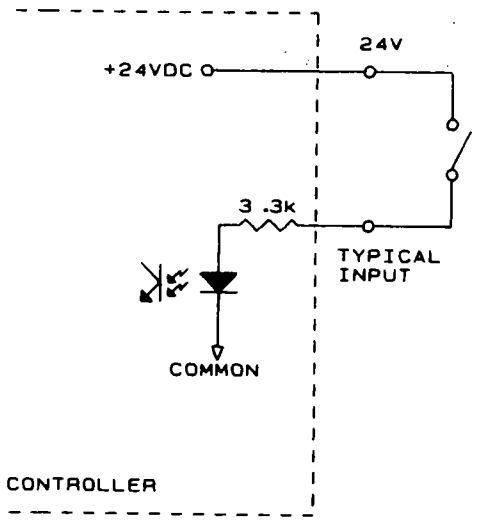
SINK OUTPUT



SOURCE OUTPUT



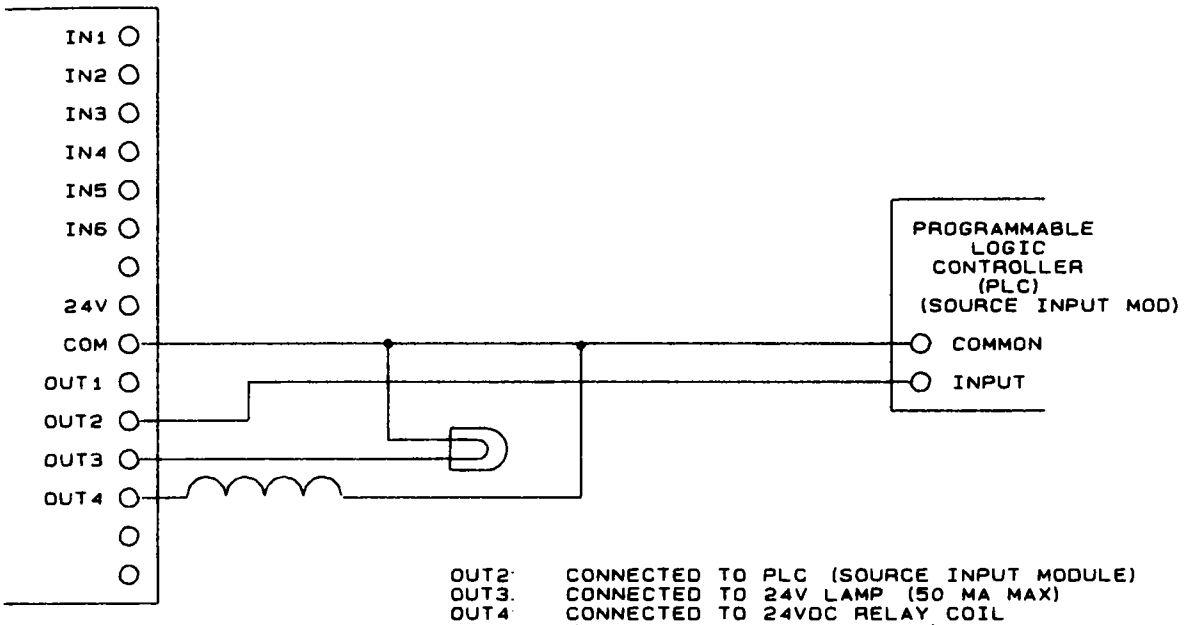
SINK INPUT



SOURCE INPUT

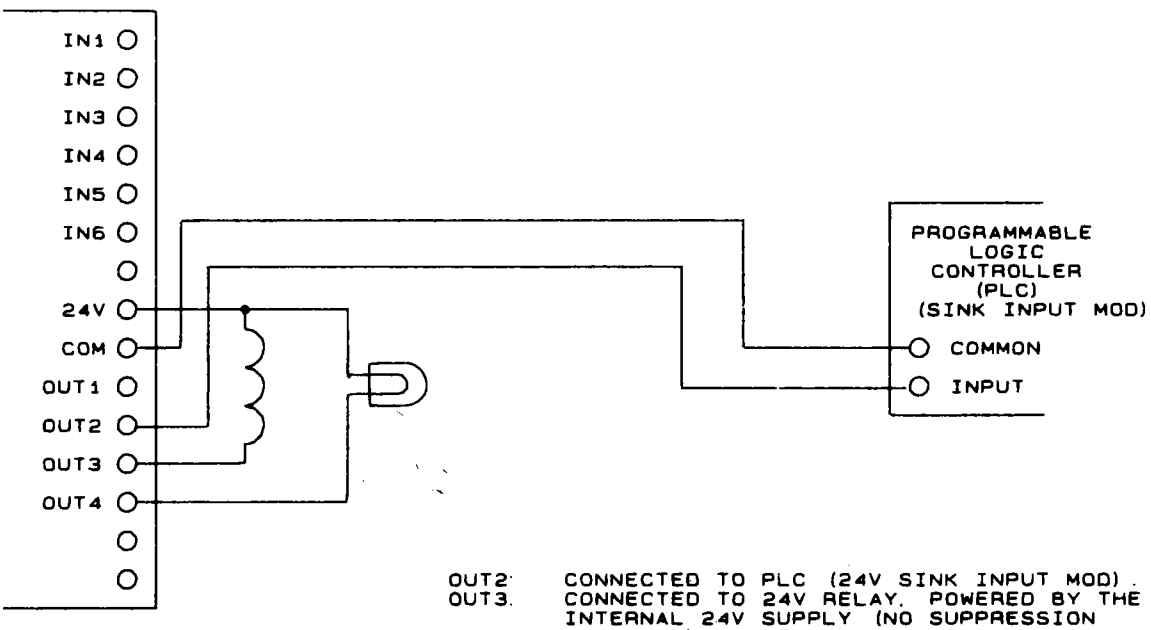
NOTES:
1. +24VDC AND COMMON ARE THE POWER SUPPLY OUTPUT AND COMMON TERMINALS, RESPECTIVELY.
2. TYPICAL OUTPUTS ARE OUT1-OUT8.
3. TYPICAL INPUTS ARE IN1-IN13, TR1, TR2, AND CLEAR.
4. ALL I/O'S ARE CONFIGURED TOGETHER FOR SINK OR SOURCE MODE VIA THE SWITCH ON TOP OF THE CONTROLLER LABELED "I/O (SINK-SOURCE)".

SOURCE OUTPUTS



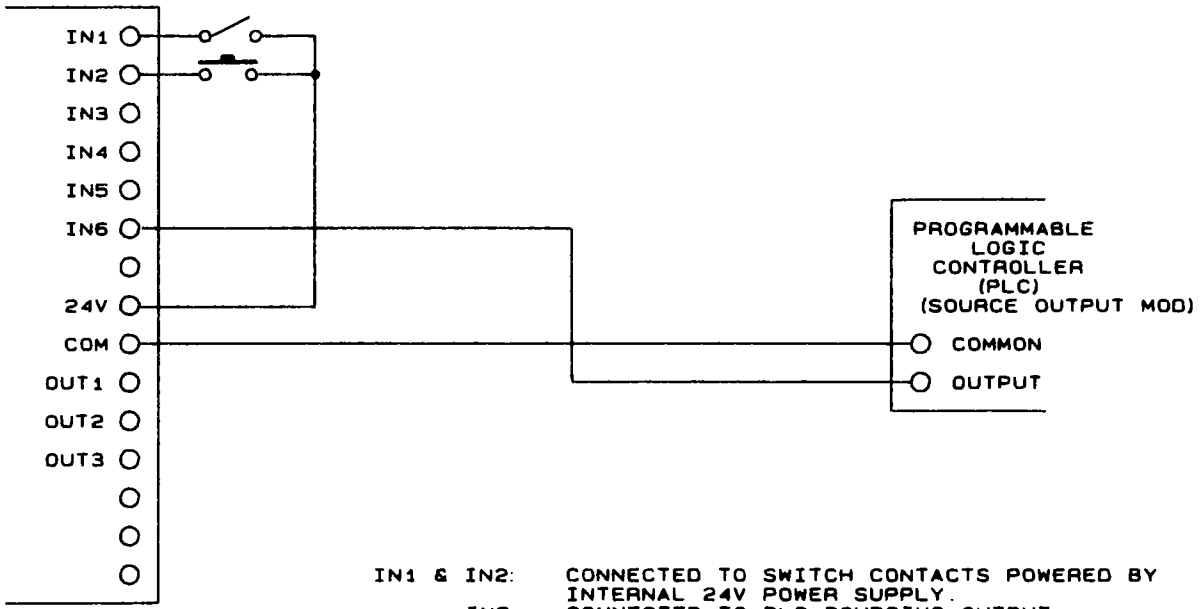
OUT2 CONNECTED TO PLC (SOURCE INPUT MODULE)
OUT3 CONNECTED TO 24V LAMP (50 MA MAX)
OUT4 CONNECTED TO 24VDC RELAY COIL (NO SUPPRESSION REQUIRED)

SINK OUTPUTS



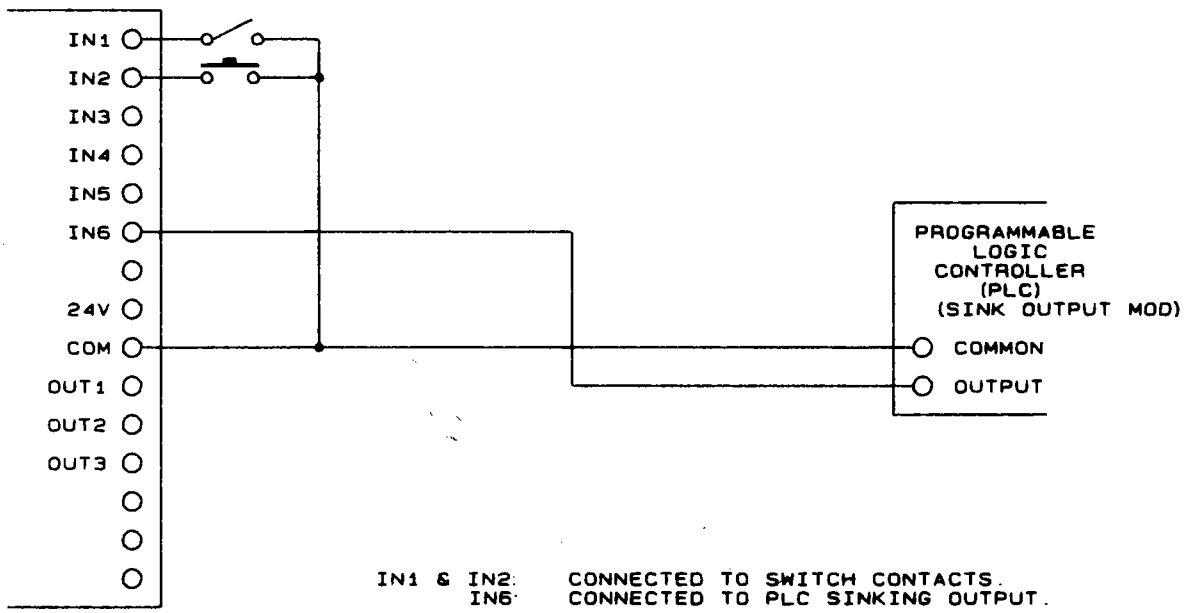
OUT2 CONNECTED TO PLC (24V SINK INPUT MOD).
OUT3 CONNECTED TO 24V RELAY, POWERED BY THE INTERNAL 24V SUPPLY (NO SUPPRESSION REQUIRED)
OUT4 CONNECTED TO 24V LAMP, POWERED BY THE INTERNAL 24V SUPPLY.

SOURCE INPUTS



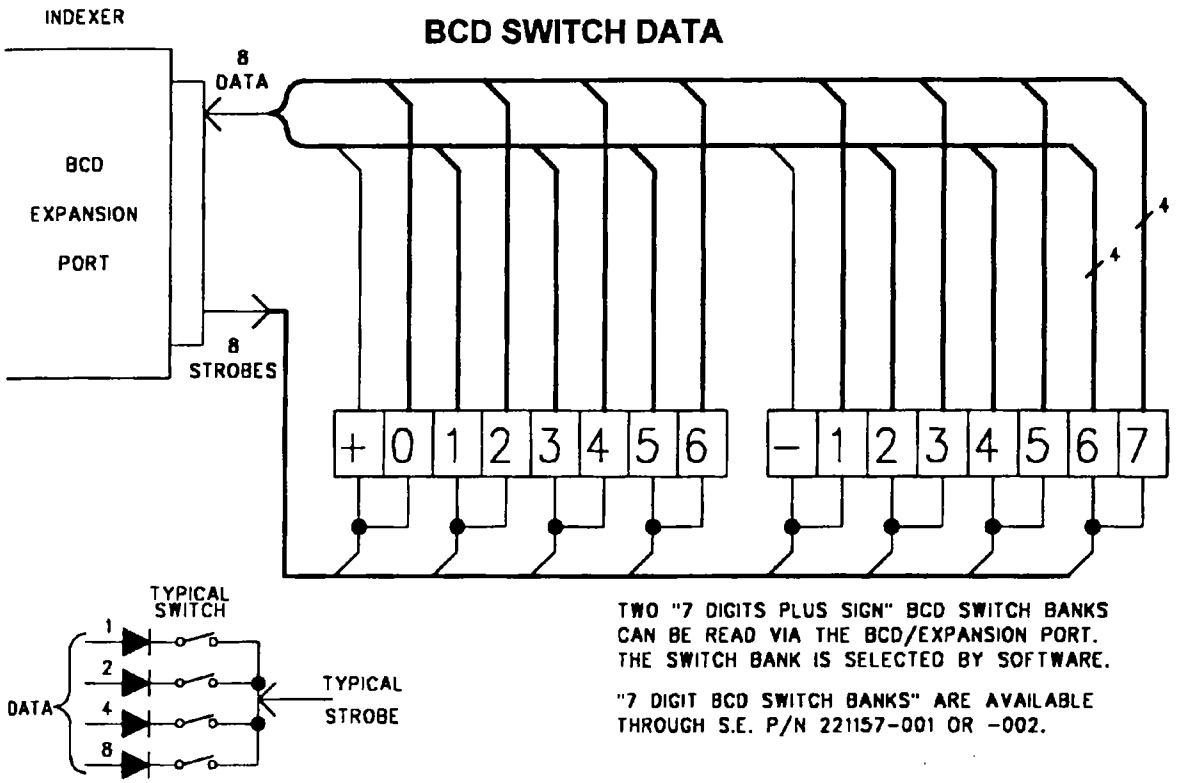
IN1 & IN2: CONNECTED TO SWITCH CONTACTS POWERED BY INTERNAL 24V POWER SUPPLY.
IN6: CONNECTED TO PLC SOURCING OUTPUT.

SINK INPUTS



IN1 & IN2: CONNECTED TO SWITCH CONTACTS.
IN6: CONNECTED TO PLC SINKING OUTPUT.

BCD SWITCH DATA



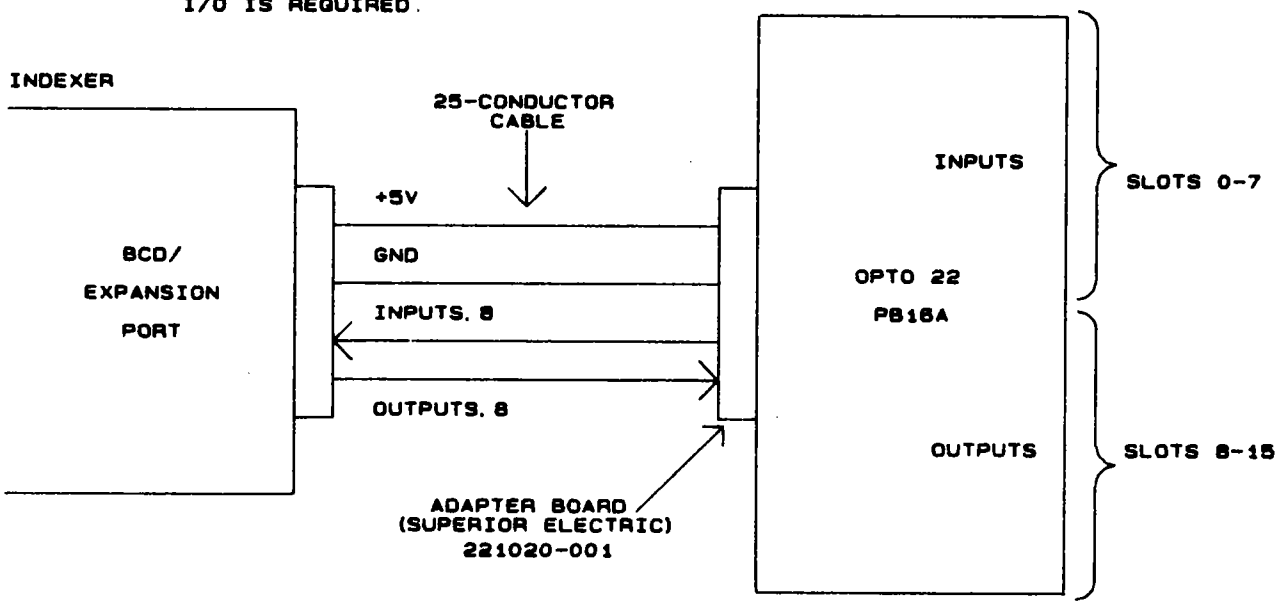
CONNECTOR PIN-OUTS

Indexer 25-pin D Connector Pin #	BCD Switch Function & Signal Name	
1		DATA 1
2		DATA 2
3		DATA 4
4		DATA 8
5		DATA 10
6		DATA 20
7		DATA 40
8		* DATA 80 or -SIGN
9-11		NC
12, 13		NOT USED
14	BCD BANK 1	STROBE X1
15		STROBE X100
16		STROBE X10,000
17		STROBE X1,000,000
18	BCD BANK 2	STROBE X1
19		STROBE X100
20		STROBE X10,000
21		STROBE X1,000,000
22, 23		NC
24, 25		NOT USED

* SIGN FOR STROBE X1,000,000; OTHERWISE DATA 80.

EXPANSION I/O

THE BCD/EXPANSION PORT CAN READILY INTERFACE TO STANDARD "OPTO 22" STYLE INPUT & OUTPUT MODULES WHEN HIGH POWER I/O IS REQUIRED.



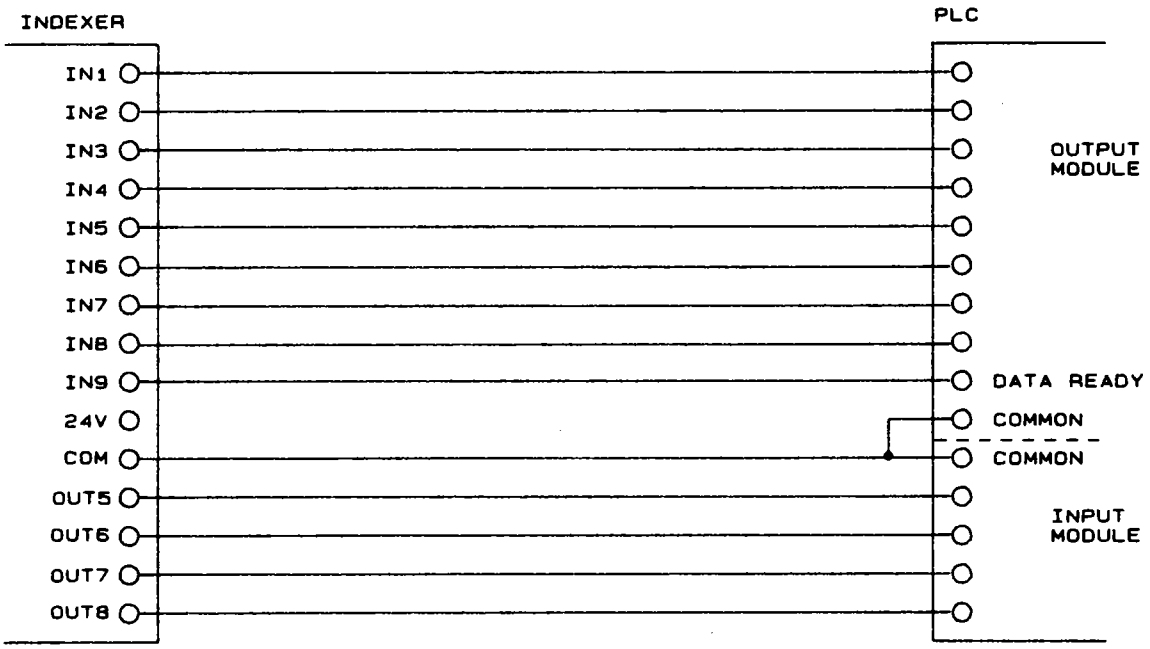
THE FOLLOWING LIMITATIONS APPLY:

MAXIMUM NUMBER OF INPUT MODULES IS 8.
MAXIMUM NUMBER OF OUTPUT MODULES IS 8.
SUPERIOR ELECTRIC SUPPLIED CABLING WILL RESTRICT INPUTS TO SLOTS 0-7 & OUTPUTS TO SLOTS 8-15.

CONNECTOR PIN-OUTS

INDEXER	SIGNAL NAME	OPTO 22
1	INPUT 0	47
2	INPUT 1	45
3	INPUT 2	43
4	INPUT 3	41
5	INPUT 4	39
6	INPUT 5	37
7	INPUT 6	35
8	INPUT 7	33
9-11	NC	NC
12, 13	+5V	49
14	OUTPUT 0	31
15	OUTPUT 1	29
16	OUTPUT 2	27
17	OUTPUT 3	25
18	OUTPUT 4	23
19	OUTPUT 5	21
20	OUTPUT 6	19
21	OUTPUT 7	17
22, 23	NC	NC
24, 25	GND	24

BCD DATA FROM PLC



READING BCD DATA FROM A PLC USES 4 OUTPUTS AND 9 INPUTS.

4 OUTPUTS [OUT1-OUT4] CONFIGURED AS STROBES.
8 INPUTS [IN1-IN8] CONFIGURED AS BCD DATA.
1 INPUT [IN9] CONFIGURED AS DATA READY.

I/O REMAINING: 4 INPUTS AND 4 OUTPUTS PLUS ANY EXPANSION I/O ON CONTROLLER, AND ANY SPARE PLC I/O

HOW I/O SINK VS. SOURCE POLARITY AND LOGIC CONVENTION (POSITIVE OR NEGATIVE LOGIC) AFFECT THE USE OF G22 AND G47 COMMANDS

The following pages show the way the control interprets the G22 (Wait for Input) and G47 (Set Output) commands, based on the L58 (Logic Convention, positive or negative) value and whether the inputs and outputs (I/O) are configured for sink or source mode.

Further details can be found in the Software Reference section of this manual, and the terms are explained in the Glossary.

INPUTS AND OUTPUTS AFFECTED BY LOGIC CONVENTION

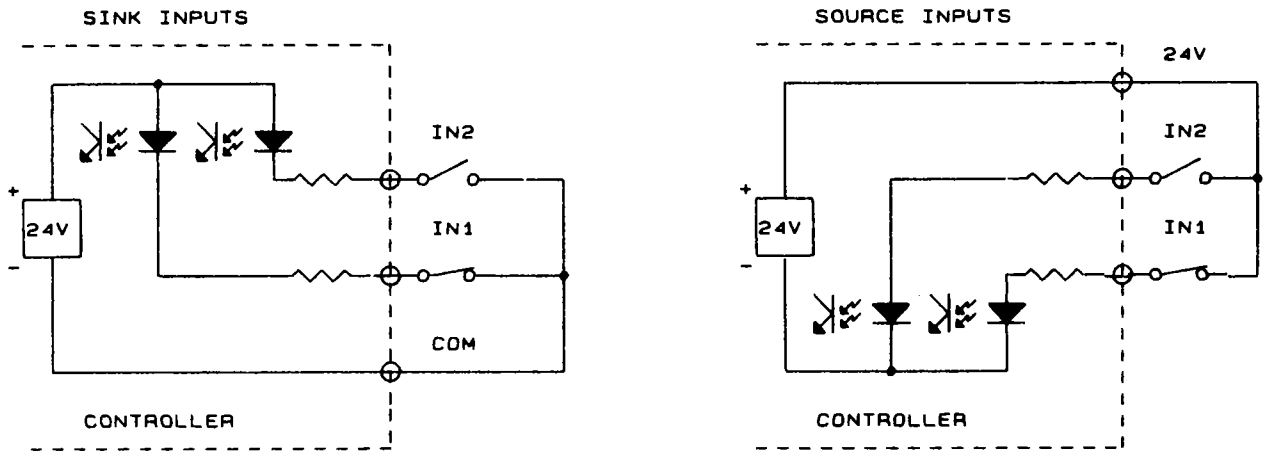
Input or Output	Positive Logic (L58 +)	Negative Logic (L58 -)
IN 1 - IN 13	Switch closed = 1	Switch closed = 0
OUT 1 - OUT 8	1 = output on	0 = output on
Expansion port configured for OPTO-22 I/O	Inputs: input active = 1	Inputs: input active = 0
	Outputs: 1 = output active	Outputs: 0 = output active
TR1, TR2, CLR inputs	Switch closed = 1	Switch closed = 0
Expansion port configured for BCD switches *	Switch closed = 1	Switch closed = 1
Fault LED *	LED on = fault	LED on = fault
Motion busy LED *	LED on = motion occurring	LED on = motion occurring

* Not affected by logic convention (L58 setting).

L58+

(POSITIVE LOGIC)

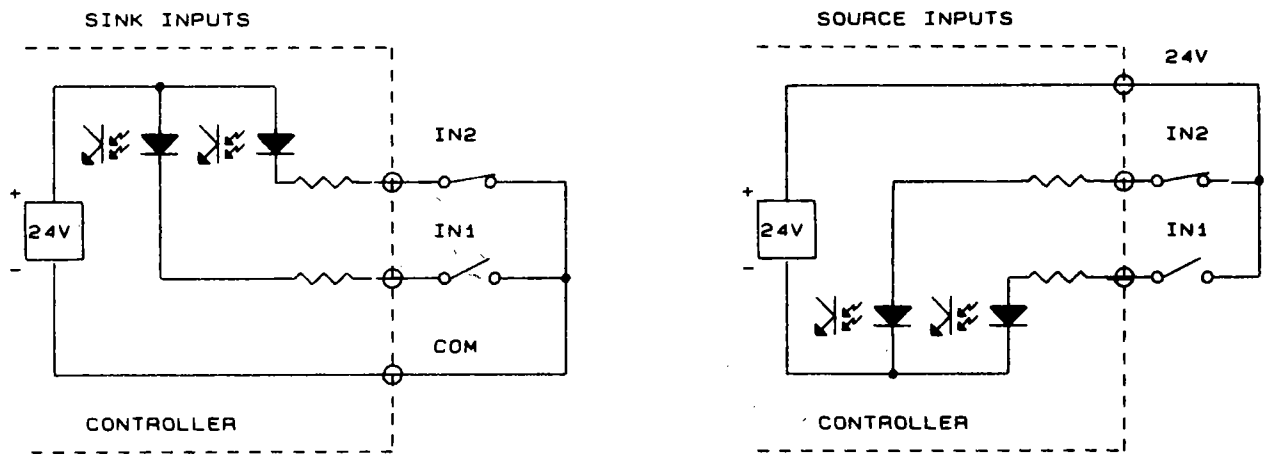
G22 X22222201 WAIT FOR
INPUT1=ON AND
INPUT2=OFF
(REMAINING INPUTS = "DON'T CARE")



L58-

(NEGATIVE LOGIC)

G22 X22222201 WAIT FOR
INPUT1=OFF AND
INPUT2=ON
(REMAINING INPUTS = "DON'T CARE")



EFFECT OF SINK/SOURCE & LOGIC CONVENTION ON G22 COMMAND (WAIT FOR INPUT CONDITION)

NOTE: Illustrations show switch positions needed to satisfy G22 examples given.

L58+

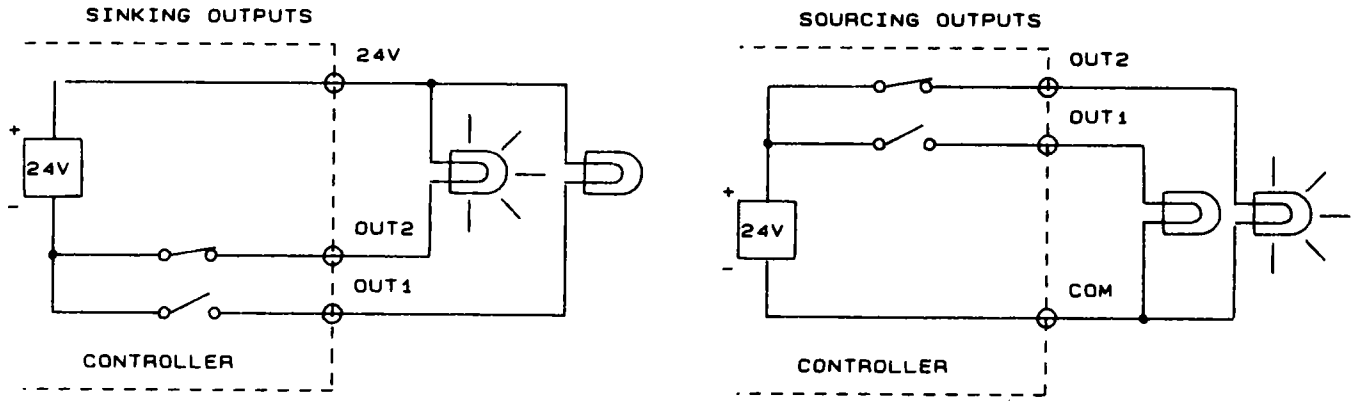
(POSITIVE LOGIC)

G47 X22222210

OUTPUT1=OFF

OUTPUT2=ON

(REMAINING OUTPUTS UNCHANGED)



L58-

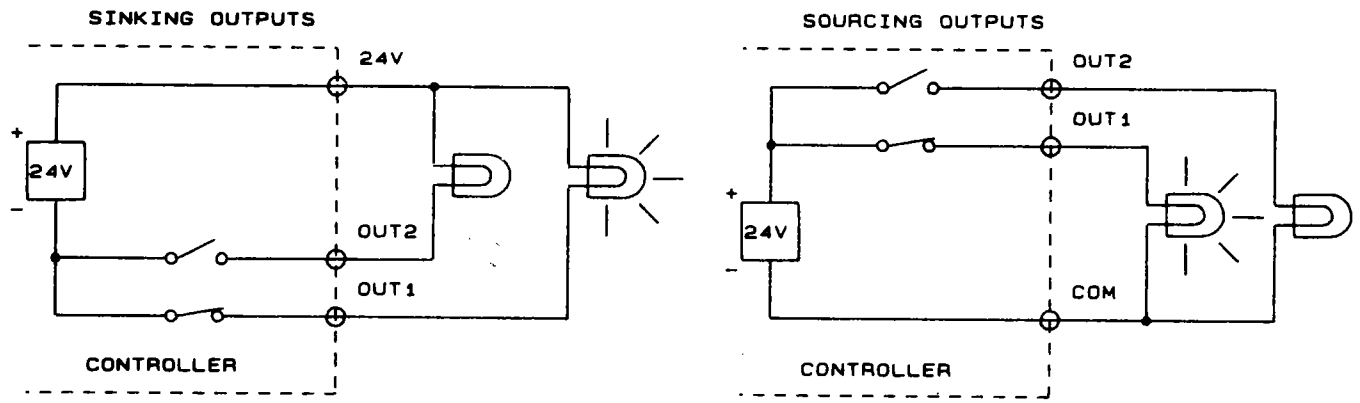
(NEGATIVE LOGIC)

G47 X22222210

OUTPUT1=ON

OUTPUT2=OFF

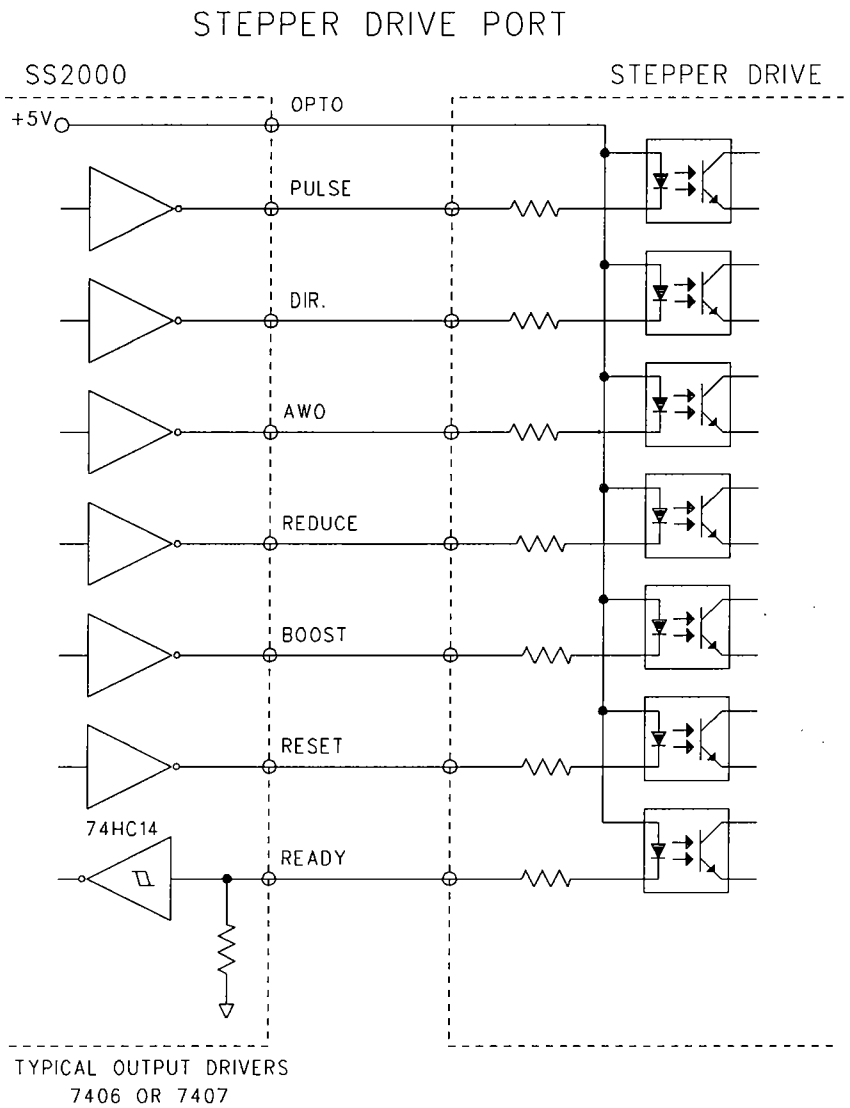
(REMAINING OUTPUTS UNCHANGED)



EFFECT OF SINK/SOURCE & LOGIC CONVENTION ON G47 COMMAND (SET OUTPUT CONDITION)

NOTE: Illustrations show output states resulting from G47 examples given.

DRIVE INTERFACE



NOTE: When connecting drives without a READY signal to the SS2000I connect the OPTO output to the READY line. The SS2000I will not operate unless the READY signal is activated (5 Vdc input).

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PROGRAMMING AND OPERATING GUIDE

SERIAL COMMUNICATIONS ISSUES

GENERAL INFORMATION

EIA (Electronic Industries Association) Standard RS274-D, the programming guide for numerically controlled machines, has been used as the basis for the Slo-Syn 2000 Programmable Motion Control command structure. Although it was not technically feasible to conform to this standard in complete detail, it proved beneficial in the program structure to permit complex and varied operations to be performed using a simple format.

Communications between the Control and a host computer or terminal used for programming and operation is via either of two serial data interfaces; both RS-232 and RS-485 connectors are provided. The serial communications parameters and commands can be grouped into three general categories:

1. **"L Codes"** are used to set parameters for each Control. These commands do not cause motion, but simply establish the motion parameters.

2. **"H Codes"** are used to set Control modes, to control manual and program execution and to transmit parameters and Control status via the serial communications port.

3. **Line Data Codes** are the codes that define the motion that will be made (X Code or Y Code), the speed at which it will be done (F Code) and G Code which can control program execution and modify the way it operates.

BUFFERING OF COMMANDS

A Slo-Syn 2000 Programmable Motion Control has two buffers dedicated to RS232 communications. Each buffer holds 255 characters. One buffer holds commands which will be processed only when the Control is not "Busy" (when a cycle is in process or when previously transmitted commands are being processed). These commands are referred to as "Standard" commands and include all L codes, H codes and Feed Rate codes. They are processed in the order in which they are received, and each command must be completed before the next command is processed.

The second buffer holds commands which will be processed as soon as they are issued, even when the Control is "Busy". These commands are known as "Immediate" commands and include only a subset of the H codes and Line Data codes. To indicate that a command should be treated as an immediate command, simply precede the command with an exclamation mark (!). A list of immediate commands is given in Appendix C. Immediate commands are processed in the order in which they are received, as are standard commands.

Multiple commands can be transmitted to the Control at the same time. The Carriage Return (ASCII 13) and/or Line Feed (ASCII 10) will terminate a string of commands. If a string of immediate commands is to be sent, the "!" character need only be used in front of the first command. The Immediate Buffer selection is canceled when the Carriage Return or Line Feed is received.

The "Backspace And Delete" command, Control H (^H) can be used to delete a character in a buffer when data is being entered. In addition, the "Delete RS232 Buffer" command, Control X (^X), can be used to delete the last line entered in the active buffer.

The number of characters remaining in either the standard or the immediate character buffer may be requested at any time. To request the status of the standard buffer, send the "/" character (ASCII 47). Send the "\" character (ASCII 92) to request the status of the immediate buffer. Neither character is actually stored in the buffer. The response format from the Control is:

nnn CRLF

where nnn is the character count remaining.

Xon/Xoff PROTOCOL

Xon/Xoff is a serial communications protocol, executed in software, that allows communications between two devices without the need for additional hardware control. This method of controlling data flow requires only a three-wire connection between the devices. The protocol is used for controlling the flow of data between the Control and another device. **It should NOT be used to determine the status of the Control.**

The Xoff character (ASCII 19) is used to stop the transmission of RS232 characters. When one device sends an Xoff to the other device, it is telling the other to stop transmitting characters. The transmitting device should comply with the request.

The Xon character (ASCII 17) is used to resume transmission of the RS232 characters. When one device sends an Xon character to the other, it is signifying that it is ready to receive more data. If there is more data to be sent, the transmitting device may now resume transmission.

When the Control sends an Xoff command to the host, all activation commands (see below) and immediate H codes can still be processed.

Note: The Xon/Xoff protocol is only used when the L26 value is 0-3.

DEVICE IDENTIFICATION

In order to daisy chain multiple Controls to communicate with a single host, each Control must be given a unique identification. The Unit ID # select switch defines the identification number of the Control. This switch is interrogated on power turn on only. The factory setting is device 01. **Each Control must be given a unique identification before the system is wired.** The device addresses need not be consecutive, and the Controls can be placed in any positions in the chain regardless of their addresses.

SERIAL PORT CONFIGURATION

The Baudrate (9600,2400,1200 or 300), character length (7 or 8), Parity (Enable, Disable, Odd or Even) can be selected via a hardware dip switch. This switch is interrogated on power turn on only. The Factory setting is 9600 baud, 8 bit word length and parity disabled.

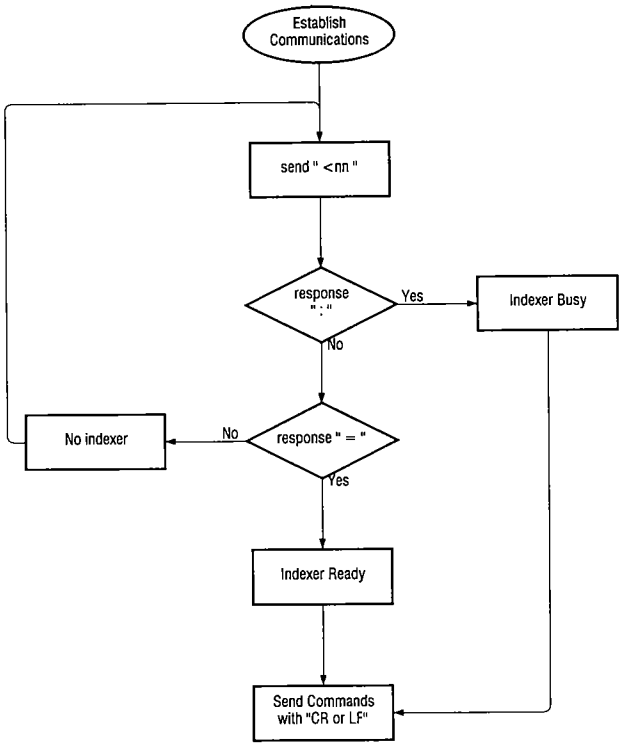
DEVICE ACTUATION

In order to accept commands from a host device, a Control must be set to the active mode. To do this, the host must send the device attention command (<) followed by the device identification number and, as always, a carriage return, line feed or a non-numeric character. For example, to activate device 01 send <01CR. The Control which has been activated will respond with an = if it is not busy, or with a : if it is busy. If you wish the Control to identify itself in the response, include a ? in the request (<01?). The response will be 01= if the Control is not busy, or 01: if it is busy. Device 01 will power up activated.

Note: If L26 = 0 thru 3, an Xon will be transmitted following the =. If L26 = 4 thru 7, no Xon will be transmitted.

All Controls can be placed in the listen mode only by issuing a <00CR from the host. No data can be transferred from the Control to the host in this mode. However, all other commands will honored by the individual controls.

If the host wishes to identify the active Control, the Device Acknowledgement command (?) can be issued. If the active device is not busy , it will respond with a nn=Xon, where nn is the device ID. If the active device is busy, it will respond with a nn:. If no device is active, no response will be received. (Xon will not be transmitted if the protocol is disabled.)



LISTEN MODE

In addition to the active mode, a Control can also be placed in the listen mode. To do this, the host must send the device attention command (<), followed by the device identification number, followed by an ampersand (&). For example, to place device 01 in the listen mode, send <01&CRLF. In response to the listen command, the Control will send a 01=Xon if it is not busy, or a 01: if it is busy. (Again, Xon will not be transmitted if the protocol is disabled.)

While in the listen mode, a Control will execute commands issued by the host. However, it will transfer data only in response to its device attention command for busy polling. All other transfer commands will be ignored while in the listen mode.

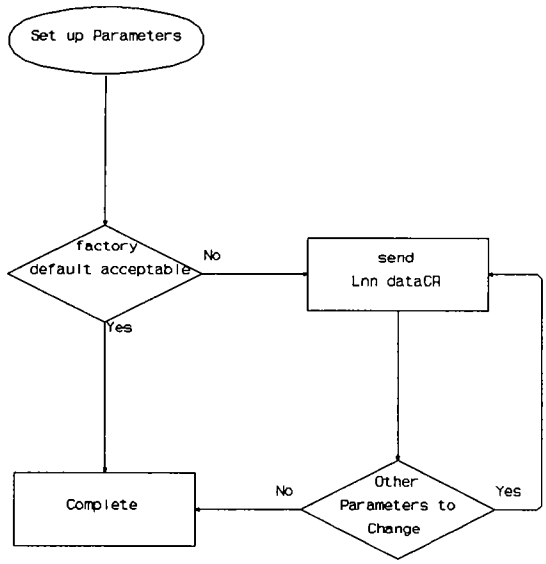
To cancel the listen mode, the host must transmit the device attention command (<), followed by the device attention character, followed by an @. For example, to cancel the listen mode for device 01, send <01@. This device will now become the active device.

All Controls can be placed in the listen mode by issuing a <00&CRLF from the host. To cancel this mode for all Controls, a <00@ can be sent from the host. When this is done, all Controls become active.

GENERAL PROGRAMMING COMMENTS

1. The first task that faces an operator is that of setting "L codes", the parameters of each Control.

2. It is important to note the **factory default values** that have been set for each parameter. These default values allow entry steps to be eliminated for those parameters where the factory default value is acceptable. (See the Appendix for values.)



3. If invalid data are entered for any parameter or field, the previous data will not be replaced.

4. If the number of characters entered for a parameter exceeds the number of characters required, the data are truncated to the correct length by eliminating the first characters sent. For example, if a parameter requires eight characters and ten are sent, only the last eight will be used.

5. In the command descriptions which follow, the field descriptions for each command use an "n" to designate a number and an "s" to designate a sign (+ or -). For example, the field designation "snnnnnnnn" designates that the field consists of a + or - sign followed by eight numbers

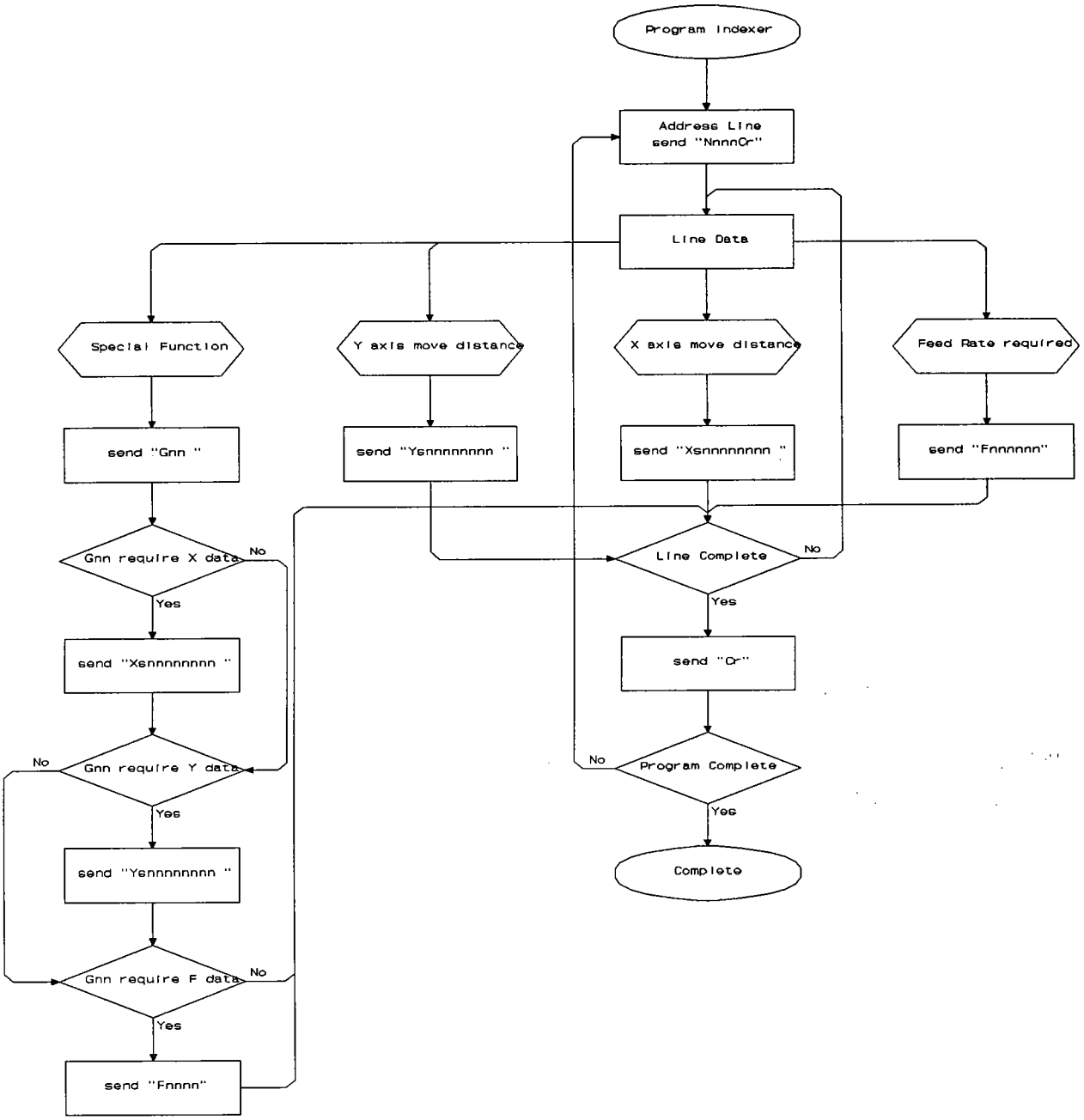
6. Some functions can be executed via switches connected to the programmable inputs. This allows the user to perform system set up through the serial port and then operate from a switch panel. **Note that if a parameter is changed over the serial port, it will override the switch setting on the panel.** For example, if the High Speed is selected on the panel and then the RS232 command for Low Speed mode is sent followed by a request for a CCW move from the panel, the move will be executed at Low Speed even though the panel switch is set at the high speed mode.

   Note also that switches are only honored if they are toggled (change state). Immediate H codes also override any switch settings.

7. When using any of the L, H and G codes, preceding zeros can be omitted. For example, H1CRLF will perform the same as H01CRLF.

8. If it is necessary to know when an index motion is complete, the Line Done Characters (L55 parameter) can be used. Note that if a Program Line Delay is programmed, the character(s) will not be transmitted until the delay has expired.

9. To enter a program line of code from your flow chart or pseudo code simply send the designated line number first, Nnnn ,. Now fill the contents of the line using the appropriate commands: Gnn for special functions, Xsnnnnnnnn or Ysnnnnnnn for move distance or G code field extension, Fnnnnnn for feed rate or G code field extension and Cr or Lf to load the line contents into non-volatile memory.



Notes: "Busy" means that the Control is executing a program or motion is occurring.

"Ready" means that motion has ceased and/or program execution is completed. The Control can now receive further information.

Immediate commands can be processed anytime.

NOTE: The Slo-Syn 2000 Programmable Motion Control **is not** compatible with the Superior Electric Micro Series programming pendant SSP-525, nor with the MS-1 Application Generator Program for personal computers.

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