KOLLMORGEN®

Because Motion Matters™

This is a Discontinued Product

Contact Kollmorgen Customer Support at 1-540-633-3545 or email us at support.kollmorgen.com if assistance is required.

G CODES

PROGRAMMING COMMAND (G-CODE) FUNCTIONAL LISTING

PROGRAM COMMANDS
G04 Delay
G11 Call Subroutine
G12 Go to line Number
G25 Loop start
G26 Loop end
G30 End Of Program
G31 Program stop
G32 Return from subroutine
G90 Absolute position mode
G91 Incremental position mode

HOMING
G76 Return to electrical home
G77 Set electrical home
G78 Return to mechanical home
G79 Set absolute position

INPUT/OUTPUT
G20 Branch on input condition
G22 Wait for input condition
G47 Set output(s)

MOTOR CURRENT CONTROL
G64 Enable reduce current
G65 Disable reduce current
G66 Enable boost current
G67 Disable boost current
G68 Motor windings off
G69 Motor windings on

SPEED CONTROL
G23 Increase feed rate
G24 Decrease feed rate
G27 High speed mode
G28 Low speed mode

ADVANCED PROGRAM COMMANDS
G05 Transmit message
G06 Simulate the reception of an Hcode
G19 Branch on register result
G21 Register control
G29 Set designated L code
G50 Set flag(s)
G51 Branch on flag condition
G54 Register execution
G55 Error trapping

EXTERNAL DATA
G29 Set designated L code
G36 Read move distance
G37 Read line number and branch
G38 Read feed rate
G52 Select external data source
G53 Select SS2000 interface I/O port

DYNAMIC MOTION
G10 Mark registration cycle
G48 Start jog cycle
G49 Stop jog cycle

BREAK POINT MOTION
G60 Enable continuous execution mode
G61 Disable continuous execution mode
G62 Wait for move distance
G63 Wait for velocity condition

G04 Delay

Function Delay program execution.

Command Format
G04 Xnnnn {Fnnnnnn}
G04 Ynnnn {Fnnnnnn}

Range

X or Y field	0 - 9,999	delay time (milliseconds)
F field	0 - 999,999	feedrate (pulses/sec)

Notes

This command can not be used on program line 0 (MDI mode)

If no value has been entered for the X or Y field, or the value is out of range, program execution will terminate.

The F field, if programmed, will become the new feedrate after the delay time has elapsed.

Examples

N1 G04 X1000	delays 1 second.
N1 G04 Y2000	delays 2 seconds.
N1 G04 X1000 F2000	delays 1 second then changes the feedrate to 2000 pulses/second.

G05 Transmit Message

Function Transmit the message number specified by the X or Y field. The messages are stored in parameters L01 thru L05.

Command Format
G05 Xn {Fnnnnnn}
G05 Yn {Fnnnnnn}

Range

X or Y field	1 - 5	message number
F field	0 - 999,999	feedrate (pulses/sec)

Notes

The F field, if programmed, will become the new feedrate.

If no value has been entered for the X or Y field, or the value is out of range, program execution will terminate.

Related commands
L01 "Message 1"
L02 "Message 2"
L03 "Message 3"
L04 "Message 4"
L05 "Message 5"

Examples

N1 G05 X1	send message #1 (L01).
N1 G05 Y2	send message #2 (L02).
N1 G05 X1 F2000	send message #1 (L01) and change the feedrate to 2000 pulses/second.

G06 Hcode execution

New code per Rev. C

Function Simulate the reception of an Hcode

Command Format
G06 Xnn
G06 Ynn

Range X or Y field any legal immediate Hcode number

Notes The F field, if programmed, is ignored.

If no value has been entered for the X or Y field, or the value is out of range, program execution will terminate.

Legal values for X or Y field

04	High Speed Mode
05	Low Speed Mode
13	Transfer Current Program Line
15	Transfer Current Line Number
17	Transfer Absolute Electrical Position
19	Transfer Mode Status
20	Transfer Output Status
21	Transfer Conditional Input Status
22	Transfer Encoder Position
24	Program Trace Mode On
25	Program Trace Mode Off
26	Transfer Pulse Error Count
27	Transfer Closed Loop Status
31	Target Velocity Increase
32	Target Velocity Decrease
41	Transfer Remaining Repeat Value
42	Transfer Last External BCD Value
43	Transfer OPTO 22 Input/Output Status
44	Transfer Register Contents
60	Transfer Present Velocity
85	Transfer Motion Error Status
86	Transfer Data Error Status
87	Transfer Program Error Line Number
88	Transfer Execution Status

Examples

N1 G06 X17	transmit present absolute position
N1 G06 X22	transmit present encoder position.

G10 Mark Registration Cycle

Function

Execute a Mark Registration cycle.

Command Format

G10 X {Fnnnnnn}	X axis, using external data
G10 Xsnnnnnnnn {Fnnnnnn}	X axis, using X field data
G10 Y {Fnnnnnn}	Y axis, using external data
G10 Ysnnnnnnnn {Fnnnnnn}	Y axis, using Y field data
G10 {Fnnnnnn}	Active axis, using external data

Range

X or Y field -99,999,999 to +99,999,999 index distance
F field 0 - 999,999 feedrate (pulses/sec)

Notes

This command can not be used during a G48 jog cycle.

The index distance of a Mark Registration cycle is always incremental.

The cycle begins as a Jog cycle. When the registration input occurs, the index portion of the cycle begins.

Parameter L16 can be used to limit the move distance during a Registration cycle. This feature allows the cycle to be terminated in the event of a loss of the registration input.

The motor speed is limited so that the distance needed to decelerate to a stop is less than the index distance. In some cases this results in a speed less than the feedrate.

The F field, if programmed, will become the new feedrate.

The repeatability of the Registration cycle is ±1 pulse.

Related commands

L16 (Registration Travel Limit)
L20 (TR1 & TR2 Configuration)
G52 (Select External Data Source)

Examples

N1 G10 X	Mark Registration using X axis. Index distance is external BCD data multiplied by the L91 X axis scale factor.
N2 G10 Y1000	Mark Registration using Y axis. Index distance is 1000.

G11 Call Subroutine

Function

Call the subroutine at the line indicated by the X or Y field and repeat the number of times indicated by the F field.

Command Format

G11 Xnnn Fnnnn
G11 Ynnn Fnnnn

Range

X or Y field	1 - 400	line number
F field	0 - 9,999	repeat count

Notes

This command can not be used on program line 0 (MDI mode)

The X or Y field is the subroutine line number. The F field is the subroutine repeat count. The total number of times the subroutine is executed is the F field value plus one.

Subroutine nesting (calling a subroutine from within a subroutine) is allowed up to four levels. Nesting beyond four levels will cause program execution to terminate.

When a Return From Subroutine (G32) command is encountered during, the Control returns to the line calling the subroutine and the cycle is repeated F + 1 times. The Control will then go on to the next program line.

Related commands

G32 (Return From Subroutine)

Example

```
N1 G11 X100 F3          call subroutine line 100 & repeat 3 times
N2 G30          end of program

N100 Y+500 F1000        moves Y+500 at 1000 pulses/sec
N101 G32                return from subroutine
```

G12 Go To Line Number

Function Branch to the line indicated by the X or Y field

Command Format
G12 Xnnn {Fnnnnnn}
G12 Ynnn {Fnnnnnn}

Range

X or Y field	1 - 400	line number
F field	0 - 999,999	feedrate (pulses/sec)

Notes This command can not be used on program line 0 (MDI mode)

The F field, if programmed, will become the new feedrate.

Example N10 G12 X2 Program execution branches to line 2

G19 Branch On Result

Function

This command allows the program to branch to a specified program line based on the result of a register-to-register comparison.

Command Format

G19 X0000nnnn Fnnn Branch if comparison result matches.

Range:

F field 1 to 400 line number
X field as shown below register comparison result

X0000nnnn

0000n--- Comparison result greater than or equal to (>=)
0000-n-- Comparison result greater than (>)
0000--n- Comparison result equal to (=)
0000---n Comparison result less than (<)

n = 0 false
n = 1 true
n = 2 don't care

Notes

If the field data are out of range, program execution will be terminated.

Related Commands

G21 Register Control
G52 Select External Data Source
G54 Register Execution

Example

Program select 1-4 via BCD input. Program 1 starts at line 100, Program 2 starts at line 150, Program 3 starts at line 200, and Program 4 starts at line 250.

```
N1  G52  X1          select BCD bank 1
N2  G21  F30         BCD data > register 3
N3  G21  X1  F40     1 > register 4
N4  G21  X4  F34     BCD data = 1?
N5  G19  X2212  F100 if yes, go to line 100
N6  G21  X2  F40     2 > register 4
N7  G21  X4  F34     BCD data = 2?
N8  G19  X2212  F150 if yes, go to line 150
N9  G21  X3  F40     3 > register 4
N10 G21  X4  F34     BCD data = 3?
N11 G19  X2212  F200 if yes, go to line 200
N12 G21  X4  F40     4 > register 4
N13 G21  X4  F34     BCD data = 4?
N14 G19  X2212 F250  if yes, go to line 250
N15 G12  X2          go to line 2
```

G20 Branch on Input Condition

Function

If the condition specified by the X or Y field occurs, the program branches to the line specified by the F field, otherwise the next line is executed.

Command Format

G20 Xnnnnnnnn Fnnn (check Programmable Input conditions)
G20 Ynnnnnnnn Fnnn (L20 nn1nn check Expansion input conditions)
G20 Ynnnn Fnnn (L20 nn2nn check SS2000 Expansion input conditions)

Range

X or Y field 0 - 99,999,999 input condition
F field 1 - 400 line number

Notes

This command can not be used on program line 0 (MDI mode)

Each digit in the X or Y field represents an input as shown below.

Xnnnnnnnn	L20 nn1nn Ynnnnnnnn	L20 nn2nn Ynnnn
n------ Input 8	n------ Expansion Input 8	n--- S2000 Expansion Input 4
-n----- Input 7	-n----- Expansion Input 7	-n-- S2000 Expansion Input 3
-n----- Input 7	-n----- Expansion Input 7	--n- S2000 Expansion Input 2
--n---- Input 6	--n---- Expansion Input 6	---n S2000 Expansion Input 1
---n--- Input 5	---n--- Expansion Input 5	
----n-- Input 4	----n-- Expansion Input 4	
-----n- Input 3	-----n- Expansion Input 3	
------n Input 2	------n Expansion Input 2	
------n Input 1	------n Expansion Input 1	

The input condition "n" for each input is a value 0 - 9. A 0 specifies an inactive input, a 1 an active input and 2 - 9 that the input state doesn't matter. Programming the X field will cause the inputs that have been configured as programmable inputs, via the L58 parameter, to be tested.

Programming the Y field will cause the expanded inputs to be tested. If the Y field is programmed and the expansion port is not configured for I/O, the programmable inputs will be tested.

The L20 parameter determines which set of expansion I/O to test. L20 nn1nn selects the Expansion inputs, while L20 nn2nn selects the S2000 Expansion board inputs (4 inputs per port).

Related commands

L20 (System Configuration)
L58 (Input Configuration)

Example

The following example has inputs 1 - 8 configured as testable inputs and the expansion port as I/O.

```
N1 G20 X22220011 F10   If Inputs 1,2,3,4 = 1,1,0,0 respectively then go to line 10
N2 G20 Y11022220 F10   If Expansion Inputs 1,6,7,8 = 0,0,1,1 respectively then go to line 10.
N3 G12 X1                                                    Go to line 1.

N10 X10000 F10000      Index X axis 10,000 pulses at 10,000 pulses/sec.
N11 G30                Program end
```

G21 Register Control

Modified per Rev. C

Function

This command controls nine registers; two dedicated and seven general purpose. These registers can be loaded, adjusted or compared.

Command Format

G21 Xsnnnnnnnn Fn0	load register Fn (1-9) with X value
G21 Fn0	load register Fn (1-9) with external BCD data
G21 Fn1	scale register Fn (1-9) using L91 X/Y scale factor
G21 Xn Fn2	move contents of register Xn (1-9) to register Fn (1-9)
G21 X+n Fn3	add register Xn (1-9) to register Fn (1-9), result in register Fn
G21 Y+nnnnnnnn Fn3	add nnnnnnnn to Register Fn (1-9) result in Register Fn
G21 X-n Fn3	subtract register Xn (1-9) from register Fn (1-9), result in register Fn
G21 Y-nnnnnnnn Fn3	subtract nnnnnnnn from Register Fn (1-9), result in Register Fn
G21 Xn Fn4	compare register Xn (1-9) with register Fn (1-9)
G21 Ysnnnnnnnn Fn4	compare Ysnnnnnnnn to Register Fn (1-9)
G21 X Fn5	load register Fn (1-9) with X absolute position
G21 Y Fn5	Load register Fn (1-9) with Y absolute position
G21 X Fn6	load X absolute position with register Fn (1-9)
G21 Y Fn6	load Y absolute position with register Fn (1-9)
G21 X Fn7	load register Fn (1-9) with X encoder position
G21 X Fn8	load Feedrate with register Fn (1-9)
G21 Xnn Fn9	load L nn X axis parameter with register Fn (1-9)
G21 Ynn Fn9	load L nn Y axis parameter with register Fn (1-9)

Range

Function 0	X field +99,999,999 to -99,999,999 F field 10-90
Function 1	X field none F field 11-91
Function 2	X field 1-9 F field 12-92
Function 3	X field 1-9 Y field -99999999 to +99999999 F field 13-93
Function 4	X field 1-9 Y field -99999999 to +99999999 F field 14-94
Function 5	X field none F field 15-95
Function 6	X field none F field 16-96
Function 7	X field none F field 17-97
Function 8	X field none F field 18-98
Function 9	X field any legal L code Y field any legal L code F field 19-99

Notes

The register assignments are as follows:

register 1	event counter 1 (counts inactive to active transitions on input 1)
register 2	event counter 2 (counts inactive to active transitions on input 2)
register 3	general purpose register
register 4	general purpose register
register 5	general purpose register
register 6	general purpose register
register 7	general purpose register
register 8	general purpose register
register 9	general purpose register

Register 1 counts inactive to active transitions on the input terminal assigned to Program testable Input 1. Refer to the L58 code in this manual for assignment

Register 2 counts inactive to active transitions on the input terminal assigned to Program testable Input 2. Refer to the L58 code in this manual for assignment

The LSB digit of the F field selects the function to be performed. The functions are:

0	load register Fn (1-9) with X value or BCD data
1	scale register Fn (1-9) using L91 scale factor
2	move register Xn (1-9) to register Fn (1-9)
3	add (X+n) or subtract (X-n) register Xn to or from register Fn (1-9)
4	compare register Fn (1-9) with the X or Y absolute position
5	load register Fn (1-9) with the X or Y absolute position
6	load the X or Y absolute position with register Fn (1-9)
7	load register Fn (1-9) with the X encoder position
8	load Feedrate with register Fn (1-9)
9	load L code parameter with register Fn (1-9)

If the F field data are out of range, program execution will be terminated.

Register scaling (G21 Fn1) uses the active axis scale factor (L91 value)

All registers are cleared when a Cycle Start is executed, but left unchanged if resuming from a Feedhold or Program Stop. If L20 nnnXn is 3, 4, 5 the registers are not cleared.

Related Commands

G52	Select External Data Source
G54	Register Execution
G58	Input Configuration
L91	Scale Factor

Examples

Incrementally index Y axis 10 times using BCD data and return to starting position

N1 G91 Y F1000	select Y axis and feedrate of 1000 pps
N2 G90	absolute position mode
N3 G52 X1	select BCD data bank 1
N4 G21 F20	BCD data > register 2
N5 G21 F21	scale register 2 BCD data using L91 Y value
N6 G21 Y F95	Y absolute position > register 9
N7 G21 X9 F82	register 9 > register 8
N8 G25 X9	loop 10 times
N9 G21 X2 F83	add register 2 to register 8
N10 G54 Y+8 F0	index Y axis to register 8 position
N11 G26	loop end
N12 G54 Y+9 F0	index Y axis to starting position

Test encoder position. If different than X absolute position, load encoder position into X absolute position.

N1 G21 X F37	encoder position > register 3
N2 G21 X F45	X absolute position > register 4
N3 G21 X3 F44	compare register 3 with register 4
N4 G19 X2212 F6	branch if registers alike to line 6
N5 G21 X F36	encoder position > X absolute position
N6 G30	

G22 Wait for Input Condition

Function

Wait until the input states match the X or Y field value.

Command Format

G22 Xnnnnnnnn {Fnnnnnn}	(wait for Prog. Input conditions)
G22 Ynnnnnnnn {Fnnnnnn}	(L20 nn1nn wait for Expansion input conditions)
G22 Ynnnn {Fnnnnnn}	(L20 nn2nn wait for S2000 Expansion input condition)

Range

X or Y field	0 - 99,999,999	input condition
F field	0 - 999,999	feedrate (pulses/sec)

Notes

This command can not be used on program line 0 (MDI mode).

The F field, if programmed, will become the new feedrate after the input condition is satisfied.

Each digit in the X or Y field represents an input as shown below.

Xnnnnnnnn	L20 nn1nn Ynnnnnnnn	L20 nn2nn Ynnnn
n------ Input 8	n------ Expansion Input 8	n--- S2000 Expansion Input 4
-n----- Input 7	-n----- Expansion Input 7	-n-- S2000 Expansion Input 3
--n---- Input 6	--n---- Expansion Input 6	--n- S2000 Expansion Input 2
---n--- Input 5	---n--- Expansion Input 5	---n S2000 Expansion Input 1
----n-- Input 4	----n-- Expansion Input 4	
-----n- Input 3	-----n- Expansion Input 3	
------n Input 2	------n Expansion Input 2	
------n Input 1	------n Expansion Input 1	

The input condition "n" for each input is a value 0 - 9. A 0 specifies an inactive input, a 1 an active input and 2 - 9 that the input state doesn't matter.

Programming the X field will cause the inputs that have been configured as programmable inputs, via the L58 parameter, to be tested.

Programming the Y field will cause the expanded inputs to be tested. If the Y field is programmed and the expansion port is not configured for I/O, the programmable inputs will be tested.

The L20 parameter determines which set of expansion I/O to test. L20 nn1nn selects the Expansion Inputs, while L20 nn2nn selects the S2000 Expansion board Inputs (four inputs per port).

Related commands

L20 (System Configuration)
L58 (Input Configuration)
G53 (Select S2000 Interface Input Port)

Example

The following example has inputs 1 - 8 configured as testable inputs and the expansion port as I/O.

N1 G22 X22220011 F10	Wait until Inputs 1,2,3,4 = 1,1,0,0 respectively.
N2 G22 Y11022220 F10	Wait until Expansion Inputs 1,6,7,8 = 0,0,1,1 respectively.
N10 X10000 F10000	Index X axis 10,000 pulses at 10,000 pulses/sec.
N11 G30	Program end

G23 Increase Feedrate

Function Increase feedrate by the Feedrate increment (L73).

Command Format G23

Notes This command can not be used on program line 0 (MDI mode) or during normal execution mode.

Each time G23 is executed, the feedrate is increased by the feedrate increment, but not beyond the feedrate limit (L71). Changes to the feedrate using G23, during a G48 jog cycle, are not saved.

If a value is entered for the X or Y field, program execution will be terminated.

Related Commands L73 (Feedrate increment)
L71 (Feedrate limit)

Example Feedrate increment L73 = 100

```
N1 G48 X+ F500      start Jog cycle, feedrate = 500 pulses/sec
N2 G23              increment feedrate by 100 pulses/sec
N3 G04 X1000        delay 1 second
N4 G49              stop Jog cycle
N5 G30              end of program
```

G24 Decrease Feedrate

Function Decrease feedrate by the Feedrate Increment (L73).

Command Format G24

Notes This command can not be used on program line 0 (MDI mode) or during normal execution mode.

Each time G24 is executed, the feedrate is decreased by the feedrate increment, but not below zero. Changes to the feedrate using G24, during a G48 jog cycle, are not saved.

If a value is entered for the X or Y field, program execution will be terminated.

Related Commands L73 (Feedrate Increment)

Example Feedrate increment L73 = 100

```
N1 G48 X+ F500      start Jog cycle, feedrate = 500 pulses/sec
N2 G24              decrease feedrate by 100 pulses/sec
N3 G04 X1000        delay 1 second
N4 G49              stop Jog cycle
N5 G30              end of program
```

G25 Loop Start
G26 Loop End

Function

Defines the start (G25) and the end (G26) of a Loop. The loop will be executed the number of times specified by the X or Y field plus one.

Command Format

G25 Xnnnn {Fnnnnnn}	nnnn = repeat count
G25 Ynnnn {Fnnnnnn}	nnnn = repeat count
G26 Xnnnn {Fnnnnnn}	repeat count is read from external data
G26 Ynnnn {Fnnnnnn}	

Range

X or Y field	0 - 9,999	repeat count
F field	0 - 999,999	feedrate (pulses/sec)

Notes

These commands cannot be used on program line 0 (MDI mode)

The loop executes lines from the loop start (G25) to the loop end (G26). When the loop is completed, execution continues with the line following the loop end (G26).

The X or Y field is the loop repeat count. The number of loop executions is the X or Y value plus 1. If the X or Y value is out of range, program execution will terminate. If no value has been entered for the X or Y field, the repeat count will be read from the selected external data source.

Loop nesting, calling another loop from within a loop, beyond four levels is not allowed. If loop nesting beyond four levels occurs, program execution will terminate.

The F field, if programmed, will become the new feedrate.

Example

Move Y+500, 4 times.

N1 G25 X3	Loop start; repeat 3 times
N2 Y+500	move Y+500 pulses
N3 G26	end of loop
N4 G30	end of program

G27 High Speed Mode

Function Sets the High Speed Mode of Operation.

Command Format

G27 X {Fnnnnnn}	Set X axis to High Speed Mode
G27 Xsnnnnnnnn {Fnnnnnn}	Set X axis to High Speed Mode followed by a move
G27 Y {Fnnnnnn}	Set Y axis to High Speed Mode
G27 Ysnnnnnnnn {Fnnnnnn}	Set Y axis to High Speed Mode followed by a move
G27 {Fnnnnnn}	Set active axis to High Speed Mode.

Range

X or Y field	-99,999,999 to +99,999,999 index distance
F field	0 - 999,999 feedrate (pulses/sec)

Default Mode High Speed Mode

Notes The X or Y field value, if programmed, will become the index distance and direction.

The F field, if programmed, will become the new feedrate.

Example N1 G27 X Sets the X axis to High Speed Mode

G28 Low Speed Mode

Function Sets the Low Speed Mode of Operation.

Command Format

G28 X {Fnnnnnn}	Set X axis to Low Speed Mode
G28 Xsnnnnnnnn {Fnnnnnn}	Set X axis to Low Speed Mode followed by a move
G28 Y {Fnnnnnn}	Set Y axis to Low Speed Mode
G28 Ysnnnnnnnn {Fnnnnnn}	Set Y axis to Low Speed Mode followed by a move
G28 {Fnnnnnn}	Set active axis to Low Speed Mode.

Range

X or Y field	-99,999,999 to +99,999,999 index distance
F field	0 - 999,999 feedrate (pulses/sec)

Default Mode High Speed Mode

Notes The X or Y field value, if programmed, will become the index distance and direction.

The F field, if programmed, will become the new feedrate.

Example N1 G28 X Sets the X axis to Low Speed Mode

G29 Set Designated L Code

Function

The L code, designated by the (F field), is loaded with the X or Y field data.

Command Format

G29 Xsnnnnnnnn Fnn	X axis L code "nn" = "snnnnnnnn"
G29 X Fnn	X axis L code "nn" = external data
G29 Ysnnnnnnnn Fnn	Y axis L code "nn" = "snnnnnnnn"
G29 Y Fnn	Y axis L code "nn" = external data
G29 Fnn	active axis L code "nn" = external data

Range

X or Y field	range depends on L code	L code data
F field	valid entries listed below	L code

The following L codes can be set using this command:

L08 Mechanical Home Direction
L09 Jog Speed
L10 Deceleration
L11 Acceleration
L12 Low Speed
L13 Step Size
L14 Home Speed
L16 Index From Run Travel Limit
L17 Mechanical Home Offset
L18 Software CW Limit
L19 Software CCW Limit
L20 System Configuration
L41 Auto Start Line Number
L43 Delay between Index & Backlash
L44 Delay after Motion
L47 Program Execution Repeat Count
L66 Backlash Compensation
L71 Ramp Frequency Limit
L73 Deviation Frequency
L87 Following Error
L90 Position Verification Enable/Disable
L91 External Move Distance Scale Factor
L93 In Position Bandwidth

Notes

This command cannot be used during a G48 jog cycle or continuous execution mode.

If the X or Y field data is omitted the data will be read from the externally selected data source.

Examples

N1 G29 X+1000 F09	the X axis jog speed (L09) = 1000
N2 G29 Y F11	the Y axis accel (L11) = external data

G30 End of Program

Function Denotes the end of the program and resets the line pointer to the line designated by the L41 parameter.

Command Format G30

Notes This command can not be used on program line 0 (MDI mode)

Following the execution of line 400, the line pointer is set to the line designated by the L41 parameter.

Related Commands L41 (Auto Start Line Number)
L47 (Repeat Count)

G31 Program Stop

Function The program stops execution and increments the line pointer. Index motion is allowed to finish and Jog motion is stopped.

Command Format G31

Notes This command can not be used on program line 0 (MDI mode)

Program execution can be resumed, with a Cycle Start command.

G32 Return from Subroutine

Function Indicates the end of a subroutine.

Command Format G32

Notes This command can not be used on program line 0 (MDI mode)

When encountered within a subroutine, the line pointer is restored to the line number from which the subroutine call (G11) was made.

If this command is encountered outside of a subroutine, program execution will terminate.

Related commands G11 (Call Subroutine)

G36 Read Move Distance

Function	Read data from the selected external data source, multiply by the L91 scale factor and use as the index distance.	
Command Format	G36 {Fnnnnnn}	Move the active axis
	G36 X {Fnnnnnn}	Move the X axis
	G36 Y {Fnnnnnn}	Move the Y axis
Range	External data -79,999,999 to +79,999,999 index distance	
Notes	This command can not be used during a G48 jog cycle.	
	The move distance is treated as either incremental or absolute, depending on the selected mode.	
	The F field, if programmed, will become the new feedrate.	
Related commands	G52 (Select External Data Source)	
Example	N1 G36 F1000 read the external data, multiply by the L91 scale factor and move the active axis with a feedrate of 1000 pulses/second.	

G37 Read Line Number and Branch

Function	Read data from the selected external data source and branch to the indicated line number.	
Command Format	G37 {Fnnnnnn}	
Range	External Data 1 - 400	line number
Notes	This command can not be used on program line 0 (MDI mode)	
	If the external data is outside the valid range, program execution will terminate.	
	The F field, if programmed, will become the new feedrate.	
Related commands	G52 (Select External Data Source)	

G38 Read Feedrate

Function Read the selected external data source and use as the feedrate.

Command Format
G38 {Xsnnnnnnnn}
G38 {Ysnnnnnnnn}

Range X or Y field -99,999,999 to +99,999,999 index distance External Data 0 - 999,999 feedrate

Notes
If the external data are outside the valid range, program execution will terminate.

The X or Y field value is the index distance and direction.

The BCD data will be scaled using the L91 scale factor.

Related commands G52 (Select External Data Source)

Example

N10 G38 X-1000	Move -1000 on the X axis using the feedrate read from the external data source.

G47 Set Outputs

Function

Set Programmable or Expansion outputs to the states specified by the X or Y field data.

Command Format

G47 Xnnnnnnnn {Fnnnnnn}	Set Programmable outputs G47
Ynnnnnnnn {Fnnnnnn}	L20 nn1nn (set Expansion Outputs)
Ynnnn {Fnnnnnn}	L20 nn2nn (set S2000 Expansion Outputs)

Range

X or Y field 0 to 99,999,999

Notes

The state of each output is specified by a digit in the X or Y field data. A 0 value sets the output inactive, a 1 sets the output active and 2-9 cause no change to the output.

The X field specifies the states of the programmable outputs. (Outputs assigned as "0" or "1" in L59)

The Y field specifies the states of the Expansion Port outputs. If the Expansion Port is not configured for I/O (L20 = nn0nn), then the programmable outputs will be set instead.

If the X or Y field is missing, program execution will terminate.

Each digit in the X or Y field represents an output as shown below:

	L20 nn1n		L20 nn2nn
Xnnnnnnnn		Ynnnnnnnn	Ynnnn
n------	Output 8	n------ Expansion Output 8	n--- S2000 Expansion Output 4
-n-----	Output 7	-n----- Expansion Output 7	-n-- S2000 Expansion Output 3
--n----	Output 6	--n---- Expansion Output 6	--n- S2000 Expansion Output 2
---n---	Output 5	---n--- Expansion Output 5	---n S2000 Expansion Output 1
----n--	Output 4	----n-- Expansion Output 4	
-----n-	Output 3	-----n- Expansion Output 3	
------n	Output 2	------n Expansion Output 2	
------n	Output 1	------n Expansion Output 1	

The F field, if programmed, will become the new feedrate.

The L20 parameter determines which set of expansion I/O to test. L20 nn1nn selects the Expansion outputs, while L20 nn2nn selects the S2000 Expansion board outputs.

Related commands

L20 (Expansion Port Configuration)
L59 (Output Configuration)
G53 (Select S2000 Interface Input Port)

Examples

Expansion Port configured as I/O (L20 = nn1nn) and Outputs 1 - 4 configured as programmable outputs

N1 G47 X00001111 (Outputs 1 - 4 all active)

N2 G47 Y10101010 (Expansion Outputs 1,3,5,7 inactive, Expansion Outputs 2,4,6,8 active)

Expansion Port configured as BCD data (L20 = nn0nn) and Outputs 5 - 8 configured as programmable outputs

N3 G47 Y10101010 (Outputs 5 & 7 inactive, Outputs 6 & 8 active)

Expansion port configured for S2000 Expansion I/O Board (L20 nn2nn)

N1 G53 X1	select Expansion Port 1
N2 G47 Y1000	Port 1 outputs 4 and 3 active, 2 and 1 inactive

G48 Start Jog Cycle

Function

Starts a Jog cycle during program execution in the direction specified by the X or Y field. The feedrate will be the Jog Speed (L09) or the value specified in the F field.

Command Format

G48 Xs {Fnnnnnn}	start a program Jog using the X axis
G48 Ys {Fnnnnnn}	start a program Jog using the Y axis

Range

X or Y field +,- direction
F field 0 - 999,999 feedrate (pulses/sec)

Notes

This command can only be used in Normal execution mode.

The following commands are allowed during a G48 jog cycle:

G04	Delay
G05	Transmit Message
G11	Call Subroutine
G12	Go To Line Number
G19	Branch On Result
G20	Branch on Input Condition
G21	Register Control
G22	Wait For Input Condition
G23	Increase Feedrate
G24	Decrease Feedrate
G25	Loop Start
G26	Loop End
G27	High Speed Mode
G28	Low Speed Mode
G30	End of Program
G31	Program Stop
G32	Return From Subroutine
G37	Read Line Number and Branch
G38	Read Feedrate
G47	Set Outputs
G49	Stop Jog Cycle
G50	Set Flags
G51	Branch on Flag Condition
G52	Select External Data Source
G53	Select S2000 Interface I/O Port
G54	Register Execution
G55	Error Trapping
G62	Wait for Move Distance
G63	Wait for Velocity Condition
G64	Enable Reduce Current
G65	Disable Reduce Current
G66	Enable Boost Current
G67	Disable Boost Current
G68	Motor Windings Off
G69	Motor Windings On
G90	Absolute Position Mode
G91	Incremental Position Mode
Fnnnnnn	Feedrate

The F field, if programmed, will become the new feedrate.

The Single Line execution mode (L06 = nn1), is suspended when a G48 command is executed. The program will execute continuously and Single Line execution mode is restored following a Stop Jog Cycle (G49), End of Program (G30), Program Stop (G31) or executing line 400.

Related Command G49 (Stop Jog Cycle)

Example

N1 G48 Y- F2000	Start CCW Y Axis JOG at 2000 pulses/sec
N2 G04 X1000 F3000	Delay 1 second, change feedrate to 3000 pulses/sec
N4 G04 X1000	Delay 1 second
N5 G30	Program End

G49 Stop Jog Cycle

Function Causes a Jog cycle to come to a controlled stop.

Command Format G49

Notes This command can only be used during a G48 jog cycle.

When executed this command brings a programmed (G48) Jog cycle to a controlled stop and pauses program execution until motion has stopped.

The X or Y field, if programmed, will terminate program execution.

Related commands G48 (Start Jog Cycle)

G50 Set Flags

Function

Set/Reset 8 internal flags based on X or Y field data.

Command Format

G59 Xnnnnnnnn {Fnnnnnn}
G59 Ynnnnnnnn {Fnnnnnn}

Range

X or Y field	0 - 99,999,999
F field	0 - 999,999 feedrate (pulses/sec)

Notes

This command can not be used on program line 0 (MDI mode)

Each digit in the X or Y field corresponds to one of 8 flags. A value of 0 clears the flag, a 1 sets it and 2 - 9 leave it unchanged.

If the X or Y field is missing, program execution will terminate.

The X or Y field output assignments are as follows:

Xnnnnnnnn
n------ flag 8
-n----- flag 7
--n---- flag 6
---n--- flag 5
----n-- flag 4
-----n- flag 3
------n flag 2
-------n flag 1

The F field, if programmed, will become the new feedrate.

Example

The following subroutine changes the state of output #1 each time it is called. The Flag is used to keep track of the output state. The flag is tested (G51) and the output is changed accordingly.

```
N100 G51 X22222220 F104     If flag 1 = 0 go to line 104
N101 G47 X22222220          Output 1 = 0
N102 G50 X22222220          flag 1 = 0
N103 G32                    else
N104 G47 X22222221          Output 1 = 1
N105 G50 X22222221          flag 1 = 1
N106 G32
```

G51 Branch on Flag Condition

Function

If the Flags match the condition specified by the X or Y field, the program branches to the line specified by the F field, otherwise the next line is executed.

Command Format

G51 Xnnnnnnnn Fnnn
G51 Ynnnnnnnn Fnnn

Units

Flag condition	X or Y field)
Line number	(F field)

Range

X or Y field	0 - 99,999,999	flag condition
F field	1 - 400	line number

Notes

This command can not be used on program line 0 (MDI mode)

If no value is entered for the X or Y field, program execution will terminate.

The flag condition "n" for each flag is a value 0 - 9. A 0 requires that the flag be cleared, a 1 requires that the flag be set and a value 2 - 9 indicates the state of the flag doesn't matter.

The X or Y field input assignments are as follows:

Xnnnnnnnn	Ynnnnnnnn
n------ flag 8	n------ 1 = CW 0 = CCW
-n----- flag 7	-n----- Software Limit
--n---- flag 6	--n---- Hardware Limit
---n--- flag 5	---n--- Mark Registration Limit
----n-- flag 4	----n-- Trigger 2 flag
-----n- flag 3	-----n- Trigger 1 flag
------n flag 2	------n velocity at speed flag
-------n flag 1	-------n motion busy flag

The MSB in the Y field selects the direction for the Software Limit or the Hardware Limit.

Examples

L20 02000	X axis registration cycle TR1 positive edge trigger, Y axis registration cycle TR2 positive edge trigger. Registration cycle starts on 2nd TR2 trigger.
N1 G60	Set Continuous Execution mode
N2 G21 X F30	Load BCD data into register 3
N3 G54 Y+3 F3	Start Y axis registration cycle using register 3, but do not arm trigger
N4 G51 Y22220222 F4	Wait for trigger 2 to be active
N5 G51 Y22221222 F5	Wait for trigger 2 to be inactive
N6 G54 F4	Arm registration cycle trigger
N7 G51 Y22222221 F7	Wait for cycle complete
L58 "+2187600000000"	Input 13 X axis CCW limit, Input 12 X axis CW limit. Jogs between CW and CCW limits five times and stops.
N1 G55 X20	Set error trapping routine starting at line 20
N2 G21 X5 F30	5 > register 3
N3 G21 X1 F40	1 > register 4
N4 G21 X5 F34	Set compare result > 0
N5 G48 X+ F2000	Start X axis Jog in CW direction
N6 G12 X6	
N20 G19 X2212 F23	Branch to line 23 if register 3 = 0
N21 G51 Y12122222 F30	If CW hard limit, go to line 30
N22 G51 Y02122222 F24	If CCW hard limit, go to line 24
N23 G30	Program end
N24 G21 X-4 F33	Register 3 minus register 4 > register 3

G51, Continued

```
N25 G21 X5 F34          Test register 3 for 0
N26 G12 X5              Start X axis Jog cycle in CW direction
N30 G48 X- F2000        Start X axis Jog cycle CCW direction @ 1000 pps
N31 G12 X6

N1 G48 X+ F1000         Start X axis Jog cycle CW @ 1000 pps
N2 G51 Y22222202 F2     Wait until at speed
N3 G04 X1000            Delay, one second
N4 G49
```

G52 Select External Data Source

Function

Selects the external data source from which, data is read.

Command Format

G52 Xn {Fnnnnnn} (L20 xx0xx, L20 xx1xx or L20 xx0xx)
G52 Yn {Fnnnnnn} (L20 xx1xx)
G52 Yn {Fnnnnnn} (L20 xx2xx)

Range

With L20 xx0xx, the range is 0-2
1 selects BCD Switch Bank 1 (Strobes 1-4)
2 selects BCD Switch Bank 2 (Strobes 5-8)

With L20 xx@xx, S2000 Expansion I/O, the range is 0-4
1 selects BCD Switch Bank 1
2 selects BCD Switch Bank 2
3 selects BCD Switch Bank 3
4 selects BCD Switch Bank 4

Default

PLC interface, if I/O is configured for it, otherwise BCD Switch Bank 1

Notes

If the PLC interface is selected and the PLC Mode is not enabled, program execution will be terminated. Refer to the L58 and L59 parameters for PLC interface selection,

If BCD switch bank 1, 2, 3 or 4 is selected and the expansion port is configured for Expansion I/O (L20 nn0nn), program execution will be terminated.

The F field, if programmed, will become the new feedrate.

Related commands

G10 (Mark Registration Cycle)
G21 (Register Control)
G29 (Set Designated L Code)
G36 (Read Move Distance)
G37 (Read Line Number and Branch)
G38 (Read Feedrate)
G79 (Set Absolute Position)

Example

This program requires a distance and feedrate selectable from external BCD switches. Bank 1 will be the move distance and Bank 2 will be the velocity for that move.

```
N1 G52 X2     select Bank 2 BCD switches
N2 G38 X      load feed rate from Bank 2 BCD switches
N3 G52 X1     select Bank 1 BCD switches
N4 G36 X      load distance from Bank 1 BCD switches and move
```

G53 Select S2000 Interface I/O Port

Function Selects the I/O port to be accessed via the S2000 Expansion I/O when an I/O function is performed during program execution.

Command Format
G53 Xn {Fnnnnnn}
G53 Yn {Fnnnnnn}

Range 1 through 6 (port 1 through port 6)

Default Port 1

Notes
If a number that is out of range is encountered, program execution will be terminated.

This command is active when the S2000 Expansion I/O is enabled (L20 nn2nn)

The F field value, if programmed, will become the High Speed Rate value.

Related Commands
G20 (Branch On Input Condition)
G22 (Wait For Input Condition)
G47 (Set Outputs)

G54 Register Execution

Function This command can be used to start an Index, Mark Registration, Wait For Move Distance or Return To Mechanical Home, or can be used to abort the current motion cycle.

Command Format

	G54 X+n F0	X axis index using Register Xn distance and direction
	G54 X-n F0	X axis index using Register Xn distance and opposite direction
	G54 Y+n F0	Y axis index using Register Yn distance and direction
	G54 Y-n F0	Y axis index using Register Yn distance and opposite direction
	G54 Xsn F1	Wait Register Xn move distance
	G54 X+n F2	X axis Mark Registration cycle using Register Xn distance and direction
	G54 X-n F2	X axis Mark Registration cycle using Register Xn distance and opposite direction
	G54 Y+n F2	Y axis Mark Registration cycle using Register Yn distance and direction
	G54 Y-n F2	Y axis Mark Registration cycle using Register Yn distance and opposite direction
(Trigger is not armed)	G54 X+n F3	X axis Mark Registration cycle using Register Xn distance and direction
(Trigger is not armed)	G54 X-n F3	X axis Mark Registration cycle using Register Xn distance and opposite direction
(Trigger is not armed)	G54 Y+n F3	Y axis Mark Registration cycle using Register Yn distance and direction
(Trigger is not armed)	G54 Y-n F3	Y axis Mark Registration cycle using Register Yn distance and opposite direction
(Arm Trigger)	G54 F4	Arm Trigger for Mark Registration cycle started by function 3 above
	G54 F5	Abort current motion cycle, if any (this will be a controller stop)
	G54 X F6	Modified Mechanical Home cycle for X axis
	G54 Y F6	Modified Mechanical Home cycle for Y axis

Range

X or Y field	1-9
F field	0-6

Notes

If the F field is out of range, program execution will be terminated.

The F field selects the function to be executed. The functions are:

0	Index cycle for X or Y axis
1	Wait for Move Distance cycle (Reference G62)
2	Mark Registration cycle for X or Y axis (Reference G10)
3	Mark Registration cycle for X or Y axis (Reference G10), do not arm Trigger
4	Mark Registration cycle for X or Y axis (Reference G10), arm Trigger only
5	Abort current motion cycle (controlled stop)
6	Modified Mechanical Home cycle

For functions 0-3, the X field selects X as the motion axis and the Y selects Y as the motion axis. If neither is programmed or the value is out of range, program execution will be terminated.

The Continuous Execution mode must be enabled when functions 3-5 are programmed. If not, enable program execution will be terminated.

If a Mark Registration cycle with no trigger armed (G54 Xsn F3) is taking place and another motion command id encountered, program execution will be terminated. The Control is waiting for an Arm The Trigger command.

The Abort Current Motion Cycle command is only effective if the Continuous Execution mode is selected (G60). This command will not stop a Home cycle.

The X or The Y field selects the register to be used for the selected function.

X+n or Y+n	Register contents
X-n or Y-n	Negate register contents

When the Mechanical Home cycle is started (G54 X F6), the motor moves in the Home direction (L08) at the Home Speed (L14). When the Home switch is activated, the absolute position is captured and the motor brought to a stop. The Absolute Position is now adjusted to reflect the current position in relationship to the Home switch.

Related Commands

G10 (Mark Registration Cycle)
G21 (Register Control)
G62 (Wait For Move Distance)

Examples

```
N1 G60 F1000          Set Continuous Execution mode. Feed Rate is 1000 pps
N2 G21 X10000 F50     10000 > register 5
N3 G21 X400 F30       400 > register 3
N4 G21 X3 F42         Register 3 > Register 4
N5 G54 X+5 F0         Index X axis 10000 pulses at 1000 pps Register 5 direction and
                      value
N6 G25 X23            Loop 24 times
N7 G54 X4 F1          Wait for compare distance using Register 4 value
N8 G47 X22222221      Output 1 active
N9 G21 X+3 F43        Register 3 + Register 4 > Register 4, add 400
N10 G04 X50           Delay 50 milliseconds, time output is active
N11 G47 X22222220     Output 1 inactive
N12 G26               Loop end
N13 G61               Disable Continuous Execution mode

N1 G52 X1             BCD bank 1 selected
N2 G21 F30            BCD data > Register 3
N3 G54 X-3 F2         X axis Mark Registration cycle, Register 3 value, opposite
                      direction
```

N1 G60 F1000	Set Continuous Execution mode. Feed Rate is 1000 pps
N2 G21 X-1000 F30	-1000 > Register 3
N3 G54 Y+3 F3	Y axis Mark Registration cycle, Trigger not armed, Register 3
N4 G51 Y22220222 F4	Wait for TR2 input active
N5 G51 Y22221222 F5	Wait for TR2 input inactive
N6 G54 F4	Arm Mark Registration trigger
N7 G20 X22222221 F10	Branch to line 10 if input 1 active, error occurred
N8 G51 Y22222221 F7	If cycle is still taking place, branch to line 7
N9 G12 X11	Go to line 11
N10 G54 F5	Abort cycle
N11 G61	Disable Continuous Execution mode

G55 Error Trapping

Function

This command detects the line to be executed if a Software Limit, Hardware Limit or Mark Registration Limit is encountered during program execution.

Command Format

G55 Xnnn {Fnnnnnn}
G55 Ynnn {Fnnnnnn}

Range

X or Y field	0-400	line number
F field	0-999,999	feed rate in pps

Notes

If X0 is programmed on the line, the Error Trapping becomes disabled and normal program termination occurs when a limit is encountered.

If the X or Y field is out of range, program execution will be terminated.

If the X field is 1 to 400 and a Software Limit, Hardware Limit or Mark Registration Limit is encountered during program execution, the program execution continues at the line specified by the X field of this command. The loop and subroutine commands are cancelled at this time.

Examples

N1 G55 X10	Error Trapping enabled at line 10
N2 G21 X6 F30	6 > Register 3
N3 G21 X1 F40	1 > Register 4
N4 G48 X+ F1000	Start X axis Jog in CW direction
N5 G12 X5	Wait for soft limit
N6 G21 X-4 F33	Decrement Register 3
N7 G21 X5 F34	Compare Register 3 for zero
N8 G19 X2202 F5	If not zero, branch to line 5
N9 G30	Program end
N10 G51 Y11222222 F13	Branch to line 13 if CCW Software Limit set
N11 G51 Y01222222 F3	Branch to line 3 if CCW Software Limit set
N12 G30	Program end, Hard Limit active
N13 G48 X- F1000	Start X axis Jog CCW direction
N14 G12 X5	Decrement the loop count

G60 Enable Continuous Execution Mode

Function

Allows program lines that don't require motion or a change of active axis to be executed during a programmed index or Jog motion.

Command Format

G60 Xsnnnnnnnn {Fnnnnnn} Continuous Execution mode enabled; move X axis
G60 Ysnnnnnnnn {Fnnnnnn} Continuous Execution mode enabled; move Y axis
G60
Continuous Execution mode enabled

Range

X or Y field -99,999,999 to +99,999,999 index distance
F field 0 - 999,999 feedrate (pulses/sec)

Notes

This command can not be used on program line 0 (MDI mode) or during a G48 Jog Cycle.

The following commands are allowed in Continuous Execution Mode:

G04	Delay
G05	Transmit Message
G10	Mark Registration Cycle
G11	Call Subroutine
G12	Go To Line Number
G19	Branch On Register Result
G20	Branch on Input Condition
G21	Register Control
G22	Wait For Input Condition
G23	Increase Feedrate
G24	Decrease Feedrate
G25	Loop Start
G26	Loop End
G27	High Speed Mode
G28	Low Speed Mode
G30	End of Program
G31	Program Stop
G32	Return From Subroutine
G36	Read Move Distance
G37	Read Line Number and Branch
G38	Read Feedrate
G47	Set Outputs
G50	Set Flags
G51	Branch on Flag Condition
G52	Select External Data Source
G53	Select S2000 Interface I/O Port
G54	Register Execution
G55	Error Trapping
G61	Disable Continuous Execution Mode
G62	Wait for Move Distance
G63	Wait for Velocity Condition
G64	Enable Reduce Current
G65	Disable Reduce Current
G66	Enable Boost Current
G67	Disable Boost Current
G68	Motor Windings Off
G69	Motor Windings On
G76	Return to Electrical Home
G77	Set Electrical Home
G78	Return to Mechanical Home
G79	Set Absolute Position
G90	Absolute Position Mode

G91	Incremental Position Mode
Xsnnnnnnnn	Index X axis
Ynnnnnnnnn	Index Y axis
Fnnnnnn	Feedrate

The F field, if programmed, will become the new feedrate.

The X or Y field value, if programmed, will set the X or Y axis active and will become the index distance and direction.

The Single Line execution mode (L06 = nn1), is suspended when a G60 command is executed. The program will execute continuously and Single Line execution mode restored following a Disable Continuous Execution Mode (G61), End of Program (G30), Program Stop (G31) or executing line 400.

Related Commands G61 (Disable Continuous Execution Mode)

G61 Disable Continuous Execution Mode

Function End Continuous Execution Mode and resume normal program execution.

Command Format

G61 {Xsnnnnnnnn} {Fnnnnnn}	disable Continuous Execution mode; index X axis
G61 {Ynnnnnnnnn} {Fnnnnnn}	disable Continuous Execution mode; index Y axis
G61	disable Continuous Execution mode

Range

X or Y field	-99,999,999 to +99,999,999 index distance
F field	0 - 999,999 feedrate (pulses/sec)

Notes This command can only be used during continuous execution mode.

If an X or Y field is programmed on the line, the index motion will not start until any previous motion is completed.

The F field, if programmed, will become the new feedrate.

Related Commands G60 (Enable Continuous Execution Mode)

Example

N20 G60 X2000 F1000	Start Continuous execution, Move the X axis 2000 pulses at a feedrate of 1000.
N21 G04 X1000	Delay 1000 milliseconds.
N22 G47 X22222221	Turn on Output 1.
N23 G61 X-2000	End Continuous execution, when the motion is complete, move the X axis -2000 pulses at a feedrate of 1000.

G62 Wait for Move Distance

Function Program execution is paused until the distance specified by the X or Y field has been reached.

Command Format
G62 Xnnnnnnnn {Fnnnnnn} wait for distance to be achieved
G62 Ynnnnnnnn {Fnnnnnn} wait for distance to be achieved

Range
X or Y field 0 - 99,999,999 move distance
F field 0 - 999,999 feedrate (pulses/sec)

Notes
This command can not be used on program line 0 (MDI mode) or during normal execution mode.

If the F field is programmed, it will become the new feedrate when the distance has been achieved.

If the absolute mode is active, then the compare distance is an absolute position, otherwise the compare distance is an incremental distance.

Related Commands G60 Enable Continuous Execution Mode

Example:

N1 G60 X10000 F2000	Continuous Execution Mode; Move X 10000 pulses at 2000 pulses/sec.
N2 G62 X1000	Wait for the occurrence of 1000 pulses from start.
N3 G47 X22222221	Output 1 On
N4 G62 X9000	Wait for the occurrence of 9000 pulses from start.
N5 G47 X22222220	Output 1 Off
N6 G61	Cancel Continuous Execution Mode
N7 G30	Program End

G63 Wait for Velocity Condition

Function

Program execution is paused until the specified F field velocity is achieved.

Command Format

G63 X+ Fnnnnnn	wait for velocity to be >= Fnnnnnn
G63 X- Fnnnnnn	wait for velocity to be < Fnnnnnn
G63 Y+ Fnnnnnn	wait for velocity to be >= Fnnnnnn
G63 Y- Fnnnnnn	wait for velocity to be < Fnnnnnn

Range

F field 1 - 999,999	compare velocity

Notes

This command can not be used on program line 0 (MDI mode) or during normal execution mode.

If an X or Y value is programmed, program execution will be terminated.

Related Commands

G62 (Wait for Move Distance)

Example

N1 G48 X+ F1000	Start Program Jog; Target Velocity 1000 pulses/sec.
N2 G63 X+ F1000	Wait for Velocity = 1000 pulses/sec.
N3 G47 X22222221 F0	Turn on Output 1, Feedrate = 0
N4 G63 X- F500	Wait for Velocity < 500 pulses/sec.
N5 G47 X22222220	Turn off Output 1
N6 G49	Stop Jog

G64 Enable Reduce Current

Function

Motor current is reduced by 50% at standstill. Reducing the motor current lowers heating, but reduces holding torque.

Command Format

G64 {Fnnnnnn}	active axis reduce current mode On
G64 X {Fnnnnnn}	X axis reduce current mode On
G64 Xsnnnnnnnn {Fnnnnnn}	X axis reduce current mode On, index X axis
G64 Y {Fnnnnnn}	Y axis reduce current mode On
G64 Ysnnnnnnnn {Fnnnnnn}	Y axis reduce current mode On, index Y axis

Range

X or Y field -99,999,999 to +99,999,999 index distance
F field 0 - 999,999 feedrate (pulses/sec)

Default Mode

Reduce Current Disabled

Notes

When the Reduce Current mode is active, an additional time delay is introduced during motion cycles. This delay allows winding current to build in the motor prior to motion and to decay after motion has stopped. The delay is approximately 10 milliseconds prior to motion and 10 milliseconds after motion has stopped. Therefore, the shortest possible time between moves is approximately 20 milliseconds.

The Reduce Current feature should only be used when maximum holding torque at standstill is not needed.

The X field, if programmed, will define the X axis index distance and direction.

The Y field, if programmed, will define the Y axis index distance and direction.

The F field, if programmed, will become the new feedrate.

The Reduce Current command will be ignored when the Windings Off (G68) mode is active.

Related commands

G65 (Disable Reduce Current)

G65 Disable Reduce Current

Function

Cancels the Reduce Current mode.

Command Format

G65 {Fnnnnnn}	active axis reduce current mode Off
G65 X {Fnnnnnn}	X axis reduce current mode Off
G65 Xsnnnnnnnn {Fnnnnnn}	X axis reduce current mode Off, index X axis.
G65 Y {Fnnnnnn}	Y axis reduce current mode Off
G65 Ysnnnnnnnn {Fnnnnnn}	Y axis reduce current mode Off, index Y axis.

Range

X or Y field -99,999,999 to +99,999,999 index distance
F field 0 - 999,999 feedrate (pulses/sec)

Default Mode

Reduce Current Disabled

Notes

Canceling a Reduce Current condition with the G65 command provides nominal holding torque at standstill and will also permit shorter cycle times.

The X field, if programmed, will define the X axis index distance and direction.

The Y field, if programmed, will define the Y axis index distance and direction.

The F field, if programmed, will become the new feedrate.

Related commands

G64 (Enable Reduce Current)

G66 Enable Boost Current

Function

Motor current is increased during accel and decel by 50%. This increases torque, but motor heating will increase.

Command Format

G66 {Fnnnnnn}	active axis boost current mode On
G66 X {Fnnnnnn}	X axis boost current mode On
G66 Xsnnnnnnnn {Fnnnnnn}	X axis boost current mode On, index X axis
G66 Y {Fnnnnnn}	Y axis boost current mode On
G66 Ysnnnnnnnn {Fnnnnnn}	Y axis boost current mode On, index Y axis

Range

X or Y field -99,999,999 to +99,999,999 index distance
F field 0 - 999,999 feedrate (pulses/sec)

Default Mode

Boost Current Disabled

Notes

When accelerating Boost Current will be applied until the motor has reached the programmed speed.

When decelerating Boost Current will be applied until the motor has stopped.

When the Boost Current feature is active, an additional time delay is introduced during motion cycles to allow time for motor winding current to build prior to motion and to decay after motion has stopped. This delay is approximately 10 milliseconds prior to motion and 10 milliseconds after motion has stopped. Therefore, the shortest possible time between moves is approximately 20 milliseconds.

The X field, if programmed, will define the X axis index distance and direction.

The Y field, if programmed, will define the Y axis index distance and direction.

The F field, if programmed, will become the new feedrate.

The Boost Current feature should be used when additional torque is required for starting or stopping.

Related commands

G67 (Disable Boost Current)

G67 Disable Boost Current

Function Cancels the Boost Current mode.

Command Format

G67 {Fnnnnnn}	active axis boost current mode Off
G67 X {Fnnnnnn}	X axis boost current mode Off
G67 Xsnnnnnnnn {Fnnnnnn}	X axis boost current mode Off, index X axis
G67 Y {Fnnnnnn}	Y axis boost current mode Off
G67 Ysnnnnnnnn {Fnnnnnn}	Y axis boost current mode Off, index Y axis

Range

X or Y field -99,999,999 to +99,999,999 index distance
F field 0 - 999,999 feedrate (pulses/sec)

Default Mode Boost Current Disabled

Notes

The X field, if programmed, will define the X axis index distance and direction.

The Y field, if programmed, will define the Y axis index distance and direction.

The F field, if programmed, will become the new feedrate.

Related commands G66 (Enable Boost Current)

G68 Motor Windings Off

Function

Motor current is reduced to zero at standstill.

Command Format

G68 {Fnnnnnn}	active axis windings off mode
G68 X {Fnnnnnn}	X axis windings off mode
G68 Xsnnnnnnnn {Fnnnnnn}	X axis windings off mode, index X axis
G68 Y {Fnnnnnn}	Y axis windings off mode
G68 Ysnnnnnnnn {Fnnnnnn}	Y axis windings off mode, index Y axis

Range

X or Y field -99,999,999 to +99,999,999 index distance
F field 0 - 999,999 feedrate (pulses/sec)

Default Mode

Motor Windings On

Notes

The G68 command should only be used when no holding torque is required at standstill.

When the Motor Windings Off function is active, an additional time delay is introduced during motion cycles to allow winding current to build in the motor prior to motion and to decay after motion has stopped. This delay is approximately 50 milliseconds prior to motion and 50 milliseconds after motion has stopped. Therefore, the shortest possible time between moves is approximately 100 milliseconds.

The X field, if programmed, will define the X axis index distance and direction.

The Y field, if programmed, will define the Y axis index distance and direction.

The F field, if programmed, will become the new feedrate.

Related commands

G69 (Motor Windings On)

G69 Motor Windings On

Function

Cancels the Motor Windings Off condition, causing current to be applied to the motor windings.

Command Format

G69 {Fnnnnnn}	active axis windings on mode
G69 X {Fnnnnnn}	X axis windings on mode
G69 Xsnnnnnnnn {Fnnnnnn}	X axis windings on mode, index X axis
G69 Y {Fnnnnnn}	Y axis windings on mode
G69 Ysnnnnnnnn {Fnnnnnn}	Y axis winding on mode, index Y axis

Range

X or Y field -99,999,999 to +99,999,999 index distance
F field 0 - 999,999 feedrate (pulses/sec)

Default Mode

Motor Windings On

Notes

When Windings On mode is active, motor winding current is applied at all times, providing holding torque at standstill and allowing less time between moves, by eliminating the 50 millisecond turn on and turn off delay.

The X field, if programmed, will define the X axis index distance and direction.

The Y field, if programmed, will define the Y axis index distance and direction.

The F field, if programmed, will become the new feedrate.

Related commands

G68 (Motor Windings Off)

G76 Return to Electrical Home

Function

Move to absolute position zero.(Electrical Home)

Command Format

G76 {Fnnnnnn}	Move active axis to Electrical Home
G76 X {Fnnnnnn}	Move X axis to Electrical Home
G76 Xsnnnnnnnn {Fnnnnnn}	Move X axis to Electrical Home, then move X axis as specified
G76 Y {Fnnnnnn}	Move Y axis to Electrical Home
G76 Ysnnnnnnnn {Fnnnnnn}	Move Y axis to Electrical Home, then move Y axis as specified

Range

X or Y field -99,999,999 to +99,999,999 index distance
F field 0 - 999,999 feedrate (pulses/sec)

Notes

This command can not be used during a G48 jog cycle.

The move to Electrical Home uses the home speed (L14).

A program line may also specify a move in addition to the home cycle.

If programmed, the X field defines the X axis move to be performed following the return to electrical home.

If programmed, the Y field defines the Y axis move to be performed following the return to electrical home.

The F field, if programmed, will become the new feedrate.

Related commands

L14 (Home Speed)

Examples

N10 G76 X	Moves X axis to Electrical Home
N11 G76 Y-1000 F1000	Moves Y axis to Electrical Home, then moves -1000 steps at 1000 pulses/sec

G77 Set Electrical Home

Function

Sets the absolute and encoder positions to zero.

Command Format

G77 {Fnnnnnn}	active axis position = 0
G77 X {Fnnnnnn}	X axis position = 0
G77 Xsnnnnnnnn {Fnnnnnn}	X axis position = 0, then move X axis as specified
G77 Y {Fnnnnnn}	Y axis position = 0
G77 Ysnnnnnnnn {Fnnnnnn}	Y axis position = 0, then move Y axis as specified

Range

X or Y field -99,999,999 to +99,999,999 index distance
F field 0 - 999,999 feedrate (pulses/sec)

Notes

This command can not be used during a G48 jog cycle.

Encoder feedback is only available on the X axis, When the command references the X axis both X absolute and encoder position are cleared, only Y absolute position is cleared for references to the Y axis.

If programmed, the X field defines the X axis move to be performed after the present position is cleared.

If programmed, the Y field defines the Y axis move to be performed after the present position is cleared.

The F field, if programmed, will become the new feedrate.

Examples

N10 G77 X	Set X absolute and encoder position to zero
N11 G76 Y-1000 F1000	Set Y absolute position to zero, then move -1000 steps at 1000 pulses/sec

G78 Return to Mechanical Home

Function

Move to mechanical home position.

Command Format

G78 {Fnnnnnn}	move active axis to mechanical home
G78 X {Fnnnnnn}	move X axis to mechanical home
G78 Xsnnnnnnnn {Fnnnnnn}	move X axis to mechanical home, then do specified move
G78 Y {Fnnnnnn}	move Y axis to mechanical home
G78 Ysnnnnnnnn {Fnnnnnn}	move Y axis to mechanical home, then do specified move

Range

X or Y field -99,999,999 to +99,999,999 index distance
F field 0 - 999,999 feedrate (pulses/sec)

Notes

This command can not be used during a G48 jog cycle.

Parameter L20 selects the home switch input (TR1 or TR2) and it's activation state (rising edge, falling edge or input active and encoder index). The latter activation option requires an encoder and is limited to use with the X axis.

When a mechanical home cycle is started, the motor moves in the home direction (L08) at the home speed (L14).

When the home switch is activated, the absolute position is captured and the motor brought to a stop.

The home offset (L17) is added to the captured position and the move to that position is started after the L43 delay has expired.

When this move is complete, the absolute position is set to zero (Homing the X axis additionally sets the encoder position to zero) and the cycle is done.

A program line may also specify a move in addition to the home cycle.

If programmed, the X field defines the X axis move to be performed following the return to mechanical home.

If programmed, the Y field defines the Y axis move to be performed following the return to mechanical home.

The F field, if programmed, will become the new feedrate.

Related commands

L08 (Mechanical Home Direction)
L14 (Home Speed)
L17 (Offset from Mechanical Home)
L20 (TR1 & TR2 Configuration)

Examples

N10 G78 X	Moves X axis to Mechanical Home
N11 G78 Y-1000 F1000	Moves Y axis to Mechanical Home, then moves -1000 steps at 1000 pulses/sec

G79 Set Absolute Position

Function

Sets the Absolute Position and Encoder Position to the value specified in the X or Y field.

Command Format

G79 {Fnnnnnn}	set active axis position using external BCD data
G79 X {Fnnnnnn}	set X axis position using external BCD data
G79 Xsnnnnnnnn {Fnnnnnn}	set X axis position using X field data
G79 Y {Fnnnnnn}	set Y axis position using external BCD data
G79 Ysnnnnnnnn {Fnnnnnn}	set Y axis position using Y field data

Range

X or Y field -99,999,999 to +99,999,999 index distance
F field 0 - 999,999 feedrate (pulses/sec)

Notes

This command can not be used during a G48 jog cycle.

Encoder feedback is only available on the X axis. When the command references the X axis both X absolute and encoder position are set, only Y absolute position is set for references to the Y axis.

If X or Y field data is not specified, external BCD data is read, multiplied by the External move distance scale factor (L91) and used to set the position.

The F field, if programmed, will become the new feedrate.

Related commands

G52 (Select external data source)

Example

N1 G79 X0 X absolute position = 0
(Alternative to using G77)

G90 Absolute Position Mode

Function

This command selects the Absolute Position mode.

Command Format

G90 {Fnnnnnn}	set active axis position mode to Absolute
G90 X {Fnnnnnn}	set X axis to absolute position mode
G90 Xsnnnnnnnn {Fnnnnnn}	set X axis to absolute position mode and move to the specified absolute position
G90 Y {Fnnnnnn}	set Y axis to absolute position mode
G90 Ysnnnnnnnn {Fnnnnnn}	set Y axis to absolute position mode and move to the specified absolute position

Range

X or Y field -99,999,999 to +99,999,999 move distance
F field 0 - 999,999 feedrate (pulses/sec)

Default Mode

Incremental Mode

Notes

Once set, the absolute position mode will be active until changed by a G91 command or until the unit is powered off. All move distances are absolute distances.

The X field, if programmed, will define the X axis index distance and direction.

The Y field, if programmed, will define the Y axis index distance and direction.

The F field, if programmed, will become the new feedrate.

Related Commands

G91 (Incremental Position Mode)

Examples

N1 G90 X0		Move X axis to absolute position 0 (Alternative to using G78)
N2	X1000 F2000	Move X axis to absolute position 1000 with a feedrate of 2000 pulses/sec
N3	X1000 F2000	No motion occurs, already at absolute position 1000

G91 Incremental Position Mode

Function

This command selects the Incremental Position mode.

Command Format

G91 {Fnnnnnn}	set active axis position mode to Incremental
G91 X {Fnnnnnn}	set X axis to Incremental position mode
G91 Xsnnnnnnnn {Fnnnnnn}	set X axis to Incremental position mode and move the specified incremental distance
G91 Y {Fnnnnnn}	set Y axis to Incremental position mode
G91 Ysnnnnnnnn {Fnnnnnn}	set Y axis to Incremental position mode and move the specified incremental distance

Range

X or Y field -99,999,999 to +99,999,999 index distance
F field 0 - 999,999 feedrate (pulses/sec)

Default Mode

Incremental Mode

Notes

The incremental position mode, active at power up, remains active until changed by a G90 command. All moves specify incremental distances.

The X field, if programmed, will define the X axis index distance and direction.

The Y field, if programmed, will define the Y axis index distance and direction.

The F field, if programmed, will become the new feedrate.

Examples

N1 G91 X	Set X axis to incremental position mode
N2 X1000 F2000	Move X axis +1000 pulses with a feedrate of 2000 pulses/sec
N3 X1000 F2000	Move X axis +1000 pulses with a feedrate of 2000 pulses/sec

H CODES

RS232 COMMAND (H-CODE) FUNCTIONAL LISTING

MOTION COMMANDS
H01 Cycle start
H06 CW direction
H07 CCW direction
H31 Increase speed
H32 Decrease speed

HOMING
H08 Return to electrical home
H09 Set electrical home
H10 Return to mechanical home

PROGRAM
H11 Clear current program line
H12 Clear program
H13 TX current program line
H14 TX program
H15 TX current line number
H16 TX parameters

STATUS QUERIES
H17 TX absolute position
H19 TX mode status
H20 TX output status
H21 TX input status
H23 TX software revision level
H29 TX program execution time
H41 TX program repeat count
H42 TX last external BCD value
H43 TX opto22 I/O status
H44 TX Registers Contents
H60 TX present speed
H88 TX execution status
H99 TX unit type

CLOSED LOOP
H22 TX encoder position
H26 TX position error
H27 TX verification status

MODE CONTROL COMMANDS
H02 Step mode
H03 Jog mode
H04 High speed mode
H05 Low speed mode
H33 Set incremental position mode
H34 Set absolute position mode

MOTOR CURRENT CONTROL
H35 Motor windings on
H36 Motor windings off
H37 Enable boost current
H38 Disable boost current
H39 Enable reduce current
H40 Disable reduce current

PROGRAM DEBUG COMMANDS
H24 Enable trace mode
H25 Disable trace mode
H85 TX system error status
H86 TX data error status
H87 TX program error line number

NOTE: A number of the H codes are also available as immediate codes by preceding them with an exclamation point (!).

H01 Cycle Start

Function This command starts program execution.

Default Mode none

Command Format H01(crlf)

Notes The Cycle Start command causes program execution to begin at the currently selected line number. Program execution is performed in a sequential fashion.

Related commands
L06 (Line Execution Format)
L41 (Auto Start Line Number)
N (Line Number)

H02 Step Mode

Function This command selects the Step mode for the active axis.

Default Mode Jog mode (on power turn-on)

Command Format H02(crlf)

Notes The H02 command does not cause motion to occur.

When the Control is in the Step mode and an H06 (CW) or an H07 (CCW) command is given, the Control will step the motor in the desired direction. The step distance for this move is the value entered for the L13 (Step Increment) parameter.

H02 will not be processed during a Feed Hold condition.

Related commands
L09 (Jog Speed)
L13 (Step Increment)
H04 (High Speed Mode)
H05 (Low Speed Mode)
H06 (CW Direction)
H07 (CCW Direction)
H19 (Transfer Mode Status)
X, (Select X axis)
Y, (Select Y axis)

H03 Jog Mode

Function The H03 command selects the Jog mode for the active axis manual motion operation.

Default Mode Jog Mode (on power turn-on)

Command Format H03(crlf)

Notes The H03 command does not cause motion to occur.

When the Control is in the Jog mode and an H06 (CW) or an H07 (CCW) command is given, the motor will Jog in the desired direction. The motor will jog until a Feed Hold or a Clear command is issued or until a limit is exceeded.

H03 will not be processed during a Feed Hold condition.

Related commands
L09 (Jog Speed)
H04 (High Speed Mode)
H05 (Low Speed Mode)
H06 (CW Direction)
H07 (CCW Direction)
H19 (Transfer Mode Status)
X, (Select X axis)
Y, (Select Y axis)

H04 High Speed Mode

Function The H04 command selects the High Speed mode for the active axis.

Default Mode High Speed mode (on power turn-on)

Command Format
H04(crlf)
!H04(crlf)

Notes The H04 command selects the L09 value as the High Speed rate for the Jog cycle or Step execution and the F value as the High Speed rate for Program Execution.

If !H04 is issued during Low Speed motion, the appropriate High Speed value will become the target velocity for the motion in progress.

Related commands
L09 (Jog Speed)
H05 (Low Speed Mode)
H19 (Transfer Mode Status)
X, (Select X axis)
Y, (Select Y axis)

H05 Low Speed Mode

Function The H05 command selects the Low Speed mode for the active axis.

Default Mode High Speed mode (on power turn-on)

Command Format
H05(crlf)
!H05(crlf)

Notes This command selects the L12 (Low Speed) parameter value as the velocity for a Jog cycle, Program Execution or Step Execution.

If an !H05 command is issued during High Speed motion, the L12 (Low Speed) value becomes the target velocity for the motion in progress. The motor will be ramped down to the L12 (Low Speed) parameter value.

Related commands
H04 (High Speed Mode)
H19 (Transfer Mode Status)
L12 (Low Speed)
X, (Select X axis)
Y, (Select Y axis)

H06 CW Direction

Function This command is used to start a Jog or Step motion in the CW direction for the active axis.

Default Mode none

Command Format H06(crlf)

Notes:If any motion other than CW manual motion is active or if a Program Cycle is active, The CW command will not be honored.

The following chart lists the action which will occur with the possible combinations of inputs that affect CW Direction.

INPUTS THAT AFFECT CW DIRECTION			
CW MOTION	**STEP/JOG**	**SPEED**	**FUNCTION**
active	Jog (H03)	High (H04)	Ramp to Jog Speed rate and Jog
active	Jog (H03)	Low (H05)	Jog at Low Speed rate
active	Step (H02)	High (H04)	Ramp to Jog Speed rate and Step
active	Step (H02)	Low (H05)	Step at Low Speed rate
active	Jog or Step	Low to High	Ramp to Jog Speed rate
active	Jog or Step	High to Low	Ramp to Low Speed rate

Related commands
L09 (Jog Speed)
L12 (Low Speed)
L13 (Step Increment)
H02 (Step Mode)
H03 (Jog Mode)
H04 (High Speed Mode)
H05 (Low Speed Mode)
X, (Select X axis)
Y, (Select Y axis)

H07 CCW Direction

Function This command is used to start a Jog or Step motion in the CCW direction the active axis.

Default Mode none

Command Format H07(crlf)

Notes **If any motion other than CCW manual motion is active or if a Program Cycle is active, the CCW command will not be honored.**

The following chart lists the action which will occur with the possible combinations of inputs that affect CCW Direction.

INPUTS THAT AFFECT CCW DIRECTION			
CCW MOTION	**STEP/JOG**	**SPEED**	**FUNCTION**
active	**Jog (H03)**	**High (H04)**	**Ramp to Jog Speed rate and Jog**
active	**Jog (H03)**	**Low (H05)**	**Jog at Low Speed rate**
active	**Step (H02)**	**High (H04)**	**Ramp to Jog Speed rate and Step**
active	**Step (H02)**	**Low (H05)**	**Step at Low Speed rate**
active	**Jog or Step**	**Low to High**	**Ramp to Jog Speed rate**
active	**Jog or Step**	**High to Low**	**Ramp to Low Speed rate**

Related commands
L09 (Jog Speed)
L12 (Low Speed)
L13 (Step Increment)
H02 (Step Mode)
H03 (Jog Mode)
H04 (High Speed Mode)
H05 (Low Speed Mode)
X, (Select X axis)
Y, (Select Y axis)

H08 Return To Electrical Home

Function The H08 command will cause the Control to perform an index move to return to the location which has been designated Electrical Home. This is an Absolute position of zero.

Default Mode none

Command Format H08(crlf)

Notes The direction for a Return To Electrical Home index move will be the reverse of the direction of the present Absolute position and the distance will be that of the present Absolute electrical position.

Related commands
H04 (High Speed Mode)
H05 (Low Speed Mode)
H09 (Set Electrical Home)
L14 (Home Speed)
X, (Select X axis)
Y, (Select Y axis)

H09 Set Electrical Home

Function The H09 commands the Control to establish the present mechanical position as Electrical Home and Encoder Home Position.

Default Mode none

Command Format H09(crlf)

Notes All Absolute positions are referenced to the Electrical Home position.

This home position will continue to be the Electrical Home position until a new Set Electrical Home command is given, a Return to Mechanical Home cycle is executed or the Control is deenergized.

H09 will not be processed while a Feed Hold condition is active.

Related Commands
H08 (Return to Electrical Home)
H10 (Return to Mechanical Home)
X, (Select X axis)
Y, (Select Y axis)

H10 Return To Mechanical Home

Function This code commands the Control to perform a Return To Mechanical Home cycle.

Default Mode none

Command Format H10(crlf)

Notes The Control begins a Return To Mechanical Home cycle by jogging at the rate programmed for the Home Speed parameter (L14). The direction of the motion is determined by the Mechanical Home Direction parameter (L08).

The Control will Jog until the Home Limit switch is activated, and will then ramp to a halt. The point at which the Home Limit switch was activated will be registered as the Home position.

When motion ceases, the Control will index to the Home position and will establish this position as the Absolute Electrical Home Position as well as the Encoder Home Position.

Related commands
L08 (Mechanical Home Direction)
L12 (Low Speed)
L14 (Home Speed)
H04 (High Speed Mode)
H05 (Low Speed Mode)
X, (Select X axis)
Y, (Select Y axis)

H11 Clear Current Program Line

Function The H11 commands the Control to clear the current program line. The line will be irretrievably erased and the line pointer will not change.

Default Mode none

Command Format H11(crlf)

Notes This command when used with the Nnnn command can be used to clear specific program lines.

Examples H11(crlf) will cause the current line to be cleared.
N004 H11(crlf) will cause line 4 to be cleared.

H12 Clear Program

Function This command, together with L48 = 0, will clear the entire program. The lines will be irretrievably erased and the line pointer will then be set to the line selected by L41.

Default Mode none

Command Format H12(crlf)

Notes If L48 = nnn and the H12 command is issued, nnn lines will be cleared starting from the current line. The line pointer will then be set to one line past the last cleared line.

Examples L48 0 H12(crlf) will clear lines 1 through 400. The line pointer will be set to the L41 value.

N1 L48 10 H12(crlf) will clear lines 1 through 10. The line pointer will be set to 11.

H13 Transfer Current Program Line Number and Contents

Function Requests the transfer of the current program line number and contents.

Default Mode none

Command Format H13(crlf)
!H13(crlf)

Notes This command when used with the Nnnn command can be used to transfer specific program lines. If the line is not programmed only the line number will be transferred.

Depending on what fields are programmed. Spaces will be transferred to represent unprogrammed fields.

Examples H13(crlf) will cause the current line to be transferred.
N004 H13(crlf) will cause line 4 to be transferred.

H14 Transfer Program

Function This command, together with L48 = 0, will transfer all programmed lines. The line pointer will then be set to the line selected by L41.

Default Mode none

Command Format H14(crlf)

Notes If L48 = nnn and this command is given, nnn programmed lines will be transferred, starting from the current line. If the line is not programmed the line will not be transferred.

If no lines are programmed a "crlf" will be transferred only and the line pointer will be set to the L41 value.

Examples L48 0 H14(crlf) will transfer all programmed lines starting with the first line programmed.

N1 L48 10 H14(crlf) will transfer the first 10 programmed lines. The line pointer will be set to the line after the last line transferred.

N40 L48 20 H14(crlf) will transfer 20 programmed lines starting at line 40. The line pointer will be set to the line after the last line transferred.

H15 Transfer Current Line Number

Function This command requests the transfer of the current line number.

Default Mode none

Command Format H15(crlf)
!H15(crlf)

Notes The data will be transferred in the following format:
Nnnn(crlf)

H16 Transfer Parameters

Function

This command, together with L49 and L50 will cause the transfer of parameters (L codes). The format of the transfer and the number parameters transferred are controlled with the L49 and L50 values.

Default Mode

none

Command Format

H16(crlf)

Notes

L49 = 0
L50 > 0
The L codes are transferred one per line with all L codes being transferred.

L49 = 0
L50 = 0
The L codes are transferred three per line with all L codes being transferred.

L49 = nn
L50 = 0
Only the Lnn code is transferred.

L49 = nn
L50 = xx (where xx is a number 1 thru 99)
Only xx number of L codes will be transferred starting with the Lnn code. The L codes will be transferred one per line.

Examples

command: L50 0 L49 09 H16(crlf)
response: L09 nnnnnn,nnnnnn(crlf)

command: L50 3 L49 11 H16(crlf)
response: L11 nnnnnnnn,nnnnnnnn(crlf)
L12 nnnnnn,nnnnnn(crlf)
L13 nnnnnnnn,nnnnnn(crlf)

H17 Transfer Absolute Position

Function

This code requests the transfer of the active axes Absolute Electrical Position.

Default Mode

none

Units

pulses

Command Format

H17(crlf)
!H17(crlf)

Notes

The data will be transferred in the following format:
Xsnnnnnnnnn(crlf)
Ysnnnnnnnnn(crlf)

The absolute position limits are +/- 2,147,483,647 pulses.

Related Commands

X, (Select X axis)
Y, (Select Y axis)

H19 Transfer Mode Status

Function The H19 code requests the transfer of the status of the Control modes.

Default Mode none

Command Format
H19(crlf)
!H19(crlf)

Notes The data will be transferred in the following format:
nnnnnnnn nnnnnnnn(crlf)

n------- --------	0 = X Incremental Mode	1 = X Absolute Mode
-n------ --------	0 = X Motor Windings Off	1 = X Motor Windings On
--n----- --------	0 = X Boost Current Off	1 = X Boost Current On
---n---- --------	0 = X Reduce Current Off	1 = X Reduce Current On
----n--- --------	0 = X Low Speed Mode	1 = X High Speed Mode
-----n-- --------	0 = X Step Mode	1 = X Jog Mode
------n- --------	0 = X Selected	1 = Y Selected
-------n --------	0 = CCW direction selected	1 = CW direction selected
-------- n-------	0 = Y Incremental Mode	1 = Y Absolute Mode
-------- -n------	0 = Y Motor Windings Off	1 = Y Motor Windings On
-------- --n-----	0 = Y Boost Current Off	1 = Y Boost Current On
-------- ---n----	0 = Y Reduce Current Off	1 = Y Reduce Current On
-------- ----n---	0 = Y Low Speed Mode	1 = Y High Speed Mode
-------- -----n--	0 = Y Step Mode	1 = Y Jog Mode
-------- ------n-	0 = X Selected	1 = Y Selected
-------- -------n	0 = CCW direction selected	1 = CW direction selected

Example !H19(crlf) sent. The following data transfer may result:

00000010 00000010(crlf)

This data transfer indicates that the Y axis is selected.

H20 Transfer Output Status

Function Transfers the status of the Control programmable outputs (L59 assignments).

Default Mode none

Command Format
H20(crlf)
!H20(crlf)

Notes The data will be transferred as follows:
nnnnnnnn(crlf)

n------- Output 8	0= inactive	1= active
-n------ Output 7	0= inactive	1= active
--n----- Output 6	0= inactive	1= active
---n---- Output 5	0= inactive	1= active
----n--- Output 4	0= inactive	1= active
-----n-- Output 3	0= inactive	1= active
------n- Output 2	0= inactive	1= active
-------n Output 1	0= inactive	1= active

The L58 parameter sign selects the polarity of the output state.
L58 +nnnnnnnnnnnnn
A logic state of 1 indicates that the output is in the active state.
L58 -nnnnnnnnnnnnn
A logic state of 1 indicates that the output is in the inactive state.

Example H20(crlf) sent. The following data transfer may result:

00000010(crlf)

This data transfer indicates that Output 2 is active. All others are inactive.

H21 Transfer Input Status

Function Transfers the status of all the Control inputs.

Default Mode none

Command Format
H21(crlf)
!H21(crlf)

Notes The data will be transferred as follows:

```
nnnnnnnn nnnnnnnn(crlf)
n------- -------- Clear Input        0 = Inactive  1 = active
-n------ -------- Trigger 2          0 = Inactive  1 = active
--n----- -------- Trigger 1          0 = Inactive  1 = active
---n---- -------- Input 13           0 = Inactive  1 = active
----n--- -------- Input 12           0 = Inactive  1 = active
-----n-- -------- Input 11           0 = Inactive  1 = active
------n- -------- Input 10           0 = Inactive  1 = active
-------n -------- Input 9            0 = Inactive  1 = active

-------- n------- Input 8            0 = Inactive  1 = active
-------- -n------ Input 7            0 = Inactive  1 = active
-------- --n----- Input 6            0 = Inactive  1 = active
-------- ---n---- Input 5            0 = Inactive  1 = active
-------- ----n--- Input 4            0 = Inactive  1 = active
-------- -----n-- Input 3            0 = Inactive  1 = active
-------- ------n- Input 2            0 = Inactive  1 = active
-------- -------n Input 1            0 = Inactive  1 = active
```

The L58 parameter sign selects the polarity of the input states for Input 1 thru Input 13, Clear, TR1 and TR2.

L58 +nnnnnnnnnnnnn
A logic state of 1 indicates that the input is in the active state.

L58 -nnnnnnnnnnnnn
A logic state of 1 indicates that the input is in the inactive state.

Example H21(crlf) sent. The following data transfer may result:

00000000 10000010(crlf)

This data transfer indicates that Input 8 and Input 2 are active. All others are inactive.

H22 Transfer Encoder Position

Closed Loop Control Only

Function This command requests the transfer of the Encoder Position.

Default Mode none

Units pulses

Command Format
H22(crlf)
!H22(crlf)

Notes The transfer format is:

Xsnnnnnnnnnn(crlf)

H23 Transfer Software Revision Level

Function This command request the transfer of the Software Revision Level.

Default Mode none

Command Format H23(crlf)

Notes The data will be transferred in the following format:
SloSyn mm/yy/x(crlf)

where:
mm = Month
yy = Year
x = Revision Level

H24 Enable Trace Mode

Function This command causes the Control to transmit the contents of each line as it is executed during program execution.

Default Mode Off

Command Format H24(crlf)
!H24(crlf)

Notes If the line is not programmed the line will not be transferred.

If a field is not programmed, the field will not be transferred.

Depending on what fields are programmed. Spaces will be transferred to represent unprogrammed fields.

H25 Disable Trace Mode

Function This command will cancel the Program Trace Mode.

Default Mode Off

Command Format H25(crlf)
!H25(crlf)

H26 Transfer Position Error

Closed Loop Control Only

Function The H26 code requests the transfer of the Position Verification Error Pulse Count. This is the difference between Absolute Electrical Position and Encoder Position.

Default Mode none

Units pulses

Command Format H26(crlf)
!H26(crlf)

Notes The transfer format is:
Xsnnnnnnnnnn(crlf)

H27 Transfer Verification Status

Closed Loop Control Only

Function The H27 code requests the transfer of the Position Verification status.

Default Mode none

Command Format H27(crlf)
!H27(crlf)

Notes The transfer format is:
Xnnnnn000(crlf)

```
n------- Position Verification          0=inactive   1=active
-n------ Following Error Detect         0=inactive   1=active
--n----- Correction Cycle In Progress   0=inactive   1=active
---n---- Unable To Correct Position     0=inactive   1=active
----n--- Position Maintenance Cycle     0=inactive   1=active
-----0-- Always zero
------0- Always zero
-------0 Always zero
```

H29 Transfer Program Execution Time

Function This command transfers the program execution time, in milliseconds.

Units milliseconds

Default Mode none

Command Format H29(crlf)

Notes A Cycle Start command restarts the timing from zero (except when restarting from a Feed Hold condition). Timing is stopped by a Feed Hold, Clear, Program Line Error, Program Stop or Program Execution Complete.

Individual line execution times can be monitored in the Single Execution mode.

Times for executing entire programs can be monitored in the Automatic Execution mode.

Accuracy of the timing is +/-2 milliseconds.

The data will be transferred as follows:

nnnnnnnn(crlf)

H31 Increase Speed

Function This command requests that the target velocity be increased by the Deviation Frequency (L73) value.

Default Mode none

Command Format !H31(crlf)

Notes If the !H31 command is given while the motor is moving, the motor speed will increase by the Deviation Frequency (L73) value.

Related commands L73 (Deviation Frequency)

H32 Decrease Speed

Function The H32 command requests that the target velocity be decreased by the Deviation Frequency (L73) value.

Default Mode none

Command Format !H32(crlf)

Notes If the !H32 command is given while the motor is moving, the motor speed will decrease by the Deviation Frequency (L73) value.

Related Commands L73 (Deviation Frequency)

H33 Set Incremental Position Mode

Function This command selects the Incremental Position mode. All moves will be made in the plus or minus direction from the **present position.**

Default Mode Incremental mode (H33)

Command Format H33(crlf)

Notes **H33 will be ignored if a Feed Hold ($) is active.**

Related Commands X, (Select X axis)
Y, (Select Y axis)

H34 Set Absolute Position Mode

Function This command selects the Absolute Position mode. All moves in this mode are referenced from the **electrical home position.**

Default Mode Incremental mode (H33)

Command Format H34(crlf)

Notes **H34 will be ignored if a Feed Hold ($) is active.**

Related Commands X, (Select X axis)
Y, (Select Y axis)

H35 Motor Windings On

Function The H35 code causes current to be applied to the motor windings at all times.

Default Mode Windings On (H35)

Command Format H35(crlf)

Notes **Use the H35 command when holding torque is required at standstill.**

Related Commands X, (Select X axis)
Y, (Select Y axis)

H36 Motor Windings Off

Function This command causes current to be removed from the motor windings when motion ceases.

Default Mode Windings On (H35)

Command Format H36(crlf)

Notes Without winding current, the motor will have no holding torque. Therefore, **the H36 command should only be used when holding torque at standstill is not needed.**

Whenever the Motor Windings Off function is active, an additional time delay is introduced during programmed motion cycles to allow winding current to build in the motor prior to the start of motion and to decay after motion has occurred. This delay is approximately 50 milliseconds prior to motion and 50 milliseconds after motion has stopped. Therefore, the shortest possible time between moves is approximately 100 milliseconds.

When the Control is in the Windings Off mode, the Reduce Current feature will be ignored.

Related Commands X, (Select X axis)
Y, (Select Y axis)

H37 Enable Boost Current

Function When the H37 command is issued, motor winding current will be increased during acceleration and deceleration by 50% of the value set by the dip switches on the drive.

Default Mode Disable Boost Current (H38)

Command Format H37(crlf)

Notes An additional time delay is introduced when the Boost Current feature is active to allow time for the motor winding current to build prior to motion and to decay after motion. This delay is approximately 10 milliseconds before the motion and 10 milliseconds after motion has stopped.

The Boost feature should be used when additional torque is needed for starting or stopping.

Related Commands X, (Select X axis)
Y, (Select Y axis)

H38 Disable Boost Current

Function This command cancels Boost current during acceleration and deceleration.

Default Mode Disable Boost Current (H38)

Command Format H38(crlf)

Related Commands X, (Select X axis)
Y, (Select Y axis)

H39 Enable Reduce Current

Function This command will cause the motor current to be reduced at standstill by 50% of the value which has been selected on the drive. This condition lowers heating of the motor and also reduces holding torque at standstill.

Default Mode Disable Reduce Current (H40)

Command Format H39(crlf)

Notes An additional time delay is introduced during programmed motion cycles whenever the Reduce feature is active. This delay allows winding current to build in the motor prior to motion and to decay after motion has stopped. The delay is approximately 10 milliseconds prior to motion and 10 milliseconds after motion has stopped.

Activate the Reduce feature only when maximum holding torque at standstill is not needed.

The Reduce command will be ignored when the Windings Off feature is active.

Related Commands X, (Select X axis)
Y, (Select Y axis)

H40 Disable Reduce Current

Function This command cancels the Reduce Current mode.

Default Mode Disable Reduce Current (H40)

Command Format H40(crlf)

Related Commands X, (Select X axis)
Y, (Select Y axis)

H41 Transfer Program Repeat Count

Function This command sends the remaining Repeat Count value.

Default Mode none

Command Format H41(crlf)
!H41(crlf)

Notes If the present Repeat Count is zero and a Cycle Start command is given, the L47 (Repeat Count) value is transferred to the Repeat Count. The count remaining can be interrogated using this command.

The Repeat Count is decremented each time a Program End or line 400 is encountered during program execution.

The Repeat Count is zero when the Control is in the Continuous Execution or the Single Execution mode.

The data will be transferred in the following format:
nnnn(crlf)

H42 Transfer Last External BCD Value

Function This command sends the Last External BCD read value, execution of a G36, G37, or G38 command.

Default Mode none

Command Format H42(crlf)
!H42(crlf)

Notes The data will be transferred in the following format:
snnnnnnnn(crlf)

H43 Transfer Expansion I/O Status

Function This command transfers the present status of Expansion Inputs and Outputs.

Default Mode none

Command Format H43(crlf)
!H43(crlf)

Notes The data will be transferred in the following format:

```
nnnnnnnn nnnnnnnn(crlf)
n------- -------- Expansion Input 8
-n------ -------- Expansion Input 7
--n----- -------- Expansion Input 6
---n---- -------- Expansion Input 5
----n--- -------- Expansion Input 4
-----n-- -------- Expansion Input 3
------n- -------- Expansion Input 2
-------n -------- Expansion Input 1

-------- n------- Expansion Output 8
-------- -n------ Expansion Output 7
-------- --n----- Expansion Output 6
-------- ---n---- Expansion Output 5
-------- ----n--- Expansion Output 4
-------- -----n-- Expansion Output 3
-------- ------n- Expansion Output 2
-------- -------n Expansion Output 1
```

This command is only valid if the OPTO 22 option is selected, L20 nn1nn.

H44 Transfer Register Contents

New code per Rev. B

Function This command transfers the contents of the nine registers.

Command Format
H44 crlf
!H44 crlf

Notes The transfer format is:

snnnnnnnnnn (crlf)	Register 1
snnnnnnnnnn (crlf)	Register 2
snnnnnnnnnn (crlf)	Register 3
snnnnnnnnnn (crlf)	Register 4
snnnnnnnnnn (crlf)	Register 5
snnnnnnnnnn (crlf)	Register 6
snnnnnnnnnn (crlf)	Register 7
snnnnnnnnnn (crlf)	Register 8
snnnnnnnnnn (crlf)	Register 9

H60 Transfer Present Speed

Function The H60 command requests that the present velocity be transferred.

Default Mode none

Units pulses per second

Command Format
H60(crlf)
!H60(crlf)

Notes The data will be transferred in the following format:
Xnnnnnn(crlf) or Ynnnnnn(crlf)

H85 Transfer System Error Status

Function The H85 code requests the transfer of the Motion Error status of the Control.

Default Mode none

Command Format H85(crlf)

Notes The data will be transferred in the following format:

```
nnnnnnnnn(crlf)

n-------- Drive not ready
-n------- Index From Run Limit exceeded
--n------ CW Software Limit Exceeded
---n----- CCW Software Limit Exceeded
----n---- CW Hardware Limit Exceeded
-----n--- CCW Hardware Limit Exceeded
------n-- Program Error
-------n- Closed Loop Error
--------n Hardware or Software Clear
```

Example !H85(crlf) The data transfer results might be as follows:

000001000(crlf)

This transfer indicates the active axis CCW hardware Limit was exceeded.

H86 Transfer Data Error Status

Function The H86 code is used to request the transfer of the Control's Data Error Status.

Default Mode none

Command Format H86(crlf)

Notes The format of the transferred data will be as follows:

```
nnnnnnnn nnnn0000(crlf)
n------- -------- Illegal G Code                                  0=inactive   1=active
-n------ -------- Illegal L Code                                  0=inactive   1=active
--n----- -------- Subroutine or Loop nesting                      0=inactive   1=active
---n---- -------- F data out of range                             0=inactive   1=active
----n--- -------- X or Y data out of range                         0=inactive   1=active
-----n-- -------- N data out of range                              0=inactive   1=active
------n- -------- Line requires F data                            0=inactive   1=active
-------n -------- Line requires X or Y data
                                                                   0=inactive   1=active

-------- n------- G code illegal in current cycle                 0=inactive   1=active
-------- -n------ Switching Axis while Jogging                    0=inactive   1=active
-------- --n----- Attempted Index during a Jog cycle              0=inactive   1=active
-------- ---n---- G Code cannot be executed from Line 0           0=inactive   1=active
-------- ----n--- No External Data Source                        0=inactive   1=active
-------- -----n-- Illegal comparison opposite direction          0=inactive   1=active
-------- ------n- X/Y sign required                              0=inactive   1=active
-------- -------n No Trigger for IFR/RMH cycle                   0=inactive   1=active
```

Illegal G Code:
Set whenever an illegal G code is encountered during a continuous motion cycle.

Illegal L Code:
Set when the data field for an L code is outside the legal range.
Set when an illegal L code is entered.
Reset when L Code data is in range or when program execution begins.

Subroutine or Loop Nesting:
Set during program execution if Subroutine or Loop nesting beyond four levels is detected.
Reset when program execution begins.

F data out of range:
Set during program execution if the F value is outside the legal range.
Set if the Strobe F (G38) value is out of range.
Set if the feedrate override value is out of range. (!F)
Reset when F data is in range or program execution begins.

X or Y data out of range:
Set during program execution if the X or Y value is outside the legal range.
Reset when program execution begins.

N data out of range:
Set when an addressed line number is out of range (0 to 400).
Set if the Strobe N (G37) value is out of range (1 to 400).
Reset when an addressed line is in range or when program execution begins.

Line requires F data:
Set during program execution if a required F field is omitted.
Reset when program execution begins.

Line requires X or Y data:
Set during program execution if a required X or Y field is omitted.
Reset when program execution begins.

G Code illegal in current cycle:
Set during program execution when an illegal G code is encountered during a program jog (G48) or Continuous Execution Mode is enabled (G60).
Reset when program execution begins.

Switching Axis while Jogging:
Set during a program Jog (G48) if a command requires Axis switching.
Reset when program execution begins.

Attempted Index during a Jog Cycle:
Set during a program Jog (G48) if a command requiring an Index is encountered.
Reset when program execution begins.

G Code cannot be executed from Line 0:
Set if an illegal G code is executed on Line 0.
Reset when program execution begins.

No External Data Source:
Set when a G code requires External BCD Data but the external source is not enabled.
Reset when program execution begins.

Illegal comparison opposite direction:
Set when the Control is in the Absolute Position Mode and Wait for distance command (G62) cannot be achieved, motion requires opposite direction.
Reset when program execution begins.

X/Y sign required:
Set when a G code requires an Axis designation and a direction.
Reset when program execution begins.

No Trigger for IFR/RMH cycle:
Set when an IFR (G10) or RMH (G78) command is executed and a Trigger source for the command is not defined, L20 code defines trigger source.
Reset when program execution begins.

If a data error occurs during program execution the line it occurred on can be interrogated using the H87 command.

H87 Transfer Program Error Line Number

Function This command requests the transfer of the program line number with an error detected during program execution.

Default Mode none

Command Format H87(crlf)

Notes The data will be transferred in the following format:

Nnnn(crlf)	(if program was terminated on a programming error)
(crlf)	(if no program error was detected)

H88 Transfer Execution Status

Function This command requests the transfer of the present execution cycle.

Default Mode none

Command Format H88(crlf)
!H88(crlf)

Notes The data will be transferred in the following format:

```
nnnnnnnn nnnnnnn0(crlf)
n------- -------- Program Execution          0=inactive  1=active
-n------ -------- Switch Execution           0=inactive  1=active
--n----- -------- Program Stop              0=inactive  1=active
---n---- -------- Slide Hold                0=inactive  1=active
----n--- -------- Delay occurring           0=inactive  1=active
-----n-- -------- Waiting for input          0=inactive  1=active
------n- -------- Waiting for velocity       0=inactive  1=active
-------n -------- Read external data         0=inactive  1=active

                                                  0=X axis     1=Y axis
-------- n------- Active Axis
-------- -n------ REH execution               0=inactive  1=active
-------- --n----- RMH execution               0=inactive  1=active
-------- ---n---- IFR execution               0=inactive  1=active
-------- ----n--- Jogging                     0=inactive  1=active
-------- -----n-- Stepping                    0=inactive  1=active
-------- ------n- Indexing                    0=inactive  1=active
-------- -------n Waiting for position        0=inactive  1=active
```

When a Slide Hold has been executed, the current cycle will still be active.

H99 Transfer Unit Type

Function This command transfers the Factory established Unit designation.

Default Mode none

Command Format H99(crlf)

Notes Up to 32 characters and a (crlf) will be sent in response to this command.

% Activate Continuous H Code Transfer Mode

Function

This command will set the active Control into the Continuous Transfer mode for designated H codes. When active the data requested by the designated H Code will be transferred continuously until the mode is canceled. This mode will be canceled by receipt of a "%CRLF" or a hardware clear or RS232 Clear "*"

Command Format

%Hnn(crlf)
!%Hnn(crlf)

Notes

Designated H Codes:

H13	Transfer Current Program Line
H15	Transfer Current Line Number
H17	Transfer Active Axis Absolute Electrical Position
H19	Transfer Mode Status
H20	Transfer Output Status
H21	Transfer Input Status
H22	Transfer Encoder Position (Closed Loop Control Only)
H26	Transfer Error Count (Closed Loop Control Only)
H27	Transfer Position Verification Status (Closed Loop Control Only)
H41	Transfer remaining repeat value
H43	Transfer Opto 22 Input/Output Status
H60	Transfer Present Velocity
H88	Transfer Execution Status

% is ignored if the Listen mode is active (&).

The L98 (Delay Between Continuous H Codes) sets the delay between continuous H code transfers.

Transfer Format

(data)(crlf) see the individual H codes for the specific format

This page intentionally left blank

CLOSED LOOP OPERATION

CLOSED LOOP OPERATION (Optional)

DESCRIPTION

The Closed Loop Option provides a means of interfacing the Control to an incremental encoder either on the motor, or on the driven mechanism. This may be needed in some applications to maintain a desired position within a particular deadband or to assure that an index command attains the destination position. This option can be easily-installed via a front-panel plug-in module and is only applicable to the X axis. This module contains the operating system program, battery-backed memory and encoder interface circuitry for detecting mechanical position.

INSTALLING THE CLOSED-LOOP OPTION

CAUTION: The module for open- or closed-loop operation contains electronic components that may be damaged by static electricity (ESD). To prevent ESD damage, you must be certain to work in a grounded, static-protected area, and only handle the module by its metal front, or by the edges of the circuit card. Keep the module in its static-protective plastic bag except when installing or removing it from the control.

CAUTION: Be sure to disconnect ac power before installing or removing the open- or closed-loop electronic module.

To install the optional plug-in module, first be sure to disconnect ac power to the control. Then, remove the two screws that fasten the module in place in the lower left corner of the control enclosure (when viewed from the front). Next, carefully unplug the original (open-loop) module from its DIN connector socket by pulling it firmly out from the front of the control chassis. Then install the closed-loop module by firmly seating it in the connector socket, noting the proper orientation of the module (observe the screw hole locations on the metal shroud). Finally, replace the two screws, connect the proper encoder to the "D" connector (see Encoder Selection, below), and restore ac power.

DESCRIPTION OF VARIOUS CLOSED LOOP OPERATING MODES

The closed loop option has four operating modes which are selected by programming the Position Verification Enable/Disable parameter, L90, with a numeric value 0 through 3. These four operating modes are:

L90 0 Following Error Detection, Position Maintenance at Standstill, and Automatic Index Command Correction are all disabled in this mode. However, absolute encoder position is maintained. This mode is used primarily for setting up the closed loop parameters.

L90 1 Following Error Detection and Position Maintenance at Standstill are enabled, but Automatic Index Command Correction is disabled in this mode. This mode is used to maintain position at standstill and to abort a cycle if a following error is detected (stalled motor detected during motion).

L90 2 Following Error Detection, Position Maintenance at Standstill, and Automatic Index Command Correction are all enabled in this mode. If a following error is detected during motion, then that cycle will automatically be stopped and restarted after the designated delay (L97 parameter value). This action will continue until the cycle is completed or the number of attempts allowed (L96 parameter value) has elapsed. A Jog cycle will simply be restarted in the designated direction. An Index will be restarted in the designated direction until the target position is attained.

L90 3 This mode is identical to the L90 2 mode except for the restarting of an Index after a following error is detected. If a following error is detected when the motor is moving toward the target position, the control will command the motor to return to the original starting position after a designated delay, the L97 parameter value. When this position is attained, the motor will move toward the target position after the designated delay (L97 parameter value). This cyclic action will continue until the target is attained or the number of attempts allowed, the L96 parameter value, has elapsed.

RELATED COMMANDS

L53 Following Error Exceeded Characters
L54 Unable to Correct Characters
L59 Output Configuration
L87 Following Error
L90 Position Verification Enable/Disable
L93 In Position Bandwidth
L94 Invert Encoder Direction
L95 Encoder Quadrature Scale Factor
L96 Number of Correction Attempts allowed
L97 Delay between Correction Attempts
H22 Transfer Absolute Encoder Position
H26 Transfer Pulse Error Count
H27 Transfer Closed Loop Status

ENCODER SELECTION

The encoder used with the Closed Loop Option should be a 5-volt incremental encoder with differential outputs. A shielded cable with a maximum length of 25 feet (7.6 meters) can be used. If a cable length greater than 25 feet is required an external 5 volt supply located at the encoder must be provided, and pin 9 of the encoder cable must not be used (this is what normally carries +5 Vdc from the control to the encoder). The 9-pin "D" connector at the Control end must have a metal case with the shield tied to the metal case to provide immunity from electrical interference. The encoder input and power supply specification are located in the SPECIFICATION section of this manual. An Encoder Compatibility Chart is shown below.

Note: If a single ended encoder is used a shielded cable with a maximum length of 5 feet (1.5 meters) can be used.

Encoder Compatibility Chart

Encoder Line Count	Drive Resolution	L95 Value	Encoder Line Count	Drive Resolution	L95 Value
50	200	0	100	200	2
200	200	4	400*	200	8
100	400	0	200	400	2
400*	400	4	800	400	8
500*	1000	2	1000	1000	4
500*	2000	0	1000	2000	2
800	3200	0	360	7200	5**
500*	10000	5**	1000	20000	5**
1250	25000	5**	2500	50000	5**

* Encoders with 400, 500, and 1250 lines and with differential outputs are available from Superior Electric.

** When L95=5, the quadrature pulse count is multiplied by 5 to obtain the encoder count. All other values of L95 result in a division into the quadrature pulse count. For example, when using a 400 line encoder with a drive setting of 200 pulses/revolution, L95=8 results in dividing the 1600 quadrature pulse count by 8 to obtain 200 counts per revolution. When using a 500 line encoder with a drive setting of 10,000 counts per revolution, L95=5 results in multiplying the 2000 quadrature pulse count by 5 to obtain 10,000 counts per revolution.

Encoder Input Connector Assignments (9-pin "D" connector)

C12 Lead Color*	C2, C4, C5 Lead Color*	All Types Terminal #	Function	Cable Wire Color	9-Pin "D" Connector Pin Number
Green	Green	1	B+ "Count"(single-ended)	Black	1
Blue	White/Green	2	B- "Count"	White	2
White	Orange	3	A+ "Gate"(single ended)	Red	3
Yellow	White/Orange	4	A- "Gate"	Green	4
Black	Black	5	Encoder common Vo	Brown	5
			not used	Blue	6
Orange	White	7	I+ "Index"	Orange	7
Brown	White/Black	8	I- "Index" (single ended)	Yellow	8
Red	Red	6	Encoder +5 Vdc	Purple	9

* Cable supplied with control must be modified for connection to encoder leads.

CAUTION DO NOT CONNECT THE ENCODER TO THE SERIAL OUTPUT CONNECTOR OR DAMAGE MAY OCCUR.

Note **If a single-ended encoder is used (the complement is not available), the B- and A- signal lines must be left unconnected.**

ENCODER SETUP

NOTE **In the following discussion, the terms "Cr" and "Lf" denote carriage return and line feed, respectively.**

1) Establish Control communications first. Transmit the following command:

<01Cr

Note **If the Control ID is not 01, substitute the correct Control ID for 01.**

2) The position verification Enable/Disable parameter should be disabled before attempting to do the encoder setup. Transmit the following command line to disable the position verification option:

L90 0CrLf

3) Select the proper encoder from the Encoder Compatibility chart and enter the appropriate value in the Encoder Quadrature Scale Factor Parameter, L95.

Example: Drive Resolution is 10000 pulses/revolution. A 500 line encoder, 2000 pulses per revolution, was selected. From the Encoder Compatibility Chart the L95=5 should be selected. Transmit the following command line to set the value.

L95 5CrLf

4) A parameter for setting the allowable Following error, which is the difference between the mechanical and electrical position, should be decided on first. The minimum value for this parameter should be four full steps. This value is entered as the L87 value. The factory default for this parameter is 10 full steps. Transmit the following command line to set the Following Error value "nnn":

L87 nnnCrLf

Example: L87 50CrLf
Enters 50 pulses as the allowable Following Error.

5) The allowable In Position Bandwidth, position deviation about the ideal position, which is the L93 parameter value, should be decided on next. This value should be attainable without excessive hunting. If the Encoder is not connected directly to the motor, this value must include the lash in the mechanics. The L93 value should be smaller than the L87 value. The factory default varies with the step resolution selected.

Example: L93 5CrLf
Enters 5 pulses as the In Position Deadband.

Refer to Appendix A for the factory default values. The use of L93 values less than the factory default may result in excessive hunting.

6) The number of correction attempts should now be decided upon. This value should be entered as the L96 value. The factory default is 100.

Example: L96 10CrLf
Enters 10 as the Number of Correction Attempts Allowed.

7) The delay between Correction Attempts (L97 parameter). This delay time should be sufficient to allow the motor to settle after a motion. In general, the larger the inertia load the longer the delay should be. The factory default is 100 milliseconds.

Example: L97 500CrLf
Enters 500 milliseconds as the delay between Correction Attempts.

8) Load the following program on the MDI line, Line 0, in the control:

N0 X1000 f1000CrLf
Move the X axis 1000 pulses in Clockwise direction at a feedrate of 1000 pulses/second.

9) Set the X axis to the Home Position by transmitting the following command line:

X,H9H17h22CrLf
Set Home position (H9), transmit Electrical Position (H17) and transmit Encoder Position (h22).
response:

X+0000000000 (Electrical Position)
X+0000000000 (Encoder Position)

10) Execute move and verify positions.

H1H17h22CrLf
Response after motion:

X+0000001000 (Electrical Position)
X+0000001000 or
X-0000001000 (Encoder Position)

if response is X-0000001000 then change the Invert Encoder Direction parameter, L94, by transmitting one of the following commands:

L94 0CrLf or L94 1CrLf
Then repeat steps 8 and 9.

11) The desired operating mode must now be selected, L90 0 or L90 1 or L90 2 or L90 3.

Refer to **Description of various Closed Loop Operating Modes** section.

The desired operating mode "n" can be selected by transmitting the following command line:

L90 nCrLf
Selects Mode "n" (0-3) as the desired operating mode.

OPERATION

When Position Maintenance is enabled, (when L90=1 or 2 or 3), the motor position will be maintained within the L93 deadband value at standstill. The Control moves the motor to the ideal position, center of the deadband, when the In Position Deadband (the L93 parameter value) is exceeded. The L97 parameter sets the minimum time between correction attempts. This timeout begins when motor motion is completed.

A positional error is detected when the Following Error, (the L87 parameter value) is exceeded during motion. When a following error condition is detected, motion stops with no deceleration. The Delay between correction Attempts, L97 parameter, begins. After the timeout, one of the following will occur:

1) Cycle termination will occur, L90=1 or Number of Position Correction Attempts, L96 parameter value, has elapsed. At this time the Encoder Position is transferred to the X Axis Absolute Position.

Note **When a Closed Loop Error occurs the Fault Led is illuminated. This error is reset when program execution begins or a motion cycle begins.**

2) Restart of Current cycle and decrement of Position Correction Attempt count, L96 parameter value.

Note **The Position Correction Attempt count value is set to the Position Correction Attempt parameter, L96, value when a non-correction cycle, Jog or Step or Index, takes place in the X axis.**

This page intentionally left blank

SECURITY CODE

SECURITY CODE

DESCRIPTION

A security code provides a means of denying access to parameters and program information. A security code of 00000000 disables the function. This is the factory setting for the security code.

When the security code feature is enabled, access to the parameters and program information upon power turn-on until the security code is entered. The code can only be changed under the following conditions:

The security code is 00000000
A matching security code has been entered
Initialization of Factory Defaults (see Appendix G), Z99 nnn, has been performed. When this is done, the parameters will be changed to the factory default values and the program contents will be cleared. It is recommended that a listing be made of the parameters and program contents before using the Z99 command.

RELATED COMMANDS

The following commands are disabled when the security code is active:

Lnn nnnnnnnn	Parameter changing via RS232
H11	Clear Current Program Line
H12	Clear Program
H13	Transfer Current Program Line And Contents
H14	Transfer Program
H16	Transfer Parameters
H24	Enable Trace Mode
Gnn, Xsnnnnnnnn, Ysnnnnnnnn and Fnnnnnn	Line Data (0-400)
X,	Select X Axis
Y,	Select Y Axis

COMMAND SYNTAX

s nnnnnnnn nnnnnnnn range is 00000000 - 99999999

NOTES

When the security code is active, the Y axis cannot be selected via RS232. However, a manual axis select can be utilized if one of the inputs is configured for X/Y select (L58, function D).

Program line data cannot be altered when the security code is active. Therefore, manual index motion cannot be executed unless a specific line was programmed for an index motion while the security code was inactive.

Example: **N000 X1000 F2000** was programmed while the security code was inactive. Index motion can be commanded when the security code is active using **N0H1crlf**.

Manual Step (H2H6 or H2H7) and Jog motions (H3H6 or H3H7) can be commanded when the security code is active

When the security code is active, L codes (parameters) cannot be changed via RS232 codes, but can be altered during program execution using the G29 command.

TROUBLESHOOTING

TROUBLESHOOTING

The status information provided by the SLO-SYN 2000 Control can be invaluable as a trouble shooting aid. The most obvious status information is provided by the front panel LED's.

Using the "FAULT" led as an error indicator, it is a relatively simple procedure to determine just what caused the error condition. If you are using a "dumb terminal" or computer that can emulate a "dumb terminal", first establish communications with the Control by issuing the command "<01 crlf". If the Control ID number is set to something other than 1 substitute that number instead of "01". The Control will respond by transmitting a "=" character. This character indicates the Control is ready to communicate. After receiving the "=" response, issue the command "H85 crlf", The Control will respond by transmitting the system error status.

Refer to the description of the H85 command in the Software Reference section of the manual for a complete listing of the possible system error responses.

In the case of a programming error, more specific information can be obtained by issuing the command "H86 crlf". The Control will respond by transmitting the program error status. Refer to the description of the H86 command in the Software Reference section of the manual for a complete list of the possible program errors.

When a fault occurs during program execution, it is possible to determine just where in the program the fault occurred by issuing the command "H87 crlf", the Control will respond by transmitting the program line number that was being executed when the error occurred. For example if the Control had transmitted "N007" in response to the "H87" command, it can be determined that program line number 7 was executing when an error occurred.

Applicable Codes: H85 Transfer system error status
H86 Transfer program error status
H87 Transfer program error line #

TRACE MODE

Trace mode allows the user to view the program line by line as the program executes. When trace mode is enabled the Control will transmit via the serial port the contents of the program line that is being executed. The device connected to the serial port must be capable of receiving and displaying standard ASCII characters. A "dumb terminal" or computer emulating a "dumb terminal" is a perfect device for viewing the program lines as they are transmitted from the Control. To enable the trace mode issue the following command "!H24 crlf".

To disable the trace mode issue an "!H25 crlf" command. The time it takes to execute the program will increase when trace mode is active.

Applicable Codes: H24 Program trace on
H25 Program trace off

USING THE "DRY RUN" FEATURE

The SLO-SYN 2000 Control has a "dry run" capability that allows the program to be executed in real time without motor motion. This feature is most useful in the development and debugging stages of program development. To enable the "dry run" feature the L06 parameter must be set to "L06 1nn" where "nn" represents the desired execution format. Once the "dry run" feature has been enabled motor motion will not be allowed. The program, however, will execute normally. To return to "normal" operating conditions where motor motion is allowed, set the L06 parameter to "L06 0nn" where "nn" again represents the desired execution format.

Applicable Codes: L06 Execution format

INDICATOR LED's

The "POWER" led will be illuminated whenever adequate AC power is provided to the Control. This led must be on before the Control will be able to communicate or execute its stored program. The "MOTION BUSY" led will be on when the motor is commanded to move. In general if the light is on, the Control has received or generated a motion command.

The "FAULT" led will light when a motion or program error has occurred or when a drive error has occurred. This led being on is the first indication that the Control has encountered a condition which has caused an error. 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

HALTING A FAULTY PROGRAM THAT KEEPS REPEATING

A situation can occur where an incorrect program may contain commands that cause it to keep repeating. If this happens, the program can be halted by downloading another program to the SS2000I Programmable Motion Controller. Downloading of a new program will cause the control to cease operation of any program that is in process.

TROUBLESHOOTING COMMANDS

Two Z commands are provided to aid in troubleshooting a problem. These commands, Z81 and Z99, are described in Appendix G of the manual.

MOST FREQUENTLY ASKED QUESTIONS

DOES THE ABSOLUTE POSITION COUNTER UPDATE DURING THE JOG AND STEP COMMANDS?

The absolute position counter maintains the electrical position during any motion regardless of the motion command or the source (serial or parallel) of the command. If a motion clear, clockwise limit or counterclockwise limit is actuated during motion, the absolute position counter contains erroneous data. The home position should be reestablished subsequent to those actions.

I PROGRAMMED A DELAY ON A PROGRAM LINE, BUT WHY IS THE DELAY LONGER THAN I PROGRAMMED?

The total delay time on a line is the value programmed in the X field plus the L44 line delay value. The L44 value must be accounted for to attain the desired dwell time between moves. The L44 value is used to allow sufficient "settling time" for the motor to come to rest before another move is attempted. If this time is not long enough, position errors may result because the motor has not stopped its "ringout" (oscillation) following a move. L44 is only added following program lines calling for motion to occur.

As an example, the following program is executed with:

L44 = 100 milliseconds:

N001 G91 X+1000 F500	(index 1000 pulses)
N002 G04 X+1000	(delay)
N003 X-1000 F500	(index -1000 pulses)
N004 G30	(program end)

The total delay time from the end of line 1 to the beginning of line 3 is the L44 delay when line 1 is done, plus the G04 delay of line 2 (the 1000 msec value in the X Field). Thus the total delay equals 100 + 1000 = 1100 milliseconds. The G04 X field should be set to the desired dwell time minus the L44 value.

G04 delay=(desired dwell)-(L44 value)

In this case, if the desired dwell is 1000 milliseconds, then

G04 delay=(1000)-(100)

= 900 milliseconds

WHAT IS THE DIFFERENCE BETWEEN "RETURN TO MECHANICAL HOME" AND "RETURN TO ELECTRICAL HOME"?

The Electrical Home (+000000 in the absolute position counter) is set either at the motor position occupied upon energizing the Control or with a "Set Electrical Home" command (H09 or G77) at any time.

The Return to Electrical Home command (H08 or G76) causes the motor to index from its current position (as indicated in the absolute position counter) in the direction opposite the absolute counter sign. This will continue until the motor reaches the absolute position counter setting of +0000000000 (Electrical Home).

Return to Mechanical Home establishes the Electrical Home with a mechanical switch. An H10 or G78 causes the motor to run in the direction programmed in the L08 parameter until the Home Limit Switch input is active. Then the motor will offset the direction and distance set with the L17 parameter. When that motion is complete, the motor position becomes Electrical Home (the absolute position counter is reset to +0000000000).

Therefore, use the Return to Mechanical Home (H10 or G78) to accurately establish Electrical Home upon power up or when the absolute position counter contains erroneous data (i.e., subsequent to a Motion Clear *). Then use the Return to Electrical Home (H08 or G76)to position the motor at a known location.

WHAT IS THE DIFFERENCE BETWEEN ABSOLUTE AND INCREMENTAL MODES OF MOTION?

Incremental Motion (set by G91) moves the number of pulses contained in the X field with the direction determined by the X field sign (+ indicating clockwise direction and counterclockwise direction set by -). The moves are made relative to the present motor position.

Absolute Motion (set by G90) moves to the position contained in the X field by moving the direction and the number of pulses to achieve that position as related to the present absolute position counter. The absolute position counter is set to zero or the home position upon power up and with the H09 and G77 commands.

HOW DO MY COMPUTER AND CONTROL PROGRAMS ACTUALLY CONNECT?

This process is called a "Handshake." Some computers use a hardware connection to accomplish this. The SS2000I Control does not. The handshaking technique used by the Control is a software method utilizing the "XON/XOFF protocol." These are discussed in detail in the Glossary under "XON/XOFF".

I AM UNABLE TO ESTABLISH SERIAL COMMUNICATIONS BETWEEN MY CONTROL AND MY HOST COMPUTER. WHAT CAN THE PROBLEM BE?

First, make sure that all the hardware connections are made, cable lengths do not exceed specified limits and that no power cables are along side of communications cables.

If no communications occur, it could be a problem with your communications parameters. Check to see that the serial communications settings on the top-mounted switches are identical for the host device and the Control. The factory default settings for the Control are 9600 baud, 8 data bits, 2 stop bits, and no parity.

SPECIFICATIONS

SPECIFICATIONS FOR PROGRAMMABLE MOTION CONTROL SS2000I

I. MECHANICAL

Dimensions:	9.5"H x 2.5"W x 5.6"D (24 x 6.4 x 14.2 mm)
Weight:	3 lb. 9 oz. (1.62 kg)

II. ENVIRONMENTAL

TEMPERATURE	
Operating	0° C to 50° C
Storage	-40° C to 75° C
HUMIDITY	95% noncondensing

III. ELECTRICAL

INPUT POWER	
Voltage:	90-265 VAC 50/60 HZ Current: less than 0.4 amperes at 115 Vac Fuse: 2 A (normal blow)
ISOLATED CURRENT-LIMITED POWER SUPPLY FOR USE WITH SINGLE POINT I/O)	24Vdc (+/- 10%) at 0.75A
INPUTS & OUTPUTS:	
SINGLE POINT I/O ELECTRICAL SPECS.	Outputs shall be able to drive a shorted load indefinitely without damage. No suppression required for inductive loads.
OUTPUTS (SINK MODE)	
Load Power Supply	Can use built-in 24 Vdc supply or external 12 to 24 Vdc supply
Current Rating	50 mA
Voltage Rating	24 Vdc
ON STATE VOLTAGE	
@ 50 mA	2.0 V max.
OFF STATE LEAKAGE	
@ 24VDC	0.6 mA max.
OUTPUTS (SOURCE MODE)	
Current Rating	50 mA
ON STATE VOLTAGE	
@ 50 mA	20 V min.
Off State Leakage	0.6 mA max.
INPUTS (SINK MODE)	
On State Voltage Range	0 - 12 volts
Input Current @ 12 V	2.3 mA
Input Current @ 0 V	6.5 mA
INPUTS (SOURCE MODE)	
On State Voltage Range	10 - 24 Vdc
Input Current @ 10 V	2.3 mA
Input Current @ 24 V	6.5 mA

IV. INTERFACE FUNCTIONS AND CONNECTOR PIN-OUTS

BCD SWITCH INTERFACE / I/O EXPANSION PORT
(25 PIN "D" FEMALE CONNECTOR)

This port consists of eight inputs and eight outputs. It is capable of reading two banks of BCD switch data (each with seven digits plus sign). The control can also interface to "OPTO 22" type PB16A I/O modules (or equivalent, such as Potter & Brumfield type 210-16), providing an additional eight inputs and eight outputs.

BCD PORT CONNECTOR PIN NUMBER	BCD SWITCH FUNCTION	EXPANSION I/O FUNCTION
1	DATA 1	INPUT 0
2	DATA 2	INPUT 1
3	DATA 4	INPUT 2
4	DATA 8	INPUT 3
5	DATA 10	INPUT 4
6	DATA 20	INPUT 5
7	DATA 40	INPUT 6
8	*DATA 80 or (-) SIGN	INPUT 7
9-11	NC	NC
12, 13	NOT USED	+5V
14	BANK 1 - X1	OUTPUT 0
15	BANK 1 - X100	OUTPUT 1
16	BANK 1 - X10, 000	OUTPUT 2
17	BANK 1 - X1, 000, 000	OUTPUT 3
18	BANK 2 - X1	OUTPUT 4
19	BANK 2 - X100	OUTPUT 5
20	BANK 2 - X10, 000	OUTPUT 6
21	BANK 2 - X1,000,000	OUTPUT 7
22, 23	NC	NC
24, 25	NOT USED	GND

* Sign for x1,000,000; otherwise, Data 80

DRIVE INTERFACE

There are two drive interfaces. Each has its own eight-position removable terminal strip connector. The pin assignments for each are as follows:

PULSE 0-1 MHZ SQ. WAVE
DIRECTION
WINDINGS OFF
REDUCE
BOOST
RESET
DRIVE READY INPUT
OPTO SUPPLY (+5V)

When "Drive Ready" is on, the drive is powered and ready.
When "Drive Ready" is off, the drive is not powered or has failed.

SERIAL PORT

The serial port is used to program the unit or to interface to a host controller. There are two serial interfaces: RS232 and RS485. Units can be daisy chained via either interface. Communication to the host via RS232 or RS485 is switch selectable.

RS232 (9 Pin "D" Female Connector)

Pin Assignments For RS232 Connector

1	V0
2	CHAIN OUT (TX)
3	Rx
4	V0
5	V0
6	ECHO
7	CHAIN IN
8	+5V
9	+5V

RS485 (5 Position Removable Terminal Strip Connector)
Pin Assignments are As Follows:

Tx -
Tx +
Rx -
Rx +
GND

SERIAL PORT PARAMETERS:

BAUD RATE	(300,1200,2400,9600) hardware switch selectable
DATA FORMAT	Hardware switch selectable
DATA LENGTH	7 or 8 bits
PARITY	Odd, even or none
UNIT ID (01-99)	Hardware switch selectable

OPTIONAL ENCODER INTERFACE:

9 pin "D" female connector (on plug-in Memory Module). Operates with differential or single-ended encoders. Count rate to 400,000 pulses per second.

ENCODER CONNECTOR	DIFF ENCODER	SINGLE ENDED ENCODER
1	B	B
2	B-	NOT USED
3	A	A
4	A-	NOT USED
5	ENCODER GND	ENCODER GND
6	NC	NC
7	Z	NOT USED
8	Z-	Z
9	ENCODER +5V	ENCODER +5V

This page intentionally left blank

GLOSSARY

GLOSSARY

ABSOLUTE MODE

Motion mode in which all motor movements are specified in reference to an electrical home position.

ABSOLUTE POSITION COUNTER

A data register in the Control which counts pulses delivered to the motor (via the drive). When the count is zero, this position is designated "Electrical Home".

ACCELERATION

The rate at which the motor speed is increased from its present speed to a higher speed (specified in pulses/second/second).

ACCURACY

The noncumulative incremental error which represents step to step error in one full motor revolution.

ALL WINDINGS OFF

Applying an average zero motor current at standstill to alleviate motor heating or eliminate holding torque.

AMBIENT TEMPERATURE

The temperature of the air surrounding the motor or drive.

ASCII

(American Standard Code for Information Interchange). A format to represent alphanumeric and control characters as seven-or eight-bit codes for data communications.

ATTENTION CHARACTER

<nn, where "nn" is a unique integer from 1-99 (set by use of the unit ID# select switches) that is assigned to a Motion Control arrayed in a multi-Control system. The Attention Character directs the program command to the specified Motion Control.

BASE SPEED

Starting speed for the motor (also known as low speed).

BAUD RATE

The rate of serial data communications expressed in binary bits per second.

BCD

(Binary Coded Decimal), a format to represent the digits 0 through 9 as four digital signals. Systems using thumbwheel switches may program commands using BCD digits.

A BCD digit uses a standard format to represent the digits 0 through 9 as four digital signals. The following table lists the BCD and complementary BCD representation for those digits. The Motion Control uses the complementary BCD codes because the signals are active low.

BCD code table (0 = low state, 1=high state)

digit	BCD code	complementary BCD code
0	0000	1111
1	0001	1110
2	0010	1101
3	0011	1100
4	0100	1011
5	0101	1010
6	0110	1001
7	0111	1000
8	1000	0111
9	1001	0110

To represent numbers greater than 9, cascade the BCD states for each digit. For example, the number 79 is 0111:1001.

BOOST CURRENT

Increase of motor current during acceleration and deceleration to provide higher torques and faster ramp rates.

CLEAR, *	Immediate Code which when received from your computer will command the indexer to immediately halt all motor motion and program execution.
COLLECTORS (OPEN)	A transistor output that takes the signal to a low voltage level with no pull-up device; resistive pull-ups are added to provide the high voltage level.
CYCLE START	Command H01 to initiate program execution.
CYCLE STOP, #	Immediate Code which when received from your computer will command the indexer to stop program execution after the present program line completes its task.
DAISY-CHAIN	A method to interface multiple Motion Controls via RS232 to a single host using only one serial port.
DAMPING	A method of applying additional friction or load to the motor in order to alleviate resonance and ringout.
DECELERATION	The rate in which the motor speed is decreased from its present speed to a lower speed (specified in pulses/second/second).
DEVICE ADDRESS	A unique number used to assign which Motion Control in a multi-drive stepper system is to respond to commands sent by a host computer or terminal. Device addresses from 1 - 99 are set by means of the ID # select switch. "00" is reserved to address all Motion Controls in a system. Factory default is 01.
DWELL	A programmed delay in program execution (specified in milliseconds. The duration set is in the X/Y field.
ELECTRICAL HOME	The motor position at which the Absolute Position Counter is zero.
EOT	Character (ASCII code 4) appended to an end of a data transmission to signify the conclusion of the data transfer.
F CODE	A six-digit field on a program line that either designates the Feedrate or contains additional data as required by the X/Y field in a G code.
FEEDHOLD, $	Immediate Code which when received from your computer will command the indexer to immediately bring motor motion to a controlled stop with the programmed deceleration.
FEEDRATE	Specified in an F field, the motor speed (in pulses per second) in which a move will occur; stored and executed in association with several G and H codes.
FRICTION	Force that is opposite to the direction of motion as one body moves over another.
FULL-STEP	Position resolution in which 200 pulses corresponds to one motor revolution in a 200 step per revolution motor.
G CODES	Preparatory commands that are stored and executed within a program that designate the function of the program line.
H CODES	Commands that set Motion Control modes and control manual and program execution.
HALF-STEP	Position resolution in which 400 pulses corresponds to one motor revolution for a 200 step per revolution motor.
HANDSHAKE	A computer communications technique in which one computer's program links up with another's. The Motion Control uses a software "Xon, Xoff" handshake method. See "XON" below.

HIGH SPEED MODE

Command H4 that allows the motor to accelerate to a high speed as all motion occurs at the programmed feedrates.

INCREMENTAL MODE

Motion mode in which all motor movements are specified in reference to the present motor position.

INDEXER

A Microprocessor-based programmable motion control that controls move distance and speeds; possesses intelligent interfacing and input/output capabilities.

INERTIA

Measurement of a property of matter that a body resists a change in speed (must be overcome during acceleration).

INERTIAL LOAD

A "flywheel" type load affixed to the shaft of a step motor. Sometimes used as a damper to eliminate resonance.

INSTABILITY

Also frequently called, "mid-range instability" or "mid-range resonance," this term refers to a resonance that occurs in the 500 - 1,500 steps/sec range. Mid-range instability is important because it refers to a loss of torque or a stalled motor condition at higher stepping rates.

Since step motors do not start instantaneously above the mid-range resonance frequency, an acceleration scheme will have to be used to pass through the troublesome region.

JOG MODE

Command H3 that configures H6 (clockwise motion) and H7 (counterclockwise motion) to move the motor continuously until a Feedhold $ command is issued.

L CODES

Contain the values for the global parameters.

LOAD

This term is used several ways in this and other manuals.

LOAD (ELECTRICAL): The current in Amperes passing through the motor windings.

LOAD (MECHANICAL): The mass to which motor torque is being applied (the load being moved by the system).

LOAD (PROGRAMMING): Transmits a program from one computer to another. "UPLOAD" refers to transmitting a program from a host computer (where a program has been written) to the Motion Control where it will be used. "DOWNLOAD" refers to transmitting a program from a Motion Control back to the host computer.

LOW SPEED MODE

Command H5 that inhibits the motor from accelerating to a high speed as all motion occurs at the programmed low speed value (also known as "Base Speed Only")

MECHANICAL HOME

The position where a switch input is used as a reference to establish electrical home.

MDI

"Manual Data Interface". A program line (line 0) designated for manual operation to facilitate rapid program loading and execution. Line 0 is stored in non-volatile memory (BBRAM). When the MDI line is executed, the execution format (L06) is ignored as line 0 executes once per each Cycle Start (H01) command, and the line pointer remains at 0.

MICROSTEPPING

A sophisticated form of motor control that allows finer resolution than full step (200 pulses per revolution) or half step (400 pulses per revolution) by adjusting the amount of current being applied to the motor windings.

For 200 step per revolution motors, typical microstepping levels are 1/10-step and 1/125 step (2000 pulses per revolution and 25,000 pulses per revolution, respectively).

N CODE

Sets the program line number.

NEGATIVE LOGIC

An "inverted" way of interpreting the state of inputs and outputs. When current flows through that input or output, the control's program treats it as inactive or "off". Set L58 - (minus sign) for negative logic.

Physical Condition	How Program Interprets I/O State
current flow = switch closed	"off" = inactive = logic 0
no current flow = switch open	"on" = active = logic 1

NESTING

The ability of an active subroutine to call another subroutine. The Motion Control can nest up to four levels.

NONVOLATILE MEMORY

Data storage device that retains its contents even if power is removed. Examples are EEPROM and battery-backed RAM.

OPTO-ISOLATION

The electrical separation of the logic section from the input/output section to achieve signal separation and to limit electrical noise. The two systems are coupled together via a transmission of light energy from a sender (LED) to a receiver (photo transistor).

PARITY

An error checking scheme used in serial communications (via the RS-232 port) to ensure that the data is received by a Motion Control is the same as the data sent by a host computer or programmer such as the SSP525.

POSITIVE LOGIC

The conventional way of interpreting the state of inputs and outputs. When current flows through that input or output, the control's program treats it as active or "on". Set L58 + (plus sign) for positive logic.

Physical Condition	How Program Interprets I/O State
current flow = switch closed	"on" = active = logic 1
no current flow = switch open	"off" = inactive = logic 0

REDUCE CURRENT

Reduction of motor current during standstill to alleviate motor heating.

RESOLUTION

The minimum position command that can be executed. Specified in steps per revolution or some equivalent.

RETURN TO ELECTRICAL HOME

Function which allows the Motion Control to position the motor to a known reference point. See also Absolute Position Counter and Mechanical Home.

RETURN TO MECHANICAL HOME

Function which allows the Motion Control to position the motor to seek a switch to establish electrical home.

RINGOUT

The transient oscillatory response (prior to settling down) of a step motor about its final position.

RS232-C

EIA (Electronic Industries Association) communication standard to interface devices employing serial data interchanges.

RS274-D

EIA (Electronic Industries Association) programming standard for numerically-controlled machines.

SET HOME

A command which, after executing, references the present motor position as "home" and the absolute position counter is set to 0. See also Absolute Position Counter.

SINKING

An input or output that is brought to a low level (signal common or low side of the input/output power supply) when active.

SOURCING

An input or output that is brought to a high level (the voltage used for the input/output power supply) when active.

STEP MODE

Command H2 that configures H6 (clockwise motion) and H7 (counterclockwise motion) to move the motor one pulse.

SUBROUTINE

A sequence of lines that may be accessed from anywhere in a program to preclude having to program those lines repetitively. This allows shorter and more efficient programs.

TORQUE

Product of the magnitude of a force and its force arm (radius) to produce rotational movement.

TRANSLATOR

A motion control device (also called "translator drive") that converts pulses to motor phase currents to produce motion.

X/Y Field

An eight digit field with a sign on a program line that either designates the motor move or contains additional data as required by the G code.

XON/XOFF

A computer software "handshaking" scheme used by a Motion Control.

The Motion Control sends an XOFF character (ASCII Code 19) when it receives a command string with a Carriage Return and has less than 50 characters remaining in its serial port buffer. The Control sends and Xon when available buffer space reaches 100 characters or in response to an ID attention with adequate buffer space remaining. Since it is impossible for the host device to immediately cease transmissions, the next three characters (subject to the total serial buffer capacity of forty characters) received subsequent to the Motion Control sending the XOFF character will be stored in the Motion Control's serial buffer (a memory dedicated to store characters that are in the process of transmission).

Similarly, the Motion Control will not transmit data if the host device has sent an XOFF character to the Control; Motion Control transmissions will resume when the Control receives an XON character.

APPENDIX

L CODE LISTING

Control Parameters

L13 nnnnnnnn,nnnnnnnn	Step Increment for X,Y axes
L16 nnnnnnnn	Index From Run Travel Limit
L18 snnnnnnnn,snnnnnnnn	Clockwise Travel Limit for X,Y axes
L19 snnnnnnnn,snnnnnnnn	Counterclockwise Travel Limit for X,Y axes
L20 nnnnn	Power Up Configuration
L41 nnn	Auto Start Line Number

RS232 Parameters

L01 "aaaaaaaaaaaaaaaaaaaa"	Message # 1
L02 "aaaaaaaaaaaaaaaaaaaa"	Message # 2
L03 "aaaaaaaaaaaaaaaaaaaa"	Message # 3
L04 "aaaaaaaaaaaaaaaaaaaa"	Message # 4
L05 "aaaaaaaaaaaaaaaaaaaa"	Message # 5
L26 n	Command Acknowledge
L48 nnn	Program Line Count Designator
L49 nn	Parameter Transfer Designator
L50 nn	Parameter Transfer Count
L52 "aaa"	Buffer Warning Characters
L53 "aaa"	Following Error Exceeded Characters
L54 "aaa"	Unable To Correct Characters
L55 "aaa"	Line Done Characters
L56 "aaa"	Program Done Characters
L98 nnnn	Delay Between %Hnn Code Transmissions

Program Parameters

L06 nnn	Execution Format
L44 nnnn	After Motion Delay
L47 nnnn	Repeat Count
L58 "shhhhhhhhhhhhh"	Input Configuration
L59 "hhhhhhhh"	Output Configuration
L91 nnnnnnnn,nnnnnnnn	External Distance BCD Scaling factor

Feed Rate Parameters

L09 nnnnnn,nnnnnn	Jog Speed for X,Y axes
L12 nnnnnn,nnnnnn	Low Speed for X,Y axes
L14 nnnnnn,nnnnnn	Home Speed for X,Y axes
L73 nnnnnn	Deviation Frequency

Ramp Parameters

L10 nnnnnnnn,nnnnnnnn	Deceleration Rate for X,Y axes
L11 nnnnnnnn,nnnnnnnn	Acceleration Rate for X,Y axes
L71 nnnnnn	Ramp Frequency Limit
L72 n	Ramp Profile Select

Mechanical Home Parameters

L08 s,s	Mechanical Home Direction for X,Y axes
L17 snnnnnnnn,snnnnnnnn	Offset From Mechanical Home for X,Y axes

Backlash Compensation

L43 nnnn	Delay Between Index and Backlash
L66 snnnnnnnn,snnnnnnnn	Backlash Compensation for X,Y axes

Closed Loop Parameters

L87 nnnn	Following Error
L90 n	Position Verification Enable/Disable
L93 nnnn	In Position Bandwidth
L94 n	Invert Encoder Direction
L95 n	Encoder Quadrature Scale Factor
L96 nnnn	Number of Attempts for Position Correction
L97 nnnn	Delay Between Correction Attempts

FACTORY DEFAULT SUMMARY

Parameter	Default for all resolutions (Z99 nnn)	Parameter	Default for all resolutions (Z99 nnn)
L01	"Message #1 goes here"	L48	020
L02	"Message #2 goes here"	L49	00
L03	"Message #3 goes here"	L50	00
L04	"Message #4 goes here"	L52	"
L05	"Message #5 goes here"	L53	"
L06	002	L54	"
L08(X,Y)	"+"	L55	"
L16	00000000	L56	"
L17(X,Y)	+00000000	L58	"+2187600000000"
L18(X,Y)	-00000000	L59	"00000000"
L19(X,Y)	+00000000	L66(X,Y)	+00000000
L20	02000	L72	0
L26	0	L90	0
L41	001	L91	10000
L43	0050	L94	1
L44	0050	L96	0100
L47	0000	L97	0100
		L98	0100

	Step Size (Z99 nnn)									
Parameter	1	2	5	10	16	36	50	100	125	250
L09(X,Y)	1000	2000	5000	10000	16000	36000	50000	100000	125000	250000
L10(X,Y)	1000	2000	5000	10000	16000	36000	50000	100000	125000	250000
L11(X,Y)	1000	2000	5000	10000	16000	36000	50000	100000	125000	250000
L12(X,Y)	300	600	1500	3000	4800	10800	15000	30000	37500	75000
L13(X,Y)	1	2	5	10	16	36	50	100	125	250
L14(X,Y)	1000	2000	5000	10000	16000	36000	50000	100000	125000	250000
L71	10000	20000	50000	100000	160000	360000	500000	999999	999999	999999
L73	100	200	500	1000	1600	3600	5000	10000	12500	25000
L87	10	20	50	100	160	360	500	1000	1250	2500
L93	0	0	0	1	2	5	5	10	15	25
L95	8	4	2	0	0	5	5	5	5	5

Recommended Encoder (Lines/Rev) for Step Size (Z99 nnn)									
1	2	5	10	16	36	50	100	125	250
400	400	500	500	800	360	500	1000	1250	2500

Note: The factory default value is "Z99 50".

APPENDIX B: H CODES

H01	Cycle Start
H02	Step Mode
H03	Jog Mode
H04	High Speed Mode
H05	Low Speed Mode
H06	CW Direction
H07	CCW Direction
H08	Return To Electrical Home
H09	Set Electrical Home
H10	Return To Mechanical Home
H11	Clear Current Program Line
H12	Clear Program Lines Using L48
H13	Transfer Current Program Line
H14	Transfer Program Lines Using L48
H15	Transfer Current Line Number
H16	Transfer Parameters
H17	Transfer Absolute Electrical Position
H19	Transfer Mode Status
H20	Transfer Output Status
H21	Transfer Input Status
H22	Transfer Absolute Encoder Position
H23	Transfer Software Revision Level
H24	Program Trace Mode On
H25	Program Trace Mode Off
H26	Transfer Pulse Error Count
H27	Transfer Closed Loop Status
H29	Transfer Program Execution Time
H31	Target Velocity Increase
H32	Target Velocity Decrease
H33	Incremental Position Mode
H34	Absolute Position Mode
H35	Motor Windings On
H36	Motor Windings Off
H37	Enable Boost Current
H38	Disable Boost Current
H39	Enable Reduce Current
H40	Disable Reduce Current
H41	Transfer Remaining Repeat Value
H42	Transfer Last External BCD value
H43	Transfer Opto 22 Input/Output Status
H44	Transfer Register Contents
H60	Transfer Present Velocity
H85	Transfer Motion Error Status
H86	Transfer Data Error Status
H87	Transfer Program Error Line Number
H88	Transfer Execution Status
H99	Transfer Model Type

APPENDIX C: IMMEDIATE COMMANDS

!Fnnnnnnn	Feed Rate Override
!H04	High Speed Mode
!H05	Low Speed Mode
!H13	Transfer Current Program Line
!H15	Transfer Current Line Number
!H17	Transfer Absolute Electrical Position
!H19	Transfer Mode Status
!H20	Transfer Output Status
!H21	Transfer Conditional Input Status
!H22	Transfer Encoder Position
!H24	Program Trace Mode On
!H25	Program Trace Mode Off
!H26	Transfer Pulse Error Count
!H27	Transfer Closed Loop Status
!H31	Target Velocity Increase
!H32	Target Velocity Decrease
!H41	Transfer Remaining Repeat Value
!H42	Transfer Last External BCD value
!H43	Transfer OPTO 22 Input/Output Status
!H44	Transfer Register Contents
!H60	Transfer Present Velocity
!H85	Transfer Motion Error Status
!H86	Transfer Data Error Status
!H87	Transfer Program Error Line Number
!H88	Transfer Execution Status

APPENDIX D: MISCELLANEOUS COMMANDS

<nnCR	Device Attention
! (ASCII 33)	Immediate Command
%Hnn	Activate Continuous H Code Transfer Mode
%CR	Deactivate Continuous H Code Transfer Mode
Nnnn	Line Number
Gnn	Preparatory Command
Xsnnnnnnnn	Program Index Distance or G Code data field
Ysnnnnnnnn	Program Index Distance or G Code data field
Fnnnnnnn	Program Feed Rate or G Code data field
Xoff (ASCII 19)	Stop Transmission
Xon (ASCII 17)	Resume Transmission
DC2 (ASCII 18)	Enable Transmission of L code characters (L52-L56) and G05 characters
DC4 (ASCII 20)	Disable Transmission of L code characters (L52-L56) and G05 characters
^H (ASCII 8)	Backspace And Delete
^X (ASCII 24)	Delete RS232 Buffer
<00CR	All Devices Listen Only
<00&	All Devices Listen Mode
<00@	Cancel Listen Mode For All Devices
<nn?	Device Active And Acknowledge ID
nn&	Device Listen Mode
nn@	Device Cancel Listen Mode And Become Active
? (ASCII 63)	Device Acknowledge ID
* (ASCII 42)	Clear command, \stops program execution, motion, and clears the RS232 buffer
$ (ASCII 36)	Feed Hold (Controlled stop)
# (ASCII 35)	Program Stop
/ (ASCII 47)	Transfer Normal Buffer Character Count Remaining
\ (ASCII 92)	Transfer Immediate Buffer Character Count Remaining

Notes: "s" is an ASCII sign (+ or -)
"n" is an ASCII number (0 to 9)
The remaining symbols are ASCII characters (decimal value shown)
"*", "$", "#", "<nn", "^H", "^X", and "?" are immediate commands which when received from your computer will command the indexer to perform the indicated action.

APPENDIX E: G CODE LISTING

code	X/Y Required	X/Y Optional	F Required	F Optional	Description
G04 G04	[Xnnnn] [Ynnnn]			{Fnnnnnn} {Fnnnnnn}	Delay (X) milliseconds Delay (Y) milliseconds
G05 G05	[Xn] [Yn]			{Fnnnnnn} {Fnnnnnn}	Transmit message (X) Transmit message (Y)
G06 G06	[Xn] [Yn]			{Fnnnnnn} {Fnnnnnn}	Hcode Execution Hcode Execution
G10 G10		{Xsnnnnnnnn} {Ysnnnnnnnn}		{Fnnnnnn} {Fnnnnnn}	Start Index From Run Primary Axis Start Index From Run Secondary Axis
G11 G11	[Xnnn] [Ynnn]		[Fnnnn] [Fnnnn]		Call Subroutine Line (X) repeat (F) times Call Subroutine Line (Y) repeat (F) times
G12 G12	[Xnnn] [Ynnn]			{Fnnnnnn} {Fnnnnnn}	Go to Line (X) Go to Line (Y)
G19	[X0000nnnn]		{Fnnn}		Test Register Compare Results
G20 G20	[Xnnnnnnnn] [Ynnnnnnnn]		[Fnnn] [Fnnn]		Branch on input Condition (X) primary inputs. Branch on input Condition (Y) secondary inputs.
G21 G21		{Xsnnnnnnnn} {Ysnnnnnnnn}	{Fnn} {Fnn}		Register Control Register Control
G22 G22	[Xnnnnnnnn] [Ynnnnnnnn]			{Fnnnnnn} {Fnnnnnn}	Wait for input Condition (X) primary inputs. Wait for input Condition (Y) secondary inputs.
G23					Increment Velocity.
G24					Decrement Velocity.
G25 G25	[Xnnnn] [Ynnnn]			{Fnnnnnn} {Fnnnnnn}	Loop start Repeat loop (X) times. Loop start Repeat loop (Y) times.
G26				{Fnnnnnn}	Loop End.
G27 G27		{Xsnnnnnnnn} {Ysnnnnnnnn}		{Fnnnnnn} {Fnnnnnn}	Set High Speed Mode X axis. Set High Speed Mode Y Axis.
G28 G28		{Xsnnnnnnnn} {Ysnnnnnnnn}		{Fnnnnnn} {Fnnnnnn}	Set Low Speed Mode X axis. Set Low Speed Mode Y Axis.
G29 G29		{Xsnnnnnnnn} {Ysnnnnnnnn}	[Fnn] [Fnn]		Program L code (F) X axis value. Program L code (F) Y axis value.
G30					End of Program.
G31					Stop Program.
G32					Return From Subroutine.
G36 G36				{Fnnnnnn} {Fnnnnnn}	Strobe X data. Strobe Y data.
G37				{Fnnnnnn}	Strobe N data and go to that line.
G38 G38		{Xsnnnnnnnn} {Ysnnnnnnnn}			Strobe F data. Strobe F data.
G47 G47	[Xnnnnnnnn] [Ynnnnnnnn]			{Fnnnnnn} {Fnnnnnn}	Set/Reset Outputs primary Outputs. Set/Reset Outputs secondary Outputs.
G48 G48	[Xs] [Ys]			{Fnnnnnn} {Fnnnnnn}	Start Continuous Jog cycle primary Axis. Start Continuous Jog cycle secondary Axis.
G49 G49					Stop Continuous Jog Cycle. Stop Continuous Jog Cycle.
G50 G50	[Xnnnnnnnn] [Ynnnnnnnn]			{Fnnnnnn} {Fnnnnnn}	Set/Reset internal flag condition. Set/Reset internal flag condition.
G51 G51	[Xnnnnnnnn] [Ynnnnnnnn]		[Fnnn] [Fnnn]		Branch on internal flag condition (X) to line (F). Branch on internal flag condition (Y) to line (F).
G52 G52	[Xn] [Yn]			{Fnnnnnn} {Fnnnnnn}	Select BCD switch bank 0 or 1 Select BCD switch bank 0 or 1
G53 G53	[Xn] [Yn]			{Fnnnnnn} {Fnnnnnn}	Select SS2000 Interface I/O Port Select SS2000 Interface I/O Port
G54 G54		{Xsn} {Ysn}	[Fn] [Fn]		Register Execution Register Execution
G55 G55	[Xnnn] [Ynnn]			{Fnnnnnn} {Fnnnnnn}	Error Trapping Error Trapping

APPENDIX E: G CODE LISTING, Continued

code	X/Y Required	X/Y Optional	F Required	F Optional	Description
G60		{Xsnnnnnnnn}		{Fnnnnnn}	Enable Continuous Execution Mode.
G60		{Ysnnnnnnnn}		{Fnnnnnn}	Enable Continuous Execution Mode.
G61		{Xsnnnnnnnn}		{Fnnnnnn}	Disable Continuous Execution Mode.
G61		{Ysnnnnnnnn}		{Fnnnnnn}	Disable Continuous Execution Mode.
G62	[Xnnnnnnnn]			{Fnnnnnn}	Wait for Distance (X) to be achieved.
G62	[Ynnnnnnnn]			{Fnnnnnn}	Wait for Distance (Y) to be achieved.
G63	[Xs]		{Fnnnnnn}		Wait for velocity (F) to be achieved in (X) axis.
G63	[Xs]		{Fnnnnnn}		Wait for velocity (F) to be achieved in (Y) axis.
G64		{Xsnnnnnnnn}		{Fnnnnnn}	Reduce Current On Mode for (X) axis.
G64		{Ysnnnnnnnn}		{Fnnnnnn}	Reduce Current On Mode for (Y) axis.
G65		{Xsnnnnnnnn}		{Fnnnnnn}	Reduce Current Off Mode for (X) axis.
G65		{Ysnnnnnnnn}		{Fnnnnnn}	Reduce Current Off Mode for (Y) axis.
G66		{Xsnnnnnnnn}		{Fnnnnnn}	Boost Current On Mode for (X) axis.
G66		{Ysnnnnnnnn}		{Fnnnnnn}	Boost Current On Mode for (Y) axis.
G67		{Xsnnnnnnnn}		{Fnnnnnn}	Boost Current Off Mode for (X) axis.
G67		{Ysnnnnnnnn}		{Fnnnnnn}	Boost Current Off Mode for (Y) axis.
G68		{Xsnnnnnnnn}		{Fnnnnnn}	Windings Off Mode for (X) axis.
G68		{Ysnnnnnnnn}		{Fnnnnnn}	Windings Off Mode for (Y) axis.
G69		{Xsnnnnnnnn}		{Fnnnnnn}	Windings On Mode for (X) axis.
G69		{Ysnnnnnnnn}		{Fnnnnnn}	Windings On Mode for (Y) axis.
G76		{Xsnnnnnnnn}		{Fnnnnnn}	Return to Electrical Home Primary Axis.
G76		{Ysnnnnnnnn}		{Fnnnnnn}	Return to Electrical Home Secondary Axis.
G77		{Xsnnnnnnnn}		{Fnnnnnn}	Set Electrical Home Primary Axis.
G77		{Ysnnnnnnnn}		{Fnnnnnn}	Set Electrical Home Secondary Axis.
G78		{Xsnnnnnnnn}		{Fnnnnnn}	Return to Mechanical Home Primary Axis.
G78		{Ysnnnnnnnn}		{Fnnnnnn}	Return to Mechanical Home Secondary Axis.
G79		{Xsnnnnnnnn}		{Fnnnnnn}	Set Absolute Position Primary Axis.
G79		{Ysnnnnnnnn}		{Fnnnnnn}	Set Absolute Position Secondary Axis.
G90		{Xsnnnnnnnn}		{Fnnnnnn}	Set Absolute Position Mode Primary Axis.
G90		{Ysnnnnnnnn}		{Fnnnnnn}	Set Absolute Position Mode Secondary Axis.
G91		{Xsnnnnnnnn}		{Fnnnnnn}	Set Incremental Position Mode Primary Axis.
G91		{Ysnnnnnnnn}		{Fnnnnnn}	Set Incremental Position Mode Secondary Axis.

APPENDIX F: PROGRAM WORKSHEETS

Control Parameters	
L Code Data	Function
L01 _	Message # 1
L02 _	Message # 2
L03 _	Message # 3
L04 _	Message # 4
L05 _	Message # 5
L06 _ _ _	Execution Format
L08 _ , _	Mechanical Home Direction
L09 _ _ _ _ _ , _ _ _ _ _	Jog Speed
L10 _ _ _ _ _ _ _ , _ _ _ _ _ _ _	Deceleration
L11 _ _ _ _ _ _ _ , _ _ _ _ _ _ _	Acceleration
L12 _ _ _ _ _ , _ _ _ _ _	Low Speed
L13 _ _ _ _ _ _ _ , _ _ _ _ _ _ _	Step Size
L14 _ _ _ _ _ , _ _ _ _ _	Home Speed
L16 _ _ _ _ _ _ _	IFR Travel Limit
L17 _ _ _ _ _ _ _ _ , _ _ _ _ _ _ _ _	Mechanical Home Offset
L18 _ _ _ _ _ _ _ _ , _ _ _ _ _ _ _ _	CW Software Travel Limit
L19 _ _ _ _ _ _ _ _ , _ _ _ _ _ _ _ _	CCW Software Travel Limit
L20 _ _ _ _ _	Power Up Configuration
L26 _	Command Acknowledge
L41 _ _ _	Auto Start Line Number
L43 _ _ _ _	Backlash Delay
L44 _ _ _ _	After Motion Delay
L47 _ _ _ _	Repeat Count
L48 _ _ _	Program Line Count
L49 _ _	Parameter Designator
L50 _ _	Parameter Count
L52 _ _ _	Buffer Warning Characters
L53 _ _ _	Following Error Characters
L54 _ _ _	Unable To Correct Characters
L55 _ _ _	Line Done Characters
L56 _ _ _	Program Done Characters
L58 _ _ _ _ _ _ _ _ _ _ _ _ _	Input Configuration
L59 _ _ _ _ _ _ _ _	Output Configuration
L66 _ _ _ _ _ _ _ , _ _ _ _ _ _ _	Backlash Compensation
L71 _ _ _ _ _	Ramp Frequency Limit
L72 _	Ramp Profile
L73 _ _ _ _ _	Deviation Frequency
L87 _ _ _ _	Following Error
L90 _	Position Verification Enable/Disable
L91 _ _ _ _._ _ _ _ , _ _ _ _._ _ _ _	External BCD Move Distance Scale Factor
L93 _ _ _ _	In Position Deadband
L94 _	Invert Encoder Direction
L95 _	Encoder Quadrature Scale Factor
L96 _ _ _ _	Correction Attempt Count
L97 _ _ _ _	Delay Between Attempts
L98 _ _ _ _	Delay between %Hnn transfers

APPENDIX F: PROGRAM WORKSHEETS, Continued

Hardware Settings	
RS232 Baud Rate (9600, 2400, 1200, 300)	_ _ _ _
RS232 Word Length (7,8)	_
RS232 Parity (Enable,Disable)	_ _ _ _ _ _ _
RS232 Parity (Odd,Even)	_ _ _ _
RS232,RS485	_ _ _ _ _
Control Identification (01-99)	_ _

APPENDIX F: PROGRAM WORKSHEETS, Continued

Program							
Line Number	G Code	Move Distance or Data	Feed Rate or Data		Line Number	G Code	Move Distance or Data	Feed Rate or Data
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____
N___	G__	X_____ Y_____	F_____		N___	G__	X_____ Y_____	F_____

APPENDIX G: TROUBLESHOOTING COMMANDS

Z81 Transfer Checksum

Function Checksums Program Lines or Parameters.

Units none

Range 0 - 1

Command Format

Z81 0 Checksum Program Lines 1 - 400
Z81 1 Checksum Parameters

Notes

Transfer response:
hhhhCrLf (hhhh = hexadecimal checksum)

Z99 Factory Defaults

Function Sets factory defaults for parameters, clears Program and verifies contents.

Units none

Range 1, 2, 5, 10, 16, 36, 50, 100, 125, 250

Command Format

Z99	sets 1/50 step (10000 pulses/rev)
Z99 nnn	sets 1/50 step (1000 pulses/rev)
Z99 1	sets full step (200 pulses/rev)
Z99 2	sets half step (400 pulses/rev)
Z99 5	sets 1/5 step (1000 pulses/rev)
Z99 10	sets 1/10 step (2000 pulses/rev)
Z99 16	sets 1/16 step (3200 pulses/rev)
Z99 36	sets 1/36 step (7200 pulses/rev)
Z99 50	sets 1/50 step (10000 pulses/rev)
Z99 100	sets 1/100 step (20000 pulses/rev)
Z99 125	sets 1/125 step (25000 pulses/rev)
Z99 250	sets 1/250 step (50000 pulses/rev)

Default Z99 50

Notes

Match the drive setting in pulses per revolution

Defaults for each setting are listed in Appendix A.

Responses

00CrLf	contents verified
15CrLf	error encountered

APPENDIX H
RED LION MESSAGE CENTER

A Red Lion Message Center can be used with the SS2000I Programmable Motion Control to display user messages. The contents of the messages are controlled by the parameters L01 through L05. The selection and transmission of messages are controlled by the execution of a program line containing a G05 code.

Substituting a "*" for a programmed "~" signifies the End Of Transmission to the Message Center Slave unit. Substituting an "|" for a programmed "^" identifies the top line of the message text on the 2 x 20 line display.

Example The following messages are displayed on the 2 x 20 line dispaly:

Select Program 1-3 Then Press Select	Program Executing	Select Input active

L01 "Select Program 1-3"	(Select Program 1-3|)
L02 "Then Press Select~"	(Then Press Select*)
L03 " ~"	(*)
L04 "Program Executing^"	(Program Executing|)
L05 "Select Input Active^"	(Select Input Active|)
N1 G20 X22222220 F5	If Select input inactive, go to line 5
N2 G05 X5	display "Select input active
N3 G05 X3	Blank lower display
N4 G22 X22222220	wait for Select input inactive
N5 G52 X1	select BCD bank 1
N6 G05 X1	display "Select Program 1-3~"
N7 G05 X2	display "Then Press Select"
N8 G22 X22222221	wait for Select input active
N9 G21 X3 F30	3 > Register 3 (max. prog #)
N10 G21 F40	load BCD data into Register 4
N11 G21 X5 F44	BCD = 0?
N12 G19 X2212 F1	branch if yes to line 1
N13 G21 X4 F34	BCD > 3?
N14 G19 X2122 F1	branch if yes to line 1
N15 G05 X4	display "Program Executing"
N16 G05 X3	blank lower display
N17 G19 X2212 F300	branch to line 300 if program 3
N18 G21 X2 F30	2 > Register 3
N19 G21 X4 F34	BCD = 2?
N20 G19 X2212 F200	branch if yes to line 200
N21	start of Program 1
N200	start of Program 2
N300	start of Program 3

SS2000I Control Setup

Unit ID BCD selection
01

DIP switch settings
232 Host position
Parity Off position
8-bit data selection
2400 baud position only

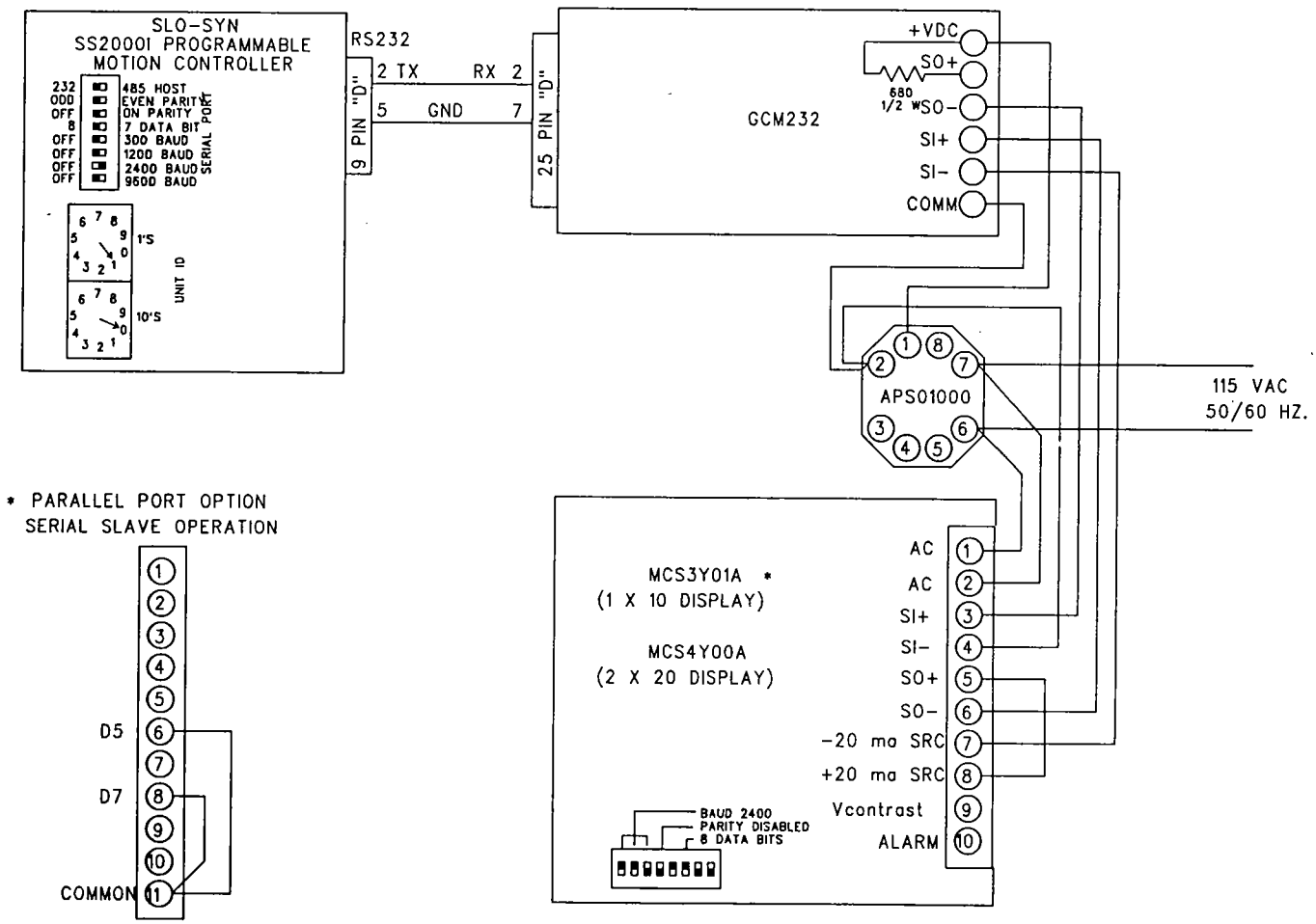
Message Control Setup

DIP switch settings

BR0 on position
BR1 on position
BR2 off position
PARITY Off position (parity off)
EVEN/ODD on position
7/8 BIT on position

2400 Baud

Wiring Use Wiring Diagram shown below

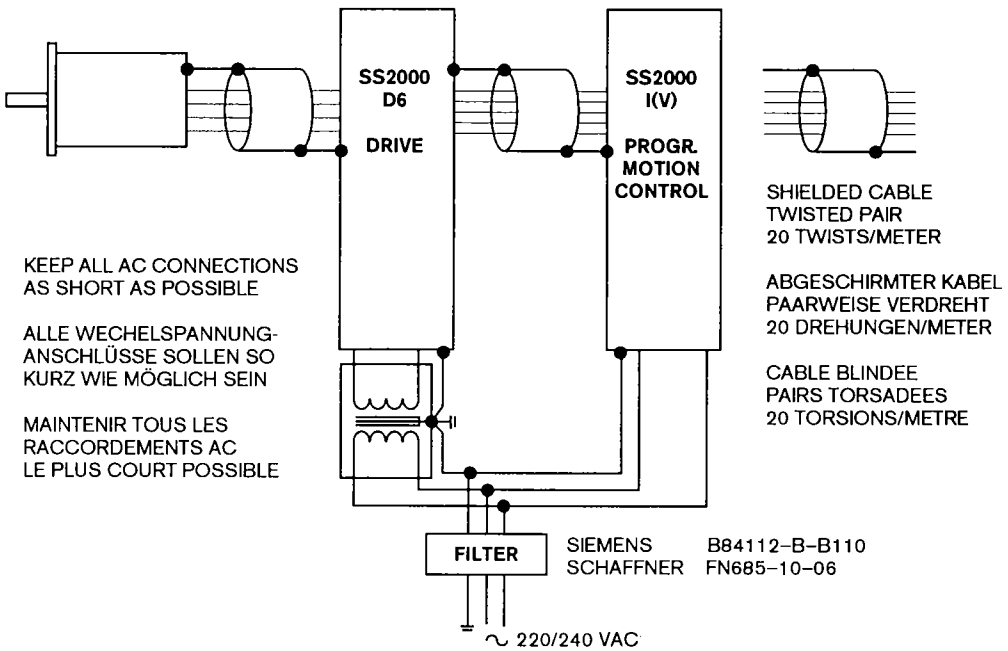


Wiring Diagram for RED LION CONTROLS SLAVE MESSAGE CENTER

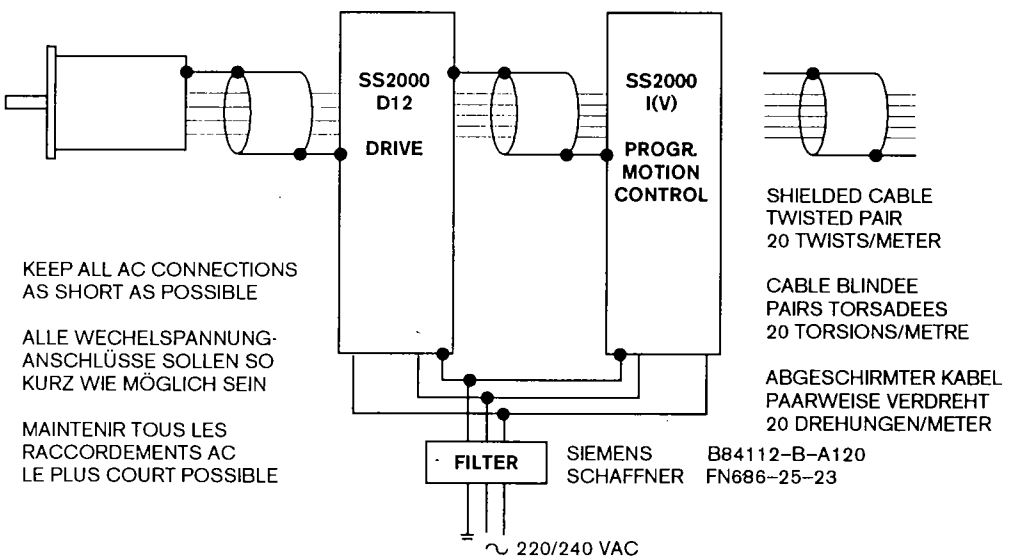
APPENDIX I
CONNECTIONS FOR CE EMC REQUIREMENTS

Mandatory connections to meet CE EMC requirements
Vorgeschriebener Anschluss zur Übereinstimmung mit CE EMC Normen
Branchement obligatoîre afin de respecter la norme CE - EMC

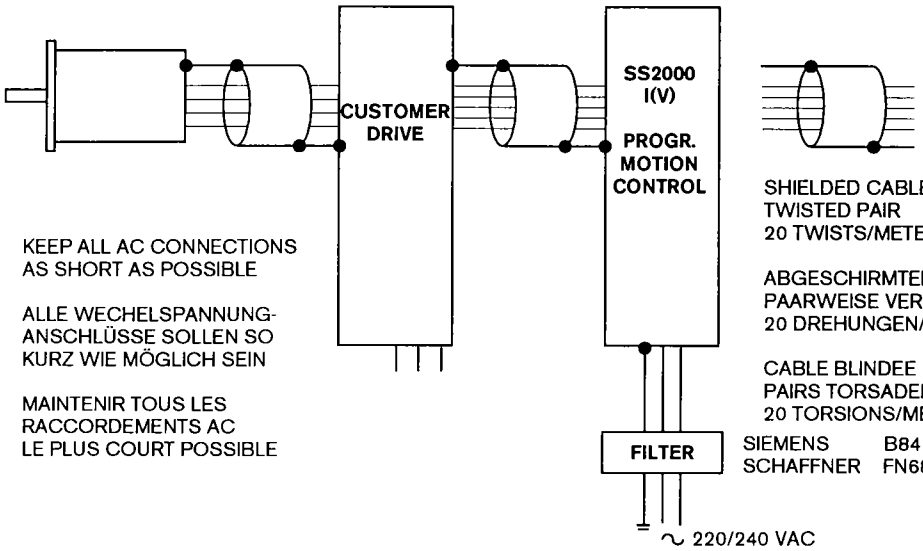
1. SLO-SYN SS2000I(V) + SS2000D6 + MOTOR



2. SLO-SYN SS2000I(V) + SS2000D12 + MOTOR



3. SLO-SYN SS2000I(V) + CUSTOMER DRIVE + MOTOR



KEEP ALL AC CONNECTIONS
AS SHORT AS POSSIBLE

ALLE WECHELSPANNUNG-
ANSCHLÜSSE SOLLEN SO
KURZ WIE MÖGLICH SEIN

MAINTENIR TOUS LES
RACCORDEMENTS AC
LE PLUS COURT POSSIBLE

SHIELDED CABLE
TWISTED PAIR
20 TWISTS/METER

ABGESCHIRMTER KABEL
PAARWEISE VERDREHT
20 DREHUNGEN/METER

CABLE BLINDEE
PAIRS TORSADEES
20 TORSIONS/METRE

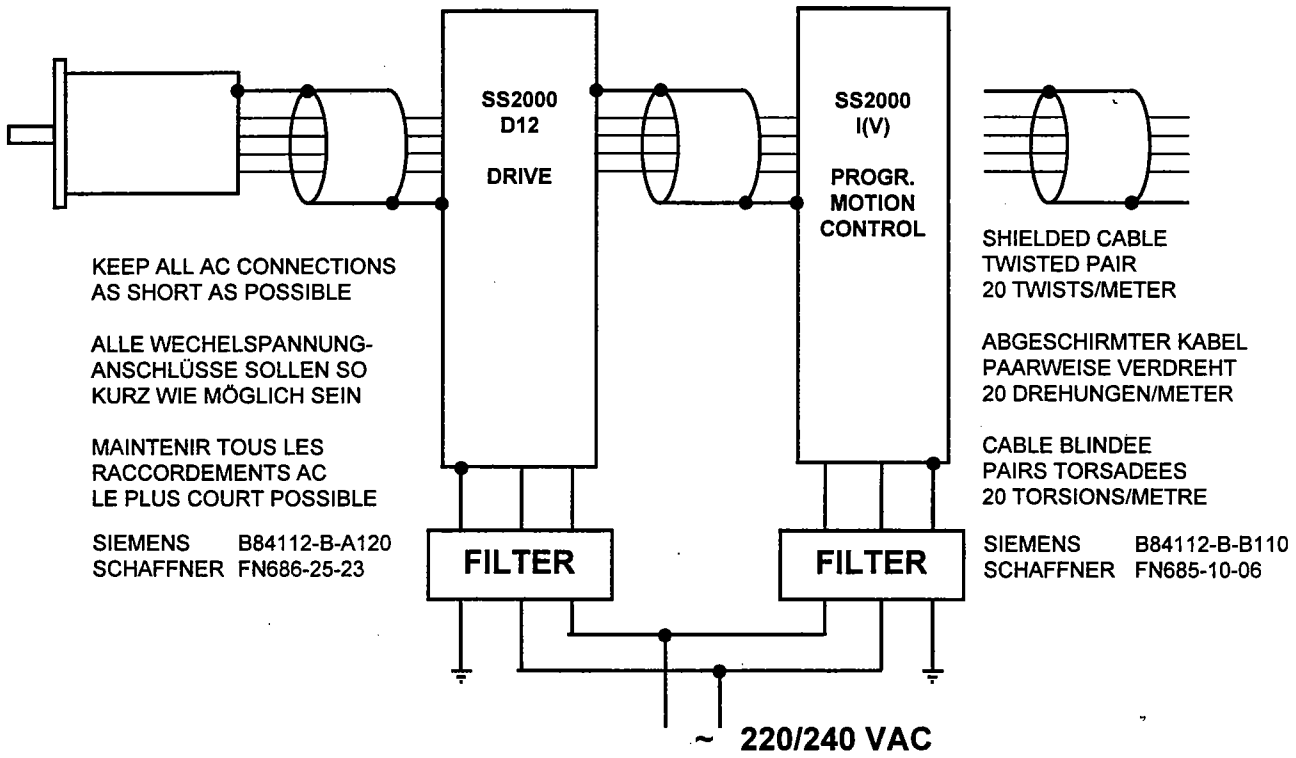
SIEMENS B84112-B-B110
SCHAFFNER FN685-10-06

This page intentionally left blank

ADDENDUM TO
INSTRUCTIONS FOR SLO-SYN® SS2000I PROGRAMMABLE MOTION CONTROL
400030-025 REV. E

The following diagram illustrates the proper connections between the SS2000D12 drive and an SS2000I or SS2000I-V programmable motion control when the system must meet CE EMC requirements. This diagram replaces diagram 2. at the bottom of page 13-15 of Instruction 400030-025 Rev. E and will be added to the instruction at the next printing. Diagram 1. on page 13-15 for connection of the SS2000D6 and an SS2000I(V) to meet CE EMC requirements is correct as is.

2. SLO-SYN SS2000I(V) + SS2000D12 + MOTOR



Printed in U.S.A.

DISTRIBUTION COAST-TO-COAST AND INTERNATIONAL

Superior Electric products are available nationwide through an extensive authorized distributor network. These distributors offer literature, technical assistance and a wide range of models off the shelf for fastest possible delivery.

In addition, Superior Electric sales engineers and manufacturers' representatives are conveniently located to provide prompt attention to customers' needs. Call the nearest office listed for ordering and application information or for the address of the closest authorized distributor.

IN U.S.A. AND CANADA
383 Middle Street
Bristol, CT 06010
Tel: (860) 585-4500
FAX: 860-589-2136

Customer Service: 1 800 787-3532
Product Application: 1 800 787-3532
Product Literature Request: 1 800 787-3532
Superior BBS: (860) 585-4482
Fax: 1 800 766-6366

IN EUROPE
Warner Electric (Int.) Inc.
La Pierreire
CH-1029 Villars-Ste-Croix, Switzerland
Tel: 41 021 631 33 55
FAX: 41 021 636 07 04

WARRANTY AND LIMITATION OF LIABILITY

Superior Electric (the "Company"), Bristol, Connecticut, warrants to the first end user purchaser (the "purchaser") of equipment manufactured by the Company that such equipment, if new, unused and in original unopened cartons at the time of purchase, will be free from defects in material and workmanship under normal use and service for a period of one year from date of shipment from the Company's factory or a warehouse of the Company in the event that the equipment is purchased from the Company or for a period of one year from the date of shipment from the business establishment of an authorized distributor of the Company in the event that the equipment is purchased from an authorized distributor.

THE COMPANY'S OBLIGATION UNDER THIS WARRANTY SHALL BE STRICTLY AND EXCLUSIVELY LIMITED TO REPAIRING OR REPLACING, AT THE FACTORY OR A SERVICE CENTER OF THE COMPANY, ANY SUCH EQUIPMENT OR PARTS THEREOF WHICH AN AUTHORIZED REPRESENTATIVE OF THE COMPANY FINDS TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP UNDER NORMAL USE AND SERVICE WITHIN SUCH PERIOD OF ONE YEAR. THE COMPANY RESERVES THE RIGHT TO SATISFY SUCH OBLIGATION IN FULL BY REFUNDING THE FULL PURCHASE PRICE OF ANY SUCH DEFECTIVE EQUIPMENT. This warranty does not apply to any equipment which has been tampered with or altered in any way, which has been improperly installed or which has been subject to misuse, neglect or accident.

THE FOREGOING WARRANTY IS IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, and of any other obligations or liabilities on the part of the Company; and no person is authorized to assume for the Company any other liability with respect to equipment manufactured by the Company. The Company shall have no liability with respect to equipment not of its manufacture. **THE COMPANY SHALL HAVE NO LIABILITY WHATSOEVER IN ANY EVENT FOR PAYMENT OF ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING, WITHOUT LIMITATION, DAMAGES FOR INJURY TO ANY PERSON OR PROPERTY.**

Written authorization to return any equipment or parts thereof must be obtained from the Company. The Company shall not be responsible for any transportation charges.

IF FOR ANY REASON ANY OF THE FOREGOING PROVISIONS SHALL BE INEFFECTIVE, THE COMPANY'S LIABILITY FOR DAMAGES ARISING OUT OF ITS MANUFACTURE OR SALE OF EQUIPMENT, OR USE THEREOF, WHETHER SUCH LIABILITY IS BASED ON WARRANTY, CONTRACT, NEGLIGENCE, STRICT LIABILITY IN TORT OR OTHERWISE, SHALL NOT IN ANY EVENT EXCEED THE FULL PURCHASE PRICE OF SUCH EQUIPMENT.

Any action against the Company based upon any liability or obligation arising hereunder or under any law applicable to the sale of equipment, or the use thereof, must be commenced within one year after the cause of such action arises.

These products are sold subject to the standard Limitation of Liability and/or Warranty of Superior Electric.

The right to make engineering refinements on all products is reserved. Dimensions and other details are subject to change.

DANA
WARNER ELECTRIC
LINEAR AND ELECTRONIC DIVISION
SUPERIOR ELECTRIC
383 Middle Street • Bristol, CT 06010
(860) 585-4500 • FAX: (860) 589-2136 • BBS: (860) 585-4482