

## Part II: SiNet™ Command Language

### Introduction

The SiNet™ Command Language (SCL) provides a means to control Si™ indexers and indexer-drives from a host PC or PLC. SCL allows the host to command the drive to perform a variety of motion and I/O tasks, and to provide the host with status information.

Individual drives can be directly connected to the serial port of a PC or PLC, or up to 8 drives can be connected to single port using the SiNet™ Hub-8. Up to 30 drives with the Multi-drop RS485 option can be connected to one RS485 or RS422 port.

The SCL mode firmware coexists in the drive with the *Si Programmer™* firmware. The drive determines the proper mode of operation by detecting a host signature at power up. The Windows-based *Si Programmer™* software automatically supplies the necessary signature, invoking *Si Programmer™* mode. Please see the section “Power Up Signature” for details.

SCL requires previous programming experience and custom application software. It is intended for systems developers who have the tools and knowledge to put together an application program that sends commands over a serial port.

One thing you cannot do with SCL is write a program to be stored in the drive. If you want to do that, use the *Si Programmer™* software. However, SCL provides a 128 character command buffer that allows the host to send commands ahead of time, while other commands are running.

SiNet™ Command Language provides more than 30 instructions. All commands begin with two uppercase ASCII characters. 9 of the commands are the same as our Windows-based Si™ language:

Feed to Length (FL)	Feed to Sensor (FS)	Feed to Position (FP)
Set Position (SP)	Seek Home (SH)	Wait for Input (WI)
Wait Time (WT)	Set Output (SO)	Change Current (CC)

Two additional instructions implement options of the Si™ Change Current instruction:

Motor Enable (ME)	Motor Disable (MD)
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Another 4 commands are used to set up move parameters:

Accel (AC)	Decel (DE)	Velocity (VE)	Distance (DI)
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7 commands configure the global parameters seen on the left-hand side of the *Si Programmer™* screen:

power up current (PC)	microstep resolution (MR)	define limits (DL)	
jog accel (JA)	jog speed (JS)	jog enable (JE)	jog disable (JD)

7 commands ask the drive for status information:

buffer status (BS)	input status (IS)	request status (RS)	model number (MN)
revision level (RV)	immediate distance (ID)	immediate position (IP)	

Power up mode (PM) sets the drive to power up in SCL mode, or in the factory default “auto detect mode.”

Send string (SS) tells the drive to send a text string back to the host. This is useful for detecting when a prior buffered command, typically a move, has completed.

Pause (PS) suspends execution of buffered commands until the continue (CT) command is received.

Stop (ST) stops a command in mid-execution. This is useful for killing an errant move, wait time or wait input instruction, especially during the debug phase of a program.

Stop and Kill Buffer (SK) stops any buffered command and removes all other commands from the buffer.

RS485 compatible drives are equipped with a Define Address (DA) command so that each drive can be assigned a unique address.

Drives with the encoder feedback option provide four commands for defining the encoder characteristics and functionality.

### *Communication Protocol*

Communication between drive and host is 9600 baud, 8 data bits, one stop bit, no parity. Each command must be terminated with a carriage return (ascii 13). Drive does not echo received characters to the host. No handshaking is required.

RS232 connection is a three wire type: transmit, receive and ground. Use the cable supplied with your Si™ drive.

RS485 connection is a five wire type: transmit+, transmit-, receive+, receive- and ground. You must provide your own cabling (Category 5 style recommended). Refer to your drive's *Hardware Manual* for more detail.

### *Power Up Signature*

To invoke SCL mode, the user's program must detect power up of the drive and supply the signature "00" within two seconds. If this is inconvenient, the drive can be set to automatically wake up in SCL mode. The *SCL Setup Utility* provides an easy way to configure the power up mode of the drives and/or hub. It also and gives the user a convenient way to try out commands and gain familiarity with SCL.

When an Si™ drive is set for "auto-detect" mode, it sends three characters to the host when power is first applied. The first character is ascii(255). The second character identifies the firmware revision. The third character of the power up packet tells the host which model Si™ product is connected.

**Note: Before installation into a multi-drop network, RS485 drives should be powered-up individually so that individual, non-conflicting addresses can be set using the "DA" command. The power up mode should be set to "2" at that time.**

### *Buffered or Immediate?*

There are two basic types of SCL commands: *buffered* and *immediate*. Buffered commands execute one at a time. If you send two buffered commands to the indexer at the same time, like an FL and an SS, the SS command sits in a buffer and doesn't execute until the FL is completed. Other commands, indicated as *immediate* in the Command Summary, are executed right away, running in parallel with a buffered command if necessary. That allows you to check the buffer status (BS), or input status (IS) while the motor is moving.

# Command Summary

command	description	parameter	write only	read only	immediate	units	range	default
AC	accel rate	accel				rev/s/s	1 - 3000	25
BS	buffer status			•	•	chars	0 - 128	
CC	change current	current				A	0 - imax	
CJ	commence jogging		•					
CT	continue		•		•			
DA	define address	address					! - @	
DE	decel rate	decel				rev/s/s	1 - 3000	25
DI	distance or position	distance				steps	±16,000,000	20000
DL	define limits	limitstate					1 - 3	1
ED	encoder deadband	deadband				counts	1 - 255	10
EF	encoder function	function					0 - 3	0
EP	encoder position	position				counts	±16,000,000	
ER	encoder ratio	ratio					1 - 255	5
FL	feed to length		•					
FP	feed to position		•					
FS	feed to sensor	input,condition	•				1 - 8, H/L/R/F	
ID	immediate distance request, in hex			•	•			
IE	immediate encoder request, in hex			•	•			
IP	immediate position request, in hex			•	•			
IS	input status request			•	•			
JA	jog accel/decel rate	accel					1 - 3000	25
JD	jog disable		•					
JE	jog enable		•					
JS	jog speed	speed					.025 - 50	1
MD	motor disable		•					
ME	motor enable		•					
MR	microstep resolution						3 - 15	8
PC	power up current	current				A	0 - imax	
PM	power up mode	mode (0,1=auto etect, 2=SCL)					1, 2	
PS	pause		•					
RS	request status			•	•			
RV	revision level request			•	•			
SH	seek home	input,condition	•				1 - 8, H/L/R/F	
SJ	stop jogging		•					
SK	stop & kill buffer		•		•			
SO	set output	outputnum,condition	•				1-3, H or L	
SP	set abs position	position					±16,000,000	
SS	send string	text string	•					
ST	stop		•		•			
VE	velocity setting	speed				rev/sec	.025 - 50	1
WI	wait for input	inputnum,condition	•				1-8, H/L/R/F	
WT	wait time	time	•			sec	.01 - 300	

## Command Descriptions

### AC – Acceleration

Sets accel rate in rev/sec/sec. Sending AC with no number causes drive to respond with present accel rate. Range is 1 – 3000.

Affects: FL, FS, FP, SH

See also: DE

Example:

You send	Drive sends
<b>AC100</b>	nothing
<b>AC</b>	<b>AC=100</b>

### BS – Buffer Status

Drive tells you how many characters remain in the command buffer.

Example:

You send	Drive sends
<b>BS</b>	<b>BS=128</b>

### CC – Change Current

Changes current setting of drive. Also allows you to request present current setting.

Affects: FL, FS, FP, SH, WI (jogging)

See also: PC

Example:

You send	Drive sends
<b>CC5.1</b>	nothing
<b>CC</b>	<b>CC=5.1</b>

### CJ - Commence Jogging

If jogging is enabled (JE command), the motor accelerates at rate set by JA command, then runs continuously at speed set by JS command. To stop jogging, use the SJ command if you want a controlled decel rate. For a faster stop, use the ST comand, but beware that if the speed or load inertia is high, the motor may coast to a stop.

### CT – Continue

Resume execution of buffered commands.

Example:

You send	Drive sends
<b>CT</b>	nothing

### DA – Define Address

Sets individual drive address character for multi-drop RS485 communication. This command should only be used with drives that have optional RS485 communications. Valid address characters are:

! " # \$ % & ' ( ) \* + , - . / 0 1 2 3 4 5 6 7 8 9 ; : < > ? @

### DE – Deceleration

Changes decel setting of drive. Also allows you to request present decel setting.  
 Range is 1 – 3000.  
 Affects: FL, FS, FP, SH  
 See also: AC

Example:

You send	Drive sends
<b>DE125</b>	nothing
<b>DE</b>	<b>DE=125</b>

### DI – Distance/Position

Sets or requests move distance, in steps. The sign of DI indicates move direction.  
 Affects: FL, FS, FP  
 See also: AC, DE, VE

Example:

You send	Drive sends	Notes
<b>DI20000</b>	nothing	cw direction
<b>DI-20000</b>	nothing	ccw direction
<b>DI</b>	<b>DI=-20000</b>	

### DL – Define Limits

Sets limits to normally open (1), normally closed (2) or not used (3).  
 Affects: FL, FS, FP, SH, WI (jogging)

Example:

You send	Drive sends	Notes
<b>DL1</b>	nothing	limits are normally open
<b>DL3</b>	nothing	limits are not used

### ED – Encoder Dead Band

On drives that have the encoder feedback option, this defines the size of the “in position” region. If static position maintenance is enabled and a motor at rest deviates from this zone, automatic correction occurs. If “end of move correction” is turned on, and the motor is outside the dead band at the end of a feed to length or feed to position move, automatic error correction occurs. The size is in encoder counts.

Example:

You send	Drive sends	Notes
<b>ED50</b>	nothing	dead band is 50 encoder counts
<b>ED</b>	<b>ED=50</b>	

### EF – Encoder Function

On drives supporting encoder feedback, the EF command tells the drive what kind of position maintenance you want. Static position maintenance watches the encoder while the motor is at rest. If an external force move the motor out of position, the drive tries to return it to within the dead band. “End of move correction” checks the encoder position after a feed to length or feed to position move. If the motor is not within the dead band, corrective action is taken. For both static position maintenance

and end of move correction, the corrective move length is half the distance to the ideal position. Additional corrections are made until the encoder position is within the dead band.

Example:

You send	Drive sends	Notes
<b>EF0</b>	nothing	all automatic encoder functions are off (but the encoder still tracks position and can be read via the EP or IE commands.)
<b>EF1</b>	nothing	Turns on end of move correction
<b>EF2</b>	nothing	Turns on static position maintenance
<b>EF3</b>	nothing	Enables static position maintenance and end of move correction

## EP – Encoder Position

On drives supporting encoder feedback, the EP command allows the host to define the present encoder position. For example, if the encoder is at 4500 counts, and you would like to refer to this position as 0, send “EP0”. Sending EP with no position parameter requests the present encoder position from the drive.

## ER – Encoder Ratio

On drives supporting encoder feedback, the ER command defines the encoder ratio. This number is the motor resolution, in steps/rev, divided by the encoder resolution, in counts/rev.

For example, if you are using a 4000 count encoder and the motor resolution is set to 20000 steps/rev (MR8), then you should set ER5. (Because 20000 / 4000 = 5. The motor will take 5 steps per encoder count.) If your motor resolution is not evenly divisible by the encoder count, try a different motor resolution (using the MR command.) Encoders with binary resolutions, such as 512 and 1024, are unacceptable.

*Note: the Si™ drive electronics use “X4” decoding, so a 1000 line encoder such as the U.S. Digital E2-1000-250-H produces 4000 counts/revolution.*

## FL – Feed to Length

Executes Feed to Length (relative move) command. Move distance and direction come from the last DI command. Speed, accel and decel are from VE, AC and DE commands.

## FP – Feed to Position

Executes Feed to Position (absolute move) command. Move position comes from the last DI command. Speed, accel and decel are from VE, AC and DE commands.

## FS – Feed to Sensor

Executes Feed to Sensor command. Requires input number (1-8) and condition (H=high, L=low, R=rising, F=falling) The motor moves until the sensor state change is detected, then stops a precise distance beyond the sensor. That distance is specified by the DI command. The direction of rotation is determined by the sign of the DI command (positive is clockwise). Speed, accel and decel are from the most recent VE, AC and DE commands.

A motor moving at a given speed, with a given decel rate, needs a certain distance to stop. If you specify too short a distance, the drive may become confused and greatly overshoot the target. Use the following formula to compute the minimum decel distance, given a velocity V (in rev/sec) and decel rate D (in rev/sec/sec.). R = steps/rev.

$$DI_{\min} = R \frac{V^2}{2D} \quad \text{Example: } DI_{\min} = (20000) \frac{(1)^2}{(2)(25)} = 400 \text{ steps}$$

The Help screen of the *SiNet™ Setup* utility contains a special calculator that computes the distance for you.

Example:

You send	Drive sends	Notes
<b>FS1L</b>	nothing	Feed to Sensor 1 low
<b>FS3R</b>	nothing	Feed to Sensor 3 rising edge

## IE – Immediate Encoder

Requests present encoder position, in hex. (Distance is in hex because conversion to ascii of another format would tax the CPU enough to interfere with a move in program. Application programs can easily convert a hex value to integer.)

Example:

You send	Drive sends	Notes
<b>IE</b>	<b>IE=00002710</b>	encoder position is +10000 counts
<b>IE</b>	<b>IE=FFFFD8F0</b>	encoder position is –10000 counts

## ID – Immediate Distance

Requests present distance, in hex. (Distance is in hex because conversion to ascii of another format would tax the CPU enough to interfere with a move in program. Application programs can easily convert a hex value to integer.)

Example:

You send	Drive sends	Notes
<b>ID</b>	<b>ID=00002710</b>	+10000 (10,000 steps into cw move)
<b>ID</b>	<b>ID=FFFFD8F0</b>	-10000 (10,000 steps into ccw move)

## IP – Immediate Position

Requests present absolute position, in hex. (Value is in hex because conversion to ascii of another format would tax the CPU enough to interfere with a move in program. Application programs can easily convert a hex value to integer.)

Example:

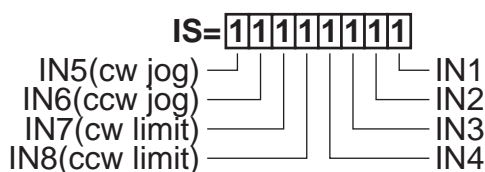
You send	Drive sends	Notes
<b>IP</b>	<b>IP=00002710</b>	abs position is 10,000 steps

## IS – Input Status

Requests immediate status of all 8 inputs.

Example:

You send	Drive sends	Notes
<b>IS</b>	<b>IS=00000000</b>	all 8 inputs are low (closed)
<b>IS</b>	<b>IS=11111111</b>	all 8 inputs are high (open)
<b>IS</b>	<b>IS=00000001</b>	input 1 is high
<b>IS</b>	<b>IS=10000000</b>	input 8 is high



## JA – Jog Acceleration

Sets accel/decel rate for jog moves in rev/sec/sec. Sending JA with no number causes drive to respond with present jog accel/decel rate. Range is 1 – 3000.

Affects: WI (jogging)

See also: JS

Example:

You send	Drive sends
<b>JA100</b>	nothing
<b>JA</b>	<b>JA=100</b>

## JD – Jog Disable

Disables jog inputs (normally active during WI instructions)

## JE – Jog Enable

Enables jog inputs (active during WI instructions)

## JS – Jog Speed

Sets speed for jog moves in rev/sec. Sending JS with no number causes drive to respond with present jog speed. Range is .025 – 50.

Affects: WI (jogging)

See also: JA

Example:

You send	Drive sends
<b>JS10.35</b>	nothing
<b>JS</b>	<b>JS=10.35</b>

## MD – Motor Disable

Disables motor (cuts current to zero).

## ME – Motor Enable

Restores previous motor current.

## MR – Microstep Resolution

Sets, or requests microstep resolution. Range is 3 – 15, from table below. The MR command should be used before setting the accel and decel rates and speed, because a change in motor resolution will corrupt these settings. The MR command also resets the step table, which moves the motor to the nearest pole position. The absolute position register is not changed.

Example:

You send	Drive sends	Notes
<b>MR8</b>	nothing	sets drive to 20,000 steps/rev
<b>MR</b>	<b>MR=8</b>	

MR Code	Steps/rev	MR Code	Steps/rev	MR Code	Steps/rev	MR Code	Steps/rev
3	2000	4	5000	5	10000	6	12800
7	18000	8	20000	9	21600	10	25000
11	25400	12	25600	13	36000	14	50000
15	50800						

## PC – Power on Current

Sets power on current in amps. Also changes present current.

Example:

You send	Drive sends
<b>PC3.2</b>	nothing

## PM – Power on Mode

Sets or requests power on mode. 1=autodetect. 2=SCL mode only. Set to 1 if you plan to use the drive with the *Si Programmer™*.

**Note: RS485 drives do not work with the *Si Programmer™* software.**

Example:

You send	Drive sends	Notes
<b>PM1</b>	nothing	drive is set to auto detect host at power on
<b>PM2</b>	nothing	drive is set for SCL mode at power on
<b>PM</b>	<b>PM=2</b>	

## PS – Pause

Suspends execution of buffered commands until the next CT command. Useful for coordinating motion among axes by sending commands to each, while paused, then resuming all drives at once. Also can be used to suspend the operation of a machine.

## RS – Request Status

Asks the drive to tell you what its doing. Responses are:

**M** = motion in progress

**W** = wait input command executing

**T** = wait time command executing

**R** = ready (none of the above happening)

## RV – Revision Level

Asks the drive what firmware it has in it.

Example:

You send	Drive sends	Notes
<b>RV</b>	<b>RV=150</b>	drive has firmware version 1.50

## SH – Seek Home

Executes seek home command. . Requires input number (1-8) and condition (H=high, L=low, R=rising, F=falling) Speed is set by the last VE command. Accel and decel are set by AC and DE. Direction comes from the sign of the last DI command (+ is clockwise, - is ccw).

Example:

You send	Drive sends	Notes
<b>SH1L</b>	nothing	Seek home 1 low
<b>SH3R</b>	nothing	Seek home 3 rising edge

## SJ – Stop Jogging

Stops the motor when jogging (CJ starts it). Decel rate is defined by JA command.

### SK – Stop & Kill

Halts any buffered command in progress. Removes any other commands from buffer.

### S0 – Set Output

Sets an output to a condition. Outputs: 1-3. Conditions: H=high(open), L=low(closed).

### SP – Set Position

Set or request absolute position. Affects FP commands.

Example:

You send	Drive sends
<b>SP100</b>	nothing
<b>SP</b>	<b>SP=100</b>

### SS – Send String

Drive sends a text string to the host when this buffered command is executed.

Example:

You send	Drive sends
<b>SSMove complete</b>	move complete

### ST – Stop

Terminates any buffered command in progress.

### VE – Velocity

Sets or requests move speed in rev/sec. Range is .025 - 50.

Affects: FL, FS, FP, SH.

Example:

You send	Drive sends
<b>VE2.525</b>	nothing
<b>VE</b>	<b>VE=2.525</b>

### WI – Wait for Input

Waits for an input to match a condition. Inputs: 1-8. Allows very precise triggering of moves if a WI command precedes a move command in the buffer.

Conditions: H=high, L=low, R= rising edge, F=falling edge.

Jogging is active during this instruction, unless disabled by JD.

Example:

You send	Drive
<b>WI3R</b>	waits for rising edge on input 3 before proceeding to next buffered command.

### WT – Wait Time

Causes a time delay, in seconds. Range is .01 – 300.

