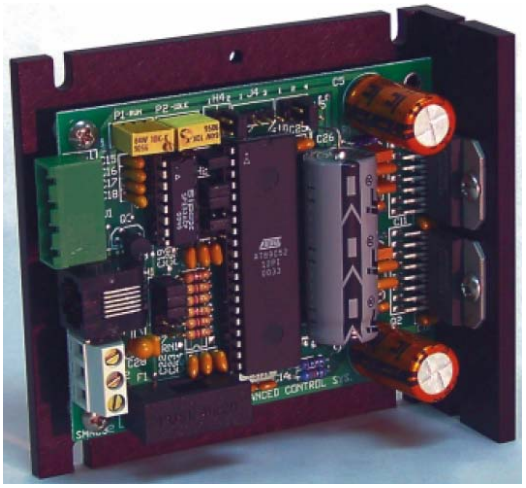
PRODUCT USER'S MANUAL

ACS
MACHINE CONTROLS

SMC-32B

Programmable Stepping Motor Driver/Controller



ACS ADVANCED CONTROL SYSTEMS CORPORATION

www.ACSMotion.com

Revision 1.3

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1. General Information

1.1 Warranty

ACS warrants its products to operate within specifications under normal use and services for a period of one year from the date of shipment. Component products, spares, replacement parts and repairs are warranted for 90 days. Software is thoroughly tested and thought to be functional, but is supplied "as is" with no warranty of any kind covering detailed performance. Accessory products not manufactured by ACS are covered by the original equipment manufacturers warranty only.

In exercising this warranty, ACS will repair or, at its option, replace, any product returned to the customer service department or an authorized service facility within the warranty period, provided that the warrantor's examination discloses that the product is defective due to workmanship or materials and has not been caused by misuse, neglect, accident, or abnormal conditions or operations.

The purchaser is responsible for the transportation and insurance charges arising from the return of products to the servicing facility. ACS will return all in-warranty products with transportation prepaid.

This warranty is in lieu of all other warranties, expressed or implied, including but not limited to any implied warranty of merchantability, fitness, or adequacy for any particular purpose or use. ACS shall not be liable for any special, incidental, or consequential damages, whether in contract, or otherwise.

1.2 Assistance and Maintenance Agreements

Answers to questions concerning installation, calibration, and use of ACS equipment are available from the customer service department, 35 Corporate Park Drive, Pembroke, MA 02359, (781)829-9228.

ACS offers a selection of customer support services.

For example, maintenance agreements provide extended warranty and allow the customer to budget maintenance costs after the initial one year warranty has expired. Other services requested by the customer, such as installation, training, on-site repair, and addition of engineering improvements, are made available through specific Supplemental Support Agreements.

1.3 Documentation Discrepancies

ACS is committed to providing state-of-the-art products and is continually refining and improving the performance of its products. While physical modifications can be implemented quite rapidly, the corrected documentation frequently requires more time to produce. Consequently, this manual may not agree in every detail with the accompanying product. There may be small discrepancies in the values of components and, occasionally, minor logic changes. Where any such inconsistencies exist, please be assured that the unit is correct and incorporates the most up-to-date circuitry.

1.4 Service Procedure

Products requiring maintenance should be returned to the customer service department or authorized service facility. If under warranty, ACS will repair and replace the part at no charge. The purchaser is only responsible for the transportation charges arising from the return of the goods to the service facility.

For all ACS products in need of repair after the warranty period, the customer must provide a Purchase Order Number before any inoperative equipment can be repaired or replaced. The customer will be billed for the parts and labor for the repair as well as for shipping.

2. SMC-32B DESCRIPTION

2.1 SMC-32B CONTROLLER FEATURES

This Advanced Control Systems Corp. stepping motor controller contains control and power drive circuitry to operate any two or four phase stepping motor with currents up to 3Amp per phase. The control program can be entered into the SMC-32B's non-volatile memory for independent operation, or it can be controlled by a host computer.

The stepping motor driver is two phase bi-polar type, which is highly efficient, and results in cool operation of motors and drivers.

Motor winding current is trimpot adjustable in the range of .125 to 3.00Amps. Idle winding current is also trimpot adjustable. Idle current control is enabled by onboard jumper.

Motors can operate in full step mode one-phase on, full step mode-two phases on, and ministep mode. Ministep modes are 2, 3, 4, 5, 6, or 8 motor ministeps per full motor step.
Step mode is selected by onboard jumpers.

The SMC-32B generates constant stepping rates as well as trapezoidal type velocity profiles. Acceleration, deceleration and top speed are all programmable.

The SMC-32B supports two limit inputs and home position input. The SMC-32B is designed to operate reliably in adverse industrial environments.

All operational variables are retained in the EEPROM nonvolatile memory.

The SMC-32B understands high level instructions in the form of serial ASCII messages. The instruction set covers all aspects of computer controlled motion and is not dependent on the type of host computer or operating systems.

Communication driver/receiver on board is a standard RS-232C type.

2.2 SMC-32B BLOCK DIAGRAM DESCRIPTION

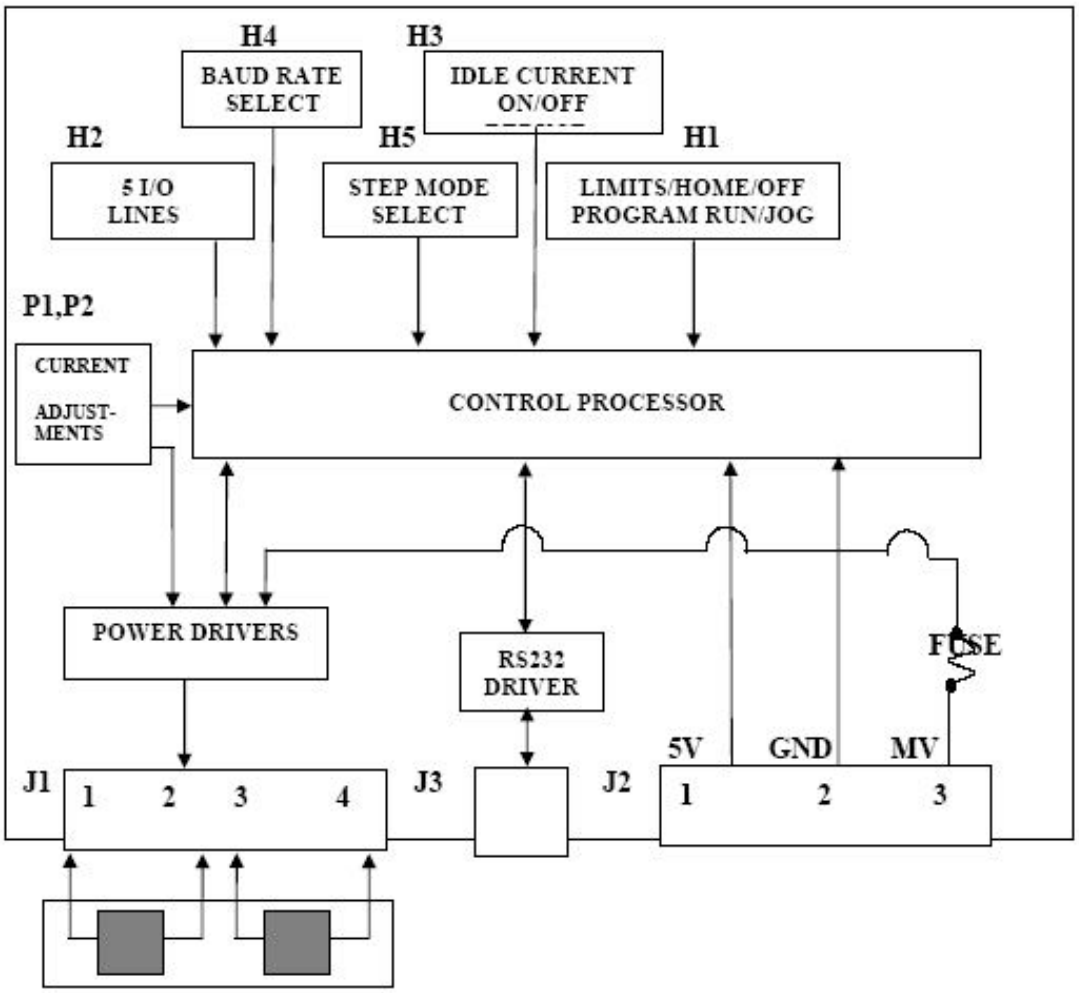


FIG. 2.1 SMC-32B BLOCK DIAGRAM

The imbedded control processor coordinates operation of the SMC-32B controller. It communicates via RS-232 communication interface with the host computer. The programs (firmware) which interprets host instructions are stored in flash memory. Operational variables, which can be changed, are stored in non-volatile memory (EEPROM).

Also, up to 50 lines of motor and I/O control program can be stored in EEPROM for independent operation of the SMC-32B.

The processor which is actually a single chip independent microcontroller generates stepping sequences to the power drivers.

Option jumpers on board are used for various configurations.

2.3 SPECIFICATIONS

POWER REQUIREMENTS:

Logic Power Supply	5VDC ±5% @50mA typical
Motor Power Supply	12 to 40 VDC @up to 2Amp

Motor supply voltages and currents depend on type of motors being connected.

MOTOR REQUIREMENTS:

Type of Motors	Two phase bi-polar stepping motors or four phase motors connected as two phase
Number of Leads	Four, six or eight
Max Winding Current	3 Amp, adjustable down to .125Amp
Duty Cycle	100%

MODE OF MOTOR OPERATION:

BiPolar Chopper Drive
Full Step – One Phase On or Two Phases On
Half Step with Torque Compensation
Three, four, five, six or eight ministeps per full step

MOTOR FUSE:

Four Amp, Fast blow

PHYSICAL DIMENSIONS:

Length:	4”
Width:	3.65”
Max. Height:	1.50”
Motor Connectors:	Phoenix type; four terminals MSTB 2,5/5-ST-5,08 or equivalent.; or terminal block

COMMUNICATION PARAMETERS:

Baud Rates:	2400, 9600, 19200, 57600 baud
Byte Structure:	10 bit ASCII characters: Start bit, 8 data bits, stop bit; no parity

ENVIRONMENT:

Operating Temperature:	-20°C to 50°C (-4°F to 140°F)
Storage Temperature:	-20°C to 70°C (-4°F to 160°F)
Humidity:	<95% non-condensing

3. INSTALLATION SET-UP

3.1 CONNECTORS, JUMPERS, AND ADJUSTMENT IDENTIFICATION

Table 3.1 identifies important points of the SMC-32B board, Appendix A show their location on the printed circuit board.

Designation	Function
J1	CONNECTOR FOR MOTOR
J2	TERMINAL STRIP FOR POWER CONNECTION
J3	COMMUNICATION PORT CONNECTOR
H1	HEADER CONNECTOR FOR LIMITS, HOME JOG, MOTOR OFF AND PROGRAM RUN
H2	INPUTS
H3	HEADER FIVE I/O LINES
H4	HEADER IDLE CURRENT REDUCTION ENABLE
H5	HEADER BAUD RATE SELECT
	HEADER STEPPING MODE SELECT

TABLE 3.1 CONNECTOR JUMPER AND ADJUSTMENT IDENTIFICATION

3.2 MOTOR CONNECTION

The stepping motor is connected to SMC-32B controller via J1 connector at the edge of the board (see Appendix A). The connector accepts one four pin screw type plug. Two or four phase stepping motor can be operated by the SMC-32B controller board. Stepping motors equipped with four, six, or eight leads can be connected in several ways.

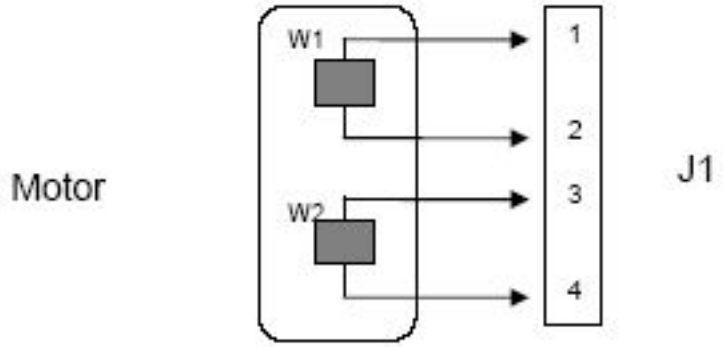


FIGURE 2.2 SMC-32B FOUR LEAD MOTOR CONNECTIONS

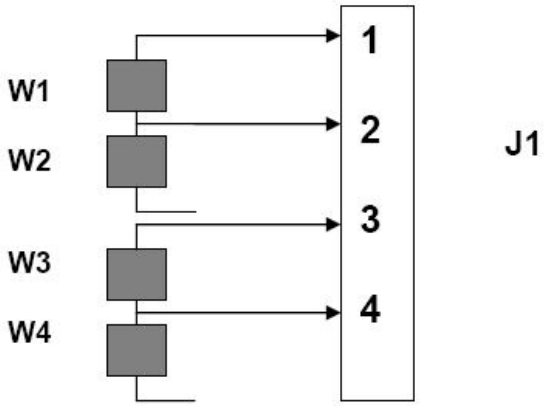


FIGURE 3.3 SMC-32B SIX LEAD MOTOR – HALF WINDING CONNECTIONS

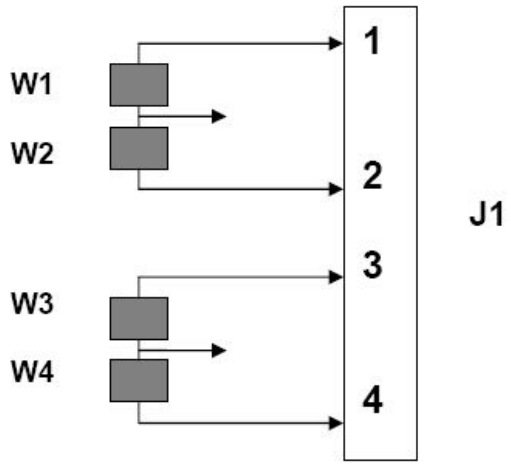


FIGURE 3.4 SMC-32B SIX LEAD MOTOR – FULL WINDINGS CONNECTIONS

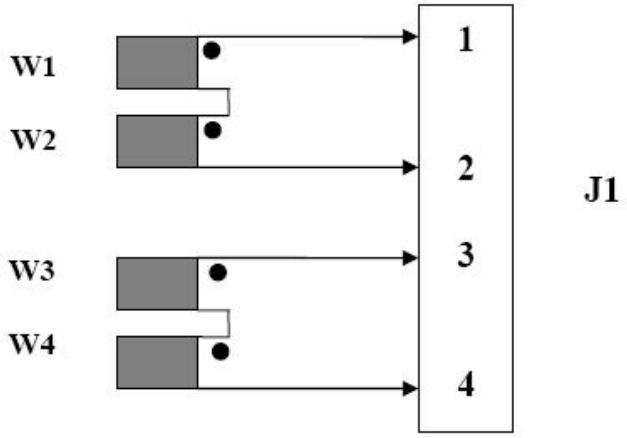


FIGURE 3.5 SMC-32B EIGHT LEAD MOTOR – SERIAL CONNECTIONS

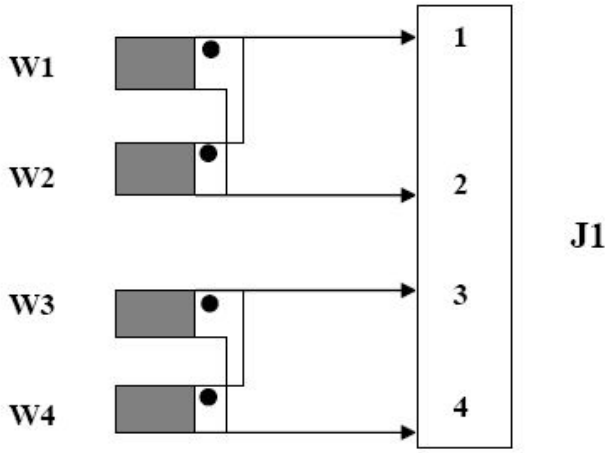


FIGURE 3.6 SMC-32B EIGHT LEAD MOTOR – PARALLEL CONNECTIONS

3.3 LIMIT INPUTS, HOME INPUT, JOG INPUTS, CURRENT OFF INPUT, PROGAM RUN INPUT

The inputs are connected to SMC-32B via a 10 pin header H1. Limit, and Home inputs are normally closed. Jog and Current Off inputs are normally open. Pulling "Program Run" input LO starts the program. Refer to Appendix A for H1 location on the board.

PIN	INPUT	PIN	INPUT
1	JOG –	2	CURRENT OFF
3	JOG +	4	PROGRAM RUN
5	HOME	6	GND
7	LIM –	8	GND
9	LIM +	10	GND

TABLE 3.3 SMC-32B CONTROL INPUTS

3.4 COMMUNICATION SPEED

Header H4 (See Appendix A for location) is to be jumped for required communication baud rate. Selections are no parity and four baud rates.

HEADER H4		
1	2	BAUD RATE
OUT	OUT	57600 BAUD
OUT	IN	19200 BAUD
IN	OUT	9600 BAUD
IN	IN	2400 BAUD

TABLE 3.4 SMC-32B BAUD RATE SELECTION

3.5 SMC-32B INPUT/OUTPUT LINES

There are five I/O lines available for controllers I/O control each of the I/O lines can be used as an input or output control. I/O lines direction are dynamically configured under the program control. Connections to I/O lines are via 10 pin header H2. Refer to Appendix A for H2 location on the board.

PIN	INPUT	PIN	INPUT
1	I/O Line 5	2	GND
3	I/O Line 4	4	GND
5	I/O Line 3	6	GND
7	I/O Line 2	8	GND
9	I/O Line 1	10	GND

TABLE 3.5 I/O LINES CONNECTION

3.6 FUSING

The SMC-32B motor control module has an on board fuse. The fuse is to be rated accordingly to protect the motor; 4 Amp fast blow maximum.

3.7 STEPPING MODE SELECT

There are eight selections for stepping mode. Refer to Table 3.7 for jumper options.

HEADER H5			
4	2	1	MODE
OUT	OUT	OUT	FULL STEP, 2 PHASES ON
OUT	OUT	IN	FULL STEP, 1 PHASE ON
OUT	IN	OUT	HALF STEP (TWO MINISTEPS/STEP)
OUT	IN	IN	THREE MINISTEPS/STEP
IN	OUT	OUT	FOUR MINISTEPS/STEP
IN	OUT	IN	FIVE MINISTEPS/STEP
IN	IN	OUT	SIX MINISTEPS/STEP
IN	IN	IN	EIGHT MINISTEPS/STEP

TABLE 3.7 STEPPING MODE SELECTION

3.8 MOTOR WINDING CURRENT ADJUSTMENT; P1, P2

P1 – Run trimpot controls motor running current.
P2 – Idle trimpot controls motor idle current.
Turning trimpot clockwise, the current will increase.

Motor Current Adjustment Procedure:

1. Insert DC Ampmeter into one of the motor windings.
2. Remove Jumper on H3 if installed.
3. Turn the Power On.
4. Single step motor until you get maximum current.
5. Adjust trimpot P1 – run for required current.
6. Insert Jumper on H3.
7. Adjust trimpot P2 – idle for required idle current.
8. Disconnect power and remove the meter.

4. INSTRUCTION SET

4.1 INSTRUCTION SET SUMMARY

Instruction and program messages are constructed from ASCII characters. Alphabetic characters can be upper or lower case.

1.	#	Start Character (Hex 23).
2.	aa = 00	Instruction Register Address for Immediate Execution
3.	aa = 01-50	Instruction Register Addresses for Program Control Execution.
4.	I	Instruction Command, One or Two Alphabetic Characters.
5.	+1000	Data Characters.
6.	↵	Termination Character: Carriage Return (Hex 0D).
7.	=	Equal Sign Indicates Data to be Entered (Hex 3D).
8.	En	E followed by a number indicates Error in Instruction.

Example: #00I+1000↵ Motor is instructed to index 1000 steps in positive direction immediately.

Response: #00R↵ Instruction Executed!

Example: #12I+1000↵ Instruction is entered into Program Register 12 for Execution under program control.

Response: #12R↵ Instruction Entered.

Each instruction with Start Character correct register address and termination character generates a response message from the SMC-32B controller.

4.2 SINGLE CHARACTER INSTRUCTION SUMMARY

J Examine or set jog rate index (2-65535 range).

C Examine or set constant speed index (2-65535 range).

V Examine or set high speed index (2-255 range).

R Examine or set acceleration/deceleration index (1-255 range).

M Move number of steps at constant speed using C index (±8,388,607 steps range).

G Go to absolute position using V and R indexes (±8,388,607 steps range).

I Index number of steps using V and R indexes (±8,388,607 steps range).

F Decelerate and stop motion (Soft Stop).

H Seek home position.

Q Immediate stop of motion (Hard Stop).

X Examine motor status.

E Examine limits and home inputs.

L Examine or enable/disable limit interrupts.

W Examine or turn on/turn off motor winding current

P Examine or set absolute position (±8,388,607 range).

S Save motion indexes.

D Load motion parameters defaults.

T Test unit.

4.3 TWO CHARACTER INSTRUCTION SUMMARY

OD Output Data

OL Output Level

JL Jump to Line

JI Jump on Input

WM Wait for Motor to Stop

WI Wait for Input

WT Wait Time

RS Repeat Loop Start

RE Repeat Loop End

SC Subroutine Call

SR Subroutine Return

EL Examine Program Lines

NO No Operation

IL Initialize Program Lines

4.4 ERROR RESPONSES

An error response in form #aaEn↵ is generated for various reasons. Instruction itself is ignored.

1. Instruction structure following #aa is not recognizable or data is out of range.
2. A motion instruction is executed while motor is already stepping.
3. A motion instruction is executed but motor current is shut off by manual input W=0 instruction.
4. A motion instruction is executed but limit in that particular direction is activated.
5. Quit or finish instruction is executed but motor is already stopped.

The following table describes error responses.

E1	Wrong instruction character
E2	Motor is stepping
E3	Wrong data
E4	Motor is stopped
E5	Bad instruction structure
E6	Current turned off
E7	Limits activated or current Off

4.5 STEPPING RATE INDEXES

Stepping rate indexes define stepping rate for jog, move, index, and go motion control instructions. Actual stepping rate in steps/sec is calculated by formula:

Step Rate = 115200/Rate Index (Steps/Sec)

Jog and move are constant rate instructions (no acceleration) and should be set below start/stop rate of the motor load combination. Table 4.1 shows some stepping rate calculations.

Step Rate Index	Step Rate (Steps/Sec)	Step Rate Index	Step Rate (Steps/Sec)
2	57600	60	1920
3	38400	80	1440
4	28800	100	1152
5	23040	150	768
6	19200	200	576
7	16457	250	460
8	14400	300	384
9	12800	400	288
10	11520	600	192
11	10473	800	144
12	9600	1000	115.2
13	886l	1152	100.0
14	8228	2000	57.6
15	7680	4000	28.8
17	6776	8000	14.4
20	5760	10000	11.52
25	4680	11500	10.00
30	3840	20000	5.76
35	3291	40000	2.88
40	2880	57600	2.00
50	2304	60000	1.92
		65000	1.77

TABLE 4.1 SMC-32B STEP RATE TABLE

4.6 JOG RATE INDEX: J

Instruction: #aaJ=500↵ Set Jog Rate Index to 500; aa = 00 to 50
Response: #aaR↵ Instruction accepted

Instruction: #aaJ↵ Examine Jog Rate Index; aa = 00 only
Response: #aaJ=500↵ Jog Rate Index is set to 500 which is 230 step per second

Notes: Jog Rate Index range is 2 to 65535. Jog Rate Index controls stepping rate when operating manual jog toggle switches which are connected to Header H1, Pins 1 and 3. Jog Rate should be set below start/stop stepping rate of motor/load combination. Jog Rate Index can be changed any time. It takes effect on the next jog motion.

4.7 CONSTANT RATE INDEX: C

Instruction: #aaC=400↵ Set Constant Rate Index to 400; aa = 00 to 50
Response: #aaR↵ Instruction accepted

Instruction: #aaC↵ Examine Constant Rate Index; aa = 00 only

Response: #aaC=400↵ Constant Rate Index is set to 400 which is 288 steps per second.

Notes: Constant Rate Index is 2 to 65535 Constant Rate Index controls stepping rate when M motion is executed. Constant Rate Index can be changed any time. It takes effect immediately.

4.8 VELOCITY RATE INDEX: V

Instruction: #aaV=20↵ Set Velocity Rate Index to 20; aa = 00 to 50
Response: #aaR↵ Instruction accepted

Instruction: #aaV↵ Examine Velocity Rate Index; aa = 00 only
Response: #aaV=20↵ Velocity Rate Index is set to 20 which is 5760 steps per second.

Notes: Velocity Rate Index controls top stepping rate while executing G or I motion instruction. Velocity Rate Index range is 2 to 255. Velocity index can be changed any time. It takes effect on the next high speed motion.

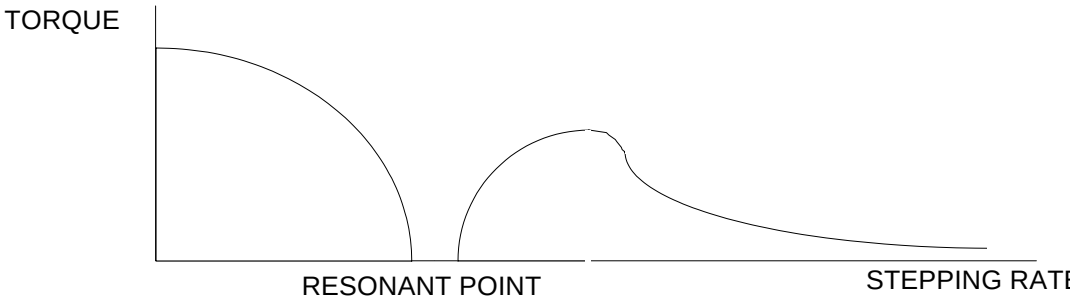
4.9 RAMP INDEX: R

Instruction: #aaR=150↵ Set Ramp Index to 150; aa = 00 to 50
Response: #aaR↵ Instruction accepted

Instruction: #aaR↵ Examine Ramp Index; aa = 00 only
Response: #aaR=150↵ Ramp Index is set to 150

Note: Ramp Index range is 1 to 255. Ramp index controls acceleration/deceleration. ramp while executing Go or Index instruction. Index 1 sets the slowest ramp, index 255 is the fastest ramp. It can be changed any time and it takes effect on the next high speed motion.

Some motors have a resonant point where there is no torque at certain frequencies. In such cases, the motor has to be started at a lower speed than the resonant point in order to fly into a higher speed area. To minimize the time to stay on the resonant point, higher ramp index for acc/dec must be applied. It is recommended that a damper should be used to increase the inertia moment if the motor goes in the resonant point with a small load.



Actual ramping rate in step/sec/sec is calculated by formula:

Ramp Rate = 720,000/(256 – Ramp Index)

Table 4.2 Shows some ramp rate calculations.

RAMP INDEX	RAMP RATE (STEPS/SEC/SEC)
2	2835
10	2927
50	3495
100	4615
150	6792
200	12857
220	20000
230	27692
240	45000
245	65455
250	120000
252	180000
253	240000
254	360000
255	720000

TABLE 4.2 RAMP RATE TABLE

4.10 MOVE NUMBER OF STEPS AT CONSTANT RATE: M

Instruction: #aaM+2000↵Move 2000 steps in positive direction; aa = 00 to 50
Response: #aaR↵ Move instruction accepted

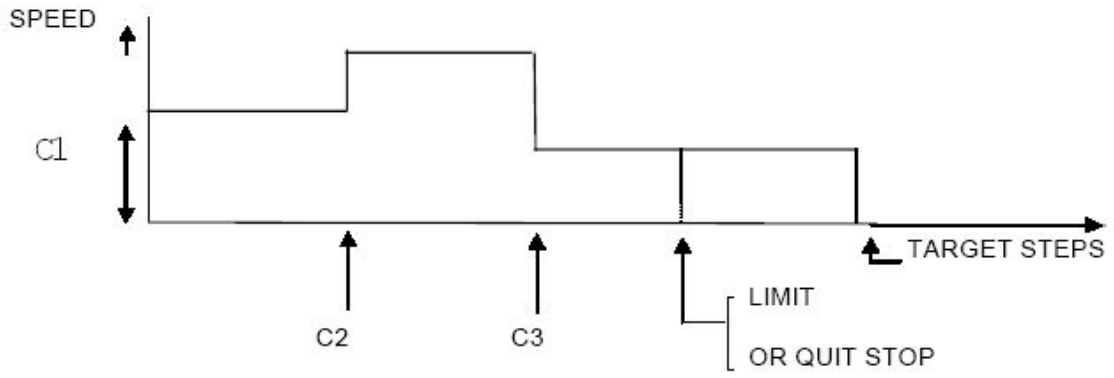
Instruction: #aaM-500↵ Move 500 steps in negative direction; aa = 00 to 50
Response: #aaR↵ Move instruction accepted

Instruction: ##aaM+↵ Move in positive direction until Quit instruction is executed Or + Limit is activated.
Response: #aaR↵ Move instruction accepted.

Instruction: #aaM-↵ Move in negative direction (same as positive).
Response: #aaR↵ Move instruction accepted.

The preset constant rate "C" can be changed at any time (changing stepping rate on the fly). See 4.7 Constant Rate Index.

Note: Motion Execute Instruction. Motor steps at constant rate C; no acceleration or deceleration. Constant stepping rate is to be set lower than start/stop rate of the motor load combination. Move commands are used when coordinated motion is required. Stepping rate is precisely controlled.

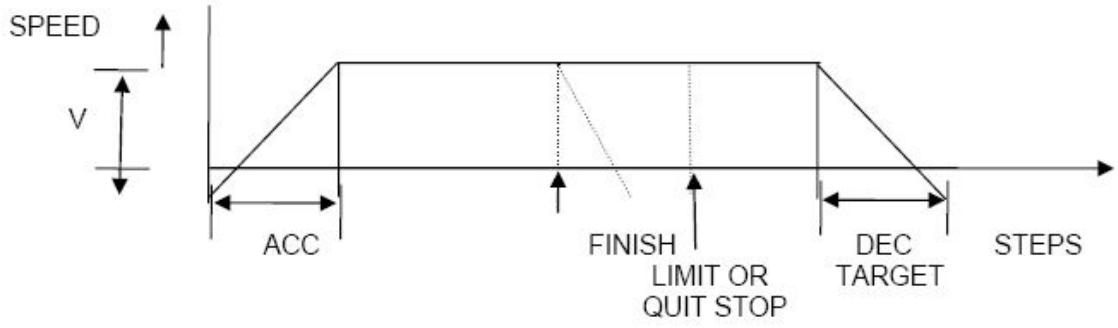


4.11 GO TO ABSOLUTE POSITION: G

Instruction: #aaG+12345↵ Go to absolute position +12345; aa = 00 to 50
Response: #aaR↵ Instruction accepted

Instruction: #aaG+0↵ Go to zero position; aa = 00 to 50
Response: #aaR↵ Instruction accepted

Notes: G Instruction is used when rapid motion is required. Motor accelerates to high speed executing trapezoidal or triangular velocity profile. Motion indexes R and V control the shape of velocity profile.



4.12 INDEX TO RELATIVE POSITION: I

Instruction:	#aaI-6000↵	Step 6000 steps from current position in negative direction; aa = 00 to 50
Response:	#aaR↵	Instruction accepted.
Instruction:	#aaI+1↵	Execute single step in positive direction; aa = 00 to 50
Response:	#aaR↵	Instruction accepted

Notes: I Instruction is similar to G instruction. Motor accelerates to high speed defined by R and V indexes. Runs at high speed, then decelerates and stops, completing the instructed number of steps.

4.13 FINISH, DECELERATING STOP: F

Instruction:	#aaF↵	Decelerate and stop motor; aa = 00 to 50
Response:	#aaR↵	Instruction accepted

Notes: Finish instruction works only when G or I type of motion is being executed. Motor decelerates to base speed and stops. No steps are lost and position counter stays accurate.

4.14 QUIT, IMMEDIATE STOP: Q

Instruction:	#aaQ↵	Motor stop immediately; aa = 00 to 50
Response:	#aaR↵	Instruction accepted

Notes: Quit instruction, works whenever motor is stepping instructed by G, I, M, H instructions.

4.15 SEEK HOME POSITION: H

Instruction:	#aaH+↵	Seek Home in positive direction; aa = 00 to 50
Response:	#aaR↵	Instruction accepted

Notes: Motor moves at constant rate (C) in positive direction until Home position is found (Home Switch activated). Motor will stop if it hits active Limit switch or Quit instruction is received.

Instruction:	#aaH-↵	Seek Home in negative direction; aa = 00 to 50
Response:	#aaR↵	Instruction accepted

Notes: Same as for positive direction.

4.16 EXAMINE MOTOR STATUS: X

Instruction:	#aaX↵	Examine if motor is stepping; aa = 00 to 50
Response:	#aaX=0↵	Motor stopped.
Or		
Response:	#aaX=1↵	Motor is stepping

Notes: Numeric character zero or one represents motor status.

4.17 EXAMINE LIMITS AND HOME INPUTS: E

Instruction:	#aaE↵	Examine Status of Limit and home inputs; aa = 00 only.
Response:	#aaE=000↵	All three inputs are Low
Or		
Response:	#aaE=001↵	Limits are Low, home input is HI

Note: Numeric character zero or one represent Low or High level respectively on time inputs.

First character is L+ (Limit in Positive direction).
Second character is L- (Limit in Negative direction).
Third character is for H (Home input).

4.18 ENABLE, DISABLE, EXAMINE LIMIT INTERRUPTS: L

Instruction:	#aaL=1↵	Enable Limits interrupts; aa = 00 to 50

Response: #aaR↵ Instruction executed

Instruction: #aaL↵ Examine Limit interrupts; aa = 00 only
Response: #aaL=1↵ Interrupts are enabled

Note: Numeric character one represents enabled limits, zero represents disabled limits. The same characters are used to enable or disable limits. When limits are enabled, limit inputs must be connected to limit switches which present normally Low status. Limits can also be jumped on the controller board.

4.19 TURN ON/OFF MOTOR WINDING CURRENT OR EXAMINE IT: W

Instruction: #aaW=0↵ Turn Motor Current Off; aa = 00 to 50
Response: #aaR↵ Instruction executed

Instruction: #aaW=1↵ Turn Motor Current On; aa = 00 to 50
Response: #aaR↵ Instruction executed

Instruction: #aaW↵ Examine Motor Current; aa = 00 only
Response: #aaW=1↵ Motor Current is On

Note: This is program control of motor current. Position is not affected by this instruction. Motor current can be turned On/Off manually with toggle switch. Manual control has higher priority than remote control. Connected to Header H1, Pin 2.

4.20 EXAMINE OR SET ABSOLUTE POSITION: P

Instruction: #aaP=+0↵ Set Position counter to zero; aa = 00 to 50
Response: #aaR↵ Instruction executed

Instruction: #aaP↵ Examine Position; aa = 00 only
Response: #aaP=+0↵ Position is zero

Note: Position can be examined at all times. Direction sign + or – is always required. Position cannot be changed when motor is stepping.

4.21 SAVE MOTION INDEXES: S

Instruction: #aaS↵ Save motion indexes; aa = 00 only
Response: #aaR↵ Instruction executed

Note: Motion Indexes J, C, V, R are saved to nonvolatile memory (EEPROM) and are reloaded on the next power-up.

4.22 LOAD MOTION PARAMETER DEFAULTS: D

Instruction:	#aaD↵	Load defaults; aa = 00 only
Response:	#aaR↵	Instruction executed

Note: Default indexes are set as follows:

V – Top rate index to 15 (7680 steps/sec)
C - Constant rate index to 300 (384 steps/sec)
J – Jog rate index to 300 (384 steps/sec)
R – Ramp index to 100

4.23 TEST UNIT: T

Instruction:	#aaT↵	Test the Unit; aa = 00 only
Response:	#aaSMC32B-R0↵	

Note: aa – register address
SMC32B – controller model
R0 – firmware revision number

4.24 OUTPUT DATA: OD

Instruction:	#aaODTEST1↵	Output Data “TEST1”; aa = 00 to 50
Response:	#aaR↵	

Note: Data is up to seven ASCII characters, outputted via serial port at controllers selected communication rate.

4.25 OUTPUT LEVEL: OL

Instruction:	#aaOL2H↵	Output HI Level on Output Line 2; aa = 00 – 50
Response:	#aaR↵	
Instruction:	#aaOL5L↵	Output LO Level on Output Line 5
Response:	#aaR↵	aa = 00 - 50

Note: Output Lines Range is 1 to 5

4.26 JUMP TO LINE: JL

Instruction: #aaJL25↵ Jump to Line 25; aa = 01 to 50
Response: #aaR↵

Note: Program line range (register address) is 00 to 50. Execution of JL Instruction modifies program flow.

4.27 JUMP ON INPUT: JI

Instruction: #aaJ12H10↵ Program continues execution on Line 10 if input 2 is Hi when executing line aa
Response: #aaR↵

4.28 WAIT FOR MOTOR TO STOP: WM

Instruction: #aaWM↵ Progam continues after motor is stopped;

aa = 00-50
Response: #aaR↵

4.29 WAIT FOR INPUT: WI

Instruction: #aaWI3L↵ Wait with Program execution until Line 3 is

Low; aa = 01 to 50
Response: #aaR↵

4.30 WAIT TIME: WT

Instruction: #aaWT100↵ Wait with Program execution for 100 time

units. Time unit is 10mSec, therefore wait for 1Sec.; aa = 01 to 50
Response: #aaR↵

Note: Range of time units is 0 to 8,388,607

4.31 REPEAT LOOP START: RS

Instruction: #aaRS50↵ Set up Repeat Loop for 50 times; aa = 01-50

Response: #aaR↵

Note: Program segment between start and end of repeat loop will be repeated 50 times. Repeat range is 0 to 255. Nested repeat loops are not supported.

4.32 REPEAT LOOP END: RE

Instruction: #aaRE↵ End of Repeat Program Segment; aa = 01 to 50
Response: #aaR↵

4.33 SUBROUTINE CALL: SC

Instruction: #aaSC32↵ Program Executes Subroutine at Line Address 32; aa = 01 to 50
Response: #aaR↵

Note: Subroutines can be located within 01 to 50 range of line addresses.

4.34 SUBROUTINE RETURN: SR

Instruction: #aaSR↵ Program Execution Return to Main Program; aa = 01-50
Response: #aaR↵

Note: Subroutine must always be ended by subroutine return instruction. Nested subroutines are note supported.

4.35 EXAMINE PROGRAM LINES: EL

Program Line 05 is displayed aa = 00 only

Instruction: #aaEL05↵ Program Line 05 is displayed; aa = 00 only
Response: #05I+1000↵

Instruction: #aaEL01,04↵
Response: #01H-↵ Program Lines 01 to 04 are displayed: aa = 00 only
#02WM↵
#03I+500↵
#04JL02↵

Note: This instruction is used when writing or editing the program.

4.36 NO OPERATION: NO

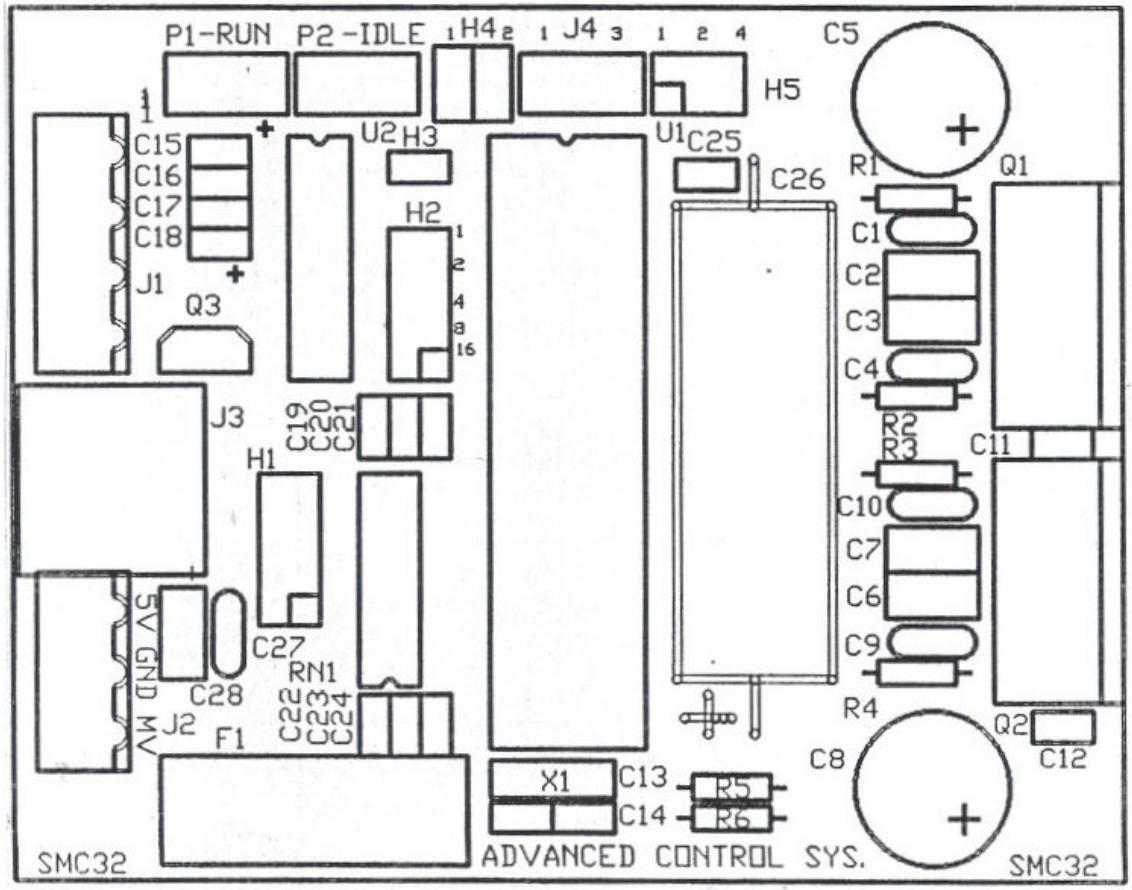
Instruction:	#NO↵	No Operation Instruction is entered into aa program
Response:	#aaR↵	Line; aa = 01 to 50

4.37 Initialize Program Lines: IL

Instruction:	#00IL01,20↵	Program Lines 01 through 20 are initialized with No Operation (NO) Instruction.
Response:	#00R↵	
Instruction:	#00IL05↵	Program Line 05 is initialized with No Operation Instruction.
Response:	#00R↵	

5. Appendices

A. SMC-32B ON-BOARD JUMPER AND SETTING LOCATIONS



B. *SAMPLE PROGRAM*

INSTRUCTION **COMMENT**

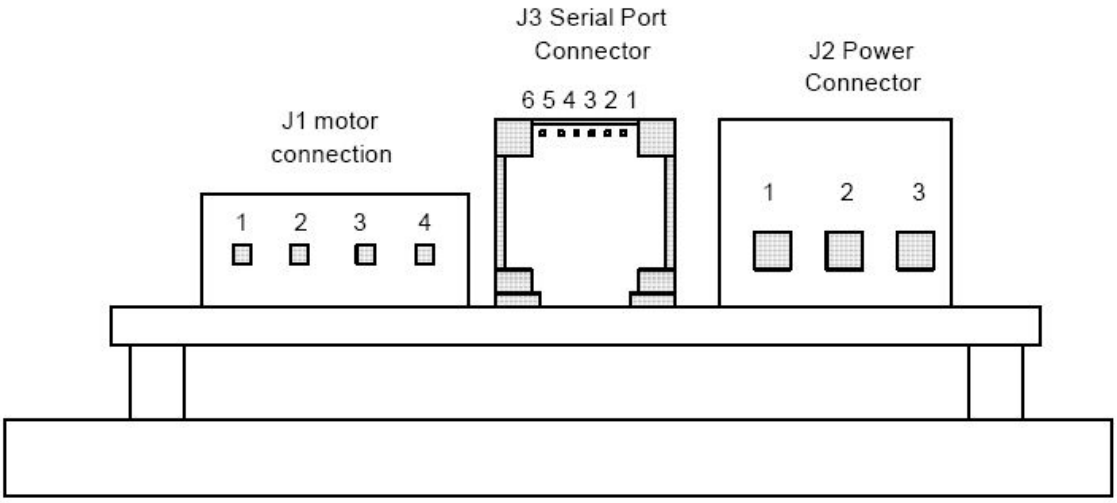
```
#01H-↵          ;Initialize motor position at neg. limit
#02WM↵          ;Wait for motor to stop
#03P=+0↵        ;Set position to 0
#04RS5↵         ;Set repeat loop for 5 repeats
#05I+2010↵      ;Index 2010 steps in positive direction
#06WM↵          ;Wait for motor to stop
#07M-10↵        ;Move 10 steps in neg. direction, backlash correction
#08WM↵          ;Wait for motor to stop
#09RE↵          ;Decrement repeat loop count, go back to 05 if not
                 zero
#10WT1000↵      ;Wait 10 sec.
#11SC20↵        ;Call subroutine at line 20
#12G+0↵         ;Go to position 0
#13OL2L↵        ;Set output line 2 low
#14WM↵          ;Wait for motor to stop
#15JL04↵        ;Go back to line 04

#20ODONE!↵      ;Output data “DONE!”
#21SR↵          ;Return to line 12
```

Note: Sample program is using default setting of R, V, C.

C. *SMC-32B PINOUT DIAGRAM*

SMC-32 Connector Pinout



J1 Motor Connection
pin 1 = winding A
pin 2 = winding A
pin 3 = winding B
pin 4 = winding B

J3 Serial Port Connections:
pin 1 = not connected
pin 2 = TX (data into SMC)
pin 3 = RX (data out of SMC)
pin 4 = must be left open
pin 5 = GND (signal reference)
pin 6 = not connected

J2 Power Connector
pin 1 = +5V Logic Supply
pin 2 = Ground
pin 3 = MV Motor Voltage

6. Manual Revision History

SMC-32B User's Manual Revision History

Revision	Date of Issue	Section	
1.0			Original Release
1.1	7-11-05	4.7	Changes to section
1.2	7-11-05	4.10	Changes to section
1.3	4-13-06	5.3	Added Pinout diagram