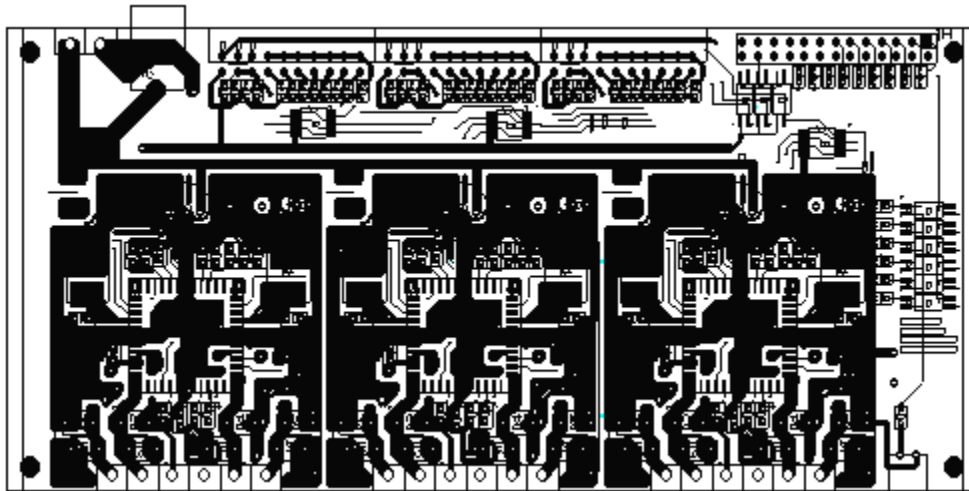


SC325MS

Stepper Motor Translator/Driver

Data Sheet and Instruction Manual



Salem Controls Inc.
Revision 1.2.2

<http://www.salemcontrols.com/>
Last Updated 3/12/06

! Warning !

Stepper motors and drivers use high current and voltages capable of causing severe injury. Do not operate this product without reading and following the instructions contained in this document and on our web site at <http://www.salemcontrols.com/>

Table of Contents

Introduction.....	3
Specifications.....	4
Schematic.....	5
Pinout Information.....	5
Logic Inputs.....	6
Step.....	6
Direction.....	7
Enable.....	7
Microstepping 1 and Microstepping 2.....	7
GND.....	8
Setup.....	9
Connecting the SC325MS to a PC.....	9
Connecting the SC325MS to Other Devices.....	9
Connecting Stepper Motors to the SC325MS.....	10
Connecting the Power Supply to the SC325MS.....	11
Current Level Selection.....	12
Using a Resistor to Set the Maximum Motor Current.....	12
Using the DIP Switch Positions to Set the Maximum Motor Current.....	13
Motor Enable Selection.....	14
Troubleshooting.....	15
Appendix 1 – Current Limit Values for DIP Switch Settings.....	16

Introduction

The SC325MS Stepper Motor Driver is a combination translator and driver built around the Allegro A3977SED (<http://www.allegromicro.com/>). The SC325MS can operate 2-phase bipolar motors up to 2.5A per channel. The SC325MS comes with an aluminum enclosure and cooling fan.

The SC325MS receives logic input signals from a PC, PLC, microcontroller, or other device and translates these signals into the signals needed to drive a stepper motor. You can supply the TTL-level signals from the parallel port of a PC, as with CNC software, or from a PLC or microcontroller, such as may be used in machine automation applications. The logic input signals control the step, direction, and motor enable status of up each axis. The microstepping level can be set using DIP switches on each axis.

The SC325MS uses PWM/chopper technology to limit current in the motors and improve torque at high speeds, and is capable of microstepping motors at up to 8 microsteps per full step. It also operates on a common step + direction (with optional enable) interface that allows it to easily interface with a PC and software (through the parallel port) or other devices capable of producing TTL-level signals.

All of the components on the SC325MS that are powered by external power supplies are optically isolated from the logic inputs from the PC or controlling device. This means that backwards EMF from stepper motors running at high current and voltage levels cannot damage connected equipment.

The enclosure of the SC325MS is anodized aluminum, with plastic end panels. The fan is 40 mm x 40 mm x 10 mm, and provides active cooling to the board through an integrated heat sink. The screw terminal connectors on the board are plug-type and can be removed, to allow for easy switching between motors and power supplies.

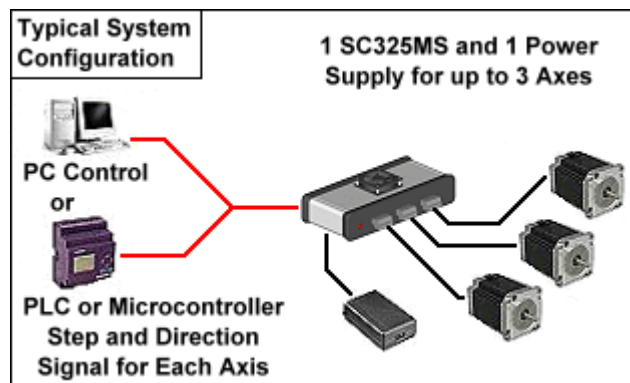


Figure 1

Figure 1 shows the typical system configuration, consisting of a controlling device, a connection between the controlling device and the SC325MS, a power supply and up to three stepper motors. Setup for the SC325MS consists of:

- Connecting the SC325MS to a PC, PLC, microcontroller, or other logic device
- Connecting stepper motors to the SC325MS

- Connecting the power supply to the SC325MS

More information on each of these steps can be found in the Setup section.

Setup normally takes only a few minutes to complete. There is also free software available for download from <http://www.salemcontrols.com/> that can be used to control the SC325MS from a PC. This document also contains the communications and pinout information that will allow the SC325MS to be controlled by TTL-level signals coming from any device.

Specifications

Part #	SC325MS
Type of Stepper Motors	2-Phase Bipolar
Maximum Motor Current	2.5A Per Phase
Current Level Selection	7-Position DIP Switch or Resistor/Potentiometer
Supply Voltage	7V – 30V
Step Sizes	Full, 1/2, 1/4, and 1/8 Step Microsteps
PWM Chopping Frequency	20 kHz
Maximum Step Frequency	500 kHz*
Terminal Blocks	Removable Screw Terminal Plugs
Logic Inputs	Step, Direction, Enable, and Logic Supply GND
Input Conditioning	Optoisolated and Buffered
Power Input	2.1 mm x 5.5 mm Center Positive Plug or 2 Screw Terminal Positions
Dimensions	Board Only: 2.52" x 6.01" Enclosure and Fan: 6.67" x 2.80" x 1.63"
Case	Anodized Aluminum with Plastic End Caps
Indicator LED	Power On

*Maximum step frequency is subject to several system characteristics and is not guaranteed.

Table 1

Schematic

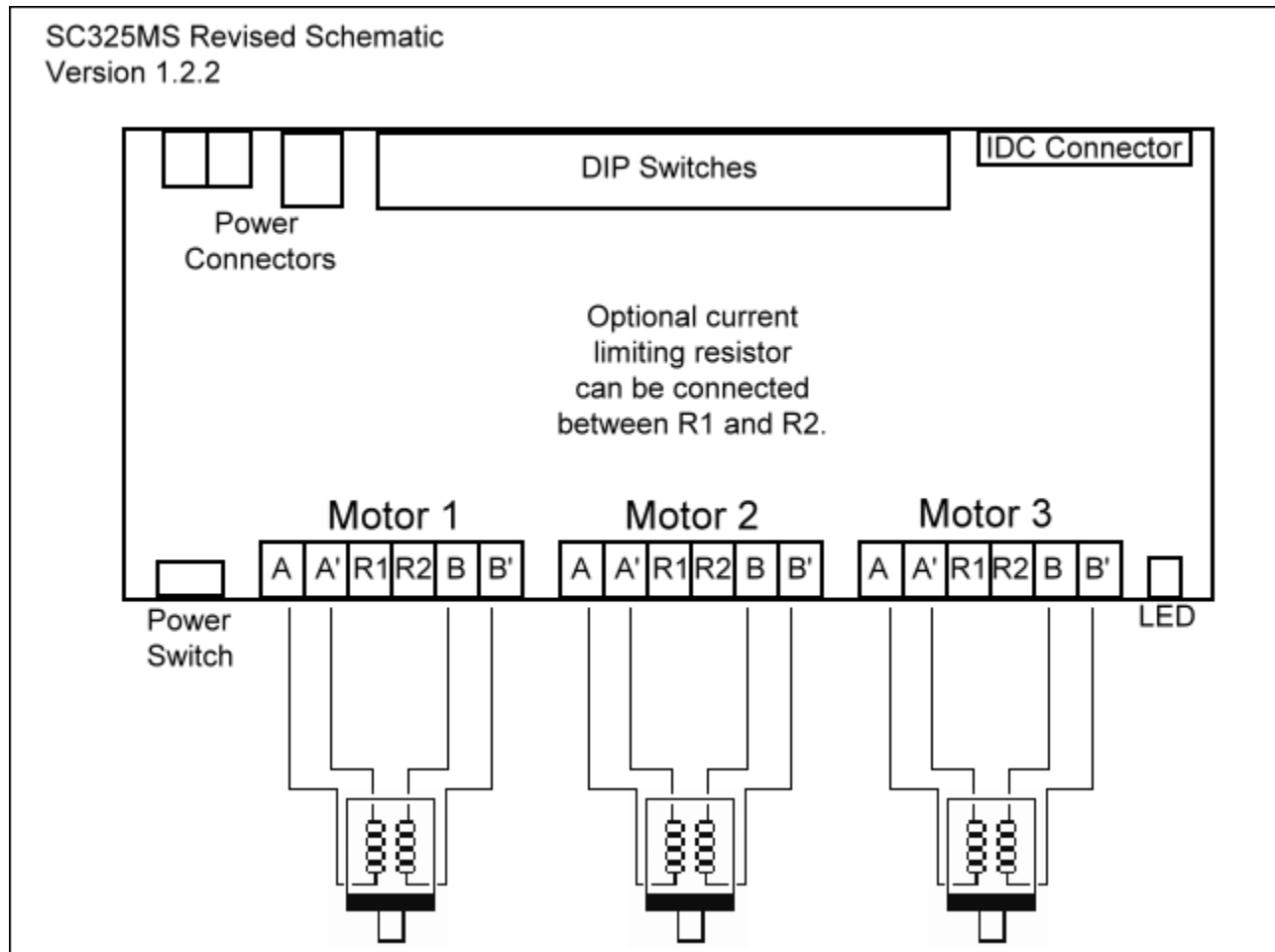


Figure 2

Pinout Information

There are a total of 20 screw terminal positions and one 26-pin IDC header on the SC325MS. The 26-pin IDC header receives logic inputs from a controlling device, whether it be a PC, PLC, microcontroller, etc. For more information on which IDC header pins connect to which logic inputs, please see the schematic, Figure 2, and the section that follows on Logic Inputs.

There are 2 screw terminal positions on each axis that can be joined by a resistor to set the current limit in the motor. The current limit in the motor for each axis can also be set using the DIP switches for the axis. Please see the section on Using a Resistor to Set the Maximum Motor Current for more information.

The 4 positions labeled A and B are for connecting 4 leads of the stepper motor to the SC325MS. Please see the section on Motor Connection Information for more about these connections.

The 2 screw terminal connections closest to the DC power jack are for connecting the positive and GND leads of a power supply to the SC325MS. You can use either the DC power jack or these two screw terminal positions to connect your power supply to the board. The position directly beside the DC power jack is for the power supply ground, and the next position is for V+ from the power supply. See the section on Connecting the Power Supply to the SC325MS for more information.

Logic Inputs

The SC325MS schematic, Figure 2, shows the various connections available on the board. These include connections for logic inputs, motor leads, current level resistor, and the power supply. A description of the logic inputs follows.

There are three logic inputs on the SC325MS for each axis. The three logic inputs are Step, Direction, and Enable. Figure 3 shows the pins of the IDC connector and Table 2 shows the logic inputs that correspond with each pin of the IDC header.

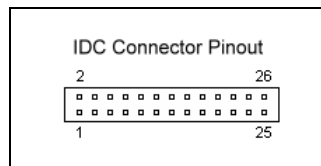


Figure 3

Pin	Connection	Pin	Connection	Pin	Connection
1	Motor 1 Enable	10		19	GND
2	Motor 1 Step	11		20	GND
3	Motor 1 Direction	12		21	GND
4	Motor 2 Step	13		22	GND
5	Motor 2 Direction	14	Motor 2 Enable	23	GND
6	Motor 3 Step	15		24	GND
7	Motor 3 Direction	16	Motor 3 Enable	25	GND
8		17		26	
9		18	GND		

Table 2

Step

When the STEP pin of the A3977SED is transitioned from GND to +5V the motor advances one step. The Step logic input on the SC325MS is connected through an optoisolated channel to this STEP pin on the A3977SED. A logic high on the Step input of the SC325MS causes the STEP pin of the A3977SED to go to +5V, and a logic low on the Step input of the SC325MS causes the STEP pin of the A3977SED to go to GND.

The motor advances one step on the rising edge of the transition from GND to +5V on the STEP pin. The Step logic input must remain high for at least 1 microsecond, and must remain low for at least 1 microsecond between steps (see the A3977SED for more information at

<http://www.allegromicro.com/datafile/3977.pdf>). The motor will advance one step for each logic transition from low to high, but this step may be a full step, 1/2 step, 1/4 step or 1/8 step, depending on the microstepping level of the SC325MS at the time the signal is received. See below for more information on microstepping levels.

Direction

This logic input causes the motor to rotate clockwise or counterclockwise. When the Direction logic input is high the motor will rotate one direction, and when the Direction logic input is low the motor will rotate the opposite direction. The actual direction for a low or high signal varies depending on the order in which the motor leads are connected to the board.

Enable

Before the motor will rotate, the SC325MS must enable the windings of the motor. The A3977SED chip has an ENABLE pin that is active low. The logic input to the SC325MS is reversed, in the sense that a logic High on the Enable input on the SC325MS will enable the motor, and a logic Low on the Enable input will disable the motor. When the motor is disabled there is no current flowing through the windings of the motor, and the motor shaft will not be held in place.

It is not necessary to always supply the Enable logic input for motor operation. You can set DIP Switch position 10 for each axis to ON to cause the ENABLE pin on the A3977SED for that axis to always be low, thereby making the motor always enabled whenever power is applied to the board. When position 10 is ON the motor will be enabled regardless of the status of the Enable logic input. When position 10 is OFF the motor will only be enabled when the Enable input is High.

Microstepping 1 and Microstepping 2

You can select the level of microstepping for each axis using DIP switch positions 8 and 9. Position 8 corresponds to Microstepping 1 and position 9 corresponds to Microstepping 2. Turning a position “off” sets it to Low, and turning a position “on” sets it to High.

These two switches determine the level of microstepping that the motor is operating at. There are 4 levels available, Full Step, Half Step, 1/4 Step, and 1/8 Step. In Full Step a 200 step per revolution motor will step 1.8 degrees each time the Step logic input transitions from low to high. The same motor will step 0.9 degrees if the SC325MS is in Half Step mode, 0.45 degrees if in 1/4 Step mode, and 0.225 degrees if in 1/8 Step mode.

To set the level of microstepping, set the Microstepping 1 and Microstepping 2 logic inputs to Low or High according to Table 3 below:

	Microstepping 1	Microstepping 2
Full Step	Low	Low
Half Step	High	Low
1/4 Step	Low	High
1/8 Step	High	High

Table 3

GND

At least one of the GND logic inputs must be connected to the GND of your logic device in order for the other logic signals to pass through the optoisolators and work properly. The optoisolators on the SC325MS are activated by the flow of a small amount of current (5mA or so) through a diode, and thus the logic inputs must have a GND present to sink this small current.

The GND pins of the parallel port are pins 18-25, and so pins 18-25 on the IDC header are for GND inputs from your controlling device. These pins are also connected to each other on the SC325MS, so any or all of them can be used. Be sure that the GND of your device is connected to at least one of these GND inputs.

Setup

To begin setup, remove the SC325MS from any packaging material and visually inspect it for damage or missing components. If the board appears to be damaged in any way please contact Salem Controls Inc. at <http://www.salemcontrols.com/> for replacement.

Figure 4 shows the connections between the SC325MS and other components of the complete motion control system. In addition to the SC325MS you will need:

- PC or other controlling device
- Up to 2.5A per phase bipolar stepper motor
- A DC power supply 7V to 30V
- Cable with 26 pin female IDC header to connect SC325MS to PC or other controlling device.

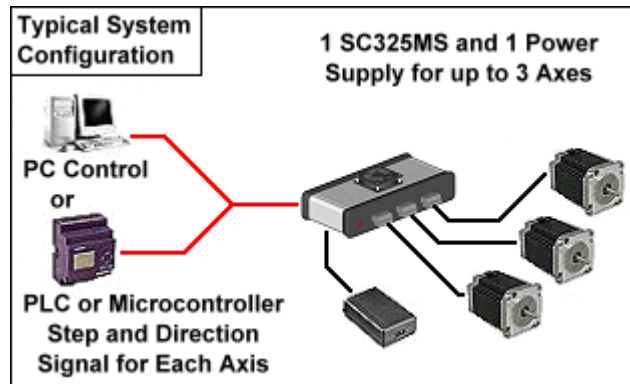


Figure 4

Connecting the SC325MS to a PC

If you are connecting the SC325MS to the parallel port of a PC you can do so using the included cables. You should have received a DB25 to 26-pin Female IDC header adapter cable and a DB25 Male – DB25 Male cable with your SC325MS. To connect the SC325MS to the parallel port of your PC simply plug connect one end of the DB25 Male cable to the PC, connect the two cables to each other, and connect the 26-pin Female IDC header to the 26-pin Male IDC header on the SC325MS.

Connecting the SC325MS to Other Devices

You can use any device capable of producing TTL-level logic signals to control stepper motors through the SC325MS. Your controlling device will need to be able to produce enough current to drive the optoisolator chips on the SC325MS. More information on the signals needed to drive the SC325MS optoisolator chips can be found in the PS2501L datasheet at <http://www.cel.com/pdf/datasheets/ps2501.pdf>

There are three logic inputs for each axis on the SC325MS. These are accessible through the 26-pin Male IDC header. Please see the section on Logic Inputs for more information on these inputs. The inputs that you will need to connect to depend on the amount of control that you need over the movement of the stepper motors.

To connect to the logic inputs of the SC325MS using the 26-pin Male IDC header you will need a cable that terminates in a 26-pin Female IDC socket. The pinout for the 26-pin header on the SC325MS can be found in the previous section on Logic Inputs. Pin # 1 of the 26-pin Male IDC header is in the lower left corner of the header when looking at the SC325MS.

Regardless of how many logic inputs you supply to the SC325MS, for any of them to work properly the GND of your controlling device must be connected to the logic GND input of the SC325MS. Please see the previous section on Logic Inputs for more information on connecting GND of your controlling device to the logic GND inputs on the SC325MS.

Connecting Stepper Motors to the SC325MS

Next, connect the stepper motor to the SC325MS. You will need a small screwdriver to connect the leads of the motor to the appropriate terminal block positions. The SC325MS can drive bipolar stepper motors up to 2.5A per channel. There is a simple diagram showing the basic connection of the motors to the SC325MS in the Schematic (Figure 2).

Most stepper motor data sheets contain a diagram that shows the phases of the motor, labeled A and B. This diagram normally shows the leads that form the ends of these phases. In the case of 2-Phase stepper motors, which are the type that the SC325MS can control, there will be 4 phase end leads (2 for each phase) to connect to the control board. These leads are normally labeled A, \bar{A} , B and \bar{B} in the motor datasheet. To connect your motor to the SC325MS, simply match up the four leads with the terminal positions on the SC325MS labeled A, \bar{A} , B and \bar{B} in the schematic, Figure 2.

There are wiring diagrams for the stepper motors that we sell on our web site in our motors section at <http://www.salemcontrols.com/products/motors.html>

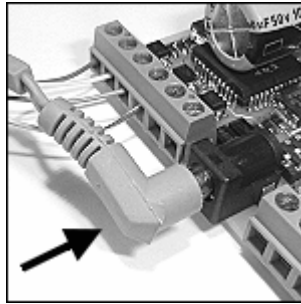
Some 2-phase motors may come with 5 or 6 leads instead of only 4. To connect these motors to the SC325MS determine the A, \bar{A} , B and \bar{B} leads and connect them to the board, and leave the remaining leads unconnected. Be sure that the ends of the unconnected leads do not touch the board, and use electrical tape, heat shrink, a wire nut, or some other means of covering the exposed wire in the unconnected leads.

Some 2-phase motors have 8 leads. In this case you will need a diagram that shows how the leads coming out of the motor form the ends of the 4 half-phases of the motor. You have two options for operation. The first is to only connect two half phases to the SC325MS. The second option is to connect two sets of half-phases together by connecting some of the leads of the motor, and then connect the two full phases that were formed to the SC325MS. Using half-phases only will result in less torque, but also less power used. Just as with a 5 or 6 lead stepper motor, the leads of the 8 lead motor that are not connected to the SC325MS should be protected to prevent damage to the board or motor.

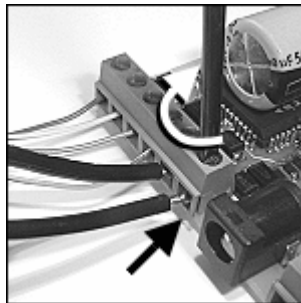
In most cases the stepper motors from one manufacturer all have the same internal wiring, and thus if you can find wiring information for one motor you can normally connect a motor with the same color of windings in the same way. If you cannot find the information you need to connect your motor to the SC325MS, please contact us.

Connecting the Power Supply to the SC325MS

Lastly, connect a power supply to the SC325MS for each motor. Be sure that the power supply is not plugged in or turned on while it is being connected to the board. If you are using a power supply with a barrel-plug type connector, the supply should be from 7V to 24V DC, and the barrel plug should be 2.1 mm x 5.5 mm and center positive.



If you are using a power supply with positive and negative leads the supply should be from 7V to 30V. The positive and negative leads should be connected to the appropriate terminal block positions. Be sure that the leads do not connect with each other or any other terminal block positions. Please see the schematic (Figure 2) for more information on the power supply connection positions.



At this point all of the equipment you need for your motion control system is in place, and you are ready to begin controlling your stepper motors with the SC325MS. You can now use the free software from our web site at <http://www.salemcontrols.com/> or your own controlling device or software. For more information on our software and its installation please see our web site at <http://www.salemcontrols.com/> For more information on using your own controlling device, please see the section on Pinout Information.

If the SC325MS fails to operate correctly please see the Troubleshooting section below or our online Support area (<http://www.salemcontrols.com/support/support.html>) and Discussion Groups (<http://www.salemcontrols.com/discussion/discussion.html>) If you still have problems please contact us at <http://www.salemcontrols.com/>

Current Level Selection

The SC325MS can limit the current level in each stepper motor from 330mA to 2.5A. You can select the maximum level of current in the windings of the stepper motors in 2 different ways on the SC325MS. One method is by manipulating DIP switch positions to select one of 128 current levels. The other method involves connecting a resistor between two screw terminal positions on the board. Each of these methods has some inherent error and the maximum current levels obtained in the formulas that follow are estimates and not exact. To know the exact current in the motor you must measure it directly.

Please note that the current level in the windings of the motor is also limited by the capability of the power supply for each axis, and the current limit level should not be set to a value greater than the rated current output of the power supply or the power supply may be damaged. Also, setting the current limit to a value higher than the rated value of the motor can cause the motor to overheat. Stepper motors may become warm during normal operation, but excessive heat can cause permanent damage to the motor. Please see the data sheet for your stepper motor for more information on heat dissipation and operating temperature.

Using a Resistor to Set the Maximum Motor Current

To use a resistor to set the current level in the motor windings, connect a resistor between the two center positions of the 6-position screw terminal plug of the SC325MS, as shown in the Schematic, Figure 2.

To find the resistor value required to set the current at a particular level, you first must calculate the total resistance formed by the combination of the DIP switch positions 1 – 7 and the resistor connected between screw terminal positions R₁ and R₂. This total resistance in kilo-ohms can be calculated as:

$$R_{tot} = 1 / (1/(1*D_1) + 1/(2*D_2) + 1/(4.02*D_3) + 1/(8.06*D_4) + 1/(16.2*D_5) + 1/(32.4*D_6) + 1/(64.9*D_7) + 1/R_c + 0.0617)$$

Where R_c is the value of the resistor you are using in kilo-ohms and D_x is the value of the DIP switch position x. For example, if DIP switch position 4 is “on”, the value of D₄ is 1. If DIP switch position 4 is “off”, the value of D₄ is 0.

When you have the value of R_{tot}, you can then calculate the reference voltage, V_{ref} using the formula:

$$V_{ref} = 5*(R_{tot}/(R_{tot} + 4.12))$$

The reference voltage can also be measured directly between the two screw terminal positions. From this voltage the current level in the motor, I_{motor}, can be calculated by:

$$I_{motor} = V_{ref} * 0.625$$

As an example, if you have all of the DIP switch positions set to “off” and you use a resistor with a value of 4 kilo-ohms connected between R₁ and R₂, the value of R_{tot} would be:

$$1/((1/4)+0.0617) = 3.21 \text{ kilo-ohms}$$

Therefore, V_{ref} would be:

$$5 \cdot (3.21 / (3.21 + 4.12)) = 2.19 \text{ V}$$

And the maximum current level in the motor, I_{motor} , would be:

$$2.19 \cdot 0.625 = 1.37 \text{ Amps}$$

You can also use a potentiometer to vary the resistance between the two terminal block positions and therefore the maximum motor current. You can also measure the reference voltage, V_{ref} , with a multimeter at the two screw terminal positions for a more accurate reading. This V_{ref} value can then be used to calculate I_{motor} .

Using the DIP Switch Positions to Set the Maximum Motor Current

The SC325MS has a 10-position DIP switch for each axis. Positions 1 – 7 of this switch are used for selecting the current level limit in the windings of the stepper motor. The current level can be set from 330 mA to 2.5A by turning a combination of these 7 switches on or off.

Each switch position is turned on when the small tab is pushed to the “on” side of the switch (normally up) and the positions are turned off when the small tab is pushed to the side of the switch where the labeling #'s are located (normally down). See figure 5.

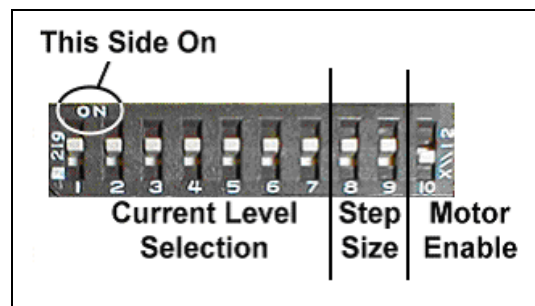


Figure 5

The table in Appendix 1 shows the setting for DIP switch positions 1 – 7 and the approximate current levels that will result in the motor windings for each setting. The actual current limit is determined by many factors, and current levels in the windings should be measured directly if precision is required. All of the values in this table were calculated based on an open circuit between the two screw terminal positions where a resistor may be connected (no resistor present). In the table, a “1” denotes the switch position being “ON” and a “0” denotes the switch position being “OFF”. The current limit in the motor windings for each group of switch settings is labeled “I (mA)”.

You can also calculate the maximum motor current using the formulas found in the previous section on using a resistor to set the maximum motor current.

Motor Enable Selection

The SC325MS has the ability to enable and disable the windings of each stepper motor. Being enabled means that the current from the power supply will be allowed to pass through the motor windings of that axis to energize the motor, either locking the shaft in place if no rotation is occurring, or rotating the shaft of the motor as the step sequence causes the motor to advance.

Without being enabled, the motor will not have any current passing through its windings, and the shaft will rotate relatively freely. For more information on enabling and disabling the motor please see the datasheet for the A3977SED Driver and Translator at <http://www.allegromicro.com/sf/3977/>.

The SC325MS allows you to determine when each axis and motor will be enabled, either all the time or only when the enable logic input on the board is HIGH. This means that the motor can be disabled when rotation is not needed so that it can cool and so that less power will be used.

It is not necessary to always supply the Enable logic input for motor operation. You can set DIP Switch position 10 on each axis to ON to cause the ENABLE pin on the A3977SED of that axis to always be low, thereby making the motor always enabled whenever power is applied to the board. When position 10 is ON the motor will be enabled regardless of the status of the Enable logic input. When position 10 is OFF the motor will only be enabled when the Enable input is High.

For more information on the ENABLE pin and functionality of the A3977SED, please refer to the A3977 data sheet which can be downloaded from <http://www.allegromicro.com/sf/3977/>. For more information on the Enable logic input please see the SC325MS schematic (Figure 2).

Troubleshooting

Please refer to the table below for help in troubleshooting problems with the SC325MS. If your problem is not solved by the information found in this table, please consult our online support documentation at www.salemcontrols.com. You can also contact us at <http://www.salemcontrols.com/contact/contact.html>

Behavior	Possible Solution
Motors Do Not Rotate	<ul style="list-style-type: none"> • Check that all cables are connected securely both to the SC325MS and to the PC or other controlling device. • Be sure that the power supply is connected to the board properly, and the power supply is plugged in and/or turned on. • Check that the power supply is the correct polarity or that the positive and negative leads are connected to the correct positions. • Check the connection of the motors to the board to make sure the leads are in the correct terminal positions. • If there is a significant load on the stepper motor the current limit in the motor may need to be increased.
Motors Vibrate Instead of Rotating, or Step or Rotate Erratically	<ul style="list-style-type: none"> • Excessive cable lengths can cause signals to degrade between the controlling device and the SC325MS. Try using a shorter cable if possible. • Check the order in which the leads of the motor are connected to the controller board. • If there is a significant load on the stepper motor the current limit in the motor may need to be increased. • Increasing the voltage of the power supply can also improve the performance of the stepper motors, especially at high step rates.
Motors Vibrate Instead of Rotating, Miss Steps or Stop Rotating at High Speeds	<ul style="list-style-type: none"> • If controlling from a PC, be sure that other software or processes running on the PC are not causing the timing of the signals from the control software to vary greatly. • Increasing the voltage of the power supply can also improve the performance of the stepper motors, especially at high step rates. • The stepper motor may not have enough torque to rotate the load.

Appendix 1

Current Limits Values for DIP Switch Settings

The tables on the following pages show the values that the current in the motor windings will be limited to for all possible DIP switch settings for positions 1 – 7. The first table is ordered by increasing values of current limit, so that a setting corresponding to a desired current limit can be found. The second table is ordered by increasing DIP switch settings, so that the current associated with a given DIP switch setting can be found. All of these values are calculated based on the assumption that there is an open circuit between R_1 and R_2 .

Please note that the actual current limit in the motor windings is affected by many factors, and the values found in these tables are only expected values, and are not guaranteed. For optimal performance the current limit should be monitored directly on the board and motor current and temperature should not be allowed to exceed rated values.

Current Limit Values for DIP Switch Settings, Ordered by Current Limit (I)

1	2	3	4	5	6	7	I (A)	1	2	3	4	5	6	7	I (A)	1	2	3	4	5	6	7	I (A)
1	1	1	1	1	1	1	0.33	1	0	1	0	1	0	0	0.47	0	1	0	1	0	0	1	0.80
1	1	1	1	1	1	0	0.33	1	0	1	0	0	1	1	0.47	0	1	0	1	0	0	0	0.82
1	1	1	1	1	0	1	0.34	1	0	1	0	0	1	0	0.48	0	1	0	0	1	1	1	0.83
1	1	1	1	1	0	0	0.34	1	0	1	0	0	0	1	0.48	0	1	0	0	1	1	0	0.85
1	1	1	1	0	1	1	0.34	1	0	1	0	0	0	0	0.49	0	1	0	0	1	0	1	0.86
1	1	1	1	0	1	0	0.34	1	0	0	1	1	1	1	0.49	0	1	0	0	1	0	0	0.88
1	1	1	1	0	0	1	0.35	1	0	0	1	1	1	0	0.50	0	1	0	0	0	1	1	0.89
1	1	1	1	0	0	0	0.35	1	0	0	1	1	0	1	0.50	0	1	0	0	0	1	0	0.91
1	1	1	0	1	1	1	0.35	1	0	0	1	1	0	0	0.51	0	1	0	0	0	0	1	0.93
1	1	1	0	1	1	0	0.35	1	0	0	1	0	1	1	0.51	0	1	0	0	0	0	0	0.94
1	1	1	0	1	0	1	0.36	1	0	0	1	0	1	0	0.52	0	0	1	1	1	1	1	0.97
1	1	1	0	1	0	0	0.36	1	0	0	1	0	0	1	0.53	0	0	1	1	1	1	0	0.99
1	1	1	0	0	1	1	0.36	1	0	0	1	0	0	0	0.53	0	0	1	1	1	0	1	1.01
1	1	1	0	0	1	0	0.36	1	0	0	0	1	1	1	0.54	0	0	1	1	1	0	0	1.03
1	1	1	0	0	0	1	0.37	1	0	0	0	1	1	0	0.54	0	0	1	1	0	1	1	1.05
1	1	1	0	0	0	0	0.37	1	0	0	0	1	0	1	0.55	0	0	1	1	0	1	0	1.07
1	1	0	1	1	1	1	0.37	1	0	0	0	1	0	0	0.56	0	0	1	1	0	0	1	1.10
1	1	0	1	1	1	0	0.38	1	0	0	0	0	1	1	0.56	0	0	1	1	0	0	0	1.12
1	1	0	1	1	0	1	0.38	1	0	0	0	0	1	0	0.57	0	0	1	0	1	1	1	1.15
1	1	0	1	1	0	0	0.38	1	0	0	0	0	0	1	0.57	0	0	1	0	1	1	0	1.17
1	1	0	1	0	1	1	0.38	1	0	0	0	0	0	0	0.58	0	0	1	0	1	0	1	1.20
1	1	0	1	0	1	0	0.39	0	1	1	1	1	1	1	0.59	0	0	1	0	1	0	0	1.23
1	1	0	1	0	0	1	0.39	0	1	1	1	1	1	0	0.60	0	0	1	0	0	1	1	1.27
1	1	0	1	0	0	0	0.39	0	1	1	1	1	0	1	0.60	0	0	1	0	0	1	0	1.30
1	1	0	0	1	1	1	0.40	0	1	1	1	1	0	0	0.61	0	0	1	0	0	0	1	1.33
1	1	0	0	1	1	0	0.40	0	1	1	1	0	1	1	0.62	0	0	1	0	0	0	0	1.37
1	1	0	0	1	0	1	0.40	0	1	1	1	0	1	0	0.63	0	0	0	1	1	1	1	1.41
1	1	0	0	1	0	0	0.41	0	1	1	1	0	0	1	0.64	0	0	0	1	1	1	0	1.46
1	1	0	0	0	1	1	0.41	0	1	1	1	0	0	0	0.64	0	0	0	1	1	0	1	1.50
1	1	0	0	0	1	0	0.41	0	1	1	0	1	1	1	0.65	0	0	0	1	1	0	0	1.55
1	1	0	0	0	0	1	0.42	0	1	1	0	1	1	0	0.66	0	0	0	1	0	1	1	1.60
1	1	0	0	0	0	0	0.42	0	1	1	0	1	0	1	0.67	0	0	0	1	0	1	0	1.65
1	0	1	1	1	1	1	0.42	0	1	1	0	1	0	0	0.68	0	0	0	1	0	0	1	1.71
1	0	1	1	1	1	0	0.43	0	1	1	0	0	1	1	0.69	0	0	0	1	0	0	0	1.77
1	0	1	1	1	0	1	0.43	0	1	1	0	0	1	0	0.70	0	0	0	0	1	1	1	1.84
1	0	1	1	1	0	0	0.44	0	1	1	0	0	0	1	0.71	0	0	0	0	1	1	0	1.91
1	0	1	1	0	1	1	0.44	0	1	1	0	0	0	0	0.72	0	0	0	0	1	0	1	1.99
1	0	1	1	0	1	0	0.44	0	1	0	1	1	1	1	0.73	0	0	0	0	1	0	0	2.07
1	0	1	1	0	0	1	0.45	0	1	0	1	1	1	0	0.74	0	0	0	0	0	1	1	2.16
1	0	1	1	0	0	0	0.45	0	1	0	1	1	0	1	0.75	0	0	0	0	0	1	0	2.26
1	0	1	0	1	1	1	0.46	0	1	0	1	1	0	0	0.77	0	0	0	0	0	0	1	2.37
1	0	1	0	1	1	0	0.46	0	1	0	1	0	1	1	0.78	0	0	0	0	0	0	0	2.49
1	0	1	0	1	0	1	0.47	0	1	0	1	0	1	0	0.79								

Current Limit Values for DIP Switch Settings, Ordered by DIP Switch Settings

1	2	3	4	5	6	7	I (A)	1	2	3	4	5	6	7	I (A)	1	2	3	4	5	6	7	I (A)
0	0	0	0	0	0	0	2.49	1	1	0	1	0	1	0	0.39	0	1	1	0	1	0	1	0.67
1	0	0	0	0	0	0	0.58	0	0	1	1	0	1	0	1.07	1	1	1	0	1	0	1	0.36
0	1	0	0	0	0	0	0.94	1	0	1	1	0	1	0	0.44	0	0	0	1	1	0	1	1.50
1	1	0	0	0	0	0	0.42	0	1	1	1	0	1	0	0.63	1	0	0	1	1	0	1	0.50
0	0	1	0	0	0	0	1.37	1	1	1	1	0	1	0	0.34	0	1	0	1	1	0	1	0.75
1	0	1	0	0	0	0	0.49	0	0	0	0	1	1	0	1.91	1	1	0	1	1	0	1	0.38
0	1	1	0	0	0	0	0.72	1	0	0	0	1	1	0	0.54	0	0	1	1	1	0	1	1.01
1	1	1	0	0	0	0	0.37	0	1	0	0	1	1	0	0.85	1	0	1	1	1	0	1	0.43
0	0	0	1	0	0	0	1.77	1	1	0	0	1	1	0	0.40	0	1	1	1	1	0	1	0.60
1	0	0	1	0	0	0	0.53	0	0	1	0	1	1	0	1.17	1	1	1	1	1	0	1	0.34
0	1	0	1	0	0	0	0.82	1	0	1	0	1	1	0	0.46	0	0	0	0	0	1	1	2.16
1	1	0	1	0	0	0	0.39	0	1	1	0	1	1	0	0.66	1	0	0	0	0	1	1	0.56
0	0	1	1	0	0	0	1.12	1	1	1	0	1	1	0	0.35	0	1	0	0	0	1	1	0.89
1	0	1	1	0	0	0	0.45	0	0	0	1	1	1	0	1.46	1	1	0	0	0	1	1	0.41
0	1	1	1	0	0	0	0.64	1	0	0	1	1	1	0	0.50	0	0	1	0	0	1	1	1.27
1	1	1	1	0	0	0	0.35	0	1	0	1	1	1	0	0.74	1	0	1	0	0	1	1	0.47
0	0	0	0	1	0	0	2.07	1	1	0	1	1	1	0	0.38	0	1	1	0	0	1	1	0.69
1	0	0	0	1	0	0	0.56	0	0	1	1	1	1	0	0.99	1	1	1	0	0	1	1	0.36
0	1	0	0	1	0	0	0.88	1	0	1	1	1	1	0	0.43	0	0	0	1	0	1	1	1.60
1	1	0	0	1	0	0	0.41	0	1	1	1	1	1	0	0.60	1	0	0	1	0	1	1	0.51
0	0	1	0	1	0	0	1.23	1	1	1	1	1	1	0	0.33	0	1	0	1	0	1	1	0.78
1	0	1	0	1	0	0	0.47	0	0	0	0	0	0	1	2.37	1	1	0	1	0	1	1	0.38
0	1	1	0	1	0	0	0.68	1	0	0	0	0	0	1	0.57	0	0	1	1	0	1	1	1.05
1	1	1	0	1	0	0	0.36	0	1	0	0	0	0	1	0.93	1	0	1	1	0	1	1	0.44
0	0	0	1	1	0	0	1.55	1	1	0	0	0	0	1	0.42	0	1	1	1	0	1	1	0.62
1	0	0	1	1	0	0	0.51	0	0	1	0	0	0	1	1.33	1	1	1	1	0	1	1	0.34
0	1	0	1	1	0	0	0.77	1	0	1	0	0	0	1	0.48	0	0	0	0	1	1	1	1.84
1	1	0	1	1	0	0	0.38	0	1	1	0	0	0	1	0.71	1	0	0	0	1	1	1	0.54
0	0	1	1	1	0	0	1.03	1	1	1	0	0	0	1	0.37	0	1	0	0	1	1	1	0.83
1	0	1	1	1	0	0	0.44	0	0	0	1	0	0	1	1.71	1	1	0	0	1	1	1	0.40
0	1	1	1	1	0	0	0.61	1	0	0	1	0	0	1	0.53	0	0	1	0	1	1	1	1.15
1	1	1	1	1	0	0	0.34	0	1	0	1	0	0	1	0.80	1	0	1	0	1	1	1	0.46
0	0	0	0	0	1	0	2.26	1	1	0	1	0	0	1	0.39	0	1	1	0	1	1	1	0.65
1	0	0	0	0	1	0	0.57	0	0	1	1	0	0	1	1.10	1	1	1	0	1	1	1	0.35
0	1	0	0	0	1	0	0.91	1	0	1	1	0	0	1	0.45	0	0	0	1	1	1	1	1.41
1	1	0	0	0	1	0	0.41	0	1	1	1	0	0	1	0.64	1	0	0	1	1	1	1	0.49
0	0	1	0	0	1	0	1.30	1	1	1	1	0	0	1	0.35	0	1	0	1	1	1	1	0.73
1	0	1	0	0	1	0	0.48	0	0	0	0	1	0	1	1.99	1	1	0	1	1	1	1	0.37
0	1	1	0	0	1	0	0.70	1	0	0	0	1	0	1	0.55	0	0	1	1	1	1	1	0.97
1	1	1	0	0	1	0	0.36	0	1	0	0	1	0	1	0.86	1	0	1	1	1	1	1	0.42
0	0	0	1	0	1	0	1.65	1	1	0	0	1	0	1	0.40	0	1	1	1	1	1	1	0.59
1	0	0	1	0	1	0	0.52	0	0	1	0	1	0	1	1.20	1	1	1	1	1	1	1	0.33
0	1	0	1	0	1	0	0.79	1	0	1	0	1	0	1	0.47								