Multi-Axis Intelligent Stepper Motor Controller

Operation Guide

SM200X Product Line

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NAM SM200X Overview

The NAM SM200X is a multi-axis intelligent stepper motor controller offered by New Age Micro. The NAM SM200X is available in 6 axes and 8 axes configurations. This Operation Guide provides pin out information, command descriptions, and electrical characteristics as well as the mechanical information needed to install the controller.

The NAM SM200X utilizes an STMicroeclectronics L6482 microstepping motor controller for each axis. For detailed technical information for the L6482, including register information, refer to the L6482 data sheet (Doc. ID 023768, Rev. 4). It can be downloaded from the STMicroeclectronics website at:

http://www.st.com

Contact Information

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Connectors and Pin Outs

Sensor Inputs

Sensor input connectors for the NAM SM200X are shown in Figure 2-1. A closeup view of a sensor input connector is shown in Figure 2-2. The pin outs for each sensor input connector are shown in Table 2-1.

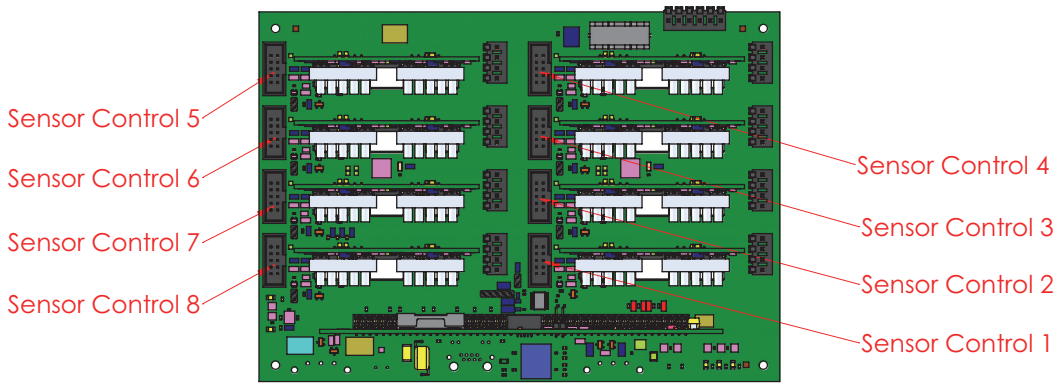

Figure 2-1 Sensor Input Connectors

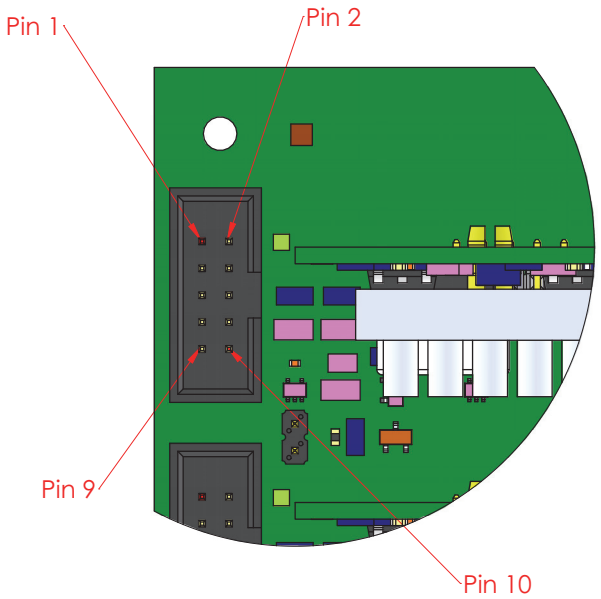

Figure 2-2 Sensor Connector Closeup

Table 2-1 Sensor Input Connector Pin Outs

Pin Number	Signal Name	Function
1	AGND	Analog ground
2	ABR LOOP DETECT	Abort loop override enabled
3	CWLIMIT	Low indicates clockwise limit has been reached
4	CCWLIMIT	Low indicates counterclockwise limit has been reached
5	+5V	Input power
6	AGND	Analog ground
7	HOME	Home position has been reached
8	AGND	Analog ground
9	VLED	
10	+5V	Input power

Stepper Motor Connectors

Stepper motor connectors for the NAM SM200X are shown in Figure 2-3. A closeup view of a stepper motor connector is shown in Table 2-4. The pin outs for each stepper motor connector are shown in Table 2-2.

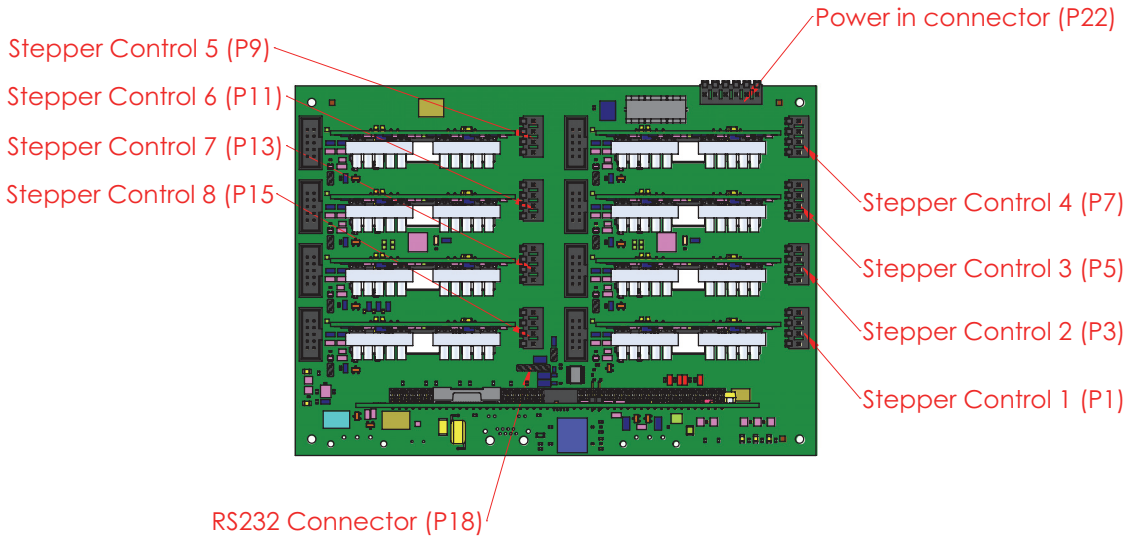

Figure 2-3 Stepper Motor Connectors

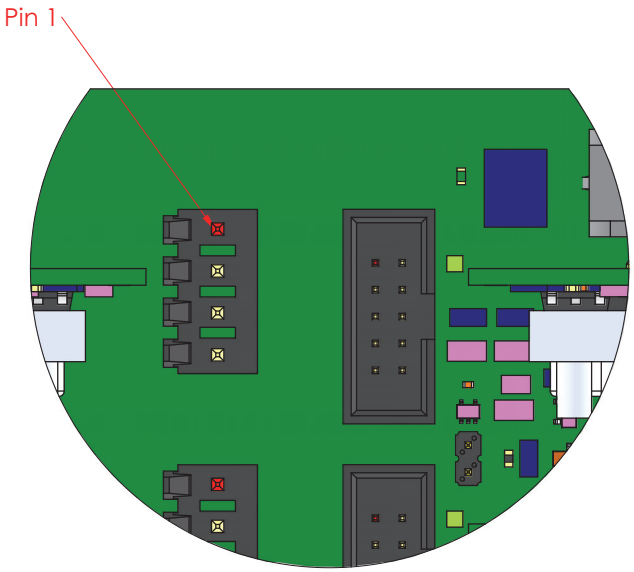

Figure 2-4 Sensor Connector Closeup

Table 2-2 Stepper Motor Connector Pin Outs

Pin Number	Signal Name	Function
1	MOTOR A1	Full bridge A output 1
2	MOTOR A2	Full bridge A output 2
3	MOTOR B1	Full bridge B output 1
4	MOTOR B2	Full bridge B output 2

Power In

The power in connector for the NAM SM200X is shown in Figure 2-3. The pin outs for the power in connector are shown in Table 2-3.

Table 2-3 Power In Connector Pin Outs

Pin Number	Signal Name	Function
1	+40V IN	Input power
2	AGND	Analog ground
3	AGND	Analog ground
4	+5V IN	Input power
5	NO CONNECT	
6	+40V IN	Input power

RS-232 Connector

The RS-232 connector for the NAM SM200X is also shown in Figure 2-3. The pin outs for the RS-232 connector are shown in Table 2-4.

Table 2-4 RS-232 Connector Pin Outs

Pin Number	Signal Name	Function
1	+5V	Input power
2	RXDATA IN	Received serial data into SM200X
3	AGND	Analog ground
4	TXDATA OUT	Transmitted serial data from SM200X
5	CTS OUT	SM200X is ready to transmit data

ABR Loop Override

The NAM SM200X provides the ability to override abort loop functionality by installing a jumper on pins 1 and 2 of the ABR Loop Override jumper posts that are located near each sensor connector on the main controller board. Removing the jumper enables the override. The jumper post locations are shown in Figure 2-5.

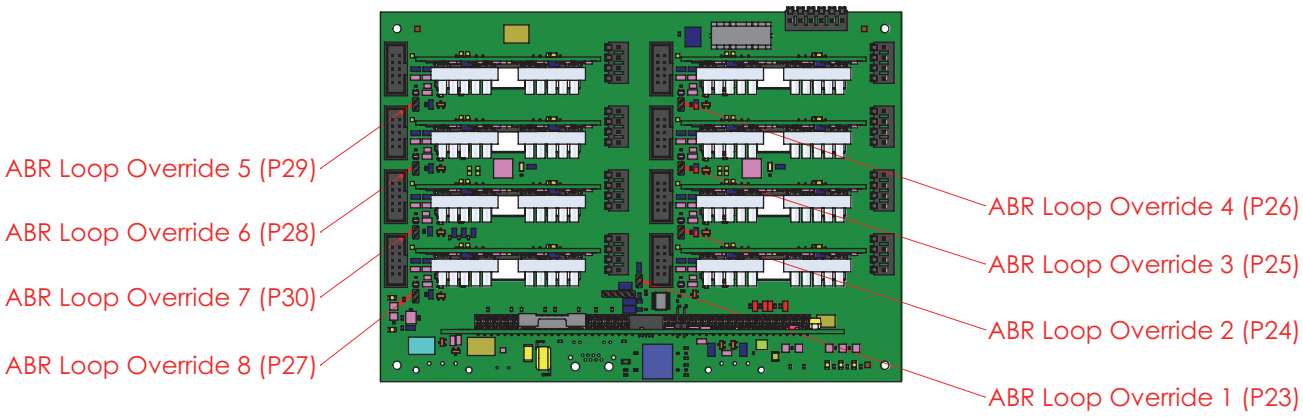

Figure 2-5 ABR Loop Override Jumper Locations

Communication Interface

This chapter provides information on the controller command set, status LEDS, and information on upgrading the controller firmware.

Controller Commands

This section describes the commands available for programming the NAM SM200X.

Command Format

All commands to the NAM SM200X consist of a string of ASCII characters as described in this chapter. The command format is as follows:

```
<command>[<space><parameter>]<CR>
```

where:

- `command` is one of the ASCII command characters listed in Table 3-1.
- `space` is the ASCII space character. This is optional and is used to separate command characters from parameters.
- `parameter` is a parameter value for the specified command. See the Command Summary section below. Parameters consist of one or more ASCII characters, e.g., the ASCII string "12" would be included in the command to specify a numeric value of twelve. Numeric values can be formatted as either decimal or hexadecimal numbers. Hexadecimal numbers will have either 'h' or 'H' appended to the numeric value portion of the command string. Multiple parameters are separated by spaces.
- `CR` is the ASCII carriage return character.

Command Summary

The commands that are supported by the NAM SM200X are listed in Table 3-1. With the exception of the Operating Mode command, all commands operate on the axis selected by the most recent Select Motor command. Issue additional Select Motor commands to access another axis.

Table 3-1 NAM SM200X Command Summary

Command Name	Command Letter and Parameter	Command Description
At Position	A <position>	Sets the current step position
Bit Set/Clear	B <bit>	Sets or clears user selectable bits Use the prefix character, '/' to perform the complement operation.
Clockwise	+	Selects clockwise for the direction of relative motions
Counterclockwise	-	Selects clockwise for the direction of relative motions
First Rate	F <rate>	Specifies the starting step rate
Go	G	Starts relative mode stepping
Number	N <steps>	Sets the number of steps for relative motions
Operating Mode	O <mode>	Sets the operating mode of the NAM SM200X
Position	P <position>	Steps to the specified absolute position
Query Parameter	? <command>	Query the parameter value of the Position command
Query Register	Q <register number>	Query the value stored in specified L6482 register
Rate	R <rate>	Specifies the slewing or maximum step rate
Restore Defaults	Y	Restores defaults and clears L6482 registers
Save All Registers	K	Saves L6482 registers to EEPROM
Select Motor	T <motor number>	Selects the motor (axis) that will be accessed by other commands
Slope	S <slope>	Specifies the acceleration or deceleration slope value
Soft Stop, disable holding	Z	Performs a soft stop and disables holding
Soft Stop, enable holding	L	Performs a soft stop and enables holding
Version	V	Provides the NAM SM200X software version
Write Register	W <register number> <value>	Write the specified value to the specified L6482 register

Command Descriptions

This section describes the commands used for programming the NAM SM200X.

At Position

Format: A <position>

Parameter Size: 22 bits

Parameter Range: 0 to 4,194,303

Description: The At Position command sets the current position of the NAM SM200X to the value specified by the position parameter. This command is typically used after stepping to a known mechanical position and can be used to set a home position.

Bit Set/Clear

Format: B <bits>
Use "/B <bits>" for the complement operation. See description.

Parameter Size: 8 bits

Parameter Range: 0 to 255

Description: The Bit Set/Clear command operates on the six user bits as specified below.

Note that the prefix character (/) can be used with the bit command to perform the complement operation (set or clear) of the specified bits.

The <bits> parameter is an 8 bit opcode/operand combination where the two most significant bits (bits 7 and 6) represent one of the opcodes shown in Table 3-2.

Table 3-2 Bit Parameter Opcodes

Bit 7	Bit 6	Opcode Description
0	0	Single bit operation. Set or clear the user bit specified in bits 0-2. When using this mode, bits 0-5 function as described in the next table.
0	1	Set the 6 user selectable bits as specified in bits 0-5 of the bit parameter.
1	0	AND the 6 user bits with bits 0-5 of the bit parameter.
1	1	OR the 6 user bits with bits 0-5 of the bit parameter.

Table 3-3 shows the bit functions of bits 0-5 when single bit operation is selected.

Table 3-3 Bit Parameter Function for Bits 0-5

Bit No.	Opcode Description
5	Unused
4	1 - Clear the specified bit 0 - Set the specified bit
3	Unused
0-2	Specifies the bit to set or clear

Clockwise

Format: +

Description: This Clockwise command selects the clockwise direction for relative stepping motions.

Counterclockwise

Format: -

Description: This Counterclockwise command selects the counterclockwise direction for relative stepping motions.

First Rate

Format: F <rate>

Parameter Size: 8 bits

Parameter Range: 0 to 255

Description: The First Rate command specifies the initial stepping rate of the NAM SM200X. The rate parameter specifies an index into the step rate table (Table 3-4).

Go

Format: G

Description: The Go command starts relative mode stepping. Use the + or - command to set the direction. Use the N command to specify the number of steps.

Number

Format:	N <steps>
Parameter Size:	22 bits
Parameter Range:	0 to 4,194,303
Description:	The Number command specifies the number of steps to take in relative step mode. Use the + command to step in the clockwise direction. Use the - command to step in the counterclockwise direction. The Number command only specifies the number of steps. No stepping occurs when the command is issued. The G command is used to start relative stepping.

Operating Mode

Format:	O <mode>
Parameter Size:	8 bits
Parameter Range:	00H or 20H (disable CTS or enable CTS)
Description:	Set bit 5 to enable CTS. Clear bit 5 to disable CTS. All other bit settings are ignored.

Position

Format:	P <position>
Parameter Size:	22 bits
Parameter Range:	0 to 4,194,303
Description:	The Position command specifies a target position. This command will start the motion. If the target position is greater than the current position, motion will be in the clockwise direction. If the target position is less than the current position, motion will be in the counterclockwise direction.

Query Parameter

Format:	? <command>
Parameter Size:	8 bits
Parameter Values:	'P' - indicates the Position command
Description:	Queries the value of the Position command.

Query Register

Format:	Q <register number>
Parameter Size:	8 bits
Parameter Range:	1 to 24
Description:	The Query Register command returns the value stored in the specified register of the L6482 microcontroller. Registers are specified using the values listed in Table 3-5.

Rate

Format:	R <rate>
Parameter Size:	8 bits
Parameter Range:	0 to 255
Description:	The Rate command specifies the maximum stepping rate of the NAM SM200X. The rate parameter specifies an index into the step rate table (Table 3-4).

Restore Defaults

Format:	Y 543217
Description:	The Restore Defaults command will restore default settings to all axes and clear the value of any saved L6482 registers in EEPEOM. The string "543217" must be included with the command character as shown above. This helps prevent accidental execution of this command.

Save All Registers

Format: K

Description: The Save Registers command will save current L6482 register settings for all axes to EEPEOM. The settings will be loaded on the next power cycle.

Select Motor

Format: T <motor number>

Parameter Size: 8 bits

Parameter Range: 1 to 8

Description: The Select Motor command selects the motor (axis) that will be accessed by other commands.

Slope

Format: S <slope>

Parameter Size: 8 bits

Parameter Range: 1 to 255

Description: The Slope command specifies the rate of acceleration or deceleration for the NAM SM200X. Smaller values result in slower rates while larger values result in higher rates. Experimentation with the slope parameter will determine the optimal rate for your application.

Soft Stop - Disable Holding

Format: Z

Description: This command will disable holding on the currently selected axis and perform a soft stop if the motor was running.

Soft Stop - Enable Holding

Format: L

Description: This command will perform a soft stop on the currently selected axis. The motor will be held with the configured holding current whether or not it was previously stopped.

Version

Format:	V
Description:	Returns the NAM SM200X software version.

Write Register

Format:	W <register number> <register value>
Parameter Size:	register number - 8 bits register value - depends on register selected
Parameter Range:	register number - 1 to 24 register value - depends on register selected
Description:	The Write Register command writes the specified value to the specified register of the L6482 microcontroller. Registers are specified using the values listed in Table 3-5.

Step Rate Table

Table 3-4 provides the step rates that can be selected using the rate parameter used with the Rate and First Rate commands. The Rate command is shown in the table.

Table 3-4 NAM SM200X Step Rate Table

R 0	18	R 32	1100	R 64	2568	R 96	3934	R 128	5238	R 160	6410	R 192	8258	R 224	11603
R 1	22	R 33	1146	R 65	2612	R 97	3986	R 129	5268	R 161	6455	R 193	8333	R 225	11752
R 2	46	R 34	1192	R 66	2657	R 98	4038	R 130	5299	R 162	6501	R 194	8410	R 226	11905
R 3	69	R 35	1237	R 67	2704	R 99	4092	R 131	5329	R 163	6548	R 195	8488	R 227	12061
R 4	92	R 36	1284	R 68	2753	R 100	4148	R 132	5361	R 164	6595	R 196	8567	R 228	12222
R 5	115	R 37	1329	R 69	2795	R 101	4186	R 133	5392	R 165	6643	R 197	8648	R 229	12387
R 6	137	R 38	1374	R 70	2838	R 102	4224	R 134	5424	R 166	6691	R 198	8730	R 230	12557
R 7	160	R 39	1421	R 71	2892	R 103	4264	R 135	5456	R 167	6740	R 199	8814	R 231	12731
R 8	183	R 40	1467	R 72	2938	R 104	4304	R 136	5489	R 168	6790	R 200	8900	R 232	12911
R 9	206	R 41	1513	R 73	2976	R 105	4344	R 137	5522	R 169	6841	R 201	8987	R 233	13095
R 10	229	R 42	1559	R 74	3025	R 106	4386	R 138	5556	R 170	6892	R 202	9076	R 234	13285
R 11	252	R 43	1605	R 75	3066	R 107	4428	R 139	5589	R 171	6944	R 203	9167	R 235	13480
R 12	275	R 44	1649	R 76	3118	R 108	4472	R 140	5624	R 172	6997	R 204	9259	R 236	13682
R 13	298	R 45	1694	R 77	3161	R 109	4516	R 141	5658	R 173	7051	R 205	9354	R 237	13889
R 14	321	R 46	1743	R 78	3194	R 110	4561	R 142	5694	R 174	7106	R 206	9450	R 238	14103
R 15	344	R 47	1787	R 79	3228	R 111	4606	R 143	5729	R 175	7161	R 207	9549	R 239	14323
R 16	367	R 48	1833	R 80	3262	R 112	4653	R 144	5765	R 176	7218	R 208	9649	R 240	14550
R 17	412	R 49	1878	R 81	3297	R 113	4701	R 145	5802	R 177	7275	R 209	9752	R 241	14785
R 18	459	R 50	1926	R 82	3333	R 114	4750	R 146	5839	R 178	7333	R 210	9857	R 242	15027
R 19	504	R 51	1971	R 83	3370	R 115	4799	R 147	5876	R 179	7392	R 211	9964	R 243	15278
R 20	550	R 52	2015	R 84	3408	R 116	4850	R 148	5914	R 180	7453	R 212	10073	R 244	15537
R 21	596	R 53	2065	R 85	3446	R 117	4902	R 149	5952	R 181	7514	R 213	10185	R 245	15805
R 22	641	R 54	2107	R 86	3485	R 118	4955	R 150	5991	R 182	7576	R 214	10300	R 246	16082
R 23	688	R 55	2152	R 87	3526	R 119	4982	R 151	6031	R 183	7639	R 215	10417	R 247	16369
R 24	733	R 56	2198	R 88	3567	R 120	5009	R 152	6071	R 184	7703	R 216	10536	R 248	16667
R 25	780	R 57	2247	R 89	3609	R 121	5037	R 153	6111	R 185	7768	R 217	10659	R 249	16975
R 26	825	R 58	2292	R 90	3652	R 122	5064	R 154	6752	R 186	7835	R 218	10784	R 250	17296
R 27	871	R 59	2338	R 91	3696	R 123	5093	R 155	6194	R 187	7902	R 219	10913	R 251	17628
R 28	917	R 60	2381	R 92	3741	R 124	5121	R 156	6236	R 188	7971	R 220	11044	R 252	17974
R 29	963	R 61	2431	R 93	3788	R 125	5150	R 157	6279	R 189	8041	R 221	11179	R 253	18333
R 30	1008	R 62	2477	R 94	3835	R 126	5179	R 158	6322	R 190	8112	R 222	11317	R 254	18707
R 31	1054	R 63	2518	R 95	3884	R 127	5208	R 159	6366	R 191	8185	R 223	11458	R 255	19097

L6482 Registers

The Query Register and Write Register commands access registers on the STMicroelectronics L6482 Microstepping Controller. These commands use a register parameter that identifies an L6482 register. Table 3-5 lists the valid register parameter values along with the corresponding L6482 register name and function.

Table 3-5 L6482 Registers

Register Parameter Value	Register Name	Register Function
1	ABS_POS	Current position
2	EL_POS	Electrical position
3	MARK	Mark position
4	SPEED	Current speed
5	ACC	Acceleration
6	DEC	Deceleration
7	MAX_SPEED	Maximum speed
8	MIN_SPEED	Minimum speed
9	FS_SPD	Full-step speed
10	TVAL_HOLD	Holding reference voltage
11	TVAL_RUN	Constant speed reference voltage
12	TVAL_ACC	Acceleration starting reference voltage
13	TVAL_DEC	Deceleration starting reference voltage
14	T_FAST	Fast decay settings
15	TON_MIN	Minimum on-time
16	TOFF_MIN	Minimum off-time
17	ADC_OUT	ADC output
18	OCD_TH	OCD threshold
19	STEP_MODE	Step mode
20	ALARM_EN	Alarms enabled
21	GATECFG1	Gate driver configuration
22	GATECFG2	Gate driver configuration
23	CONFIG	IC configuration
24	STATUS	Status

LED Functions

The NAM SM200X features LEDs that indicate the status of stepper motors and RS-232 activity.

Stepper Motor LEDs

Figure 3-1 shows the LEDS that are present on each stepper motor controller board.

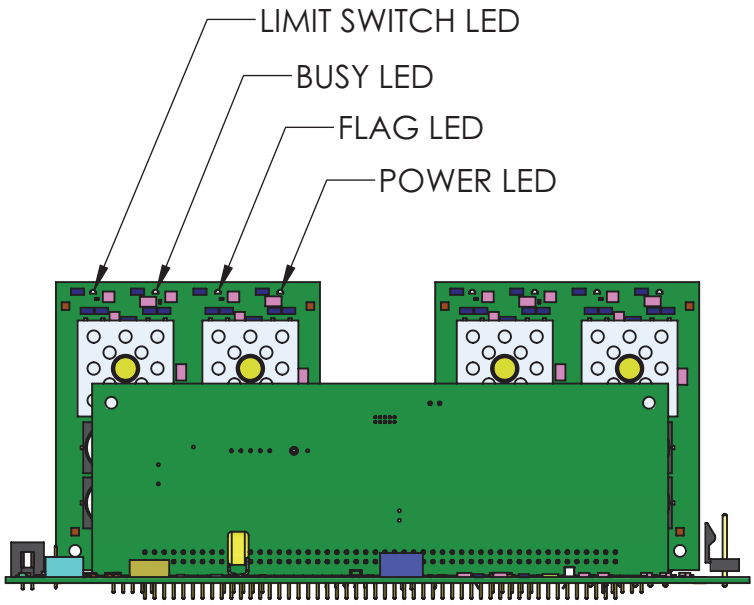

Figure 3-1 Stepper Motor LEDs

The function of each stepper motor LED is described in Table 3-6.

Table 3-6 Stepper Motor LED Functions

LED Name	LED Function
LIMIT SWITCH	Indicates that the motor has reached either the home position, clockwise limit, or counterclockwise limit.
BUSY	Indicates that the motor is moving.
FLAG	Indicates a fault condition.
POWER	Indicates that power is being supplied to the individual controller board.

RS-232 LEDs

Figure 3-2 shows the LEDS that are present on the main controller board for indicating the state of RS-232 activity.

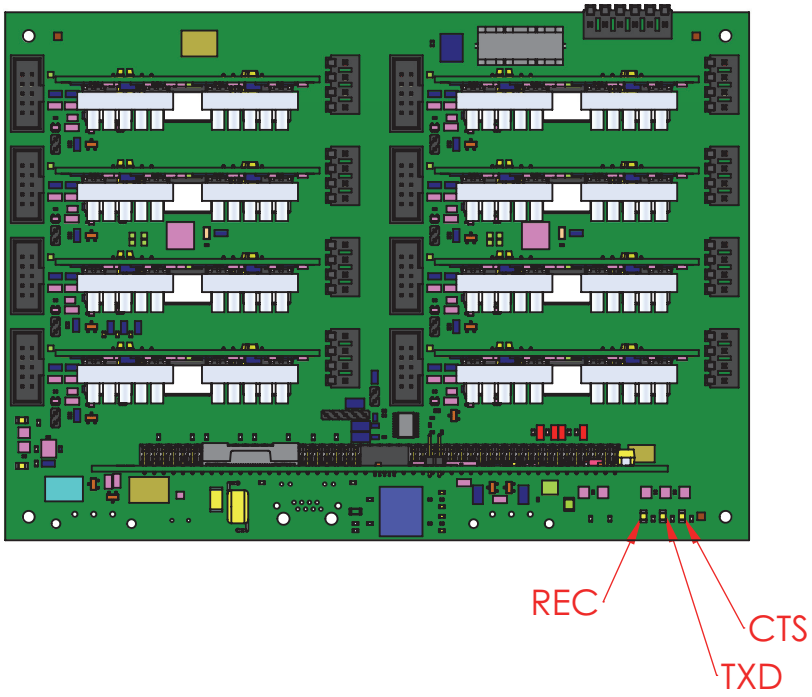

Figure 3-2 RS-232 LEDs

The function of each RS-232 LED is described in Table 3-7.

Table 3-7 RS- 232 LED Functions

LED Name	LED Function
REC	The motor controller is receiving RS-232 data
TXD	The motor controller is transmitting RS-232 data
CTS	On indicates the motor is ready to accept a command.

CPU LED

The CPU board has a status LED that provides startup information and indicates when the NAM SM200X is ready to accept commands. Figure 3-3 shows the location of the CPU Status LED.

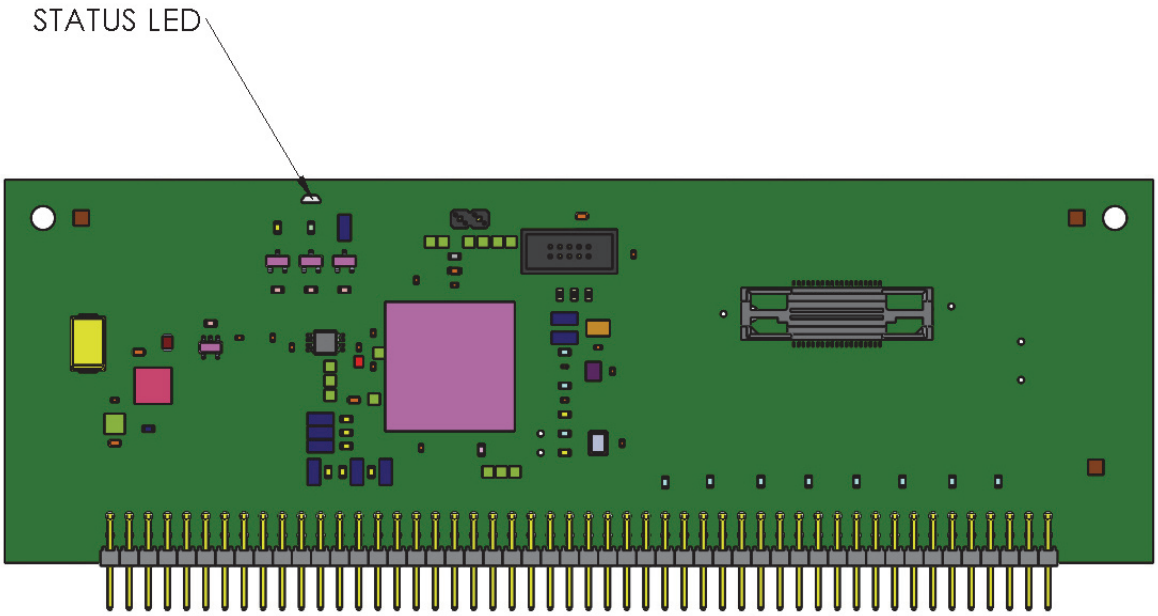

Figure 3-3 CPU Status LED

Table 3-8 provides descriptions of the CPU statuses.

Table 3-8 CPU Status LED Descriptions

LED Color	Description
Red	Controller is booting
Blue	Controller is initializing
Green	Stepper motor controller is ready to accept commands

Firmware Updates

Updates to the NAM SM200X firmware can be made by uploading an updated version of the firmware binary file to the controller as described below. Contact New Age Micro for information on obtaining firmware binary file updates.

Use a terminal emulation program, e.g., Tera Term, to configure the serial port on your computer and upload the binary file as follows. Tera Term is a freely available open source program.

1. Connect the serial port of the NAM SM200X with the serial port of the computer with the terminal emulation program installed.
2. Power up the NAM SM200X.
3. Open the terminal emulation program.
4. Set the port to the assigned port on your computer.
5. Set the serial port parameters as shown in Table 3-9.

Table 3-9 Serial Port Parameters

Parameter	Value
Baud rate	9600
Data	8 bit
Parity	None
Stop	1 bit
Flow control	None

6. Upload the binary file containing the firmware update. In Tera Term, this is done by selecting “Send File...” from the File menu and then selecting the firmware image file. Note that if there is an option to specify binary mode, select that option.
7. When the file transfer is complete, the NAM SM200X will reboot.
8. When the boot process is complete (the CPU Status LED will be green), issue the Version (‘V’) command to verify the correct firmware version.

Ordering Information and Part Numbers

Stepper Motor Controllers

The NAM SM200X product line consists of stepper motor controllers that are available in a variety of configurations. Options that are configurable are:

- number of axes (from 1 to 8)
- physical layer
- communication protocol

Available physical layers are listed in Table 4-1.

Table 4-1 SM200X Physical Layers

Physical Layer ID	Physical Layer Description
232	RS-232
485	RS-485
CAN	Control Area Network
ETH	Ethernet
USB	Universal Serial Bus

Available protocols are listed in Table 4-2.

Table 4-2 SM200X Protocols

Protocol ID	Protocol Description
A	CY545
M	Modbus

How to Order

SM200X controllers can be ordered by referencing the part number that specifies the controller configuration using the following part number format:

```
SM200<X>-<physical layer><protocol>-<version>
```

For example, to order version 1.0 of an 8 axis controller with RS-232 communication using the CY545 protocol, the following part number would be used:

```
SM2008-232A-1.0
```

Mating Connectors

Manufacturer part numbers for mating connectors to the NAM SM200X connectors are listed in Table 4-3.

Table 4-3 Mating Connector Part Numbers

Description	Manufacturer	Manufacturer Part No.	Quantity
Stepper Control Mating Connector	TE Connectivity	3-640426-4	8
Power In Mating Connector	TE Connectivity	3-643817-6	1
RS-232 Mating Connector	Phoenix Contact	1942277	1
Sensor Control Mating Connector	TE Connectivity	1659620-1	8

Electrical Specifications

Table 5-1 lists electrical specifications for the NAM SM200X.

Table 5-1 SM200X Electrical Specifications

Specification	Value
Power Requirements	5 V ± 5% @ 0.5 amps 12-40 V @ 4 amps
Stepping Options	The following stepping options are supported: • Full • Half • Quarter • Eighth • Sixteenth
Maximum current per motor	4 amps
Operating Temperature	0°C to 70°C
Storage Temperature	-40°C to 125°C
Step Frequency	15 kHz maximum

Mechanical Information

The locations of mounting holes as well as the dimensions of the NAM SM200X are shown in Figure 6-1.

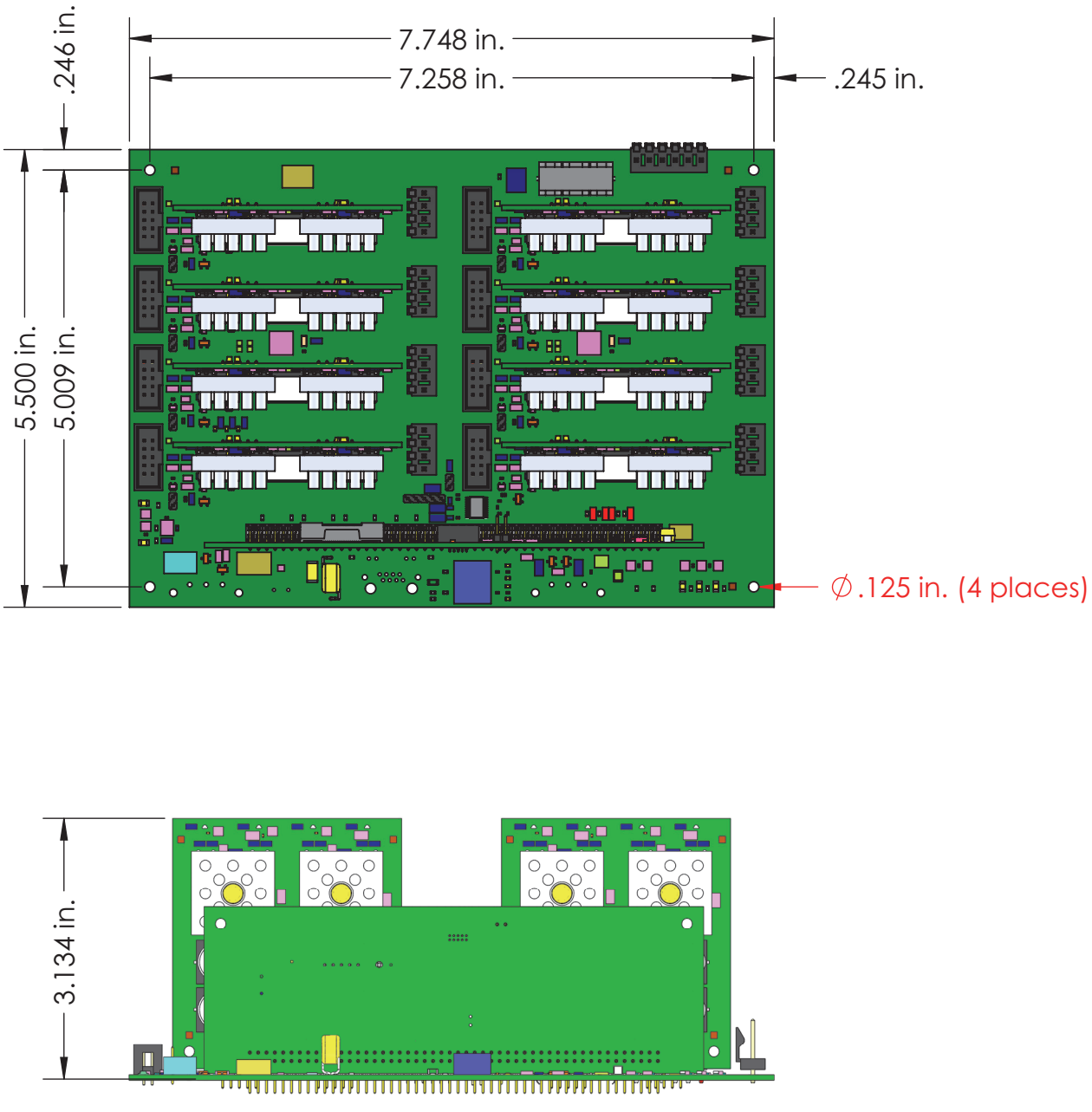

Figure 6-1 NAM SM200X Mounting Holes and Dimensions