AUDIOHMS MST-109 Microstep Stepper Motor Drive User Manual

Contents

AUDIOHMS MST-109 Microstep Stepper Motor Drive

www.audiohms.com

Description

- MST-109 is a micro step stepper motor drive designed to be used with maximum supply voltage of 60V and a maximum current of 9A.
- The drive is based on a DSP microcontroller and has built-in sophisticated options for stepper motors control. These options are, an advanced algorithm for managing the operation of the stepper motor at higher revolution speed, the selection of microsteps up to 1/256 (binary and decimally selection), then the selection of quiet operation when the stepper motor is not in operation. This makes it possible to make maximum use of the available torque of the stepper motor at higher speeds.
- The selection of micro steps, as well as other operating mode options, is made using DIP switches with 8 positions, which are located on the drive board.
- Setting the current of stepper motors in the range of 1.0–9.0 A is done using an external resistor.
- Powerful MOSFET transistors in TO220 package are used to drive stepper motors.
- Stepper motors are controlled via three lines, STEP, DIR and ENA (Enable). This means that already developed popular software such as: mikro CNC (free), Mach3, Mach4, Linux CNC (free) and similar can be used for multi-axis control.
- The MST-109 can be connected to a computer via any Audios Automatics Ethernet, USB motion controller and also via an IO3-R3 breakout board that communicates with the computer via the LPT port.
- A single power supply (from 22–60 V DC) is required to power the stepper motor drive. The drive has an additional circuit for stabilizing the voltage necessary to power the control electronics.
- The drive has an automatic reduction of the current flowing through the windings of the stepper motor. If there is no signal on the STEP line for more than 1 s, the coils current will be decreased to 50% of the set value. This reduces unnecessary heating of stepper motors.
- The built-in soft start enables the stepper motor 1s after the supply voltage arrives, which reduces the current shock when switching power on.
- The microstep drive for stepper motors MST-109 has a built-in overvoltage protection that is activated when the supply voltage exceeds 65 VDC.
- For currents above 4 A per stepper motor phase, it is necessary to place the drive on an additional heat sink.

Highlighted characteristics

- New generation of micro step drive for stepper motors based on DSP microcontroller.
- Precise, sophisticated stepper motor current regulation that provides higher torque at higher rpm.
- True sinusoidal shape of the current profile, without distortion and crossover distortion, which leads to less variation of the torque during microstepping, less vibration, noise and less heating of the stepper motor.
- Auto decay mode, without artifacts of the current profile present in the older generation of drives, suppresses the distortion caused by slow decay when the current decreases and fast decay when the current increases through the windings of the stepper motor.
- Up to 1/256 micro steps, resulting in 51200 steps per revolution of a typical stepper motor, for fine motion control even at low stepper motor revolution speeds.
- Built-in soft start/pause.

Technical specifications

Microstep resolution	1/1, 1/2, 1/4, 1/5, 1/8, 1/10, 1/16, 1/20, 1/25, 1/32, 1/50, 1/64, 1/100, 1/128, 1/200 and 1/256 microsteps
Number of axis	1
Phase current	9 A max
Current setting	1,0–9,0 A (by external resistor)
Supply voltage	22–60 V DC max, recommended up to 55 V DC
Input control interface	Opto-isolated STEP, DIR and ENA (enable) command lines
Input current	8.5 mA at 5 V (TTL)
Input signal width	> 1 µs (recommended > 5 µs)
Dimensions	80 mm x 105 mm x 31 mm
Weight	~170 g

NOTE: Specifications are subject to change without notice

Drive outline and wiring diagram

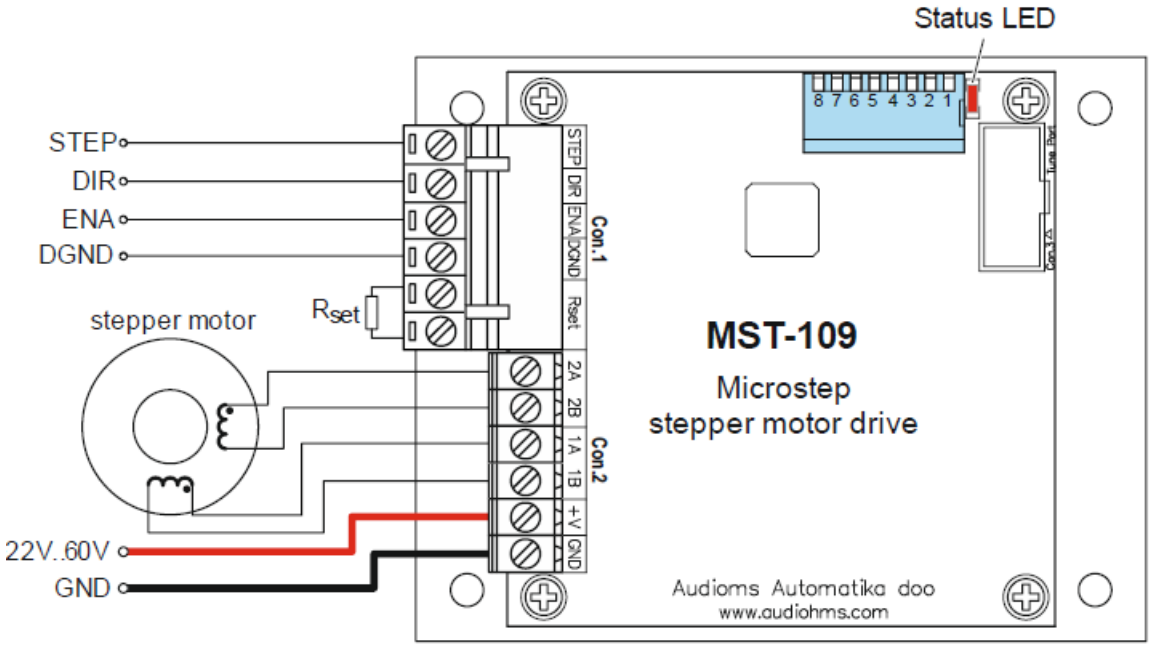


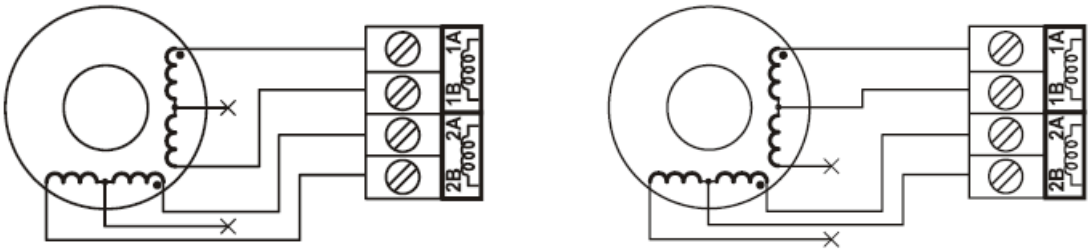
Figure 4.1 Drive outline and wiring diagram

Figure 4.1 gives the drive outline and wiring diagram of the microstep stepper motor drive MST-109.
If a linear power source is used to supply the drive, it needs to be well filtered with an electrolytic capacitor. There is an additional electrolytic capacitor on the MST-109 drive board. It is recommended to use a slow-blow fuse on the power line of each individual drive.
If TTL logic is used on the STEP, DIR and ENA lines, then in the case of logic “1” a current of 8.5 mA will flow through these lines.

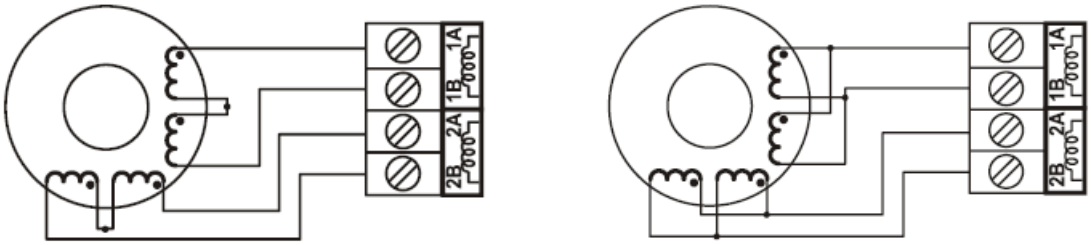
NOTE: A step will occur on each rising edge of the signal on the STEP command line.

Connection stepper motor

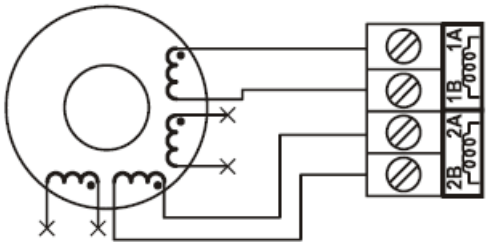
Stepper motors with 4, 6 and 8 leads can be connected to drive MST-109. Connection of stepper motor with 4 leads is shown at Figure 4.1, while other possible connections are shown on Figure 5.1. Calculation of maximum phase current I_{max}, , related to nominal current, I_{nom} (I_{nom} is recommended from stepper motor manufacturer), for all possible configuration are shown.



- Connecting stepper motor with 6 leads (full coil configuration) $I_{max} = 0{,}7 \cdot I_{nom}$
- Connecting stepper motor with 6 leads (half coil configuration) $I_{max} = I_{nom}$



- Connecting stepper motor with 8 leads (series connection) $I_{max} = 0{,}7 \cdot I_{nom}$
- Connecting stepper motor with 8 wires (parallel connection) $I_{max} = 1{,}4 \cdot I_{nom}$



- Connecting stepper motor with 8 wires (half coil configuration) $I_{max} = I_{nom}$

Parameters settings

The setting of the operating parameters of the microstep drive MST-109 is done using an 8-position DIP switch. It is set using a DIP switch (Figure 6.1):

- Microsteps selection (DIP switch positions from 1 to 4),
- Gain selection (DIP switch positions 5 and 6),
- Activating the silent mode of operation in the idle state of the stepper motor (DIP switch position 7), and
- Enable mode (DIP switch position 8).

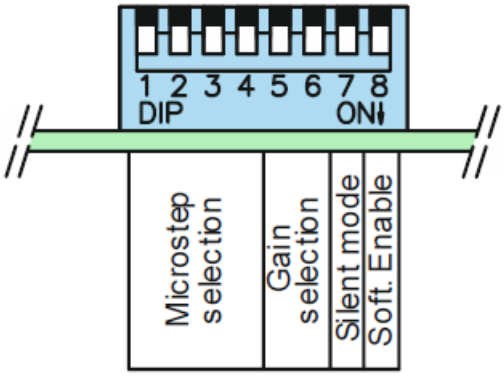


Figure 6.1 DIP switches function description

DIP switches function description Selection of DIP switch positions

- The “raised” (↑) position is “zero” (0) in the operating parameters selection tables, and
- The “down” (↓) position is “one” (1) in the operating parameters selection tables.

The following is a more detailed description of the setting of stepper motor drive MST-109 operating parameters.

Microstep selection

DIP switches in positions 1, 2, 3 and 4 (Figure 6.1) provide the choosing of 16 different microsteps option (Table 6.1). Choice of binary and decimally microstep values is possible.

The last column in the given table shows how many pulses on STEP line are required to be sent to the MST-109 drive in order for the stepper motor to complete one full rotation for all available microstep selections. A stepper motor that requires 200 pulses for a full revolution in full-step mode is considered.

Table 6.1 Microstep selection

DIP switch position				Microstep selection	Required number of pulses for full revolution
1	2	3	4		
0	0	0	0	1/1 Full-step	200
0	0	0	1	1/2	400
0	0	1	0	1/4	800
0	0	1	1	1/5	1000
0	1	0	0	1/8	1600
0	1	0	1	1/10	2000
0	1	1	0	1/16	3200
0	1	1	1	1/20	4000
1	0	0	0	1/25	5000
1	0	0	1	1/32	6400
1	0	1	0	1/50	10000
1	0	1	1	1/64	12800
1	1	0	0	1/100	20000
1	1	0	1	1/128	25600
1	1	1	0	1/200	40000
1	1	1	1	1/256	51200

Gain selection

Gain is a suggestion to the built-in stepper drive current regulator for the desired mode of operation (more or less aggressive). It is possible to choose 4 different levels of amplification. DIP switches in positions 5 and 6 are used for that purpose (Figure 6.1). The choice of gain depends on the inductance of the stepper motor. Table 6.2 gives possible gain choices. The stepper motor coil inductance value can be found in the technical documentation that comes with the stepper motor.

Table 6.2 Gain selection

DIP switch position		Gain selection	Stepper motor inductance
5	6		
0	0	Lowest	For stepper motors with coil inductance from 1 mH to 4 mH. Large stepper motors or stepper motors where the coils per phase are connected in parallel
0	1	Middle	For stepper motors with coil inductance from 4 MH to 8 MH
1	0	Higher	For stepper motors with coil inductance from 8 MH to 12 MH
1	1	Highest	For stepper motors with coil inductance greater than 12 MH. Stepper motors with a relatively high nominal coil resistance or stepper motors where the coils per phase are connected in series

NOTE: Sometimes it is necessary to experimentally find the optimal choice of gain depending on the specific stepper motor – mechanical transmission system.

Selection of Silent mode

The microstep drive MST-109 provides the option of silent operation when the stepper motor do not rotate. The selection is made using the DIP switch in position 7. When the DIP switch 7 is “down” (↓), i.e.. is “one” (1) (Figure 6.1), then the Silent mode of operation is active. Otherwise, it is inactive.

Enable mode selection

The DIP switch in position 8 (Figure 6.1) provides the possibility of choosing two Enable modes of operation

- If switch 8 is inactive (↑) then Software Enable mode is selected. In this mode, the ENA input on connector Con.1 (Figure 4.1) is active. If there is logical “high” at the ENA input, the drive is active and will execute the commands coming to it from the STEP and DIR command lines. In case there is a logical “low” at the ENA input, then the MST-109 drive is inactive, STEP and DIR commands are not executed and the stepper motor is not energized (this option is often used if it is necessary to manually rotate the stepper motor), and
- If switch 8 is active (↓) then Hardware Enable is selected. In this mode, the ENA input on connector Con.1 (Figure 4.1) is not functional. The drive is always active.

Examples of working parameters settings

Figure 6.2 shows two example of parameter settings on the MST-109 microstep drive.

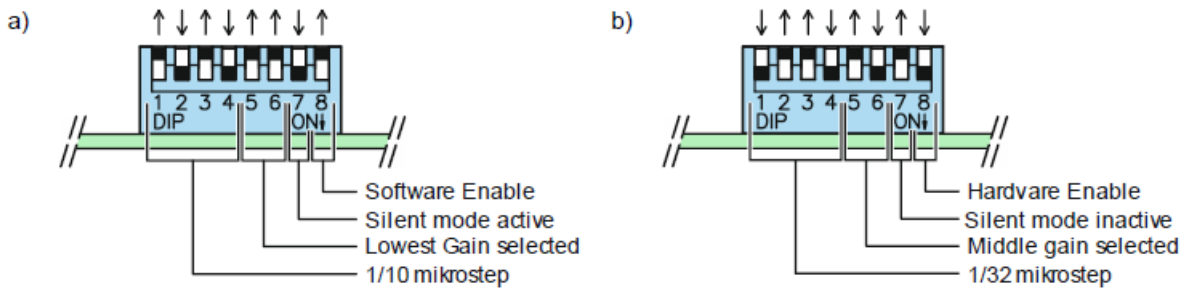


Figure 6.2

Stepper motor current setting

The setting of the stepper motor current is performed using an external resistor marked with 4.1). Use 1/4W resistors with a maximum tolerance of 5%.

NOTE: Replacing the Rset resistor should only be done when the stepper motor drive power supply is turned off.

Table 7.1 gives the recommended current set resistor values.
Table 7.1 Choosing of Rset resistor

***I*, A**	***Rset*, Ω**
1	Without resistor
1,5	33k
2,0	18k
2,5	10k
3,0	6k8 (7k5)
3,5	4k7 (5k6)
4,0	3k9
4,5	3k (3k3)
5,0	2k4 (2k7)
5,5	1k8
6,0	1k5
6,5	1k (1k2)
7,0	750
7,5	510
8,0	330
8,5	150
9,0	0

Procedure for setting the current on the stepper motor

- Start from the minimum current value, or start without the resistor Rset installed.
- Gradually increase the current through the phases of the stepper motor, until the current given in the characteristics for the stepper motor is reached.
- If the motor heats up, it is necessary to reduce the set current to a level that does not cause excessive heating of the stepper motor.

In certain cases, a noise (or slight “squeal”) can be heard from the stepper motor even when the motor does not rotate. The reason for this is the PWM mode of operation of the stepper motor drive MST-109.
NOTE: The MST-109 microstep drive has built-in circuit that hardware monitors the current through the stepper motor windings. If the current through the motor windings exceeds the set current value by more than 30 %, the drive will stop working, ie. overcurrent protection is activated. In this case, it is necessary to turn off the power supply to the drive and turn on again the power supply to the stepper motor drive.

Status LED

There is a status LED on the MST-109 stepper motor drive board (Figure 4.1). Table 8.1 gives a description of the possible motor drive states indicated by the status LED.

Table 8.1

Does not light up	Stepper motor drive is not powered
Blinking slow	Stepper motor is powered up, Disable mode
Constantly lights	Stepper motor is powered up, Enable mode
2 short blink	Overcurrent detection
3 short blink	Overvoltage protection. When the supply voltage exceeds 65 VDC, overvoltage protecti on is activated

Recommendations when using the stepper motor drive MST-109

1. The positive power line of drive should have fast-blow fuse
    - for stepper motors to 3 A use fast-blow fuse 1.25–1.5 A, and
    - for stepper motors over 3 A use fast-blow fuse 2–2.5 A.
2. Recommended power supply voltage should be in the range of 22–60 V DC. Modern stepper motors have nominal voltage about 2–3 V. The recommended power supply voltage of the drive should be 10–15 times higher than nominal stepper motor voltage. It is quite enough to obtain good speed-torque characteristics of the motor.
3. Length of the cable for connection between stepper motor and drive should be as smaller as possible. Recommendation is that two conductors that supply phase be twisted around the longitudinal axis (twisted pair) like telephone twisted pair. It is preferred to use shielded cable, where cable armature will be connected to the side of the drive enclosure where is the electronics (not to ground of power supply).
4. It is not recommended that contactor and other electromagnetic power switches be close to microstep stepper motor drive MST-109, because it can induce strong electromagnetic discharge and strong mechanical impacts that can damage the drive.

Before delivery all microstep drives MST-109 are tested on power supply voltage in range of 20–40 V DC and output current up to 7.5 A. Supply voltage that exceeds 60 V DC, incorrectly connected power supply, incorrectly connected and defective stepper motor, strong electromagnetic discharge etc. can permanently damage the drive.

DOCUMENT REVISIONS

- Ver. 1.0 April 2023., Preliminary version
- Audioms Automatika doo Kragujevac, Serbia
- **web**: www.audiohms.com
- **E-mail**: office@audiohms.com
- MST-109 Microstep stepper motor drive – User's manual, April 2023.

Documents / Resources

	**AUDIOHMS MST-109 Microstep Stepper Motor Drive** [pdf] User Manual MST-109 Microstep Stepper Motor Drive, MST-109, Microstep Stepper Motor Drive, Stepper Motor Drive, Motor Drive, Drive

References

- Audiohms - drajveri za upravljanje koračnim i DC servo motorima
- User Manual