



PROGRAMMABLE STEP MOTOR CONTROLLER SMSD-8.0

Manual

SMSD.80.001

1. Product designation

Programmable step motor controller SMSD-8.0 is designed to operate with stepper motor with maximum current per phase up to 8.0 Amp. There are four control modes provided: programmable, manual, simple driver or "synchro".

2. Functions and possibilities

- Recording the operation algorithm from a computer to EEPROM of the unit as a sequence of commands.
- Reading the saved algorithm from the EEPROM to a computer.
- The unit can operate and be controlled by computer ("direct control") or in a standalone mode.
- In the manual mode: the unit receives analog signal "SPEED" (voltage signal 0 – 5VDC, internal or external potentiometer) and digital signals "DIR" and "EN".
- In the simple driver mode: the unit receives signals "STEP", "DIR" – 0VDC low level and 15VDC high level, and digital signal "EN".
- In the "synchro" mode unit receives quadrature-phase signal.
- For synchronized operation of several units and other devices there are 3 digital inputs and one output relay are provided.
- There is zero positioning function provided (only in controller mode): start zero search by a command or by a signal on the digital input. Stop zero searching movement as input signal is received. The function provides homing by an individual input.
- The unit stops motor motion as receives a signal on an "Enable" input.

3. Technical characteristic

Common characteristics:

- Number of controlled stepper motors: 1
- Maximum output current per phase: 8,0 Amp
- Minimum output current per phase: 1,5 Amp
- Microstepping modes: 1, 1/2, 1/4, 1/16
- Pulse frequency in programmable and manual modes: 1 - 10000 Hz
- Voltage input: 24 - 72 VDC
- Maximum overall dimensions: 140x121x44 mm

Inputs DIR, STEP (simple driver mode):

- High voltage level: 3 – 15 VDC
- Low voltage level: 0 – 0,8 VDC
- Input resistance: no less 1,0 KOhm

Digital inputs EN, IN1, IN2, START, RESET, HOME, "0":

- Contact to COM

Communication interface – USB, virtual COM RS232:

- baud: 9600
- bits: 8
- parity: even
- stop bit: 1

Additional output «5 VDC»:

- Voltage: 4,5 – 6,5 VDC
- Maximum load current: 20 mAmp

Environmental Conditions:

Ambient Temperature: -25...+40°C
Humidity: 90% RH or less upon condition +25°C
Condensation and freezing: none
Pressure: 650...800 mm of mercury

4. Construction

SMSD-8.0 is designed as a circuit plate with electronic elements, installed on a heat sink plate and covered with a metal case. Besides electronic components, there are indicating and control elements, connection terminals and connectors on the board (img. 1).

Terminal screws for step motor windings (1) and power supply (2);

Control buttons "START" (13), "RESET" (14), and duplicate terminals START/COM (18) and "RESET/COM" (21);

Finding home position button "HOME" (12) and duplicate terminals HOME/COM (16) and terminals for home sensor "0"/COM (17).

Internal preset potentiometer "SPEED" (15) to adjust speed in the manual mode, and terminals for an external potentiometer connection (22) to control motor speed in manual mode.

LEDs for indication of the controller status (7).

Switches SW1 – SW4 to set the current of the motor windings.

Switch SW5 to set the automatic reduction of holding current.

Switch SW6, SW7 to set the microstepping mode.

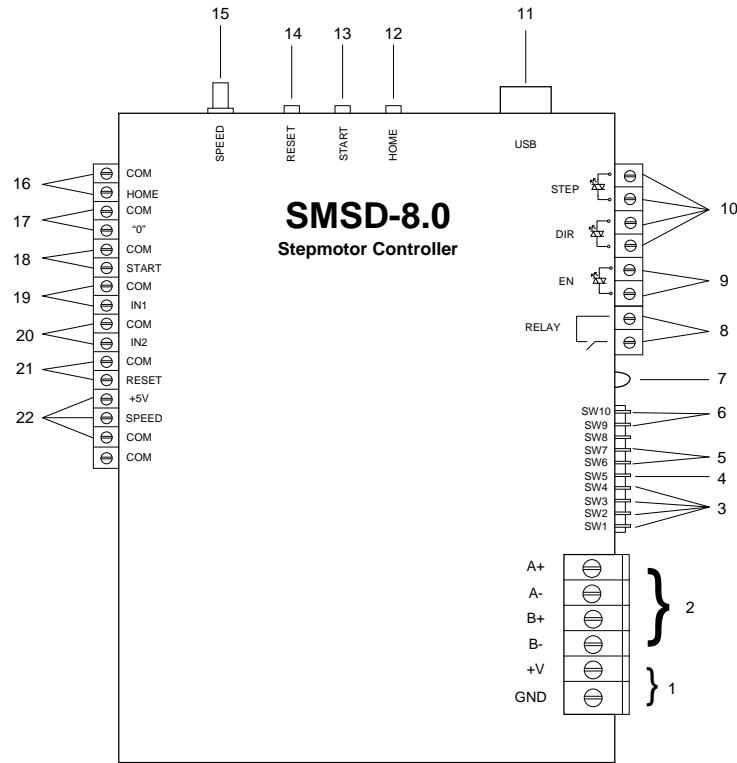
Switch SW9, SW10 to set the operation mode.

Terminals for connection control signals "DIR", "STEP" (10) and digital signal "EN" (9).

Programmable relay (8).

Programmable inputs IN1/CON (19), IN2 / COM (20).

USB plug for a computer connection (11).



Img. 1. SMSD-8.0 controller scheme

5. Assembly and connection

Please, learn this manual carefully before connection and assembly.

Please, wire just when power is off. Do not attempt to change wiring while the power is on.

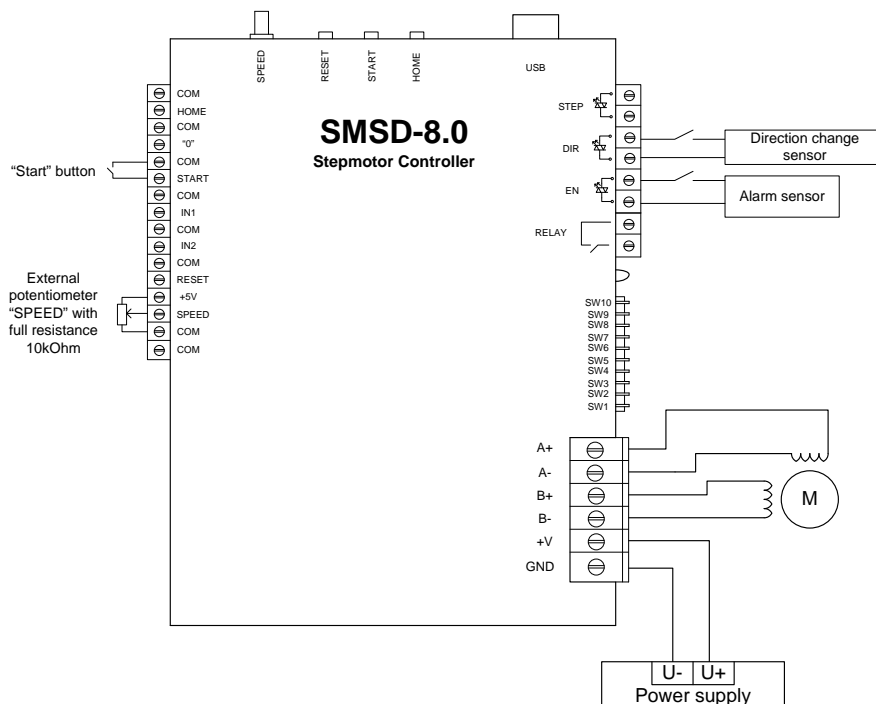
Please, provide a reliable contact in connection terminals. During wiring, please, observe the polarity and wire management.

Assembly and connection order

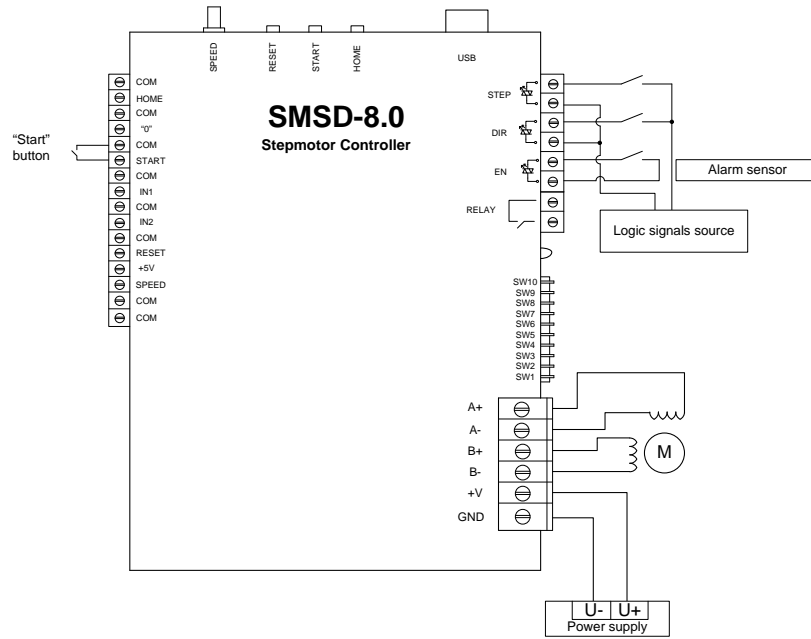
1. Connect the SMSD-8.0 controller with stepper motor, switches and electric DC power supplier according to one of schemes shown down in images 2 – 5.
2. Connect if it is necessary the SMSD-8.0 controller to a computer by an interface USB cable.

Connection schemes

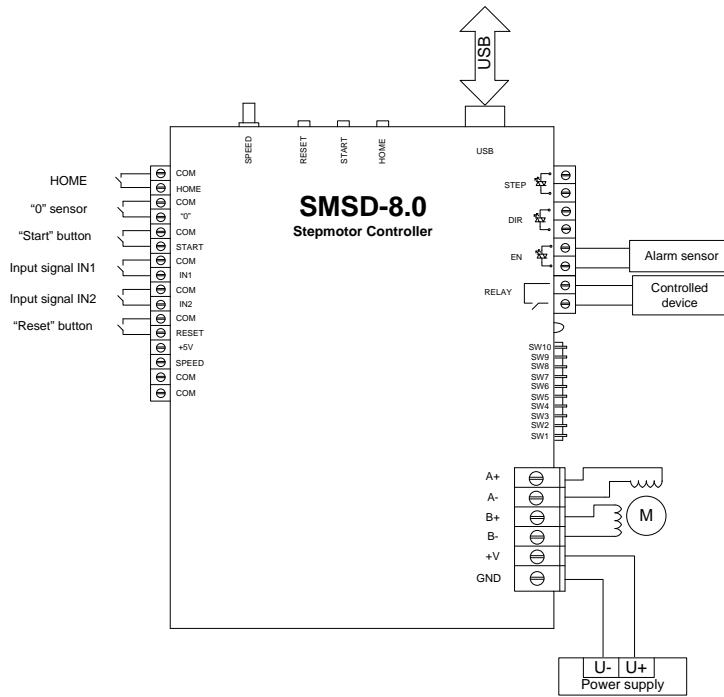
The connection examples are in the images 2 – 5. The switch connection example is in the image 6.



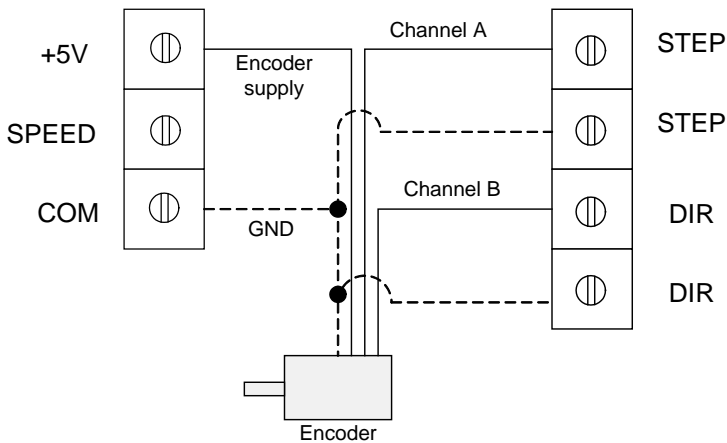
Img. 2. Manual mode connection example



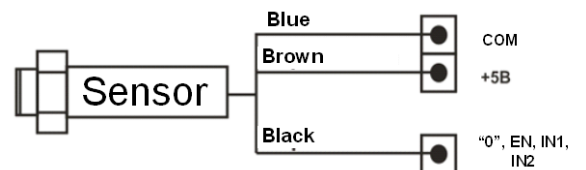
Img. 3. Driver mode connection example



Img. 4. Controller mode connection example



Img. 5. Encoder connection example for "synchro" mode operation



Img. 6. NPN switch connection example

Motor connection

The SMSD-8.0 controller provides operation with 2 or 4-phase stepper motors, 4, 6 or 8 wires. Winding connection examples are in the table 1. Connect step motor wires to A, A*, B and B* terminals of SMSD-8.0.

Table 1

Scheme 1	Scheme 2	Scheme 3	Scheme 4
<p>8 wires steppmotor connection (4 phases): Scheme 1 – serial connection; Scheme 2 – parallel connection.</p> <p>6 wires steppmotor connection (2 phases with midpoint taps): Scheme 3;</p> <p>4 wires steppmotor connection (2 phases without midpoint taps): Scheme 4 .</p>			

6. Before starting

1. Make sure the power supply is turned off.
2. Make assembly and connection according to paragraph 5.
3. Choose the suitable current and set microsteps SW1 – SW4 according to table 2.

Table 2

Current, Amp	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
SW1	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On
SW2	Off	Off	On	On	Off	Off	Off	Off	On	On	Off	Off	On	On
SW3	Off	Off	Off	Off	On	On	Off	Off	Off	Off	On	On	On	On
SW4	Off	Off	Off	Off	Off	Off	On	On	On	On	On	On	On	On

4. Choose suitable microstepping mode and set micro switches SW6, SW7 according to table 3.

Table 3

Microstepping mode		1	1/2	1/4	1/16
Microstep	The full step is 1.8°	1.8	0.9	0.45	0.1125
Microswitches	SW6	On	Off	On	Off
	SW7	On	On	Off	Off

5. Set the switch SW5 for automatic reduction of holding current: **SW5 – ON → 100%; SW5 – OFF → 70%.**
6. Choose suitable operation mode and set micro switches SW9, SW10 according to the table 4.

Table 4

Operation mode	SW9	SW10
Controller	ON	ON
Manual	OFF	ON
Driver	ON	OFF
“Synchro”	OFF	OFF

If the unit is powered, the new operation mode is applied after RESET (by button or input signal).

7. Check wiring once again and turn on the power supply.

7. Operation modes

Manual mode

The speed is adjusted by the internal potentiometer SPEED or external potentiometer or analog signal 0-5VDC. Speed value is saved when leaving this mode, and it is restored when re-entry this mode.

When the external potentiometer is used, it is necessary to set the minimum speed with internal potentiometer SPEED (fully counter-clockwise) and connect external potentiometer with full resistance 10kOhm to terminals +5V / SPEED / COM (img.2), or connect contacts of analog signal source to terminals SPEED / COM.

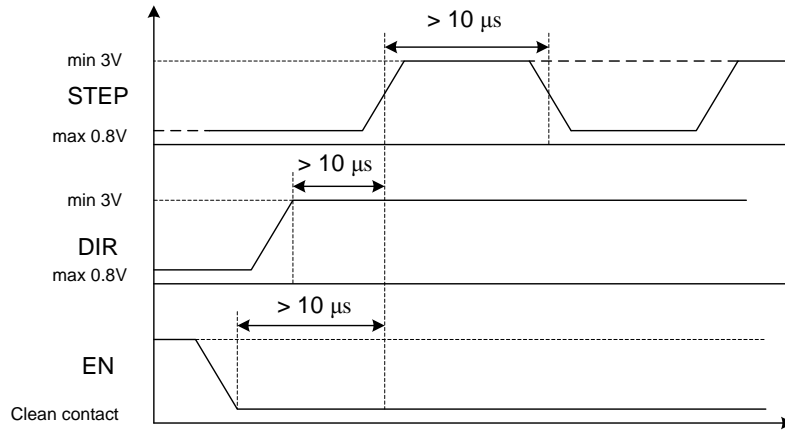
To change direction it is necessary to set signal DIR: high level or low level.

To start motion you need to push START button or use START/COM terminals. To stop motion you need to push START button once more or RESET button, in this case power is removed from the motor windings.

If EN signal is used: high level – motor is stopped, low level – motor continues motion.

Driver mode

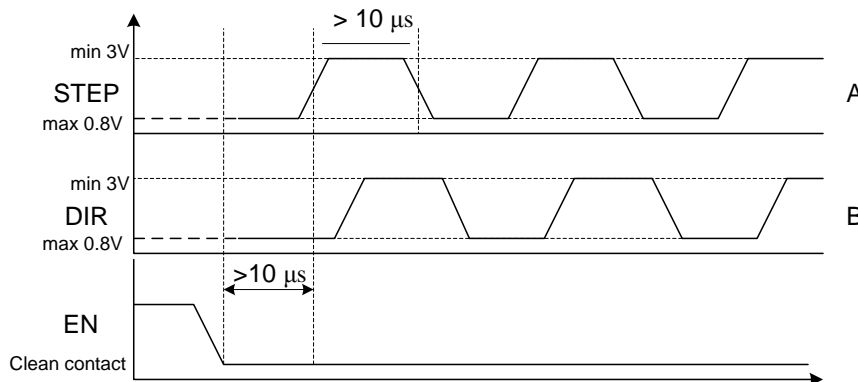
Connection example is in the image 3. One step (or microstep) executes as front edge of the voltage pulse on the “STEP” input. Direction switches by changing voltage level on the “DIR” input. The motor can be stopped by the active signal on the “EN” input (clean contact) - power is removed from the motor windings.



Img. 7. STEP and DIR input signals

“Synchro” mode

Connection example is in the image 5. The unit receives quadrature-phase signal on the “STEP” and “DIR” inputs according to the oscillogram in the image 8.



Img. 8. STEP and DIR input signals

One step (or microstep) executes as front edge of the voltage pulse. Direction is determined by the outpacing phase. The motor can be stopped by the active signal on the “EN” input (clean contact) - power is removed from the motor windings.

Controller mode

There are two possible variant of operation in this mode:

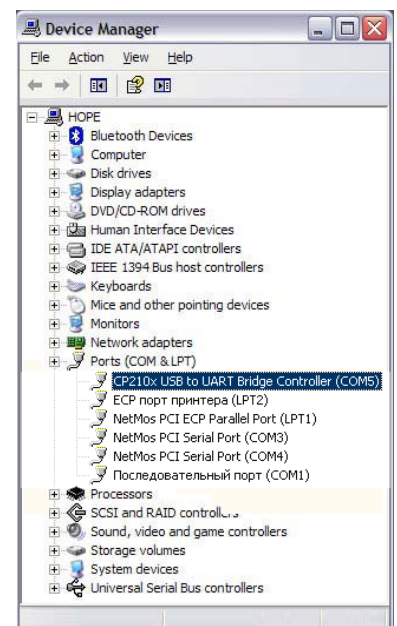
- Direct control: it gives the possibility to control the step motor in “real time”;
- Stand alone mode: for a standalone operation the executing program should be saved via USB (virtual RS-232), after that the USB cable can be disconnected.

For virtual RS-232 communication the special driver USB-RS-232 should be installed to the computer. Please, save on computer hard drive the installation pack CP210x_VCP_Win2K_XP_S2K3.zip, which is supplied with the controller SMSD-8.0. Unpack and execute the exe file. Please, follow the instructions during the installation progress. As a result when the controller is connected to the PC, the additional program COM-port appears (CP2102 USB to UART Bridge Controller).

The availability and the number of new port can be checked in windows device manager (Windows XP: On the desktop right-click on My Computer and click Properties or open the Control Panel and double-click the System icon. In the System Properties window click the Hardware tab. In the Hardware tab click the Device Manager button) – image 9. This COM-port should be used for communication with SMSD-8.0 controller. The port properties should be set in a terminal program according to the table 1. As a terminal program SMC_Program or some other software (software should provide RS-232 ASCII communication) can be used. The program is available and supplied with the SMSD-8.0 controller.

Saving execute program with SMC_Program

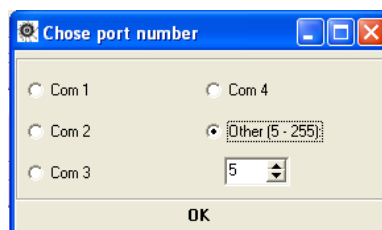
The program should be copied to the hard drive of the computer. Unpack the program pack. SMC_Program doesn't require registration and installation. The write read operations should be allowed in the program folder (carefully check for windows vista and windows 7).



Img. 9

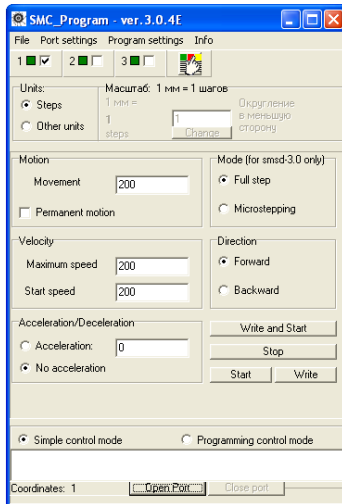


Img. 12

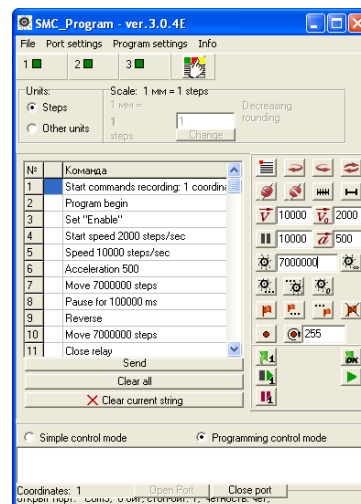


Img. 13

It is necessary to set port properties in SMC_Program. Menu "Port settings" > «Chose port» (image 12) chose the connected port number and press "Ok" (image 13).

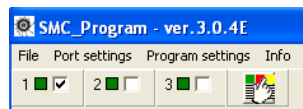


Img. 10. SMC_Program – control via simple panel



Img. 11. SMC_Program – program assembling



In the simple control panel window (img 10) check the box 1, (coordinate 1 – img.14).



Img. 14

If the program is in the simple control mode (image 10) - input motor operation parameters (steps number, speed, acceleration, direction) and press the button "write" to record parameters to the controller and press the button "start" to start motion according to the recorded command sequence. Or press the button "Write and start" to record new parameters and start motion at the moment.

If the program is in the programming control mode (image 11) add to the command list:

- 1) «Start loading to the coordinate 1» ;
- 2) Add commands to assemble the operation algorithm.
- 3) «End loading» .
- 4) Press the button «send» under the command list.

Commands list and description are in the section 8. "Commands", and in the SMC_Program manual.

After the commands sequence (operation algorithm) is recorded into the controller there are two possibilities: to continue control by the SMC_Program or to use the controller in standalone mode. To start program executing in the standalone mode press the "Start" button or contact "Start" and "GND" at the controller frame.

When "Direct control" is used command "start loading to the coordinate 1", "End loading" are not used. You need to check the box "Direct control" in "Programming control mode" and command is executed as soon as it is written in command window.

Saving execute program with other terminal program with RS-232 communication function

Set the port number (check in the windows device manager, image 9), set port parameters according to the section 3. Input required commands sequence using the ASCII codes (table 5, 6; section 8).

8. Commands

Commands in the programmable mode should be byte-serial (character-serial) transferred. Every command should be completed with the ending character "***". The ending character "\n" instead of "***" cancels previous bytes transfer (whole string). There is the commands list in the table 5. The SMSD-8.0 controller receives and checks every command after receiving the ending character "***". Controller sends to the communication port a reply after receiving every command (successful or error command). All possible controller replies are presented in the table 6.

Table5

№	Command	Standalone mode	«Direct control»
1	LD	Start loading to the controller – after LD command controller is in the loading mode.	-
2	RD	Read the command sequence from the controller memory.	-
3	ST	Start or stop the commands sequence executing Start if the controller in the programmable standby mode, stop if the commands sequence is executing.	After receiving this command, the motor will stop immediately, the previous command is considered complete
4	LB	-	Start loading to the operational buffer. If this command is received while driving, the motor is stopped and turned off.
5	RB	-	<u>Read the command sequence from the operational buffer.</u> If this command is received while driving, the motor is stopped and turned off.
6	SBddd	-	Start the commands sequence of the operational buffer

			executing. ddd – sets how many times the program from the operational buffer should be executed (from 1 to 255). If it is necessary to stop program executing use ST command
7	ED	Complete executing commands sequence. After accepting this command the controller records all transferred commands into the memory and turns to the standby mode.	Complete executing commands sequence. After accepting this command the controller record all commands to operational buffer and turns to the standby mode
8	BG	Set the address pointer in 0	
		Begin - start a new algorithm, the previous sequence is cleared.	Begin - start a new algorithm in the bufer, the previous sequence is cleared.
9	EN	Set "enable" - turn on the motor	
10	DS	Set "disable" - turn off the motor	
11	DL	Forward motion	<u>Forward motion</u> - if the motor is stopped, the start of the motion will be in this direction; - if this command was received while driving, the remaining steps are processed in the direction according this command
12	DR	Backward motion	<u>Backward motion</u> - if the motor is stopped, the start of the motion will be in this direction; - if this command was received while driving, the remaining steps are processed in the direction according this command
13	RS	Reverse	<u>Reverse</u> - if the motor is stopped, the start of the motion will be carried out in the opposite direction; - if this command was received while driving, the remaining steps are processed in the opposite direction
14	AL(-)ddd ¹	Acceleration ddd: min = -1000, max =1000	
15	SDddd (1 to 10000)	Speed ddd	<u>Speed:</u> - if the motor is stopped the start of the motion will be carried out with this speed; if acceleration is used this command sets the final speed; if there is no acceleration this speed will be used as start speed; - if this command was received while driving, the remaining steps are processed with this speed
16	SSddd (1 to 2000)	<u>Start speed:</u> This command is used only for starting motion and only when acceleration is used (AL≠0)	
17	SF	Turn relay on	
18	CF	Turn relay off	
19	MV	Continuous movement	<u>Continuous motion</u> - if the motor is stopped, this command starts perpetual motion; - if this command was received while driving, continuous motion with current speed begins
20	MVddd (1 to 10000000)	Move to ddd steps	<u>Motion on number of steps</u> (min 1pul – 10000000pul) - if this command was received when the motor is stopped, the motor will make ddd steps and stop; - if this command was received while driving, the motor will make ddd steps and stop, previous command will be considered complete
21	MH	Indefinite movement, till signal to input IN2	<u>Continuous movement, till signal to input IN2</u> - if this command is received when the motor is stopped, continuous motion will begin till signal to input IN2; - if this command is received while driving, from this moment the motor will start continuous movement with the current speed till signal to input IN2
22	ML	Indefinite movement, till signal to input IN1	<u>Continuous movement, till signal to input IN1</u> - if this command is received when the motor is stopped, continuous motion will begin till signal to input IN1; - if this command is received while driving, from this moment the motor will start continuous movement with the current speed till signal to input IN1
23	HM	Indefinite movement, till signal to input "0" (zero limit switch)	<u>Continuous movement, till signal to input "0" (zero limit switch)</u> - if this command is received when the motor is stopped, continuous motion will begin till signal to input "0"; - if this command is received while driving from this moment the motor will start continuous movement with the current speed till signal to input "0";

24	SPddd	Pause for dddddd ms, max = 100000000	<i>Pause:</i> min 1ms – max 10000000ms After receiving this command the motor will stop and wait for ddd ms and then will continue to execute the remaining steps. If in pause time the commands MV, MVddd, MH, ML, HM a received, they are executed immediately and previous command is considered complete
25	LL	Set label for cycle operation	Set label for cycle operation – for program in buffer
26	JPddd (1 to 255)	Repeat from label ddd times, max=255. Set 2 commands JPddd to create endless cycle.	Repeat from label <i>ddd</i> times, max 255. Set 2 commands <i>JPddd</i> to create endless cycle
27	WL	Indefinite pause, wait for a signal to input IN1	<i>Indefinite pause, wait for a signal to input IN1</i> - if this command is received when the motor is stopped, next command will be executed after signal on the input IN1; - if this command is received while driving, from this moment the motor is stopped waiting for a signal to input IN1 the previous command is considered complete
28	WH	Indefinite pause, wait for a signal to input IN2	<i>Indefinite pause, wait for a signal to input IN2</i> - if this command is received when the motor is stopped, next command will be executed after signal on the input IN2; - if this command is received while driving, from this moment the motor is stopped waiting for a signal to input IN2, the previous command is considered complete

‡ In “direct control” controller checks the value of acceleration:

The motor is stopped:

if while starting motion

$(SD - SS) \cdot AL < 0$ or $AL = 0$,

acceleration and start speed will be ignored and the motor will start operation with the speed SD.

The motor rotates:

if $(SD - S_{cur}) \cdot AL < 0$, where S_{cur} – current speed or $AL = 0$, acceleration will be ignored and the motor will change its speed stepwise and remaining steps will be done with the speed SD.

Table 6

Reply	Description
E10*	The command successfully accepted
E12*	Interrupting or command execution by sending another command
E14*	Program executing completed
E15*	Communication Error (check port parameters)
E16*	Command error (check controller mode or ASCII code of the command)
E19 *	Command data error (check command data – integer, in allowed range, see table 5

9. LED

Manual mode (SW9 – OFF, SW10 – ON)

The SMSD-8.0 is powered, step motor is stopped – light green color LED indicator.

Step motor is rotating – blink green color LED indicator.

EN signal is active – blink both LED indicators.

Driver mode (SW9 – ON, SW10 – OFF)

Light green color indicator.

After RESET – do not light both LED indicators.

“Synchro” mode (SW9 – ON, SW10 – ON)

The SMSD-8.0 is powered, step motor is stopped – do not light both LED indicators.

Step motor is rotating – light green color or red color LED indicator (it depends on the direction of rotation).

Controller mode (SW9 – ON, SW10 – ON)

Standby mode – red color LED indicator.

The SMSD-8.0 controller goes to the standby mode in one of the next cases:

- After program executing completed;
- After program executing was stopped by command «ST1».
- After power on (if microswitches SW9=On and SW10=On);
- After “Reset” button or input activated (if microswitches SW9=On and SW10=On).

In the standby mode the SMSD-8.0 controller wait for one of the next event:

- Arrival one of the control commands from a computer (table 6, accepted commands are «LD», «RD», «ST»);
- Start executing program by pressing the button “Start” or input signal “Start” (connect “Start” and “Com”);
- Start searching for a limit switch (zero position) by pressing the “Home” button or input signal “Home” (connect “Home” and “Com”);
- Turn to the other operation mode: manual or simple driver modes (see section 6 and table 4).

Program executing mode – blink red color LED indicator.

The SMSD-8.0 controller turns to the program executing mode and start motion algorithm from the standby mode in case of:

- “Start” button pressed or input activated (connect “Start” and “Com”);
- Arrival the control command «ST»;

The SMSD-8.0 controller turns back from program executing to the standby mode in case of:

- Executing program completed;
- Arrival the control command «ST»;
- “Reset” button pressed or input activated (connect “Reset” and “Com”).

Waiting for an external signal submode – blink red color LED indicator.

The SMSD-8.0 controller turns to this submode during program executing, as per the command “WH” or “WL” – waiting for an external signal. The controller suspends program executing till receiving active signal to input IN1 or IN2. As the signal arrives to IN1 or IN2 (as per the command) the controller resumes program executing.

Commands loading to the controller’s memory – light both LED indicators.

The SMSD-8.0 controller turns to this mode from the standby mode as receives the command “LD”. In the commands loading mode the controller accepts the executing commands only (table 5). After arriving the command “ED” the controller record all received executing commands to the memory and turns to the standby mode.

Reading commands from the controller –light both LED indicators.

The SMSD-8.0 controller turns to this mode from the standby mode. The sequence of executing commands from the controller memory transfers to the computer as the controller receives the command “RD”. After the commands transferred the controller turns back to the standby mode.

Temporary stop mode –blink both LED indicators.

The SMSD-8.0 controller turns to this submode during program executing as receives the signal «EN». The controller suspends program executing while the signal is active. As the signal turns to inactive the controller resumes the program executing.

10. Delivery in complete sets

The stepper motor controller SMSD-8.0	1 pcs.
SMC_Program can be delivered on a CD or by e-mail	1 pcs.
Manual SMSD.80.000	1 pcs.
Switch (Hall effect) SM8-31010NA – as an option, extra cost, on a request	1 pcs.

11. Warranty

Any repair or modifications are performed by the manufacturer or an authorized company.

The manufacturer guarantees the failure-free operation of the controller for 12 months since date of sale when the operation conditions are satisfied – section 3.

The manufacturer sales department address: Smart Motor Devices OÜ,

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Phone: + 372 6559914,
e-mail: mail@stepmotor.biz
url: <http://www.stepmotor.biz>