User's Manual

FOR

ET-SMC
STEPPER MOTOR CONTROLLER

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STEPPER MOTOR CONTROLLER INTERFACE MODULE (ET-SMC)

The ET-SMC Module demonstrates to the students as to how stepper motors can be controlled through I/O Lines and how the stepper motor moves step by step. The students can study the forward/Backward Motion, ½ degree movement of the etc.

General Description:

D.C Stepping Motors: - Stay they are entering into all branches of engineering. There are many systems to monitor various processes and give out control signals in the form of digits but there is only one device to convert these digital pulses into precise incremental motion and that device is stepping motor. Stepping motor is a device, which converts digital pulses into precise angular or linear steps of desired value. The stepping motors in general have the following specifications:

1. Permanent magnet D.C stepping Motors, two phase bifiller wound, Step angle-1.8 degree + /- 5% Non- commutative. Steps / Revolution: 200.

2. Features:
   - Instantaneous response to control pulses.
   - Holds on to the position infinitely in static condition.
   - No burn- out due to locked rotar.
   - Speed can be varied over a wide margin form 0-10,000 step /- sec. Equivalent to 0-3,000 RPM.
   - High torque to inertia ratio. Can be overdriven without any damage.
   - Can be programmed in three parameters namely, **speed, direction and number of steps.**

DIFFERECE BETWEEN STEPPER AND SERVO MOTOR:-

Stepper Motors differ from conventional Servo Motors in the following ways.

1) There is no control winding in stepping motors. Both windings are Identical.

2) The stepping rate (speed of rotation) is governed by frequency of switching and not by supply voltage.

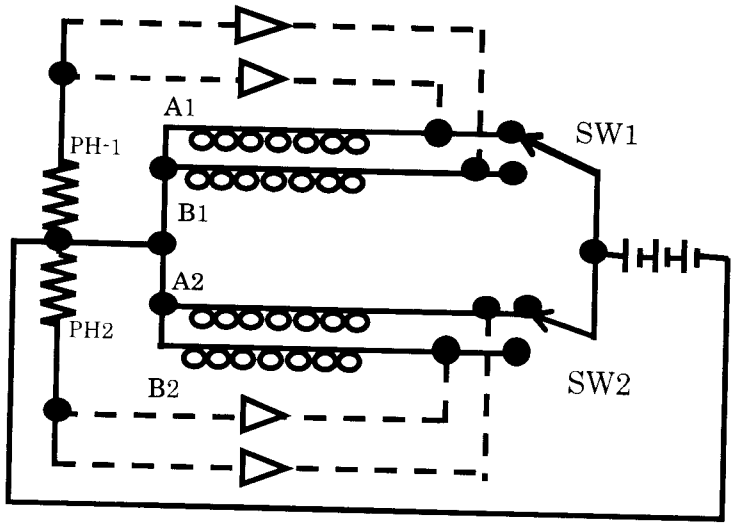
3) A pulse input two phase clock (Instead of continuous pulses) will move the shaft of motor by one step for every pulse, thus number of steps to be moved can be precisely controlled.

4) When there is no pulses input, the rotor will remain locked up in the position in which last step was taken. At any time two windings are always energized which lock the rotor electromagnetically.

5) Stepping motors can be programmed in three parameters namely:
   A. Direction.
   B. Speed and
   C. Number of steps.

WORKING OF STEEPING MOTOR:-

The stepping action is caused by sequential switching of supply to the two phase of the motor as described in switching diagram. All stepping motors are of bifiller type with six leads. Each of the two phases of motor has double winding with a center tap.



Switching Diagram of DC Stepping Motor.

Switching the supply from one side to another of a phase causes reversal of magnetic polarity with out actually reversing the polarity of supply. Four step-input sequences gives 1.8 degree (Full) step function where as eight step input sequence gives 0.9 (half) step function.

SWITCHING SEQUENCE

STEP	SW-1	SW-2	PH-1		PH-2		PHASE-1		PHASE-2	
			A1	B1	A2	B2	A1	B1	A2	B2
1	1	2	0	1	0	1	0	1	0	1
2	1	4	1	0	0	1	0	0	0	1
3	3	4	1	0	1	0	1	0	0	1
4	3	2	0	1	1	0	1	0	0	0
5	1	2	0	1	0	1	1	0	1	0
							0	0	1	0
							0	1	1	0
							0	1	0	0
							0	1	0	1

That above switching Logic will move the shaft in one direction. To change the direction, read the sequence upward.

The specified torque of any stepping motor is the torque at stand still (holding torque). This torque is directly proportional to the current in the winding, which is governed by the DC resistance of winding. As the switching sequence starts, the inductive reactance of the winding which increases with the frequency of switching opposes the rise of current to desired level within the time given for one step depending upon the speed of level causes drop in torque as the speed increase. In order to improve torque at high speed, it is necessary to maintain current at the desired level. This can be done by one of the following methods:

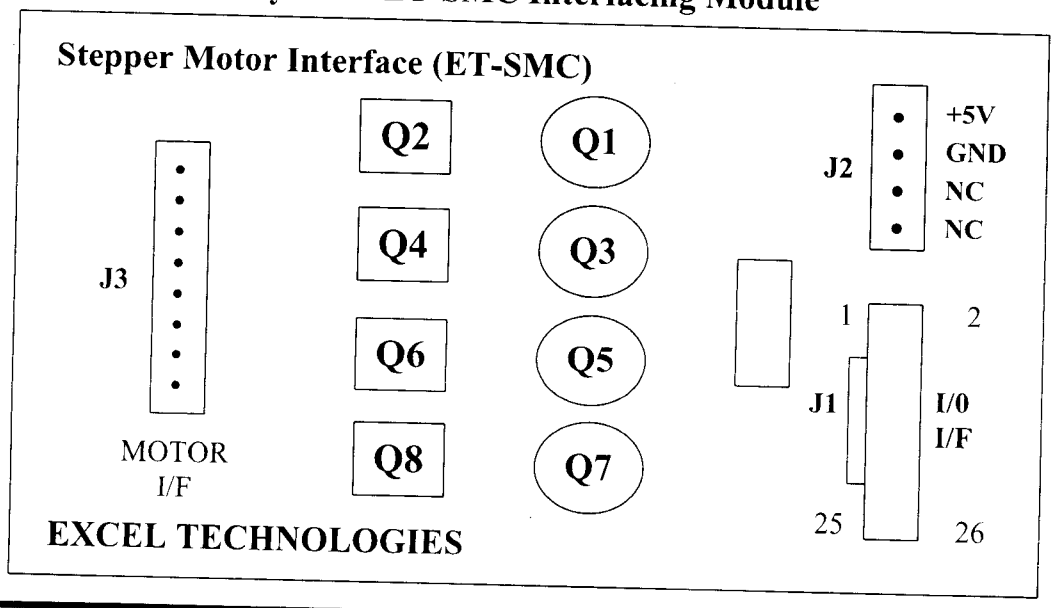
1) By increasing supply voltage and introducing current limiting resistance in each phase. Introduction of resistance improves the time constant of winding. Seven to nine time the winding resistance in each phase will give very good improvement in torque / speed characteristics.

2) By using a constant current source with or without a chopper instead off using a constant voltage source which will give even better performance.

STARTING AND STOPPING UNDER LOAD:

There is a limit for every type of stepping motor as regards the speed at which it will start and stop without loosing step. The limit is due to load torque as well as load inertia. To overcome this, acceleration and declaration techniques have to be employed. Acceleration means stepping rate on switching should be very low and should increase to desired level gradually depending on inertia to be encountered. Acceleration / deceleration may be as high as1000 to 3000 step / sec.

Layout of ET-SMC Interfacing Module



SETUP FOR THE EXPERIMENT:

This explanation as well as the explanation of the Program under the heading " Description of the Program" is for 8085 LED Kit. However if you are interfacing the Stepper Motor Module to other Kits, then also refer to the specific instruction before the program listing for that particular Kit also

1) Connect the ET-SMC I/F module to the 8255- I port connector J1 of the kit using 26-pin flat FRC cable. The pin No.1 of the connector on the module as well as the kit are marked. Please ensure that the pin no.1 of the connector on the Kit is connected to pin no. 1 of the connector on the module.

2) Also connect the +5V to the Module power connector.

3) Enter the program given below from the memory location mentioned in the program.

4) Connect the Power of the Motor to +5V or as specified on the motor and Run the program and observe that the motor is running.

DESCRIPTION OF THE PROGRAM:

The program initializes the 8255 (PPI-1) in order to make p ort A as output port. The PA0 to PA3 is connected through buffer and driving circuit to the winding of the stepper motor. The codes for clockwise movement of stepper motor are FA, F6, F5 and F9 (refer switching sequence). These codes are to be outputted in the sequence they are written. In case of anti clockwise movement of the stepper motor output codes are as F9, F5, F6, and F4. The delay routine is called to generate the delay (max of the about 1 sec.) between the steps. This delay can be changed to make faster steps. The minimum delay depends upon the maximum speed of the stepper motor specified.

The speed of steps can be varied by changing the constant at 2031 & 32 and 2037 and 2038. These values are taken by register pair DE and a corresponding delay is generated. Both the delays are added up to give the final delay. The individual delay can be calculated by (24 N + 17) X basic Machine cycle. Here N is the number stored in D register pair.

NOTE: - Listing of program for various models of Microprocessor and Micro controller kits is given below. Please select the model of kit being used before entering the program into the kit.

1) PROGRAM FOR 8085 KITS HAVING LED DISPLAY:

Connect the J1 of the Kit to the Module through 26 Pin FRC Cable. Ensure that the pin-1 of the J1 at the Kit end is connected to the pin-1 of the

Module connector. Enter the program from address 2000. Execute the program from address 2000

ADDRESS	OP-CODE	LABEL	MNEMONICS	REMARKS
2000	3E 80		MVI A 80	Initialize All Ports As Output Port.
2002	D3 03		OUT 03	
2004	3E **FA**	START	MVI A **FA**	Out Put Code For Step 0.
2006	D3 00		OUT 00	
2008	CD 30 20		CALL 2030	Delay Between Two Steps.
200B	3E **F6**		MVI A **F6**	Out Put Code For Step 1.
200D	D3 00		OUT 00	
200F	CD 30 20		CALL 2030	Delay Between Two Steps.
2012	3E **F5**		MVI A **F5**	Out Put Code For Step 2
2014	D3 00		OUT 00	
2016	CD 30 20		CALL 2030	Delay Between Two Steps.
2019	3E **F9**		MVI A **F9**	Out Put Code For Steps 3
201B	D3 00		OUT 00	
201d	CD 30 20		CALL 2030	Delay Between Two Steps.
2020	C3 04 20		JMP 2004	

DELAY ROUTINE: - Now Enter from the Address 2030 onward

2030	11 00 00		LXI D - 00 00	Generate A Delay
2033	CD BC 03		CALL 03BC	
2036	11 00 00		LXI D - 00 00	Generate A Delay
2039	CD BC 03		CALL 03BC	
203C	C9		RET	Return

Note:-

1. **To change the Direction, reverse the switching sequence from** FA, F6, F5, F9 **to** F9, F5, F6, FA.
2. **To vary the speed change the data at location 2032 and 2038 (FROM 00 TO 0F OR 05).**

2) PROGRAM FOR 8085 KITS HAVING LCD DISPLAY:

Connect the J1 of the Kit to the Module through 26 Pin FRC Cable. Ensure that the pin-1 of the J1 at the Kit end is connected to the pin-1 of the Module connector. Enter the program from address 2000. Execute the program from address 2000.

ADDRESS	OP-CODE	LABEL	MNEMONICS	REMARKS
2000	3E 80		MVI A 80	Initialize All Ports OF 8255-1 As Output Port.
2002	D3 03		OUT 03	
2004	3E **FA**	START	MVI A **FA**	Out Put Code For Step 0.
2006	D3 00		OUT 00	
2008	CD 30 20		CALL 2030	Delay Between Two Steps.
200B	3E **F6**		MVI A **F6**	Out Put Code For Step 1.
200D	D3 00		OUT 00	
200F	CD 30 20		CALL 2030	Delay Between Two Steps.
2012	3E **F5**		MVI A **F5**	Out Put Code For Step 2
2014	D3 00		OUT 00	
2016	CD 30 20		CALL 2030	Delay Between Two Steps.
2019	3E **F9**		MVI A **F9**	Out Put Code For Steps 3
201B	D3 00		OUT 00	
201d	CD 30 20		CALL 2030	Delay Between Two Steps.
2020	C3 04 20		JMP 2004	Jump to START

DELAY ROUTINE: - NOW ENTER FROM THE ADDRESS 2030 ONWARD

2030	11 00 00		LXI D - 00 00	Generate A Delay
2033	CD A6 03		CALL 03BC	
2036	11 00 00		LXI D - 00 00	Generate A Delay
2039	CD A6 03		CALL 03BC	
203C	C9		RET	Return

Note:-

1. **To change the Direction, reverse the switching sequence from** FA, F6, F5, F9 **to** F9, F5, F6, FA.
2. **To vary the speed change the data at location 2032 and 2038 (change 00 TO 0F OR 05).**

********END*********