Stepping Motor Drive IC

IMC Magnetics Corp., Western Division, proudly introduces its new SDB-520 (A) stepping-motor drive IC chip which is intended for a wide variety of applications.

This chip can control three and four phase stepping-motors in either 1, 2, or 1-2 phase excitation-mode operations.

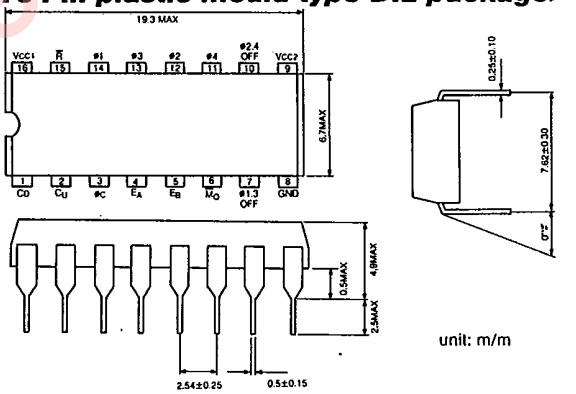
The product is a result of our continuous effort to simplify and lower the cost of complicated circuitry previously required for this purpose. The entire logic circuit for signal processing is loaded onto a single chip in the SDB-520 (A). Therefore, it is fully operational as a driver, with only a minimum additional equipment. All you need to supply is a pulse generator, a power transistor and some direct current.

Characteristics:

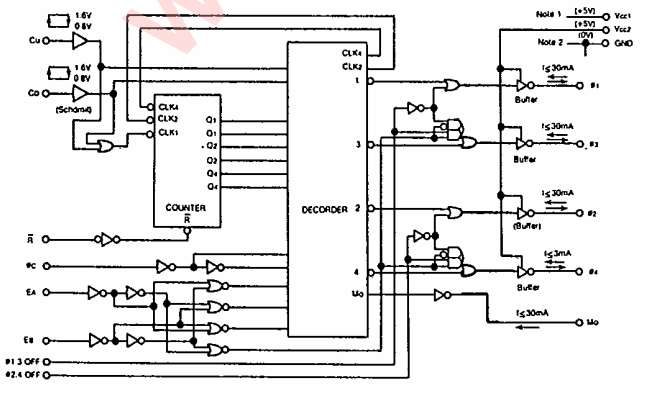
1) Chip operates on 5V power supply.
2) Is able to drive three phase pulse motors in 1, 2, or 1-2 phase excitation modes.
3) Is able to drive four phase pulse motors in 1, 2, or 1-2 phase excitation modes.
4) Chip allows high level output current of up to Io= ±30mA (ø1, ø2, ø3, ø4)
5) Input (C_U C_D) is designed to accomodate a high noise margin. (With built-in Schmidt trigger)
6) Comes with excitation "OFF" terminal.
7) Comes with sequence monitor.
8) Has line-drive functions.
9) Output pin (ø1, ø2, ø3, ø4) equipped with clamping diodes.
10) Equipped with output current short circuit protective circuit.

● External dimensions

<16 Pin plastic mould type DIL package>



● Block diagram



Note 1: Is used for all logic gates except ø1~ø4 output gates.
Note 2: Common to all logic gates.

● Description of pin function

No.	SYMBOL				
1	C_D	Input Pulse	Rotation counter clock-wise		
2	C_U	Input Pulse	Rotation Clock-wise		
3	øc	3 phase 4 phase	Phase transfer "H" 4 phase "L" 3 phase		
4	EA	Mode of Switching Pin	E_B	E_A	Mode
5	EB		0	0	Line drive
			0	1	1 Phase exitation
			1'	0	2 Phase excitation
			1	1	1-2 Phase excitation
6	$\overline{M_O}$	Sequence monitor	Monitor forced to "L" level upon indication of 000 on the built-in counter.		
7	OFF ø1-3	Exitation switch OFF, or Line drive input	Pin ø3 is forced to "L" level regardless of sequence, when output pin ø1–ø2 indicates ø1–ø3 = 0		
8	GND	OV connection pin for power source			
9	VCC2	Power source for output driver ø1–ø4			
10	OFF ø2-4	Excitation, Switch OFF or Line drive input	Pin ø1, ø4 is forced to "L" level regardless of Sequence. when output pins ø1, ø4 indicater ø2, ø4 = 0		
11-ø4, 12-ø2, 13-ø3, 14-ø1			Output driver pins		
15	$\overline{R}$	Reset input pin			
16	VCC1	Power sorce for logic circuit			

Function table:

Input Pin								Function
E	EA	ES	øC	CU	CD	ø1-3'	ø2-4	
1	1	0	0	☆	☆	1	1	3 Phase motor, 1 phase excitation
1	0	1	0	☆	☆	1	1	3 Phase motor, 2 phase excitation
1	1	1	0	☆	☆	1	1	3 Phase motor, 1-2 phase excitation
1	1	0	1	☆		1	1	4 Phase motor, 1 phase excitation
1	0	1	1	☆	☆	1	1	4 Phase motor, 2 phase excitation
1	1	1	1	☆	☆	1	1	4 Phase motor, 1-2 phase excitation
1	EA + EB = 1		1/1	⎍	0	1	1	Rotation CW-ward
1	EA + EB = 1		1/1	0	⎍	1	1	Rotation CCW-ward
1	EA + EB = 1		1/1	☆	☆	0	0	ø1 = ø2 = ø3 = ø4 = 0 O
1	EA + EB = 1		1/1	☆	☆	0	1	ø1 = ø3 = 0 ø2, ø4 Normal op O
1	EA + EB = 1		1/1	☆	☆	1	0	ø2 = ø4 = 0 ø1, ø Normal op O
◇	0	0	◇	◇	◇	0	0	ø1 = 0 ø3 = 1 ø2 = 0 ø4 = 1
◇	0	0	◇	◇	◇	0	1	ø = 0 ø3 = 1 ø2 = 0 ø4 = 1
◇	0	0	◇	◇	◇	1	0	ø = 0 ø3 = 0 ø2 = 0 ø4 = 1
◇	0	0	◇	◇	◇	1	1	ø1 = 1 ø3 = 0 ø2 = 1 ø4 = 0
0	◇	◇	◇	◇	◇	1	1	"1" 0 = "2" 0 = "4" 0 = 0 M̄o = 0

NOTE)
☆ mark signifies pulse flow to CU or CD.
When CU is in operation, CD = 0 and when CD is in operation, CU = O
◇ mark signifies "Don't CARE" meaning that, input to pins marked ◇ are ignored when EA=EB=0.
O mark indicates counter is in normal operation.
"1" Q, "2" Q, "3" Q } are FLIP-Flop actions carried out the counter.

Sequence of excitation

<3 Phase motor excitation system>

1 Phase excitation

Step \ Phase	ø1	ø2	ø3	ø4	M̄o
0	1	0	0	0	0
1	0	1	0	0	1
2	0	0	1	0	1

CCW ↕ CW

2 Phase excitation

Step \ Phase	ø1	ø2	ø3	ø4	M̄o
0	1	1	0	0	0
1	0	1	1	0	1
2	1	0	1	0	1

CCW ↕ CW

1-2 Phase excitation

Step \ Phase	ø1	ø2	ø3	ø4	M̄o
0	1	0	0	0	0
1	1	1	0	0	1
2	0	1	0	0	1
3	0	1	1	0	1
4	0	0	1	0	1
5	1	0	1	0	1

CCW ↕ CW

<4 Phase motor excitation system>

1 Phase excitation

Step \ Phase	ø1	ø2	ø3	ø4	M̄o
0	1	0	0	0	0
1	0	1	0	0	1
2	0	0	1	0	1
3	0	0	0	1	1

CCW ↕ CW

2 Phase excitation

Step \ Phase	ø1	ø2	ø3	ø4	M̄o
0	1	1	0	0	0
1	0	1	1	0	1
2	0	0	1	1	1
3	1	0	0	1	1

CCW ↕ CW

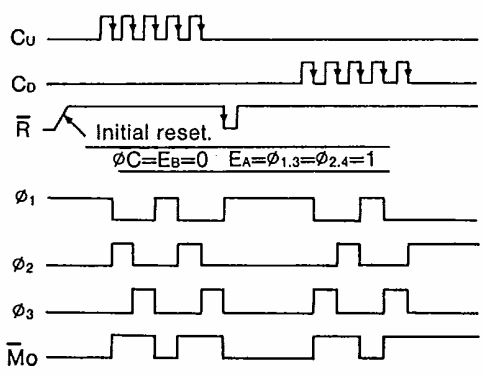
1-2 Phase excitation

Step \ Phase	ø1	ø2	ø3	ø4	M̄o
0	1	0	0	0	0
1	1	1	0	0	1
2	0	1	0	0	1
3	0	1	1	0	1
4	0	0	1	0	1
5	0	0	1	1	1
6	0	0	0	1	1
7	1	0	0	1	1

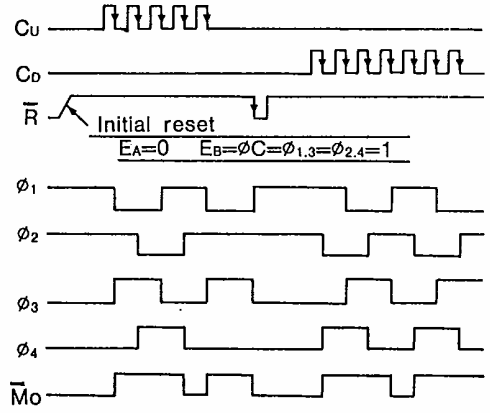
CCW ↕ CW

Timing chart

3 Phase motor excitation system
(1 phase excitation)



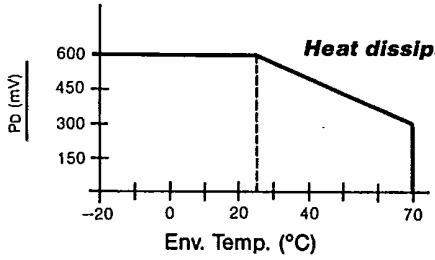
4 Phase motor excitation system
(2 phase excitation)



• Absolute maximum rate

Ta = 25°C

Item	Symbol	Rate Value	Conditions	Unit
Power supply voltage	V_{CC1}	−0.5~+7.5		V
	V_{CC2}	−0.5~+7		V
Surge output current	I_O*1	±50	V_{CC1}=V_{CC2}=5V	mA
	I_O*2	±20	V_{CC1}=5V	mA
Output dielectic voltage *3	V_O*1	−1~+6	V_{CC2}=5V	V
	V_O*2	−1~+6	V_{CC1}=5V	V
Input voltage	V_I*4	−0.5~Vcc+0.5	V_{CC1}=5V	V
	V_I*5	−0.5~Vcc+0.5	V_{CC1}=5V	V
Power consumption	Pd	600	Ta<25°C	mW
Heat dessipation rate	Kθ	6.5	Ta>25°C	mW/°C
Operation temperature	Top	−10~+70		°C
Storage temperature	Tstg	−55~155		°C



NOTE)
*1: When output pin (ϕ_1, ϕ_2, ϕ_3, ϕ_4) is subjected to conditions indicate, output characteristics shall be: pulse range 10μ/ sec. repetition freq. 10KHz
*2: When monitor pin (Mo) is subjected to conditions indicated, monitor short circuit shall occure within 1 sec.
*3: If output pin is to be subjected to surge voltage from exterior source, surge current shall be 50mA max.
*4: C_U, C_D output pin
*5: Input pin other than C_U, C_D.

• Limit of Recommended operation

Item	Symbol	LIMIT		Conditions	Unit
		MIN	MAX		
Supply voltage	V_{CC1}	4.5	5.5		V
	V_{CC2}	4.5	5.5		V
Level "H" output current	I_{OH}*1		−30	V_{CC1} = V_{CC2} = 5V	μA
	I_{OH}*2		−80*3	V_{CC1} = 5V	μA
Level "L" output current	I_{OL}*1		30	V_{CC1} = V_{CC2} = 5V	mA
	I_{OL}*2		+3.2	V_{CC1} = 5V	mA
Operation frequency	f	100		tw = 2μ Sec	KHz
Input pulse ange	tw	2			μSec

NOTE)
*1): Output pin (ϕ_1, ϕ_2, ϕ_3, ϕ_4)
*2): Monitor pin (Mo)
*3): Output voltage to be specified to 2.4V.

•Elecrical characteristics

Ta = 25°C V_{CC1} = V_{CC2} = 5V

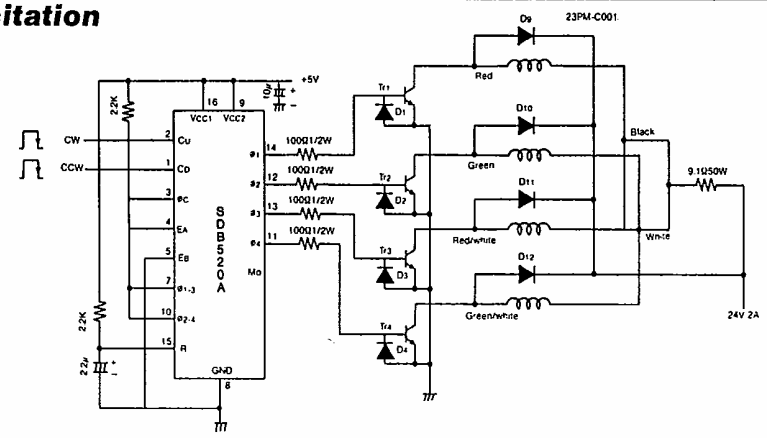
Item	Symbol	Test Conditione	Rate			Unit
			MM	TYP	MAX	
Level "H" input voltage	V_{IH}*1	V_{CC1} = 5V	2			V
Level "L" input voltage	V_{IL}*1	V_{CC1} = 5V			0.5	V
Input threshold voltage	V_{T^+}*2	V_{CC1} = 5V	1.3	2.0	2.4	V
	V_{T^-}*2	V_{CC1} = 5V	0.5	0.8	1.2	V
Level "H" output voltage	V_{OH}*3	I_{OH} = −80μA	2.4			V
	V_{OH}*4	I_{OH} = −30mA V_{CC1} = V_{CC2} = 5V	2.5			V
Level "L" input voltage	V_{OL}*3	I_{OL} = 3.2 mA			0.4	V
	V_{OL}*4	I_{OL} = 30 mA V_{CC1} = V_{CC2} = 5 V			0.6	mA
Level "H" input current	I_{IH}*1	V_{CC1} = 5V V_I = 5.5 V			0.15XN	mA
	I_{IH}*2	V_{CC1} = 5 V V_I = 6.0 V			10	μA
Level "L" input current	I_{IL}*1	V_{CC1} = 5V V_I = 0.4 V			0.8XN	mA
	I_{IL}*2	V_{CC1} = 5V V_I = 0.4 V			0.4	mA
Input threshold current	I_{T^+}*2	V_{CC1} = 5V V_I = V_{T+}		0.13		mA
	I_{T^-}*2	V_{CC1} = 5V V_I = V_{T-}		0.17		mA
Current consumption	I_{CC1}*5	V_{CC1} = 5 V			20	mA
	I_{CC2}*5	V_{CC1} = V_{CC2} = 5V			5	mA

NOTE)
*1: Input other than C_D, C_U shall be besed upon:
øC: N=1 R=1
E_A: N=1 E_B: N=1
ø1.3 OFF ø2, 4 OFF: N=2
*2 C_D, C_U input
*3 Monitor output
*4 ø1, ø2, ø3, ø4 Output
*5 All input set to GND
ll output to open.

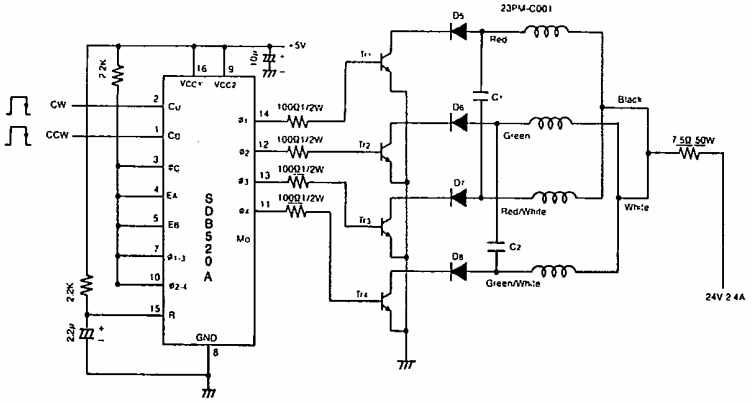
Stepping motor drive IC <<Application example>>

4 phase stepping motor

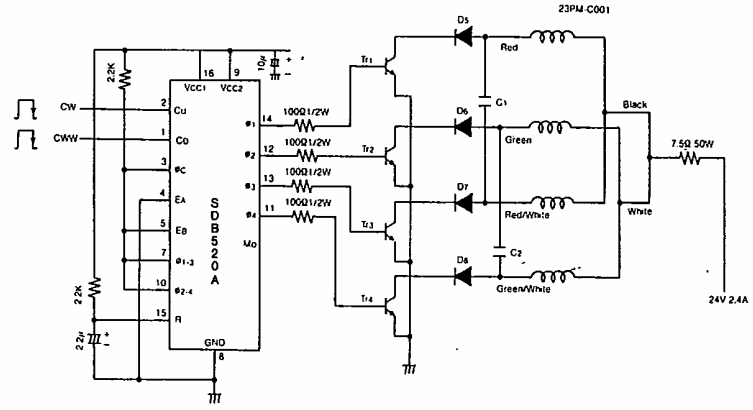
• 1 phase excitation



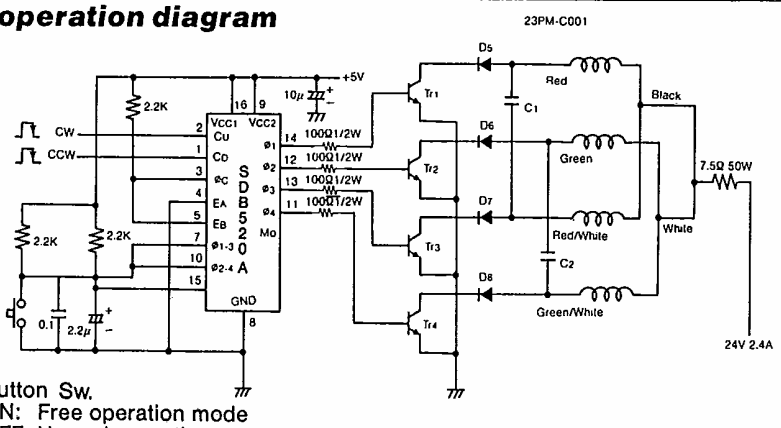
• 1·2 phase excitation



• 2 phase excitation



• Motor free operation diagram



Button Sw.
ON: Free operation mode
OFF: Normal operation mode

NOTE)
Tr1~Tr4 2SC1884
D1~D4 1S1587
D5~D8 6BG11
D9~D12 1BZ61
C1~C3 1~10μF (MP)
common to all wiring diagrams.