Pulse Input Bipolar Stepper Motor Driver

■GENERAL DESCRIPTION

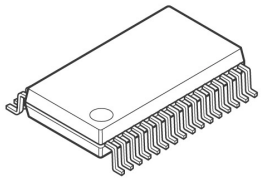
NJU7384 is a bipolar drive stepping motor driver.

The control method used is a simple pulse train input control (STEP & DIR) method of programming. Also, low power consumption was realized as a result of the adoption of a highly efficient CMOS.

As the control functions, the external input RESET and ENABLE functions are used, and as the protective function, a thermal shutdown (TSD) is incorporated.

The package uses the low thermal resistance SSOP32 which can withstand a high output current.

■PACKAGE OUTLINE

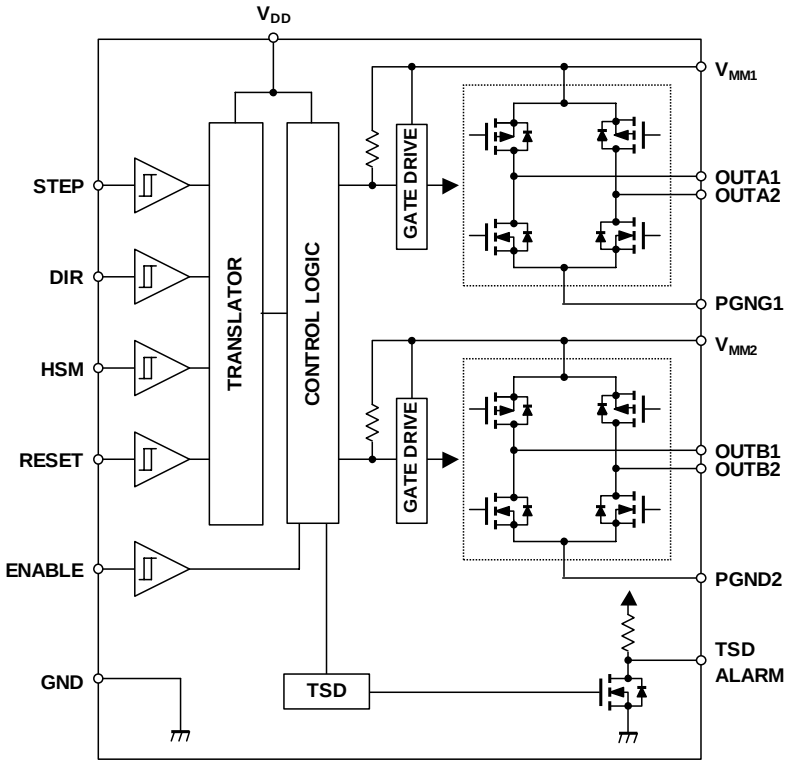


NJU7384V

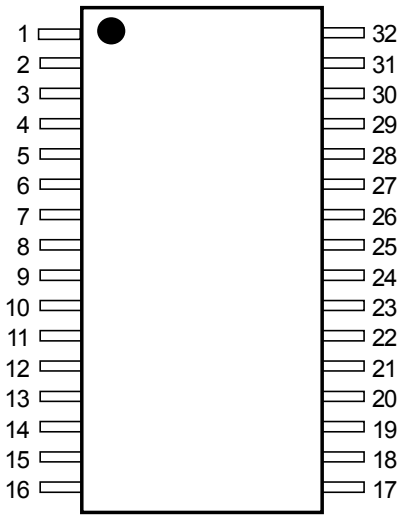
■FEATURES

- Operating Voltage 3.0 to 5.5V (Logic : V_{DD})
  4.0 to 8.0V (H bridge : V_{MM})
- Maximum Output Current 700mA/ch
- Pulse Input (STEP&DIR) Control
- Half / Full Step Change Function
- Thermal Shutdown Circuit
- Thermal Shutdown Alarm Output
- RESET Function
- ENABLE Function
- CMOS Technology
- Package Outline SSOP32

■BLOCK DIAGLAM



■ PIN FUNCTION



1. NC	32. V_{MM1}
2. NC	31. V_{MM1}
3. NC	30. OUTA1
4. V_{DD}	29. OUTA1
5. NC	28. OUTA2
6. STEP	27. OUTA2
7. DIR	26. PGND1
8. HSM	25. PGND1
9. RESET	24. PGND2
10. ENABLE	23. PGND2
11. TSD ALARM	22. OUTB2
12. NC	21. OUTB2
13. GND	20. OUTB1
14. NC	19. OUTB1
15. NC	18. V_{MM2}
16. NC	17. V_{MM2}

■ PIN DESCRIPTION

PIN No.	SYMBOL	FUNCTION	NOTE
1,2,3	NC	Non connection pins	-
4	V_{DD}	Logic Power-Supply input pin	-
5	NC	Non connection pin	-
6	STEP	Pulse signal input pin for motor rotation control pin	1 pulse input ⇒ 1 clock motion
7	DIR	Forward / Reverse rotation control	"H"= Forward (CW), "L"= Reverse (CCW)
8	HSM	Full / Half step mode control pin	"H"= Full step, "L"= Half step
9	RESET	Phase initialize signal input pin	"H"= Normal operation, "L"= Phase initialize
10	ENABLE	Output signal all off control signal input pin	"H"= Normal operation, "L"= Output all off
11	TSD ALARM	TSD alarm output pin	TSD operating ="L" signal output
12	NC	Non connection pins	-
13	GND	Logic ground (GND) pin	-
14,15,16	NC	Non connection pins	-
17,18	V_{MM2}	H bridge power-supply pins	Connect to motor power-supply
19,20	OUTB1	Output pin B1	-
21,22	OUTB2	Output pin B2	-
23,24	PGND2	H bridge ground (GND) pin	-
25,26	PGND1	H bridge ground (GND) pin	-
27,28	OUTA2	Output pin A2	-
29,30	OUTA1	Output pin A1	-
31,32	V_{MM1}	H bridge power-supply pins	Connect to motor power-supply

* Short all logic ground terminals and the H bridge ground terminal externally.
* Short all H bridge power supply voltage terminals externally.
* Fix the potential of unused logic input terminals externally.

■ **ABSOLUTE MAXIMUM RATINGS** (Ta=25°C)

PARAMETER	RATINGS	SYMBOL(unit)	NOTE
Logic Power Supply Voltage	+7.0	V_{DD} (V)	*1)
H Bridge Power Supply Voltage	+9.0	V_{MM} (V)	-
Logic Input Voltage	-0.3 ~ V_{DD}	V_{ID} (V)	-
Motor Output Current (Max)	700	I_{OPEAK}(mA/ch)	-
Logic Input Current	10	I_{IPEAK} (mA)	-
Operating Temperature Range	-40 ~ +85	Topr (°C)	-
Operating Junction Temperature Range	-40 ~ +150	Tj(°C)	-
Storage Temperature Rnage	-50 ~ +150	Tstg(°C)	-
Power Dissipation	1175	P_D (mW)	*2)

*1) : VDD ≤ VMM

*2) : EIAJ/JEDEC STD 2 Layer substrate

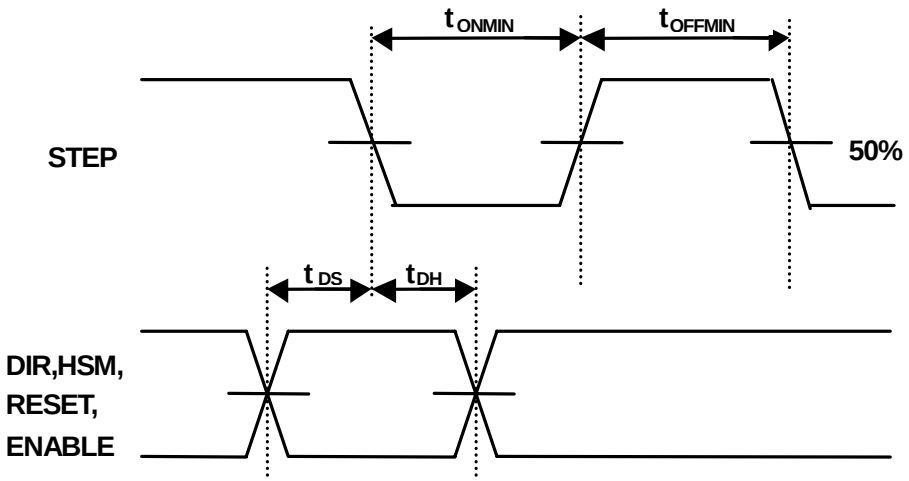
■ **RECOMMENDED OPERATING CONDITIONS** (Ta=25°C)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Logic Power Supply Voltage Range	V_{DD}	3.0	5.0	5.5	V	$V_{DD} \leq V_{MM}$
H Bridge Power Supply Voltage Range	V_{MM}	4.0	6.0	8.0	V	-
Logic H Input Voltage	V_{IH}	3.5	-	V_{DD}	V	V_{DD}=5.0V, No load
Logic L Input Voltage	V_{IL}	0	-	1.2	V	
STEP-ON Time	t_{ONMIN}	10	-	-	µs	
STEP-OFF Time	t_{OFFMIN}	10	-	-	µs	
Data Setup Time	t_{DS}	1	-	-	µs	
Hold Time	t_{DH}	1	-	-	µs	
Input Clock Frequency	f_{CLK}	-	-	50	kHz	

■ **ELECTRICAL CHARACTERISTICS** (Ta=25°C, V_{DD}=5V, V_{MM}=6V)

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
■General						
Operating Current	I_{DD}	STEP, DIR, HSM, RESET, ENABLE="5V", No Load, V_{DD} Meas.	-	0.3	0.6	mA
	I_{MM}	STEP, DIR, HSM, RESET, ENABLE="5V", No load, V_{MM} Meas.	-	0.3	0.6	mA
Thermal Shutdown Operating Temperature	T_{TSD}	-	-	180	-	°C
Thermal Shutdown Hysteresis	T_{HYS}	-	-	30	-	°C
■Input (STEP, DIR, HSM, ENABLE, RESET Terminals)						
Logic Input Current	I_{IH}	STEP, DIR, HSM, ENABLE, RESET ="5V"	-	-	1	μA
	I_{IL}	STEP, DIR, HSM, ENABLE, RESET ="0V"	-1	-	-	μA
■H Bridge (Output)						
H Output Voltage	V_{OH}	Io=+400mA	5.5	5.7	-	V
L Output Voltage	V_{OL}	Io= -400mA	-	0.2	0.4	V
Upper Side Output ON Resistance	R_{OH}	Io=400mA	-	0.75	1.25	Ω
Under Side Output ON Resistance	R_{OL}	Io=400mA	-	0.50	1.00	Ω
Output Leak Current	$I_{O\ LEAK}$	-	-	1.0	-	μA
■Signal Output						
TSD Alarm L Output Voltage	V_{TSD}	No external pull-up resistance	-	-	0.3	V
TSD Pull-up Resistance	R_{TSD}	-	-	10	-	kΩ

■ TIMING CONDITION



■ TRUTH TABLE

LOGIC IN		MODE
V_{DD}	H	OPERATE
	L	Hi Z
DIR	H	CW
	L	CCW
HSM	H	FULL STEP
	L	HALF STEP
RESET	H	OPERATE
	L	RESET
ENABLE	H	OPERATE
	L	Hi Z

*V_{MM} : Motor voltage supply
*OPERATE : Follow the input logic
*Hi Z : Output all off (A1, A2, B1,B2)

■ EXCITATION SEQUENCE

Condition: FULL STEP, HSM=ENABLE=RESET

Pulse	*0*	*1*	*2*	*3*
OUTA1	L	H	H	L
OUTA2	H	L	L	H
OUTB1	L	L	H	H
OUTB2	H	H	L	L
IA	-	+	+	-
IB	-	-	+	+
DIR=HIGH	CW			
DIR=LOW	CCW			

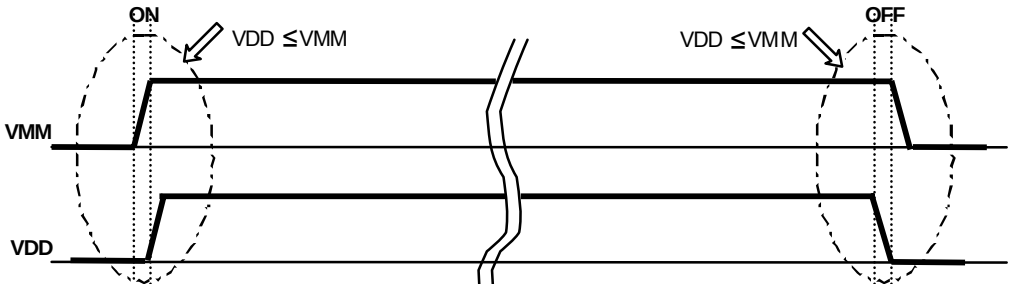
Condition: HALF STEP, HSM=LOW, ENABLE=RESET=HIGH

Pulse	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
OUTA1	L	Hi Z	H	H	H	Hi Z	L	L
OUTA2	H	Hi Z	L	L	L	Hi Z	H	H
OUTB1	L	L	L	Hi Z	H	H	H	Hi Z
OUTB2	H	H	H	Hi Z	L	L	L	Hi Z
IA	-	0	+	+	+	0	-	-
IB	-	-	-	0	+	+	+	0
DIR=HIGH	CW							
DIR=LOW	CCW							

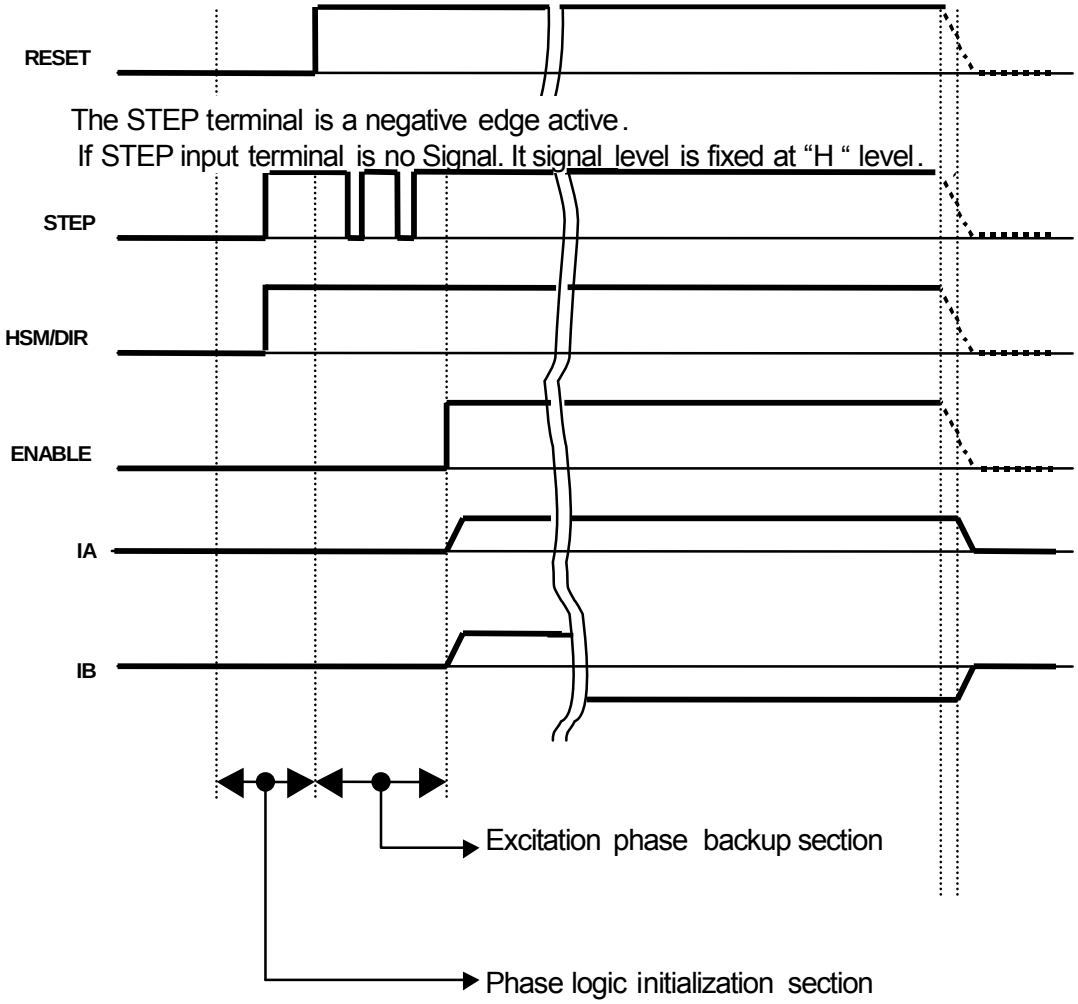
* Regarding the current flow direction, the direction A1→A2 and B1→B2 is indicated as +, and the direction A2→A1 and B2→B1 is indicated as –.

■POWER SUPPLY ON/OFF TIMING

Regarding the switch-on sequence of the logic power supply V_{DD} and the motor power supply V_{MM}, input V_{DD} after V_{MM} has risen. The recommended sequence is shown below.



The RESET signal is "L" level in the range of turning ON . And Phase logic is initialized.



■RECOMMENDED STEP MODE CHANGEOVER (HSM)

The current flowing through the stepping motor must be controlled continuously so that a mis-step does not occur. Also, the following precautions must be observed concerning changing of the setting of the HSM input.

(1) A mis-step does not occur during changeover from a full step to a half step

(2) Regarding changeover from a half step to a full step,

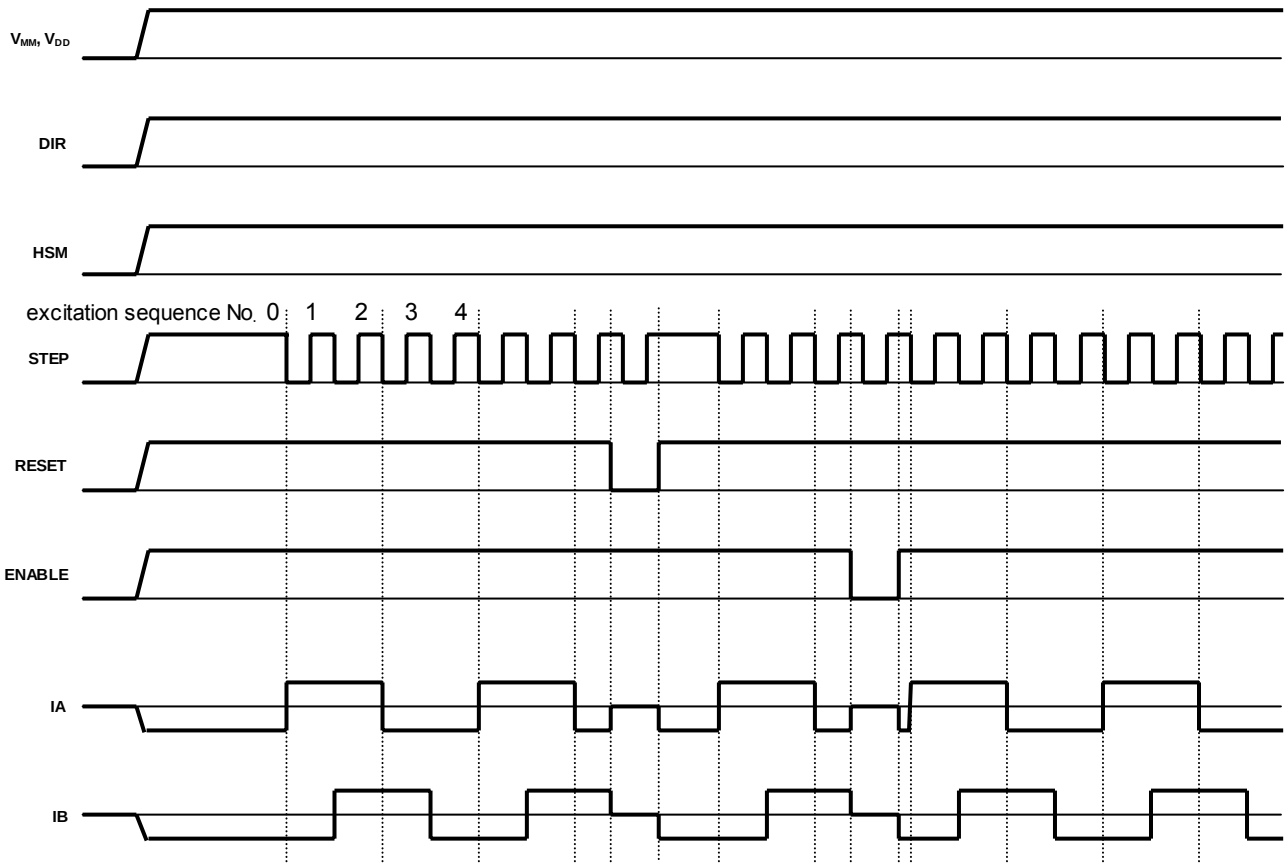
(a) A mis-step does not occur during changeover from a half step (excitation sequence 0, 2, 4, 6) to a full step.

(b) A mis-step occurs during changeover from a half step (excitation sequence 1, 3, 5, 7) to a full step.

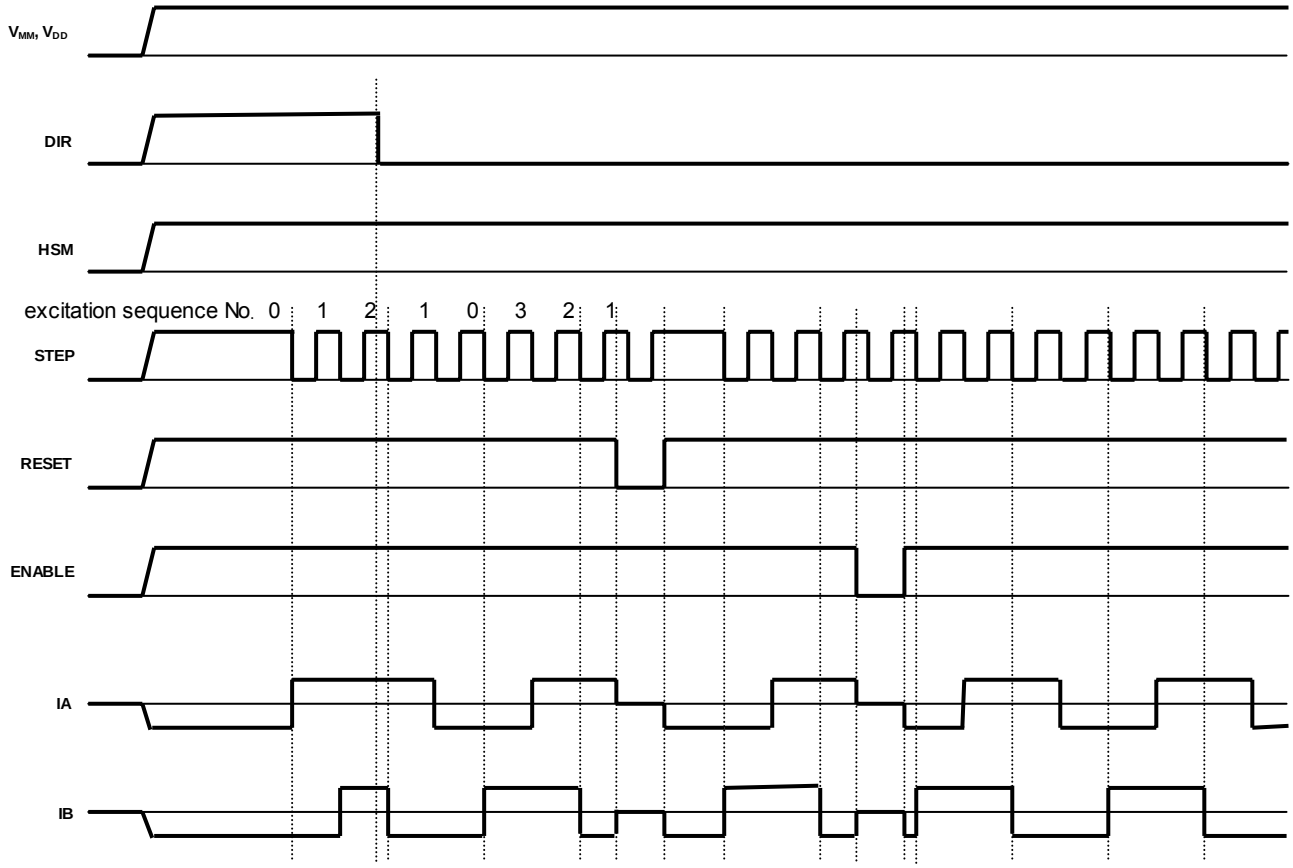
For the above reason, it is recommended that mode changeover from a half step to a full step be carried out during the period when the RESET input is “L” logic.

■ TIMING CHART

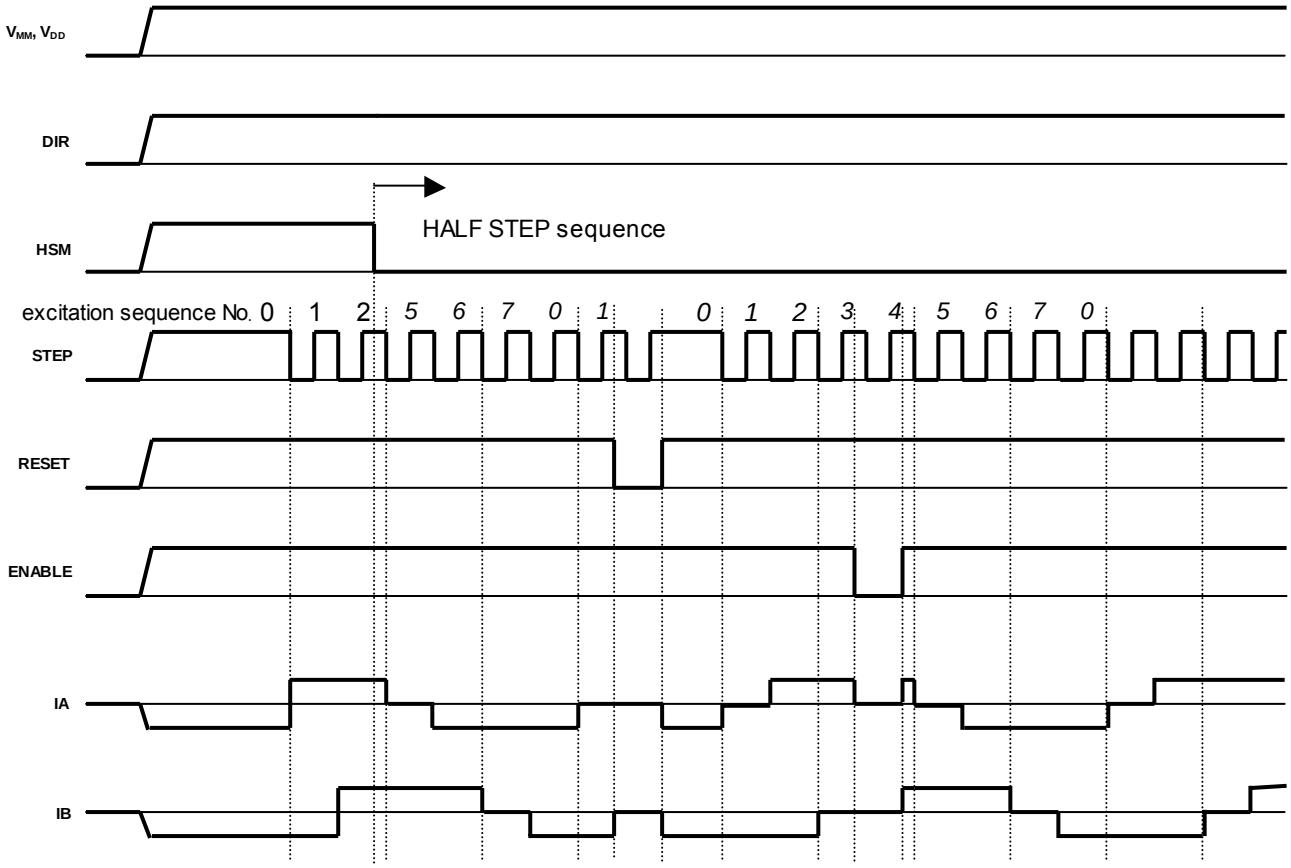
- Fixed mode (Full step / Forward direction)
  Condition : DIR="H", HSM="H"



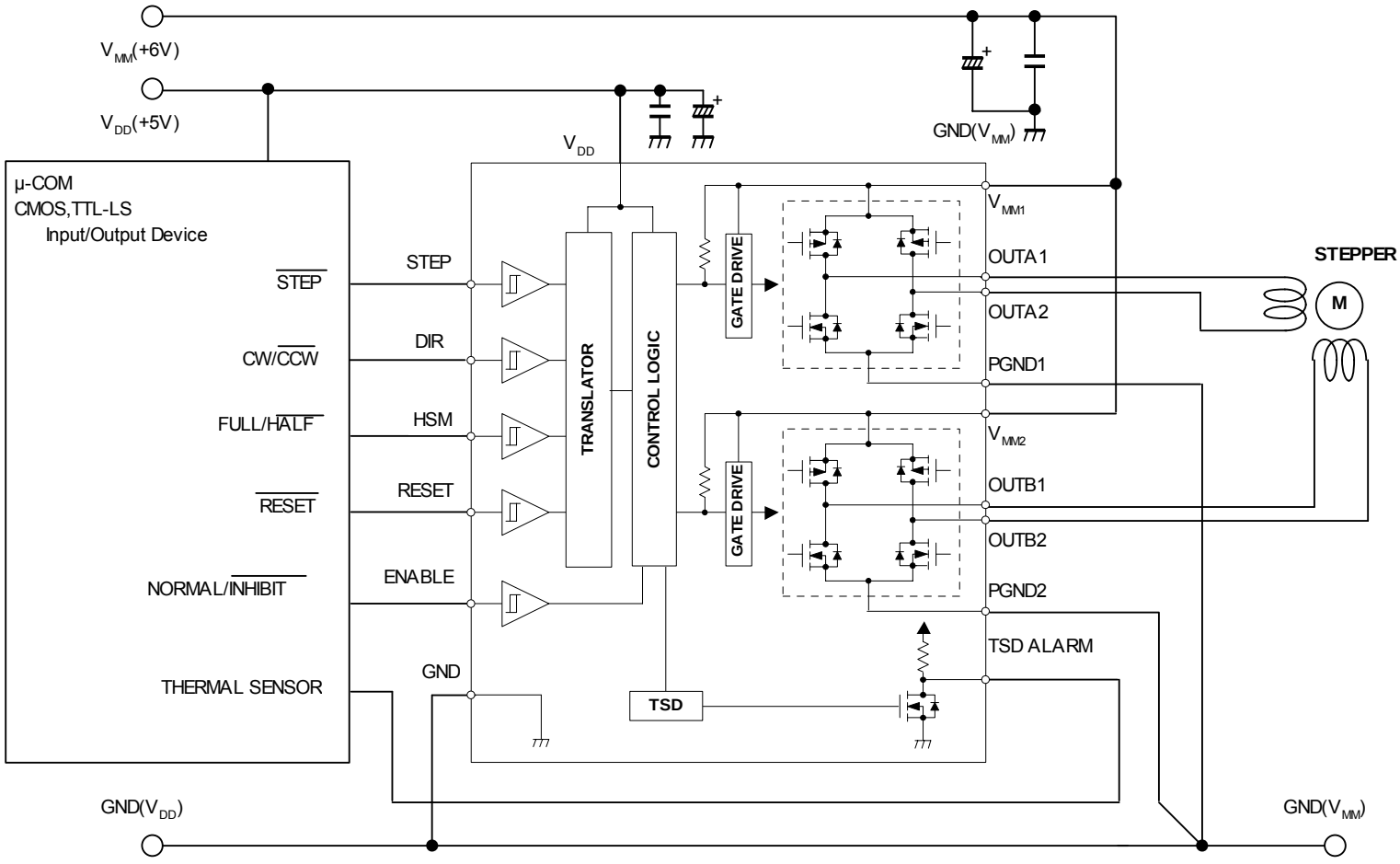
- Direction change (Full step / Forward direction ⇒ Reverse direction)
  Condition : DIR="H" ⇒ "L", HSM="H"



- Step mode change (Full step ⇒ Half step)
  Condition : DIR="H", HSM="H" ⇒ "L"



■ APPLICATION CIRCUIT



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