NEC

MOS INTEGRATED CIRCUIT

μPD16836

THREE-PHASE SPINDLE MOTOR DRIVER FOR MONOLITHIC CD-ROM

DESCRIPTION

The μPD16836 is a three-phase spindle motor driver for CD-ROM drives which consists of a CMOS control circuit and MOS bridge output. It employs a three-phase full-wave PWM driving method and a MOS FET in the output stage to lower the power consumption compared with drivers using conventional bipolar transistors.

FEATURES

- Low ON resistance (Sum of ON resistance of top and bottom transistors) Ron = 1.2 Ω (TYP.)
- Low power consumption using three-phase full-wave PWM driving system
- START/STOP pins enable braking operation in STOP mode
- Standby pin turns off internal circuitry in standby mode
- Low current consumption: I_{DD} = 3mA (MAX.), $I_{DD(ST)}$ = 100 μA (MAX.)
- Internal thermal shutdown circuit
- Internal overcurrent protection circuit (can be externally set)
- Internal FG output function
- Reverse prevention circuit
- 24-pin plastic SOP (375 mil)

ORDERING INFORMATION

Part Number	Package
μPD16836GT	24-pin plastic SOP (375 mil)

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C)

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{DD}		–0.5 to +7.0	V
	V_M		–0.5 to +15.0	V
Input voltage	V_{IN}		–0.5 to V_{DD} + 0.5	V
Instantaneous output current[Note 1]	I_{OP}	PW ≤ 5 ms, Duty ≤ 40 %	±1.3	A
Power dissipation[Note 2]	P_T		1.25	W
Peak junction temperature	$T_{CH(MAX.)}$		150	°C
Storage temperature range	T_{stg}		–55 to +150	°C

Notes 1. Permissible current value per one phase, when mounted on the printed circuit board

2. When mounted on the printed circuit board (100 mm × 100 mm × 1 mm, glass epoxy)

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RECOMMENDED OPERATING RANGE

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply voltage	V_{DD}	4.5		5.5	V
	V_M	10.8		13.2	V
Instantaneous output current	I_{OP}			1.0	A/phase
CL pin input voltage	V_{CL}	0.3		1.0	V
Operating temperature range	T_A	–20		75	°C

ELECTRICAL SPECIFICATIONS (Unless otherwise specified, T_A = 25 °C, V_{DD} = 5 V, V_M =12 V)

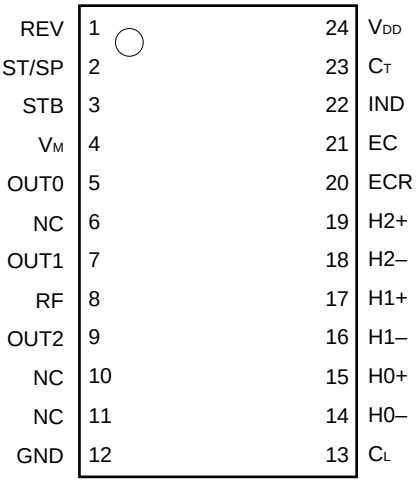
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
<Overall>						
Current consumption 1 (V_{DD})	I_{DD}	STB = L		1.5	3.0	mA
Current consumption 2 (standby)	$I_{DD\ (ST)}$	STB = H			0.1	mA
<ST/SP, REV, STB>						
High-level input voltage	V_{IH}	ST/SP = H	0.6×V_{DD}		V_{DD}	V
Low-level input voltage	V_{IL}	ST/SP = L			0.8	V
Input pull-down resistor	R_{IND}		60	100	140	kΩ
<Control circuit>						
Triangular wave oscillation frequency	f_{PWM}	C_T = 100 pF	40	100	250	kHz
<Hole amplifier>						
In-phase input voltage range	V_{Hch}		1.0		2.8	V
Hysteresis voltage	V_{Hhis}			20		mV
Input bias current	I_{Hbias}				1.0	μA
<FG output>						
IND pin high-level voltage	V_{FG_H}	Io = –4 mA	3.5			V
IND pin low-level voltage	V_{FG_L}	Io = +4 mA			0.5	V
<Output block>						
Output ON resistance	R_{ON}**Note**	Io = 200 mA, T_A = –20 to 70 °C		1.2	1.8	Ω
Output turn-ON time	t_{ON}	R_M = 5 Ω (Star connection)		1.0	2.0	μs
Output turn-OFF time	t_{OFF}			1.0	2.0	μs
<Torque command>						
Control reference input voltage range	ECR		1.5		3.0	V
Control input voltage range	EC		1.0		3.5	V
Input current	I				100	μA
Input differential voltage	ECR–EC	Duty = 100 %		0.32		V
DEADZONE (+)	EC d+		5	75	150	mV
DEADZONE (–)	EC d–		–150	–75	–150	mV

Note Sum of ON resistance of top and bottom transistors

The thermal shutdown circuit operates at $T_{CH} \geq 150$ °C

The low-voltage malfunction prevention circuit (UVLO) operates at V_{DD} = 4 V (TYP.)

PIN CONFIGURATION

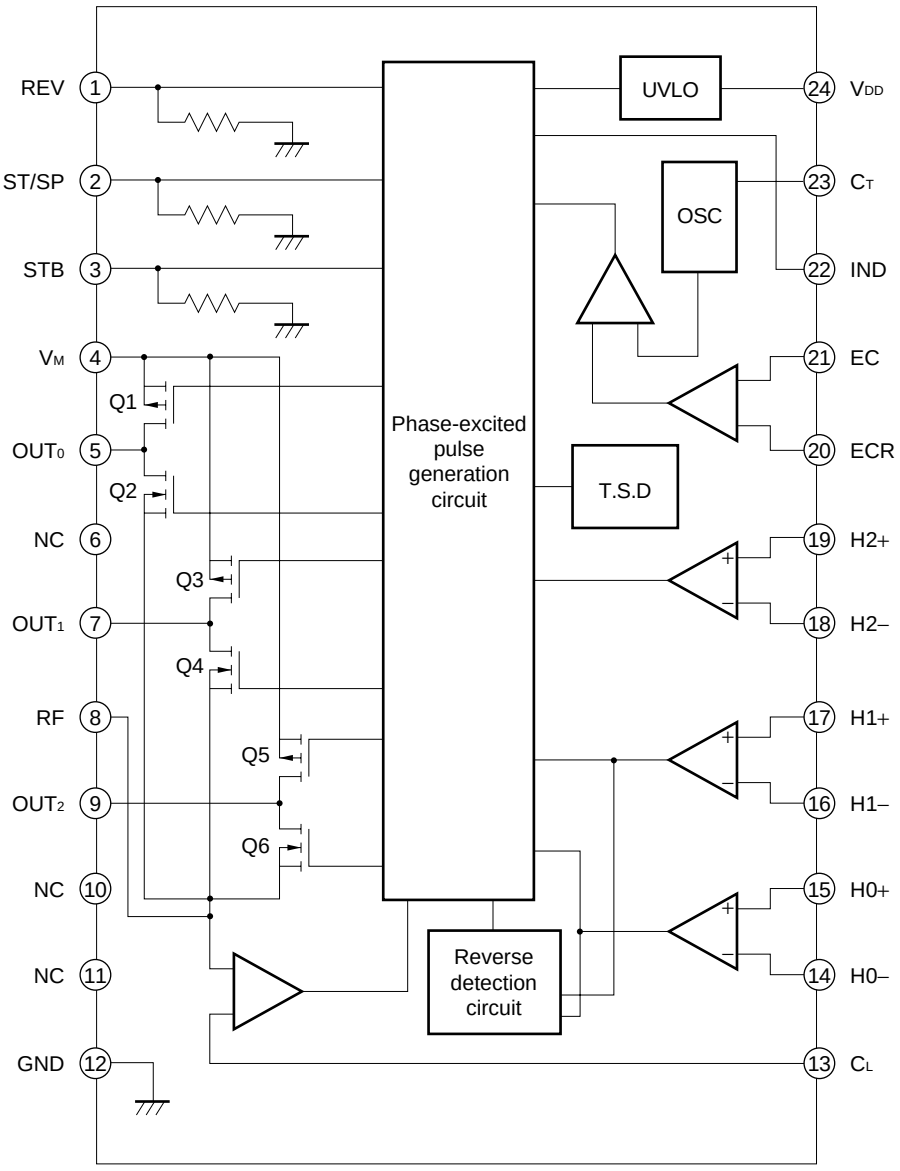


PIN FUNCTIONS

Package: 24-pin plastic SOP (375 mil)

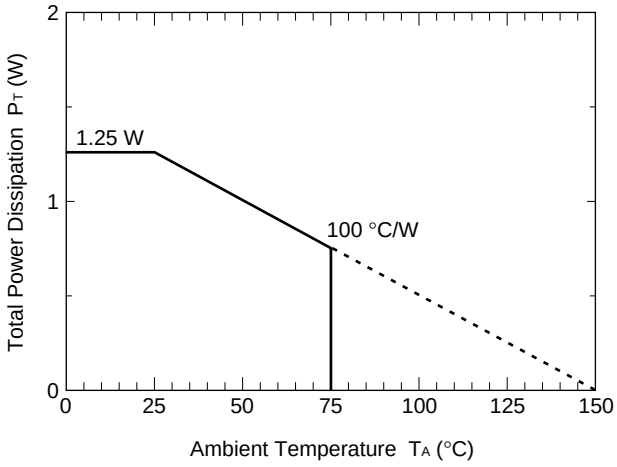
Pin Number	Pin Name	I/O	Pin Functions
1	REV	I	Reverse operation input pin (reverse brake)
2	ST/SP	I	Start/stop input pin
3	STB	I	Standby operation input pin
4	V_M	–	Motor block power supply voltage (12 V)
5	OUT0	O	Motor connection pin (output pin)
6	NC	–	Open pin
7	OUT1	O	Motor connection pin
8	RF	I	Sense resistor connection pin
9	OUT2	O	Motor connection pin
10	NC	–	Open pin
11	NC	–	Open pin
12	GND	–	GND pin
13	C_L	I	Reference voltage input pin for overcurrent detection
14	H0–	I	Hole signal input pin
15	H0+	I	Hole signal input pin
16	H1–	I	Hole signal input pin
17	H1+	I	Hole signal input pin
18	H2–	I	Hole signal input pin
19	H2+	I	Hole signal input pin
20	ECR	I	Control reference voltage input pin
21	EC	I	Control voltage input pin
22	IND	O	Index signal output pin
23	C_T	I	Capacitor connection pin for oscillator frequency setting
24	V_{DD}	–	Control block power supply voltage input pin (5 V)

BLOCK DIAGRAM

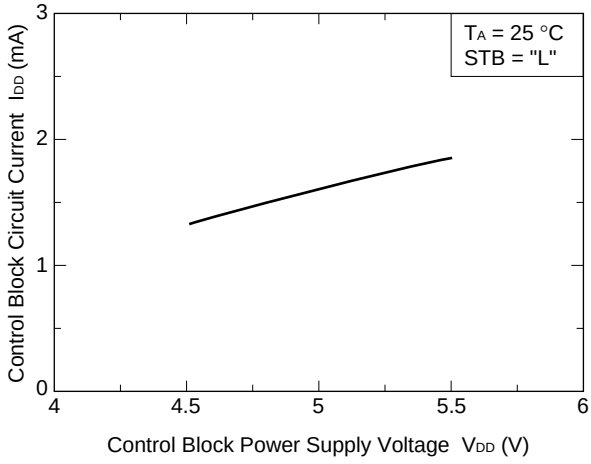


TYPICAL CHARACTERISTIC CURVES (T_A = 25 °C)

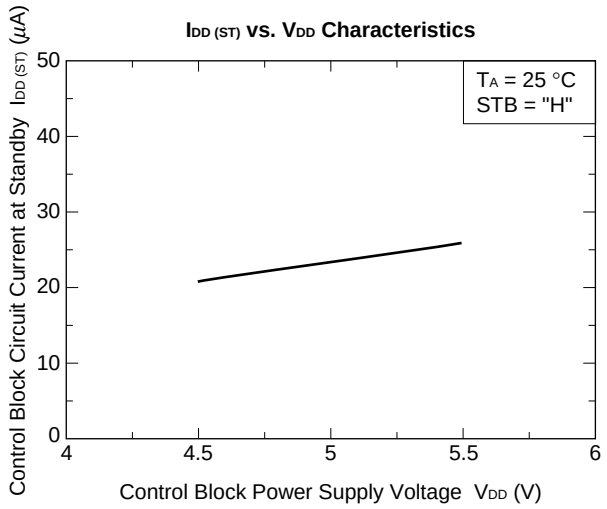
P_T vs. T_A Characteristics



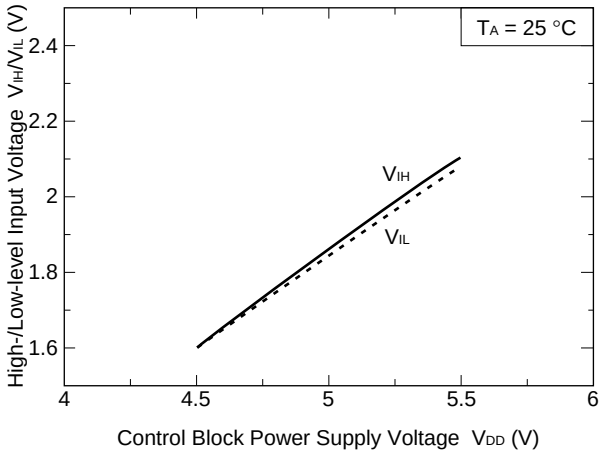
I_{DD} vs. V_{DD} Characteristics



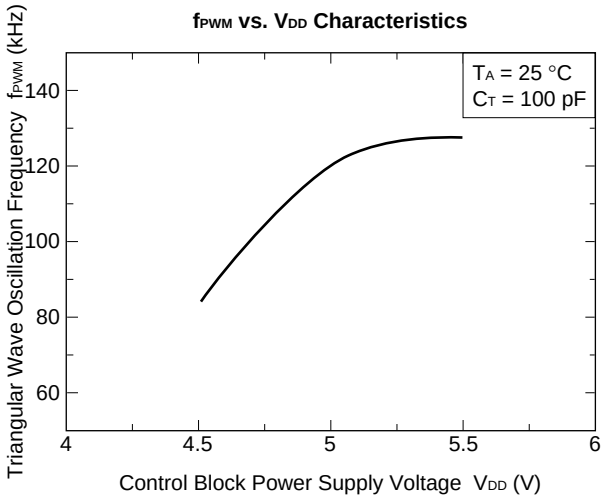
$I_{DD\ (ST)}$ vs. V_{DD} Characteristics



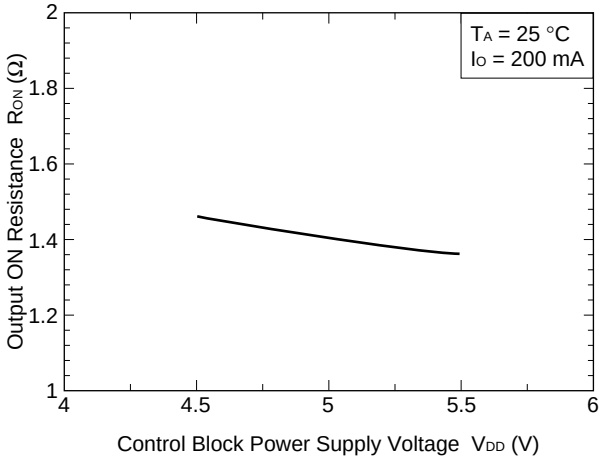
V_{IH}/V_{IL} vs. V_{DD} Characteristics



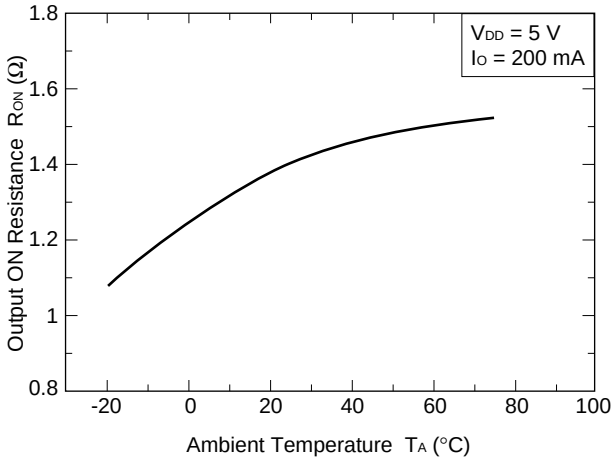
f_{PWM} vs. V_{DD} Characteristics



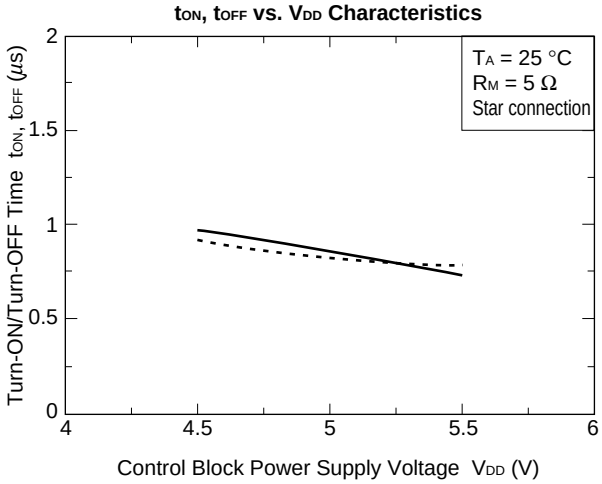
R_{ON} vs. V_{DD} Characteristics



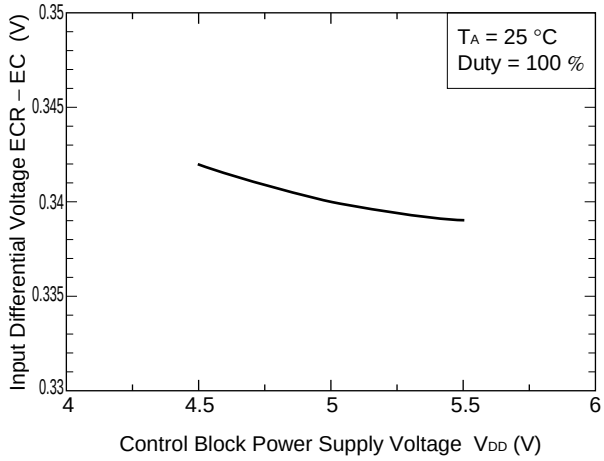
R_{ON} vs. T_A Characteristics



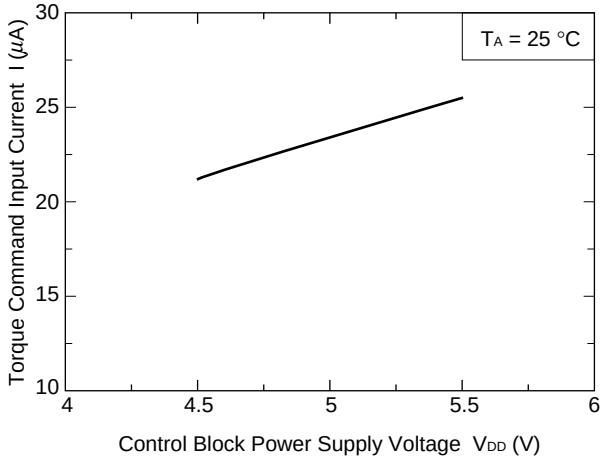
t_{ON}, t_{OFF} vs. V_{DD} Characteristics



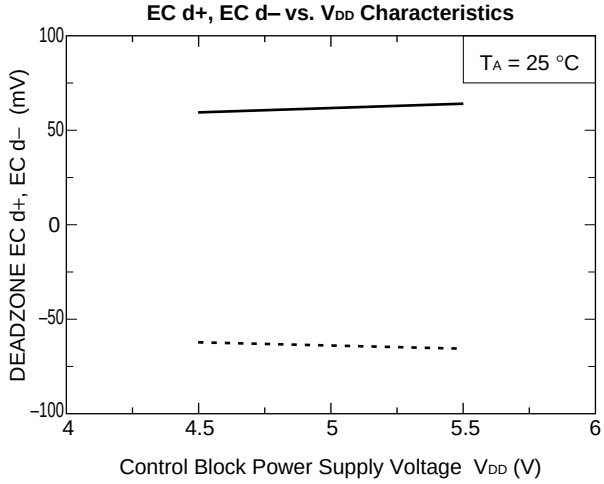
ECR – EC vs. V_{DD} Characteristics



I vs. V_{DD} Characteristics



EC d+, EC d– vs. V_{DD} Characteristics



FUNCTION OPERATION TABLE

(1) ST/SP = "H"

Input Signal				Circuit Operation Mode	Source → Sink
CMP0	CMP1	CMP2	PWM		
H	H	L	H	Operation	W → V
H	H	L	L	Brake	
H	L	L	H	Operation	W → U
H	L	L	L	Brake	
H	L	H	H	Operation	V → U
H	L	H	L	Brake	
L	L	H	H	Operation	V → W
L	L	H	L	Brake	
L	H	H	H	Operation	U → W
L	H	H	L	Brake	
L	H	L	H	Operation	U → V
L	H	L	L	Brake	

Brake: For circuit operation, each high-side switch of the source and sink turns ON.

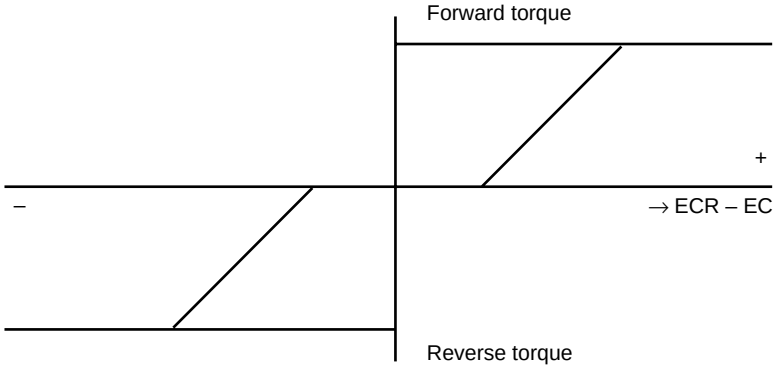
(2) ST/SP = "L"

Input Signal				Circuit Operation Mode
CMP0	CMP1	CMP2	PWM	
–	–	–	–	Stop

Remark Q1, Q3, and Q5 are ON. Q2, Q4, and Q6 are OFF.

(3) Torque command

The relationship between the control reference voltage (ECR) and control voltage (ECR – EC), and torque is as follows. Dead band width is 150 mV (TYP).



	Reverse Pin Voltage (REV)	
	L	H
ECR > EC	Forward	Reverse[Note]
ECR < EC	Reverse[Note]	Stop

Note Stops after detecting reverse.

(4) Standby mode

The internal power supply for the μPD16836 is turned off by setting the standby mode.

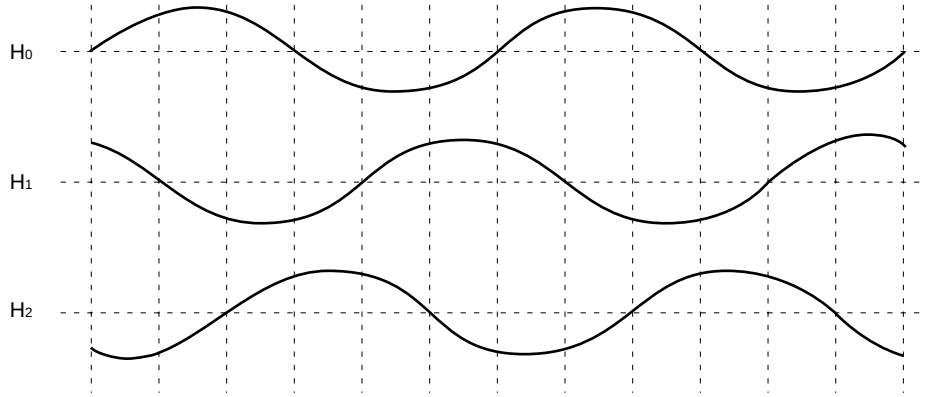
Each pin output is high-impedance in the standby mode. The internal oscillation block also stops, and the circuit current can be reduced.

After the normal operation mode has been set, a few of 10's of μs are necessary for the motor to restart.

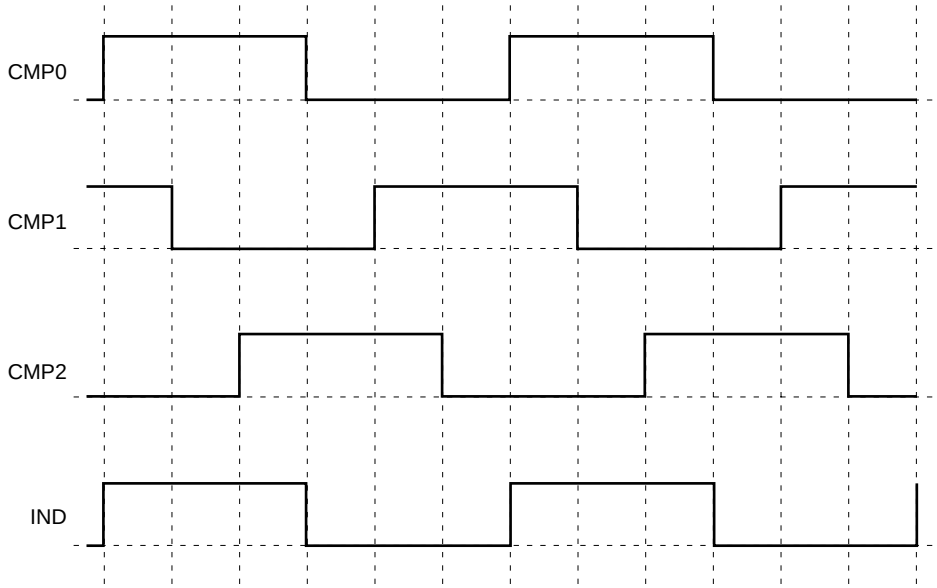
STB Pin	Operation Mode
L	Normal mode
H	Standby mode

TIMING CHART

(1) Hole signal input



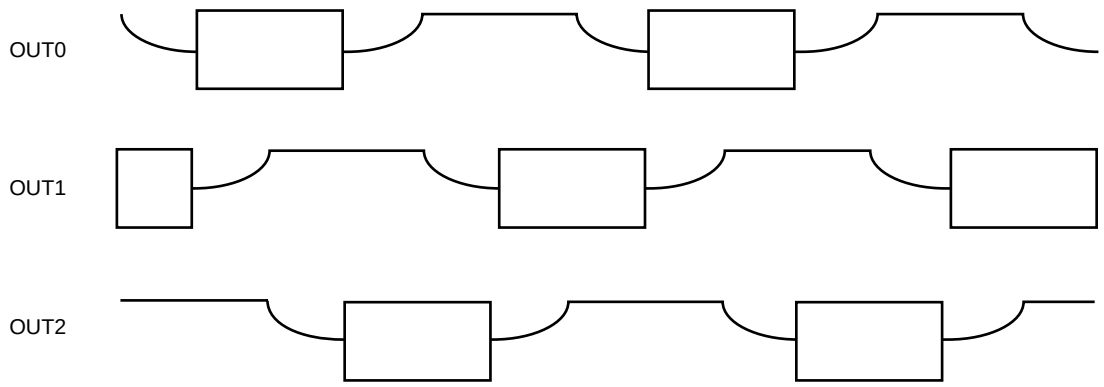
(2) CMP signal



(3) Output MOSFET driving and comparator selection

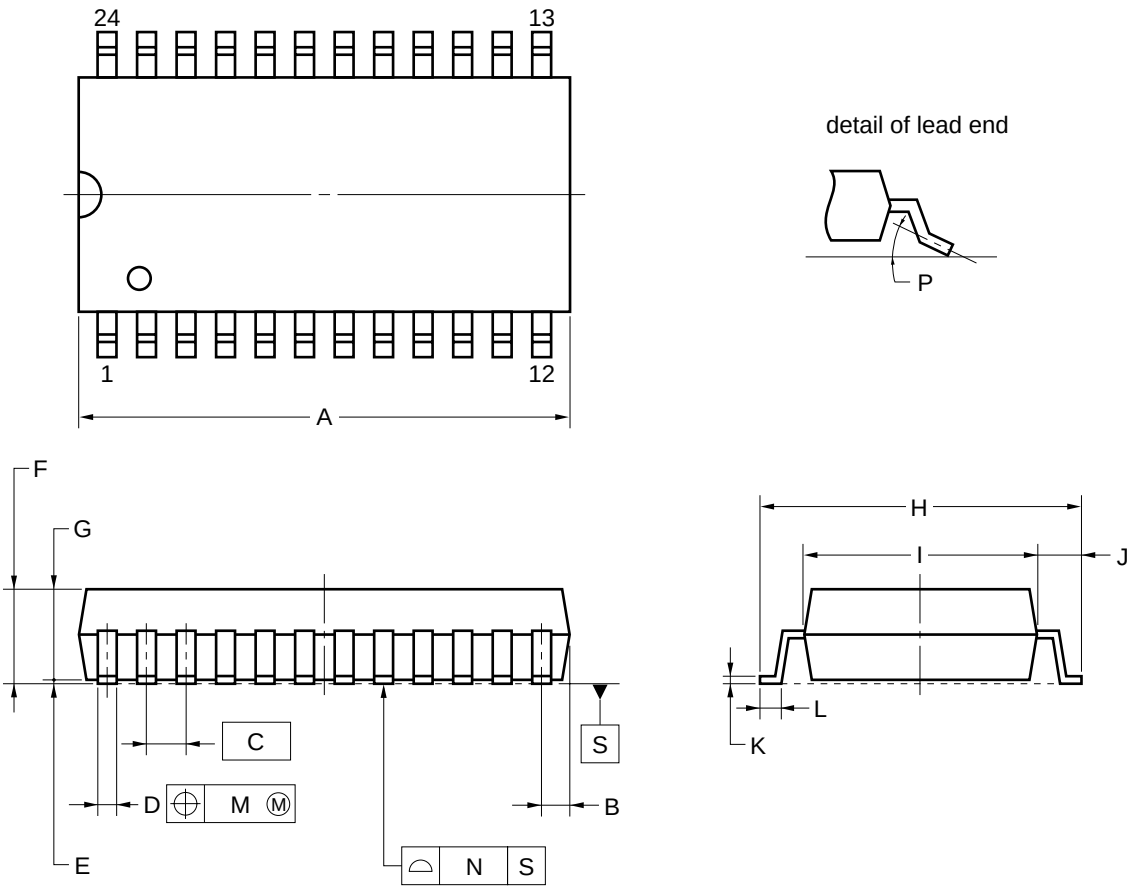
Q1		SW	SW		ON	ON		SW	SW		ON	ON	
Q2		SW	SW					SW	SW				
Q3	SW		ON	ON		SW	SW		ON	ON		SW	SW
Q4	SW					SW	SW					SW	SW
Q5	ON	ON		SW	SW		ON	ON		SW	SW		ON
Q6				SW	SW					SW	SW		

(4) Motor driving waveform



PACKAGE DRAWING

24 PIN PLASTIC SOP (375 mil)



NOTE

1. Controlling dimention — millimeter.

2. Each lead centerline is located within 0.12 mm (0.005 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	$15.3^{+0.41}_{-0.2}$	$0.602^{+0.017}_{-0.008}$
B	0.87 MAX.	0.035 MAX.
C	1.27 (T.P.)	0.050 (T.P.)
D	$0.42^{+0.08}_{-0.07}$	$0.017^{+0.003}_{-0.004}$
E	0.125±0.075	0.005±0.003
F	2.9 MAX.	0.115 MAX.
G	2.50±0.2	$0.098^{+0.009}_{-0.008}$
H	10.3±0.2	$0.406^{+0.008}_{-0.009}$
I	7.2±0.2	$0.283^{+0.009}_{-0.008}$
J	1.6±0.2	0.063±0.008
K	$0.17^{+0.08}_{-0.07}$	$0.007^{+0.003}_{-0.004}$
L	0.8±0.2	$0.031^{+0.009}_{-0.008}$
M	0.12	0.005
N	0.10	0.004
P	$3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$	$3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$

P24GT-50-375B-2

ELECTRICAL SPECIFICATIONS

Solder this product under the following recommended conditions.

For details of the recommended soldering conditions, refer to information document **Semiconductor Device Mounting Technology Manual (C10535E)**.

For soldering methods and conditions other than those recommended, consult NEC.

Soldering Methods	Soldering Conditions	Recommended Conditions Symbol
Infrared reflow	Package peak temperature: 235 °C, Time: 30 secs. max. (210 °C min.), Number of times: three times max., Number of days: none[Note], Flux: Rosin-based flux with little chlorine content (chlorine: 0.2 Wt% max.) is recommended.	IR35-00-3
VPS	Package peak temperature: 215 °C, Time: 40 secs. max. (200 °C min.), Number of times: three times max., Number of days: none[Note], Flux: Rosin-based flux with little chlorine content (chlorine: 0.2 Wt% max.) is recommended.	VP15-00-1
Wave soldering	Package peak temperature: 260 °C, Time: 10 secs. max., Preheating temperature: 120 °C max., Number of times: once, Flux: Rosin-based flux with little chlorine content (chlorine: 0.2 Wt% max.) is recommended.	WS60-00-1

Note Number of days in storage after the dry pack has been opened. The storage conditions are at 25 °C, 65% RH MAX.

Caution Do not use two or more soldering methods in combination.

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