NEC

Phase-out/Discontinued

MOS INTEGRATED CIRCUIT

μPD16858B/C

THREE-PHASE SPINDLE MOTOR DRIVER FOR MONOLITHIC CD-ROM

DESCRIPTION

The μPD16858B/C is a three-phase spindle motor driver for CD-ROM drives and consists of a CMOS control circuit and a MOS bridge output.

This motor driver employs a three-phase full-wave PWM driving method. Because it has an output stage consisting of MOS FETs, the motor driver consumes less power than the existing linear drivers using bipolar transistors.

The product is supplied in the form of a small, slim 30-pin shrink SOP.

This spindle motor driver is ideal for driving slim-type spindle motors in notebook PCs and so on.

FEATURES

- Both normal PWM type (16858B) and synchronous rectification PWM type (16858C) are available.
- Low ON resistance (sum of ON resistances of upper and lower MOS FETs): R_{ON} = 0.8 Ω (TYP)
- Low power consumption to three-phase full-wave PWM driving
- START/STOP pin is provided. Brake is applied in STOP mode.
- Standby pin is provided. Internal circuitry is turned off in standby mode.
- Low current consumption: I_{DD} = 3 mA (MAX), $I_{DD\ (ST)}$ = 1 μA (MAX), torque command current = 30 μA (MAX)
- Thermal shut-down circuit and current-limiting circuit
- Low-voltage malfunctioning prevention circuit
- FG output function
- Reverse rotation prevention circuit
- Hole bias function
- 30-pin shrink SOP (300 mil)

ORDERING INFORMATION

Part Number	Package
μPD16858BGS-GJG	30-pin shrink SOP (0.65-mm pitch, 300 mil)
μPD16858CGS-GJG	30-pin shrink SOP (0.65-mm pitch, 300 mil)

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Printed in Japan

ABSOLUTE MAXIMUM RATINGS

(T_A = 25 °C, 1 Ω/1 mH load condition: mounted on glass epoxy substrate measuring 100 mm × 100 mm × 1 mm with 15% of copper foil)

Parameter	Symbol	Condition	Rating	Unit
Supply voltage	V_{DD}		–0.5 to +5.7	V
	V_M		–0.5 to +5.7	V
Input voltage	V_{IN}		–0.5 to V_{DD} + 0.5	V
Steady-state DC output current[Note 1]	$I_{D\ (DC)}$	DC	±0.5	A/phase
Steady-state instantaneous output current[Note 2]	$I_{D\ (pulse)}$	PW ≤ 5 ms, Duty ≤ 30 %	±1.3	A/phase
Output current at reverse brake[Note 3]	$I_{DR\ (pulse)}$	PW ≤ 5 ms, Duty ≤ 30 %	±1.5	A/phase
Power consumption	P_T		1.0	W
Peak joint temperature	$T_{CH\ (MAX)}$		150	°C
Storage temperature range	T_{stg}		–55 to +150	°C

Notes 1. Rated current at constant-speed revolution

2. Rated current on starting or locking

3. Rated current at reverse brake

RECOMMENDED OPERATING CONDITIONS

(T_A = 25 °C, 1 Ω/1 mH load condition: mounted on glass epoxy substrate measuring 100 mm × 100 mm × 1 mm with 15% of copper foil)

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply voltage	V_{DD}	4.5		5.5	V
	V_M	4.5		5.5	V
Steady-state DC output current[Note 1]	$I_{D\ (DC)}$			±0.4	A/phase
Steady-state instantaneous output current[Note 2]	$I_{D\ (pulse)}$			±1.0	A/phase
Output current at reverse brake[Note 3]	$I_{DR\ (pulse)}$			±1.2	A/phase
Hole bias current	I_{HB}		10	20	mA
IND pin output current	I_{FG}	0	±2.5	±5	mA
Operating temperature range	T_A	–20		75	°C

Notes 1. Recommended maximum current at constant-speed revolution

2. Recommended maximum current on starting or locking (It is recommended that the current be limited to 1.0 A or less.)

3. Recommended maximum current at reverse brake

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

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
[Overall]						
Current consumption 1 (during operation)	I_{DD}	STB = V_{DD}			3.0	mA
Current consumption (in standby mode)	$I_{DD\ (ST)}$	STB = GND			1.0	μA
[ST/SP, STB, REV]						
High-level input voltage	V_{IH}		0.6 V_{DD}		V_{DD}	V
Low-level input voltage	V_{IL}				0.8	V
Input pull-down resistor	R_{IND}			120		kΩ
[Control circuit]						
Triangular wave oscillation frequency	f_{PWM}	C_T = 100 pF		75		kHz
[Hole amplifier]						
In-phase input voltage range	V_{Hch}		1.5		3.5	V
Hysteresis voltage	V_{Hhis}	V_H = 2.5 V		15		mV
Input bias current	I_{Hbias}				1.0	μA
[Hole bias block]						
Hole bias voltage	V_{HB}	I_{HB} = 10 mA		0.3	0.5	V
[FG output]						
IND pin high-level voltage	V_{FG_H}	I_{FG} = –2.5 mA	V_{DD}–1.0			V
IND pin low-level voltage	V_{FG_L}	I_{FG} = +2.5 mA			0.5	V
[Output block]						
Output ON resistance (upper + lower)	R_{ON}	I_{DR} = 200 mA T_A = –20 to +75 °C		0.8	1.2	Ω
OFF leakage current	$I_{D\ (OFF)}$				10	μA
Output turn-on time	t_{ONH}	R_M = 5 Ω Star wiring			1.0	μs
Output turn-off time	t_{OFFH}				1.0	μs
[Torque command]						
Control reference input voltage range	ECR		0.3		4.0	V
Control input voltage range	EC		0.3		4.0	V
Input current	I_{IN}	EC, ECR = 0.5 to 3 V			30	μA
Input voltage difference	ECR-EC[Note]	DUTY = 100 %, ECR = 2.0 V		1.1		V
DEAD ZONE (+)	EC_d+	ECR = 2.0 V	0		100	mV
DEAD ZONE (–)	EC_d–	ECR = 2.0 V	0		–100	mV
[Overcurrent detector]						
Input offset voltage	V_{IO}		–15		+15	mV
CL pin voltage	V_{CL}			100		mV

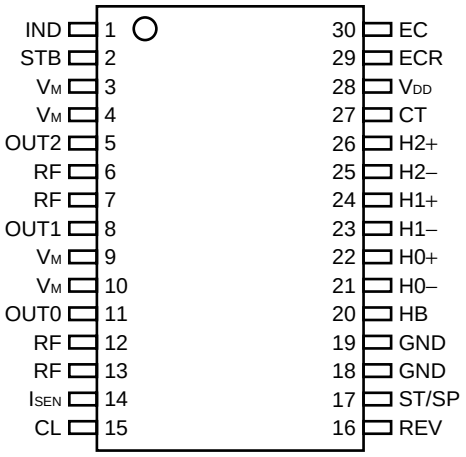
Note Excluding the dead zone.

The overheating protection circuit (T.S.D) operates at T_{CH} > 150 °C.

The low-voltage malfunctioning prevention circuit (UVLO) operates at 4 V (TYP).

PIN FUNCTION

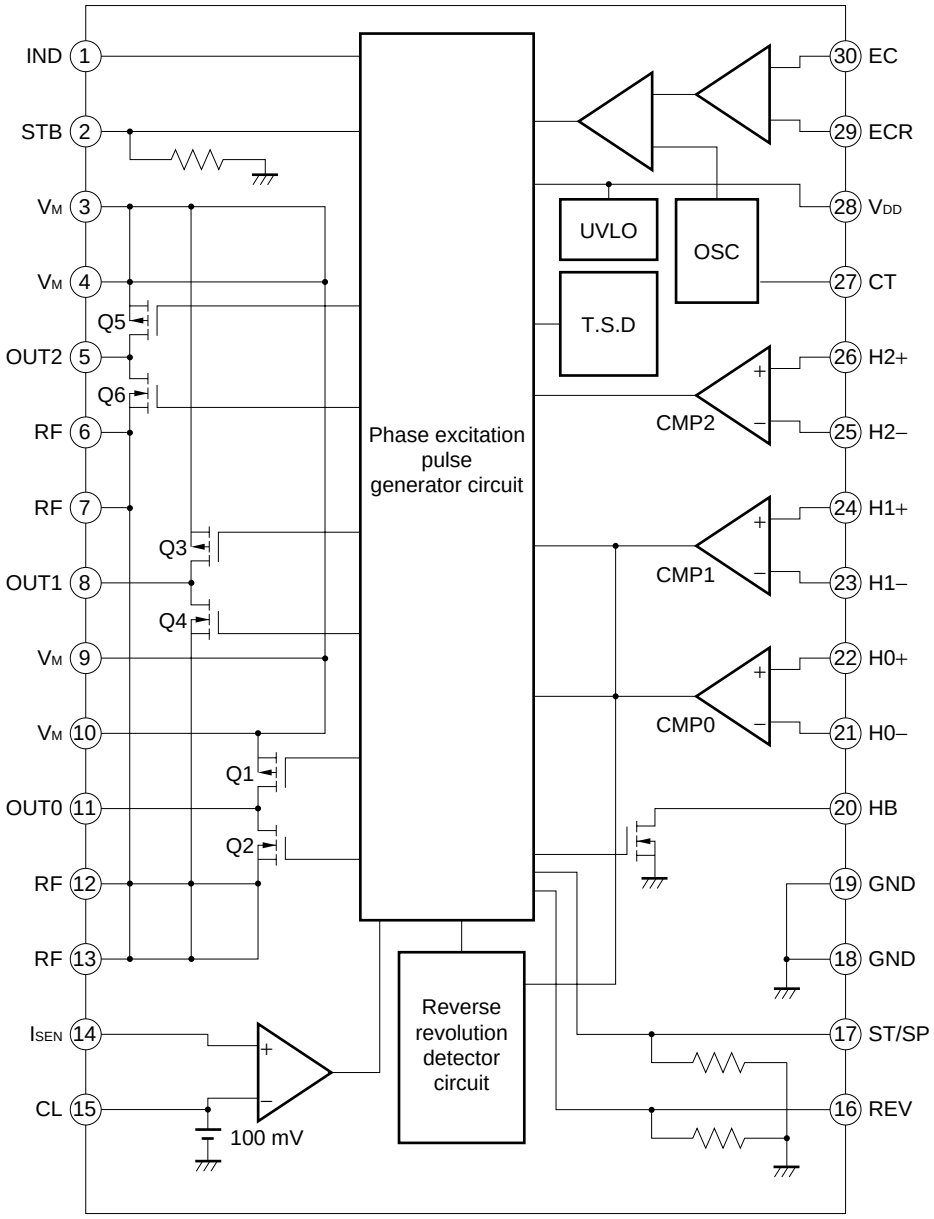
Package: 30-pin shrink SOP (300 mil)



Pin No	Pin Name	Pin Function
1	IND	Index signal output pin
2	STB	Standby operation input pin
3	V_M	Motor block supply voltage input pin
4	V_M	Motor block supply voltage input pin
5	OUT2	Motor connection pin
6	RF	Three-phase bridge common pin
7	RF	Three-phase bridge common pin
8	OUT1	Motor connection pin
9	V_M	Motor block supply voltage input pin
10	V_M	Motor block supply voltage input pin
11	OUT0	Motor connection pin
12	RF	Three-phase bridge common pin
13	RF	Three-phase bridge common pin
14	I_{SEN}	Sense resistor connection pin
15	CL	Overcurrent detection voltage filter pin
16	REV	Reverse operation input pin
17	ST/SP	Start/stop input pin
18	GND	GND pin
19	GND	GND pin
20	HB	Hole bias pin
21	H0–	Hole signal input pin
22	H0+	Hole signal input pin
23	H1–	Hole signal input pin
24	H1+	Hole signal input pin
25	H2–	Hole signal input pin
26	H2+	Hole signal input pin
27	C_T	Oscillation frequency setting capacitor connection pin
28	V_{DD}	Control system supply voltage input pin
29	ECR	Control reference voltage input pin
30	EC	Control voltage input pin

Remark Where more than one pin with the same name exists (such as V_M, RF, and GND), connect all of them, not just one of them.

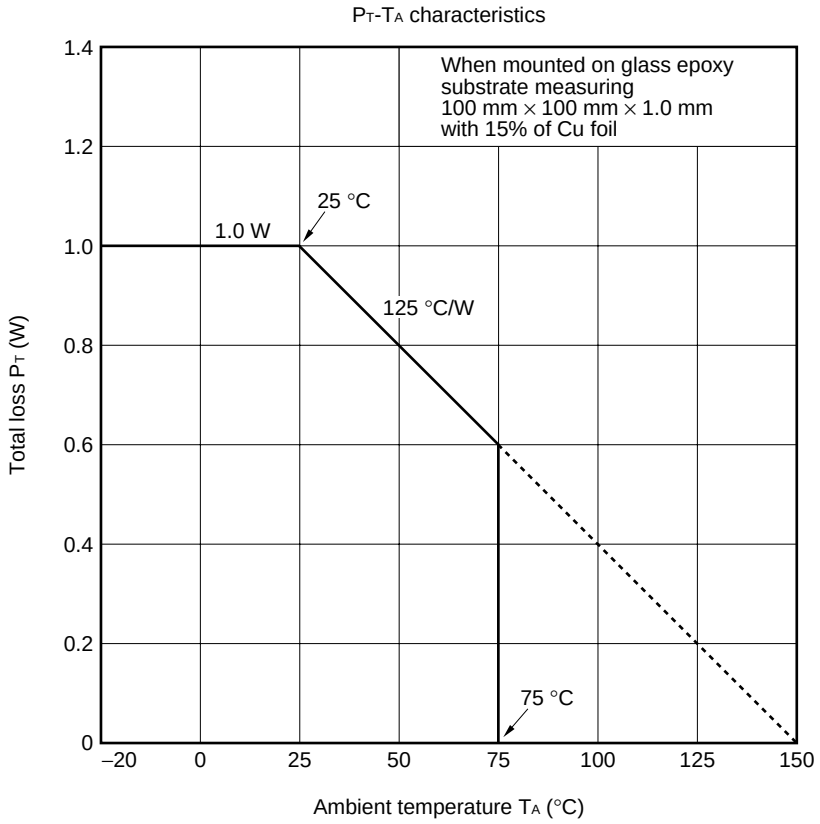
BLOCK DIAGRAM



Remarks 1. The CL pin is used to connect a filter. Leave this pin open when it is not used.

2. Where more than one pin with the same name exists (such as V_M, RF, and GND), connect all of them, not just one of them.

TOTAL LOSS VS AMBIENT TEMPERATURE CHARACTERISTICS



Caution If the ambient temperature is 25 °C or less, a power of up to 1 W can be applied. If the temperature rises beyond 25 °C, perform derating by referring to the above figure. At 75 °C, which is the maximum level of the recommended operating temperature, a power of up to 0.6 W can be applied to the IC.

FUNCTION OPERATION TABLE

(1) ST/SP = "H"

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

Brake: Regenerated via parasitic diode of high-side Pch MOS FET (μPD16858B).
Regenerated via high-side Pch MOS FET channel (μPD16858C).

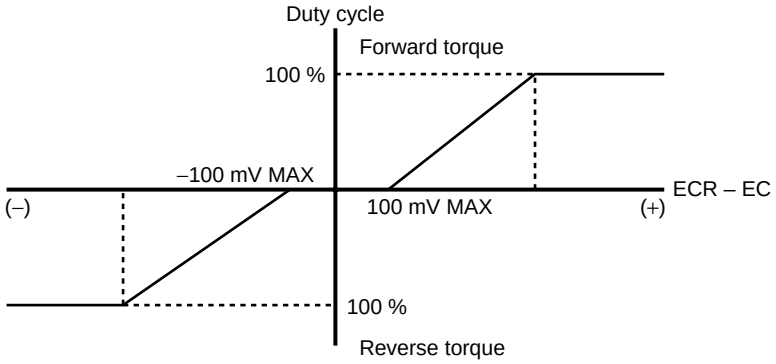
(2) ST/SP = "L"

Input Signal				Circuit Operation Mode
CMP0	CMP1	CMP2	PWM	
–	–	–	–	Short brake

Short brake: High-side MOS FET turns ON and low-side MOS FET turns OFF.

(3) Torque command

The relation between the difference between the control reference voltage (ECR) and control voltage (EC) (ECR – EC) and torque is as follows:



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

Note Stops if reverse revolution is detected.
During reverse revolution, the counter electromotive current flows through the parasitic diode of the Pch MOS FET at the high side (μPD16858B), or the channel of Pch MOS FET at the high side (μPD16858C).

(4) Standby mode

The power supplied to the internal circuitry of the IC can be turned off by setting the IC in the standby mode. In the standby mode, each pin goes into a high-impedance state (H bridge all OFF). The internal oscillation block also stops and therefore, the circuit current can be decreased.

If the motor driver is stopped by using the standby pin while the driver is operating, the motor is stopped by force of inertia. It takes the motor driver about several 10 μs to start when it is set in the normal operation mode.

STB Pin	Operation Mode
H	Normal mode
L	Standby mode

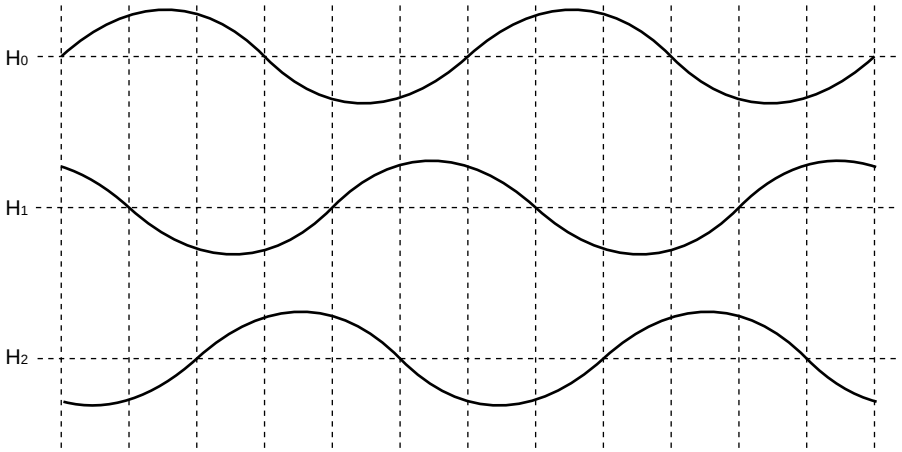
Caution Output current

The rated output current differs depending on whether the motor revolves at a constant speed (steady state), is started (steady state), or reversed and brake is applied. The rated DC current when the motor revolves at a constant speed is 0.5 A, and the rated instantaneous current when the motor is started is 1.3 A. When brake is applied to stop the motor and when the motor is reversed, the maximum current is 1.5 A.

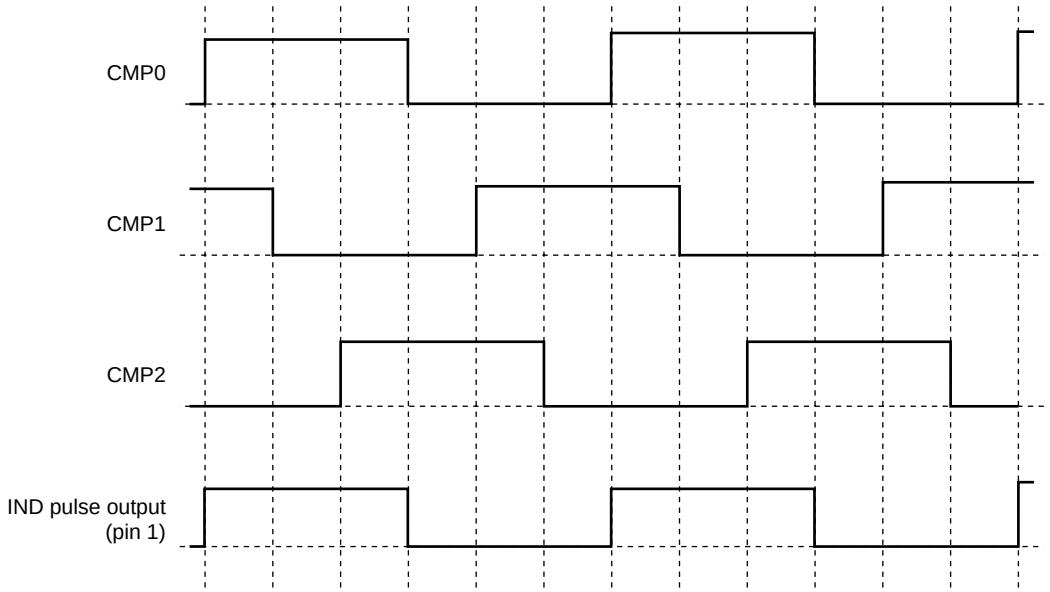
When a brake is applied or the motor is reversed, a current exceeding that when the motor revolves at a constant speed (immediately before a brake is applied) instantaneously flows because of the counter electromotive force due to the motor inductance. Determine the value of overcurrent for the steady state, taking the peak current for reversing or applying a brake to the motor into consideration.

TIMING CHARTS

(1) Hole signal input



(2) CMP signal



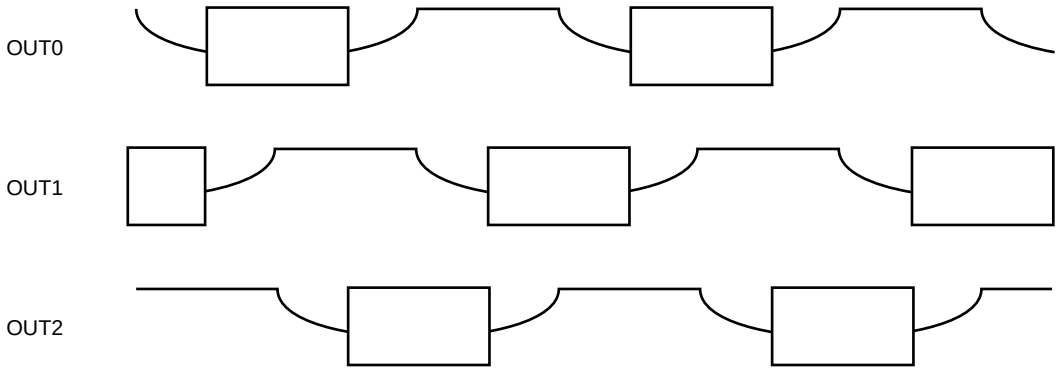
(3) Output MOS FET driving and comparator selection (blank: switch OFF)

Q1		($\overline{SW}$)	($\overline{SW}$)		ON	ON		($\overline{SW}$)	($\overline{SW}$)		ON	ON	
Q2		SW	SW					SW	SW				
Q3	($\overline{SW}$)		ON	ON		($\overline{SW}$)	($\overline{SW}$)		ON	ON		($\overline{SW}$)	($\overline{SW}$)
Q4	SW					SW	SW					SW	SW
Q5	ON	ON		($\overline{SW}$)	($\overline{SW}$)		ON	ON		($\overline{SW}$)	($\overline{SW}$)		ON
Q6				SW	SW					SW	SW		

The high-side MOS FET at the output stage of the μPD16858C performs synchronous switching (switching in parentheses).

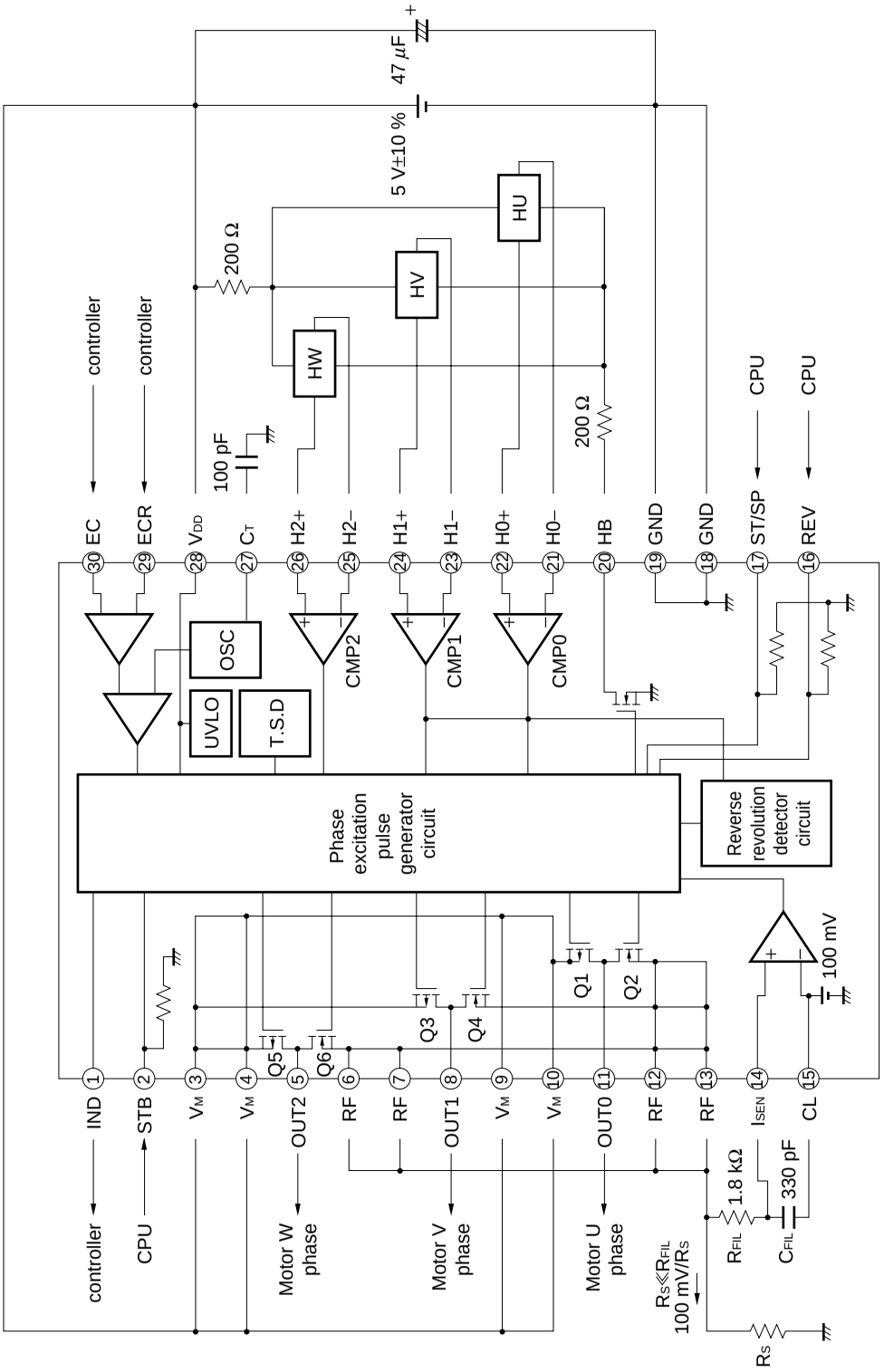
The high-side MOS FET of the μPD16858B does not perform switching in parentheses but is in the OFF state.

(4) Motor driving wave



Phase-out/Discontinued

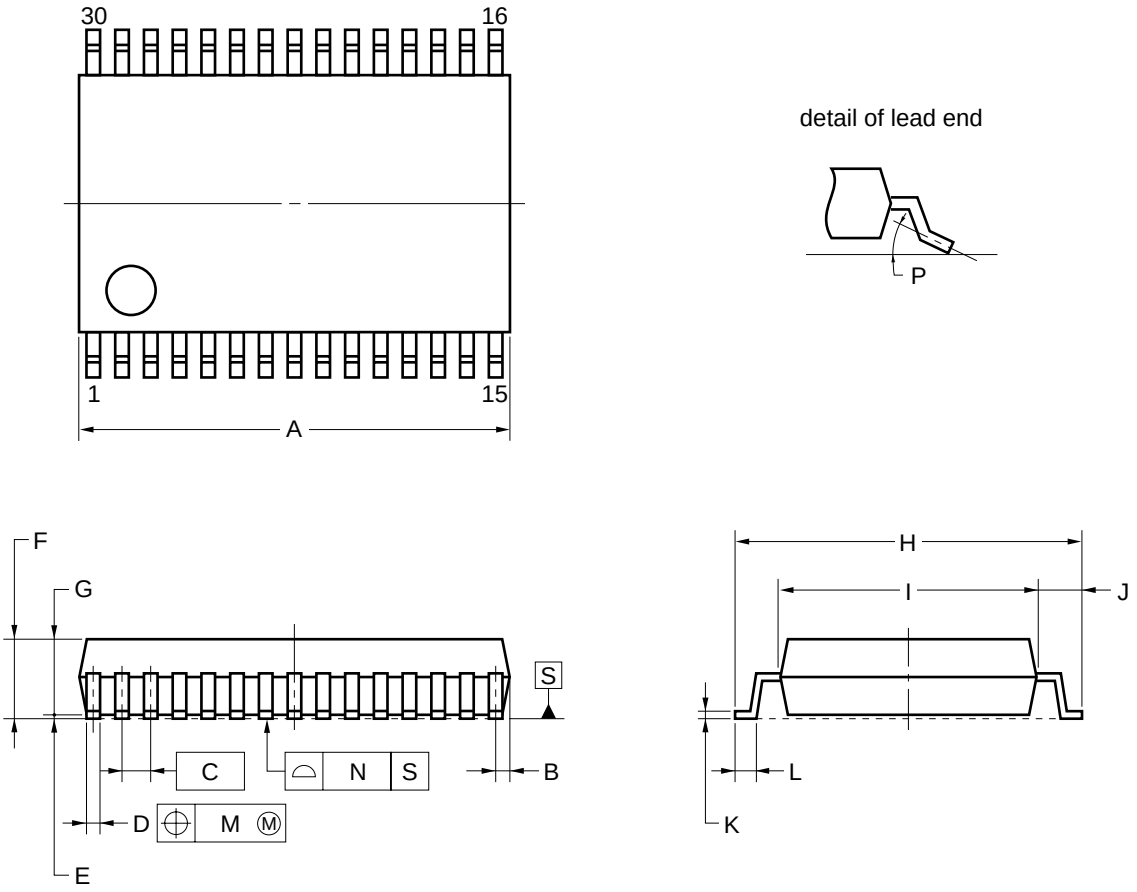
APPLICATION CIRCUIT EXAMPLE



Caution It is recommended that a tantalum capacitor of several 10 μF be inserted between V_M and GND to reduce noise during PWM. Determine the value of R_S so that the output current does not exceed the rating.

PACKAGE DRAWING

30 PIN PLASTIC SHRINK SOP (300 mil)



NOTES

1. Controlling dimension —— millimeter.

2. Each lead centerline is located within 0.10 mm (0.004 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	9.85±0.26	0.388±0.011
B	0.51 MAX.	0.020 MAX.
C	0.65 (T.P.)	0.026 (T.P.)
D	$0.32^{+0.08}_{-0.07}$	$0.013^{+0.003}_{-0.004}$
E	0.125±0.075	0.005±0.003
F	2.0 MAX.	0.079 MAX.
G	1.7±0.1	0.067±0.004
H	8.1±0.2	0.319±0.008
I	6.1±0.2	0.240±0.008
J	1.0±0.2	$0.039^{+0.009}_{-0.008}$
K	$0.17^{+0.08}_{-0.07}$	$0.007^{+0.003}_{-0.004}$
L	0.5±0.2	$0.020^{+0.008}_{-0.009}$
M	0.10	0.004
N	0.10	0.004
P	$3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$	$3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$

P30GS-65-300B-2

RECOMMENDED SOLDERING CONDITONS

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 Method(s)	Soldering Conditions	Recommended Conditions Symbol
Infrared reflow	Package peak temperature: 235 °C, Time: 30 sec 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 sec 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.	VP15-00-3
Wave soldering	Package peak temperature: 260 °C, Time: 10 sec 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.

[MEMO]

[MEMO]

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