

# 5ch Motor Driver Monolithic IC MM1646XH

## Outline

This IC is a motor driver IC for DVD players with 5ch built in (for spindle, sled, focus, tracking, loading).

## Features

1. 5ch motor driver in one package.
2. Small package ensures heat loss of 2.2W.
3. Built-in short brake (spindle).
4. Built-in thermal shutdown function.

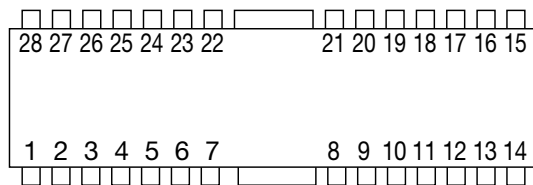
## Package

HSOP-28D

## Applications

1. for DVD players
2. for DVD minicomponent

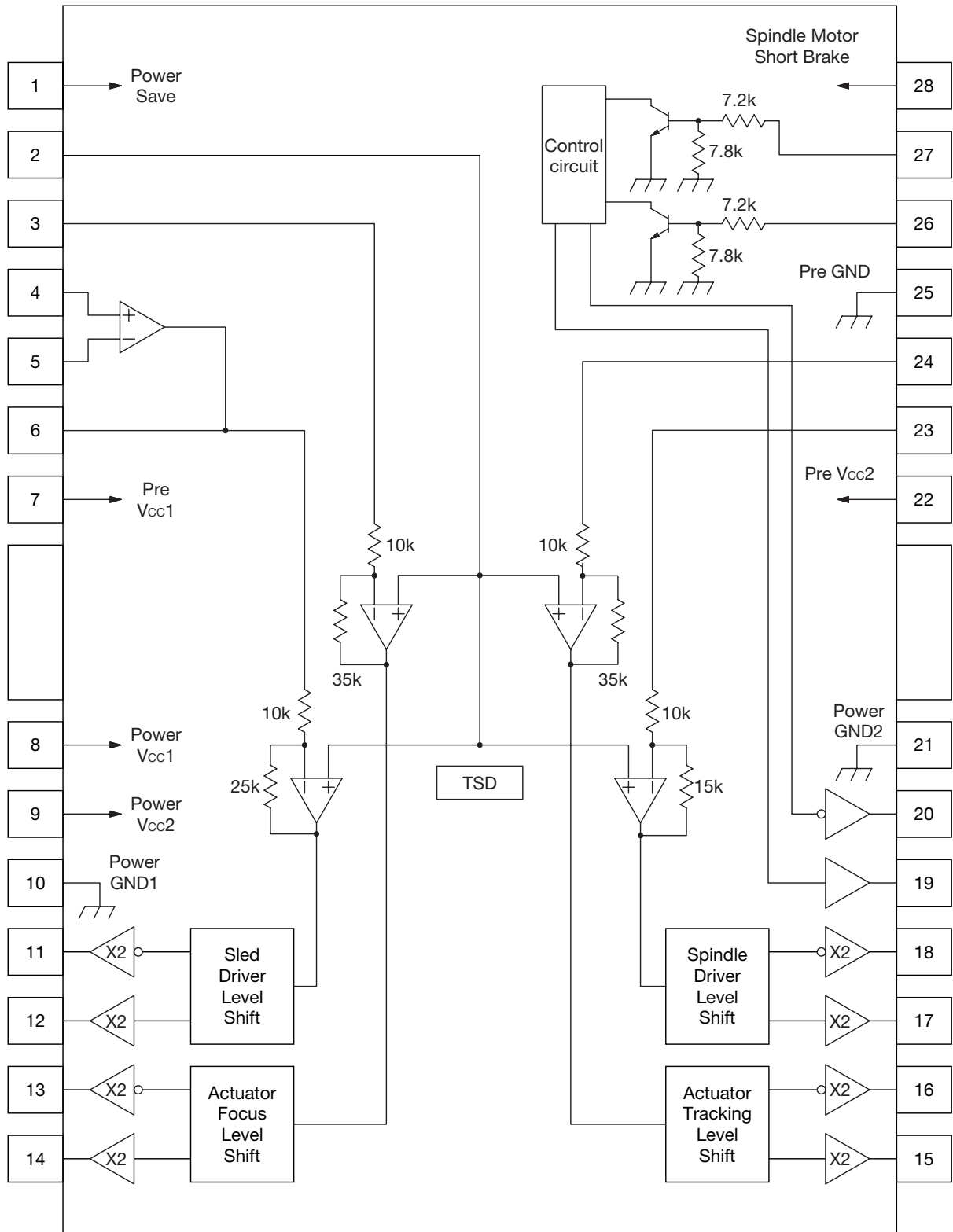
## Pin Assignment



HSOP-28D  
(TOP VIEW)

1	PS	15	OUT4+
2	V <sub>BIAS</sub>	16	OUT4-
3	V <sub>IN1</sub>	17	OUT3+
4	V <sub>IN2+</sub>	18	OUT3-
5	V <sub>IN2-</sub>	19	OUTL+
6	VO2	20	OUTL-
7	PreV <sub>cc1</sub>	21	PowerGND2
8	PowerV <sub>cc1</sub>	22	PreV <sub>cc2</sub>
9	PowerV <sub>cc2</sub>	23	V <sub>IN3</sub>
10	PowerGND1	24	V <sub>IN4</sub>
11	OUT2-	25	PreGND
12	OUT2+	26	V <sub>INLO-</sub>
13	OUT1-	27	V <sub>INLO+</sub>
14	OUT1+	28	SB

Block Diagram



TSD: Thermal shutdown

Pin Description

Pin no.	Pin name	Function	Internal equivalent circuit diagram
1	PS	Input for power save control	
2	V <sub>BIAS</sub>	Input for reference voltage	
3 23 24	V <sub>IN1</sub> V <sub>IN3</sub> V <sub>IN4</sub>	Input for focus driver Input for tracking driver Input for spindle driver	
4 5	V <sub>IN2+</sub> V <sub>IN2-</sub>	Non inverted input for OP-amp Inverting input for OP-amp	
6	VO2	Output of OP-amp	
7	PreV <sub>cc1</sub>	V <sub>cc</sub> for pre - drive block and power block of sled	
8	Power V <sub>cc1</sub>	V <sub>cc</sub> for power block of spindle	
9	Power V <sub>cc2</sub>	V <sub>cc</sub> for power block of actuator	
10	Power GND2	GND for power block	
21	Power GND2	GND for power block	

Pin no.	Pin name	Function	Internal equivalent circuit diagram
22	PreVcc2	Vcc for pre - drive block	
25	PreGND	GND for pre - drive block	
11 12	OUT2- OUT2+	Inverted output of sled Non inverted output of sled	
13 14	OUT1- OUT1+	Inverted output of focus Non inverted output of focus	
15 16	OUT4+ OUT4-	Non inverted output of tracking Inverted output of tracking	

Pin no.	Pin name	Function	Internal equivalent circuit diagram
17 18	OUT3+ OUT3-	Non inverted output of spindle Inverted output of spindle	
19 20	OUTL+ OUTL-	Non inverted output of loading Inverted output of loading	
26 27	V <sub>INLO</sub> - V <sub>INLO</sub> +	Non inverted input of loading Inverted input of loading	
28	SB	Short brake input	

## Absolute Maximum Ratings (Ta=25°C)

Item	Symbol	Ratings	Units
Supply voltage	PreVcc1, 2 PowerVcc1, 2	-0.3~13.5	V
Input voltage	V <sub>IN</sub>	-0.3~PreVcc+0.3	V
Maximum output current 1	I <sub>o1</sub>	1.2 *1	A
Maximum output current 2	I <sub>o2</sub>	0.6 *1	A
Allowable loss	P <sub>d</sub>	2.2 *2	W
Operating temperature	T <sub>OPR</sub>	-40~+85	°C
Storage temperature	T <sub>STG</sub>	-55~+150	°C

Note: \*1 Maximum output current I is output current of CH1 ~CH4

Maximum output current 2 is output current of loading part

\*2 Use base condition: 100 X100mm, t=1.6mm, Glass epoxy mounting

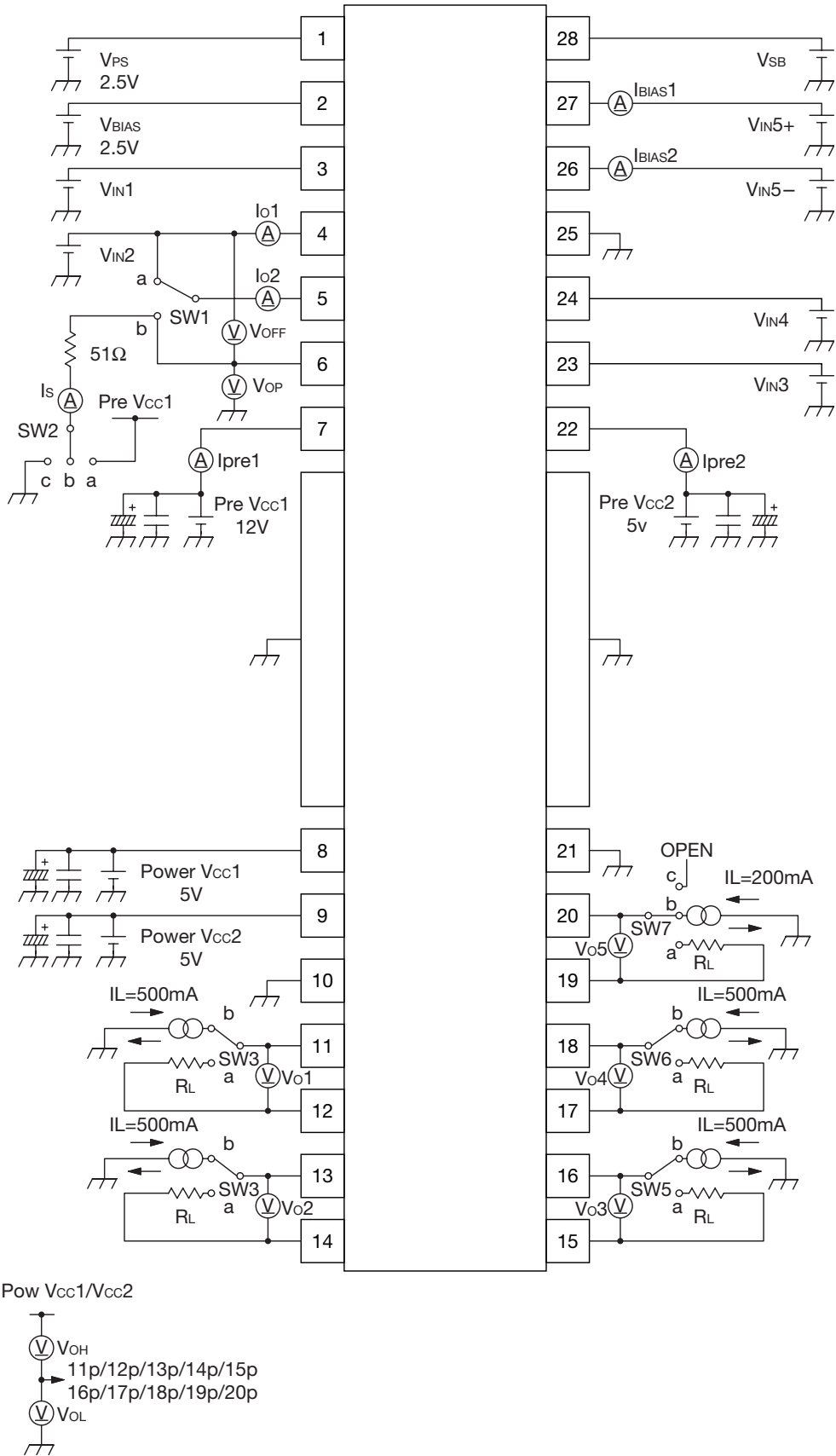
## Recommended Operating Conditions

Item	Symbol	Ratings	Units
Operating supply voltage	PreVcc1	4.3~13.2	V
	PreVcc2	4.3~13.2	
	PowerVcc1	4.3~PreVcc1	
	PowerVcc2	4.3~PreVcc1	

**Electrical Characteristics** (Except where noted otherwise, Ta=25°C, PreVcc1=12V, PreVcc2=PowerVcc1=PowerVcc2=5V, VBIAS=VPS=2.5V, RL=8Ω)

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
<b>Quiescent current</b>						
Quiescent current 1	Icc1	PS=H (I pre Vcc1) consumption current except a loading part		18	27	mA
Quiescent current 2	Icc2	PS=H, VINLO+/LO-=0V Loading Part Stand-by			0.5	mA
Quiescent current 3	Icc3	PS=L, VINLO+=5V, LO-=0V Loading Part CW		25	35	mA
Quiescent current 4	Icc4	PS=L, VINLO+=5V, LO-=5V Loading Part Brake		48	67	mA
Power-save quiescent current	Ips1	PS=L, VINLO+/LO-=0V Loading Part Stand-by			0.5	mA
Voltage for power-save ON	VPSON		0		0.5	V
Voltage for power-save OFF	VPSOFF		2.0			V
Voltage for short-brake ON	VSBON		2.0			V
Voltage for short-brake OFF	VSBOFF		0		0.5	V
<b>ch1/ch4 actuator driver</b>						
Output offset voltage	VOFF	VIN=VBIAS	-50	0	50	mV
Output saturation voltage H	VOH	IL=-500mA		1.0	1.5	V
Output saturation voltage L	VOL	IL=500mA			0.6	V
Closed loop voltage gain	Gv	VIN=VBIAS±0.2V	21.0	23.0	25.0	dB
<b>ch2 sled motor driver</b>						
Output offset Voltage	VOFFSL	VIN=VBIAS	-100	0	100	mV
Output saturation voltage H	VOHSL	IL=-500mA		1.0	1.5	V
Output saturation voltage L	VOLSL	IL=500mA			0.6	V
Closed loop voltage gain	GVSL	VIN=VBIAS±0.2V	18.0	20.0	22.0	dB
<b>ch2 OP-amp</b>						
Input offset voltage	VOFFOP	VIN=VBIAS	-10		10	mV
Common mode input range	VICM		-0.3		11.0	V
Input bias current	IBOP	VIN=VBIAS		30	300	nA
High-level output voltage	VOHOP		4.8			V
Low-level output voltage	VOLOP			0.1	0.3	V
Output source current	ISO		0.3	0.5		mA
Output sink current	ISI		1			mA
<b>Spindle motor driver</b>						
Output offset voltage	VOFFSP	VIN=VBIAS	-50	0	50	mV
Output saturation voltage H	VOHSP	IL=-500mA		1.0	1.5	V
Output saturation voltage L	VOLSP	IL=500mA			0.6	V
Closed loop voltage gain	GVSP	VIN=VBIAS±0.2V	13.5	15.5	17.5	dB
<b>Loading motor driver</b>						
Output saturation voltage H	VOHLOA	IL=-200mA		1	1.5	V
Output saturation voltage L	VOLLOA	IL=200mA			0.6	V
Voltage for VINLO-/+ON	VINH		2.0			V
Voltage for VINLO-/+OFF	VINL		0		0.5	V
Input current for VINLO-/+	INBIAS	VINLO (+), (-) =2.5V		250	330	μA

Measuring Circuit

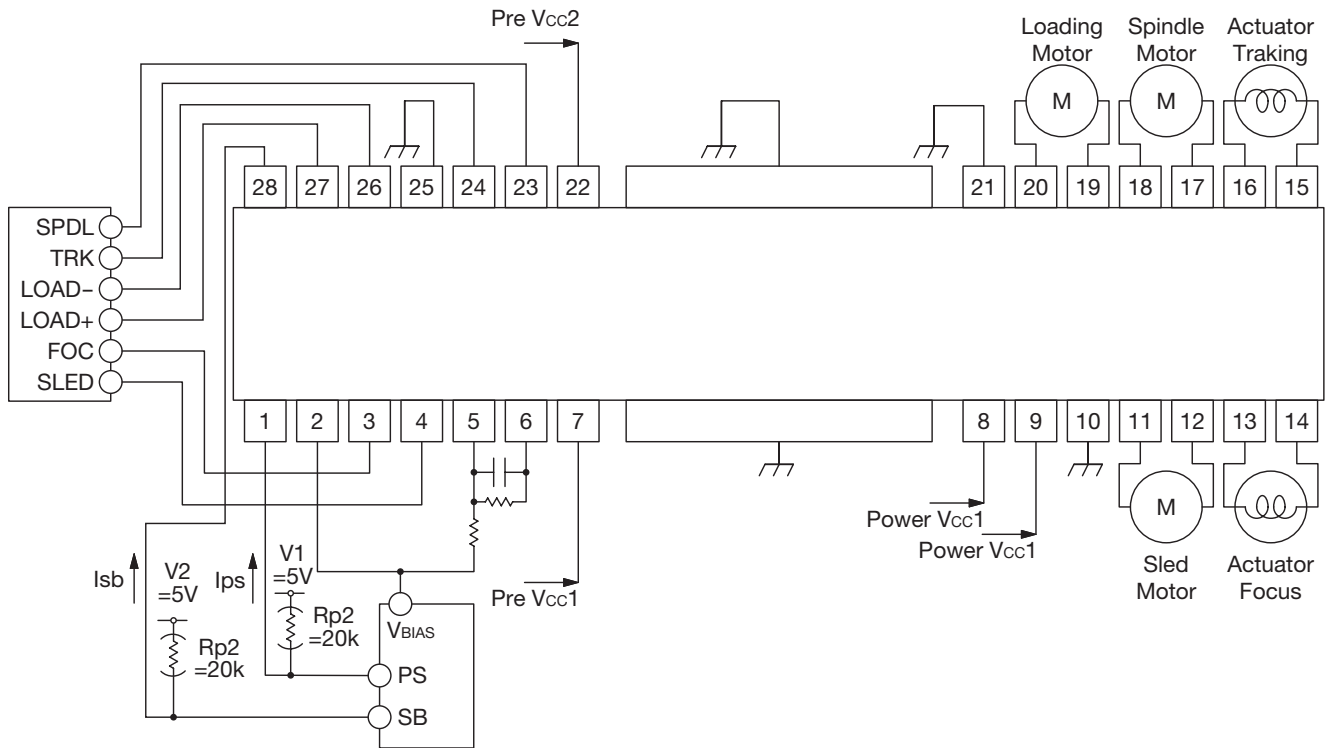




**Input Condition Table**

Item	Input voltage					SW			Condition	Measure point
	V <sub>IN1</sub> ~ V <sub>IN4</sub>	V <sub>IN5-</sub>	V <sub>IN5+</sub>	V <sub>PS</sub>	V <sub>SB</sub>	SW1	SW2	SW3~ SW7		
Quiescent current 1	2.5V	0V	0V	5V	0V	b	b	a	No load	Ipre1
Quiescent current 2	2.5V	0V	0V	5V	0V	b	b	a	No load	Ipre2
Quiescent current 3	2.5V	5V	0V	0V	0V	b	b	c	No load	Ipre2
Quiescent current 4	2.5V	5V	5V	0V	0V	b	b	c	No load	Ipre2
Power-save 1 quiescent current	2.5V	0V	0V	0V	0V	b	b	a	No load	Ipre1
Voltage for power 1 save ON	2.5V	0V	0V	0.5V	0V	b	b	a		Ipre1
Voltage for power-save OFF	2.5V	0V	0V	2.0V	0V	b	b	a		Ipre1
Voltage for short-brake ON	2.6V	0V	0V	5V	2.0V	b	b	a		Ipre1
Voltage for short-brake OFF	2.6V	0V	0V	5V	0.5V	b	b	a		Ipre1
<b>ch1~ch4/ch1~ch4 &lt;Driver&gt;</b>										
Output offset voltage	2.5V	0V	0V	5V	0V	b	b	c	V <sub>IN</sub> =V <sub>BIAS</sub>	V <sub>O1</sub> ~V <sub>O4</sub>
Output saturation voltage H	5V	0V	0V	5V	0V	b	b	b	I <sub>L</sub> =-500mA	V <sub>OH1</sub> ~V <sub>OH4</sub>
Output saturation voltage L	0V	0V	0V	5V	0V	b	b	b	I <sub>L</sub> =500mA	V <sub>OL1</sub> ~V <sub>OL4</sub>
Closed loop voltage gain	2.7V	0V	0V	5V	0V	b	b	a		V <sub>O1</sub> ~V <sub>O4</sub>
<b>ch2&lt;OP-amp&gt;</b>										
Input offset voltage	2.5V	0V	0V	5V	0V	b	b	a	V <sub>IN</sub> =V <sub>BIAS</sub>	V <sub>OFF</sub>
Common mode input range	0.3V 11V	0V	0V	5V	0V	a	b	a		V <sub>OP</sub>
Input bias current	2.5V	0V	0V	5V	0V	a	b	a	V <sub>IN</sub> =V <sub>BIAS</sub>	I <sub>O1,2</sub>
High-level output voltage	5V	0V	0V	5V	0V	b	b	a		V <sub>OP</sub>
Low-level output voltage	0V	0V	0V	5V	0V	b	b	a		V <sub>OP</sub>
Output source current	5V	0V	0V	5V	0V	b	c	a		I <sub>S</sub>
Output sink current	0V	0V	0V	5V	0V	b	a	a		I <sub>S</sub>
<b>Loading motor driver</b>										
Output saturation voltage H	2.5V	0V	5V	5V	0V	b	b	b	I <sub>L</sub> =-200mA	V <sub>OH5</sub>
Output saturation voltage L	2.5V	5V	0V	5V	0V	b	b	b	I <sub>L</sub> =200mA	V <sub>OL5</sub>
Voltage for V <sub>INLO-</sub> /+ON	2.5V	2.0V	0V	5V	0V	b	b	a		Ipre2
Voltage for V <sub>INLO-</sub> /+OFF	2.5V	0.5V	0V	5V	0V	b	b	a		Ipre2
Input current for V <sub>INLO-</sub> /+	2.5V	2.5V	2.5V	5V	0V	b	b	a		I <sub>BIAS1,2</sub>

Application Circuit



- 1) It is in use that the by-pass capacitor is between Vcc-pin and GND-pin of IC as possible as near (approximately 0.1μF).
- 2) Heat dissipation fins are in use to connect to the external GND.
- 3) It is in use that the pull-up resistance, if required for PS and SB.

Current of PS and SB is showed as follow.

$$I_{PS} = (V1 - V_{PS}) / R_{P1}$$

$$I_{SB} = (V2 - V_{SB}) / R_{P2}$$

V1 (V2)=5V: pull up voltage

R<sub>P1</sub> (R<sub>P2</sub>)=5V: pull up resistance

In the event a problem which may affect industrial property or any other rights of us or a third party is encountered during the use of information described in these circuit. Mitsumi Electric Co., Ltd. shall not be liable for any such problem, nor grant a license therefor.

Movement explanation

1. Four type mute circuit that is off state built-in.

Item	Conditions	Function
Power-save mute function (PIN 1)	OPEN or Below 0.5V typ.	Circuit is muted from 1ch to 4ch.
	Current of PS is 110μA. when 5.0V typ.	Normal operating.
Bias mute function (PIN 2)	Below 0.9V typ.	Output current is muted.
	Over 1.2V typ.	Normal operating.
Supply voltage mute function (PIN7)	Below 3.5V typ.	Output current is muted.
	Over 3.7V typ.	Normal operating.
Thermal shutdown circuit	Chip temperature rises to 175°C typ.	Output current is muted.
	Chip temperature falls below 150°C typ.	Normal operating.

2) Short-brake Function (spindle motor: ch3)

Short-brake function (28 PIN)	Open or below 0.5V typ.	Normal operating.
	Current of SB is 280μA. when 5.0V.	spindle motor is stopped. *Refer to fig.1

3. Input / Output truth table

a. Power Save part

PS	Driver output	
	ch1~4	Loading
L	OFF	ON
H	ON	ON

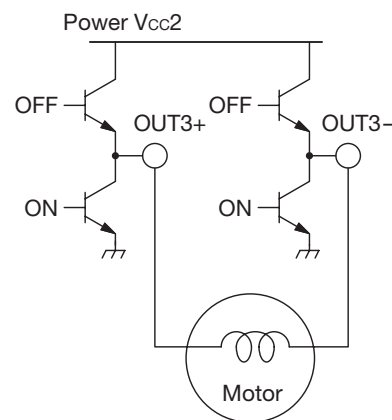
b. Thermal shutdown

TSD	Driver output	
	ch1~4	Loading
ON	OFF	ON
OFF	ON	ON

c. Loading part

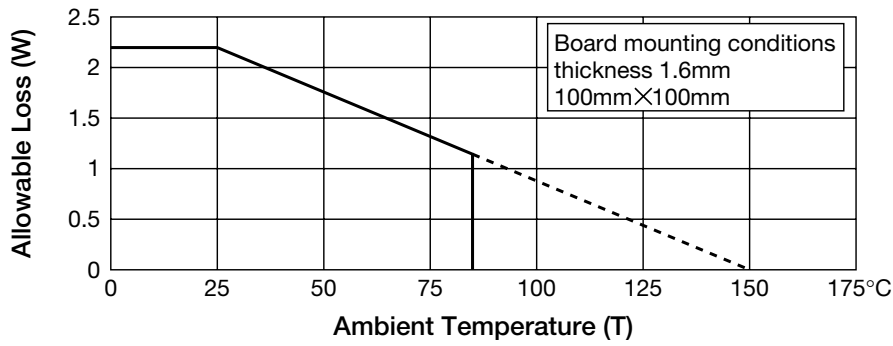
V <sub>INLO+</sub>	V <sub>INLO-</sub>	OUTL+	OUTL-	Mode
H	L	H	L	Forward Mode
L	H	L	H	Reverse Mode
H	H	L	L	Brake Mode
L	L	OPEN	OPEN	Standby Mode

■ Circuit behavior of short-brake

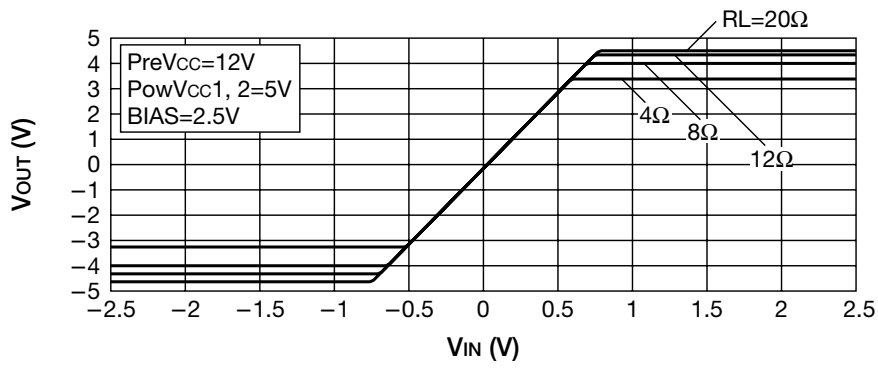


## Characteristics

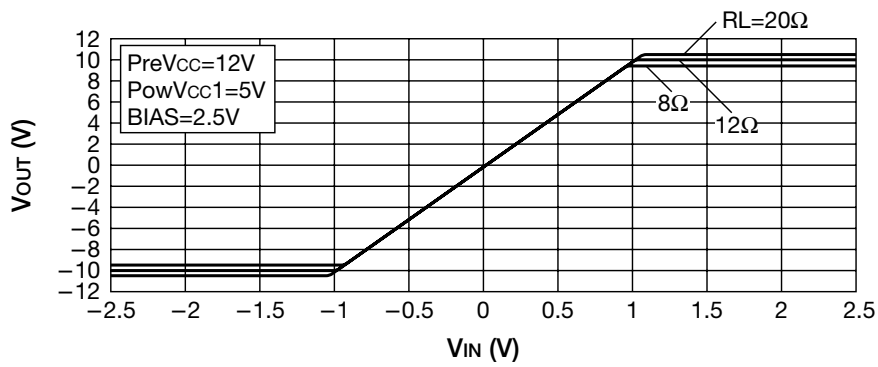
### Allowable Loss



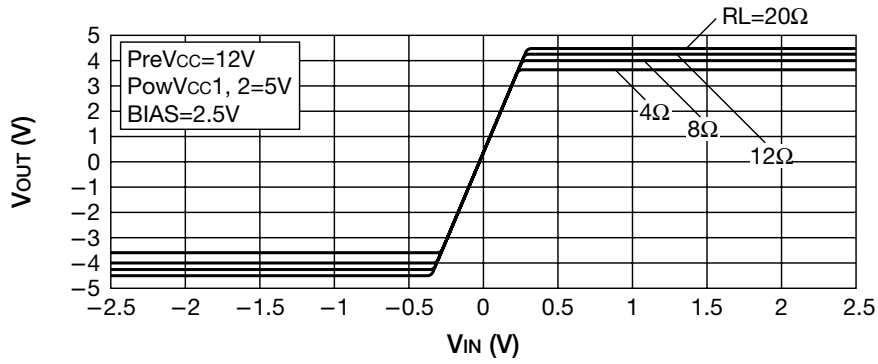
### Spindle Driver Output Voltage



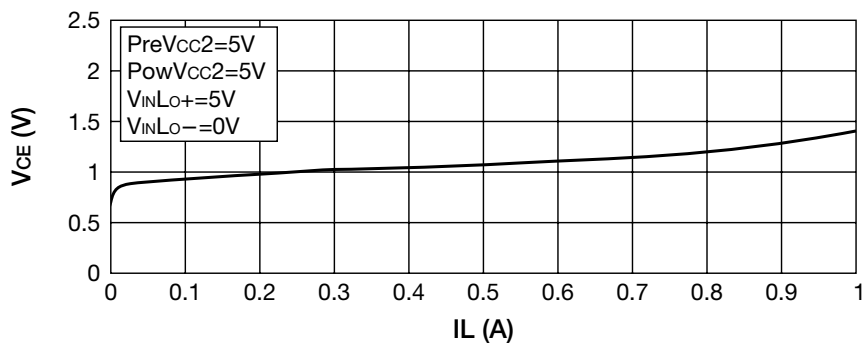
### Sled Driver Output Voltage



■ Focus / Tracking Driver Output Voltage



■ Loading Driver  $I_L$  vs Saturation Voltage H



■ Loading Driver  $I_L$  vs Saturation Voltage L

