

■General Description

- Two Pch MOSFETs for high side power switches, two Nch for low side and one control IC are integrated into one package.
- Enables to drive a motor by DC drive at up to 5ADC or by pulse drive at up to 16A.
- PWM input signal is 20 kHz max, and phase changeover frequency is 500Hz max.
- Input signals for IN1 and IN2 control the output of each phase with normal, reverse, brake, and free-run mode.
- In order to prevent shoot through current during phase changeover, the control IC set the dead time. Dead time: 20μS (typ).
- Versatile protection functions:
 - Over current protection for each power switch (Latch mode)
 - Thermal shutdown (TSD)
 - DIAG output function: Outputs the diagnosis during abnormal operation.

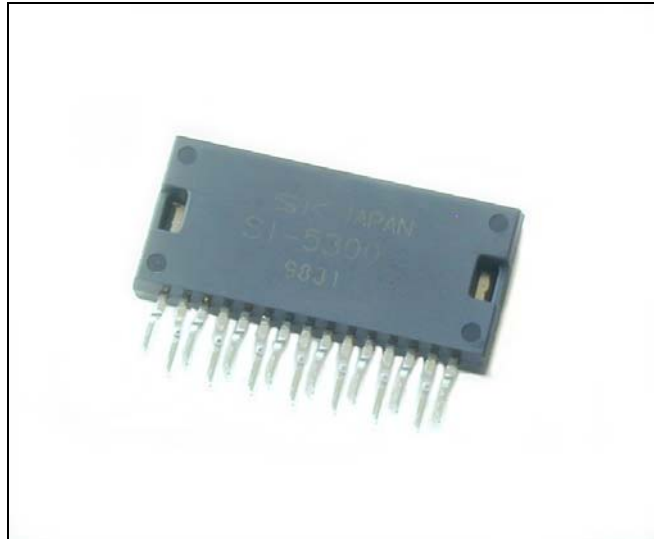
■Applications

- Driving various DC motors (PWM control)
- Throttle valve for automotive application

■Features

SI-5300 incorporates two high side Pch MOSFETs, two low side Nch MOSFETs, and a control IC in one package. Overcurrent protection function for each power switch, and thermal shutdown function for control IC. Also, the dead time (20μS) is set in the control IC to prevent turning on the high side MOSFETs at the same timing.

■Package---SPM

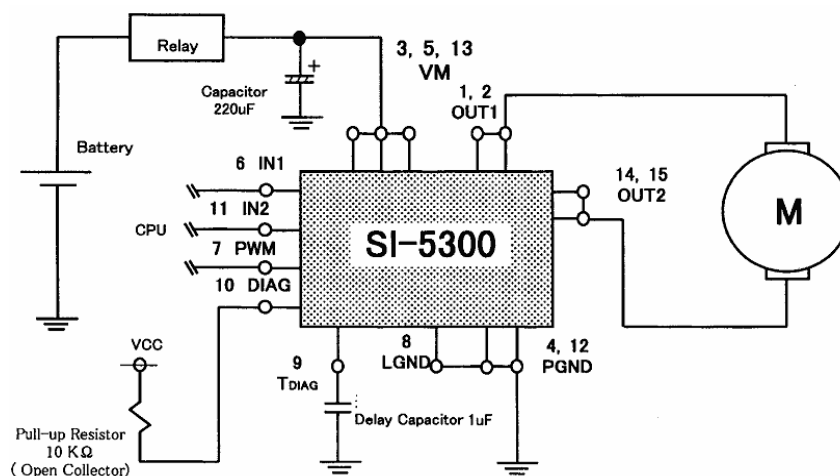


■Key Specifications

- Absolute maximum rating *1 with infinite heatsink

Parameter	Signal	Ratings	Remarks
Motor supply voltage	VM	40V(max)	
Input voltage	VINx,PWM	-0.3~7.0V	
Output current	Io	±5A	
	Iop-p	±16A	
PWM control frequency	f PWM	20KHz(max)	
Phase transition frequency	f CW	500Hz(max)	
Junction temperature	Tj	-40~150°C	
Power dissipation	PD1	3.6W	
	PD2	33.7W	*1

Typical Connection



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1. Absolute maximum ratings (Ta=25°C)

Characteristics	Symbol	Rating	Unit	Remarks
Motor Supply Voltage	VM	40	V	
Output Current	IOUT1	±5	A	
	IOUT2	±16	A	*1
Logic Input Voltage	IN1	-0.3 to 7	V	
	IN2	-0.3 to 7	V	
	PWM	-0.3 to 7	V	
PWM Control Frequency	fPWM	20	KHz	Duty=20~80%
Forward and Reverse Change Frequency	fCW	500	Hz	*2
Total Device Power Dissipation	Pd1	3.6	W	No heatsink
	Pd2	33.7	W	Infinite heatsink
Thermal Resistance	θj-a	35	°C/W	
	θj-c	3.7	°C/W	
Junction Temperature	Tj	-40 to 150	°C	
Operation Temperature	Top	-40 to 85	°C	
Storage Temperature	Tstg	-40 to 150	°C	

*1 $PW \leq 1mS, Duty \leq 50\%$

*2 The dead time for the length current prevention in positive and the reversing switch is set by internal control IC. The set point in internal control IC at the dead time is 20 μS (TYP).

Please confirm, and use the load condition.

2. Recommended operating conditions

Characteristics	Symbol	Rating	Unit	Remarks
Motor Supply Voltage	VM	6 to 18	V	
Logic Input Voltage	VIN1, VIN2, PWM	-0.3 to 5	V	
PWM Control Frequency	fPWM	10	KHz	
Output Current	Io	±3	A	
DIAG Terminal Output Voltage	VDIAG	-0.3 to 6	V	
DIAG Terminal Sink Current	IDIAG	1	mA	
Operation Temperature	Top	-40 to 85	°C	

3. Electrical characteristics (T_j=25°C, V_M=14V, I_o=3A unless otherwise specified)

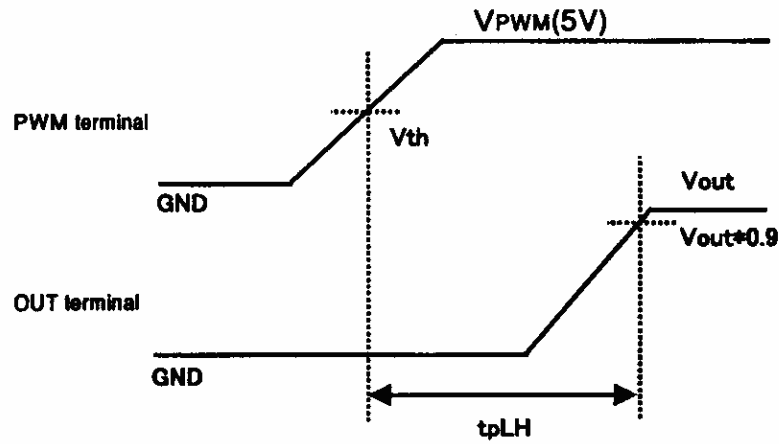
Characteristics	Symbol	Rating			Unit	Remarks
		min	typ	max		
Motor Supply Voltage	V _M	6		18	V	V _M =24V(2min)
Output saturation voltage	V, V _M -V _o			0.8	V	I _o =3A
	V, V _o -P _G			0.3		I _o =3A
Output leak current	I _L ,L			100	μA	V _M =40V
	I _L ,H			100		V _M =40V
Output transmission time	t _p LH			10 *5	μS	VPWM : L⇒H(V _{th} =2.5typ)
	t _p HL			15 *6		VPWM : H⇒L(V _{th} =2.5typ)
	t _p HL-t _p LH			10		
Forward voltage characteristic of diode between drain and source	V _F ·L		0.8		V	I _o =3A
			1.0			I _o =10A
	V _F ·H		0.8			I _o =3A
			1.0			I _o =10A
Quiescent current	I _M 1		22		mA	Stop mode
	I _M 2		22			Forward and reverse mode
	I _M 3		16			Brake mode
Voltage of input terminal	V _{IN} ,H	3.0			V	V _{IN} 1=V _{IN} 2=VPWM
	V _{IN} ,L			2.0		V _{IN} 1=V _{IN} 2=VPWM
Current of input terminal	I _{IN} ,L	-100			μA	V _{IN} 1=V _{IN} 2=VPWM=0V
	I _{IN} ,H			200	μA	V _{IN} 1=V _{IN} 2=VPWM=5V
Over current protection starting current	I _{ocp}	16			A	*3
DIAG terminal output Voltage of pulse width	t _{DIAG}	20			mS	C _{DIAG} =1μF(typ)
DIAG terminal output Voltage of satisfaction	V _D ·L			0.3	V	I _D ·S _{INK} =1mA *4

【Note】

*3 The standard value of I_{ocp} is assumed to be a value by which the output of each power MOSFET cuts off. When the protection circuit of OCP and TSD operates, power MOSFET's keeps cutoff. When a signal(5V:H⇒0V:L) is input to the terminal PWM, the cutoff operation will be released. Moreover, Three minutes (T_a=25°C, f_{PWM}=10Khz, V_M=14V) are assumed to be max at the over current state continuance Time in the V_M operation and ground of output terminal (OUT1,OUT2). It is not the one to assure the operation including reliability in the state that the sort-circuit continues for along time.

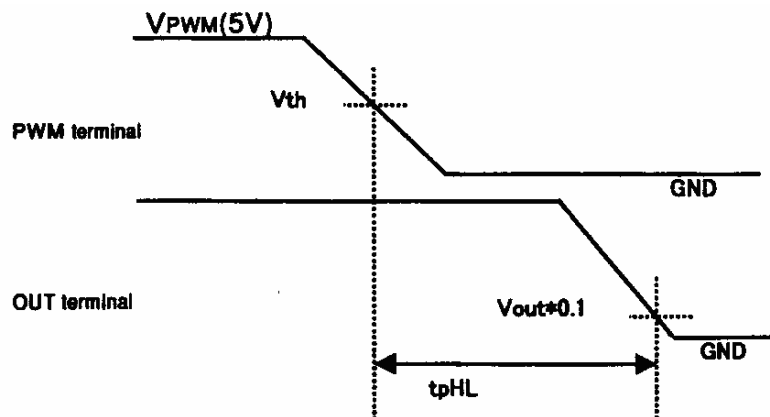
*4 DIAG signal output terminal is an collector output. Use a pull-up resistor when connecting it to a logic circuit.

*5 Output transmission time(t_{pLH})



Output transmission time t_{pLH} is time from $V_{th}(2.5V_{typ})$ of the terminal of PWM to output ($V_{out} \cdot 0.9$) of the output terminal.

*6 Output transmission time(t_{pHL})

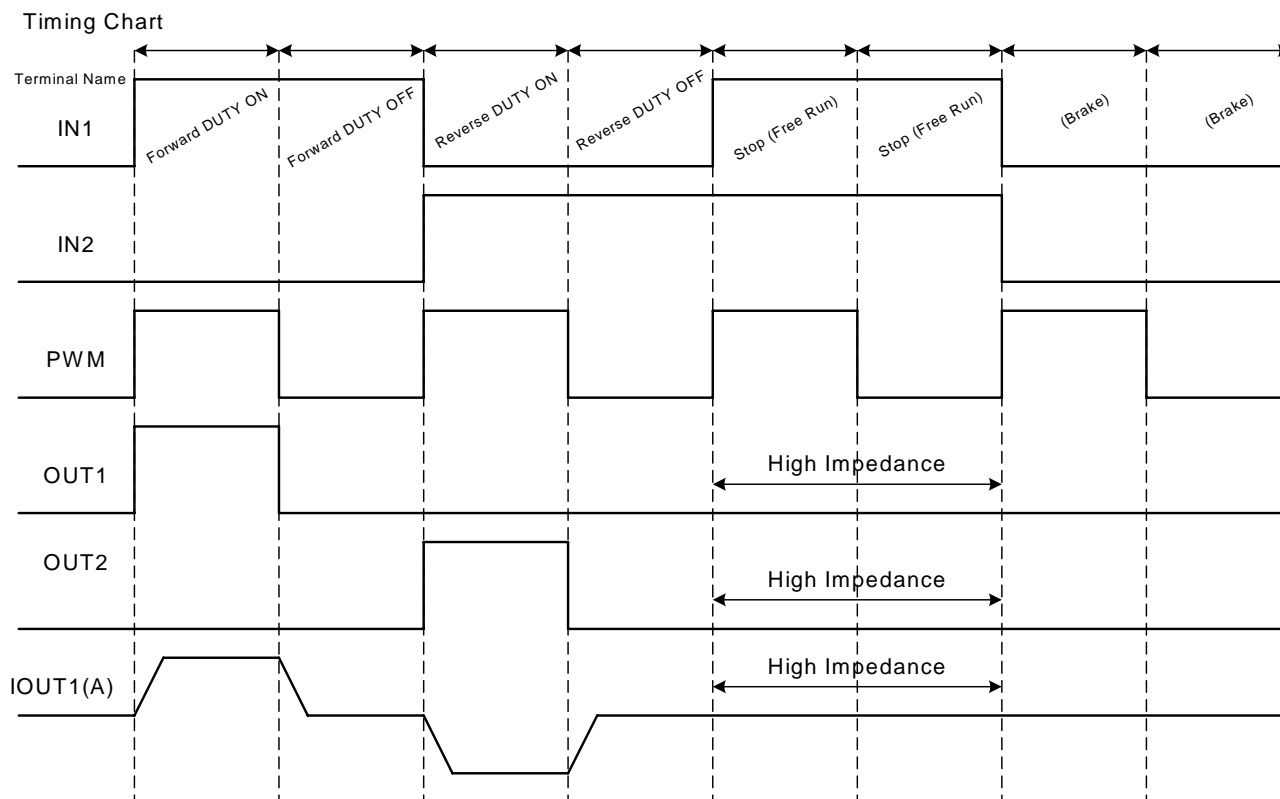


Output transmission time t_{pHL} is time from $V_{th}(2.5V_{typ})$ of the terminal of PWM to output ($V_{out} \cdot 0.1$) of the output terminal.

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4. Timing chart of input and output



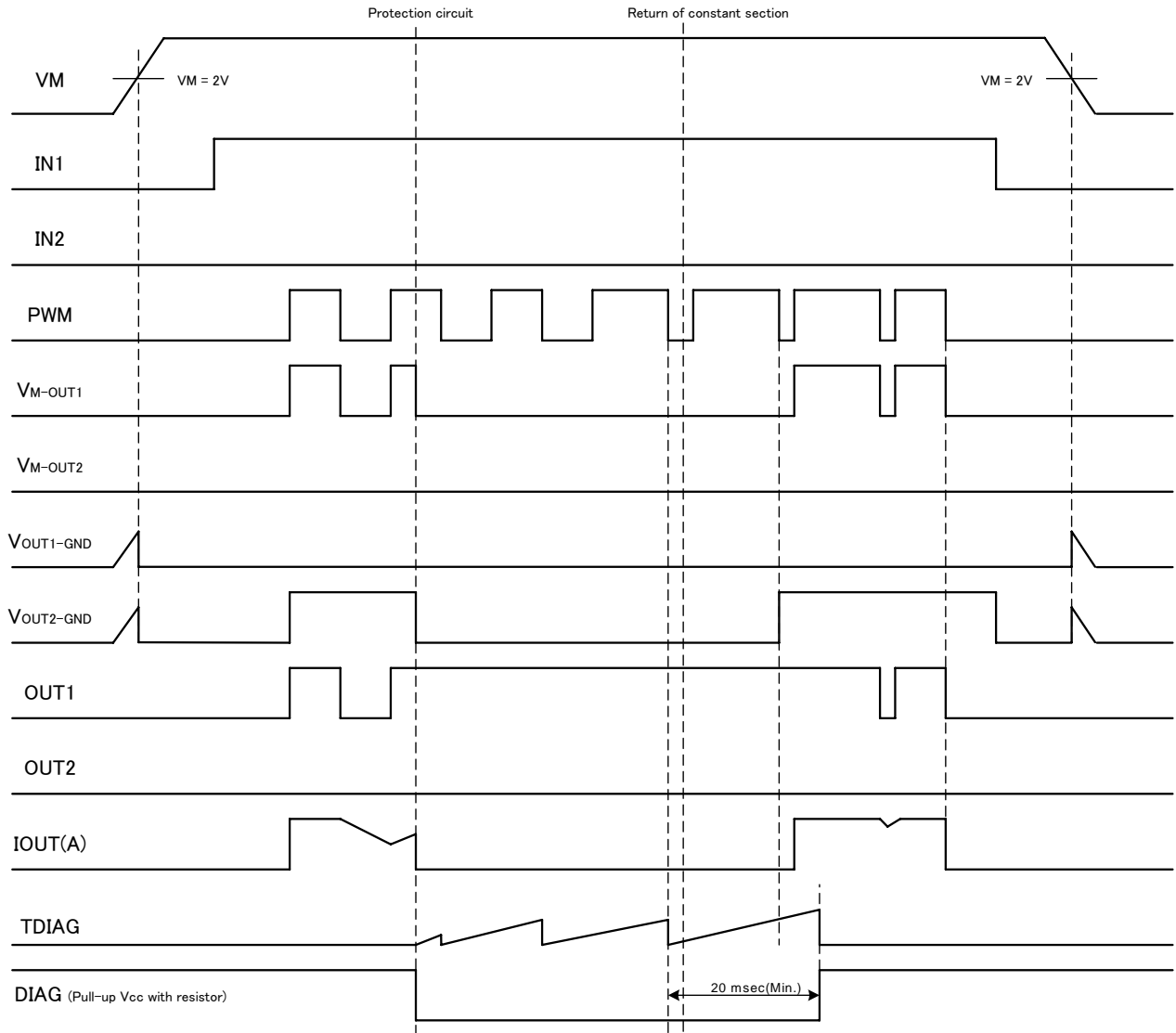
Input signal			Output Signal		Power MOS operation				Function
IN1	IN2	PWM	OUT1	OUT2	Tr1(P1)	Tr2(P2)	Tr3(N1)	Tr4(N2)	
H	H	H	Z	Z	OFF	OFF	OFF	OFF	Stop mode
H	H	L	Z	Z	OFF	OFF	OFF	OFF	Stop mode
L	L	H	GND	GND	OFF	OFF	ON	ON	Break mode
L	L	L	GND	GND	OFF	OFF	ON	ON	Break mode
H	L	H	VM	GND	ON	OFF	OFF	ON	Normal mode(Duty ON)
H	L	L	Z	GND	OFF	OFF	OFF	ON	Normal mode(Duty OFF)
L	H	H	GND	VM	OFF	ON	ON	OFF	Reverse mode(Duty ON)
L	H	L	GND	Z	OFF	OFF	ON	OFF	Reverse mode(Duty OFF)

H: High level L: Low level Z: High impedance

GND: GND level ON: Power MOSFET ON OFF: Power MOSFET OFF

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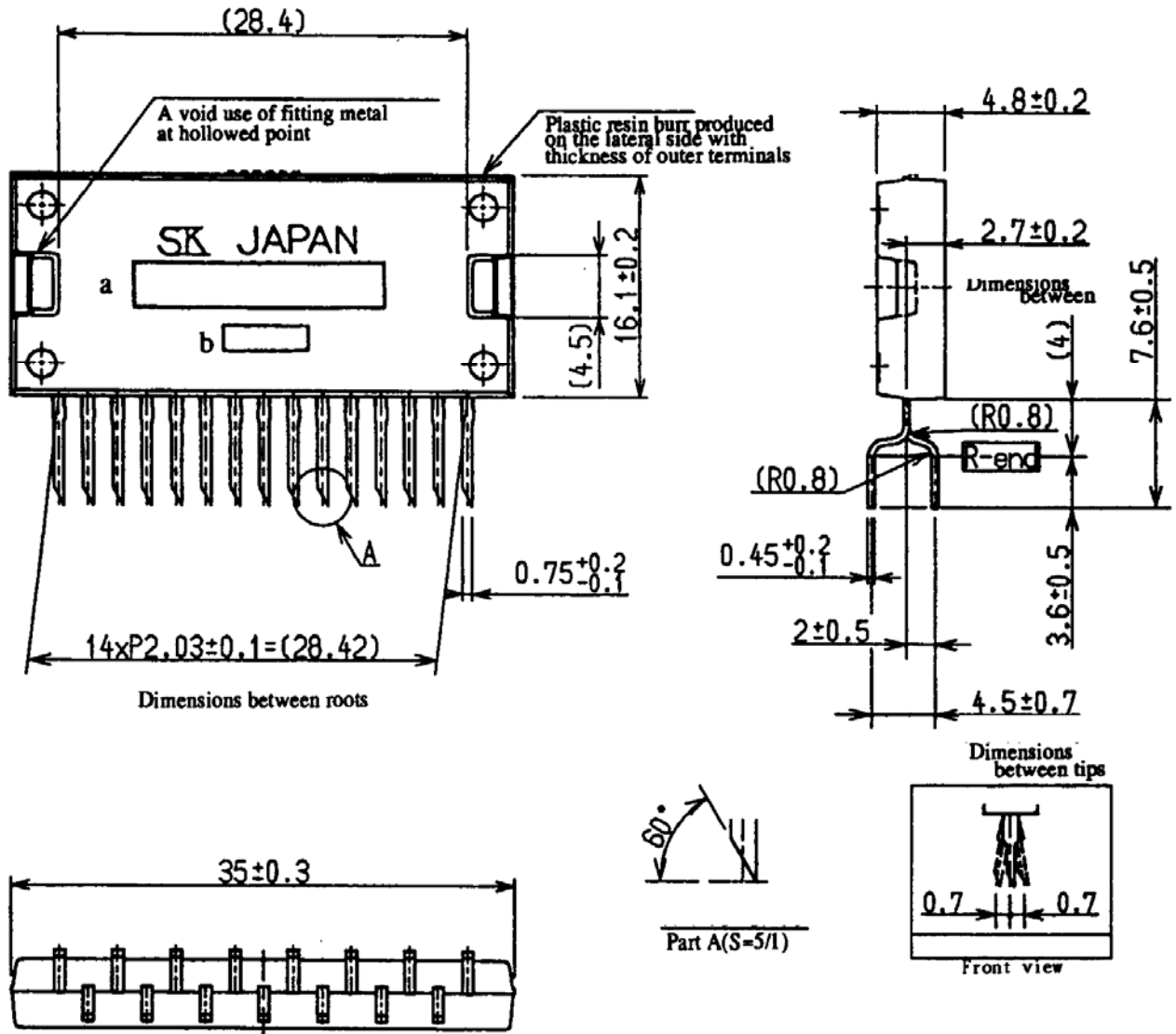
5. Timing chart



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7. Package information(Lead forming No.1505)
 Package type , physical dimensions and material



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

☆ Appearance

The body shall be clean and shall not bear any stain , rust or flaw.

☆ Marking

The type number and lot number shall be marked on the body by Laser which shall not be unreadable easily.

a: Type number

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b: lot number

1st letter

The last digit of year

2nd letter

Month

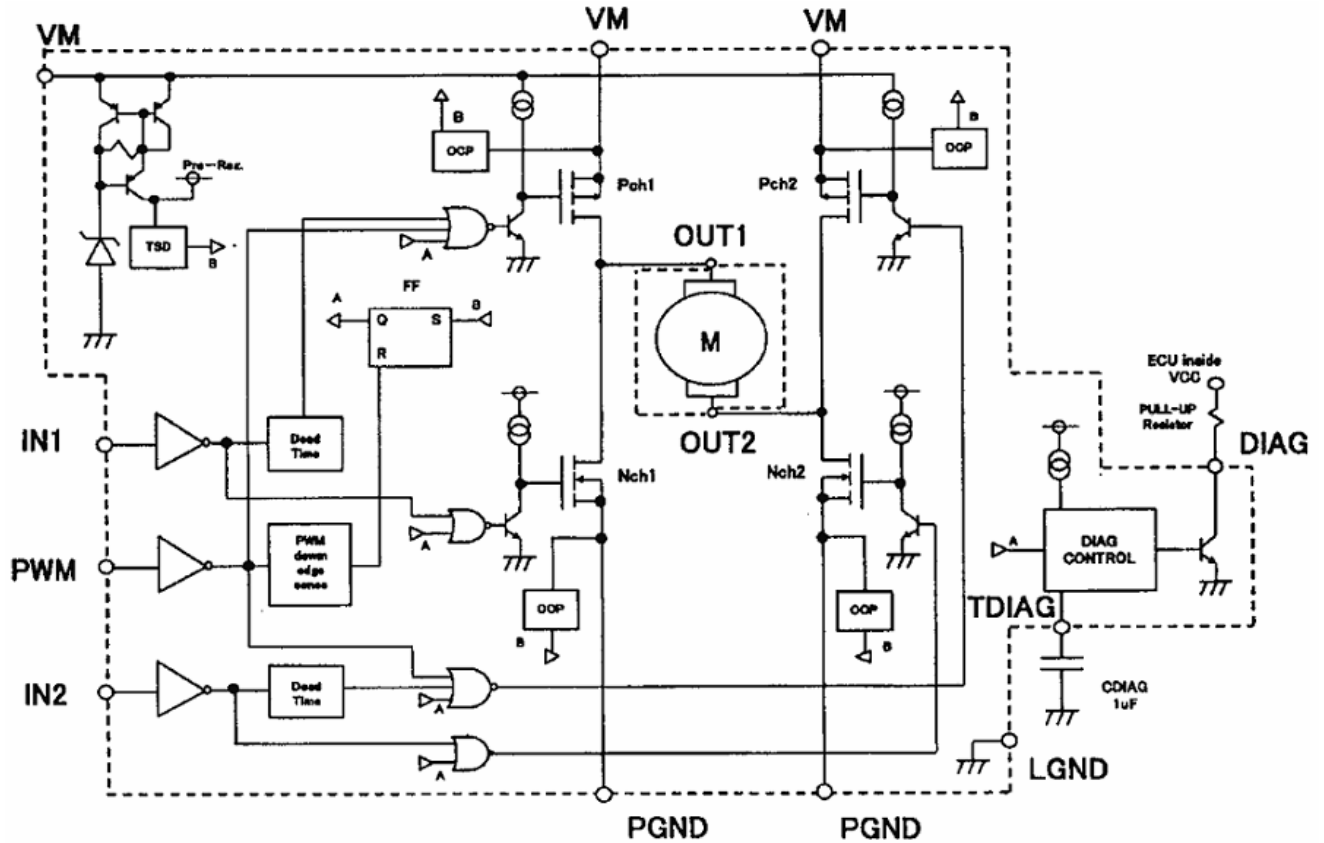
3rd & 4th

day Arabic numerals

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8-1. Equivalent Circuit



Pre-Reg : Battery inside circuit Dead Time : Protection circuit of length current
 PWM down edge sense : Detection circuit of PWM signal
 OCP : Over Current protection circuit TSD : Over temperature protection circuit
 DIAG CONTROL : DIAG control circuit

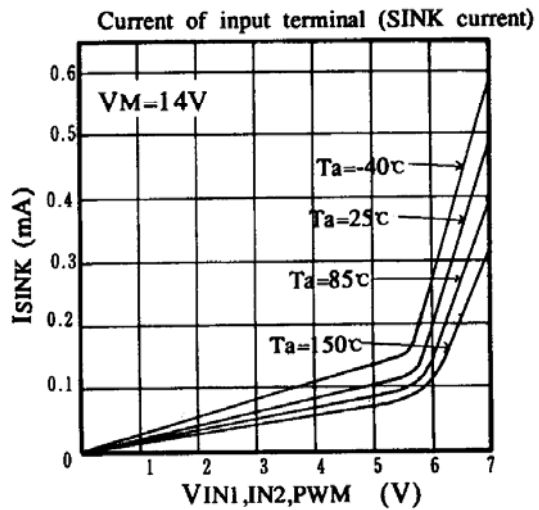
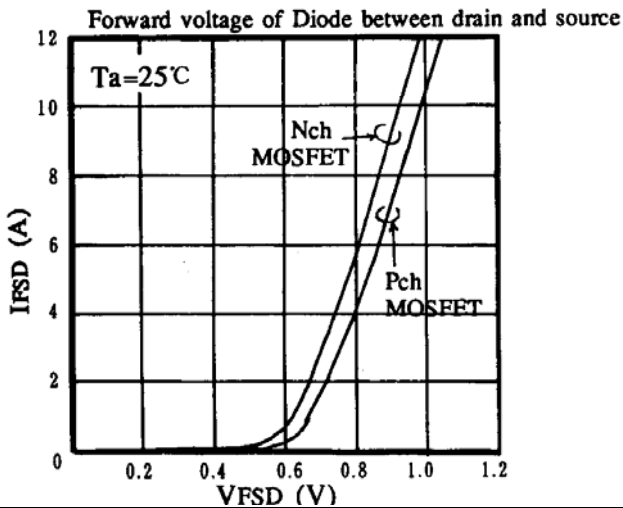
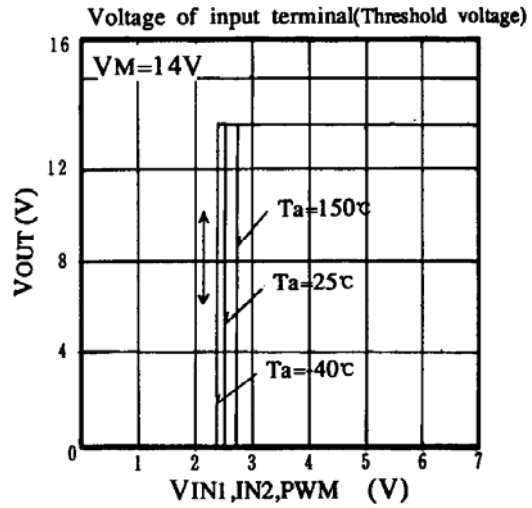
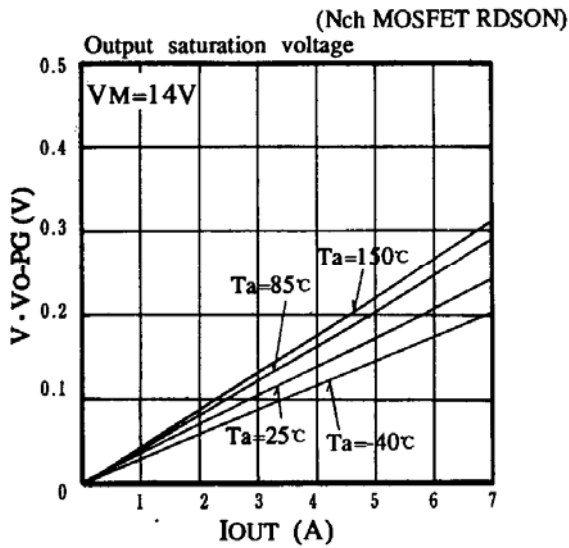
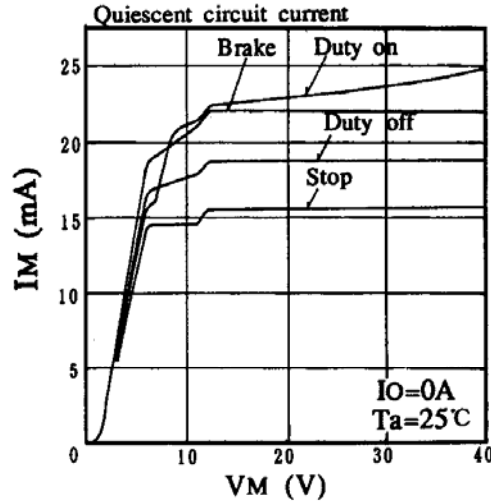
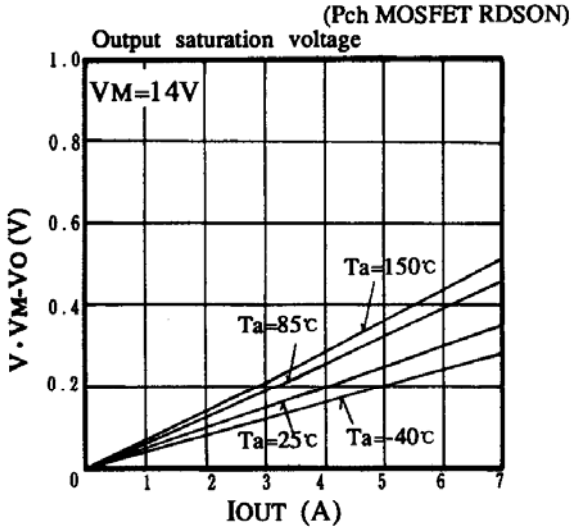
8-2. Terminal

Pin	Symbol	Function	Pin	Symbol	Function
1	OUT1	OUTPUT terminal 1	9	TDIAG	DIAG Delay time
2	OUT1	OUTPUT terminal 1	10	DIAG	Output terminal DIAG
3	VM	Motor Supply Voltage terminal	11	IN2	Input terminal IN2
4	PGND	PGND	12	PGND	PGND
5	VM	Motor Supply Voltage terminal	13	VM	Motor Supply Voltage terminal
6	IN1	Input terminal IN1	14	OUT2	OUTPUT terminal 2
7	PWM	Input terminal PWM	15	OUT2	OUTPUT terminal 2
8	LGND	LGND			

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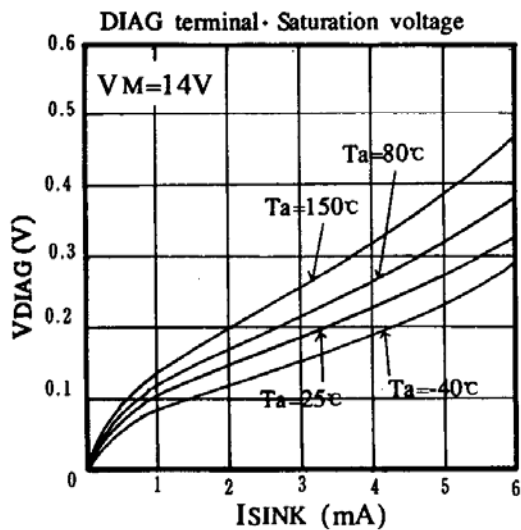
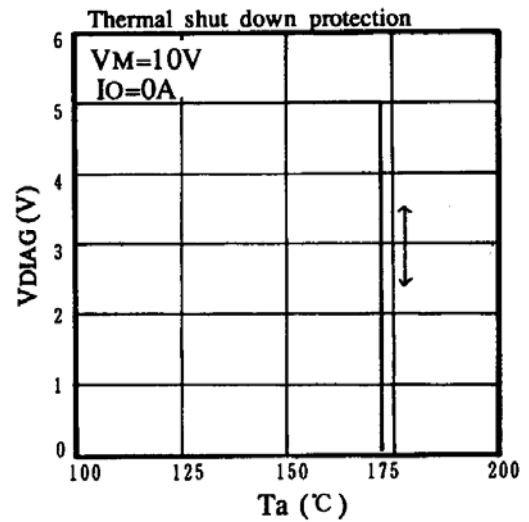
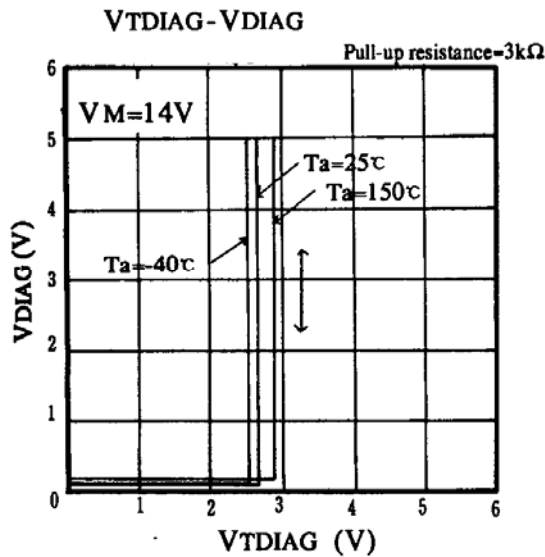
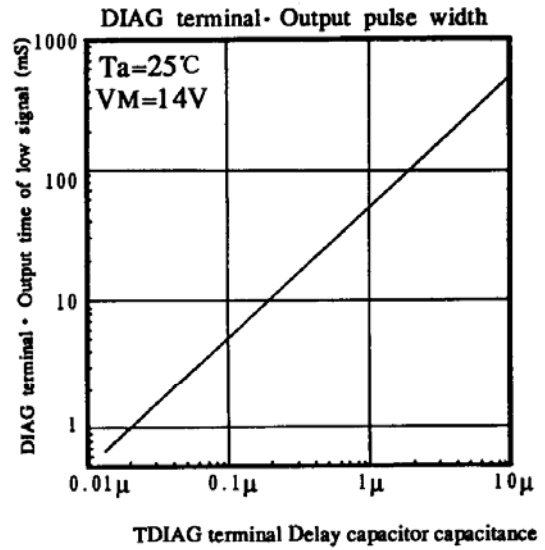
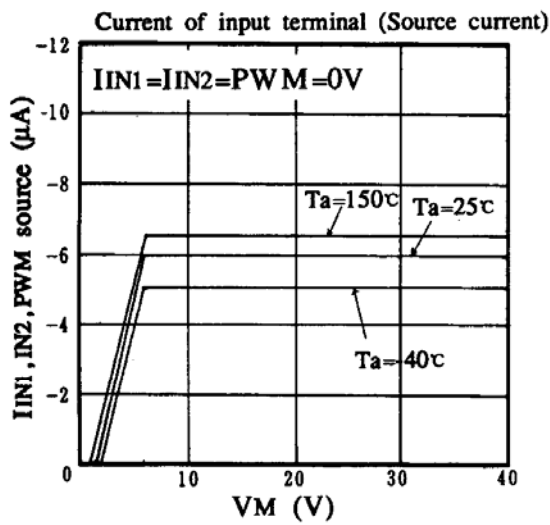
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9. Electrical characteristics $T_a=25^\circ\text{C}$



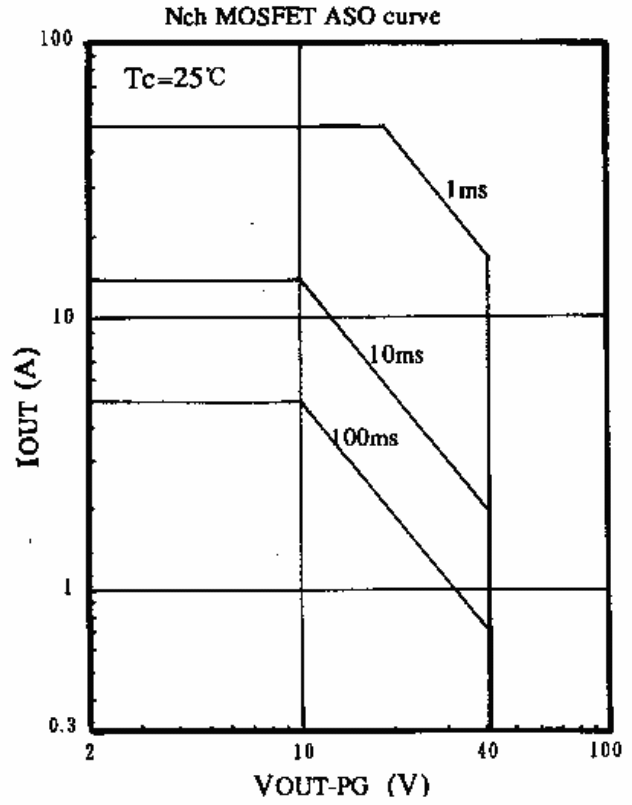
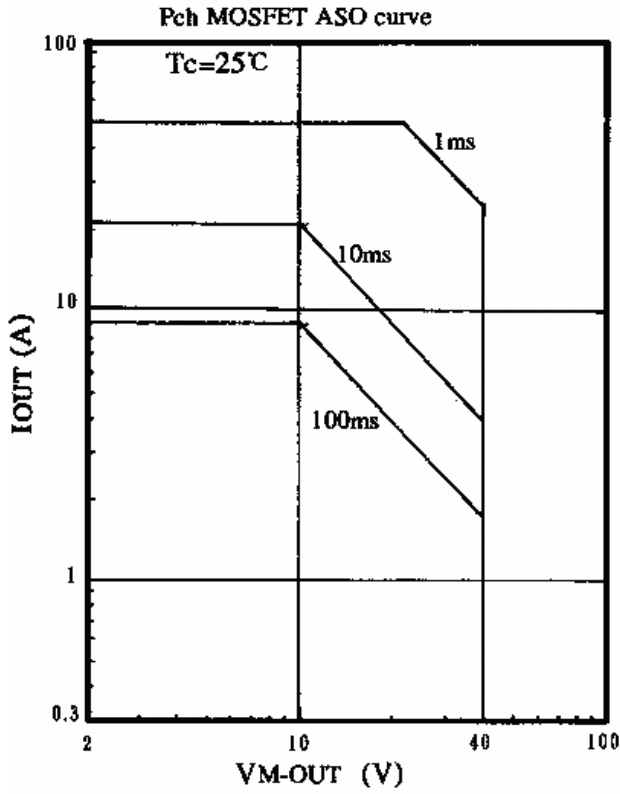
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