

■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

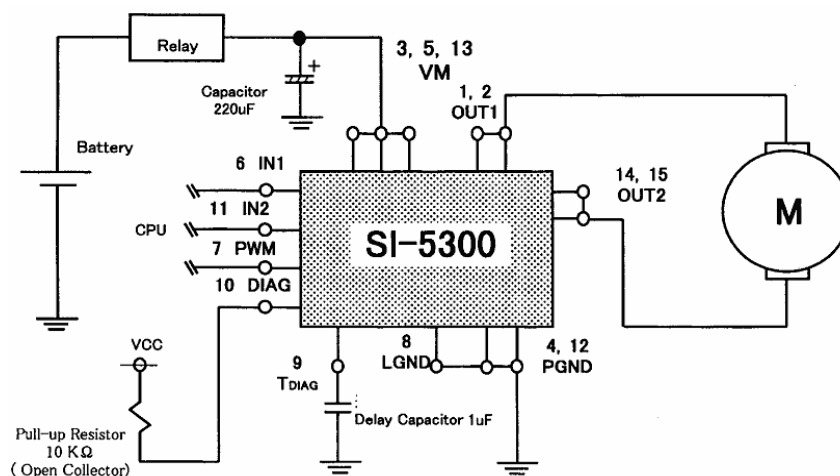


■Key Specifications

- 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



SI-5300

September 2005

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 (Tj=25°C, VM=14V, Io=3A unless otherwise specified)

| Characteristics | Symbol | Rating | | | Unit | Remarks |
|--|-----------|--------|-----|-------|------|---------------------------|
| | | min | typ | max | | |
| Motor Supply Voltage | VM | 6 | | 18 | V | VM=24V(2min) |
| Output saturation voltage | V, VM-Vo | | | 0.8 | V | Io=3A |
| | V, Vo-PG | | | 0.3 | | Io=3A |
| Output leak current | IL,L | | | 100 | μA | VM=40V |
| | IL,H | | | 100 | | VM=40V |
| Output transmission time | tpLH | | | 10 *5 | μS | VPWM : L⇒H(Vth=2.5typ) |
| | tpHL | | | 15 *6 | | VPWM : H⇒L(Vth=2.5typ) |
| | tpHL-tpLH | | | 10 | | |
| Forward voltage characteristic of diode between drain and source | VF·L | | 0.8 | | V | Io=3A |
| | | | 1.0 | | | Io=10A |
| | VF·H | | 0.8 | | | Io=3A |
| | | | 1.0 | | | Io=10A |
| Quiescent current | IM1 | | 22 | | mA | Stop mode |
| | IM2 | | 22 | | | Forward and reverse mode |
| | IM3 | | 16 | | | Brake mode |
| Voltage of input terminal | VIN,H | 3.0 | | | V | VIN1=VIN2=VPWM |
| | VIN,L | | | 2.0 | | VIN1=VIN2=VPWM |
| Current of input terminal | IIN,L | -100 | | | μA | VIN1=VIN2=VPWM=0V |
| | IIN,H | | | 200 | μA | VIN1=VIN2=VPWM=5V |
| Over current protection starting current | Iocp | 16 | | | A | *3 |
| DIAG terminal output Voltage of pulse width | tDIAG | 20 | | | mS | CDIAG=1μF(typ) |
| DIAG terminal output Voltage of satisfaction | VD·L | | | 0.3 | V | ID·SINK=1mA *4 |

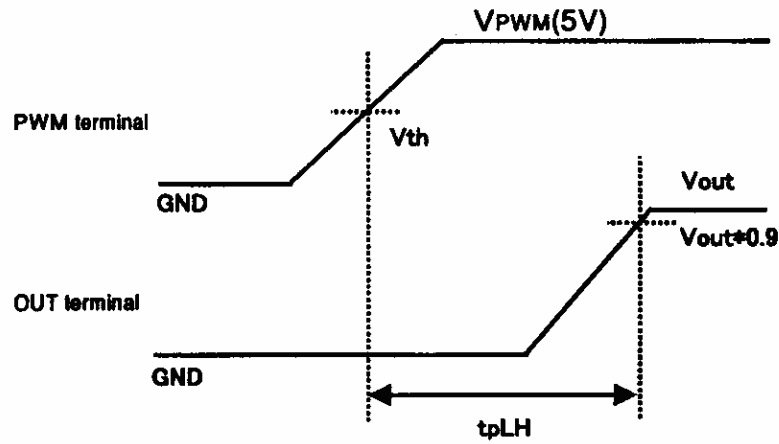
【Note】

*3 The standard value of Iocp 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 (Ta=25°C, fPWM=10Khz, VM=14V) are assumed to be max at the over current state continuance Time in the VM 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 apull-up resistor when connecting it to a logic circuit.

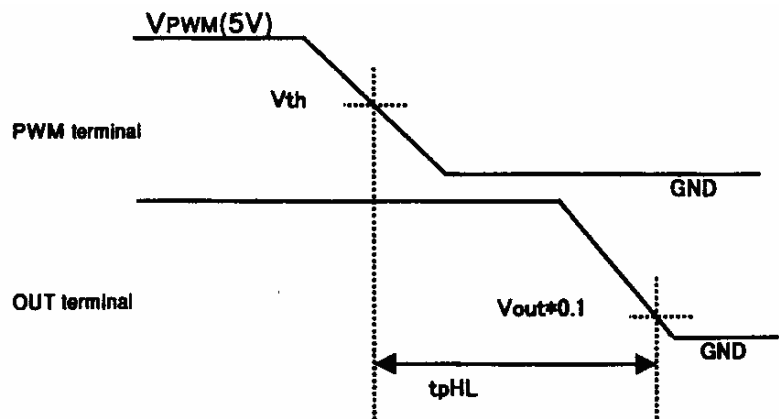
SI-5300

*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})

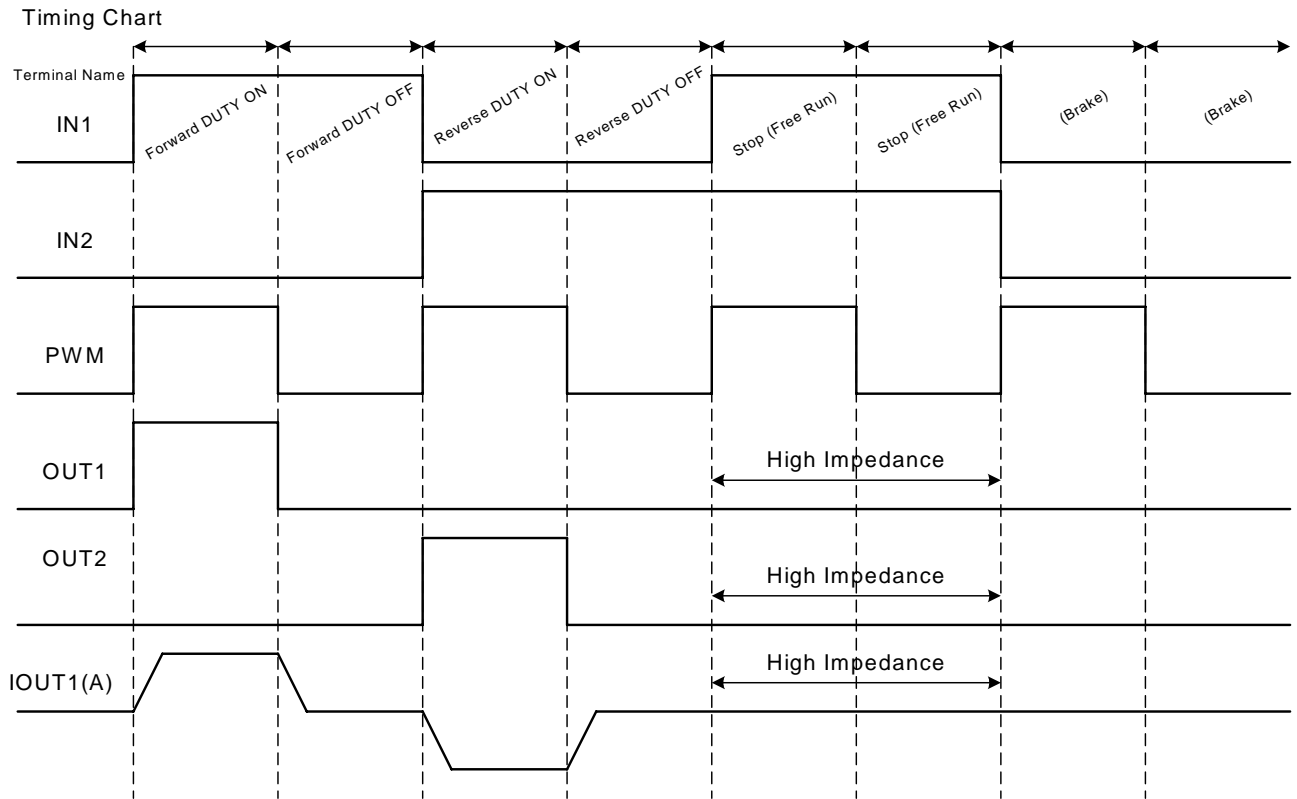


Output transmission time t_{pHL} is time from $V_{th}(2.5V_{typ})$ of the terminal of PWM to output ($V_{out} \cdot 0.1$) of the output terminal.

SI-5300

September 2005

4. Timing chart of input and output



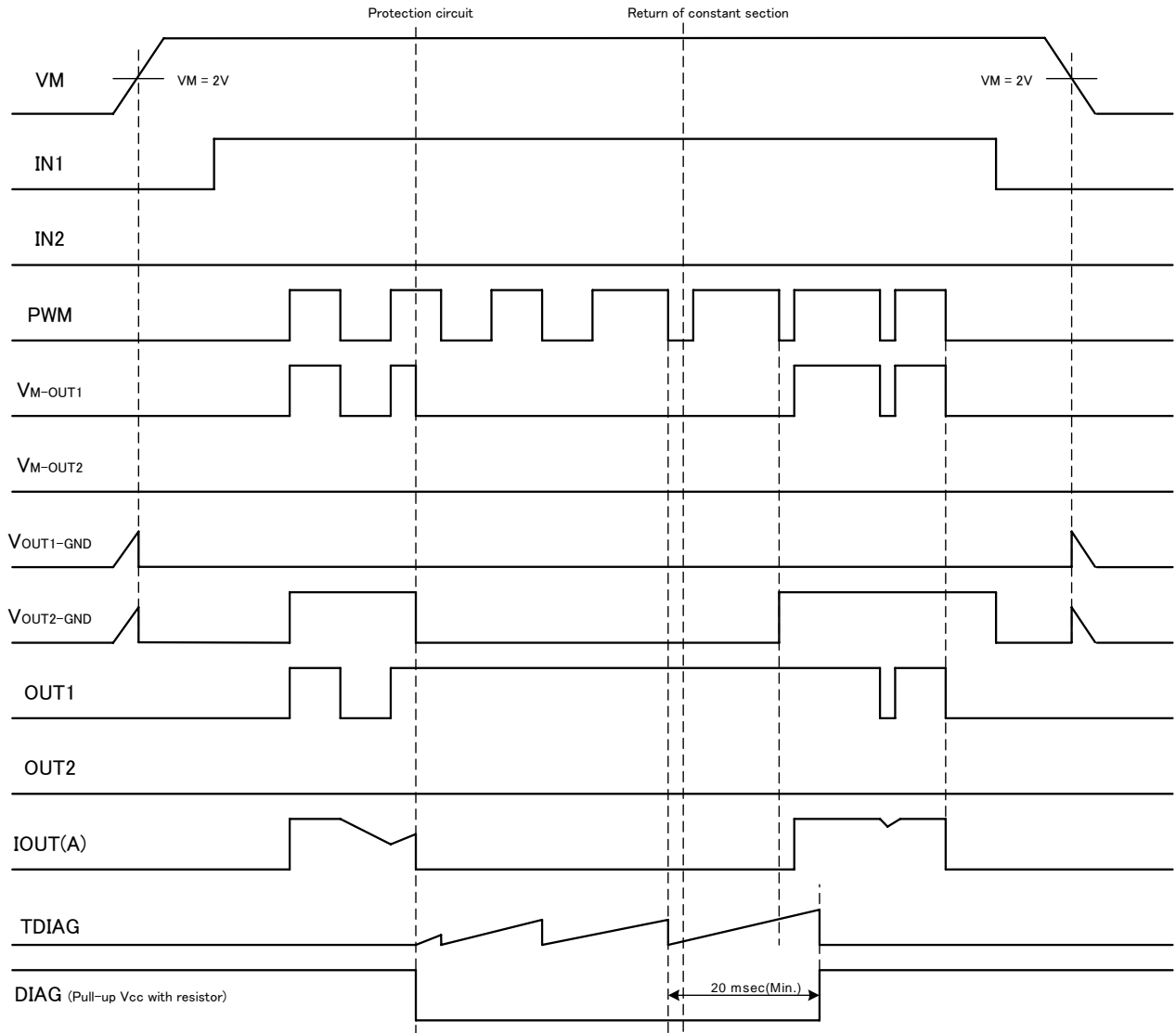
| Input signal | | | Output Signal | | Power MOS operation | | | | Function |
|--------------|-----|-----|---------------|------|---------------------|---------|---------|---------|------------------------|
| IN1 | IN2 | PWM | OUT1 | OUT2 | Tr1(P1) | Tr2(P2) | Tr3(N1) | Tr4(N2) | |
| H | H | H | Z | 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

SI-5300

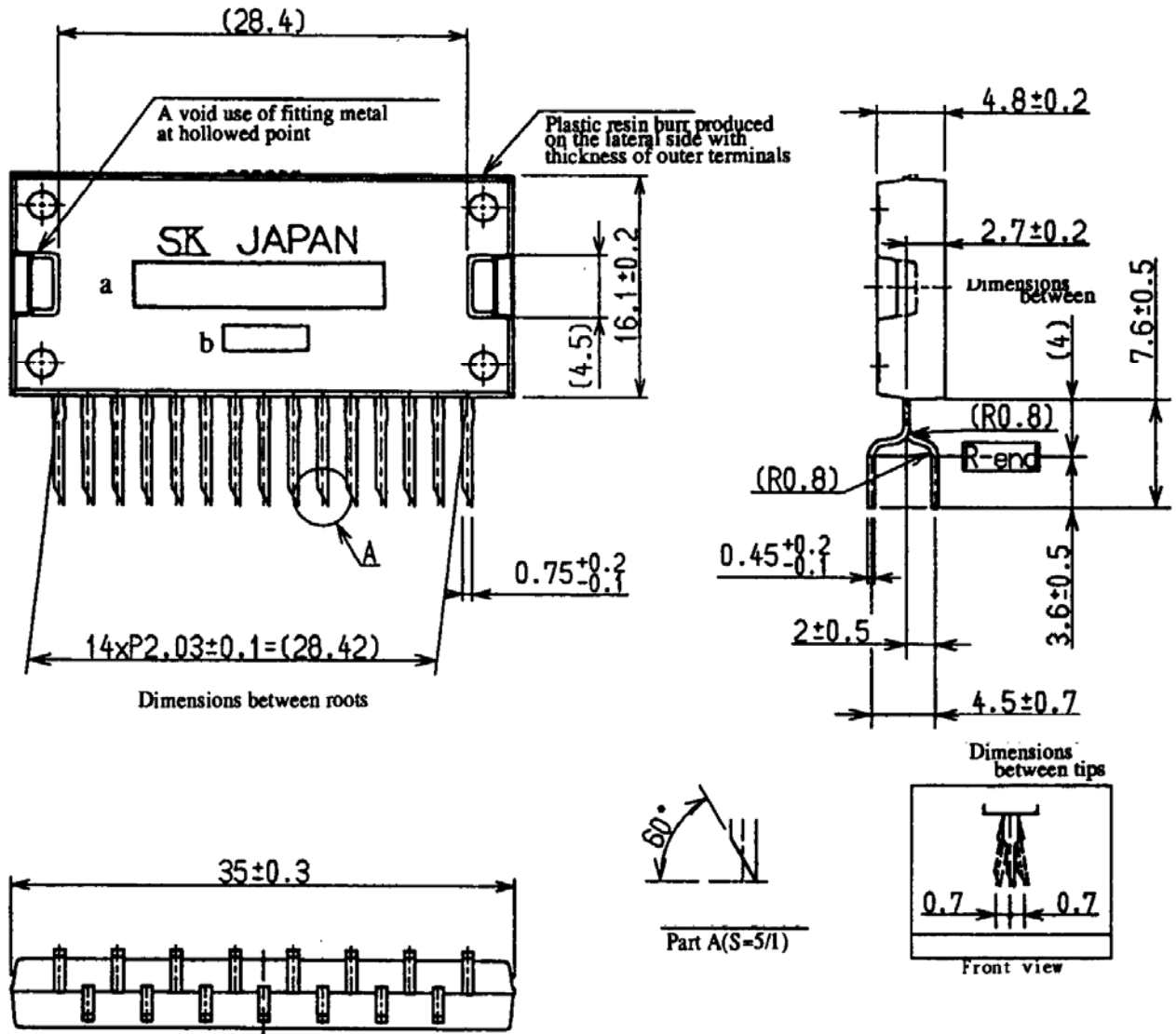
5. Timing chart



SI-5300

September 2005

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

SI-5300

b: lot number

1st letter

The last digit of year

2nd letter

Month

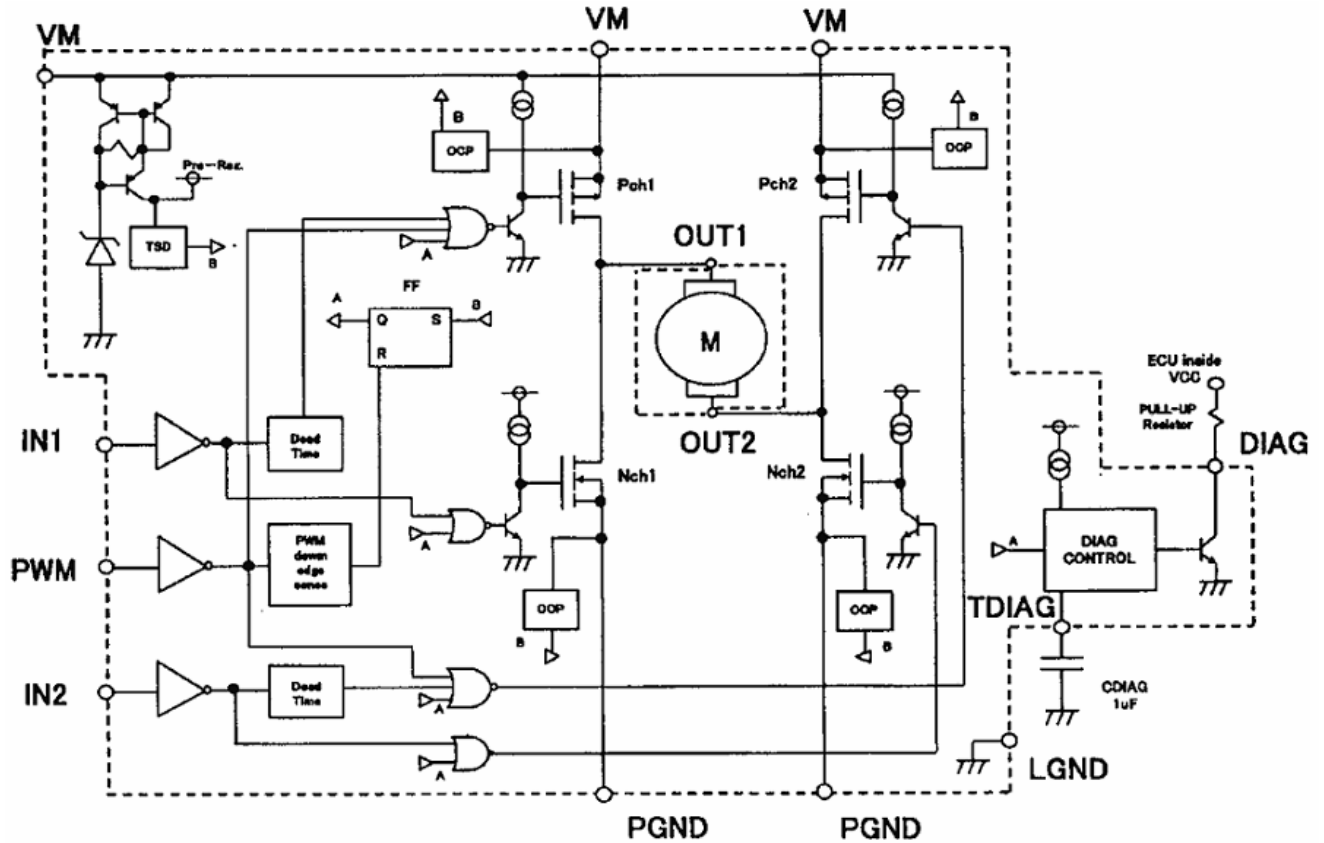
3rd & 4th

day Arabic numerals

SI-5300

September 2005

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

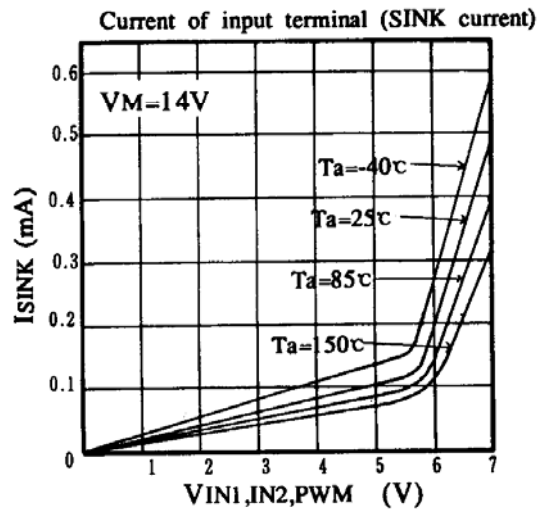
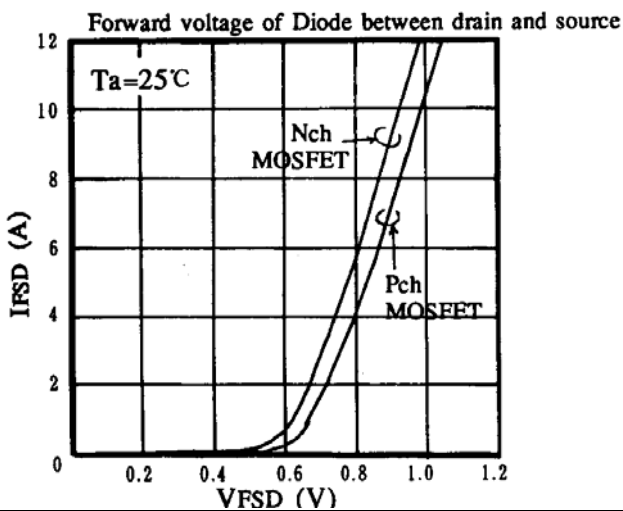
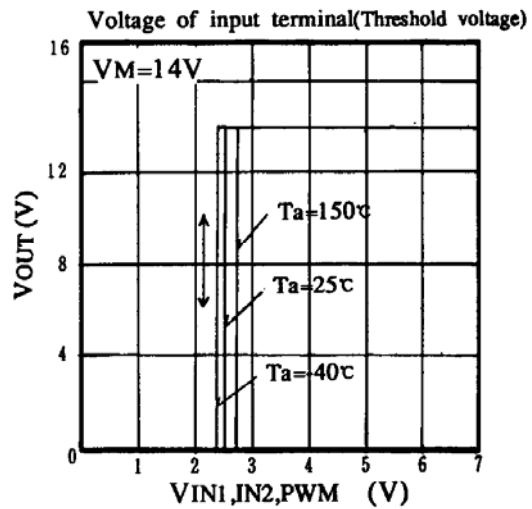
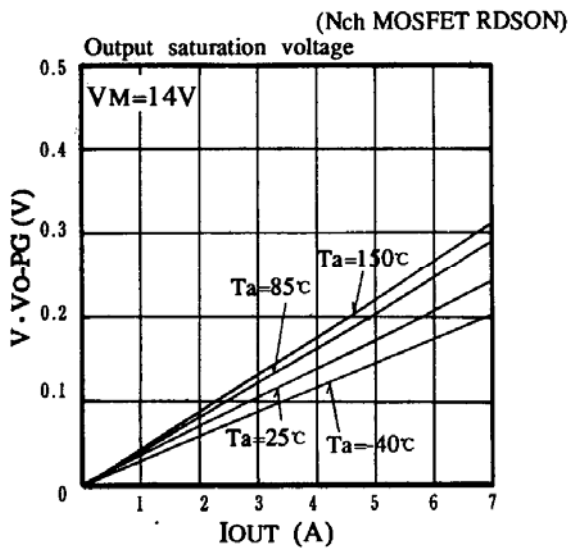
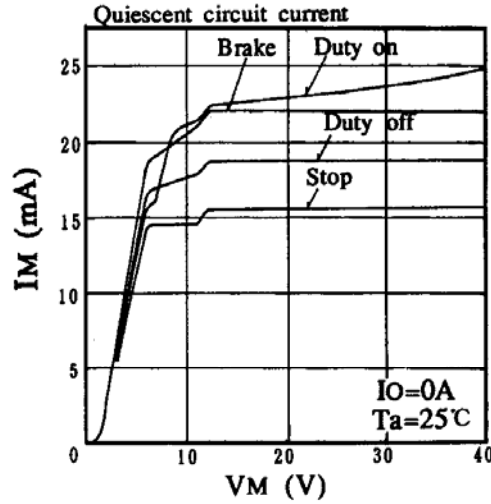
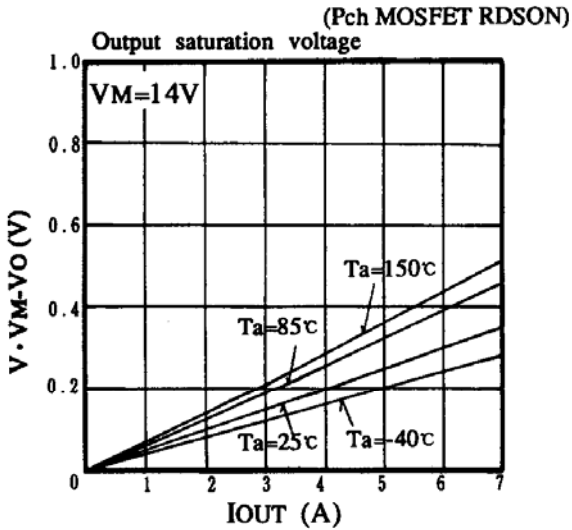
8-2. Terminal

| 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 | | | |

SI-5300

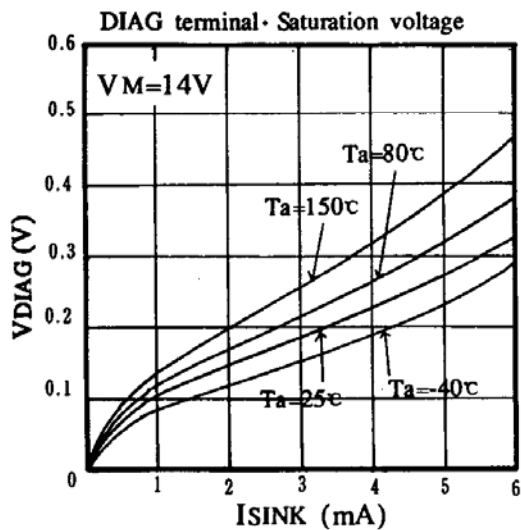
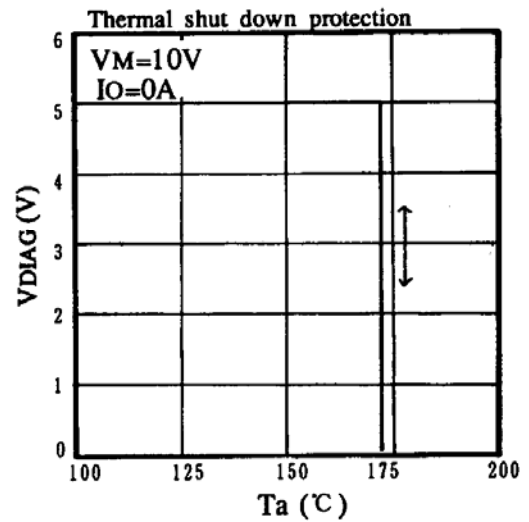
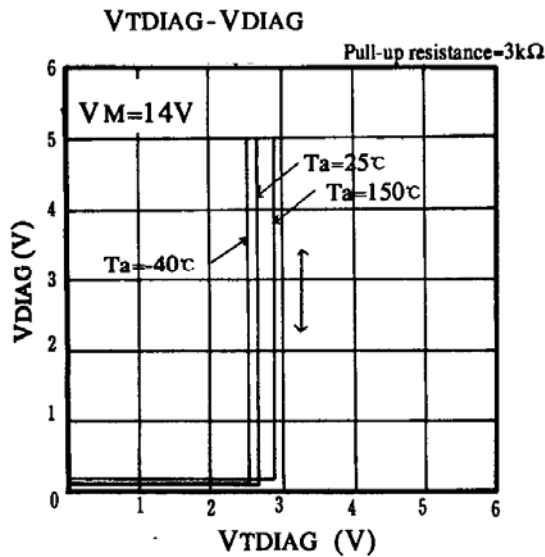
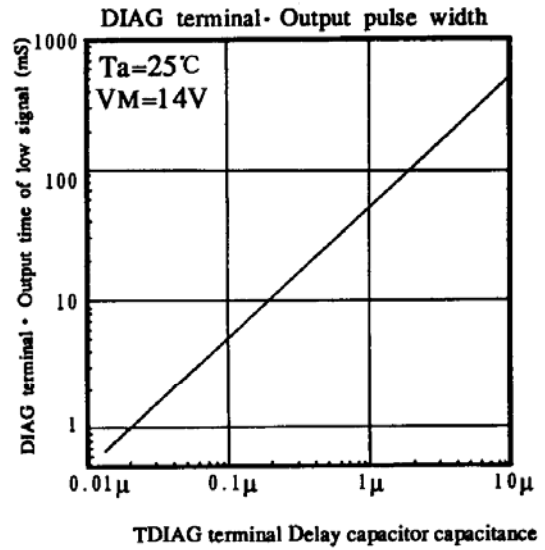
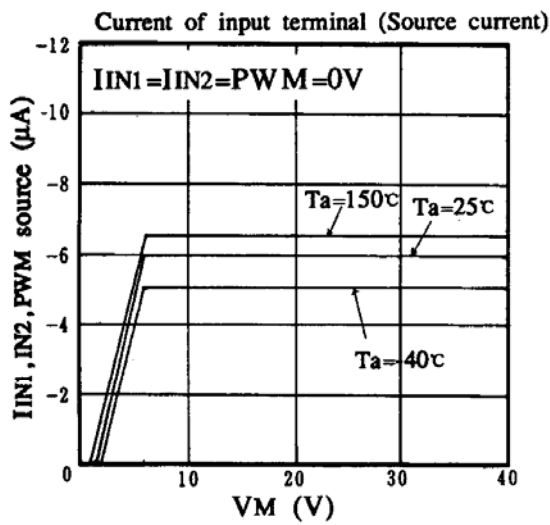
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9. Electrical characteristics Ta=25°C



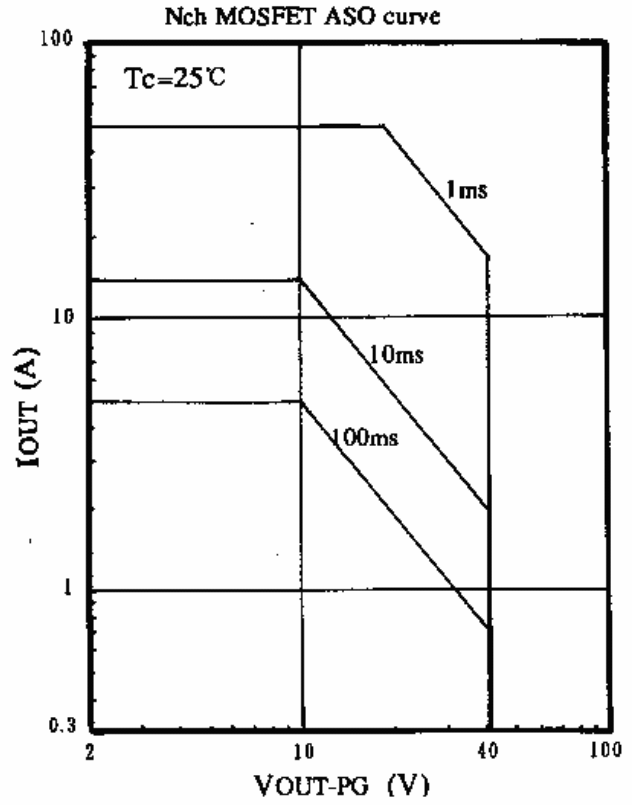
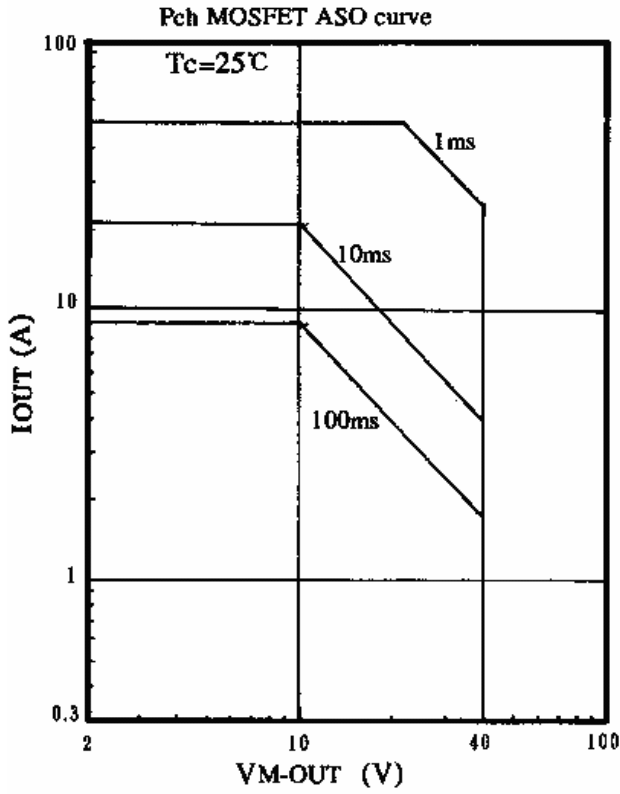
SI-5300

September 2005



SI-5300

September 2005



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