

TRIPLE IGBT/MOS DRIVER WITH CURRENT SENSE

- THREE POWER IGBT/MOS AND PULSE TRANSFORMER DRIVERS
- CURRENT SENSE COMPARATOR
- UNCOMMITTED OP-AMP
- 0.6 A PER CHANNEL PEAK OUTPUT CURRENT CAPABILITY
- LOW OUTPUT IMPEDANCE TYP: 7Ω AT 200mA
- CMOS/LSTTL COMPATIBLE INVERTING INPUT WITH HYSTERESIS
- 4V TO 16V SINGLE SUPPLY OPERATION
- LOW BIAS CURRENT TYP: 1.5mA
- ADJUSTABLE UNDERVOLTAGE LOCKOUT LEVEL
- STAND-BY MODE
- CHANNEL PARALLELING CAPABILITY

DESCRIPTION

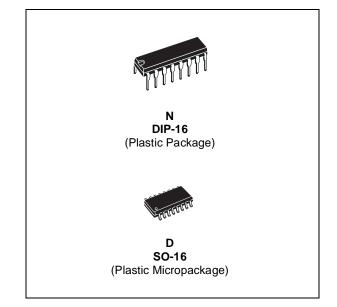
The TD310 is designed to drive one, two or three Power IGBT/MOS and has driving capability for pulse transformer. So it is perfectly suited to interface control IC with Power Switches in low side or half-bridge configuration.

TD310 includes a current sense comparator which inhibit the output drivers in case of overcurrent. An alarm output signals the even to a controller.

TD310 also includes an uncommitted op-amp which can be used for current measurement (as an amplifier before the A/D input of a microcontroller) of for other general purpose.

Programmable undervoltage lockout and standby mode make TD310 suitable for a large area of environment and application.

Typical applications are low side IGBT and power MOSFET drive in three phase systems, pulse transformer drive, and general purpose pulse drive.

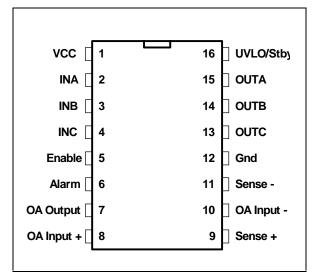


ORDER CODE

| Part Number | Temperature Range | Pacl | kage |
|-----------------|-------------------|------|------|
| i art i diliber | Temperature Mange | Ν | D |
| TD310I | -40°C, +125°C | ٠ | ٠ |

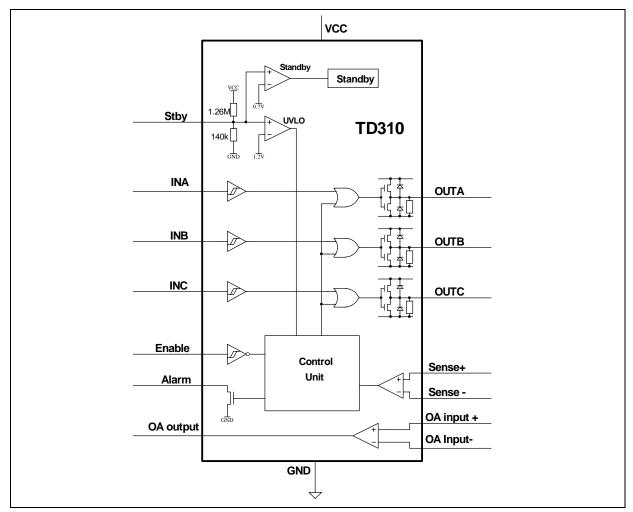
N = Dual in Line Package (DIP) D = Small Outline Package (SO) - also available in Tape & Reel (DT)

PIN CONNECTIONS (top view)



December 2001

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|------------------|--------------------------------|-------------------------|------|
| V _{CC} | Supply Voltage | 18 | V |
| V _i | Input Voltage | 0 to V _{CC} | V |
| V _{is} | Sense Input Voltage | -0.3 to V _{CC} | V |
| Tj | Operating Junction Temperature | -40 to 150 | °C |
| T _{amb} | Operating Ambient Temperature | -40 to 125 | °C |

OPERATING CONDITIONS

| Symbol | Parameter | Value | Unit |
|-----------------|----------------|---------|------|
| V _{CC} | Supply Voltage | 4 to 16 | V |

INSTRUCTION FOR USE

- 1 The TD310 supply voltage must be decoupled with a 1μ F min. capacitor.
- 2 If the application involving TD310 requires maximum output current capability, this current must be pulsed: pulse width 1µsec, duty cycle 1% at $T_{amb.}$

ELECTRICAL CHARACTERISTICS

 $V_{CC} = 15V, T_{amb} = 25^{\circ}C$ (unless otherwise specified)

| $\begin{split} & _{\text{CC}} & \text{Supply Current with inputs in High State} & 1.5 & 2 & mA \\ \hline \text{LOGIC INPUT (all inputs)} & & & & & \\ \hline \text{COGIC INPUT (all inputs)} & & & & & & & \\ \hline \text{Vis} & \text{High Input Voltage} & 2 & & & & & & & \\ \hline \text{Vis} & \text{High Input Voltage} & & & & & & & & & \\ \hline \text{Vis} & \text{Low Input Vortent} & & & & & & & & & & \\ \hline \text{Input Output Current} & & & & & & & & & & & \\ \hline \text{Ins} & \text{Low Input Current} & & & & & & & & & & & \\ \hline \text{Propagation Delay (10% input to 10% output)} & & & & & & & & & & \\ \hline \text{Vart Input Output Delay} & & & & & & & & & & \\ \hline \text{Vart Inhibiting Time & & & & & & & & & & \\ \hline \text{Ins} & \text{Low Input Current} & & & & & & & & & & \\ \hline \text{Unput Inhibiting Time Steween Channels} & & & & & & & & & \\ \hline \text{Output Delay Time Between Channels} & & & & & & & & & & \\ \hline \text{Output DriveRS} & & & & & & & & & & \\ \hline \text{Vaci Information Drop Voltage (A/B/C outputs)} & & & & & & & & & & \\ \hline \text{Issik = 200mA} & & & & & & & & & & & & \\ \hline \text{Vaci Sinking Drop Voltage (A/B/C outputs)} & & & & & & & & & & & & \\ \hline \text{Issik = 200mA} & & & & & & & & & & & & & \\ \hline \text{Vaci Output Pul Down Resistor} & & & & & & & & & & & & & \\ \hline \text{ALARM OUTPUT} & & & & & & & & & & \\ \hline \text{Low Level Sinking Current} & & & & & & & & & & & & & & \\ \hline \text{Iss} & \text{Low Level Sinking Current} & & & & & & & & & & & & & & \\ \hline \text{Is} & \text{Low Uset Sinking Current} & & & & & & & & & & & & & & & \\ \hline \text{Is} & \text{Inbibition Time if Sense Input Triggered} & & & & & & & & & & & & & \\ \hline \text{Iss In UD Offset Voltage} & & & & & & & & & & & & & & \\ \hline \text{Vacu Inbibition Time of Sense Input Triggered} & & & & & & & & & & & & \\ \hline \text{Is} & \text{Delay Time to Output Fall if Sense Input Triggered} & & & & & & & & & & & & & \\ \hline \text{Low ID DVI Delay Fall if Sense Input Triggered} & & & & & & & & & & & & & & & & & & &$ | Symbol | Parameter | Min. | Тур. | Max. | Unit | |
|--|-----------------------------------|--|----------|-----------------|------|----------|--|
| $ \begin{array}{c c c c c c c } \hline V_{\mu L} & High Input Voltage & 2 & V \\ V_{LL} & Low Input Voltage & 0.8 & V \\ I_{H1} & High Input Current & 10 & pA \\ \hline Voltage & 10 & 10 & pA \\ \hline Voltage & 10 & 000 & 0$ | I _{CC} | Supply Current with Inputs in High State | | 1.5 | 2 | mA | |
| | LOGIC II | NPUT (all inputs) | | • | | | |
| | V _{IH} | High Input Voltage | 2 | | | V | |
| $ \begin{array}{c c c c c c c c c c c c c c c c c c c $ | V _{IL} | Low Input Voltage | | | 0.8 | V | |
| | I _{IH} | High Input Current | | 10 | | pА | |
| $ t_{at.} t_{at.$ | ۱ _{IL} | Low Input Current | | 10 | | pА | |
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| t_{ii} Input Inhibiting Time 100 ns t_{td} Differential Delay Time Between Channels 20 ns OUTPUT DRIVERS 20 ns V_{sod} Surcing Drop Voltage (A/B/C outputs) Isink = 200mA 3 V V_{sod} Sinking Drop Voltage (A/B/C outputs) Isink = 200mA 5 V V_{dem} Demagnetizing Drop Voltage (A/B/C outputs) Idemag. = 100mA 2 V $Ropd$ Output Pull Down Resistor 47 K2 ALARM OUTPUT 1 μ A 4 K2 I_{a} Low Level Sinking Current V ₀ = 0.8V 5 35 mA I_{a} High Level Sinking Current V ₁ = 0.8V 5 35 mA I_{a} Inhibition Time if Sense Input Triggered 1 μ A t_{a} Inhibition Time of Sense Input Triggered 1 ms t_{a} Inhibition Time of Sense Input Triggered 10 mV t_{a} Inhibition Time of Sense Input Triggered 10 mV t_{a} Inhibition Time of Sense Input Triggered 10 mV t_{a} Inhibition | τ _{dL} , τ _{eH} | | | 60 | 400 | | |
| t_{dd} Differential Delay Time Between Channels 20 ns OUTPUT DRIVERS Sourcing Drop Voltage (A/B/C outputs) Isource = 200mA 3 V V _{sid} Sinking Drop Voltage (A/B/C outputs) Isoink = 200mA 5 V V _{sid} Sinking Drop Voltage (A/B/C outputs) Isoink = 200mA 5 V V _{sid} Demagnetizing Drop Voltage (A/B/C outputs) Idemag. = 100mA 2 V Roped Output Pull Down Resistor 47 K2 ALARM OUTPUT 1 μA K2 Is Low Level Sinking Current V ₀ = 0.8V 5 35 mA Is Low Level Sinking Current V ₀ = 0.8V 1 μA Al arm Output : Delay Time to Alarm Fall if Sense Input Triggered 500 ns SENSE INPUT Vice Input Offset Voltage 20 mV V ₁₀₅ Input Offset Voltage 40 mV mo t_s Delay Time to Output Fall if Sense Input Triggered 1 ms 600 ns t_s Delay Time to Output Fall if Sense Input Triggered 10 mV mV 0 OPERATIONAL AMPLIFIER 0 <td< td=""><td>te</td><td></td><td>_</td><td>100</td><td></td><td>ns</td></td<> | te | | _ | 100 | | ns | |
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| V _{sod} Sourcing Drop Voltage (A/B/C outputs) I _{gauree} = 200mA 3 V V _{sid} Sinking Drop Voltage (A/B/C outputs) Isink = 200mA 5 V V _{sid} Sinking Drop Voltage (A/B/C outputs) Isink = 200mA 5 V V _{dem} Demagnetizing Drop Voltage (A/B/C outputs) Idemag. = 100mA 2 V Ropd Output Pull Down Resistor 47 kΩ ALARM OUTPUT 47 kΩ Ish High Level Sinking Current V _O = 0.8V 5 35 mA Ish High Level Sinking Current V _O = 0.8V 1 μA t _A Alarm Output : Delay Time to Alarm Fall if Sense Input Triggered 1 1 μA t _A Alarm Output : Fall if Sense Input Triggered 1 1 ms t _S Delay Time to Output Fall if Sense Input Triggered 600 ns t _S Inhibition Time of Sense Input Triggered 600 ns t _S Inhibition Time of Sense Input Triggered 10 mV OperACTIONAL AMPLIFIER 0 to V _{Cc} ⁺ - 1.5 V V _{icm} <td< td=""><td></td><td></td><td></td><td>20</td><td></td><td>113</td></td<> | | | | 20 | | 113 | |
| V sod I source = 200mÅ 3 V V sid Sinking Drop Voltage (A/B/C outputs) lsink = 200mÅ 5 V V dem Demagnetizing Drop Voltage (A/B/C outputs) ldemag. = 100mA 2 V Ropd Output Pull Down Resistor 47 kΩ ALARM OUTPUT 1 47 kΩ Is Low Level Sinking Current V _O = 0.8V 5 35 mA Is, High Level Sinking Current V _O = 0.8V 5 35 mA Is, High Level Sinking Current V _O = 0.8V 5 35 mA Is, High Level Sinking Current V _O = 0.8V 1 μA A larm Output : Delay Time to Alarm Fall if Sense Input Triggered 1 ms SENSE INPUT 5 300 ns Vios Inhibition Time if Sense Input Triggered 1 ms ts Delay Time to Output Fall if Sense Input Triggered 10 mV ts Delay Time to Output Fall if Sense Input Triggered 10 mV ts Delay Time to Sense Input Triggered 1 Ma visms Sense Hysteresis 40 mV <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> | | | | | | | |
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| V_{shys} Sense Hysteresis40mVOPERATIONAL AMPLIFIER V_{icm} Common Mode Input Voltage Range0 to $V_{CC}^+ \cdot 1.5$ V V_{io} Input Offset Voltage10mVGBPGain Bandwidth Product1MHz A_{vd} Open Loop Gain60dBSRSlew Rate at Unity Gain ($R_L = 100k\Omega$, $C_L = 100pF$, $V_i = 3$ to 7V)0.6V/µsSTAND-BY V_{stdby} Standby Mode Threshold Voltage0.31.1V I_{stdby} Standby Mode Supply Current30µAUNDER VOLTAGE LOCKOUT I_{adj} Under Voltage Level Adjust Current1µA/V V_{st1} Internal Stop Threshold (without external adjustment)10.713.3V | t _s | | | | 600 | ns | |
| OPERATIONAL AMPLIFIER V_{icm} Common Mode Input Voltage Range $0 \text{ to } V_{CC}^+ - 1.5$ V V_{io} Input Offset Voltage 10 mV GBP Gain Bandwidth Product 1 MHz A_{vd} Open Loop Gain 60 dB SR Slew Rate at Unity Gain ($R_L = 100 k\Omega$, $C_L = 100 pF$, $V_i = 3 \text{ to } 7V$) 0.6 V/ μ s STAND-BY V 30 μ A V stdby Standby Mode Threshold Voltage 0.3 1.1 V Istdby Standby Mode Threshold Voltage 0.3 1.1 V Istdby Standby Mode Supply Current 30 μ A UNDER VOLTAGE LOCKOUT 1 μ A/V V_{st1} Internal Stop Threshold (without external adjustment) 10.7 13.3 V | t _{si} | Inhibition Time of Sense Input | | 300 | | ns | |
| OPERATIONAL AMPLIFIER V_{icm} Common Mode Input Voltage Range $0 \text{ to } V_{CC}^+ \cdot 1.5$ V V_{io} Input Offset Voltage 10 mV GBP Gain Bandwidth Product 1 MHz A_{vd} Open Loop Gain 60 dB SR Slew Rate at Unity Gain ($R_L = 100 k\Omega$, $C_L = 100 pF$, $V_i = 3 \text{ to } 7V$) 0.6 V/ μ s STAND-BY V Standby Mode Threshold Voltage 0.3 1.1 V I_{stdby} Standby Mode Supply Current 30 μ A UDER VOLTAGE LOCKOUT I μ A/V V_{st1} Internal Stop Threshold (without external adjustment) 10.7 13.3 V | V _{shys} | Sense Hysteresis | | 40 | | mV | |
| VioInput Offset Voltage10mVGBPGain Bandwidth Product1MHz A_{vd} Open Loop Gain60dBSRSlew Rate at Unity Gain (R _L = 100kΩ, C _L = 100pF, V _i = 3 to 7V)0.6V/µsSTAND-BY V_{stdby} Standby Mode Threshold Voltage0.31.1V I_{stdby} Standby Mode Supply Current30µAUNDER VOLTAGE LOCKOUT I_{adj} Under Voltage Level Adjust Current1µA/V V_{st1} Internal Stop Threshold (without external adjustment)10.713.3V | OPERAT | IONAL AMPLIFIER | | | | | |
| VioInput Offset Voltage10mVGBPGain Bandwidth Product1MHz A_{vd} Open Loop Gain60dBSRSlew Rate at Unity Gain (R _L = 100kΩ, C _L = 100pF, V _i = 3 to 7V)0.6V/µsSTAND-BY V_{stdby} Standby Mode Threshold Voltage0.31.1V I_{stdby} Standby Mode Supply Current30µAUNDER VOLTAGE LOCKOUT I_{adj} Under Voltage Level Adjust Current1µA/V V_{st1} Internal Stop Threshold (without external adjustment)10.713.3V | V _{icm} | Common Mode Input Voltage Range | 0 | to V_{cc}^+ - | 1.5 | V | |
| GBPGain Bandwidth Product1MHz A_{vd} Open Loop Gain60dBSRSlew Rate at Unity Gain (R _L = 100kΩ, C _L = 100pF, V _i = 3 to 7V)0.6V/µsSTAND-BYV _{stdby} Standby Mode Threshold Voltage0.31.1VIstdbyStandby Mode Supply Current30µAUNDER VOLTAGE LOCKOUTI _{adj} Under Voltage Level Adjust Current1µA/VV _{st1} Internal Stop Threshold (without external adjustment)10.713.3V | | | | | | mV | |
| A_{vd}Open Loop Gain60dBSRSlew Rate at Unity Gain (R _L = 100kΩ, C _L = 100pF, V _i = 3 to 7V)0.6V/µsSTAND-BYV _{stdby} Standby Mode Threshold Voltage0.31.1VI _{stdby} Standby Mode Supply Current30µAUNDER VOLTAGE LOCKOUTI _{adj} Under Voltage Level Adjust Current1µA/VV _{st1} Internal Stop Threshold (without external adjustment)10.713.3V | - | | | 1 | | | |
| SRSlew Rate at Unity Gain (R _L = 100kΩ, C _L = 100pF, V _i = 3 to 7V)0.6V/µsSTAND-BY V_{stdby} Standby Mode Threshold Voltage0.31.1V I_{stdby} Standby Mode Supply Current30µAUNDER VOLTAGE LOCKOUT I_{adj} Under Voltage Level Adjust Current1µA/V V_{st1} Internal Stop Threshold (without external adjustment)10.713.3V | A _{vd} | | 60 | | | | |
| STAND-BY V _{stdby} Standby Mode Threshold Voltage 0.3 1.1 V I _{stdby} Standby Mode Supply Current 30 μA UNDER VOLTAGE LOCKOUT Inder Voltage Level Adjust Current 1 μA/V V _{st1} Internal Stop Threshold (without external adjustment) 10.7 13.3 V | | | | 0.6 | | V/µs | |
| V _{stdby} Standby Mode Threshold Voltage 0.3 1.1 V I _{stdby} Standby Mode Supply Current 30 μA UNDER VOLTAGE LOCKOUT Inder Voltage Level Adjust Current 1 μA/V V _{st1} Internal Stop Threshold (without external adjustment) 10.7 13.3 V | | | | 1 | 1 | I | |
| Istaby Standby Mode Supply Current 30 μA UNDER VOLTAGE LOCKOUT I _{adj} Under Voltage Level Adjust Current 1 μA/V V _{st1} Internal Stop Threshold (without external adjustment) 10.7 13.3 V | | | 0.3 | | 1.1 | V | |
| UNDER VOLTAGE LOCKOUT I _{adj} Under Voltage Level Adjust Current 1 μA/V V _{st1} Internal Stop Threshold (without external adjustment) 10.7 13.3 V | | | | 30 | | μA | |
| I _{adj} Under Voltage Level Adjust Current 1 μA/V V _{st1} Internal Stop Threshold (without external adjustment) 10.7 13.3 V | | | ļ | Į | Į | <u> </u> | |
| Vst1Internal Stop Threshold (without external adjustment)10.713.3V | | | | 1 | [| μA/V | |
| | | o i | 10.7 | - | 13.3 | • | |
| | V _{hys} | Threshold Hysteresis | | 0.8 | | V | |

UVLO/stdby pin functioning modes

Due to the wide supply voltage range of the TD310, the UVLO function (Under Voltage Lock Out) is externally adjustable by a resistor bridge.

The bridge rate can be calculated in relation with the expected UVLO protection level as follows :

$$V_{UVLO} \times \frac{R1}{R1 + R2} = 1.2V$$
 (where R1 is the lower resistor of the bridge)

The internal resistor sets the default UVLO value to 12V (*) and might influence the external bridge rate if the values of the external resistors are too high. Moreover, the internal resistor ratio is accurate, but the tolerance on the absolute value of each internal resistor (typically 140k and 1.26M) is about +/-20%. If an external bridge is used, we recommend to choose resistor values not greater than 10k.

The standby threshold value depends of the UVLO value as follows:

$$V_{stdby} = \frac{0.7}{1.2} V_{UVLO}$$

Both UVLO and stdby functions can be inhibited by connecting the UVLO/stdby pin to V_{cc}^+ via a pull up resistor (ex 150k Ω).

| | Pin | 16 | 9/11 | 5 | 2/3/4 | 15/14/13 | 6 | 7/8/10 | Con- | |
|--------|--------|----------------|-------------------|--------|----------|-----------|-------|--------|--------------|---|
| | Config | UVLO/ stdby | Sense+/ Sense- | Enable | In A/B/C | Out A/B/C | Alarm | Op-Amp | sumption | |
| | | | + > - | Х | Х | L | L | | | |
| Normal | 1 | Н | + < - | Н | IN | ĪN | н | OK | H (1.5mA) | |
| | | | + < - | L | Х | L | п | | | (|
| Stdby | 2 | | + > - | х | х | | L | HZ | L | |
| Sluby | 2 | L | + < - | ~ | ~ | L | Н | 112 | (30µA) | |
| UVLO | 3 | М | Х | Х | Х | L | L | OK | Н | |

The following table summarizes the functions of the TD310 :

Configuration 1: UVLO/stdby = H

The TD310 is in a normal consumption state (1.5mA), the operational amplifier is normally functioning and the buffer outputs are determined by the sense comparator inputs, the enable inputs and the buffer inputs.

Configuration 2 : UVLO/stdby = L

The TD310 is in a low consumption state (standby mode 30μ A), the buffer outputs are set to low state and the operational amplifier is in high impedance state.

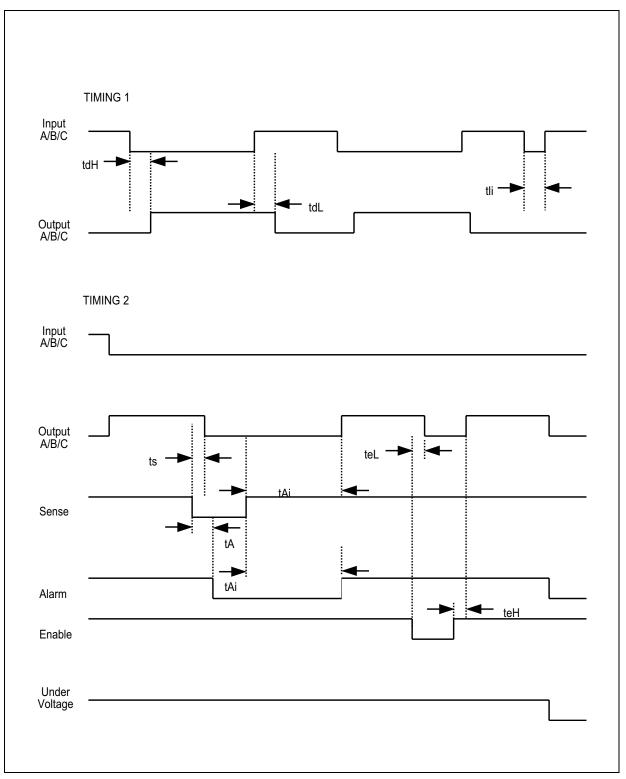
Configuration 3 : UVLO/stdby = M

The VCC supply voltage is between VUVLO and Vstdby (**). The TD310 remains in a normal consumption state and the operational amplifier is normally functioning but the buffer outputs and the alarm pin are set to low state.

^(*) If the UVLO level remains unadjusted, it is recommended to bypass the UVLO/stdby pin with a 1nF capacitor.

^(**) If the supply voltage falls below V_{stdby} , the TD310 is set in standby mode (configuration 2).

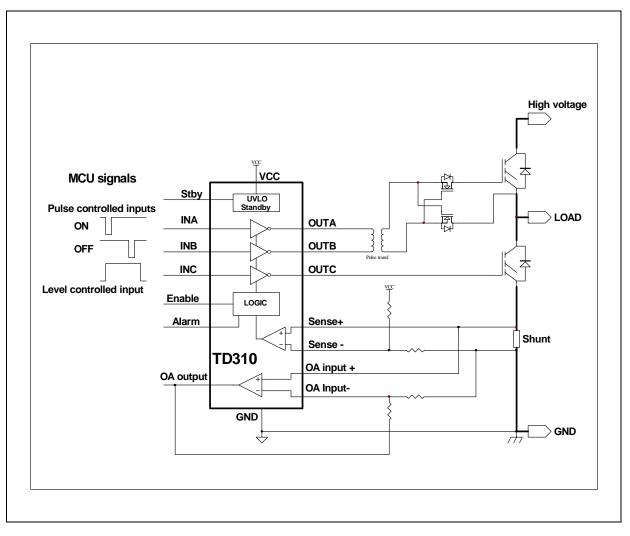
TIMING DIAGRAM



A7/

TYPICAL APPLICATIONS

Figure 1 : HALF BRIDGE DRIVE IN THREE PHASE MOTOR SYSTEM



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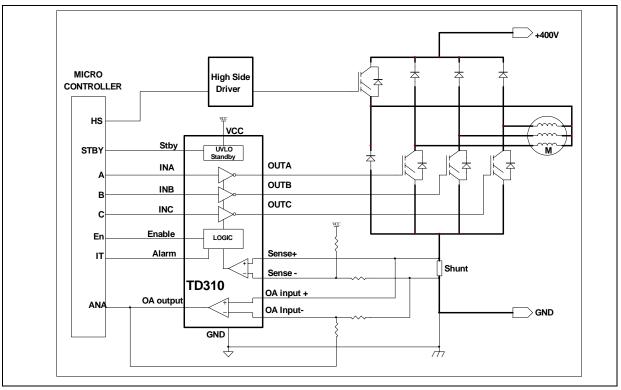
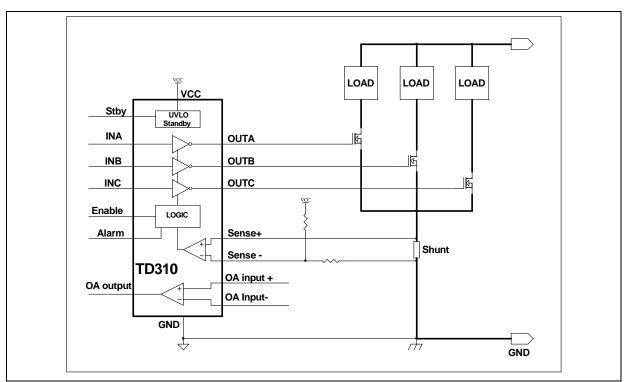


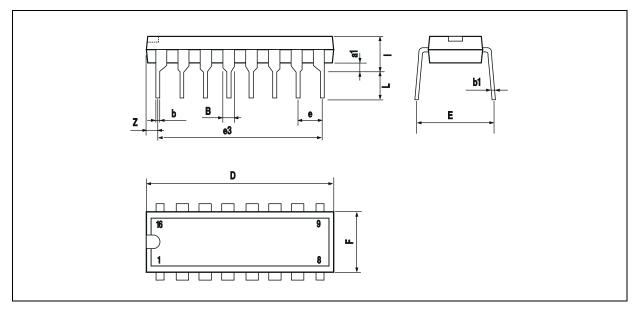
Figure 2 : THREE PHASE MOTOR LOW SIDE DRIVE

Figure 3 : LOW SIDE DRIVE



PACKAGE MECHANICAL DATA

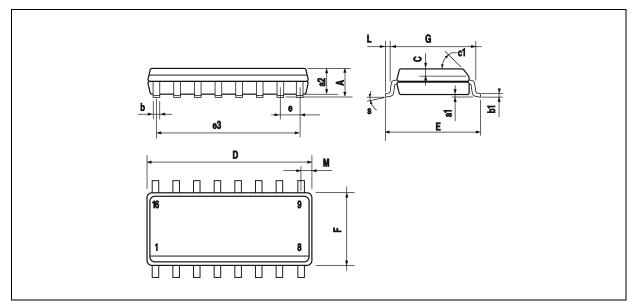
16 PINS - PLASTIC DIP



| Dim. | | Millimeters | | Inches | | | |
|------|------|-------------|------|--------|-------|-------|--|
| | Min. | Тур. | Max. | Min. | Тур. | Max. | |
| a1 | 0.51 | | | 0.020 | | | |
| В | 0.77 | | 1.65 | 0.030 | | 0.065 | |
| b | | 0.5 | | | 0.020 | | |
| b1 | | 0.25 | | | 0.010 | | |
| D | | | 20 | | | 0.787 | |
| E | | 8.5 | | | 0.335 | | |
| е | | 2.54 | | | 0.100 | | |
| e3 | | 17.78 | | | 0.700 | | |
| F | | | 7.1 | | | 0.280 | |
| i | | | 5.1 | | | 0.201 | |
| L | | 3.3 | | | 0.130 | | |
| Z | | | 1.27 | | | 0.050 | |

PACKAGE MECHANICAL DATA

16 PINS - PLASTIC MICROPACKAGE (SO)



| Dim. | | Millimeters | | Inches | | | |
|------|-----------|-------------|------|--------|-------|-------|--|
| | Min. | Тур. | Max. | Min. | Тур. | Max. | |
| А | | | 1.75 | | | 0.069 | |
| a1 | 0.1 | | 0.2 | 0.004 | | 0.008 | |
| a2 | | | 1.6 | | | 0.063 | |
| b | 0.35 | | 0.46 | 0.014 | | 0.018 | |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 | |
| С | | 0.5 | | | 0.020 | | |
| c1 | | | 45° | (typ.) | • | • | |
| D | 9.8 | | 10 | 0.386 | | 0.394 | |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 | |
| е | | 1.27 | | | 0.050 | | |
| e3 | | 8.89 | | | 0.350 | | |
| F | 3.8 | | 4.0 | 0.150 | | 0.157 | |
| G | 4.6 | | 5.3 | 0.181 | | 0.209 | |
| L | 0.5 | | 1.27 | 0.020 | | 0.050 | |
| М | | | 0.62 | | | 0.024 | |
| S | 8° (max.) | | | | | | |

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