

# 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 <sub>CC</sub>	Supply Voltage	18	V
V <sub>i</sub>	Input Voltage	0 to V <sub>CC</sub>	V
V <sub>is</sub>	Sense Input Voltage	-0.3 to V <sub>CC</sub>	V
Tj	Operating Junction Temperature	-40 to 150	°C
T <sub>amb</sub>	Operating Ambient Temperature	-40 to 125	°C

## **OPERATING CONDITIONS**

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	4 to 16	V

## INSTRUCTION FOR USE

- 1 The TD310 supply voltage must be decoupled with a  $1\mu$ 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 <sub>CC</sub>	Supply Current with Inputs in High State		1.5	2	mA	
	LOGIC II	NPUT (all inputs)		•			
	V <sub>IH</sub>	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 <sub>IL</sub>	Low Input Voltage			0.8	V	
	I <sub>IH</sub>	High Input Current		10		pА	
$      t_{at.} t_{at.$	۱ <sub>IL</sub>	Low Input Current		10		pА	
tdt. teH         Output Delay         60         400         ns           til         Input Inhibiting Time         100         ns           til         Input Inhibiting Time         100         ns           Vexter         Sourcing Drop Voltage (A/B/C outputs)         20         ns           Nexter         Sourcing Drop Voltage (A/B/C outputs)         3         V           Vsod         Sinking Drop Voltage (A/B/C outputs)         5         V           Vdem         Demagnetizing Drop Voltage (A/B/C outputs)         2         V           Vdem         Demagnetizing Drop Voltage (A/B/C outputs)         2         V           Ndemagnetizing Drop Voltage (A/B/C outputs)         2         V           Is         Cutput Pull Down Resistor         47         kQ           ALARM OUTPUT         1         ImA         1         ImA           t_a         Alarm Output: Delay Time to Alarm Fall if Sense Input Triggered         1         ImA           t_a         Inhibition Time if Sense Input Triggered         1         Ims           t_ai         Inhibition Time of Sense Input Triggered         600         ns           t_si         Inhibition Time of Sense Input Triggered         10         mV           GBP Gain Bandw							
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t_{dd}       Differential Delay Time Between Channels       20       ns         OUTPUT DRIVERS       Sourcing Drop Voltage (A/B/C outputs) Isource = 200mA       3       V         V <sub>sid</sub> Sinking Drop Voltage (A/B/C outputs) Isoink = 200mA       5       V         V <sub>sid</sub> Sinking Drop Voltage (A/B/C outputs) Isoink = 200mA       5       V         V <sub>sid</sub> 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 <sub>0</sub> = 0.8V       5       35       mA         Is       Low Level Sinking Current V <sub>0</sub> = 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 <sub>105</sub> 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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SENSE INPUT $V_{ios}$ Input Offset Voltage       20       mV $t_{Ai}$ Inhibition Time if Sense Input Triggered       1       ms $t_s$ Delay Time to Output Fall if Sense Input Triggered       600       ns $t_s$ Inhibition Time of Sense Input       300       ns $v_{shys}$ Sense Hysteresis       40       mV         OPERATIONAL AMPLIFIER $V_{icm}$ Common Mode Input Voltage Range       0 to $V_{cc}^+ - 1.5$ V $V_{icm}$ Common Mode Input Voltage Range       0 to $V_{cc}^+ - 1.5$ V $V_{icm}$ Common Mode Input Voltage Range       0 to $V_{cc}^+ - 1.5$ V $V_{icm}$ Common Mode Input Voltage Range       0 to $V_{cc}^+ - 1.5$ V $V_{icm}$ Common Mode Input Voltage Range       0 to $V_{cc}^+ - 1.5$ V $V_{io}$ Input Offset Voltage       1       MHz $A_{vd}$ Open Loop Gain       60       dB         SR       Slew Rate at Unity Gain ( $R_L = 100 k\Omega, C_L = 100 pF, V_i = 3 to 7V$ )       0.6 $V/\mu s$ Statuby       Standby Mode Threshold Voltage       0.3       1.1       V         Ist	l <sub>sh</sub>	High Level Sinking Current			1	μΑ	
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V <sub>stdby</sub> Standby Mode Threshold Voltage         0.3         1.1         V           I <sub>stdby</sub> Standby Mode Supply Current         30         μA           UNDER VOLTAGE LOCKOUT         Inder Voltage Level Adjust Current         1         μA/V           V <sub>st1</sub> Internal Stop Threshold (without external adjustment)         10.7         13.3         V				1	1	I	
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UNDER VOLTAGE LOCKOUT           I <sub>adj</sub> Under Voltage Level Adjust Current         1         μA/V           V <sub>st1</sub> Internal Stop Threshold (without external adjustment)         10.7         13.3         V				30		μA	
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Vst1Internal Stop Threshold (without external adjustment)10.713.3V				1	[	μA/V	
		<b>o i</b>	10.7	-	13.3	•	
	V <sub>hys</sub>	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 $\Omega$ ).

	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  $30\mu$ 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.

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

<sup>(\*\*)</sup> 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



57



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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