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International
IOR Rectifier

IR51HD310

SELF-OSCILLATING HALF-BRIDGE

Features

- Output Power MOSFETs in half-bridge configuration
  400V Rated Breakdown Voltage
- High side gate drive designed for bootstrap operation
- Bootstrap diode integrated into package
- Accurate timing control for both Power MOSFETs
  Matched delay to get 50% duty cycle
  Matched deadtime of 1.2us
- Internal oscillator with programmable frequency

$$f = \frac{1}{1.4 \times (R_T + 75\Omega) \times C_T}$$

- Zener clamped Vcc for offline operation
- Half-bridge output is out of phase with R_T

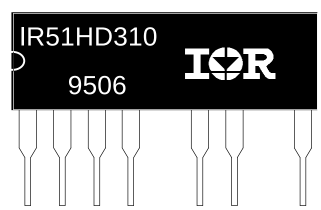
Product Summary

V_{IN} (max)	400V
Duty Cycle	50%
Deadtime	1.2µs
$R_{DS(on)}$	3.6Ω
P_D (T_A = 25 ºC)	2.0W

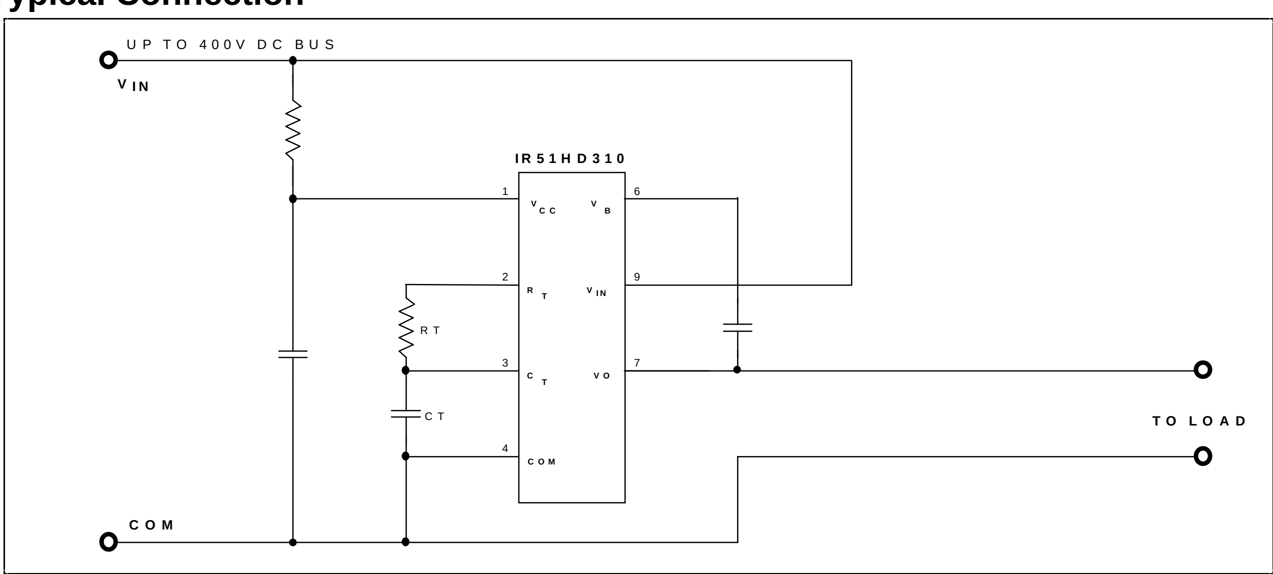
Description

The IR51HD310 is a high voltage, high speed, self-oscillating half-bridge. Proprietary HVIC and latch immune CMOS technologies, along with the HEXFET® power MOSFET technology, enable ruggedized single package construction. The front-end features a programmable oscillator which functions similar to the CMOS 555 timer. The supply to the control circuit has a zener clamp to simplify offline operation. The output features two HEXFETs in a half-bridge configuration with an internally set deadtime designed for minimum cross-conduction in the half-bridge. Propagation delays for the high and low side power MOSFETs are matched to simplify use in 50% duty cycle applications. The device can operate up to 400 volts.

Package



Typical Connection



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Absolute Maximum Ratings

Absolute Maximum Ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are absolute voltages referenced to COM, all currents are defined positive into any lead. The Thermal Resistance and Power Dissipation ratings are measured under board mounted and still air conditions.

Symbol	Parameter Definition	Min.	Max.	Units
V_{IN}	High Voltage Supply	-0.3	400	V
V_B	High Side Floating Supply Absolute Voltage	-0.3	425	
VO	Half-Bridge Output Voltage	-0.3	$V^+ + 0.3$	
V_{RT}	R_T Voltage	-0.3	$V_{CC} + 0.3$	
V_{CT}	C_T Voltage	-0.3	$V_{CC} + 0.3$	
I_{CC}	Supply Current (Note 1)	---	25	mA
I_{RT}	R_T Output Current	-5	5	
dv/dt	Peak Diode Recovery dv/dt	---	4.0	V/ns
P_D	Package Power Dissipation @ $T_A \leq +25^oC$	---	2.00	W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	---	60	ºC/W
T_J	Junction Temperature	-55	150	ºC
T_S	Storage Temperature	-55	150	
T_L	Lead Temperature (Soldering, 10 seconds)	---	300	

Recommended Operating Conditions

The Input/Output logic timing diagram is shown in Figure 1. For proper operation the device should be used within the recommended conditions.

Symbol	Parameter Definition		Min.	Max.	Units
V_B	High Side Floating Supply Absolute Voltage		VO + 10	$VO + V_{CLAMP}$	V
V_{IN}	High Voltage Supply		---	400	
VO	Half-Bridge Output Voltage		-5	400	
I_D	Continuous Drain Current	($T_A = 25^oC$)	---	0.70	A
		($T_A = 85^oC$)	---	0.45	
I_{CC}	Supply Current (Note 1)		---	5	mA
T_A	Ambient Temperature		-40	125	ºC

Note 1: Because of the IR51HD310's application specificity toward off-line supply systems, this IC contains a zener clamp structure between the chip V_{CC} and COM which has a nominal breakdown voltage of 15.6V. Therefore, the IC supply voltage is normally derived by current feeding the V_{CC} lead (typically by means of a high value resistor connected between the chip V_{CC} and the rectified line voltage and a local decoupling capacitor from V_{CC} to COM) and allowing the internal zener clamp circuit to determine the nominal supply voltage. Therefore, this circuit should not be driven by a DC, low impedance power source of greater than V_{CLAMP}.

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Dynamic Electrical Characteristics

V_{BIAS} (V_{CC}, V_B) = 12V unless otherwise specified.

Symbol	Parameter Definition	T_A = 25ºC Min.	Typ.	Max.	Units	Test Conditions
t_{rr}	Reverse Recovery Time (MOSFET Body Diode)	---	240	---	ns	I_F = 700mA
Q_{rr}	Reverse Recovery Charge (MOSFET Body Diode)	---	0.85	---	µC	di/dt = 100A/µs
DT	Deadtime, LS Turn-Off to HS Turn-On & HS Turn-Off to LS Turn-On	---	1.2	---	µs	
D	R_T Duty Cycle	---	50	---	%	f_{OSC} = 20 kHz

Static Electrical Characteristics

V_{BIAS} (V_{CC}, V_B) = 12V unless otherwise specified.

Symbol	Parameter Definition	T_A = 25ºC Min.	Typ.	Max.	Units	Test Conditions
Supply Characteristics						
V_{CCUV+}	V_{CC} Supply Undervoltage Positive Going Threshold	---	8.4	---	V	
V_{CCUV-}	V_{CC} Supply Undervoltage Negative Going Threshold	---	8.0	---		
I_{QCC}	Quiescent V_{CC} Supply Current	---	300	---	µA	
V_{CLAMP}	V_{CC} Zener Shunt Clamp Voltage	---	15.6	---	V	I_{CC} = 5 mA
Floating Supply Characteristics						
I_{QBS}	Quiescent V_{BS} Supply Current	---	30	---	µA	
I_{OS}	Offset Supply Leakage Current--- --- 50		V			B = V_{IN} = 400V
Oscillator I/O Characteristics						
f_{OSC}	Oscillator Frequency	---	20	---	kHz	R_T = 35.7 kΩ, C_T = 1 nF
		---	100	---		R_T = 7.04 kΩ, C_T = 1 nF
I_{CT}	C_T Input Current	---	0.001	1.0	µA	
V_{CTUV}	C_T Undervoltage Lockout --- 100	---		2.5V < V		CC < V_{CCUV+}
V_{RT+}	R_T High Level Output Voltage, V_{CC} - R_T	---	20	---	mV	I_{RT} = -100 µA
		---	200	---		I_{RT} = -1 mA
V_{RT-}	R_T Low Level Output Voltage	---	20	---		I_{RT} = 100 µA
		---	200	---		I_{RT} = 1 mA
V_{RTUV}	R_T Undervoltage Lockout, V_{CC} - R_T	---	100	---		2.5V < V_{CC} < V_{CCUV+}
V_{CT+}	2/3 V_{CC} Threshold	---	8.0	---	V	
V_{CT-}	1/3 V_{CC} Threshold	---	4.0	---		
Output Characteristics						
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	---	3.6	---	Ω	I_D = 700 mA
V_{SD}	Diode Forward Voltage --- 0.8 ---				V	Tj = 150 ºC

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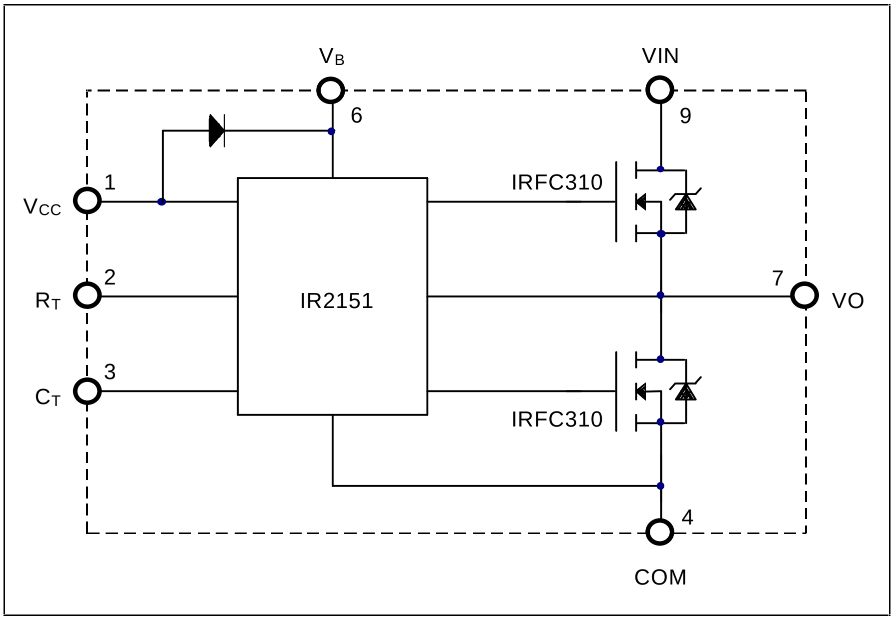
Functional Block Diagram



Lead Definitions

Symbol	Lead Description
V_{CC}	Logic and internal gate drive supply voltage. An internal zener clamp diode at 15.6 V nominal is included to allow the V_{CC} to be current fed directly from V_{IN} typically by means of a high value resistor.
R_T	Oscillator timing resistor input; a resistor is connected from R_T to C_T. R_T is out of phase with the half-bridge output (VO).
C_T	Oscillator timing capacitor output; a capacitor is connected from C_T to COM in order to program the oscillator frequency according to the following equation: $$f = \frac{1}{1.4 \times (R_T + 75\Omega) \times C_T}$$ where 75Ω is the effective impedance of the R_T output stage.
V_B	High side gate drive floating supply. For bootstrap operation a high voltage fast recovery diode is needed to feed from V_{CC} to V_B.
V_{IN}	High voltage supply.
VO	Half-bridge output.
COM	Logic and low side of half-bridge return.

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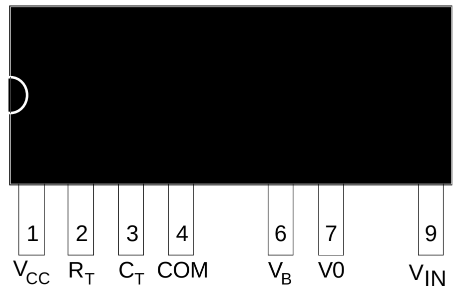
Lead Assignments



9 Lead SIP w/o Leads 5 & 8

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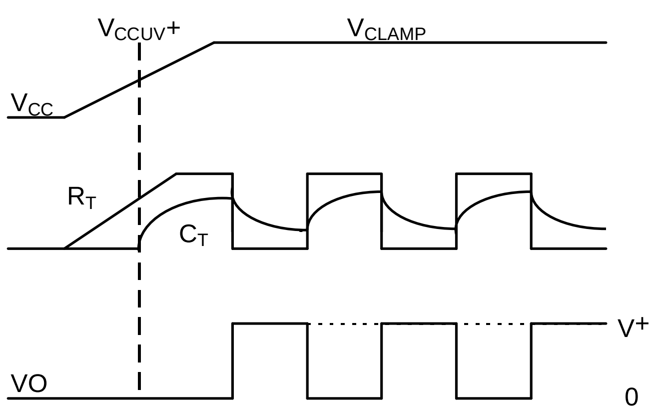

Figure 1. Input/Output Timing Diagram

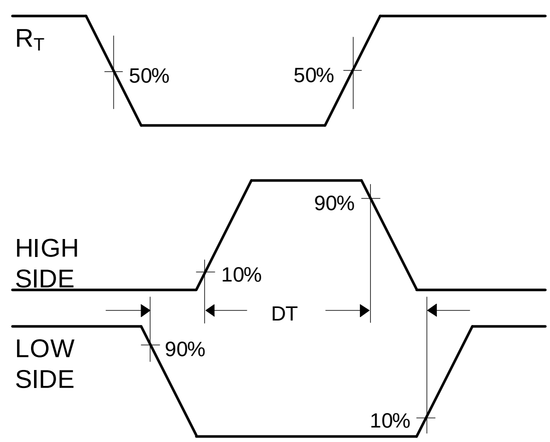

Figure 2. Deadtime Waveform Definitions

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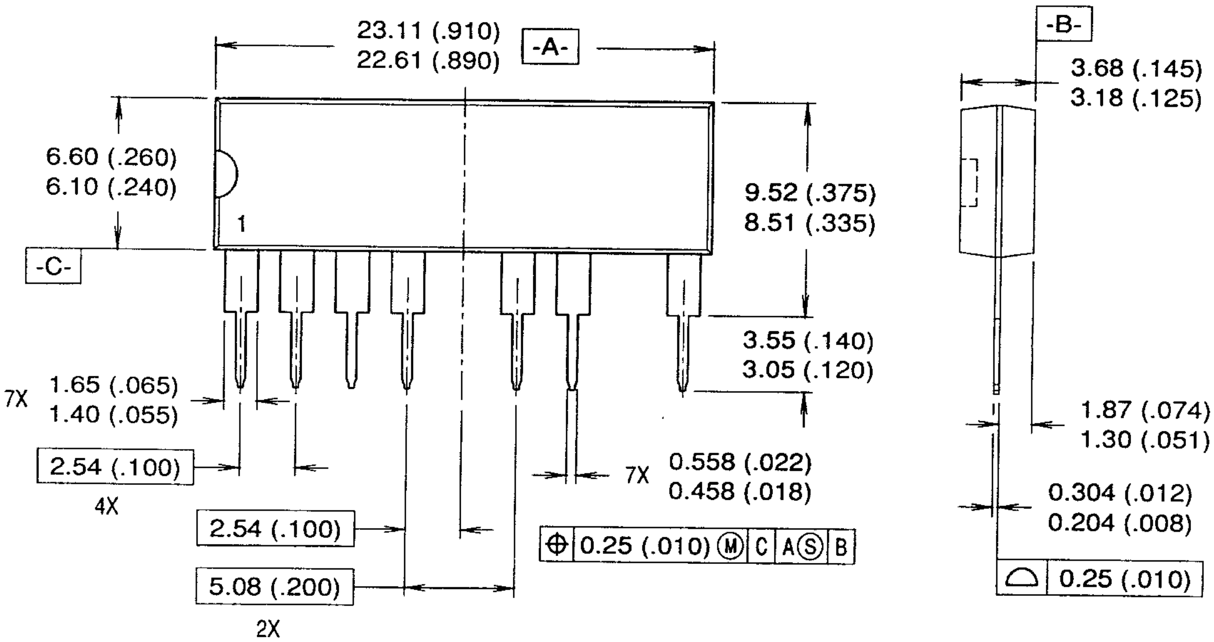

NOTES:
1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).

Package Outline

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WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, Tel: (310) 322 3331
EUROPEAN HEADQUARTERS: Hurst Green, Oxted, Surrey RH8 9BB, UK Tel: ++ 44 1883 732020
IR CANADA: 7321 Victoria Park Ave., Suite 201, Markham, Ontario L3R 2Z8, Tel: (905) 475 1897
IR GERMANY: Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 6172 96590
IR ITALY: Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 11 451 0111
IR FAR EAST: 171 (K&H Bldg.), 30-4 Nishi-ikebukuro 3-Chome, Toshima-ku, Tokyo Japan Tel: 81 3 3983 0086
IR SOUTHEAST ASIA: 315 Outram Road, #10-02 Tan Boon Liat Building, Singapore 0316 Tel: 65 221 8371
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