International
IOR Rectifier

Preliminary Data Sheet No. PD-60083H

IR51H(D)XXX (NOTE: For new designs, we recommend IR's new products IR53H(D)XXX)

SELF-OSCILLATING HALF BRIDGE

Features

- Output Power MOSFETs in half-bridge configuration
- High side gate drive designed for bootstrap operation
- Bootstrap diode integrated into package (is HD type)
- 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

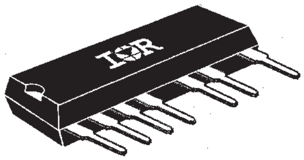
Product Summary

V_{IN} (max)	250V - H(D)214/224 300V - H(D)737 400V - H(D)310/320 500V - H(D)420
Duty Cycle	50%
Deadtime	1.2µs
$R_{ds(on)}$	0.75Ω - H(D)737 1.1Ω - H(D)224 1.8Ω - H(D)320 2.0Ω - H(D)214 3.0Ω - H(D)420 3.6Ω - H(D)310
P_D (T_A = 25°C)	2.0W

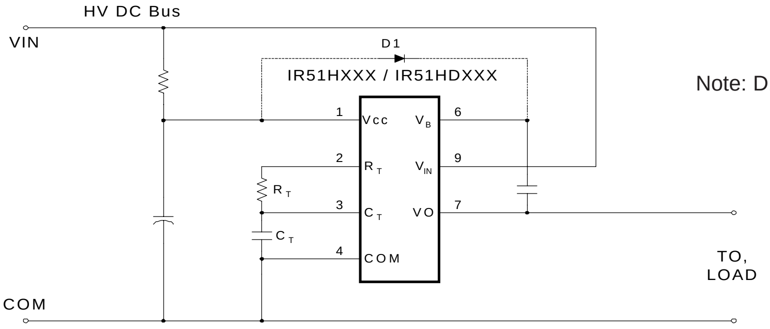
Description

The IR51H(D)XXX are complete high voltage, high speed, self-oscillating half-bridges. 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 the V_{IN} (max) rating.

Package



Typical Connection



Note: D1 is not required for HD type

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	Definition		Minimum	Maximum	Units
V_{IN}	High voltage supply	-214	- 0.3	250	V
		-224	- 0.3	250	
		-310	- 0.3	400	
		-320	- 0.3	400	
		-420	- 0.3	500	
		-737	- 0.3	300	
V_B	High side floating supply absolute voltage	-214	- 0.3	275	
		-224	- 0.3	275	
		-310	- 0.3	425	
		-320	- 0.3	425	
		-420	- 0.3	525	
		-737	- 0.3	325	
V_O	Half-bridge output		-0.3	V_{IN} + 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		—	3.5	V/ns
P_D	Package power dissipation @ $T_A \leq +25°C$		—	2.00	W
Rth_{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	

NOTE 1:

Because of the IR51H(D)XXX's application specificity toward off-line supply systems, this IC contains a zener clamp between 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 Vcc lead (typically by means of a high value resistor connected between the chip Vcc and the rectified line voltage and a local decoupling capacitor from Vcc 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 source of greater than $V_{CLAMP.}$

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	Definition			Minimum	Maximum	Units
V_B	High side floating supply absolute voltage			$V_O + 10$	$V_O + V_{clamp}$	V
V_{IN}	High voltage supply		-214	—	250	
			-224	—	250	
			-310	—	400	
			-320	—	400	
			-420	—	500	
			-737	—	300	
V_O	Half-bridge output voltage		-214	-5	275	
			-224	-5	275	
			-310	-5	425	
			-320	-5	425	
			-420	-5	525	
			-737	-5	325	
I_D	Continuous drain current	($T_A = 25°C$)	-214	—	0.85	A
			-224	—	1.1	
			-310	—	0.7	
			-320	—	0.9	
			-420	—	0.7	
			-737	—	1.3	
		($T_A = 85°C$)	-214	—	0.55	
			-224	—	0.7	
			-310	—	0.45	
			-320	—	0.6	
			-420	—	0.5	
			-737	—	0.8	
I_{CC}	Supply current (note 1)			—	5	mA
T_A	Ambient temperature			-40	125	℃

Dynamic Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}) = 12V, T_A = 25°C unless otherwise specified.

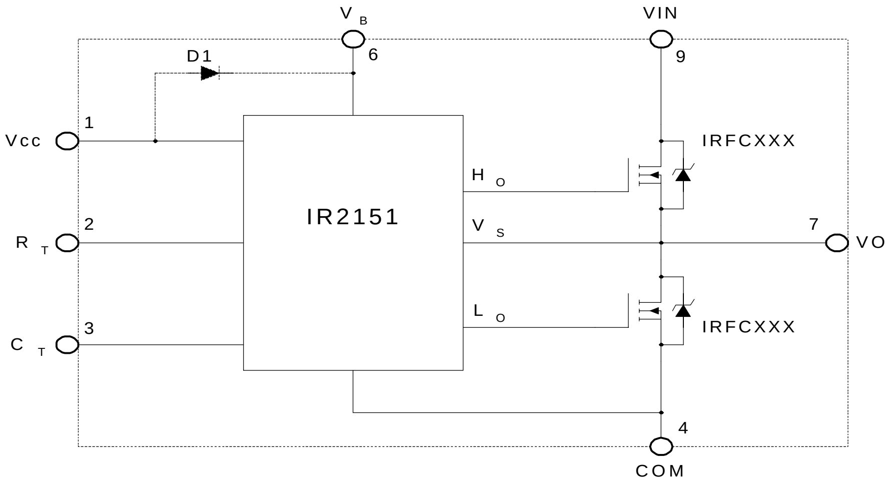
Symbol	Definition		Min.	Typ.	Max.	Units	Test Conditions	
t_{rr}	Reverse recovery time (MOSFET body diode)	-214	—	190	—	ns	I_F=850mA	di/dt =100 A/µs
		-224	—	200	—		I_F=1.1A	
		-310	—	240	—		I_F=700mA	
		-320	—	270	—		I_F=900mA	
		-420	—	240	—		I_F=700mA	
		-737	—	320	—		I_F=1.3A	
Q_{rr}	Reverse recovery charge (MOSFET body diode)	-214	—	0.55	—	µC	I_F=850mA	di/dt =100 A/µs
		-224	—	0.7	—		I_F=1.1A	
		-310	—	0.45	—		I_F=700mA	
		-320	—	0.6	—		I_F=900mA	
		-420	—	0.5	—		I_F=700mA	
		-737	—	0.8	—		I_F=1.3A	
D_T	Deadtime, LS turn-off to HS turn-on & HS turn-off to LS turn-on		—	1.2	—	µs		
D	R_T duty cycle		—	50	—	%	fosc = 20 kHz	

Static Electrical Characteristics

V_{BIAS} (V_{CC}, V_B) = 12V, T_A = 25ºC unless otherwise specified.

Symbol	Definition	Min.	Typ.	Max.	Units	Test Conditions
V_{CCUV+}	V_{CC} supply undervoltage positive going threshold	—	8.4	—	V	
V_{CCUV-}	V_{CC} supply undervoltage negative going threshold	—	8.0	—	V	
I_{QCC}	Quiescent V_{CC} supply current	—	300	—	µA	V_{CC} > V_{CCUV}
V_{CLAMP}	V_{CC} zener shunt clamp voltage	—	15.6	—	V	I_{CC} = 5mA
I_{QBS}	Quiescent V_{BS} supply current	—	30	—	µA	
I_{OS}	Offset supply leakage current	—	—	50		V_B = V_{IN} = 500V
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	—	mV	Note 2
V_{RT+}	R_T high level output voltage, V_{CC} - R_T	—	20	—		I_{RT} = 100µA
		—	200	—		I_{RT} = -1mA
V_{RT-}	R_T low level output voltage	—	20	—		I_{RT} = 100µA
		—	200	—		I_{RT} = -1mA
V_{RTUV}	R_T undervoltage lockout, V_{CC} - R_T	—	100	—		I_{RT} = 100µA
V_{CT+}	2/3 V_{CC} threshold	—	8.0	—	kHz	
V_{CT-}	1/3 V_{CC} threshold	—	4.0	—		
Rds(on)	Static-drain-to-source on-resistance -214	—	2.0	—	Ω	I_F=850mA di/dt =100 A/µs
	-224	—	1.1	—		I_F=1.1A
	-310	—	3.6	—		I_F=700mA
	-320	—	1.8	—		I_F=900mA
	-420	—	3.0	—		I_F=700mA
	-737	—	0.75	—		I_F=1.3A
V_{SD}	Diode forward voltage -214	—	0.8	—		I_F=850mA
	-224	—	0.85	—	V	I_F=1.1A
	-310	—	0.8	—		I_F=700mA
	-320	—	0.7	—		I_F=900mA
	-420	—	0.8	—		I_F=700mA
	-737	—	0.8	—		I_F=1.3A

Functional Block Diagram

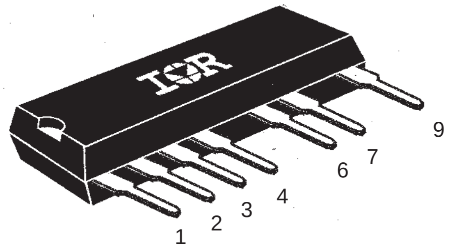


Fast recovery diode D1 is incorporated in IR51HDXXX only

Lead Definitions

Symbol	Lead Description
V_{CC}	Logic and internal gate drive supply voltage. An internal zener clamp diode at 15.6 V norminal is included to allow the V_{CC} to be current fed directly from VIN typically by means of a high value resistor.
R_T	Oscillator timing resistor output; a resistor is connected from R_T to C_T. RT is out of phase with the half-bridge output (VO).
C_T	Oscillator timing capacitor input; a capacitor is connected from C_T to COM in order to program the oscillator frequency according to the following equation: $$f = \frac{1}{1.4 \times (R_T + 75\Omega) \times C_T}$$ C_T PIN also invokes shutdown function (see note 2) where 75Ω is the effective impedence 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. (HD type circuits incorporate this diode).
V_{IN}	High voltage supply
VO	Half Bridge output
COM	Logic and low side of half bridge return

Lead Assignments



1	V_{CC}	6	V_B
2	R_T	7	VO
3	C_T	9	V_{IN}
4	COM		

9 Lead SIP without Leads 5 and 8

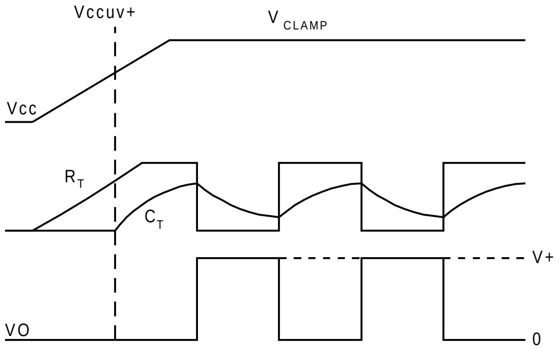


Figure 1. Input/Output Timing Diagram

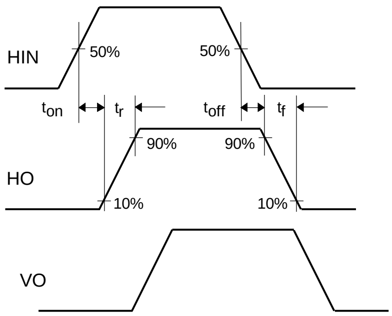
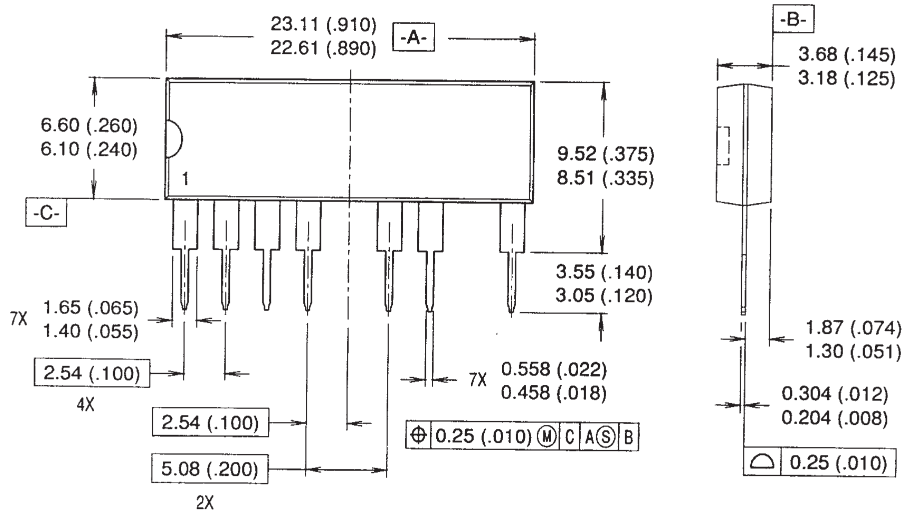


Figure 2. Switching Time Waveform Definitions



NOTES:
1. Dimensioning and tolerancing per ANSI Y14.5M-1982
2. Controlling Dimension: INCH
3. Dimensions are shown in millimeters (inches)

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