# IR21531(D) (S)

## **SELF-OSCILLATING HALF-BRIDGE DRIVER**

#### **Features**

- Integrated 600V half-bridge gate driver
- 15.6V zener clamp on Vcc
- True micropower start up
- Tighter initial deadtime control
- Low temperature coefficient deadtime
- Shutdown feature (1/6th Vcc) on C<sub>T</sub> pin
- Increased undervoltage lockout Hysteresis (1V)
- Lower power level-shifting circuit
- Constant LO, HO pulse widths at startup
- Lower di/dt gate driver for better noise immunity
- Low side output in phase with RT
- Internal 50nsec (typ.) bootstrap diode (IR21531D)
- Excellent latch immunity on all inputs and outputs
- ESD protection on all leads

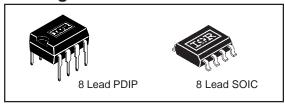
#### **Description**

The IR21531(D)(S) are an improved version of the popular IR2155 and IR2151 gate driver ICs, and incorporates a high voltage half-bridge gate driver with a front end oscillator similar to the industry standard CMOS 555 timer. The IR21531 provides more functionality and

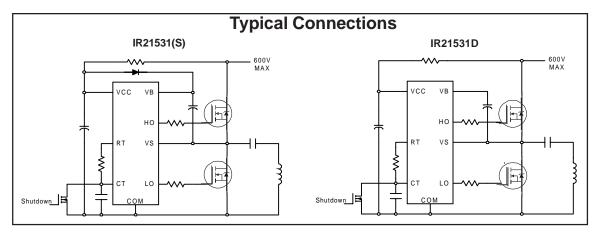
#### **Product Summary**

600V max.
50%
80/40ns
15.6V
0.6 µs

#### **Packages**



is easier to use than previous ICs. A shutdown feature has been designed into the C<sub>T</sub> pin, so that both gate driver outputs can be disabled using a low voltage control signal. In addition, the gate driver output pulse widths are the same once the rising undervoltage lockout threshold on V<sub>CC</sub> has been reached, resulting in a more stable profile of frequency vs time at startup. Noise immunity has been improved significantly, both by lowering the peak di/dt of the gate drivers, and by increasing the undervoltage lockout hysteresis to 1V. Finally, special attention has been payed to maximizing the latch immunity of the device, and providing comprehensive ESD protection on all pins.



# IR21531(D) (S)

#### **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	Min.	Max.	Units	
V <sub>B</sub>	High side floating supply voltage	-0.3	625		
Vs	High side floating supply offset voltage		V <sub>B</sub> - 25	V <sub>B</sub> + 0.3	
V <sub>HO</sub>	High side floating output voltage		V <sub>S</sub> - 0.3	V <sub>B</sub> + 0.3	.,
V <sub>LO</sub>	Low side output voltage		-0.3	V <sub>CC</sub> + 0.3	V
V <sub>RT</sub>	R <sub>T</sub> pin voltage		-0.3	V <sub>CC</sub> + 0.3	
Vct	C <sub>T</sub> pin voltage		-0.3	V <sub>CC</sub> +0.3	
lcc	Supply current (note 1)		_	25	mA
I <sub>RT</sub>	R <sub>T</sub> pin current	-5	5	111/4	
dV <sub>S</sub> /dt	Allowable offset voltage slew rate		-50	50	V/ns
PD	Maximum power dissipation @ T <sub>A</sub> ≤ +25°C (8 Lead DIP)		_	1.0	W
	(8 Lead SOIC)		_	0.625	- VV
Rth <sub>JA</sub>	Thermal resistance, junction to ambient (8 Lead DIP)		_	125	°C/W
	(8 Lead SOIC)		_	200	· C/vv
TJ	Junction temperature		-55	150	
T <sub>S</sub>	Storage temperature	-55	150	°C	
TL	Lead temperature (soldering, 10 seconds)		_	300	

#### **Recommended Operating Conditions**

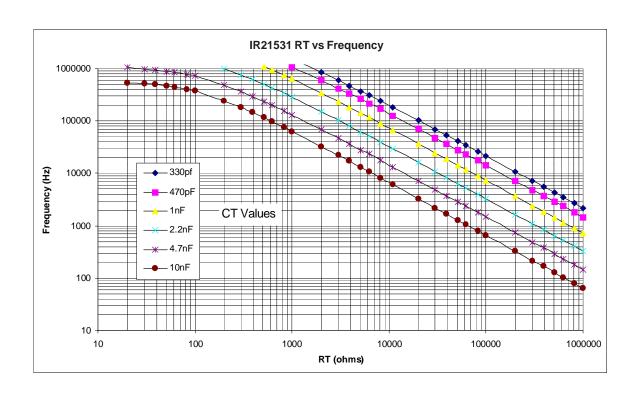
For proper operation the device should be used within the recommended conditions.

Symbol	Definition	Min.	Max.	Units	
V <sub>BS</sub>	High side floating supply voltage	V <sub>CC</sub> - 0.7	VCLAMP		
Vs	Steady state high side floating supply offset voltage	-3.0 (note 2)	600	600 V	
Vcc	Supply voltage	10	VCLAMP		
Icc	Supply current	(note 3)	5	mA	
TJ	Junction temperature	-40	125	°C	

- Note 1: This IC contains a zener clamp structure between the chip V<sub>CC</sub> and COM which has a nominal breakdown voltage of 15.6V. Please note that this supply pin should not be driven by a DC, low impedance power source greater than the V<sub>CLAMP</sub> specified in the Electrical Characteristics section.
- Note 2: Care should be taken to avoid output switching conditions where the V<sub>S</sub> node flies inductively below ground by more than 5V.
- Note 3: Enough current should be supplied to the V<sub>CC</sub> pin of the IC to keep the internal 15.6V zener diode clamping the voltage at this pin.

### **Recommended Component Values**

Symbol	Component	Min.	Max.	Units
R <sub>T</sub>	Timing resistor value	10	_	kΩ
C <sub>T</sub>	C <sub>T</sub> pin capacitor value	330	_	pF



# IR21531(D) (S)

#### **Electrical Characteristics**

 $V_{BIAS}$  (V<sub>CC</sub>, V<sub>BS</sub>) = 12V, C<sub>L</sub> = 1000 pF, C<sub>T</sub> = 1 nF and T<sub>A</sub> = 25°C unless otherwise specified. The V<sub>IN</sub>, V<sub>TH</sub> and I<sub>IN</sub> parameters are referenced to COM. The V<sub>O</sub> and I<sub>O</sub> parameters are referenced to COM and are applicable to the respective output leads: HO or LO.

Low Voltage Supply Characteristics							
Symbol	Definition	Min.	Тур.	Max.	Units	Test Conditions	
V <sub>CCUV+</sub>	Rising V <sub>CC</sub> undervoltage lockout threshold	8.1	9.0	9.9			
V <sub>CCUV</sub> -	Falling V <sub>CC</sub> undervoltage lockout threshold	7.2	8.0	8.8	V		
Vccuvh	V <sub>CC</sub> undervoltage lockout Hysteresis	0.5	1.0	1.5	1		
IQCCUV	Micropower startup V <sub>CC</sub> supply current	_	75	150	μА	V <sub>C</sub> C ≤ V <sub>C</sub> CUV-	
IQCC	Quiescent V <sub>CC</sub> supply current		500	950	μΑ		
V <sub>CLAMP</sub>	V <sub>CC</sub> zener clamp voltage	14.4	15.6	16.8	V	I <sub>CC</sub> = 5mA	
Floatin	g Supply Characteristics						
Symbol	Definition	Min.	Тур.	Max.	Units	Test Conditions	
I <sub>QBSUV</sub>	Micropower startup V <sub>BS</sub> supply current	_	0	10		V <sub>CC</sub> ≤ V <sub>CCUV</sub> -	
I <sub>QBS</sub>	Quiescent VBS supply current	_	30	50	μΑ		
V <sub>BSMIN</sub>	Minimum required V <sub>BS</sub> voltage for proper functionality from R <sub>T</sub> to HO	_	4.0	5.0	V	V <sub>CC</sub> =V <sub>CCUV+</sub> + 0.1V	
I <sub>LK</sub>	Offset supply leakage current	_	<u> </u>	50	μΑ	V <sub>B</sub> = V <sub>S</sub> = 600V	
VF	Bootstrap diode forward voltage (IR21531D)	0.5	_	1.0	V	IF = 250mA	
Oscilla	tor I/O Characteristics						
Symbol	Definition	Min.	Тур.	Max.	Units	Test Conditions	
fosc	Oscillator frequency	19.4	20	20.6	kHz	$R_T = 36.9k\Omega$	
		94	100	106	NI IZ	$RT = 7.43k\Omega$	
d	RT pin duty cycle	48	50	52	%	fo < 100kHz	
ICT	C <sub>T</sub> pin current		0.001	1.0	uA		
I <sub>CTUV</sub>	UV-mode C <sub>T</sub> pin pulldown current	0.30	0.70	1.2	mA	V <sub>CC</sub> = 7V	
V <sub>CT+</sub>	Upper C <sub>T</sub> ramp voltage threshold		8.0	_			
VCT-	Lower C⊤ ramp voltage threshold	_	4.0	_	V		
VCTSD	CT voltage shutdown threshold	1.8	2.1	2.4			
$V_{RT+}$	High-level RT output voltage, VCC - VRT	_	10	50		I <sub>RT</sub> = 100μA	
			100	300	1	I <sub>RT</sub> = 1mA	
VRT-	Low-level R <sub>T</sub> output voltage	_	10	50		I <sub>RT</sub> = 100μA	
			100	300	mV	I <sub>RT</sub> = 1mA	
VRTUV	UV-mode R⊤ output voltage		0	100	1	V <sub>CC</sub> ≤ V <sub>CCUV</sub> -	
VRTSD	SD-Mode RT output voltage, VCC - VRT	_	10	50		I <sub>RT</sub> = 100μA, V <sub>CT</sub> = 0V	
		_	10	300	1	I <sub>RT</sub> = 1mA, V <sub>CT</sub> = 0V	

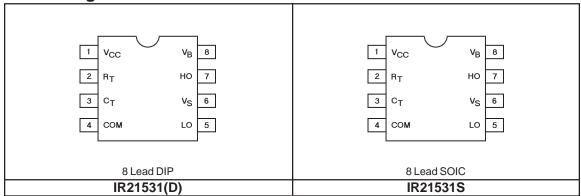
### **Electrical Characteristics (cont.)**

Gate D	Gate Driver Output Characteristics						
Symbol	Definition	Min.	Тур.	Max.	Units	Test Conditions	
VoH	High level output voltage, VBIAS -VO	_	0	100		Io = OA	
VOL	Low-level output voltage, VO	_	0	100	mV	I <sub>O</sub> = OA	
VOL_UV	UV-mode output voltage, VO	_	0	100	1111	I <sub>O</sub> = OA	
						$I_O = OA$ $V_{CC} \le V_{CCUV}$	
tr	Output rise time	_	80	150			
tf	Output fall time	_	45	100	nsec		
t <sub>sd</sub>	Shutdown propogation delay	_	660	_			
td	Output deadtime (HO or LO)	0.35	0.60	0.85	μsec		

#### **Lead Definitions**

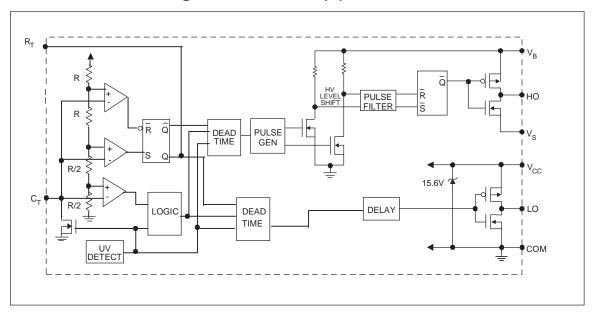
Symbol	Description
Vcc	Logic and internal gate drive supply voltage
R <sub>T</sub>	Oscillator timing resistor input
C <sub>T</sub>	Oscillator timing capacitor input
COM	IC power and signal ground
LO	Low side gate driver output
Vs	High voltage floating supply return
НО	High side gate driver output
V <sub>B</sub>	High side gate driver floating supply

# **Lead Assignments**

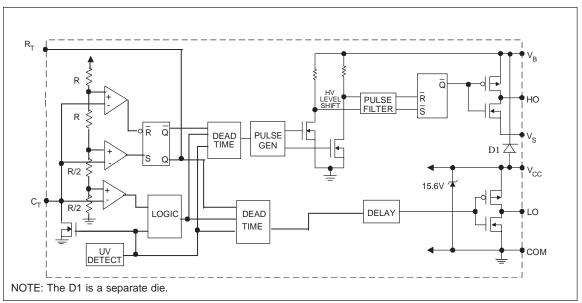


NOTE: The IR21531D is offered in 8 lead DIP only.

### **Functional Block Diagram for IR21531(S)**

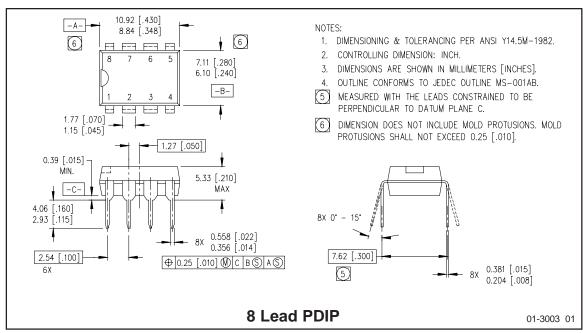


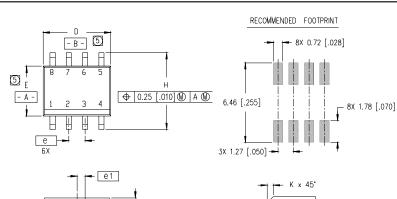
### Functional Block Diagram for IR21531D



# International TOR Rectifier

# IR21531(D) (S)





0.10 [.004]

Dild	INCH	ES	MILLIME	TERS
DIM	MIN	MAX	MIN	MAX
Α	.0532	.0688	1.35	1,75
A1	.0040	.0098	0.10	0.25
В	.014	.018	0.36	0.46
С	.0075	.0098	0.19	0.25
D	.189	.196	4.80	4.98
Ε	.150	.157	3.81	3.99
е	.050 BASIC		1.27 BASIC	
e 1	.025 B	ASIC	0.635 BASIC	
Н	.2284	.2440	5.80	6.20
K	.011	.019	0.28	0.48
L	.016	.050	0,41	1,27
у	0.	8'	0.	8*

#### NOTES:

- 1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982.
- 2. CONTROLLING DIMENSION: MILLIMETER.

8X B

- 3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
- 4. OUTLINE CONFORMS TO JEDEC OUTLINE MS-012AA.
- DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS.
  MOLD PROTRUSIONS NOT TO EXCEED 0.25 [.006],
- 6 DIMENSION IS THE LENGTH OF LEAD FOR SOLDERING TO A SUBSTRATE.

#### 8 Lead SOIC

6

01-0021 08

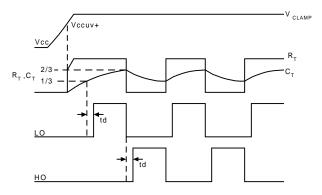


Figure 1. Input/Output Timing Diagram

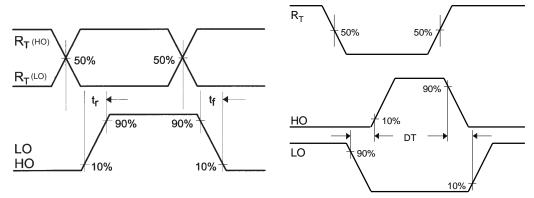


Figure 2. Switching Time Waveform Definitions

Figure 3. Deadtime Waveform Definitions



WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245 Tel: (310) 252-7105 http://www.irf.com/ Data and specifications subject to change without notice. 4/6/2001