International IΩR Rectifier

IR3312(S)

PROGRAMMABLE CURRENT SENSING HIGH SIDE SWITCH

Features

- Load current feedback
- Programmable over current shutdown
- Active clamp
- E.S.D protection
- Input referenced to Vcc
- Over temperatue shutdown
- Reverse battery protection

Description

The IR 3312(S) is a Fully Protected 4 terminal high side switch. The input signal is referenced to Vcc. When the input voltage Vcc - Vin is higher than the specified Vih threshold, the output power MOSFET is turned-on. When Vcc - Vin is lower than the specified Vil threshold, the output MOSFET is turned-off. A sense current proportional to the current in the power Mosfet is sourced to the Ifb pin. Over-current shutdown occurs when Vifb - Vin > 4.5 V. The current shutdown threshold is adjusted by selecting the proper RIfb. Either over-current and over-temperature latches off the switch. The device is reset by pulling the input pin high. Other integrated protections (ESD, reverse battery, active clamp) make the IR3312(S) very rugged and suitable for the automotive environment.

Product Summary

$R_{ds(on)}$	20mΩ
$V_{cc.op.}$	6 to 28V
Current ratio	2800
$I_{shutdown}$	3 to 30A
Active clamp	35V
Load Dump	40V

Package

5 Lead TO220
IR3312

5 Lead
D²Pak (SMD220)
IR3312S

Typical Connection

IR3312(S)

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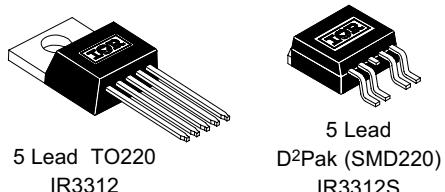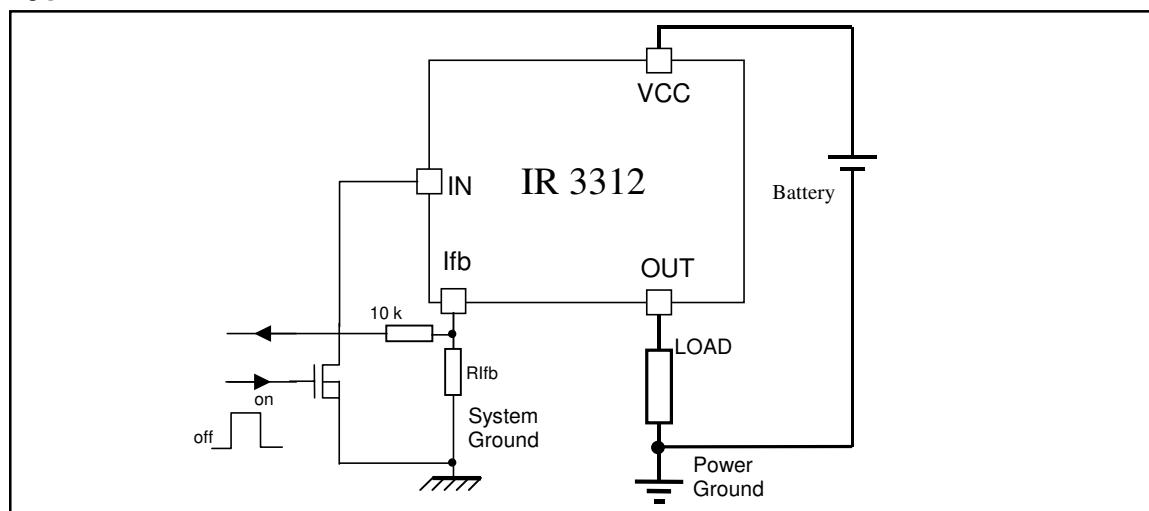
Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are referenced to Vcc lead. ($T_{Ambient}$ = 25°C unless otherwise specified).

Symbol	Parameter	Min.	Max.	Units
Vcc - Vin max	Maximum input voltage	-16	50	V
Vcc-VIfb max	Maximum Ifb voltage	-0.3	50	
Vcc - Vout max.	Maximum output voltage	-0.3	33	
Ids cont.	Diode max. permanent current (Rth = 60 °C/W) (1)	—	2.8	A
Ids1 cont	Diode max. permanent current (Rth = 5 °C/W) (1)	—	25	
Ids pulsed	Diode max. pulsed current (1)	—	100	
ESD 1	Electrostatic discharge (human body model)C=100pF, R=1500Ω,	—	4	kV
ESD 2	Electrostatic discharge (machine model)C=200pF,R=0Ω, L=10∞H	—	0.5	
Pd	Power dissipation (Rth = 60 °C/W)	—	2	W
TJ max.	Max. storage and junction temperature	-40	150	°C
Min RIfb	Minimum resistor on the Ifb pin	0.3	—	kΩ
Ifb max	Max. Ifb current	-20	+20	mA

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
R_{th} 1	Thermal resistance junction to Ambient - TO220	60	—	
R_{th} 2	Thermal resistance junction to case - TO220	0.7	—	
R_{th} 1	Thermal resistance with standard footprint - SMD220	60	—	
R_{th} 2	Thermal resistance with 1" square footprint - SMD220	35	—	
R_{th} 3	Thermal resistance junction to case - SMD220	0.7	—	

Recommended Operating Conditions

These values are given for a quick design. For operation outside these conditions, please consult the application notes.

Symbol	Parameter	Min.	Max.	Units
Vcc -Vin	Continuous input voltage	6	28	
Vcc -VIfb	Continuous Ifb pin voltage	0.3	28	
Vcc	Supply to power ground voltage	6	28	
Iout	Continuous output current (Rth/amb < 5 °C/W, Tj = 125°C)	—	14	A
Iout 85°C amb.	Continuous output current (Rth/amb < 60 °C/W, Tj = 125°C)	—	3.9	
RIfb	Ifb resistor to program Isd and scale (2 & 3)	0.5	3.5	kΩ
Pulse min.	Minimum turn-on pulse width	1	—	ms
Fmax	Maximum operating frequency	—	500	Hz
Fmax Prot.	Maximum frequency with protections activated	—	200	

1) Limited by junction temperature. Pulsed current is also limited by wiring
2) <500 Ohm or shorting Ifb to gnd may damage the part with Isd around 37A
3) >5000 Ohm or leaving Ifb open will shutdown the part. No current will flow in the load.

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Protection Characteristics

$T_j = 25^oC$ (unless otherwise specified), RIfb = 500 to 5kOhm.

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
VIfb -Vin @ Isd	Over-current shutdown threshold	4	4.5	5.4	V	
Tsd	Over-temp. shutdown threshold	—	165	—	°C	see Fig. 7
Treset	Protection reset time	—	50	300	∝S	see Fig. 7
OV	Over voltage shutdown (not latched)	33	36	41	V	
Isdf	Fixed over current shutdown	30	37	45	A	VIfb<Vin
Isd_1k	Adjustable over current shutdown 1K	9	12	16	A	RIfb=1k
Min.Pulse	Minimum pulse width (no WAIT state)	200	500	1200	∝s	see Fig. 6
WAIT	WAIT function timer	0.5	1.2	3.5	ms	see Figs. 6 and 7
Rev.Rds$_{on}$	Rds(on) reverse battery protection	10	16	28	mΩ	Vcc-Vin=-12V, Iload=5A

Static Electrical Characteristics

$(T_j = 25^oC$, $V_{CC} = 14V$ unless otherwise specified.)

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Iq	Total quiescent current (Iout +Ifb)	—	22	50	∝A	Vcc-Vin=0, Vcc-Vout=12V Vcc-VIfb=12V
Iin	Input current	1.5	4	6	mA	Vcc-Vin=14V
Vih	High level input threshold voltage (4)	—	5	5.5		
Vil	Low level input threshold voltage (4)	3.5	4	—		
Vhys	Input hysterisis = Vih-Vil	0.4	1	1.5		
Iout qs	Output quiescent current	—	9	15	∝A	Vcc-Vin=0; Vcc-VIfb=0; Vcc-Vout=12V
Rds1 on	ON state resistance (5)	10	15	20		Iout=15A, Vcc-Vin=14V
Rds2 on	ON state resistance (5)	10	16	28		Iout=10A, Vcc -Vin=6V
Rds3 on	ON state resistance (5)	20	28.5	38		Iout=15A, Tj = 150ºC
Vclamp1	Vcc to Vout active clamp voltage	33	35	—		Iout = 10mA
Vclamp2	Vcc to Vout active clamp voltage	—	36	40		Iout=30A,Vcc-VIfb<20V
Vsd	Body diode forward voltage	—	0.85	1		Iout=5A
Vaval.	Vcc to Vout avalanche voltage	40	43	50		Iout=100mA,Vcc-Vfb> 35V

Switching Electrical Characteristics

$V_{CC} = 14V$, Resistive Load = 0.4Ω, $T_j = 25^oC$, (unless otherwise specified).

| Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Td$_{on}$	Turn-on delay time to Vcc-Vout= 0.9 Vcc	2	9	20		
T$_{r1}$	Rise time to Vcc-Vout=5V	0.2	1	5	∝s	
T$_{r2}$	Rise time to Vcc -V$_{out}$ = 0.1V$_{CC}$	5	15	60		
E$_{on}$	Turn ON energy	—	0.75	1.5	mJ	
Td$_{off}$	Turn-off delay to Vcc -V$_{out}$ = 0.1V$_{CC}$	5	14	60		
T$_f$	Fall time to Vcc-Vout = 0.9 V$_{CC}$	2	7	25		
E$_{off}$	Turn OFF energy	—	0.5	1	mJ	

4) Input thresholds are measured directly between the input pin and the tab. Any parasitic resistance in common between the load current path and the input signal path can significantly affect the thresholds.
5) Rds(on) is measured between the Tab and the Out pin, 5mm away from the package.

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Current Sense Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Ratio	I load / Ifb current ratio	2,400	2,800	3,300	—	T_j = 25ºC ,Rfb = 500Ω, I = 30A
Ratio_TC	Iload/Ifb variation over temperature	-5	0	+5	%	T_j = -40 To +150ºC
offset	Load current diagnostic offset	-0.45	0	0.45	A	I = 2A
Trst	Ifb response time (low signal)	—	5	15	∝s	90% of the I load step

Functional Block Diagram

Lead Assignments

3 (Vcc)

1 - In
2 - Ifb
3 - Vcc (tab)
4 - NC
5 - Out

3 (Vcc)

1 2 3 4 5

1 2 3 4 5
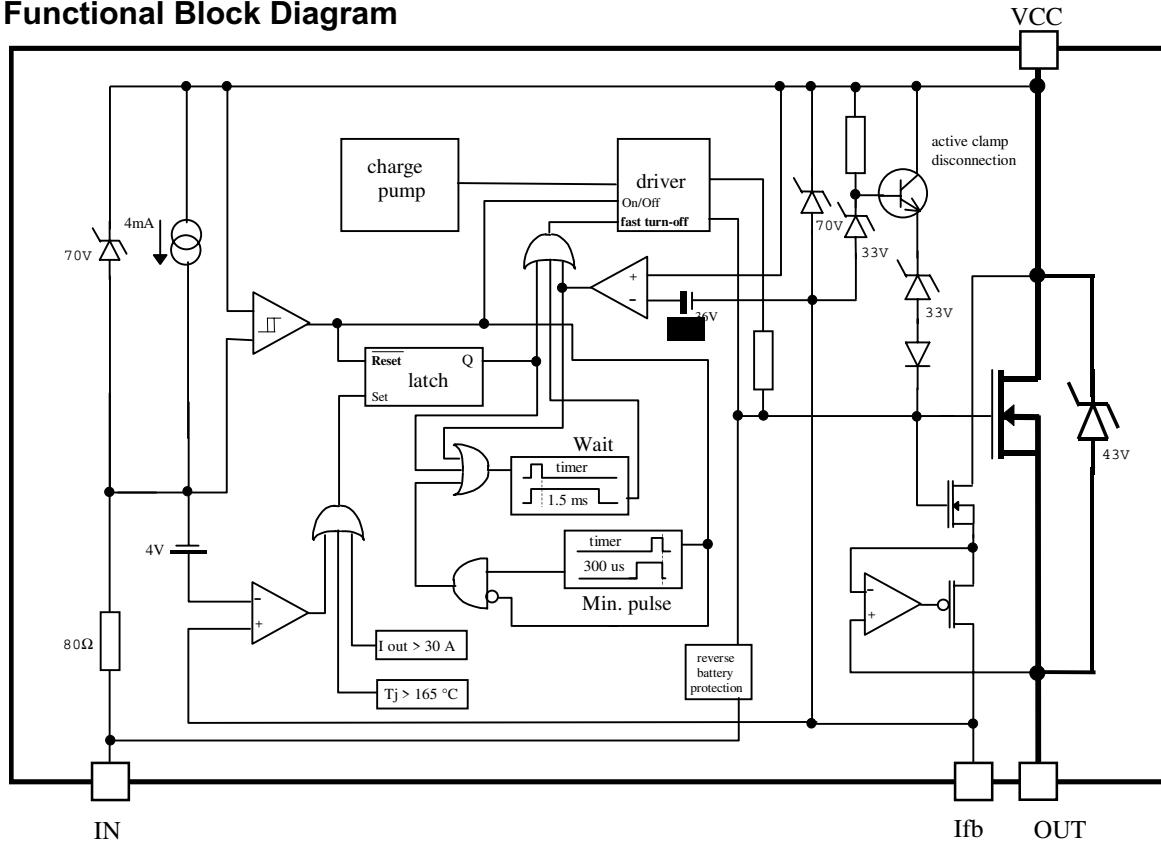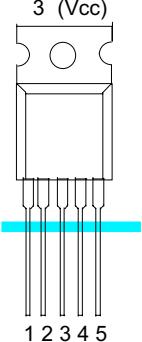
5 Lead - TO220
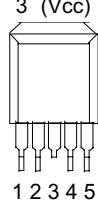
5 Lead - D^{2}PAK (SMD220)

IR3312	IR3312S
Part Number	

Vcc-Vin
Vcc-Vin max
Vcc-Vin1 max
Vcc-Vin (op)
Vih
Vil
Vhys

Vcc

$\overline{\text{In}}$ IR3312

Iin
Iin max
Iin1,2
Iin(on)

VIfb   Ifb   Out

Ifb

Vcc-Vout
Vcc-Vout max
Vclamp1
Vclamp2

Iout
Iout max
-Ids cont.
-Ids pulsed
Iout 85°C
Isd
Iq

Vcc-Vin

Vcc
90%

Vcc-Vout

5V
10 %

DV/dt(on)

Td on

Tr1

Tr2
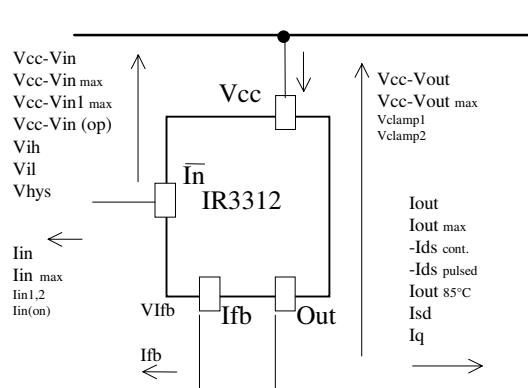
Figure 1 - Voltages and currents definitions
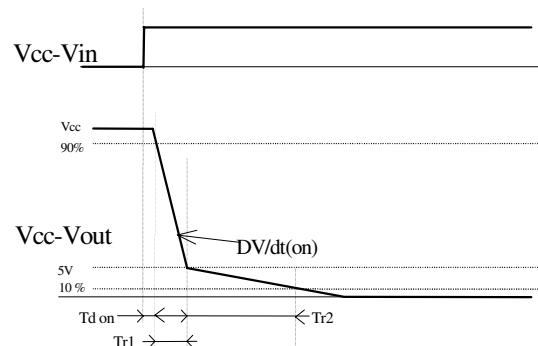
Figure 2 - Switching time definitions (turn-on)
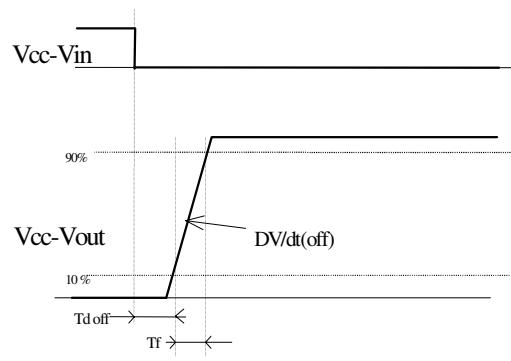
Figure 3 - Switching time definitions (turn-off)

Vcc-Vin

90%

Vcc-Vout

DV/dt(off)

10 %

Td off

Tf
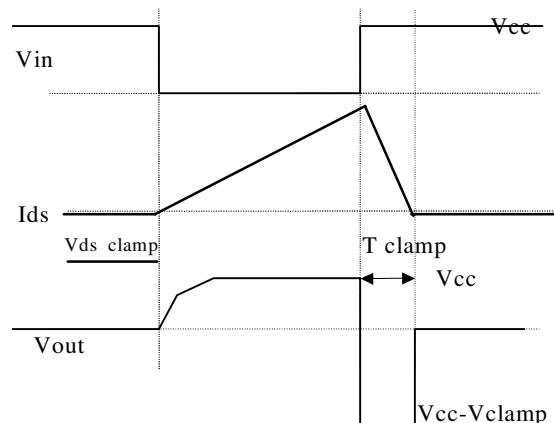
Figure 4 - Active clamp waveforms

Vcc

Vin

Ids

Vds clamp

T clamp

Vcc

Vout

Vcc-Vclamp

(see Design tip to evaluate power dissipation)
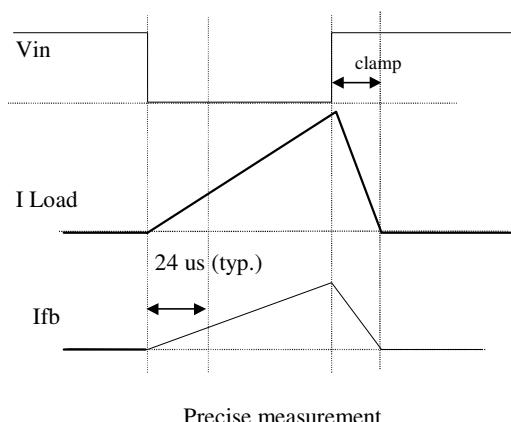
Figure 5 - Current sense precision:
Accurate measurement only when the power Mosfet is fully ON

Vin

clamp

I Load

24 us (typ.)

Ifb

Precise measurement
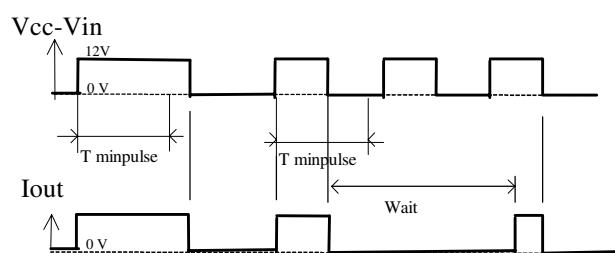
Figure 6 - Minimum pulse & WAIT function

Vcc-Vin

12V

0 V

T minpulse

T minpulse

Iout

0 V

Wait
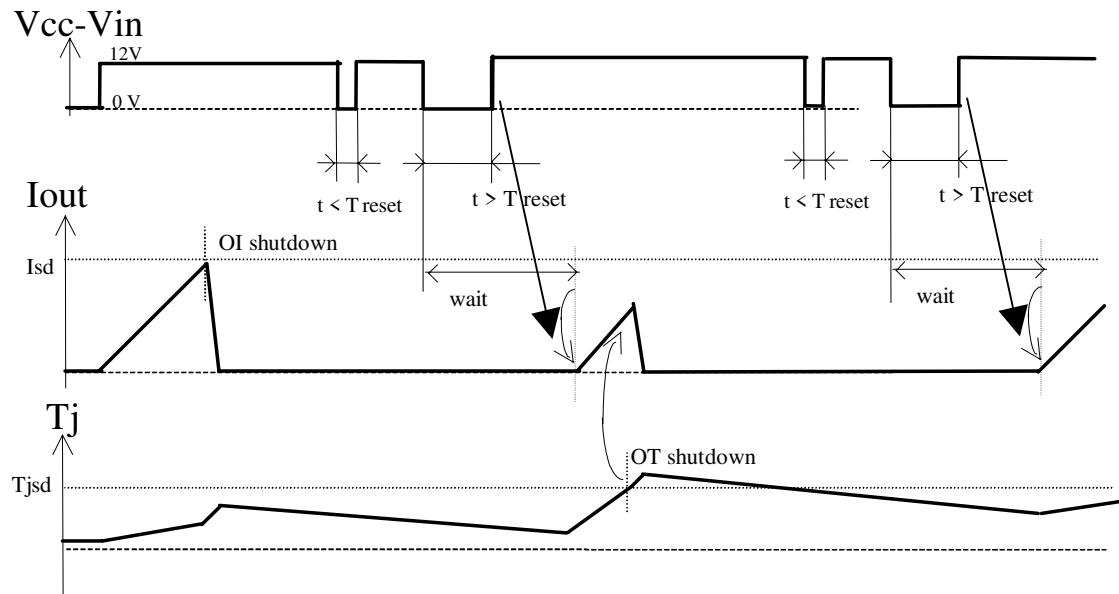
Figure 7 - Protection Timing Diagrams

All curves are typical characteristics. Operation in hatched areas is not recommended. Tj=25^0C, RIfb=500 Ohm, Vcc=14V (unless otherwise specified).
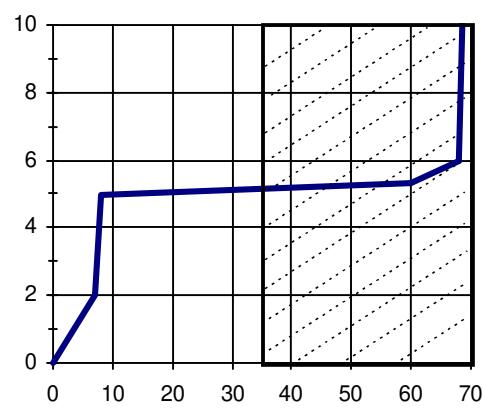
Figure 8 - Icc (mA) vs Vcc-Vin (V)
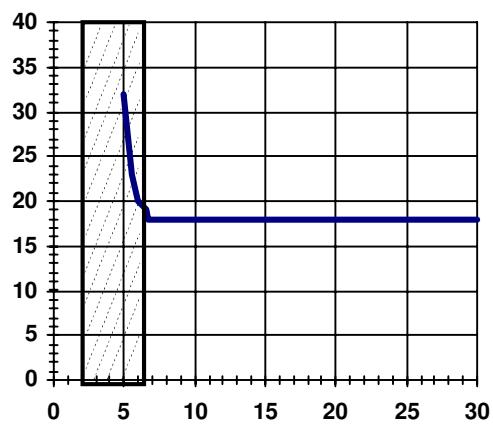
Figure 9- Rds$_{on}$ (mΩ) vs Vcc-Vin (V)

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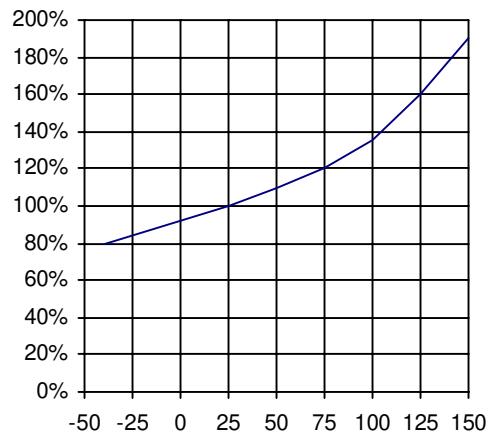
Figure 10 -Normalized Rdson (%) vs Tj   (^{o}C)
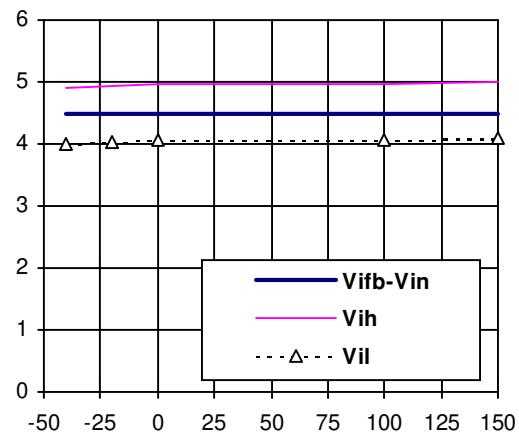

Figure 11 - Vih, Vil & Vifb -Vin (V) vs Tj (^{o}C)
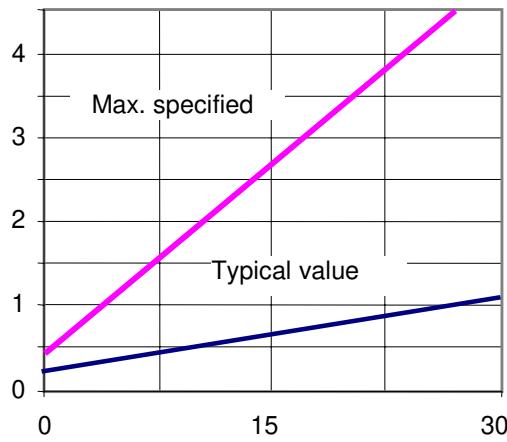

Figure 12 - Error (+/-A) vs Iload (A)
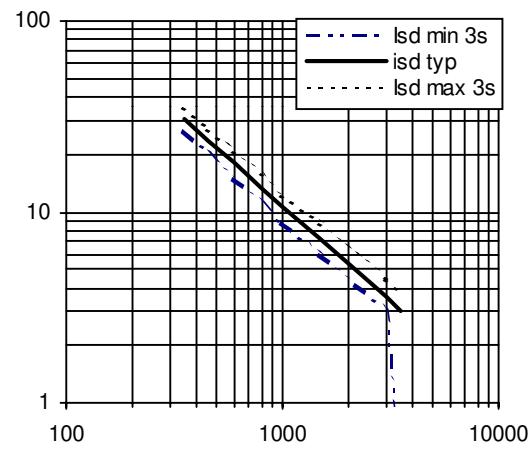
Figure 13 - Isd (A) vs RIfb (Ohm)

IR3312(S)
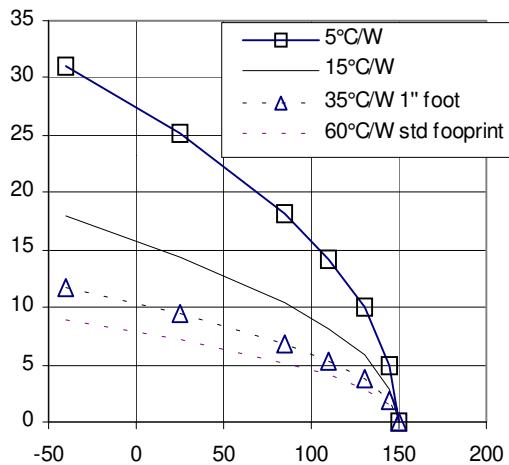
Figure 14 - Max. DC current (A) vs Temp. (°C)
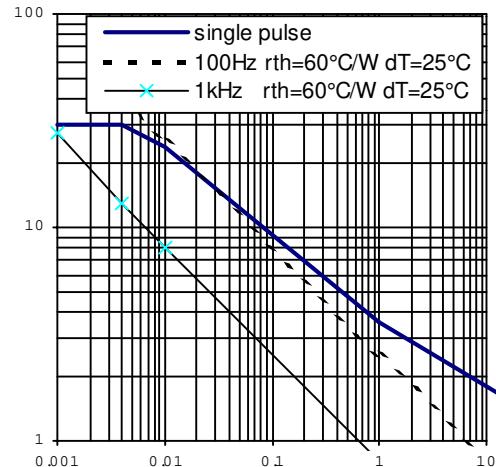
Figure 15 - Max. I (A) vs inductance (mH)
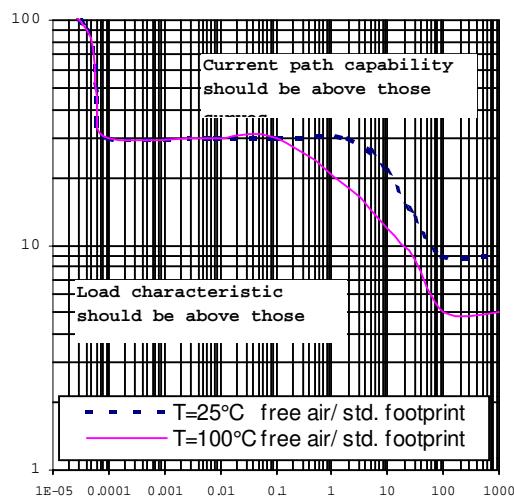
Figure 16 - I out (A) vs Protection resp. Time (s)

Figure 17 - Rth (°C/W) vs Time (s)

IR3312(S)

International **IQR** Rectifier
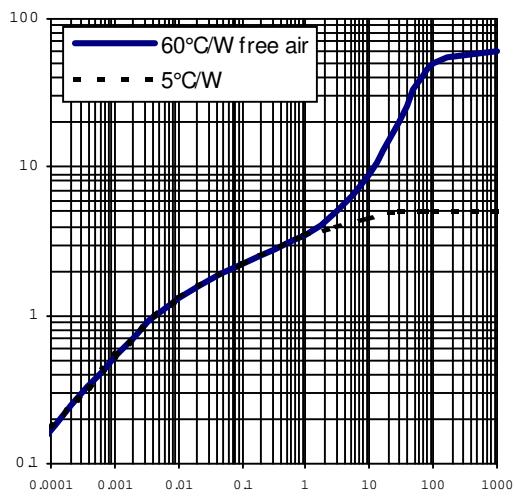
Case Outline - TO220 (5 lead)

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. OUTLINE SIMILAR TO JEDEC OUTLINE SERIES TS-001.

IRGB 01-3042 01
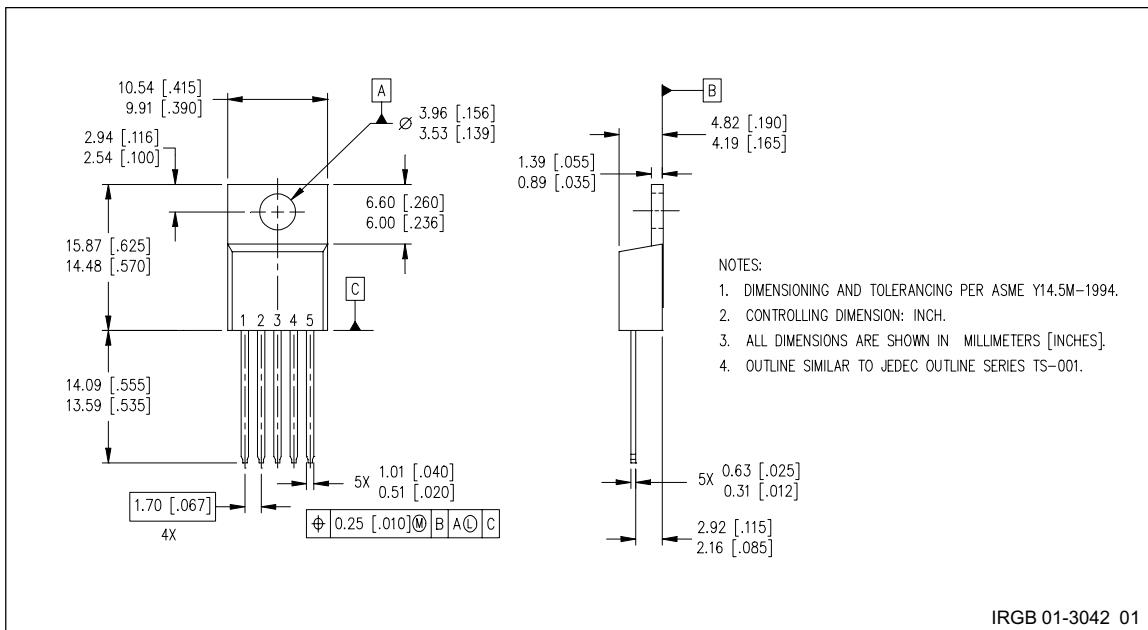
Case Outline   5 Lead - D^{2}PAK (SMD220)

NOTES:

1.0   DIMENSIONING AND TOLERANCE PER ANSI 14.5 M, 1982
(DIMENSIONES Y TOLERANCIAS BASADAS EN ANSI 14.5 M, 1982)

2.0   CONTROLLING DIMENSIONS IN INCHES.
(DIMENSIONES CONTROLADAS EN PULGADAS)

3.0   OUTLINE CONFORMS TO JEDEC OUTLINE 115-0178
(DIBUJO CONFORME A JEDEC ^

4.0   DIMENSIONS DO NOT INCLUDE PLATING THICKNESS MAX. 0.16(.006) OR BURRS
(LAS DIMENSIONES NO INCLUYEN ESPESOR DE PLATINADO
MAX. 0.16(.006) O REBABAS)

5.0   DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES)
(LAS DIMENSIONES SON MOSTRADAS EN MILIMETROS (PULGADAS))

6.0   PARALLELISM AND ANGULARITY MAX. 0.1(.004)
(PARALELISMO Y ANGULARIDAD MAX. 0.1(.004))

IR3312(S)

International
IQR Rectifier

Tape & Reel   5 Lead - D²PAK (SMD220)

TRR

FEED   DIRECTION

1.60 [.063]
1.50 [.059]

4.10 [.161]
3.90 [.153]

ø 1.60 [.063]
1.50 [.059]

1.85 [.073]
1.65 [.065]

11.60 [.457]
11.40 [.449]

0.368 [.0145]
0.342 [.0135]

15.42 [.609]
15.22 [.601]

24.30 [.957]
23.90 [.941]

10.90 [.429]
10.70 [.421]

16.10 [.634]

ø 1.75 [.069]
1.25 [.049]

4.72 [.186]
4.52 [.178]

ø 13.52 [.532]
12.80 [.504]

ø 360.00
[14.173]
MAX.

ø 60.00
[3.362]
MIN.

26.40 [1.039]
24.40 [.961]

NOTES:
1. OUTLINE CONFORMS TO EIA-481 & EIA-541.
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].

01-3071 00 / 01-3072 00

International
IQR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245 Tel: (310) 252-7105
Data and specifications subject to change without notice.
This product has been designed and qualified for the Automotive [Q100] market.   *7/26/2004*

Note: For the most current drawings please refer to the IR website at:
http://www.irf.com/package/