International
IOR Rectifier

IR3311(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

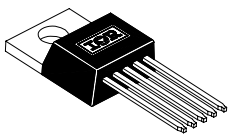
Description

The IR 3311(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 IR3311(S) very rugged and suitable for the automotive environment.

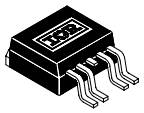
Product Summary

$R_{ds(on)}$	12mΩ
$V_{cc.op.}$	6 to 28V
Current ratio	5300
$I_{shutdown}$	6A to 58A
Active clamp	35V
Load Dump	40V

Package

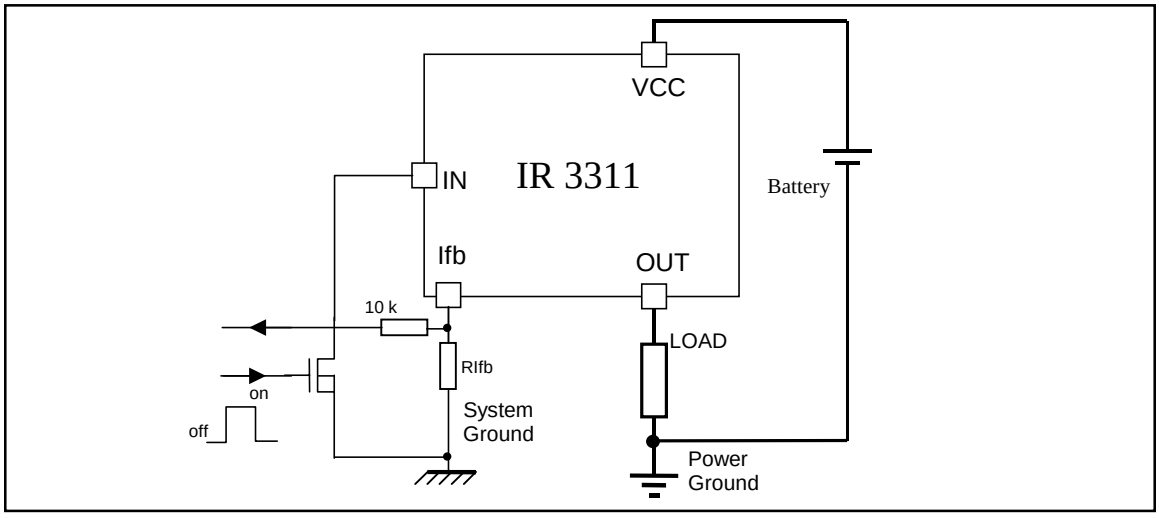


5 Lead TO220
IR3311



5 Lead
D²Pak (SMD220)
IR3311S

Typical Connection



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	30	
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)	—	30	
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=10µH	—	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	—	°C/W
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	V
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)	—	18	A
Iout 85°C amb.	Continuous output current (Rth/amb < 60 °C/W, Tj = 125°C)	—	5	
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 90A
3) >5000 Ohm or leaving Ifb open will shutdown the part. No current will flow in the load.

Protection Characteristics

Tj = 25°C (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	µS	see Fig. 7
OV	Over voltage shutdown (not latched)	—	36	—	V	
Isdf	Fixed over current shutdown	58	70	90	A	VIfb<Vin
Isd_1k	Adjustable over current shutdown 1K	18	24	31	A	RIfb=1k
Min.Pulse	Minimum pulse width (no WAIT state)	200	500	1200	µs	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	6	10	18	mΩ	Vcc-Vin=-12V, Iload=10A

Static Electrical Characteristics

(T_j = 25°C, V_{cc} = 14V unless otherwise specified.)

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Iq	Total quiescent current (Iout +Ifb)	—	22	50	µA	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	V	
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	µA	Vcc-Vin=0; Vcc-VIfb=0; Vcc-Vout=12V
Rds1 on	ON state resistance (5)	5	9	12	mΩ	Iout=30A, Vcc-Vin=14V
Rds2 on	ON state resistance (5)	5	9.5	17		Iout=17A, Vcc -Vin=6V
Rds3 on	ON state resistance (5)	10	17	23		Iout=30A, Tj = 150°C
Vclamp1	Vcc to Vout active clamp voltage	30	35	—	V	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°C, (unless otherwise specified).

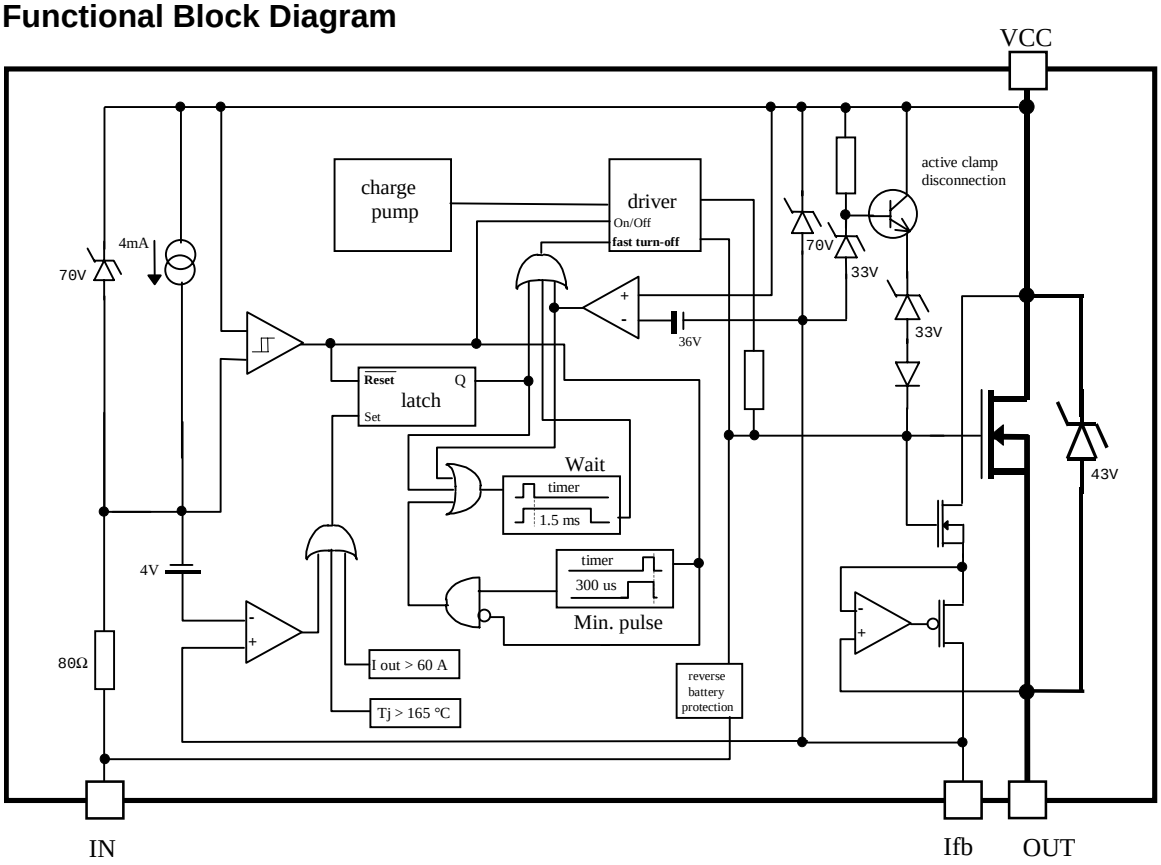
Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Td_{on}	Turn-on delay time to Vcc-Vout= 0.9 Vcc	2	9	20	µs	see figure 2
T_{r1}	Rise time to Vcc-Vout=5V	0.4	1.6	5		
T_{r2}	Rise time to V_{cc} -V_{out} = 0.1V_{cc}	10	30	100		
E_{on}	Turn ON energy	—	1.5	3	mJ	
Td_{off}	Turn-off delay to V_{cc} -V_{out} = 0.1V_{cc}	6	25	80	µs	see figure 3
T_f	Fall time to Vcc-Vout = 0.9 V_{cc}	3	10	30		
E_{off}	Turn OFF energy	—	1	2	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.

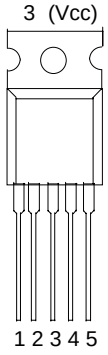
Current Sense Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Ratio	I load / Ifb current ratio	4,500	5,300	6,300	—	T_j = 25°C ,Rfb = 500Ω, I = 50A
Ratio_TC	Iload/Ifb variation over temperature	-5	0	+5	%	T_j = -40 To +150°C
offset	Load current diagnostic offset	-0.9	0	0.9	A	I = 2A
Trst	Ifb response time (low signal)	—	0	15	µs	90% of the I load step

Functional Block Diagram

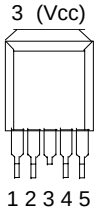


Lead Assignments



5 Lead - TO220

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



5 Lead - D^2PAK (SMD220)

IR3311	IR3311S
Part Number	

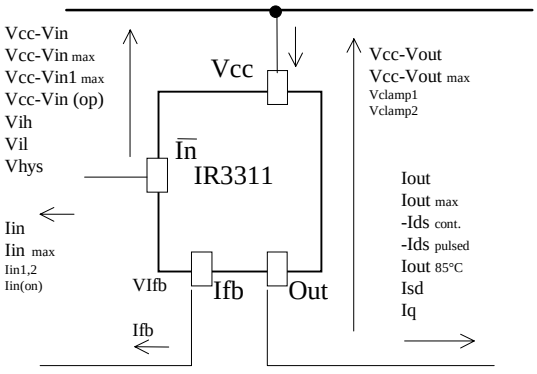


Figure 1 - Voltages and currents definitions

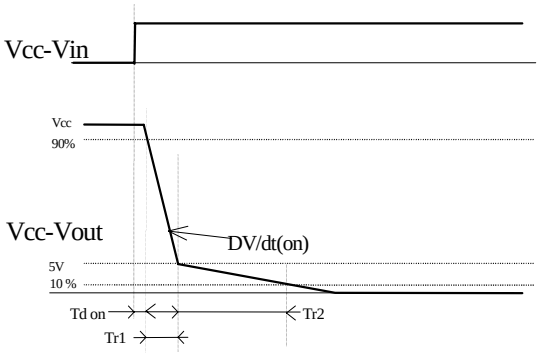


Figure 2 - Switching time definitions (turn-on)

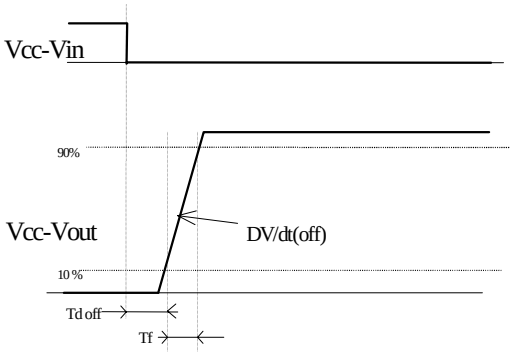
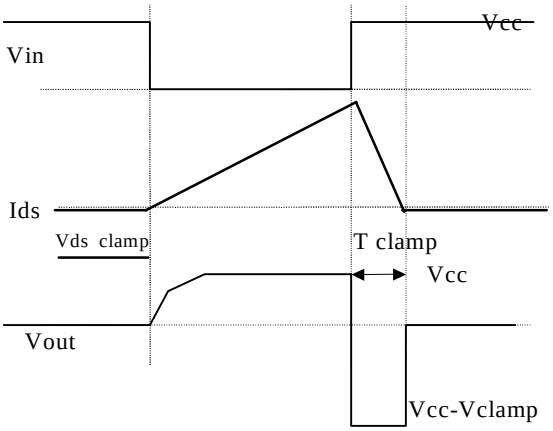
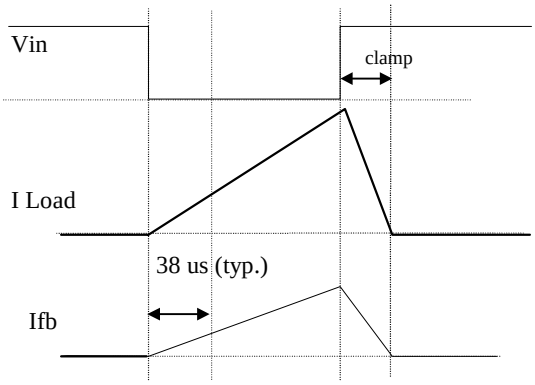


Figure 3 - Switching time definitions (turn-off)



(see Design tip to evaluate power dissipation)

Figure 4 - Active clamp waveforms



Precise measurement

Figure 5 - Current sense precision:
Accurate measurement only when the power Mosfet is fully ON

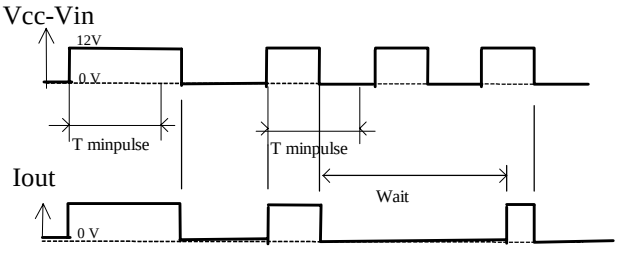


Figure 6 - Minimum pulse & WAIT function

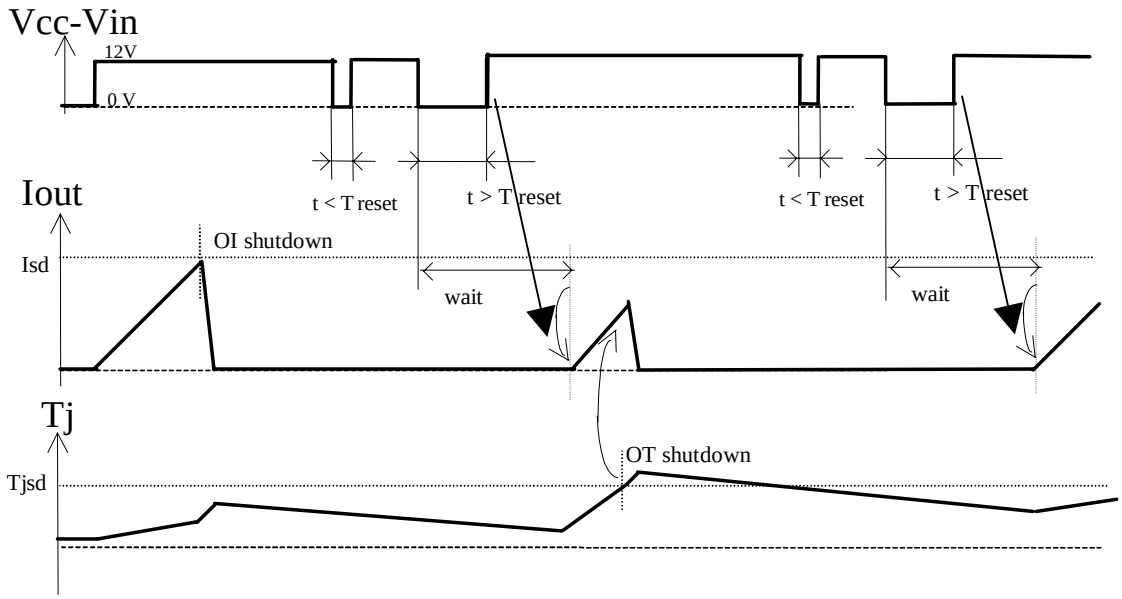


Figure 7 - Protection Timing Diagrams

All curves are typical characteristics. Operation in hatched areas is not recommended. Tj=25^{0}C, RIfb=500 Ohm, Vcc=14V (unless otherwise specified).

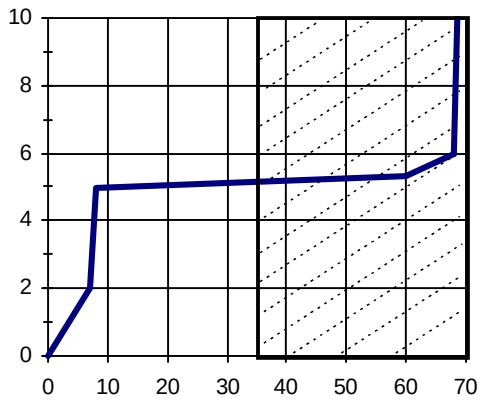


Figure 8 - Icc (mA) vs Vcc-Vin (V)

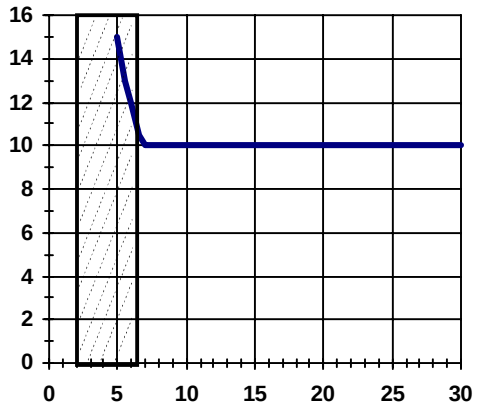


Figure 9- Rds$_{on}$ (mΩ) vs Vcc-Vin (V)

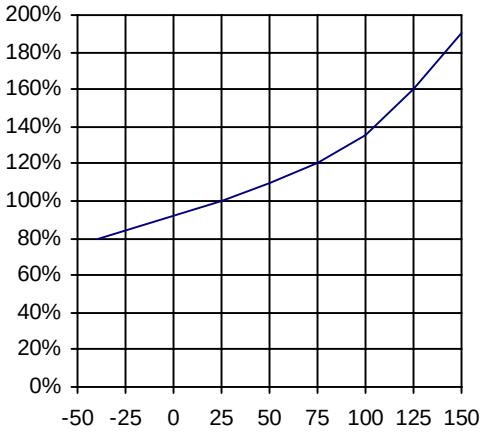


Figure 10 -Normalized Rdson (%) vs Tj (°C)

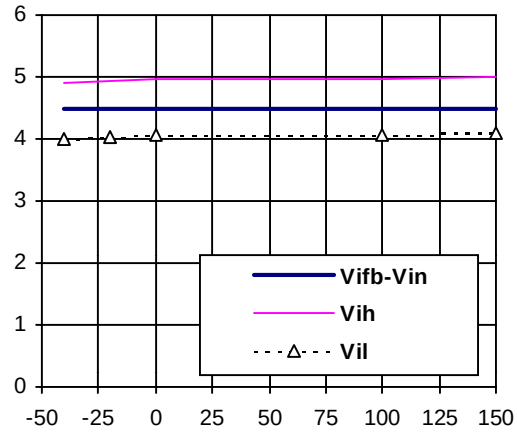


Figure 11 - Vih, Vil & Vifb -Vin (V) vs Tj (°C)

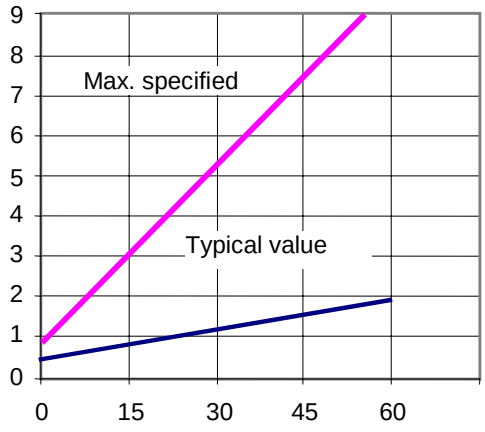


Figure 12 - Error (+/-A) vs Iload (A)

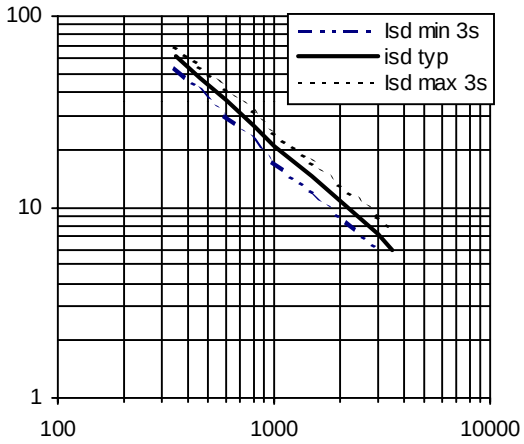


Figure 13 - Isd (A) vs RIfb (Ohm)

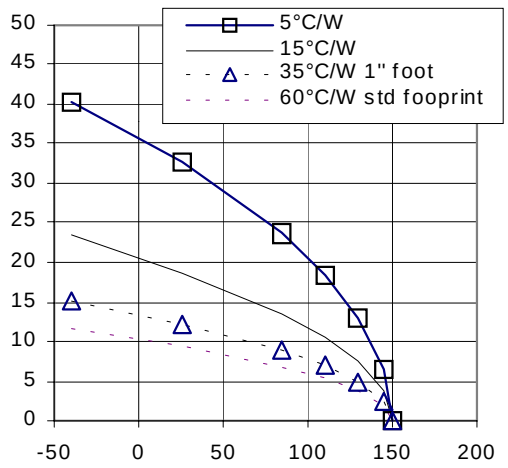


Figure 14 - Max. DC current (A) vs Temp. (℃)

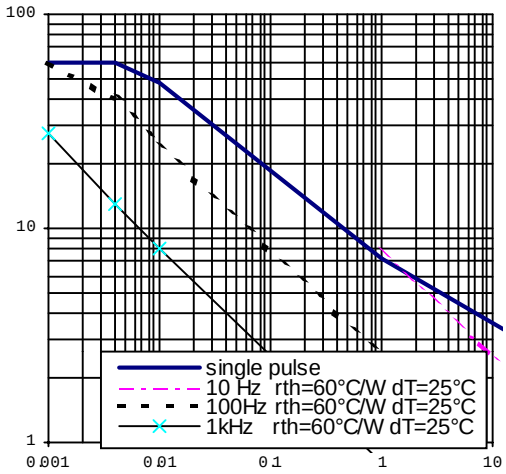


Figure 15 - Max. I (A) vs inductance (mH)

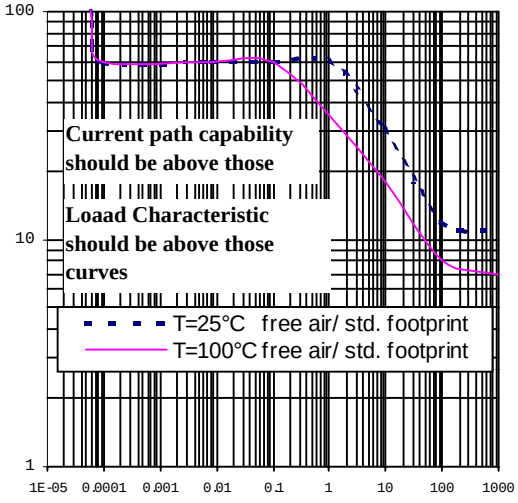


Figure 16 - I out (A) vs Protection resp. Time (s)

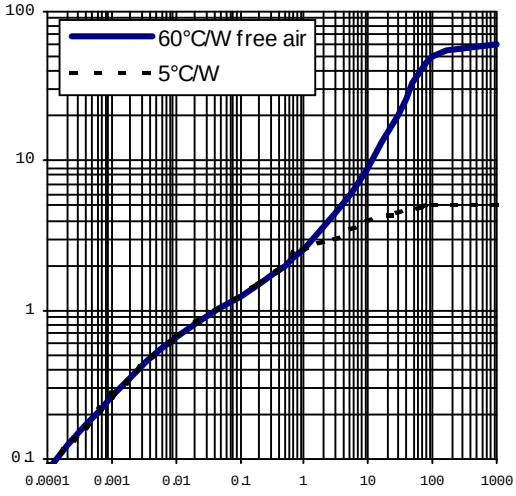
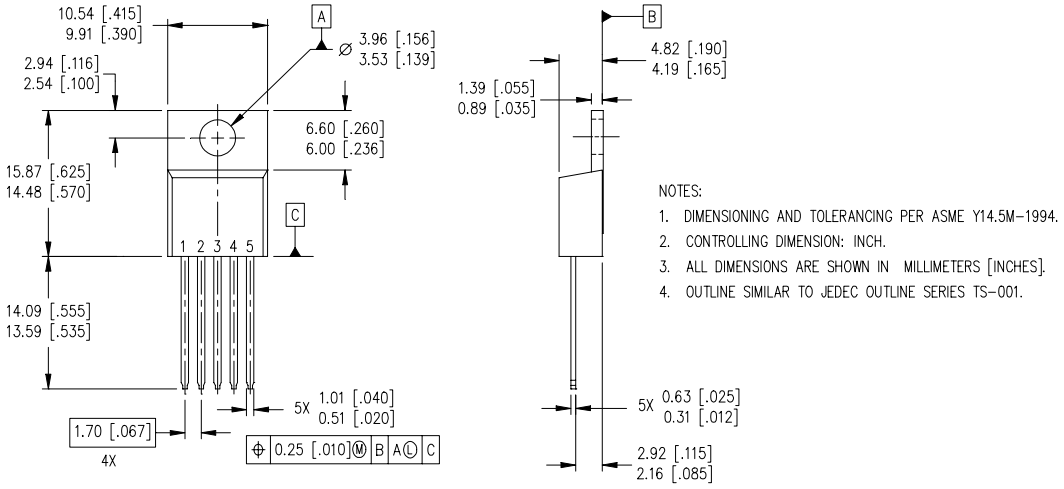
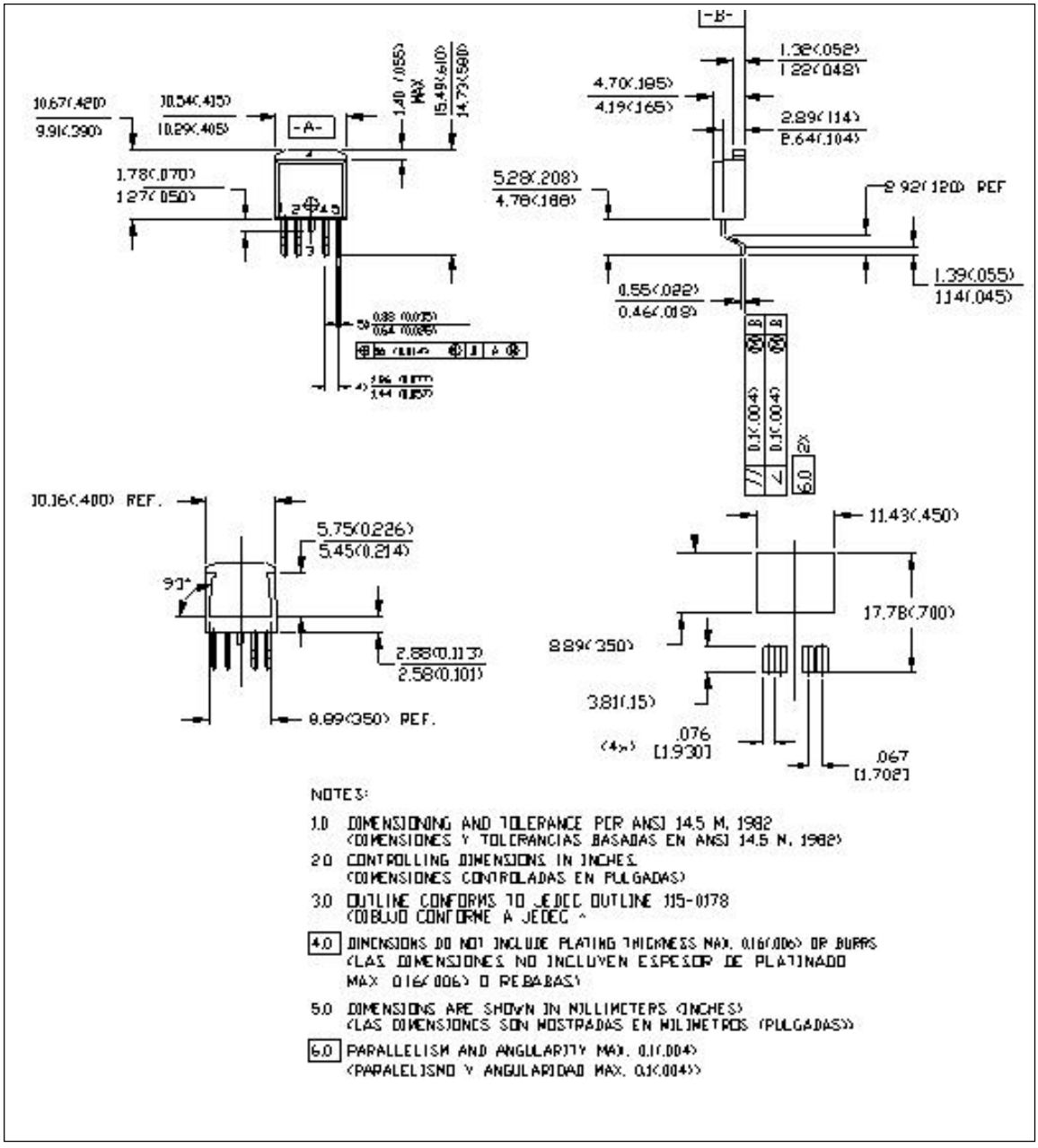


Figure 17 - Rth (^{O}C/W) vs Time (s)

Case Outline - TO220 (5 lead)



Case Outline 5 Lead - D²PAK (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)

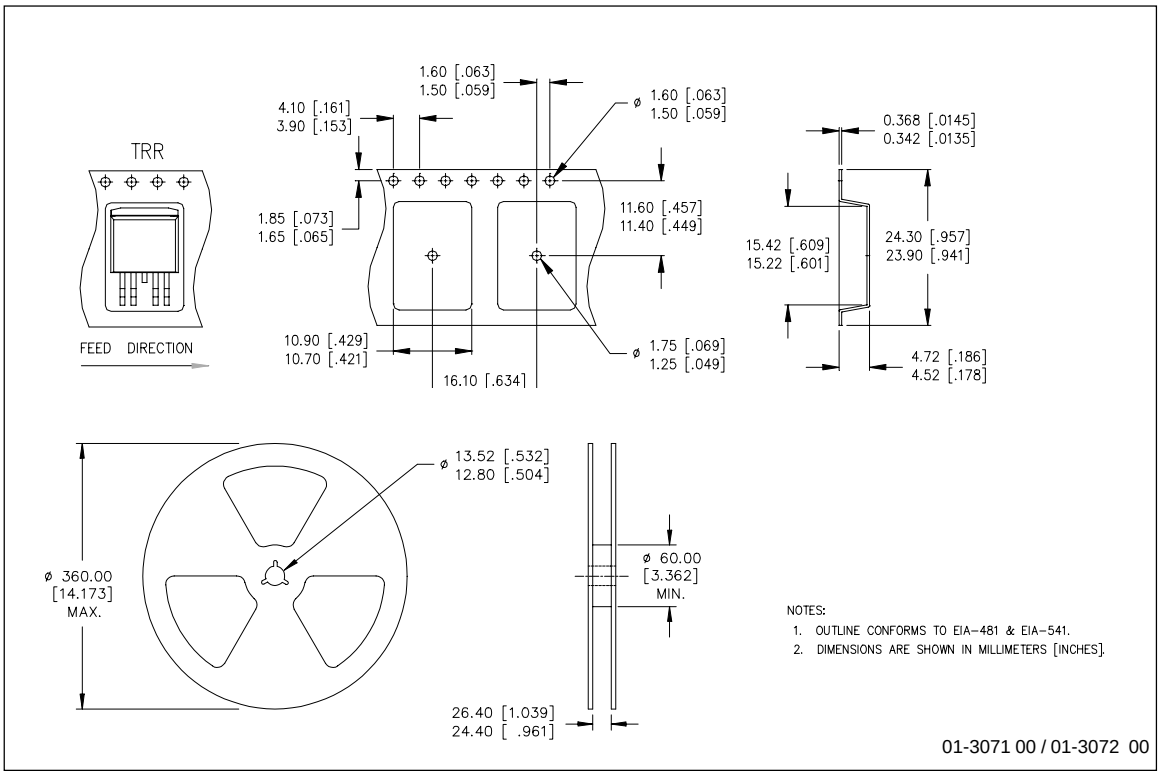
3.0 OUTLINE CONFORMS TO JEDEC OUTLINE TO-263AB
(DIBUJO CONFORME A JEDEC TO-263AB)

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))

Tape & Reel 5 Lead - D^{2}PAK (SMD220)



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. 10/21/2003