International
IOR Rectifier

IR3316(S)PbF

LOW EMI CURRENT SENSE HIGH SIDE SWITCH

Features

- Load current feedback
- Programmable over current shutdown
- Active clamp
- ESD protection
- Input referenced to Vcc
- Over temperature shutdown
- Switching time optimized for low EMI
- Reverse battery protection

Product Summary

Rds(on)	7 mΩ max.
Vcc op.	6 to 26V
Current Ratio	8800
Prog. Ishutdown	10 to 90A
Vclamp	40V

Packages

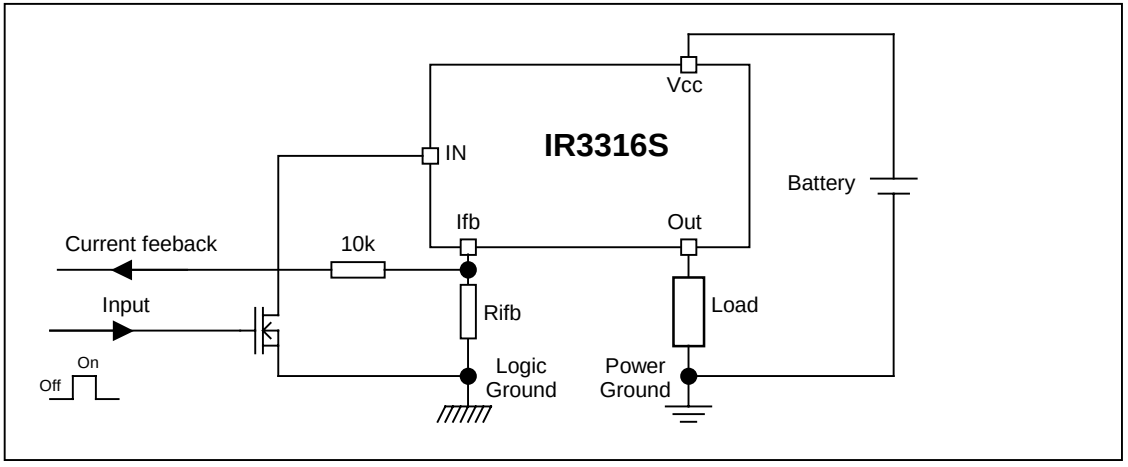
TO-220
IR3316

D²Pak
Pin 4 and 5 fused
IR3316S

Description

The IR3316(S)PbF is a fully protected 4 terminals high side switch. The input signal is referenced to Vcc. When the input voltage Vcc - Vin is higher than the specified threshold, the output power Mosfet is turned on. When the Vcc - Vin is lower than the specified Vil threshold, the output Mosfet is turned off. A current proportional to the power Mosfet current is sourced to the Ifb pin. Over current shutdown occurs when Vst-Vin > 4.5V. 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 switch very rugged in automotive environment.

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. (Tambient=25°C unless otherwise specified).

Symbol	Parameter	Min.	Max.	Units
Vcc-Vin	Maximum Vcc voltage	-16	37	V
Vcc-Vin cont.	Maximum continuous Vcc voltage	-16	26	
Vcc-Vfb	Maximum Ifb voltage	-16	33	
Vcc-Vout	Maximum output voltage	-0.3	37	
Ids cont.	Maximum body diode continuous current Rth=60°C/W (1)	—	2.8	A
Ids pulsed	Maximum body diode pulsed current (1)	—	100	
Pd	Maximum power dissipation Rth=60°C/W	—	2	W
ESD1	Electrostatic discharge voltage (Human body) C=100pF, R=1500Ω	—	4	kV
ESD2	Electrostatic discharge voltage (Machine Model) C=200pF,R=0Ω	—	0.5	
Tj max.	Max. storage & operating temperature junction temperature	-40	150	°C
Min Rfb	Minimum on the resistor on Ifb pin	0.3	—	kΩ
Ifb max.	Max. Ifb current	-50	50	mA

(1) Limited by junction temperature. Pulsed is also limited by wiring

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
Rth1	Thermal resistance junction to ambient D²-Pak Std footprint	60	—	°C/W
Rth2	Thermal resistance junction to case D²-Pak	0.7	—	
Rth2	Thermal resistance junction to case TO220	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
Iout	Continuous output current			A
	Tambient=85°C, Rth=5°C/W, Tj=125°C		23	
	Tambient=85°C, Rth=60°C/W, Tj=125°C	—	7	
Rifb	Recommended Ifb resistor (2)(3)	0.5	3.5	kΩ
Pulse min.	Minimum turn-on pulse width	1	—	ms
Fmax.	Maximum operating frequency	—	200	Hz

2) If Rifb is too low, the device can be damaged.
3) If Rifb is too high, the device may not switch on.

Protection Characteristics

Tj=25°C, Rifb=500 to 5kΩ

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Vifb-Vin@Isd	Over-current shutdown threshold	4	4.7	5.6	V	
Tsd	Over temperature threshold	—	165	—	°C	See fig. 5
OV	Over voltage protection (not latched)	26	29	33	V	
Isdf	Fixed over current shutdown	90	120	140	A	Vifb<Vifb-Vin@Isd
Isd_1k	Programmable over current shutdown 1k	30	40	50		Rifb=1kΩ
Treset	Time to reset protection	—	50	500	µs	See fig. 5
Min. pulse	Min. pulse width (no WAIT state)	400	900	2000		
WAIT	WAIT function timer	0.4	1	2	ms	See fig. 4 and 5
Rds(on) rev.	Reverse battery On state resistance	4	6.7	10	mΩ	Vcc-Vin=-14V, Iout=30A

Static Electrical Characteristics

Tj=25°C, Vcc=14V (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Vcc op.	Operating Voltage range	6	—	26	V	
Icc off	Supply leakage current	—	1.5	5	µA	Vin=Vcc, Vcc-Vout=14V, Vcc-Vifb=14V
Iin, on	On state IN positive current	1.5	3	6	mA	Vcc-Vin=14V
Vih	High level Input threshold voltage (4)	—	5.4	6.2	V	
Vil	Low level Input threshold voltage (4)	4	4.9	5.8		
Vhyst	Input hysteresis Vih-Vil	0.2	0.4	1		
Iout	Drain to source leakage current	—	1.2	5	µA	Vin=Vcc, Vcc-Vifb=0V, Vcc-Vout=14V
Rds(on)	On state resistance (5) Tj=25°C	4	5.5	7	mΩ	Iout=30A, Vcc-Vin=14V
	On state resistance (5) Tj=25°C	4	6	10		Iout=17A, Vcc-Vin=6V
	On state resistance (5)(6) Tj=150°C	7	10.5	13.5		Iout=30A, Vcc-Vin=14V
V clamp1	Vcc to Vout clamp voltage 1	36	39	—	V	Iout=50mA
V clamp2	Vcc to Vout clamp voltage 2	—	40	43		Iout=30A

(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) Rdson is measured between the tab and the Out pin, 5mm away from the package.
(6) Guaranteed by design

Switching Electrical Characteristics

Vcc=14V, Resistive load=0.5Ω, Tj=25°C

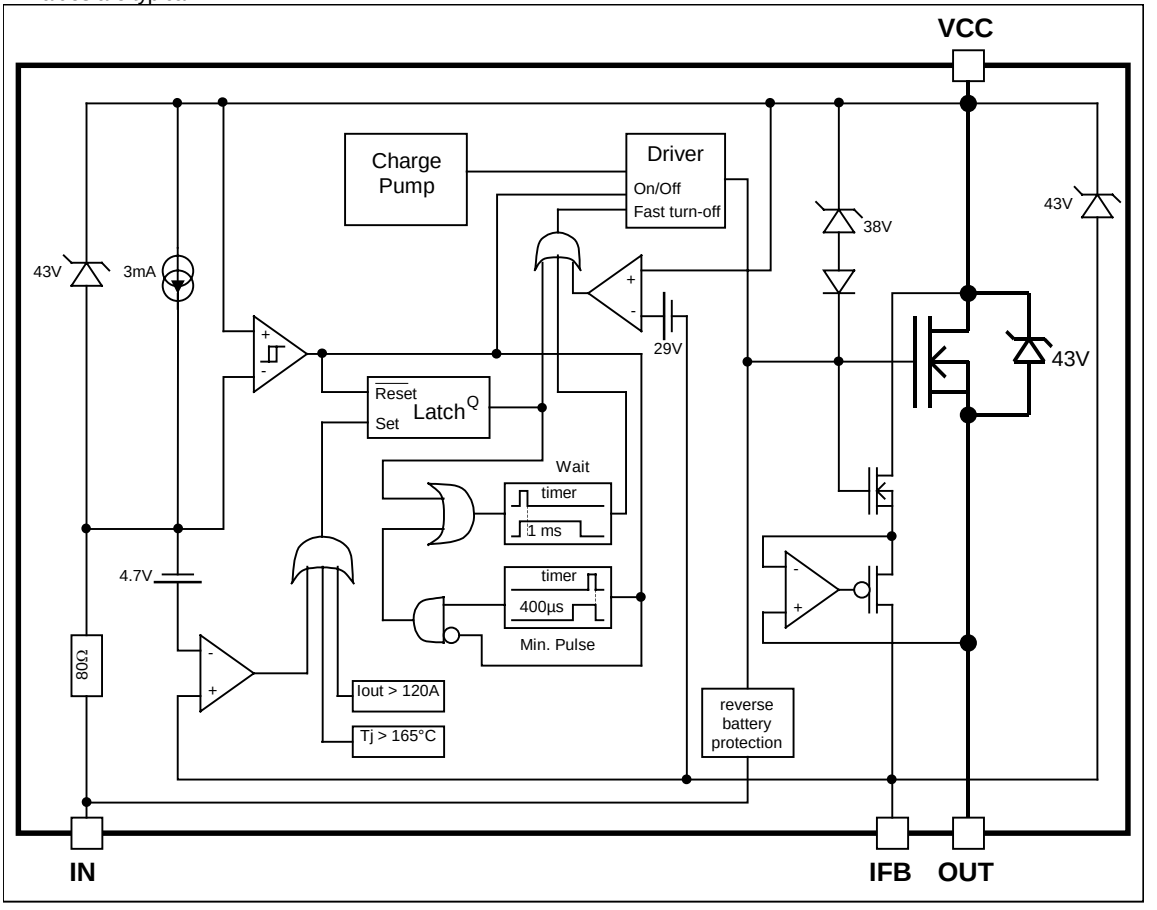
Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Tdon	Turn on delay time to 10% Vcc	30	120	300	µs	See figure 2
Tr1	Rise time to Vcc-Vout=5V	20	50	125		
Tr2	Rise time to Vcc-Vout=0.1Vcc	30	80	200		
Eon	Turn on energy	—	14	—	mJ	
Tdoff	Turn off delay time	30	140	350	µs	
Tf	Fall time to Vout=10% of Vcc	35	100	250		
Eoff	Turn off energy	—	7	—	mJ	

Current Sense Characteristics

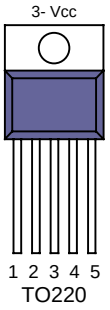
Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Ratio	I Load/Ifb current ratio	7,500	8,800	9,950	—	Tj=25°C, Rfb=500Ω, Iout=60A
Ratio_TC	I Load/Ifb variation aver temperature(6)	-5	—	+5	%	Tj=-40°C to 150°C
Offset	Load current diagnostic offset	-0.22	0	+0.2	A	Iout=2A
Trst	Ifb response time (low signal)	—	1	—	µs	90% of the Iout step

Functional Block Diagram

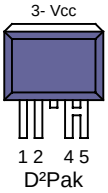
All values are typical



Lead Assignments



1- In
2- Ifb
3- Vcc (tab)
4- Out(TO220 NC)
5- Out



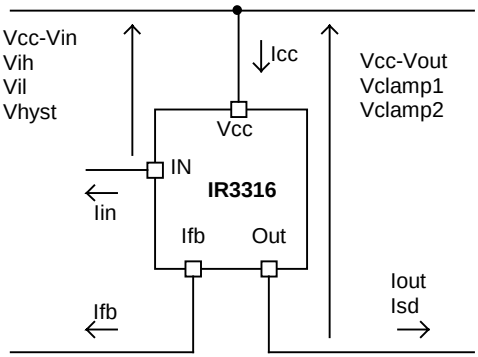


Figure 1 – Voltages and current definitions

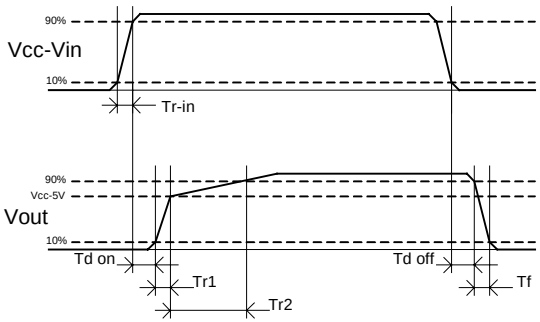


Figure 2 – Switching time definitions

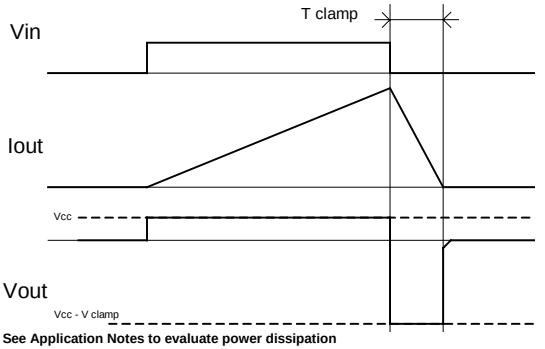


Figure 3 – Active clamp waveforms

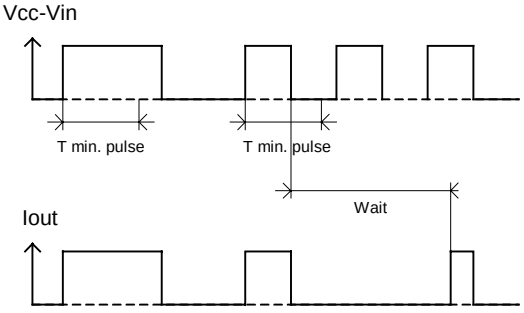


Figure 4 – Min. pulse and Wait function

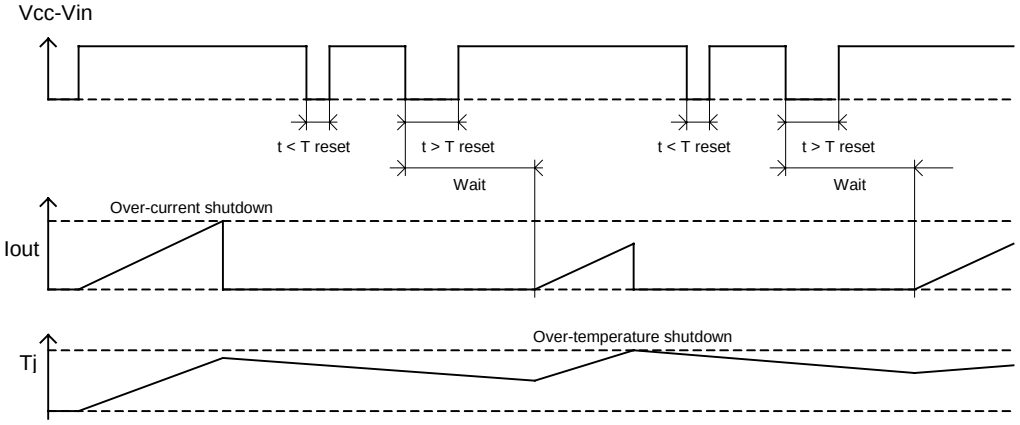


Figure 5 – Protection Timing Diagrams

All curves are typical characteristics. Operation in hatched areas is not recommended. Tj=25°C, Rifb=500ohm, Vcc=14V (unless otherwise specified).

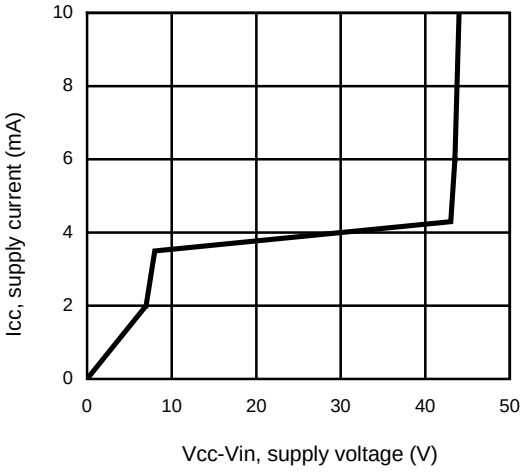


Figure 6 – Icc (mA) Vs Vcc-Vin (V)

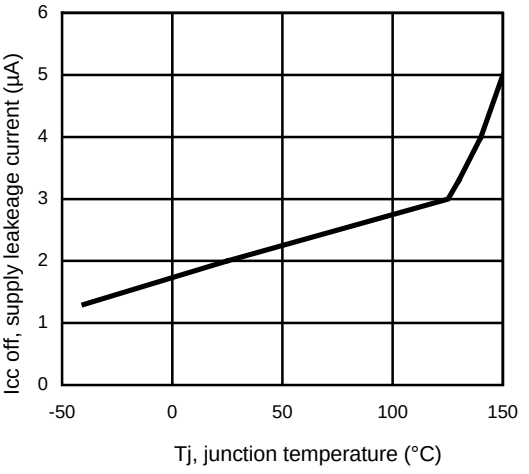


Figure 7 – Icc off (µA) Vs Tj (°C)

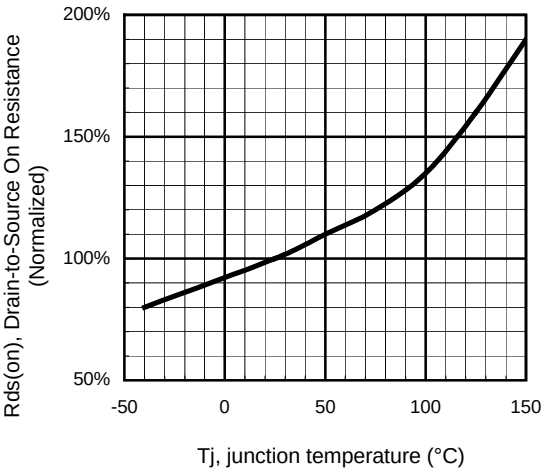


Figure 8 - Normalized Rds(on) (%) Vs Tj (°C)

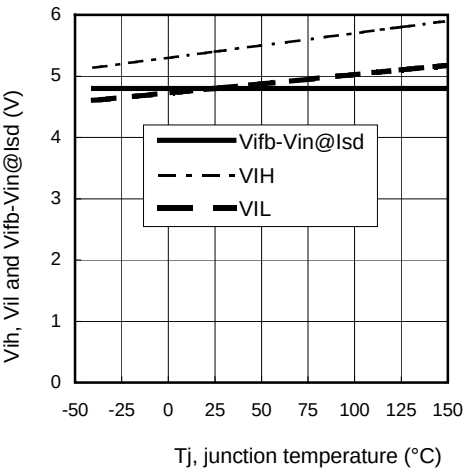


Figure 9 – Vih, Vil and Vifb-Vin@Isd (V) Vs Tj (°C)

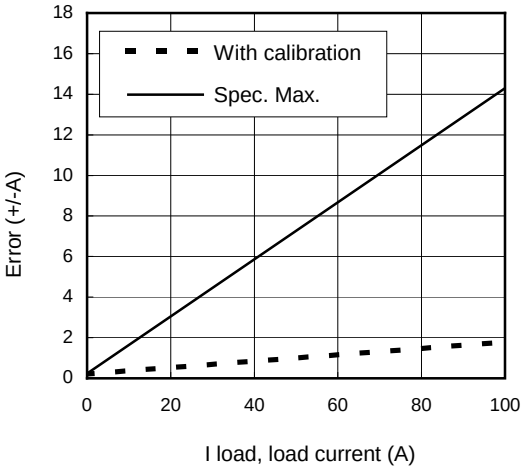


Figure 10 – Error (+/- A) Vs I load (A)

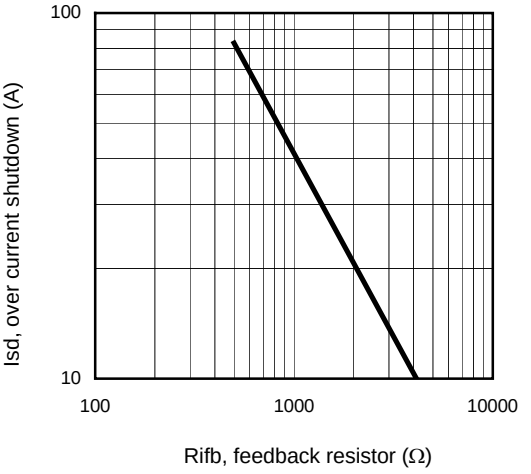


Figure 11 – Ids (A) Vs Rifb (Ω)

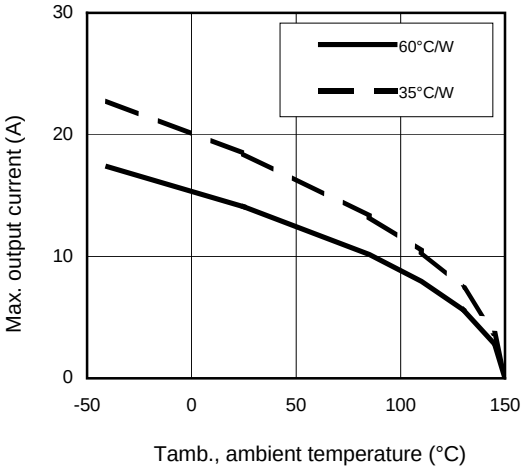


Figure 12 – Max. Iout (A) Vs Tamb. (°C)

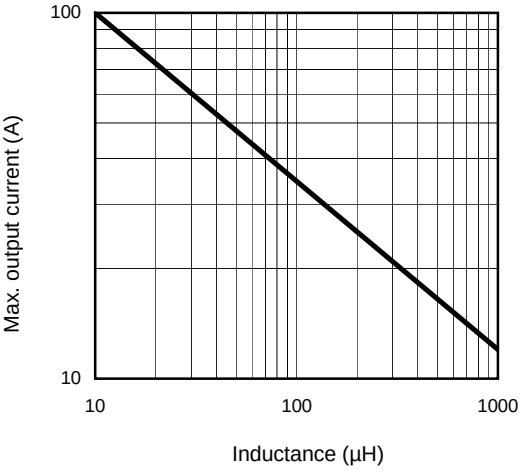


Figure 13 – Max. Iout (A) Vs inductance (µH)

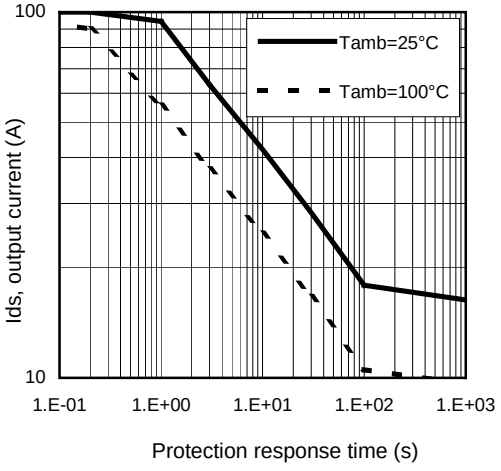


Figure 14 – Ids (A) Vs over temperature protection response time (s)

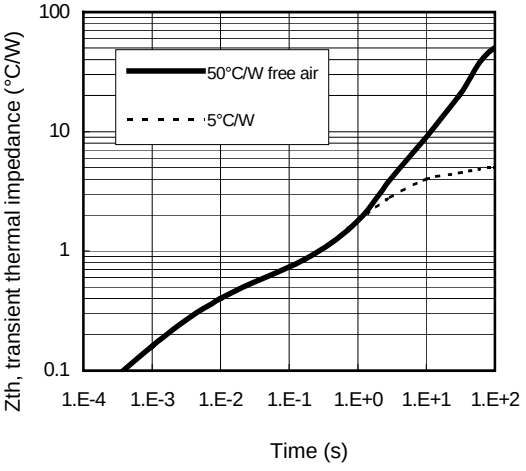
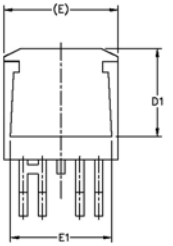
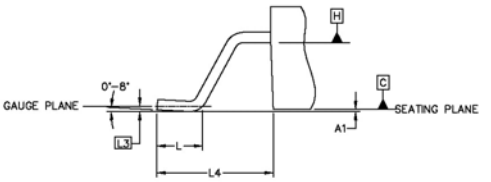


Figure 15 – Transient thermal impedance (°C/W) Vs time (s)

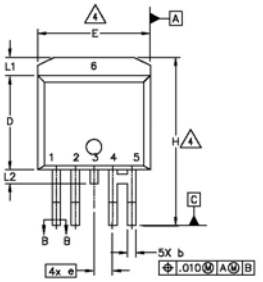
Case Outline 5 Lead - D2PAK - Automotive Q100 PbF MSL1 qualified

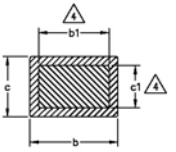


VIEW A–A



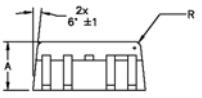
DETAIL "A"
ROTATED 90°
SCALE 8:1

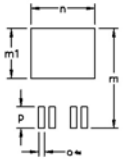




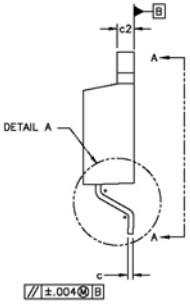
SECTION B–B
SCALE: NONE

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1		0.254		.010	
b	0.66	0.91	.026	.036	4
b1	0.66	0.81	.026	.032	
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	4
c2	1.14	1.65	.045	.065	
D	8.51	9.65	.335	.380	3
D1	6.86		.270		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	1.70 BSC		.067 BSC		
H	14.73	15.49	.580	.609	
L	1.14	1.39	.045	.055	
L1		1.65		.065	
L2	1.27	1.78	.050	.070	
L3	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208	
m	17.78		.700		
m1	8.89		.350		
n	11.43		.450		
o	1.93		.076		
p	3.81		.150		
R	0.51	0.71	.020	.028	





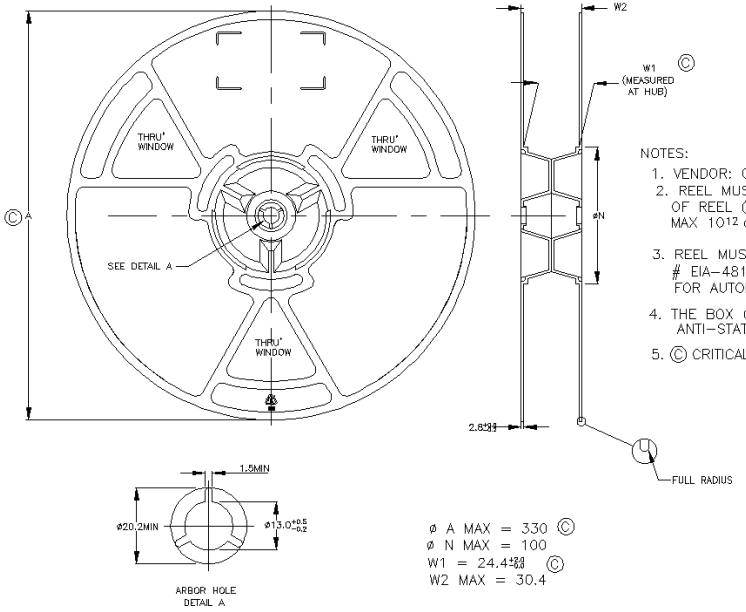
FOOT PRINT
SCALE 2:1



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: MILLIMETERS
6. LEADS AND DRAIN ARE PLTED WITH 100% Sn

Tape & Reel 5 Lead - D2PAK

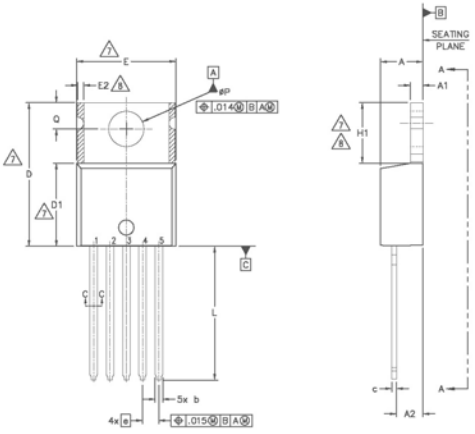


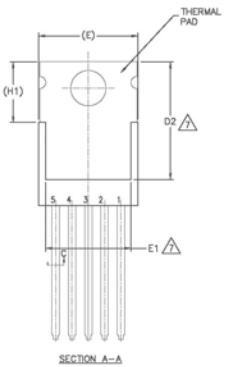
NOTES:

1. VENDOR: OPTIONAL
2. REEL MUST HAVE ANTI–STATIC COATING SURFACE RESISTIVITY OF REEL (AS PER EIA–541) uin: 10^{5} ohm/SQUARE; MAX 10^{12} ohm/SQUARE
3. REEL MUST ALSO MEET REQUIREMENTS OF EIA STANDARD # EIA–481A, TAPING OF SURFACE–MOUNT COMPONENTS FOR AUTOMATIC PLACEMENT.
4. THE BOX OF PACKING MUST CONTAIN THE REELS INSIDE AN ANTI–STATIC BAG.
5. © CRITICAL

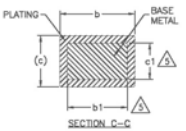
ø A MAX = 330 ©
ø N MAX = 100
W1 = 24.4 ©
W2 MAX = 30.4

Case Outline 5 Leads – TO220 – Automotive Q100 PbF qualified





SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.83	.140	.190	
A1	0.51	1.40	.020	.055	
A2	2.03	2.92	.080	.115	
b	0.64	0.89	.025	.035	
b1	0.64	0.84	.025	.033	5
c	0.36	0.61	.014	.024	
c1	0.36	0.56	.014	.022	5
D	14.22	16.51	.560	.650	4
D1	8.38	9.02	.330	.355	
D2	11.68	12.88	.460	.507	7
E	9.65	10.67	.380	.420	4,7
E1	6.86	8.89	.270	.350	7
E2	–	0.76	–	.030	8
e	1.70 BSC		.067 BSC		
H1	5.84	6.86	.230	.270	7,8
L	12.70	14.73	.500	.580	
øP	3.53	3.73	.139	.147	
Q	2.54	3.05	.100	.120	



NOTES:
1.– DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M– 1994.
2.– DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
3.– LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
4.– DIMENSION D, D1 & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
5.– DIMENSION b1 & c1 APPLY TO BASE METAL ONLY.
6.– CONTROLLING DIMENSION : INCHES.
7.– THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E,H1,D2 & E1
8.– DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.
9.– OUTLINE CONFORMS TO JEDEC TO-220, EXCEPT A2 (max.) AND D2 (min.) WHERE DIMENSIONS ARE DERIVED FROM THE ACTUAL PACKAGE OUTLINE.
10.– LEADS AND DRAIN ARE PLATED WITH 100% Sn

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245 Tel: (310) 252-7105
Data and specifications subject to change without notice.
D2Pak is MSL1 qualified.
This product has been designed and qualified for the Automotive [Q100] market. 20/02/2008