

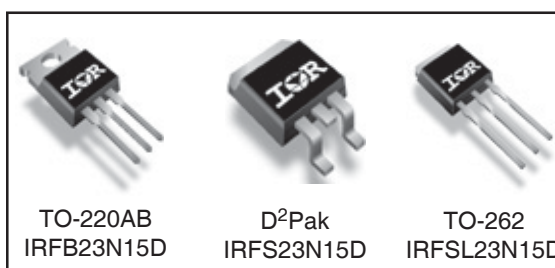
Applications

- High frequency DC-DC converters
- Lead-Free

Benefits

- Low Gate-to-Drain Charge to Reduce Switching Losses
- Fully Characterized Capacitance Including Effective C_{OSS} to Simplify Design, (See App. Note AN1001)
- Fully Characterized Avalanche Voltage and Current

V_{DSS}	$R_{DS(on)}$ max	I_D
150V	0.090 Ω	23A



Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	23	A
I_D @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	17	
I_{DM}	Pulsed Drain Current ①	92	
P_D @ $T_A = 25^\circ\text{C}$	Power Dissipation ②	3.8	W
P_D @ $T_C = 25^\circ\text{C}$	Power Dissipation	136	
	Linear Derating Factor	0.9	W/ $^\circ\text{C}$
V_{GS}	Gate-to-Source Voltage	± 30	V
dv/dt	Peak Diode Recovery dv/dt ③	4.1	V/ns
T_J	Operating Junction and	-55 to + 175	$^\circ\text{C}$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds		
	Mounting torque, 6-32 or M3 screw④	300 (1.6mm from case) 10 lbf•in (1.1N•m)	

Typical SMPS Topologies

- Telecom 48V input DC-DC Active Clamp Reset Forward Converter

IRFB/IRFS/IRFSL23N15DPbF

Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

International
IR Rectifier

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	150	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.18	—	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}, I_D = 1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.090	Ω	$V_{GS} = 10V, I_D = 14A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	3.0	—	5.5	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	25	μA	$V_{DS} = 150V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 120V, V_{GS} = 0V, T_J = 150^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 30V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -30V$

Dynamic @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
g_{fs}	Forward Transconductance	11	—	—	S	$V_{DS} = 25V, I_D = 14A$
Q_g	Total Gate Charge	—	37	56	nC	$I_D = 14A$
Q_{gs}	Gate-to-Source Charge	—	9.6	14		$V_{DS} = 120V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	19	29	ns	$V_{GS} = 10V, \text{④}$
$t_{d(on)}$	Turn-On Delay Time	—	10	—		$V_{DD} = 75V$
t_r	Rise Time	—	32	—		$I_D = 14A$
$t_{d(off)}$	Turn-Off Delay Time	—	18	—		$R_G = 5.1\Omega$
t_f	Fall Time	—	8.4	—	pF	$V_{GS} = 10V, \text{④}$
C_{iss}	Input Capacitance	—	1200	—		$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	260	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	65	—		$f = 1.0MHz$ ⑥
C_{oss}	Output Capacitance	—	1520	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$
C_{oss}	Output Capacitance	—	120	—		$V_{GS} = 0V, V_{DS} = 120V, f = 1.0MHz$
$C_{oss \text{ eff.}}$	Effective Output Capacitance	—	210	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 120V \text{ ⑤}$

Avalanche Characteristics

	Parameter	Typ.	Max.	Units
E_{AS}	Single Pulse Avalanche Energy②	—	260	mJ
I_{AR}	Avalanche Current①	—	14	A
E_{AR}	Repetitive Avalanche Energy①	—	13.6	mJ

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	1.1	$^\circ\text{C/W}$
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface ⑥	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient⑦	—	62	
$R_{\theta JA}$	Junction-to-Ambient⑦	—	40	

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	23	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	92		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 14A, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	150	220	ns	$T_J = 25^\circ\text{C}, I_F = 14A$
Q_{rr}	Reverse Recovery Charge	—	0.8	1.2	μC	$di/dt = 100A/\mu s$ ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$)				

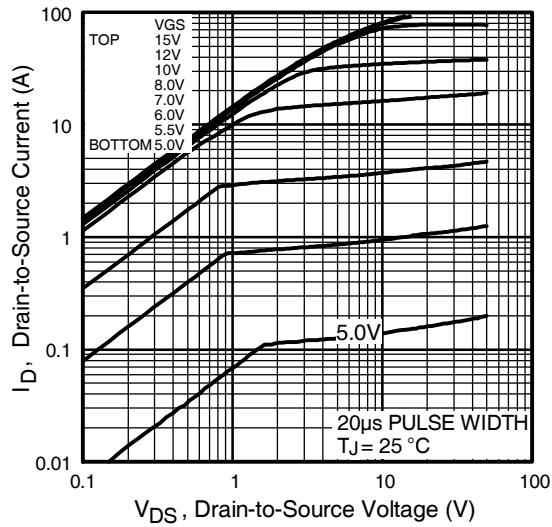


Fig 1. Typical Output Characteristics

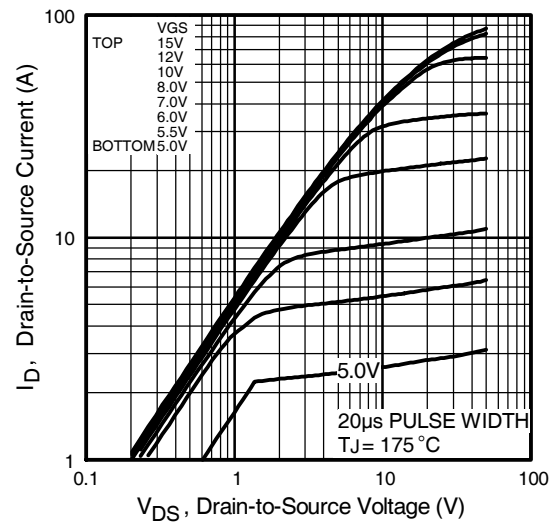


Fig 2. Typical Output Characteristics

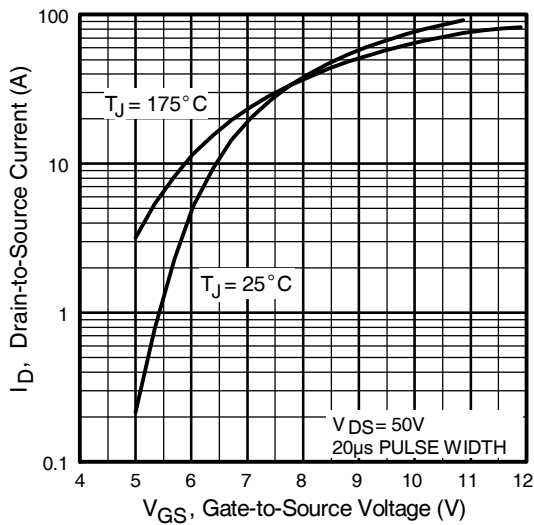


Fig 3. Typical Transfer Characteristics

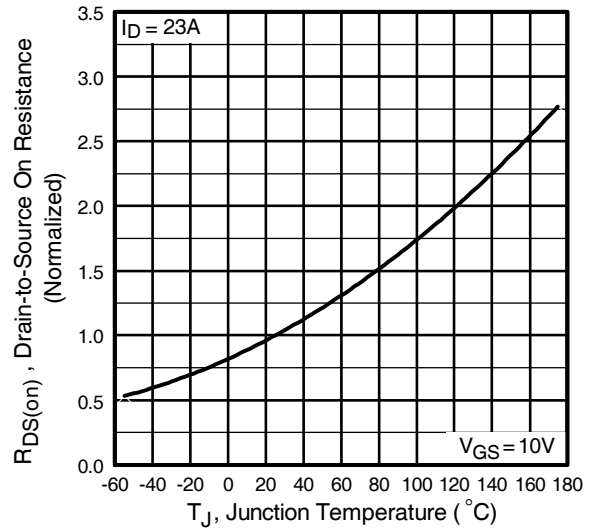


Fig 4. Normalized On-Resistance Vs. Temperature

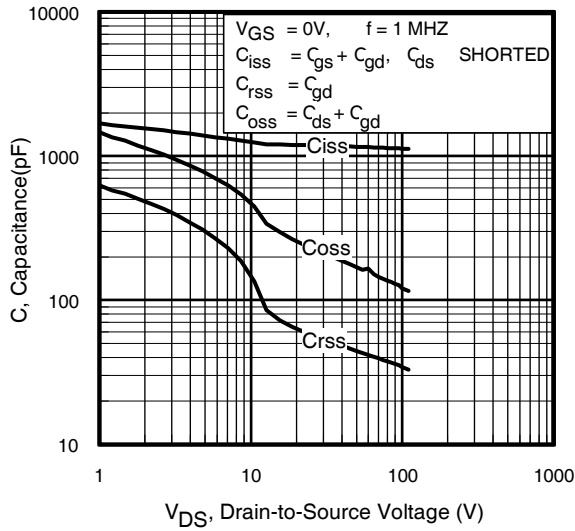


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

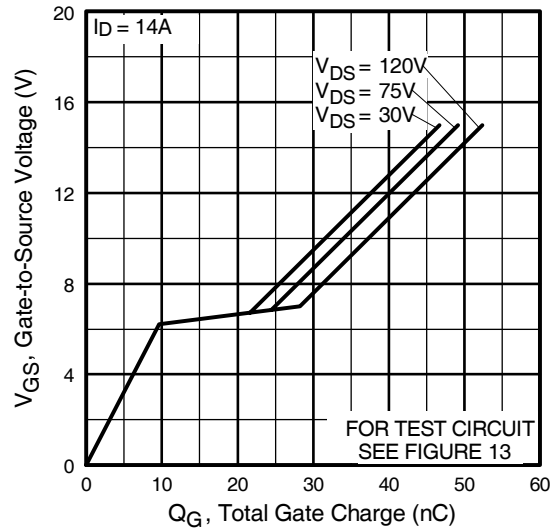


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

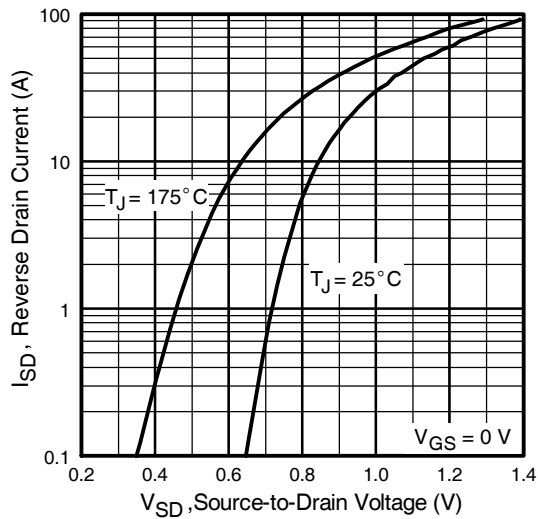


Fig 7. Typical Source-Drain Diode Forward Voltage

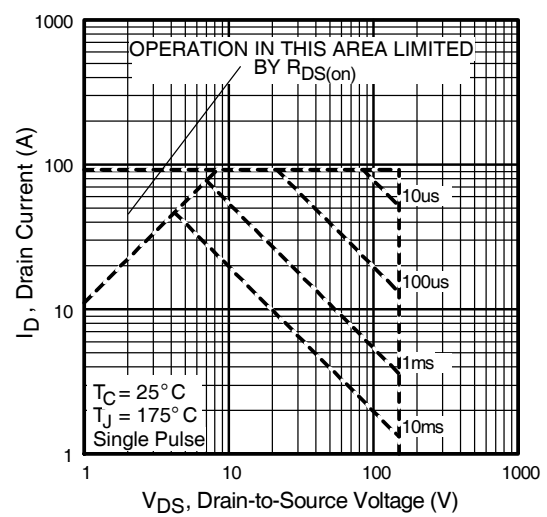


Fig 8. Maximum Safe Operating Area

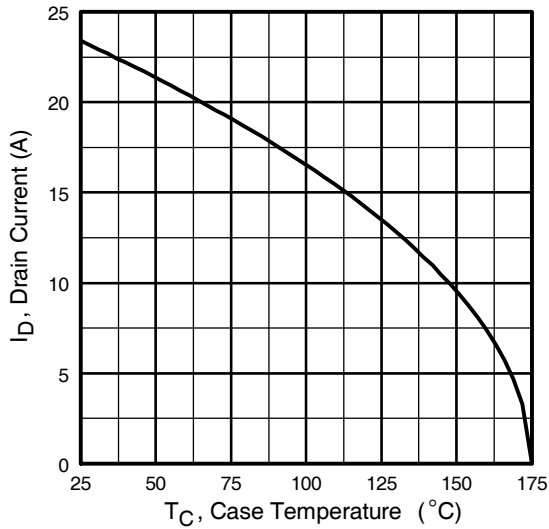


Fig 9. Maximum Drain Current Vs. Case Temperature

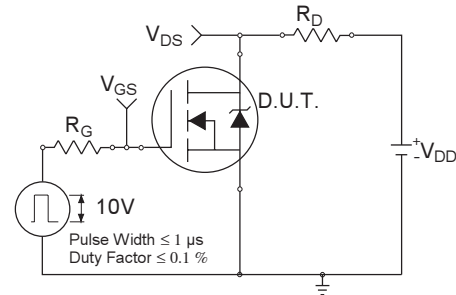


Fig 10a. Switching Time Test Circuit



Fig 10b. Switching Time Waveforms

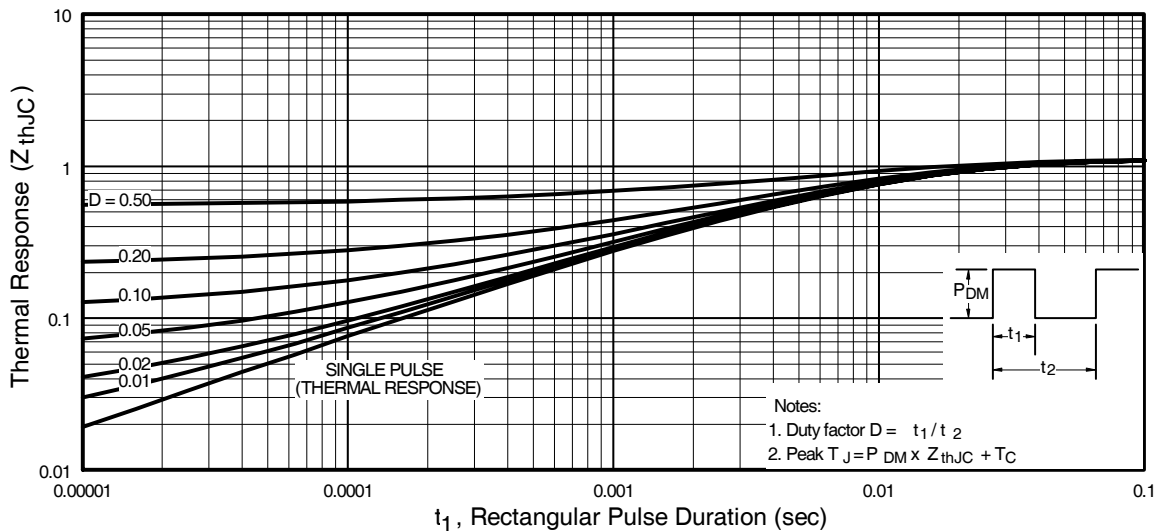


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

IRFB/IRFS/IRFSL23N15DPbF

International
IR Rectifier

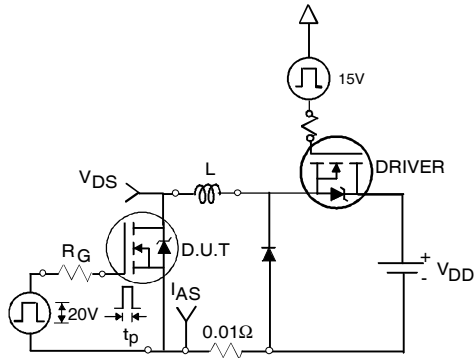


Fig 12a. Unclamped Inductive Test Circuit



Fig 12b. Unclamped Inductive Waveforms

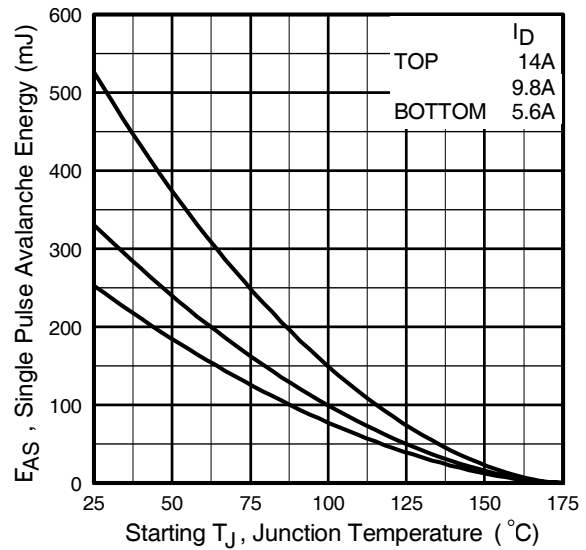


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

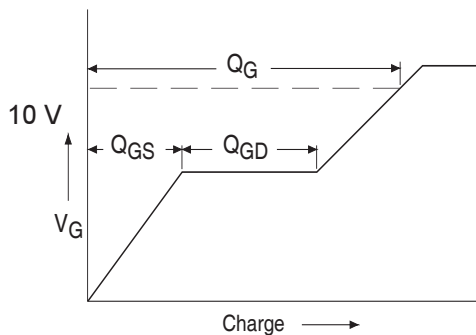
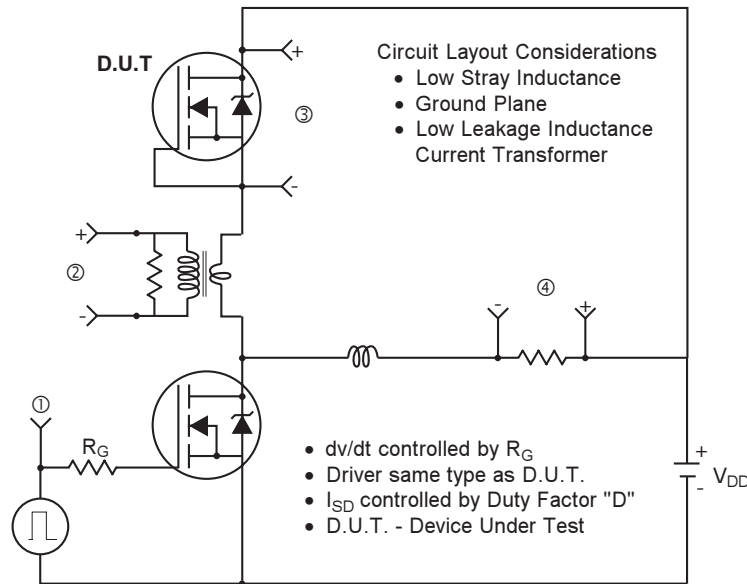


Fig 13a. Basic Gate Charge Waveform



Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



* $V_{GS} = 5V$ for Logic Level Devices

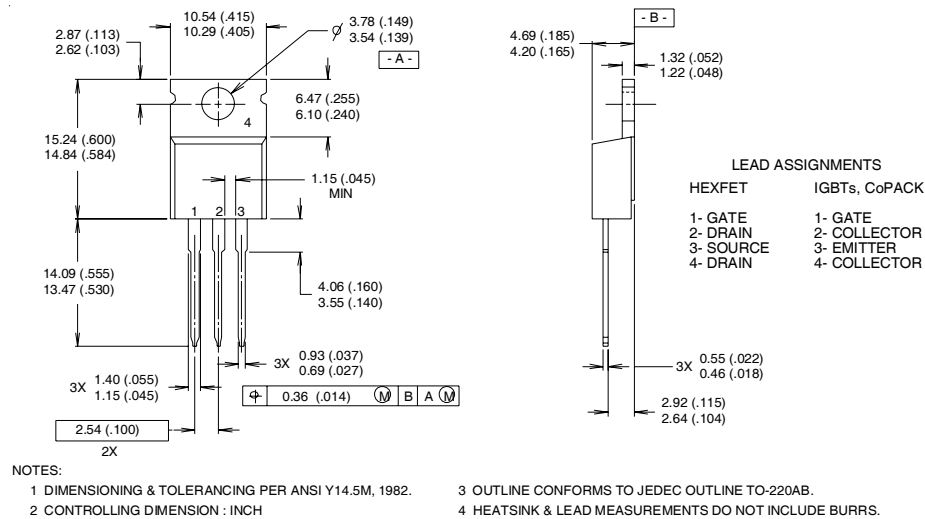
Fig 14. For N-Channel HEXFET® Power MOSFETs

IRFB/IRFS/IRFSL23N15DPbF

International
IR Rectifier

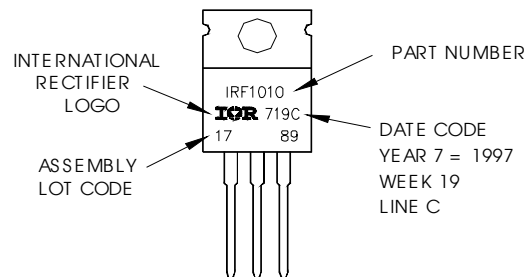
TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



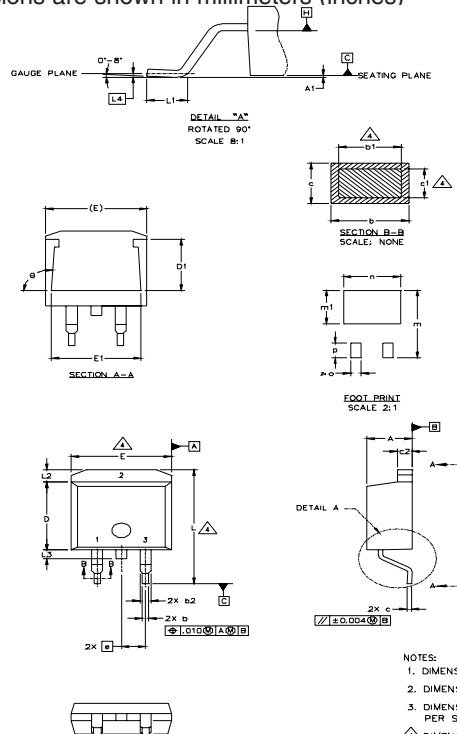
TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"
Note: "P" in assembly line
position indicates "Lead-Free"



D²Pak Package Outline

Dimensions are shown in millimeters (inches)



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	4
A1		0.127		.005	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	
b2	1.14	1.40	.045	.055	4
c	0.43	0.63	.017	.025	
c1	0.38	0.74	.015	.029	
c2	1.14	1.40	.045	.055	
D	8.51	9.65	.335	.380	3
D1	5.33		.210		3
E	9.65	10.67	.380	.420	
E1	6.22		.245		
e	2.54 BSC		.100 BSC		
L	14.61	15.88	.575	.625	
L1	1.78	2.79	.070	.110	
L2		1.65		.065	
L3	1.27	1.78	.050	.070	
L4	0.25 BSC		.010 BSC		
m	17.78		.700		
m1	8.89		.350		
n	11.43		.450		
o	2.08		.082		
p	3.81		.150		
θ	90°	93°	90°	93°	

LEAD ASSIGNMENTS

HEXFET	IGBTs, CoPACK	DIODES
1.- GATE	1.- GATE	1.- ANODE *
2.- DRAIN	2.- COLLECTOR	2.- CATHODE
3.- SOURCE	3.- EMITTER	3.- ANODE

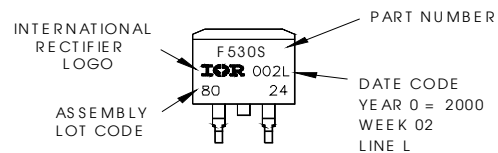
* PART DEPENDENT.

- 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: INCH.

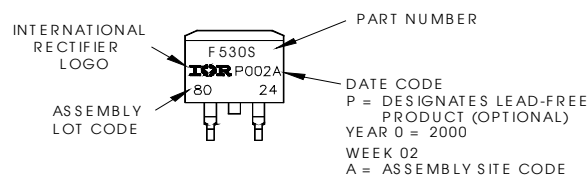
D²Pak Part Marking Information (Lead-Free)

EXAMPLE: THIS IS AN IRF530S WITH
LOT CODE 8024
ASSEMBLED ON WW 02, 2000
IN THE ASSEMBLY LINE "L"

Note: "P" in assembly line
position indicates "Lead-Free"



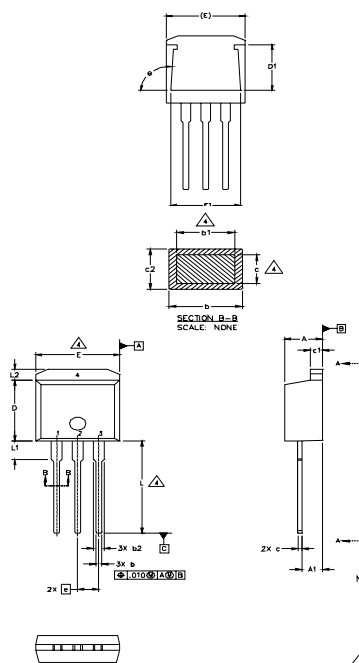
OR



IRFB/IRFS/IRFSL23N15DPbF

International
IR Rectifier

TO-262 Package Outline



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	4
A1	2.03	2.92	.080	.115	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	
b2	1.14	1.40	.045	.055	4
c	0.38	0.63	.015	.025	
c1	1.14	1.40	.045	.055	
c2	0.43	.063	.017	.029	
D	8.51	9.65	.335	.380	3
D1	5.33		.210		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54 BSC		.100 BSC		
L	13.46	14.09	.530	.555	
L1	3.56	3.71	.140	.146	
L2		1.65		.065	

LEAD ASSIGNMENTS

HEXFET

- 1. - GATE
- 2. - DRAIN
- 3. - SOURCE
- 4. - DRAIN

IGBT

- 1 - GATE
- 2 - COLLECTOR
- 3 - EMITTER

NOTES:

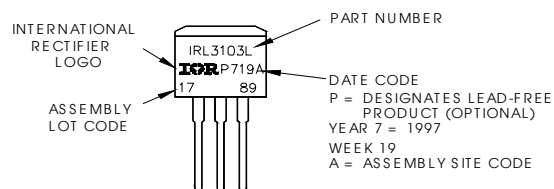
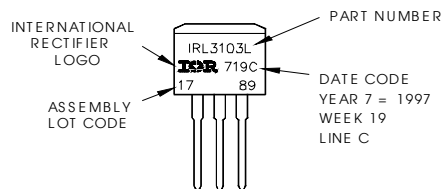
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES]
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

Note: "P" in assembly line position indicates "Lead-Free"

OR



TRR

FEED DIRECTION

TRL

FEED DIRECTION

1.60 (.063)
1.50 (.059)

4.10 (.161)
3.90 (.153)

1.85 (.073)
1.65 (.065)

11.60 (.457)
11.40 (.449)

1.60 (.063)
1.50 (.059)

15.42 (.609)
15.22 (.601)

24.30 (.957)
23.90 (.941)

0.368 (.0145)
0.342 (.0135)

1.75 (.069)
1.25 (.049)

16.10 (.634)
15.90 (.626)

10.90 (.429)
10.70 (.421)

4.72 (.136)
4.52 (.178)

13.50 (.532)
12.80 (.504)

Ø 330.00 (14.173) MAX.

27.40 (1.079)
23.90 (.941)

Ø 60.00 (2.362) MIN.

30.40 (1.197) MAX.

26.40 (1.039)
24.40 (.961)

NOTES :

1. CONFORMS TO EIA-418.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION MEASURED @ HUB.
4. INCLUDES FLANGE DISTORTION @ OUTER EDGE.

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting $T_J = 25^\circ\text{C}$, $L = 2.7\text{mH}$
 $R_G = 25\Omega$, $I_{AS} = 14\text{A}$.
- ③ $I_{SD} \leq 14\text{A}$, $di/dt \leq 240\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$,
 $T_J \leq 175^\circ\text{C}$
- ④ Pulse width $\leq 300\mu\text{s}$; duty cycle $\leq 2\%$.
- ⑤ C_{OSS} eff. is a fixed capacitance that gives the same charging time as C_{OSS} while V_{DS} is rising from 0 to 80% V_{DSS}
- ⑥ This is only applied to TO-220AB package
- ⑦ This is applied to D²Pak, when mounted on 1" square PCB (FR-4 or G-10 Material).
For recommended footprint and soldering techniques refer to application note #AN-994.

International
IOR Rectifier

11

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

IMPORTANT NOTICE

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenhheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (www.infineon.com).

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Infineon:](#)

[IRFB23N15DPBF](#) [IRFS23N15DTRLP](#)