Absolute Maximum Ratings

Symbol	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	120①	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	84①	
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V (Wire Bond Limited)	56	
I_{DM}	Pulsed Drain Current ②	520	
P_D @T_C = 25°C	Maximum Power Dissipation	98	W
	Linear Derating Factor	0.66	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C
	Soldering Temperature, for 10 seconds (1.6mm from case)	300	

Avalanche Characteristics

Symbol	Parameter	Max.	Units
$E_{AS\ (Thermally\ limited)}$	Single Pulse Avalanche Energy ③	125	mJ
$E_{AS\ (Thermally\ limited)}$	Single Pulse Avalanche Energy ⑩	251	
I_{AR}	Avalanche Current ②	See Fig 15,16, 23a, 23b	A
E_{AR}	Repetitive Avalanche Energy ②		mJ

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑨	—	1.52	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount) ⑧	—	50	
$R_{\theta JA}$	Junction-to-Ambient ⑨	—	110	

Static @ T_J = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	40	—	—	V	V_{GS} = 0V, I_D = 250μA ②
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	26	—	mV/°C	Reference to 25°C, I_D = 1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	3.0	3.9	mΩ	V_{GS} = 10V, I_D = 56A ⑤
			4.4	—	mΩ	V_{GS} = 6.0V, I_D = 28A ⑤
$V_{GS(th)}$	Gate Threshold Voltage	2.2	3.0	3.9	V	V_{DS} = V_{GS}, I_D = 100μA
I_{DSS}	Drain-to-Source Leakage Current	—	—	1.0	μA	V_{DS} = 40V, V_{GS} = 0V
		—	—	150		V_{DS} = 40V, V_{GS} = 0V, T_J = 125°C
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	V_{GS} = 20V
	Gate-to-Source Reverse Leakage	—	—	-100		V_{GS} = -20V
R_G	Internal Gate Resistance	—	1.5	—	Ω	

Notes:

① Calculated continuous current based on maximum allowable junction temperature. Bond wire current limit is 56A. Note that current limitations arising from heating of the device leads may occur with some lead mounting arrangements. (Refer to AN-1140)

② Repetitive rating; pulse width limited by max. junction temperature.

③ Limited by T_{Jmax}, starting T_J = 25°C, L = 0.08mH R_G = 50Ω, I_{AS} = 56A, V_{GS} =10V.

④ $I_{SD} \leq$ 100A, di/dt ≤ 1306A/μs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq$ 175°C.

⑤ Pulse width ≤ 400μs; duty cycle ≤ 2%.

⑥ C_{oss} eff. (TR) is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

⑦ C_{oss} eff. (ER) is a fixed capacitance that gives the same energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

⑧ When mounted on 1" square PCB (FR-4 or G-10 Material). For recom mended footprint and soldering techniques refer to application note #AN-994.

⑨ R_θ is measured at T_J approximately 90°C.

⑩ Limited by T_{Jmax} starting T_J = 25°C, L= 1mH, R_G = 50Ω, I_{AS} = 22A, V_{GS} =10V.

* L_D and L_S are Internal Drain Inductance and Internal Source Inductance

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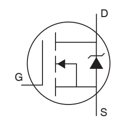
Dynamic @ T_J = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
gfs	Forward Transconductance	170	——	——	S	V_{DS} = 10V, I_D = 56A
Q_g	Total Gate Charge	——	65	130	nC	I_D =56A
Q_{gs}	Gate-to-Source Charge	——	18	——		V_{DS} =20V
Q_{gd}	Gate-to-Drain ("Miller") Charge	——	22	——		V_{GS} = 10V ⑤
Q_{sync}	Total Gate Charge Sync. (Q_g - Q_{gd})	——	43	——		I_D = 56A, V_{DS} =0V, V_{GS} = 10V
$t_{d(on)}$	Turn-On Delay Time	——	9.8	——	ns	V_{DD} = 20V
t_r	Rise Time	——	13	——		I_D = 30A
$t_{d(off)}$	Turn-Off Delay Time	——	32	——		R_G = 2.7Ω
t_f	Fall Time	——	20	——		V_{GS} = 10V ⑤
C_{iss}	Input Capacitance	——	3150	——	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	——	480	——		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	——	330	——		f = 1.0 MHz, See Fig. 5
C_{oss} eff. (ER)	Effective Output Capacitance (Energy Related)	——	570	——		V_{GS} = 0V, V_{DS} = 0V to 32V ⑦ See Fig. 12
C_{oss} eff. (TR)	Effective Output Capacitance (Time Related)	——	680	——		V_{GS} = 0V, V_{DS} = 0V to 32V ⑥

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	——	——	120①	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ②	——	——	480	A	
V_{SD}	Diode Forward Voltage	——	0.9	1.3	V	T_J = 25°C, I_S = 56A, V_{GS} = 0V
dv/dt	Peak Diode Recovery ④	——	4.8	——	V/ns	T_J = 175°C, I_S = 56A, V_{DS} = 40V ⑤
t_{rr}	Reverse Recovery Time	——	20	——	ns	T_J = 25°C V_R = 34V,
		——	21	——		T_J = 125°C I_F = 56A
Q_{rr}	Reverse Recovery Charge	——	13	——	nC	T_J = 25°C di/dt = 100A/µs ⑤
		——	13	——		T_J = 125°C
I_{RRM}	Reverse Recovery Current	——	1.8	——	A	T_J = 25°C
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD) *				

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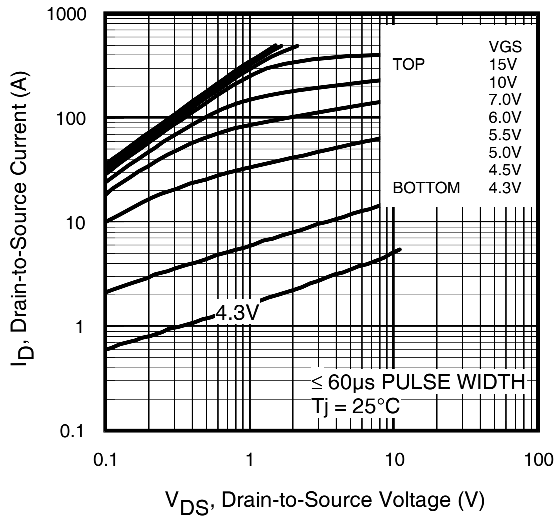

Fig 3. Typical Output Characteristics

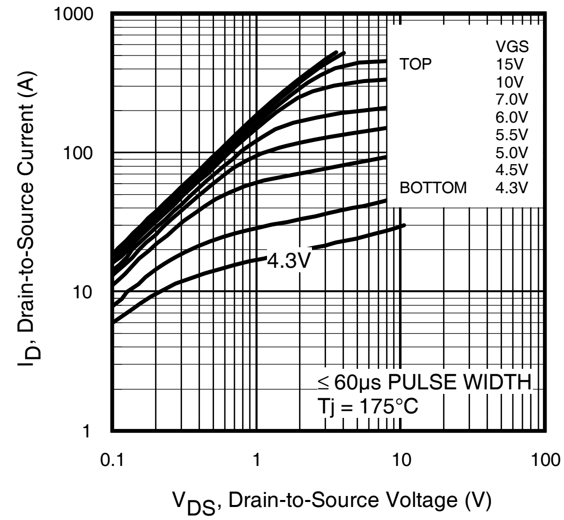

Fig 4. Typical Output Characteristics

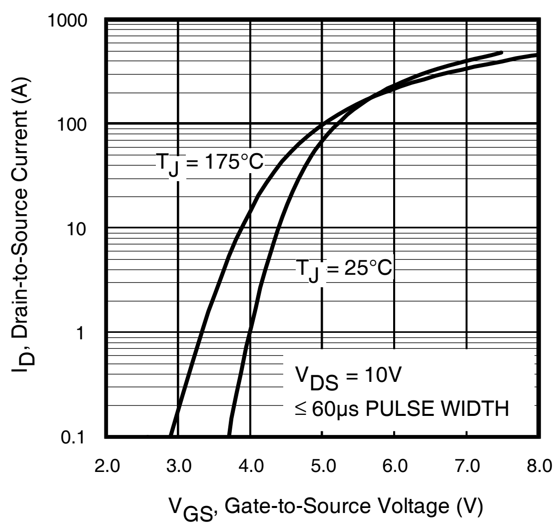

Fig 5. Typical Transfer Characteristics

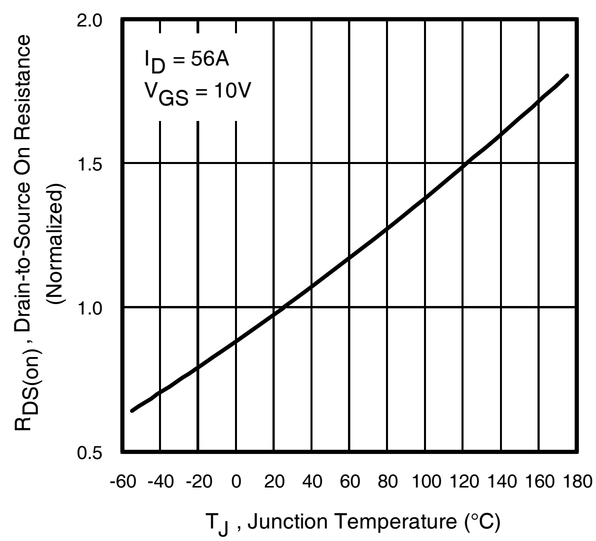

Fig 6. Normalized On-Resistance vs. Temperature

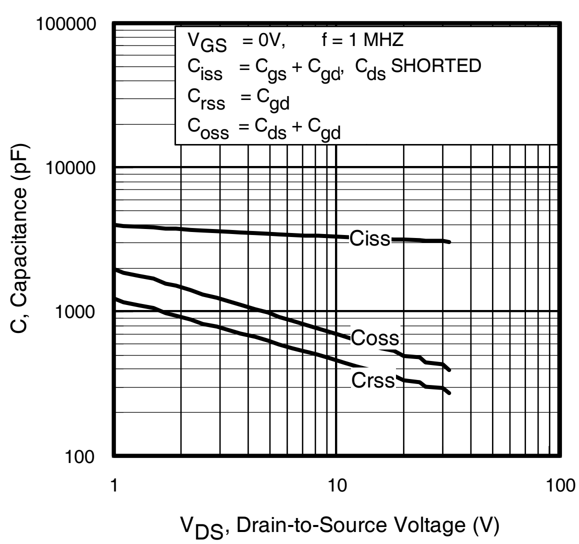

Fig 7. Typical Capacitance vs. Drain-to-Source Voltage

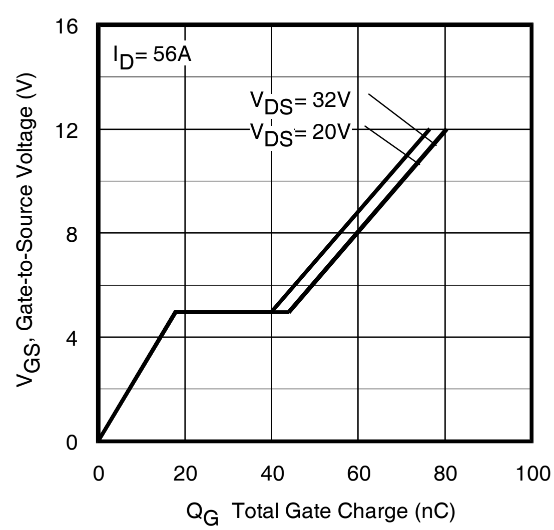

Fig 8. Typical Gate Charge vs. Gate-to-Source Voltage

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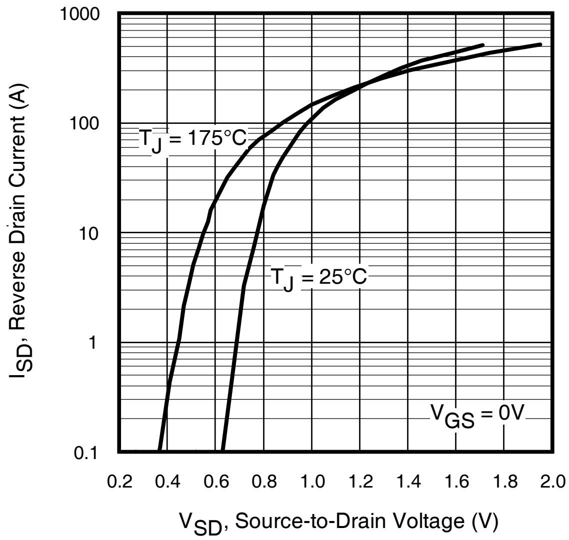

Fig 9. Typical Source-Drain Diode Forward Voltage

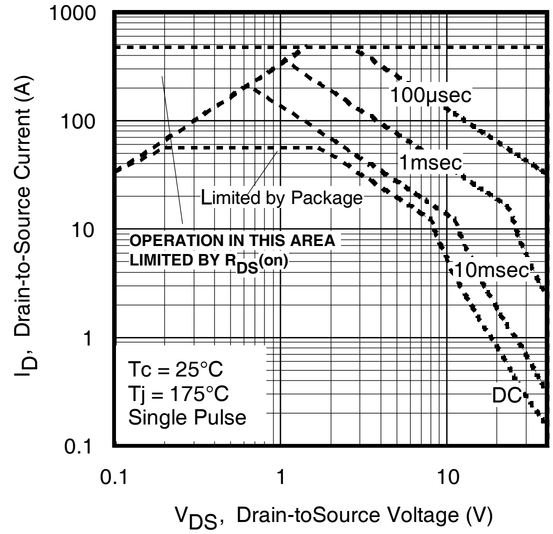

Fig 10. Maximum Safe Operating Area

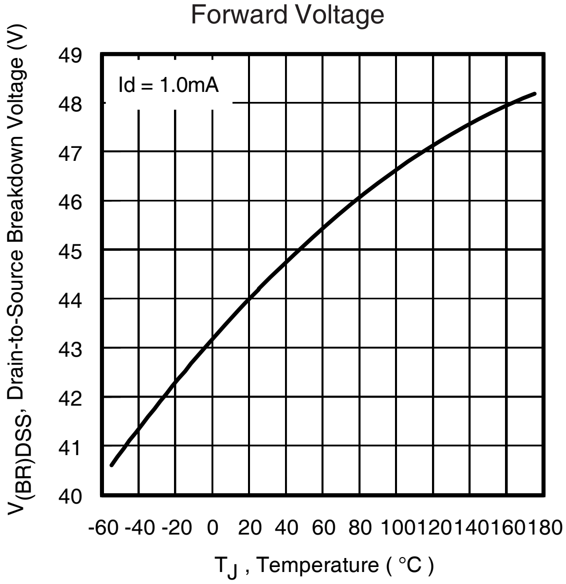

Fig 11. Drain-to-Source Breakdown Voltage

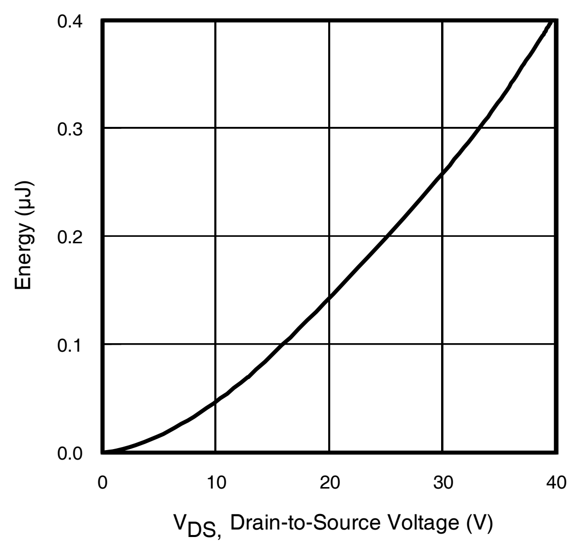

Fig 12. Typical C_{OSS} Stored Energy

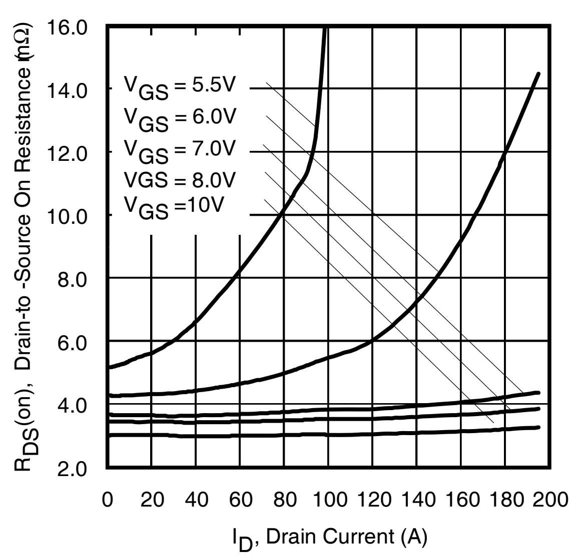

Fig 13. Typical On-Resistance vs. Drain Current

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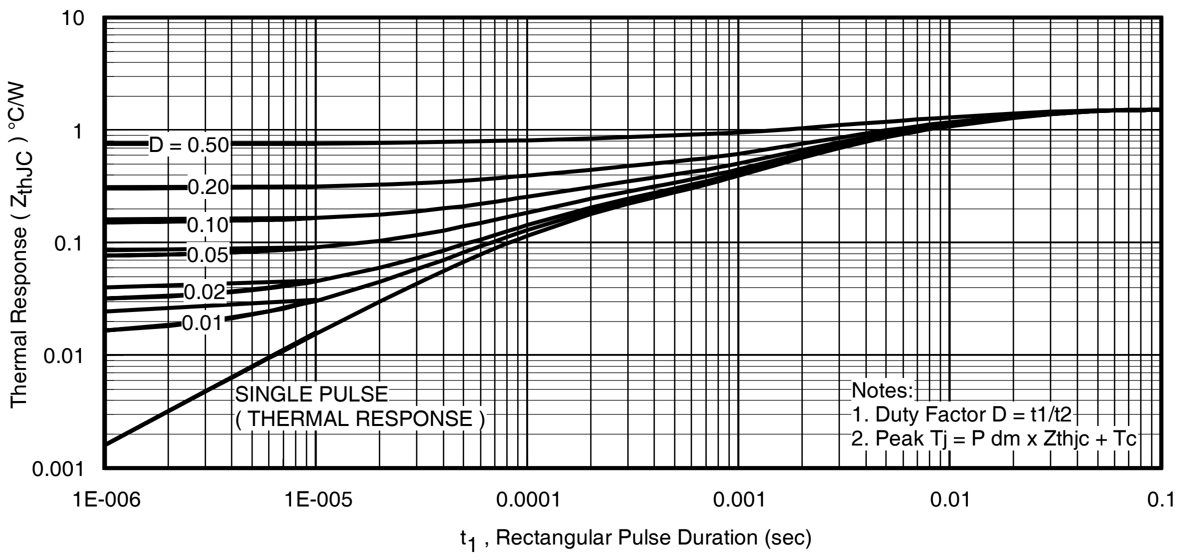

Fig 14. Maximum Effective Transient Thermal Impedance, Junction-to-Case

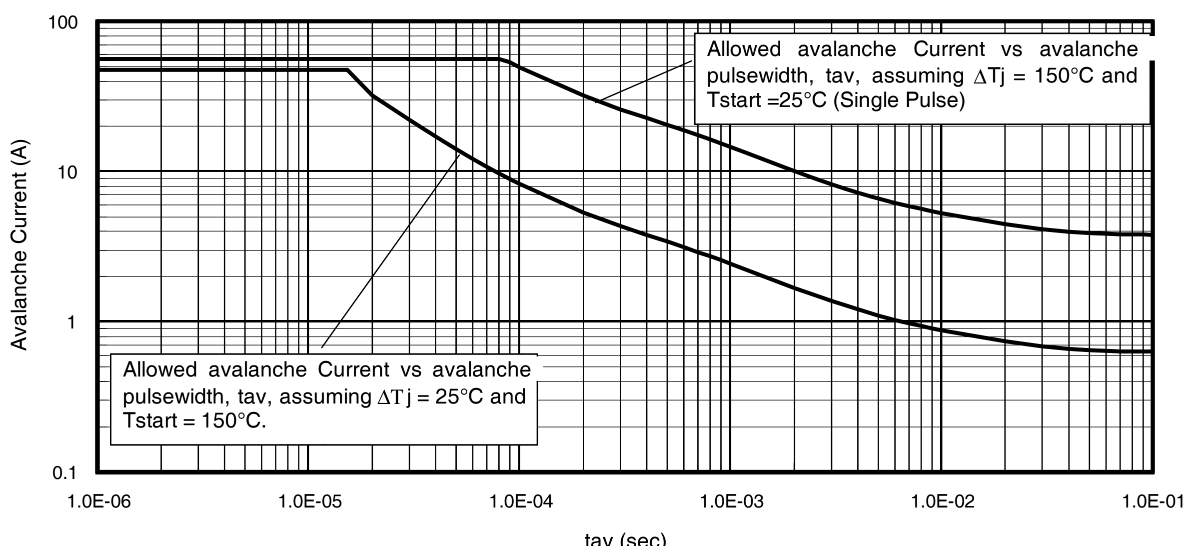

Fig 15. Typical Avalanche Current vs.Pulsewidth

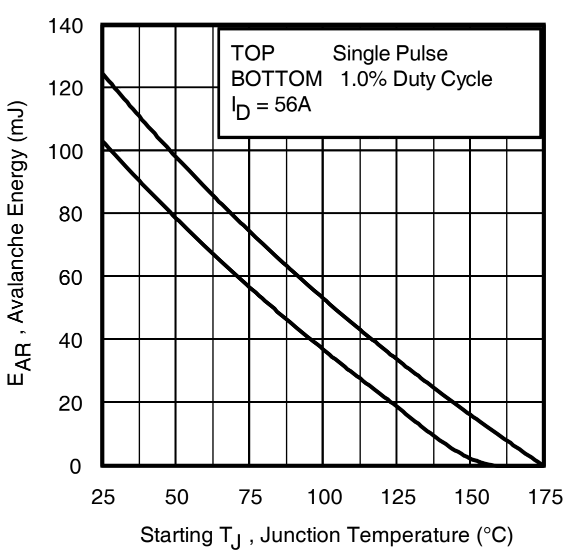

Fig 16. Maximum Avalanche Energy vs. Temperature

Notes on Repetitive Avalanche Curves , Figures 14, 15:
(For further info, see AN-1005 at www.irf.com)

1. Avalanche failures assumption:
   Purely a thermal phenomenon and failure occurs at a temperature far in excess of T_{jmax}. This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as T_{jmax} is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 23a, 23b.
4. $P_{D\ (ave)}$ = Average power dissipation per single avalanche pulse.
5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
6. I_{av} = Allowable avalanche current.
7. ΔT = Allowable rise in junction temperature, not to exceed T_{jmax} (assumed as 25°C in Figure 14, 15).
   t_{av} = Average time in avalanche.
   D = Duty cycle in avalanche = $t_{av} \cdot f$
   $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see Figures 14)

$$P_{D\ (ave)} = 1/2\ (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$
$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$
$$E_{AS\ (AR)} = P_{D\ (ave)} \cdot t_{av}$$

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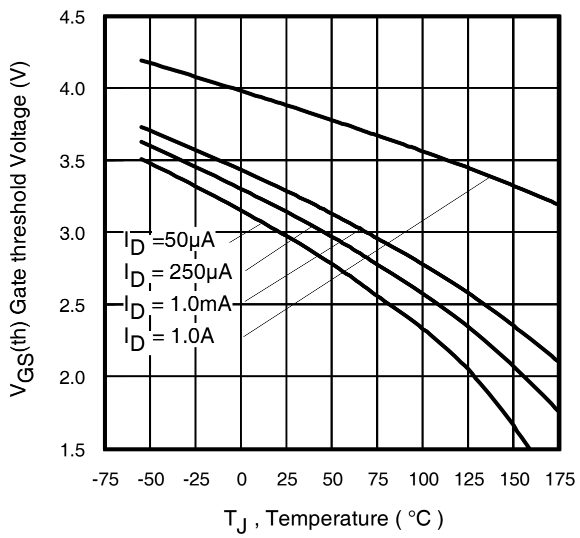

Fig 17. Threshold Voltage vs. Temperature

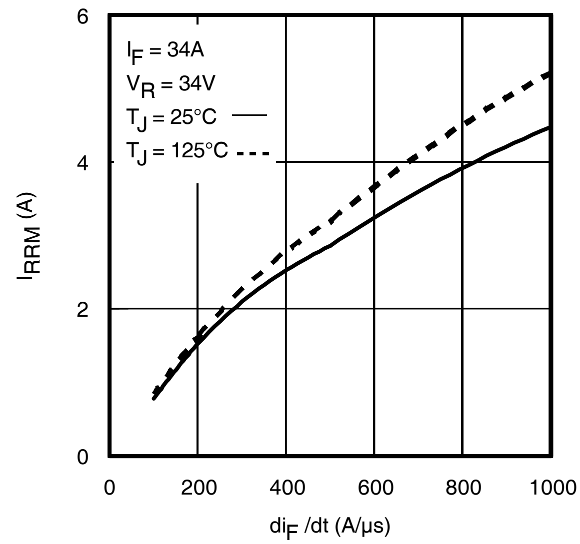

Fig. 18 - Typical Recovery Current vs. di_f/dt

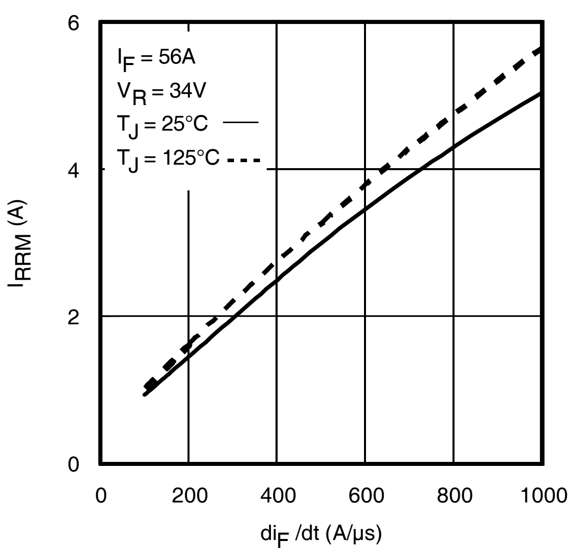

Fig. 19 - Typical Recovery Current vs. di_f/dt

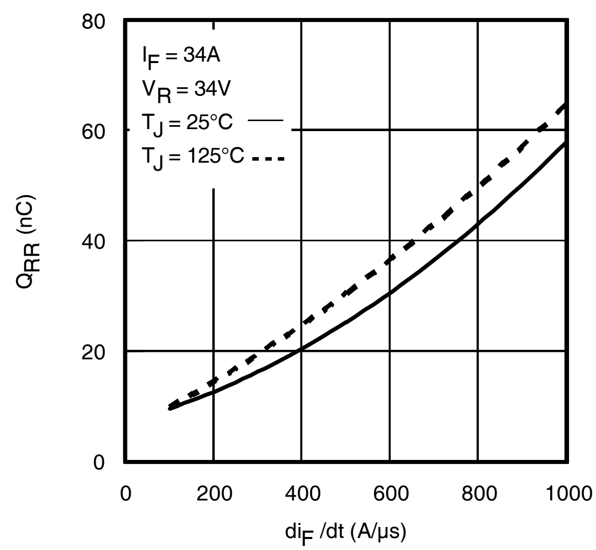

Fig. 20 - Typical Stored Charge vs. di_f/dt

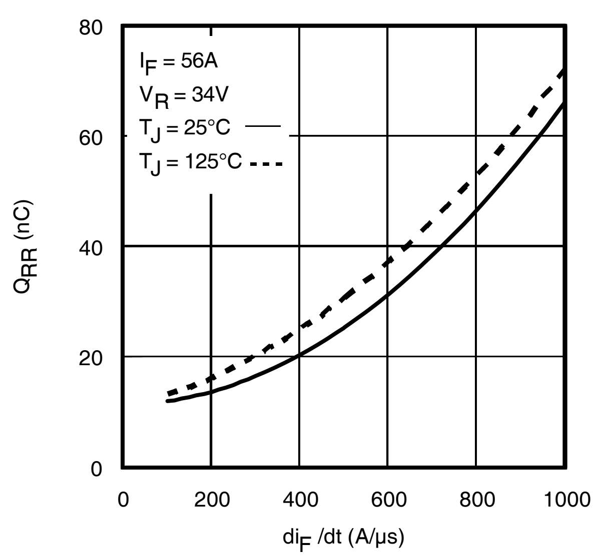

Fig. 21 - Typical Stored Charge vs. di_f/dt

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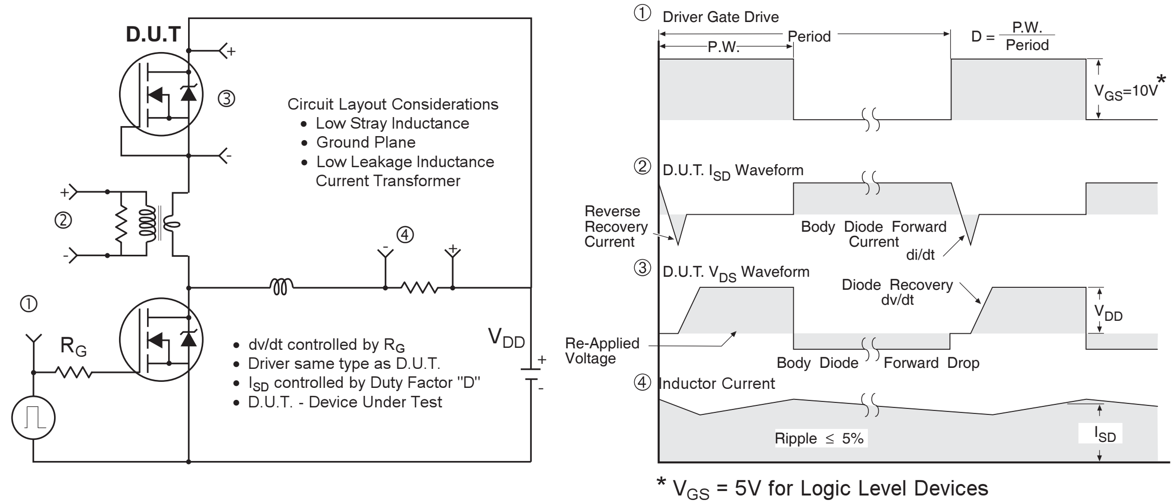

Fig 22. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

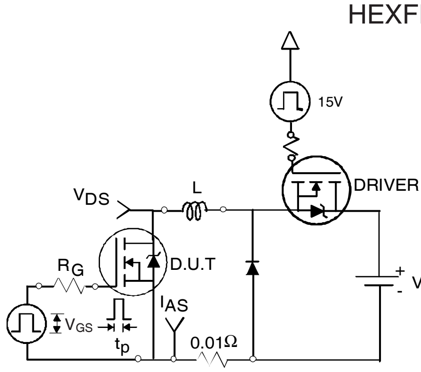

Fig 23a. Unclamped Inductive Test Circuit

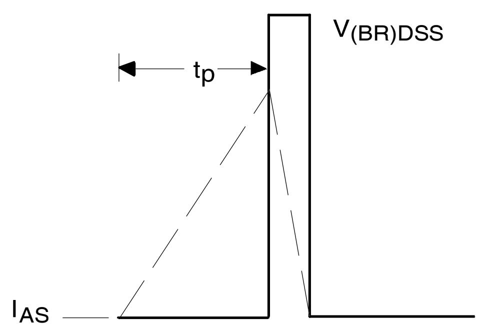

Fig 23b. Unclamped Inductive Waveforms

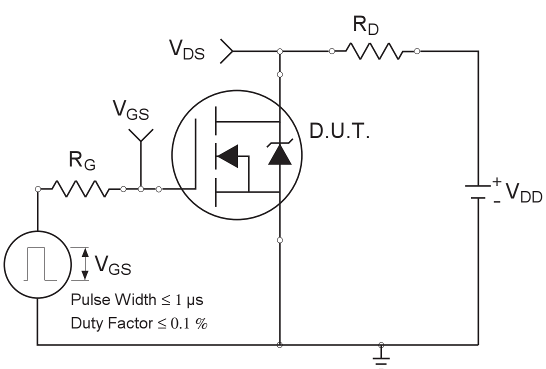

Fig 24a. Switching Time Test Circuit

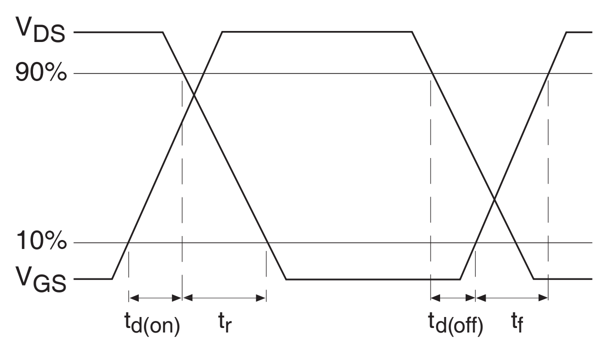

Fig 24b. Switching Time Waveforms

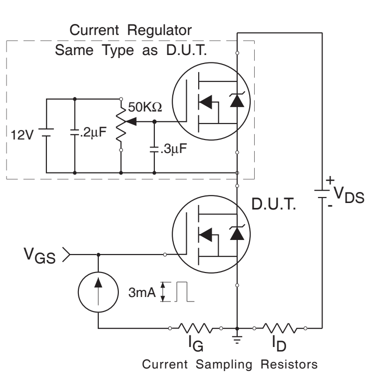

Fig 25a. Gate Charge Test Circuit

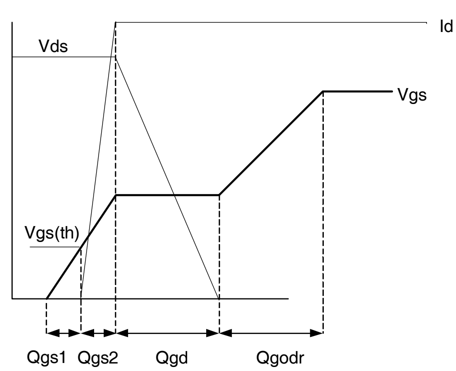

Fig 25b. Gate Charge Waveform

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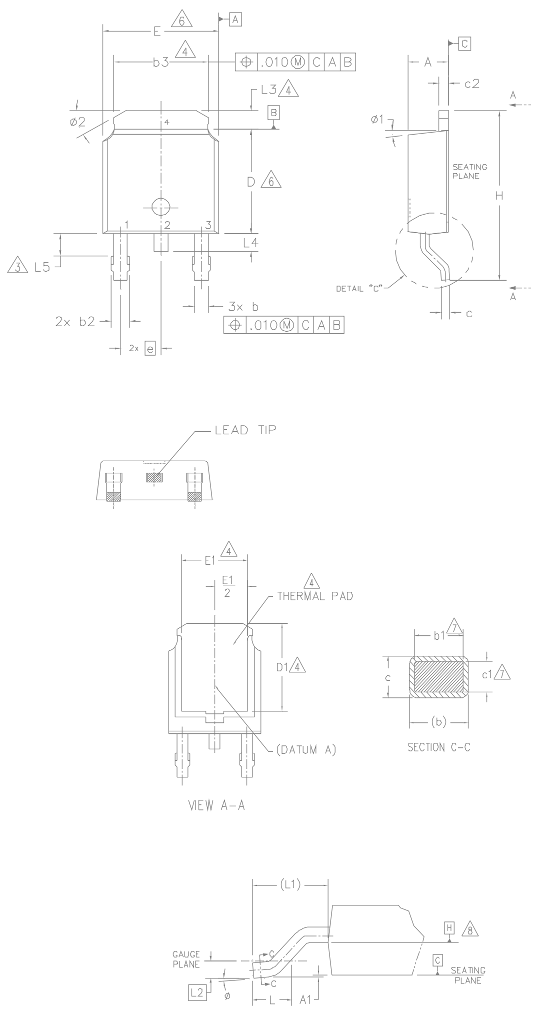
D-Pak (TO-252AA) Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

1.– DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994

2.– DIMENSION ARE SHOWN IN INCHES [MILLIMETERS].

3.– LEAD DIMENSION UNCONTROLLED IN L5.

4.– DIMENSION D1, E1, L3 & b3 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.

5.– SECTION C–C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 AND 0.10 [0.13 AND 0.25] FROM THE LEAD TIP.

6.– DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .006 [0.15] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.

7.– DIMENSION b1 & c1 APPLIED TO BASE METAL ONLY.

8.– DATUM A & B TO BE DETERMINED AT DATUM PLANE H.

9.– OUTLINE CONFORMS TO JEDEC OUTLINE TO–252AA.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	2.18	2.39	.086	.094	
A1	–	0.13	–	.005	
b	0.64	0.89	.025	.035	
b1	0.64	0.79	.025	.031	7
b2	0.76	1.14	.030	.045	
b3	4.95	5.46	.195	.215	4
c	0.46	0.61	.018	.024	
c1	0.41	0.56	.016	.022	7
c2	0.46	0.89	.018	.035	
D	5.97	6.22	.235	.245	6
D1	5.21	–	.205	–	4
E	6.35	6.73	.250	.265	6
E1	4.32	–	.170	–	4
e	2.29 BSC		.090 BSC		
H	9.40	10.41	.370	.410	
L	1.40	1.78	.055	.070	
L1	2.74 BSC		.108 REF.		
L2	0.51 BSC		.020 BSC		
L3	0.89	1.27	.035	.050	4
L4	–	1.02	–	.040	
L5	1.14	1.52	.045	.060	3
ø	0°	10°	0°	10°	
ø1	0°	15°	0°	15°	
ø2	25°	35°	25°	35°	

LEAD ASSIGNMENTS

HEXFET

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

IGBT & CoPAK

1.– GATE
2.– COLLECTOR
3.– EMITTER
4.– COLLECTOR

D-Pak (TO-252AA) Part Marking Information

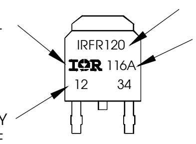
EXAMPLE: THIS IS AN IRFR120
WITH ASSEMBLY
LOT CODE 1234
ASSEMBLED ON WW 16, 2001
IN THE ASSEMBLY LINE "A"

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

"P̄" in assembly line position indicates "Lead-Free" qualification to the consumer-level

INTERNATIONAL RECTIFIER LOGO

ASSEMBLY LOT CODE



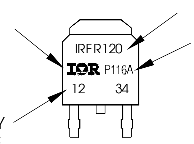
PART NUMBER

DATE CODE
YEAR 1 = 2001
WEEK 16
LINE A

OR

INTERNATIONAL RECTIFIER LOGO

ASSEMBLY LOT CODE



PART NUMBER

DATE CODE
P = DESIGNATES LEAD-FREE PRODUCT (OPTIONAL)
P̄ = DESIGNATES LEAD-FREE PRODUCT QUALIFIED TO THE CONSUMER LEVEL (OPTIONAL)
YEAR 1 = 2001
WEEK 16
A = ASSEMBLY SITE CODE

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

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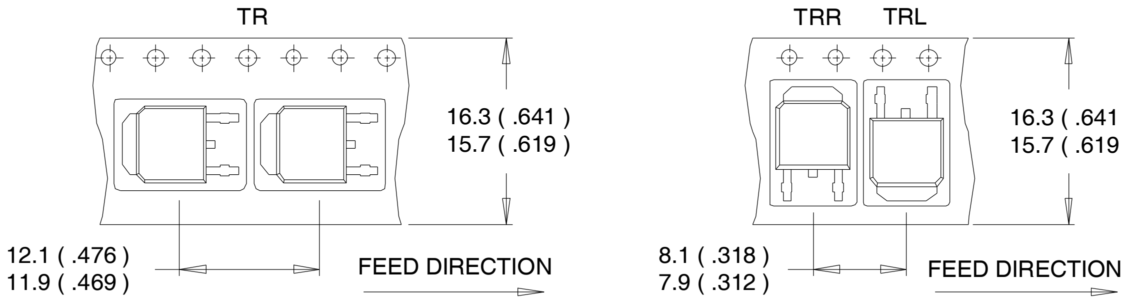
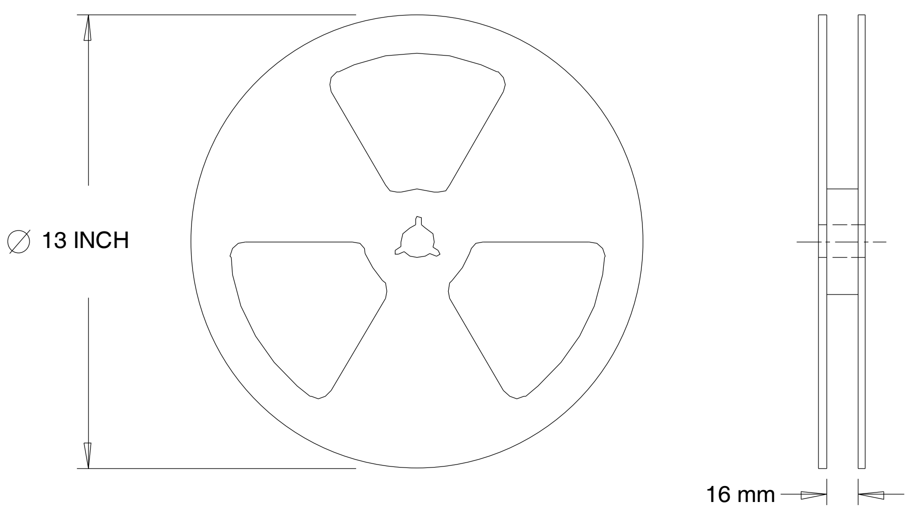
D-Pak (TO-252AA) Tape & Reel Information

Dimensions are shown in millimeters (inches)



NOTES :
1. CONTROLLING DIMENSION : MILLIMETER.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
3. OUTLINE CONFORMS TO EIA-481 & EIA-541.



NOTES :
1. OUTLINE CONFORMS TO EIA-481.

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

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Qualification information†

Qualification level	Industrial†† (per JEDEC JESD47F††† guidelines)	
Moisture Sensitivity Level	D-PAK	MSL1 (per JEDEC J-STD-020D†††)
RoHS compliant	Yes	

† Qualification standards can be found at International Rectifier's web site: http://www.irf.com/product-info/reliability/

†† Higher qualification ratings may be available should the user have such requirements. Please contact your International Rectifier sales representative for further information: http:www.irf.com/whoto-call/salesrep/

††† Applicable version of JEDEC standard at the time of product release.

Revision History

Date	Comment
1/6/2015	• Updated $E_{AS\ (L=1mH)}$ = 251mJ on page 2 • Updated note 10 "Limited by T_{Jmax}, starting T_J = 25°C, L = 1mH, R_G = 50Ω, I_{AS} = 22A, V_{GS} =10V". on page 2 • Updated package outline on page 9.

International Rectifier

IR WORLD HEADQUARTERS: 101 N. Sepulveda Blvd., El Segundo, California 90245, USA

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