

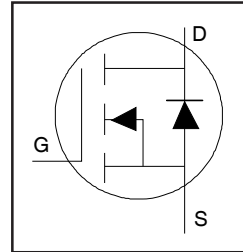
Applications

- Brushed Motor drive applications
- BLDC Motor drive applications
- Battery powered circuits
- Half-bridge and full-bridge topologies
- Synchronous rectifier applications
- Resonant mode power supplies
- OR-ing and redundant power switches
- DC/DC and AC/DC converters
- DC/AC Inverters

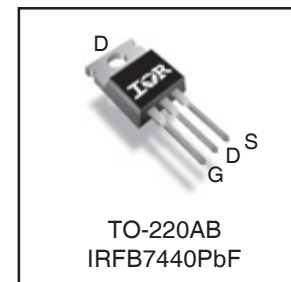
Benefits

- Improved Gate, Avalanche and Dynamic dv/dt Ruggedness
- Fully Characterized Capacitance and Avalanche SOA
- Enhanced body diode dV/dt and dI/dt Capability
- Lead-Free
- RoHS Compliant, Halogen-Free*

HEXFET® Power MOSFET



V_{DS}	40V
$R_{DS(on)}$ typ. max.	2.0mΩ 2.5mΩ
I_D	172A①
I_D (Package Limited)	120A



G	D	S
Gate	Drain	Source

Base Part Number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
IRFB7440PbF	TO-220	Tube	50	IRFB7440PbF

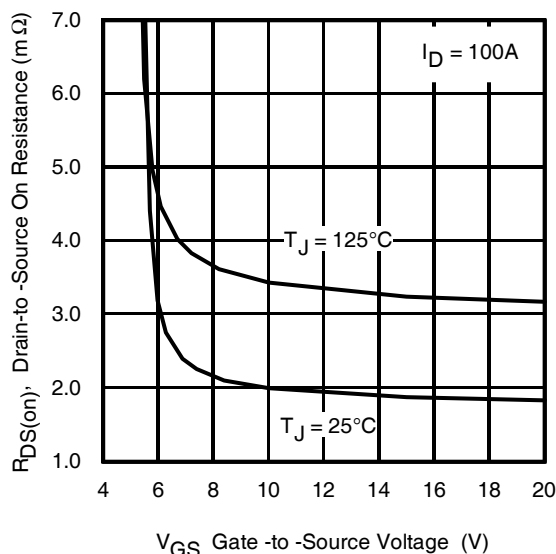


Fig 1. Typical On-Resistance vs. Gate Voltage

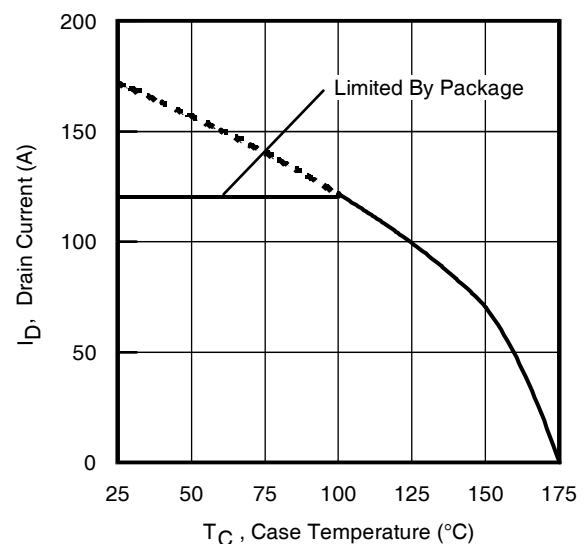


Fig 2. Maximum Drain Current vs. Case Temperature

Absolute Maximum Ratings

Symbol	Parameter	Max.	Units
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	172①	A
I_D @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	122①	
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V (Wire Bond Limited)	120	
I_{DM}	Pulsed Drain Current ②	772	
P_D @ $T_C = 25^\circ\text{C}$	Maximum Power Dissipation	143	W
	Linear Derating Factor	0.95	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
T_J	Operating Junction and	-55 to + 175	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds (1.6mm from case)	300	
	Mounting torque, 6-32 or M3 screw	10lbf·in (1.1N·m)	

Avalanche Characteristics

E_{AS} (Thermally limited)	Single Pulse Avalanche Energy ③	161	mJ
E_{AS} (Thermally limited)	Single Pulse Avalanche Energy ④	387	
I_{AR}	Avalanche Current ②	See Fig. 14, 15, 22a, 22b	A
E_{AR}	Repetitive Avalanche Energy ②		mJ

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ③	—	1.05	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient	—	62	

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	40	—	—	V	$V_{GS} = 0V$, $I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.035	—	V/°C	Reference to 25°C , $I_D = 5.0mA$ ②
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	2.0	2.5	mΩ	$V_{GS} = 10V$, $I_D = 100A$ ⑤
		—	3.0	—	mΩ	$V_{GS} = 6.0V$, $I_D = 50A$ ⑤
$V_{GS(th)}$	Gate Threshold Voltage	2.2	3.0	3.9	V	$V_{DS} = V_{GS}$, $I_D = 100\mu A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	1.0	μA	$V_{DS} = 40V$, $V_{GS} = 0V$
		—	—	150		$V_{DS} = 40V$, $V_{GS} = 0V$, $T_J = 125^\circ\text{C}$
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	—	2.6	—	Ω	

Notes:

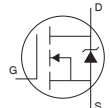
- ① Calculated continuous current based on maximum allowable junction temperature. Bond wire current limit is 120A. Note that current limitations arising from heating of the device leads may occur with some lead mounting arrangements. (Refer to AN-1140)
- ② Repetitive rating; pulse width limited by max. junction temperature.
- ③ Limited by T_{Jmax} , starting $T_J = 25^\circ\text{C}$, $L = 0.032mH$
 $R_G = 50\Omega$, $I_{AS} = 100A$, $V_{GS} = 10V$.
- ④ $I_{SD} \leq 100A$, $di/dt \leq 1330A/\mu s$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 175^\circ\text{C}$.
- ⑤ Pulse width $\leq 400\mu s$; duty cycle $\leq 2\%$.
- 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 R_θ is measured at T_J approximately 90°C .
- ⑨ Limited by T_{Jmax} , starting $T_J = 25^\circ\text{C}$, $L = 1mH$, $R_G = 50\Omega$, $I_{AS} = 28A$, $V_{GS} = 10V$.
- * Halogen -Free since April 30, 2014

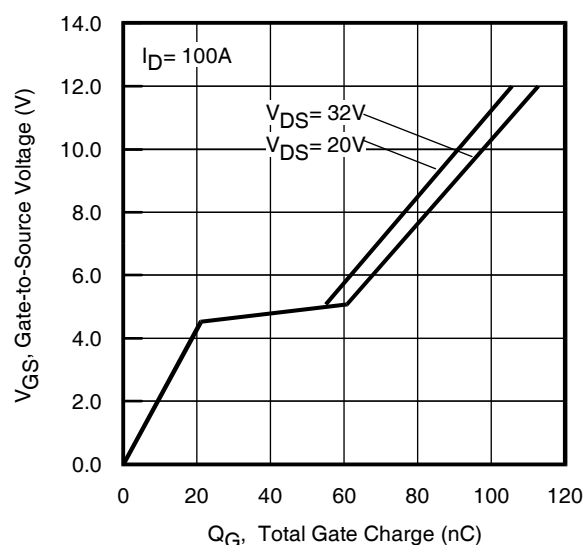
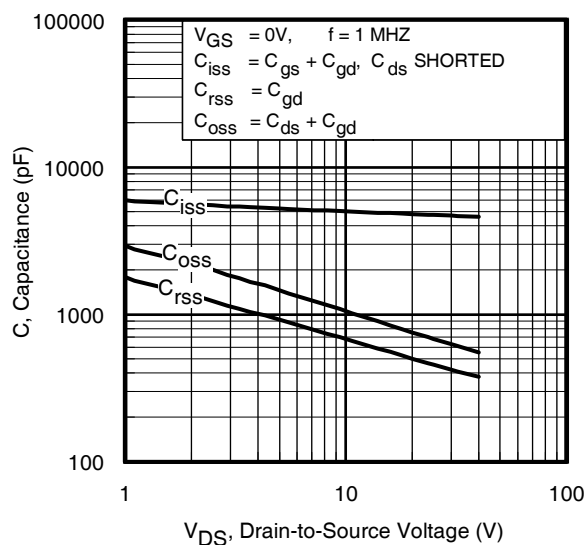
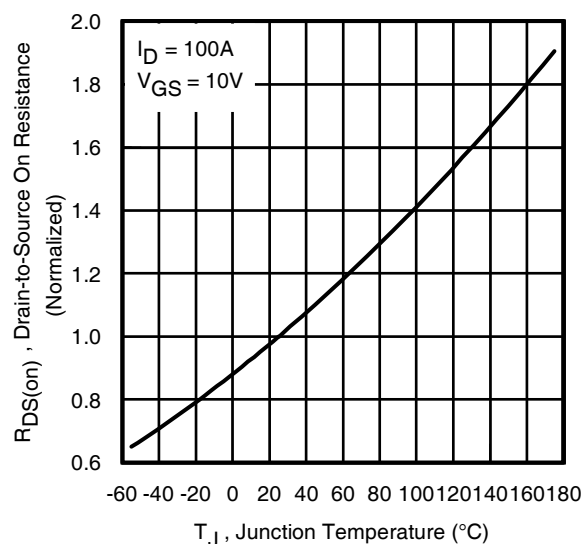
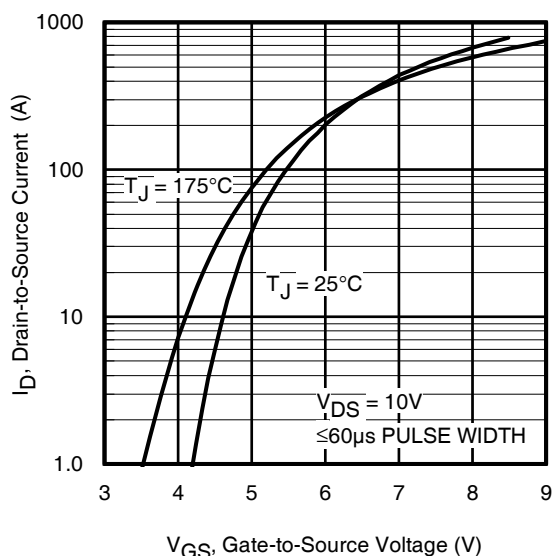
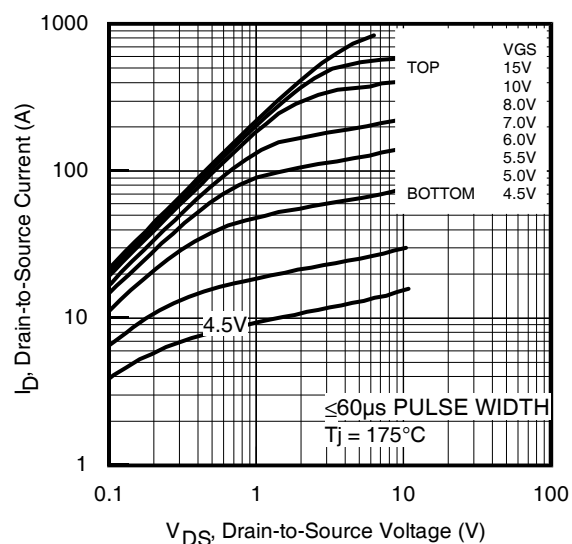
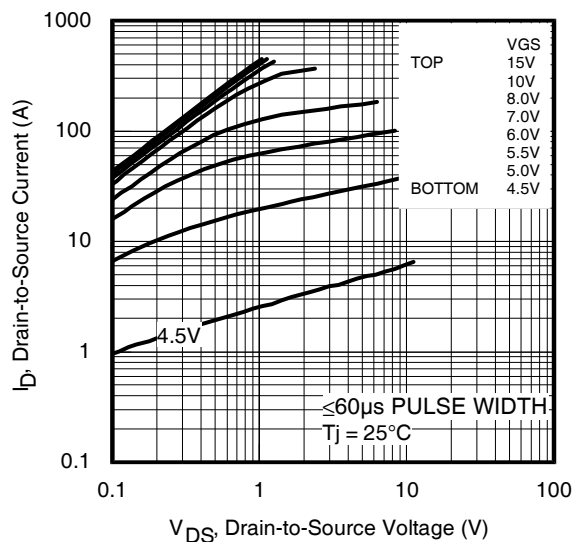
Dynamic @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

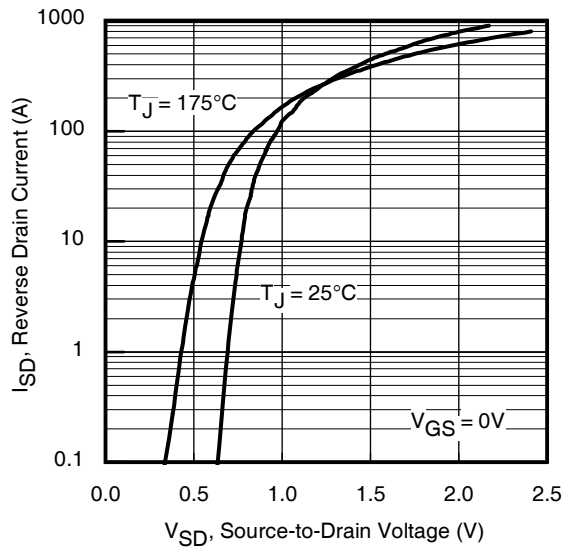
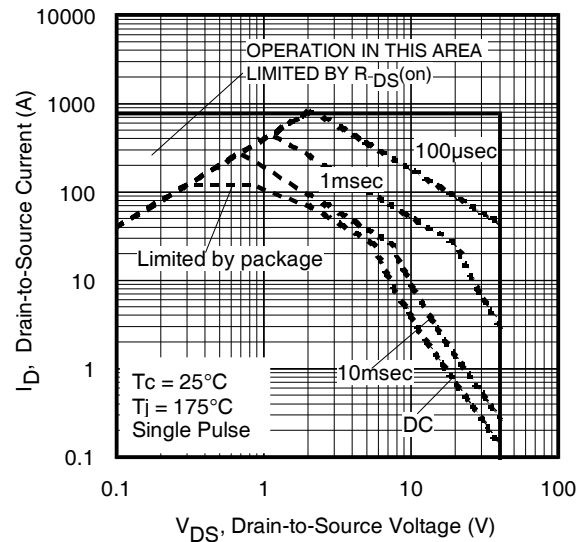
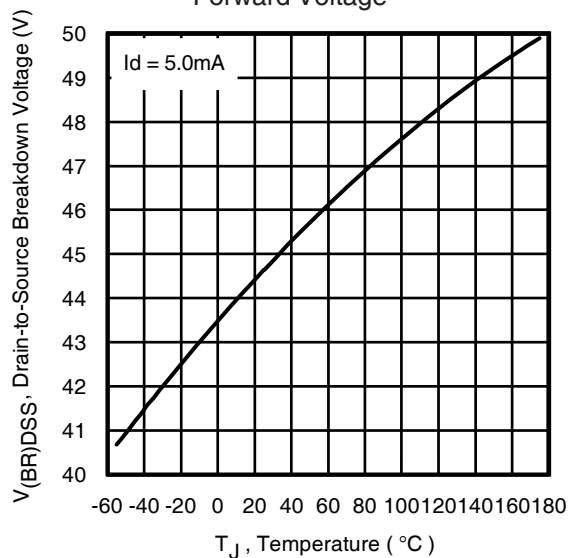
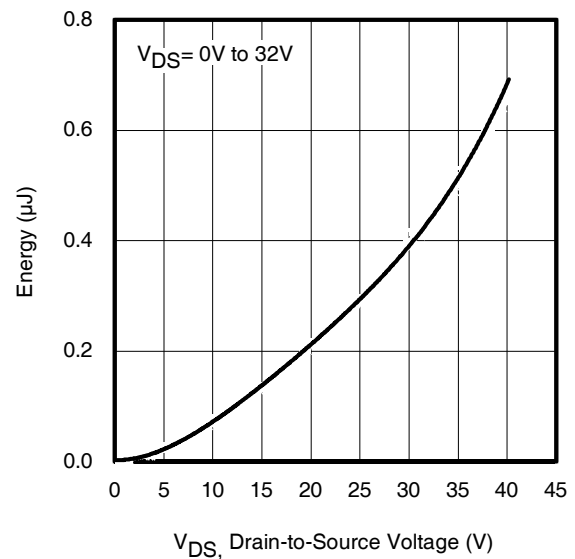
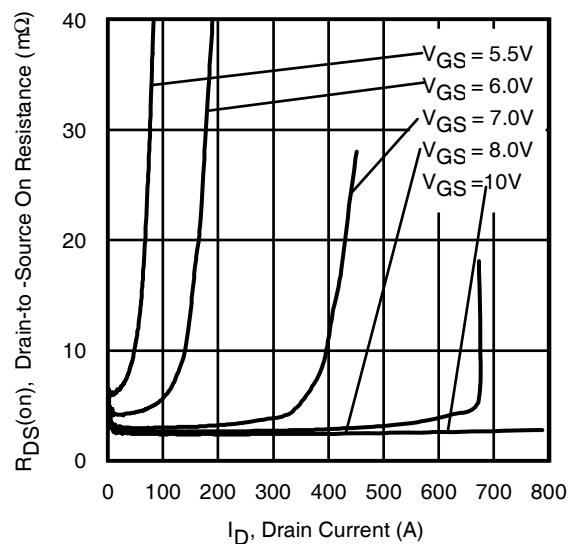
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
g_{fs}	Forward Transconductance	88	—	—	S	$V_{DS} = 10\text{V}$, $I_D = 100\text{A}$
Q_g	Total Gate Charge	—	90	135	nC	$I_D = 100\text{A}$ $V_{DS} = 20\text{V}$ $V_{GS} = 10\text{V}$ ⑤
Q_{gs}	Gate-to-Source Charge	—	23	—		
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	32	—		
Q_{sync}	Total Gate Charge Sync. ($Q_g - Q_{gd}$)	—	58	—		
$t_{d(on)}$	Turn-On Delay Time	—	24	—	ns	$V_{DD} = 20\text{V}$ $I_D = 30\text{A}$ $R_G = 2.7\Omega$ $V_{GS} = 10\text{V}$ ⑤
t_r	Rise Time	—	68	—		
$t_{d(off)}$	Turn-Off Delay Time	—	115	—		
t_f	Fall Time	—	68	—		
C_{iss}	Input Capacitance	—	4730	—	pF	$V_{GS} = 0\text{V}$ $V_{DS} = 25\text{V}$ $f = 1.0\text{ MHz}$ $V_{GS} = 0\text{V}$, $V_{DS} = 0\text{V}$ to 32V ⑦ $V_{GS} = 0\text{V}$, $V_{DS} = 0\text{V}$ to 32V ⑥
C_{oss}	Output Capacitance	—	680	—		
C_{rss}	Reverse Transfer Capacitance	—	460	—		
$C_{oss \text{ eff. (ER)}}$	Effective Output Capacitance (Energy Related)	—	845	—		
$C_{oss \text{ eff. (TR)}}$	Effective Output Capacitance (Time Related)	—	980	—		

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	172	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ②	—	—	772	A	
V_{SD}	Diode Forward Voltage	—	0.9	1.3	V	$T_J = 25^\circ\text{C}$, $I_S = 100\text{A}$, $V_{GS} = 0\text{V}$ ⑤
dv/dt	Peak Diode Recovery ④	—	6.8	—	V/ns	$T_J = 175^\circ\text{C}$, $I_S = 100\text{A}$, $V_{DS} = 40\text{V}$
t_{rr}	Reverse Recovery Time	—	24	—	ns	$T_J = 25^\circ\text{C}$ $V_R = 34\text{V}$, $T_J = 125^\circ\text{C}$ $I_F = 100\text{A}$ $T_J = 25^\circ\text{C}$ $di/dt = 100\text{A}/\mu\text{s}$ ⑤ $T_J = 125^\circ\text{C}$
Q_{rr}	Reverse Recovery Charge	—	17	—		
		—	20	—	nC	
I_{RRM}	Reverse Recovery Current	—	1.3	—	A	$T_J = 25^\circ\text{C}$






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

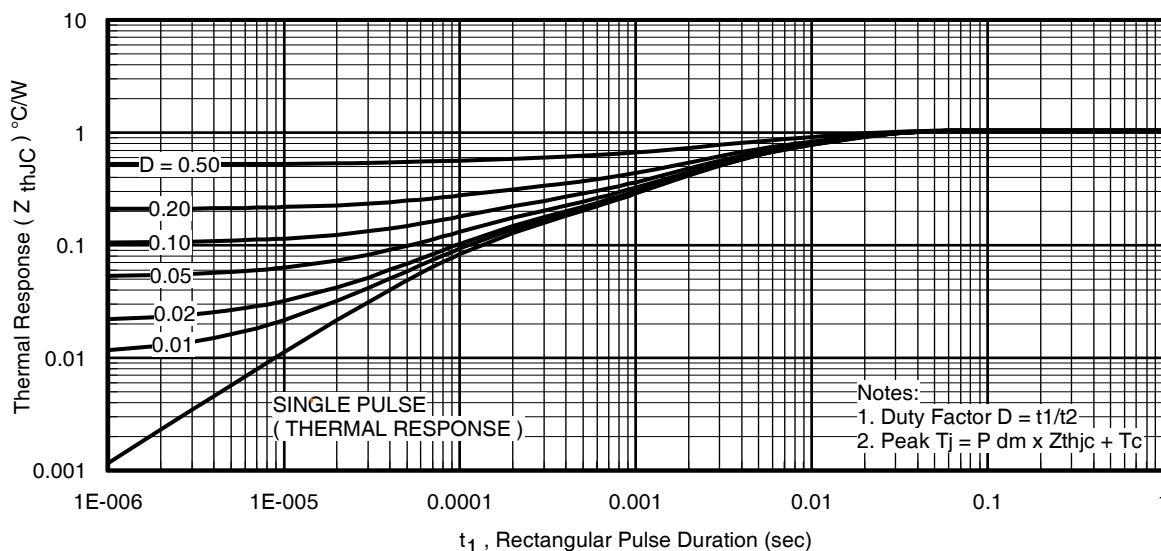


Fig 14. Maximum Effective Transient Thermal Impedance, Junction-to-Case

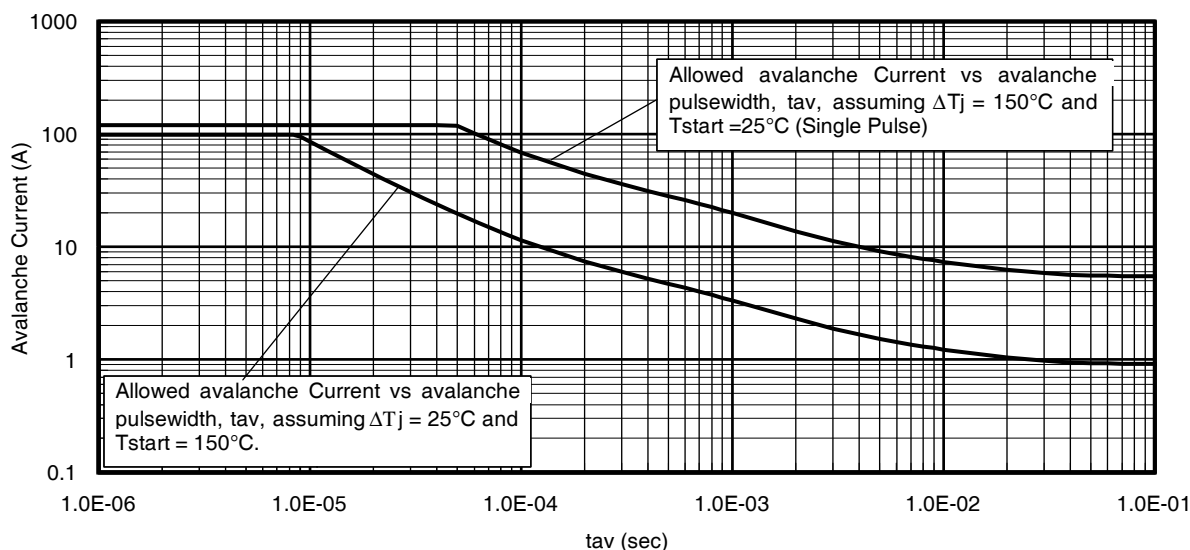


Fig 15. Typical Avalanche Current vs. Pulsewidth

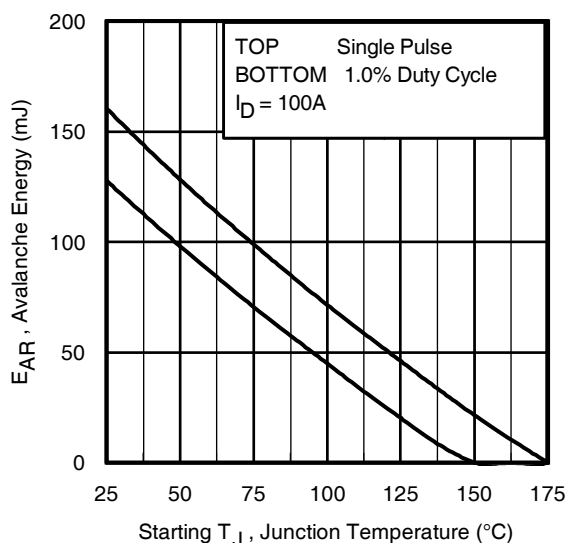


Fig 16. Maximum Avalanche Energy vs. Temperature

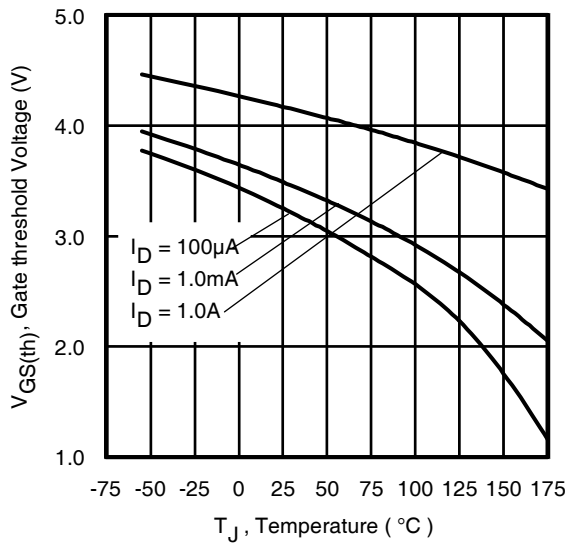
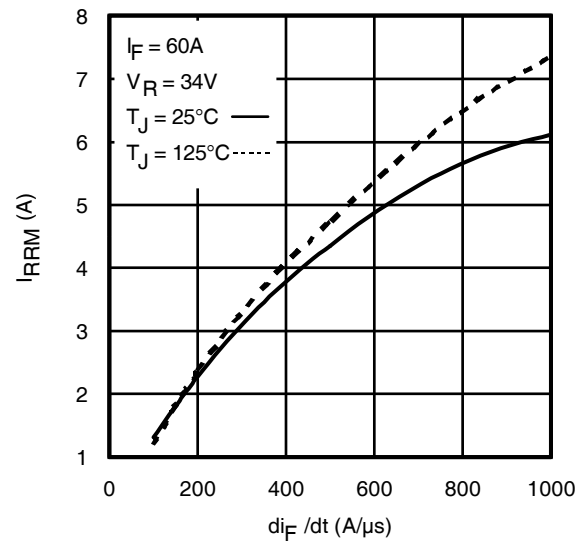
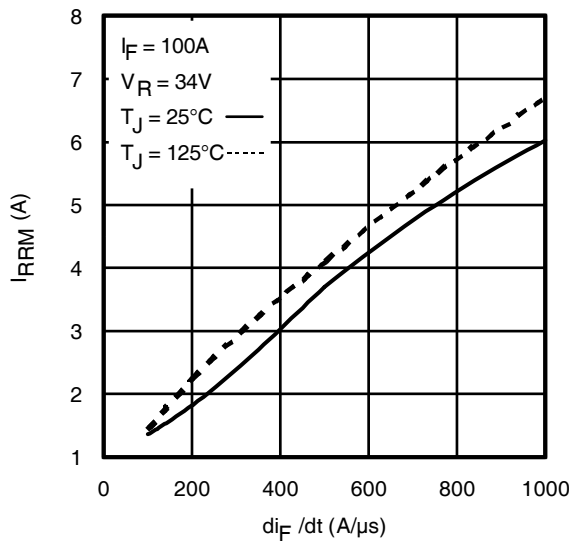
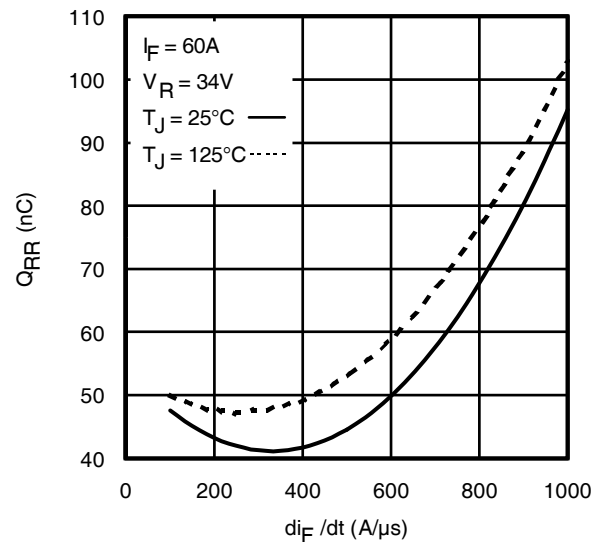
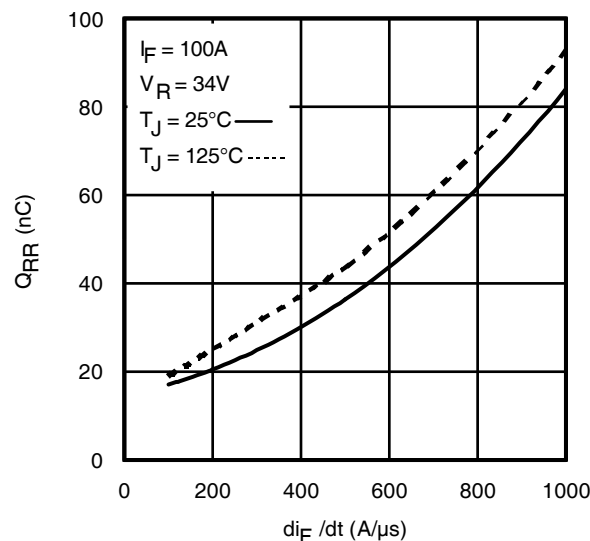
Notes on Repetitive Avalanche Curves , Figures 14, 15:
(For further info, see AN-1005 at www.irf.com)

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 16a, 16b.
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 13)

$$P_{D(ave)} = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$

$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$


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

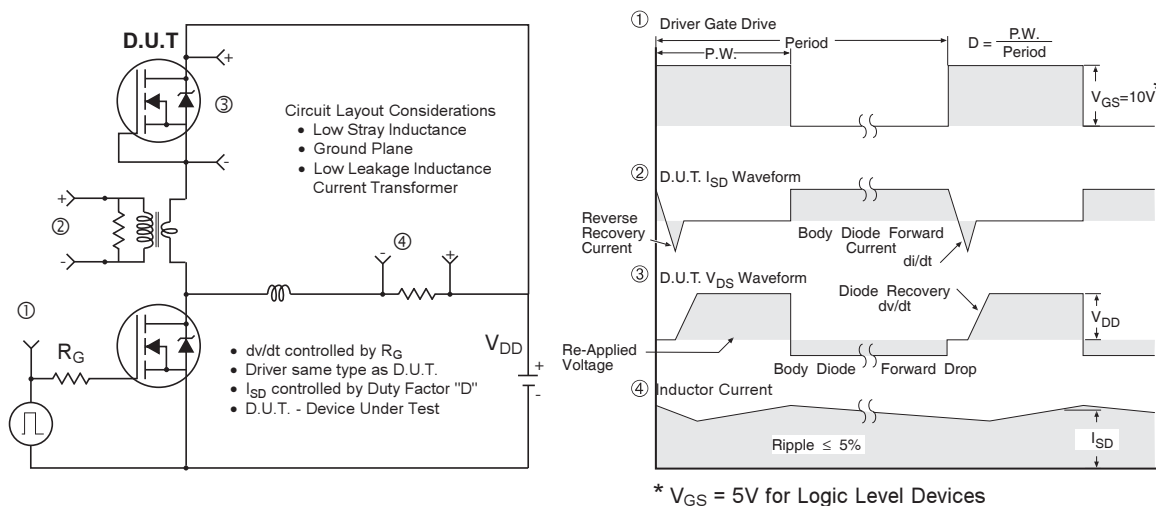


Fig 22. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

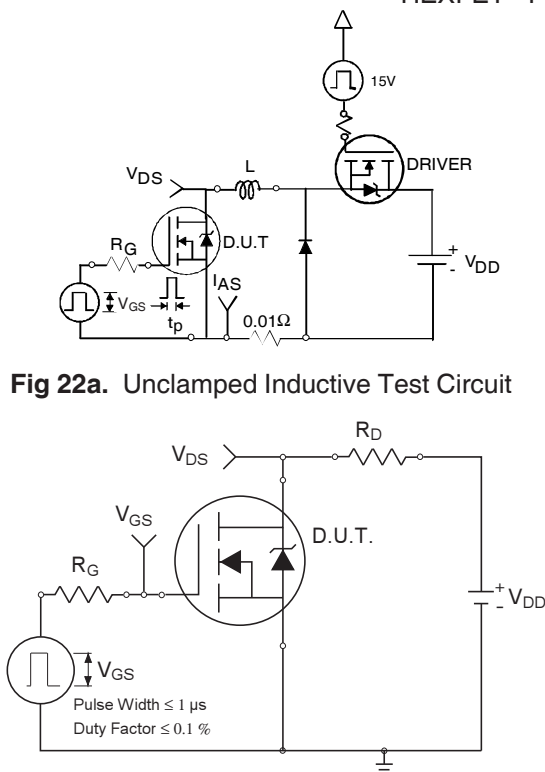


Fig 22a. Unclamped Inductive Test Circuit

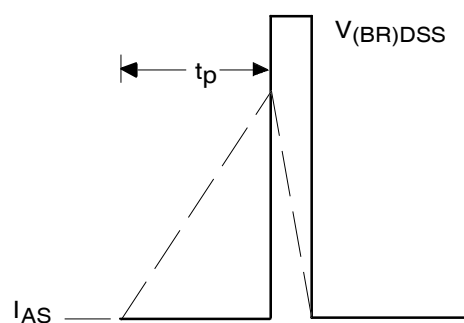


Fig 22b. Unclamped Inductive Waveforms

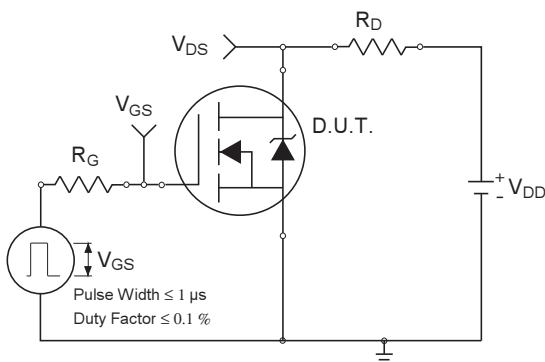


Fig 23a. Switching Time Test Circuit

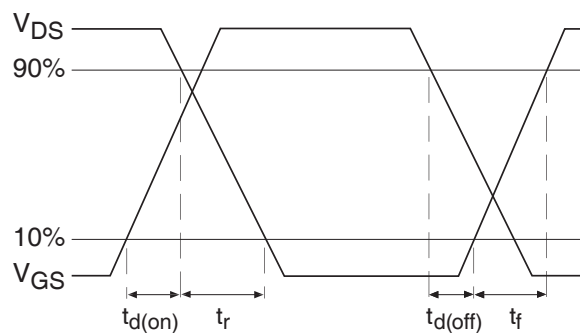


Fig 23b. Switching Time Waveforms

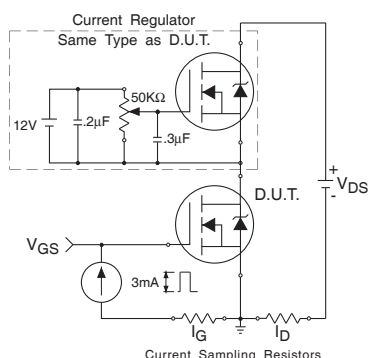


Fig 24a. Gate Charge Test Circuit

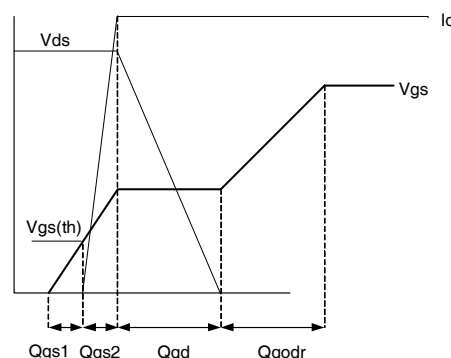
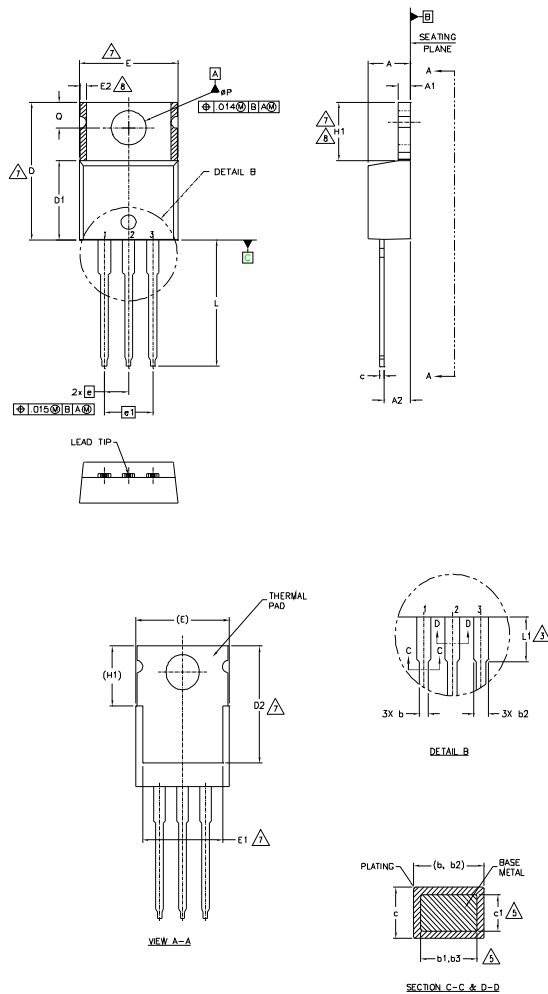


Fig 24b. Gate Charge Waveform

TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



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, b3 & 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.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.83	.140	.190	5
A1	1.14	1.40	.045	.055	
A2	2.03	2.92	.080	.115	
b	0.38	1.01	.015	.040	
b1	0.38	0.97	.015	.038	
b2	1.14	1.78	.045	.070	5
b3	1.14	1.73	.045	.068	
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	7
D2	11.68	12.88	.460	.507	
E	9.65	10.67	.380	.420	
E1	6.86	8.89	.270	.350	4,7
E2	—	0.76	—	.030	8
e	2.54 BSC		.100 BSC		7,8
e1	5.08 BSC		.200 BSC		
H1	5.84	6.86	.230	.270	
L	12.70	14.73	.500	.580	
L1	3.56	4.06	.140	.160	
øP	3.54	4.08	.139	.161	3
Q	2.54	3.42	.100	.135	

LEAD ASSIGNMENTS

HEXFET

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

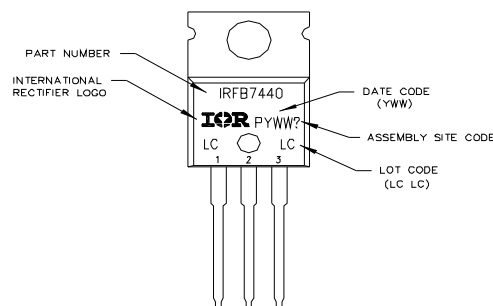
IGBTs, CoPACK

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

DIODES

- 1.- ANODE
- 2.- CATHODE
- 3.- ANODE

TO-220AB Part Marking Information



MARKING DESCRIPTION

PART#: IRFB7440
(P): LEAD FREE RELEASED
(Y): LAST DIGIT OF YEAR
(WW): WORK WEEK
(?): ASSEMBLY SITE CODE
(LC LC): LAST 4 DIGITS OF LOT CODE

TO-220AB packages are not recommended for Surface Mount Application.

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

Qualification information[†]

Qualification level	Industrial (per JEDEC JESD47F ^{††} guidelines)	
Moisture Sensitivity Level	TO-220	Not applicable
RoHS compliant	Yes	

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

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

Revision History

Date	Comment
4/22/2014	- Updated data sheet with new IR corporate template. - Updated package outline and part marking on page 9. - Added bullet point in the Benefits "RoHS Compliant, Halogen -Free" on page 1.
2/19/2015	- Updated $E_{AS}(L=1mH) = 387mJ$ on page 2 - Updated note 9 "Limited by T_{Jmax}, starting $T_J = 25^{\circ}C$, $L = 1mH$, $R_G = 50\Omega$, $I_{AS} = 28A$, $V_{GS} = 10V$". on page 2

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