

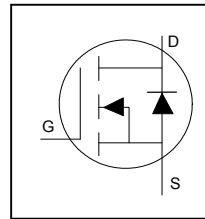
Application

- 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

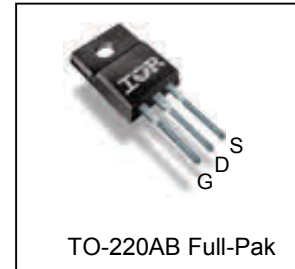
Benefits

- 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

HEXFET® Power MOSFET



V_{DSS}	40V
R_{DS(on)} typ.	2.0mΩ
	max
I_D	95A



G	D	S
Gate	Drain	Source

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRFI7440GPbF	TO-220 Full-Pak	Tube	50	IRFI7440GPbF

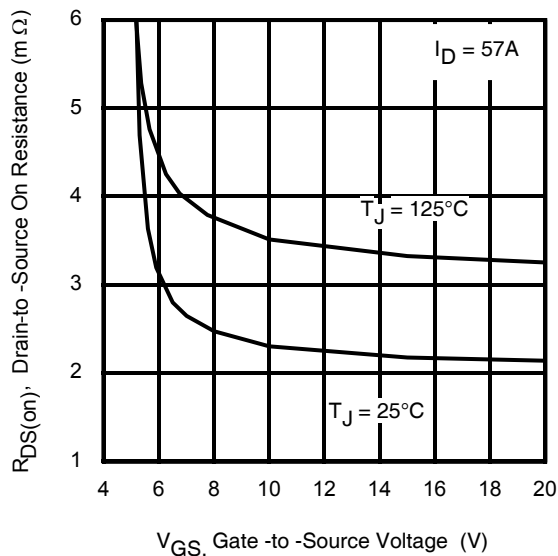


Fig 1. Typical On-Resistance vs. Gate Voltage

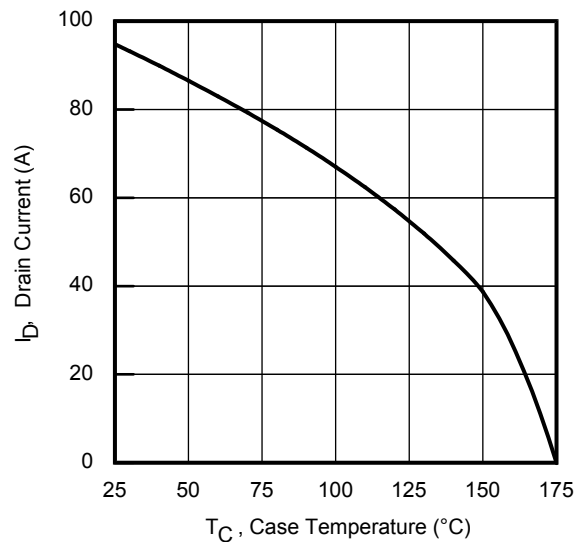


Fig 2. Maximum Drain Current vs. Case Temperature

Absolute Maximum Rating

Symbol	Parameter	Max.	Units
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$	95	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$	67	
I_{DM}	Pulsed Drain Current ①	380	
$P_D @ T_C = 25^\circ\text{C}$	Maximum Power Dissipation	42	W
	Linear Derating Factor	0.28	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)		
	Mounting Torque, 6-32 or M3 Screw	10 lbf-in (1.1 N·m)	

Avalanche Characteristics

E_{AS} (Thermally limited)	Single Pulse Avalanche Energy ②	201	mJ
E_{AS} (Thermally limited)	Single Pulse Avalanche Energy ③	407	
I_{AR}	Avalanche Current ①	See Fig. 15, 16, 23a, 23b	A
E_{AR}	Repetitive Avalanche Energy ①		mJ

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑦	—	3.6	°C/W
$R_{\theta JA}$	Junction-to-Ambient	—	65	

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	$V_{GS} = 0\text{V}, I_D = 250\mu\text{A}$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	37	—	mV/°C	Reference to $25^\circ\text{C}, I_D = 2\text{mA}$ ①
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	2.0	2.5	mΩ	$V_{GS} = 10\text{V}, I_D = 57\text{A}$
$V_{GS(th)}$	Gate Threshold Voltage	2.2	3.0	3.9	V	$V_{DS} = V_{GS}, I_D = 100\mu\text{A}$
I_{DSS}	Drain-to-Source Leakage Current	—	—	1.0	μA	$V_{DS} = 40\text{V}, V_{GS} = 0\text{V}$
		—	—	150		$V_{DS} = 40\text{V}, V_{GS} = 0\text{V}, T_J = 125^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 20\text{V}$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -20\text{V}$
R_G	Gate Resistance	—	2.3	—	Ω	

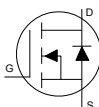
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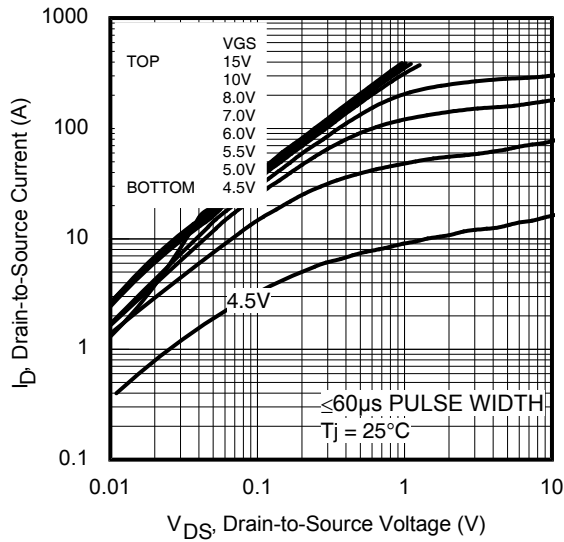
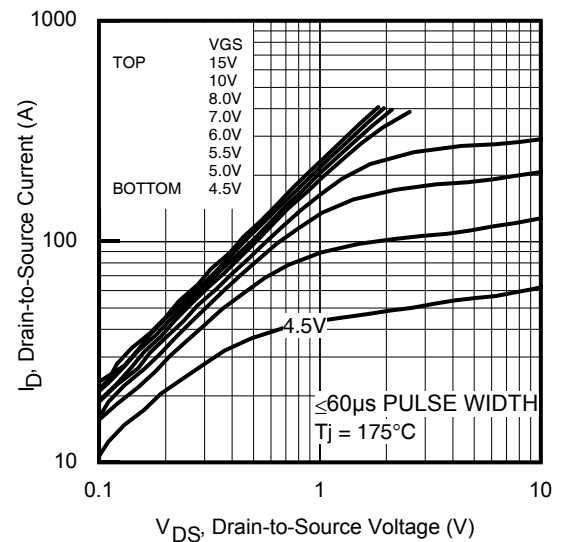
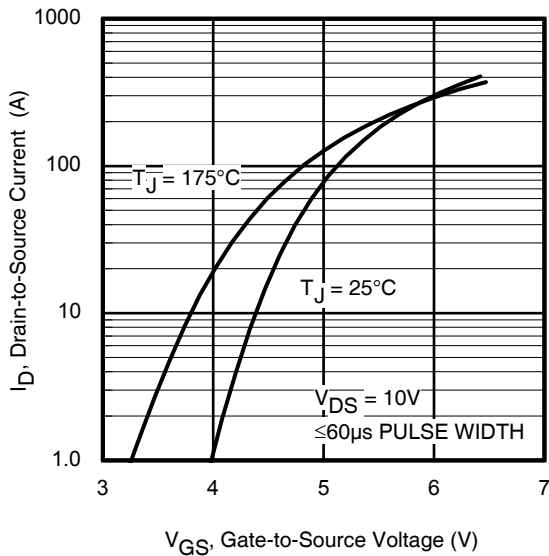
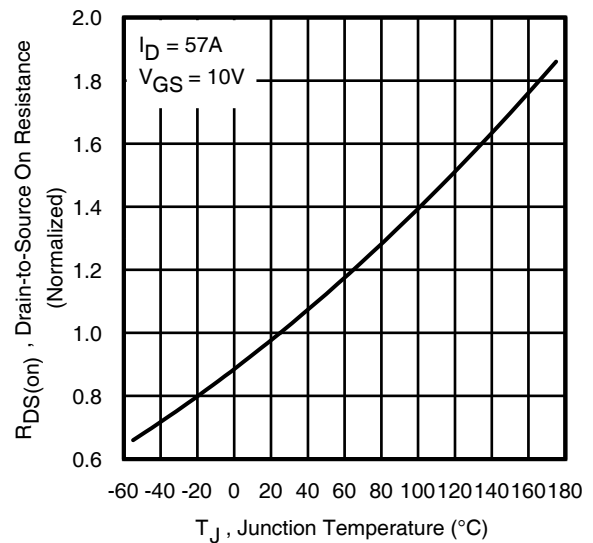
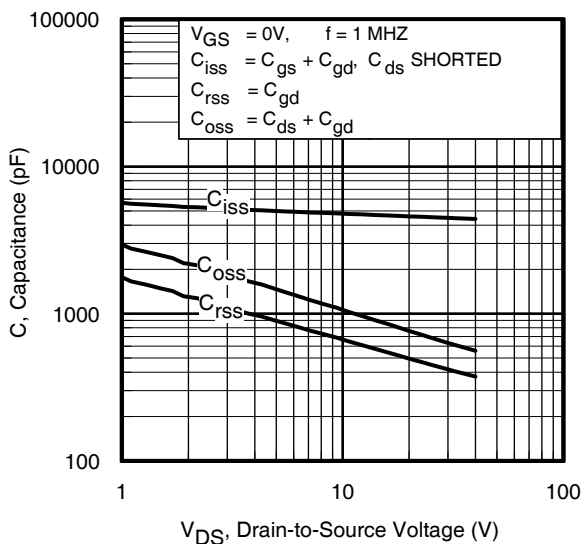
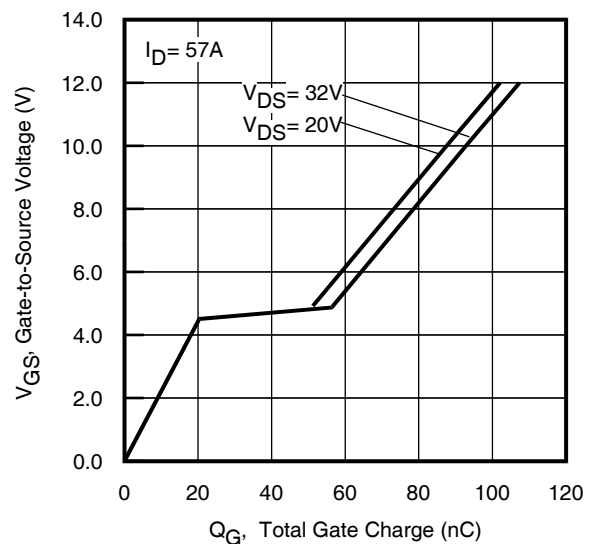
- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Limited by T_{Jmax} , starting $T_J = 25^\circ\text{C}$, $L = 124\mu\text{H}$, $R_G = 50\Omega$, $I_{AS} = 57\text{A}$, $V_{GS} = 10\text{V}$.
- ③ $I_{SD} \leq 57\text{A}$, $di/dt \leq 962\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 175^\circ\text{C}$.
- ④ Pulse width $\leq 400\mu\text{s}$; duty cycle $\leq 2\%$.
- ⑤ 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} .
- ⑥ 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} .
- ⑦ R_θ is measured at T_J approximately 90°C .
- ⑧ Limited by T_{Jmax} , starting $T_J = 25^\circ\text{C}$, $L = 1\text{mH}$, $R_G = 50\Omega$, $I_{AS} = 29\text{A}$, $V_{GS} = 10\text{V}$.

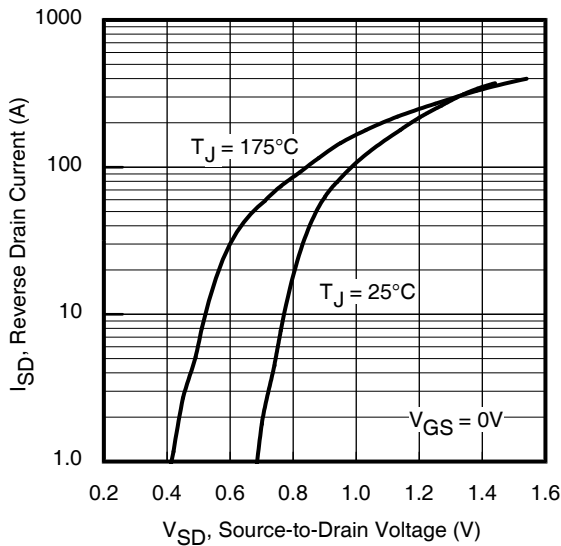
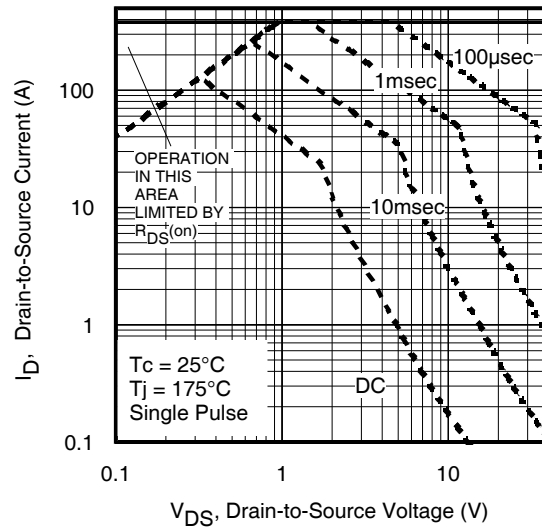
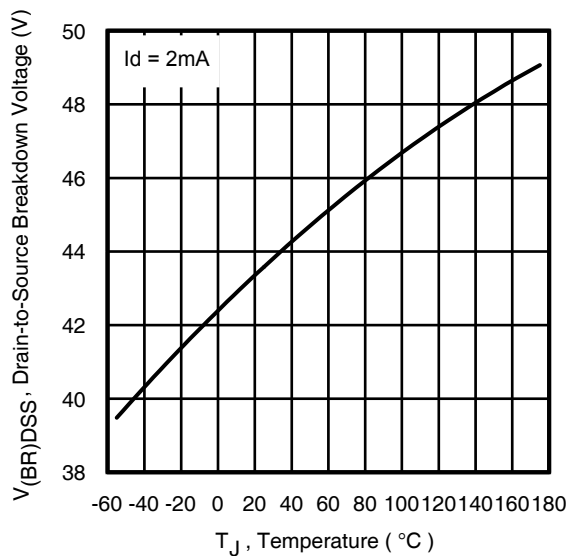
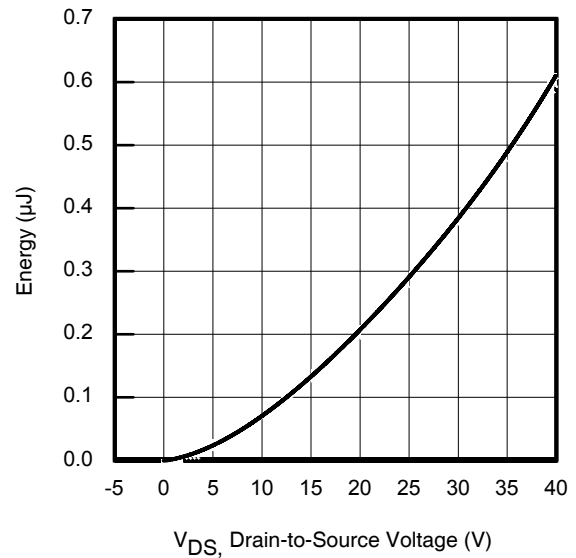
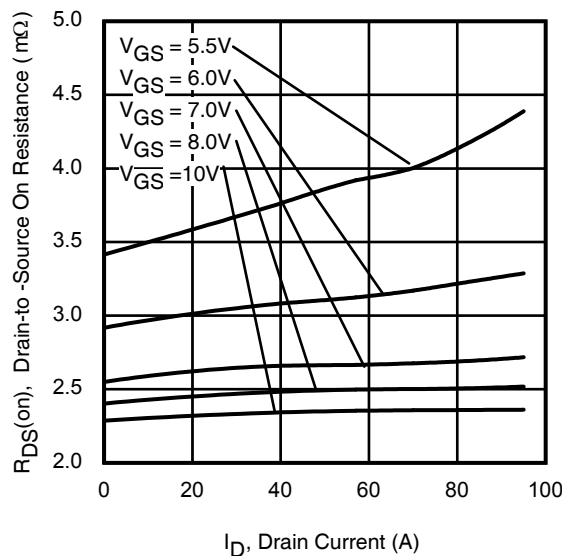
Dynamic Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

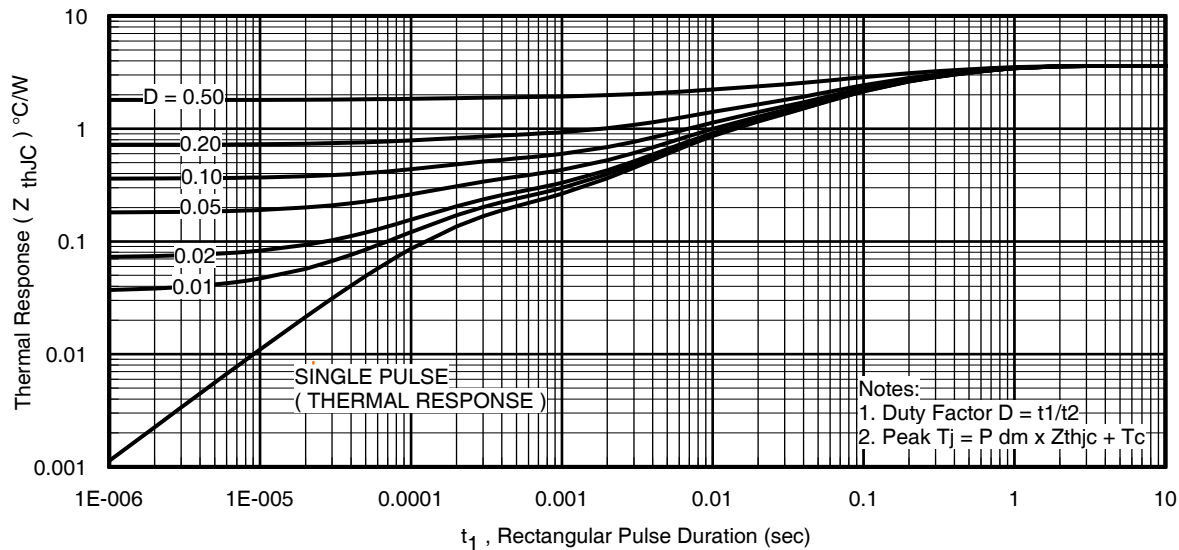
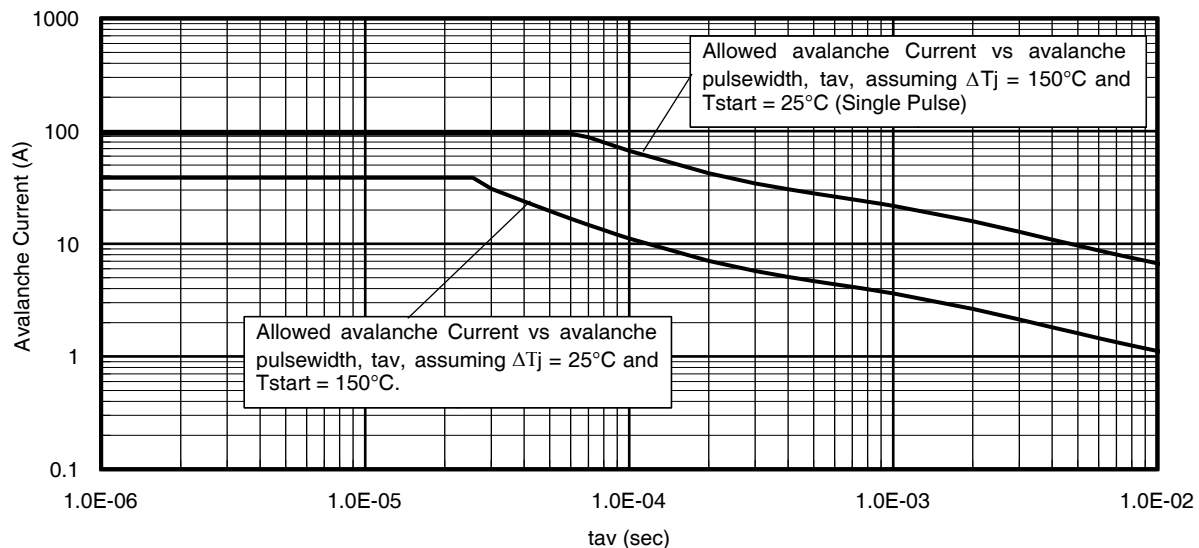
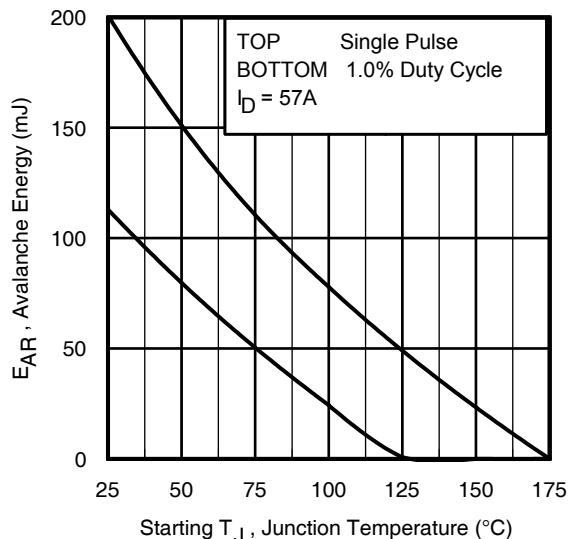
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
gfs	Forward Transconductance	144	—	—	S	$V_{DS} = 10\text{V}, I_D = 57\text{A}$
Q_g	Total Gate Charge	—	88	132	nC	$I_D = 57\text{A}$ $V_{DS} = 20\text{V}$ $V_{GS} = 10\text{V}$
Q_{gs}	Gate-to-Source Charge	—	22	—		
Q_{gd}	Gate-to-Drain Charge	—	30	—		
Q_{sync}	Total Gate Charge Sync. ($Q_g - Q_{gd}$)	—	58	—		
$t_{d(on)}$	Turn-On Delay Time	—	11	—	ns	$V_{DD} = 20\text{V}$ $I_D = 57\text{A}$ $R_G = 2.7\Omega$ $V_{GS} = 10\text{V}^{(4)}$
t_r	Rise Time	—	42	—		
$t_{d(off)}$	Turn-Off Delay Time	—	56	—		
t_f	Fall Time	—	36	—		
C_{iss}	Input Capacitance	—	4549	—	pF	$V_{GS} = 0\text{V}$ $V_{DS} = 25\text{V}$ $f = 1.0\text{MHz}$, See Fig.7
C_{oss}	Output Capacitance	—	689	—		
C_{riss}	Reverse Transfer Capacitance	—	450	—		
$C_{oss\text{ eff.}(ER)}$	Effective Output Capacitance (Energy Related)	—	835	—		
$C_{oss\text{ eff.}(TR)}$	Output Capacitance (Time Related)	—	981	—		

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode) ⁽¹⁾	—	—	95	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ⁽¹⁾	—	—	380		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 57\text{A}, V_{GS} = 0\text{V}^{(4)}$
dv/dt	Peak Diode Recovery dv/dt ⁽³⁾	—	5.1	—	V/ns	$T_J = 175^\circ\text{C}, I_S = 57\text{A}, V_{DS} = 40\text{V}^{(4)}$
t_{rr}	Reverse Recovery Time	—	36	—	ns	$T_J = 25^\circ\text{C}$ $V_{DD} = 34\text{V}$ $T_J = 125^\circ\text{C}$ $I_F = 57\text{A}$,
		—	38	—		
Q_{rr}	Reverse Recovery Charge	—	45	—	nC	$T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$ $di/dt = 100\text{A}/\mu\text{s}^{(4)}$
		—	49	—		
I_{RRM}	Reverse Recovery Current	—	2.1	—	A	$T_J = 25^\circ\text{C}$


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


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. Avalanche Current vs. Pulse Width

Fig 16. Maximum Avalanche Energy vs. Temperature
**Notes on Repetitive Avalanche Curves , Figures 15, 16:
(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 13)

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

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

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

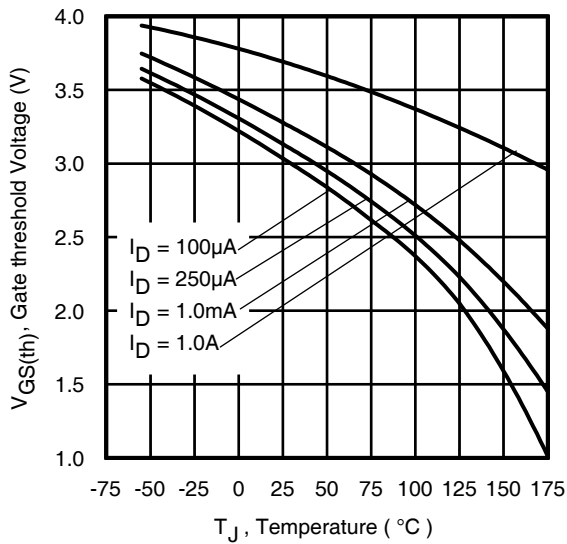


Fig 17. Threshold Voltage vs. Temperature

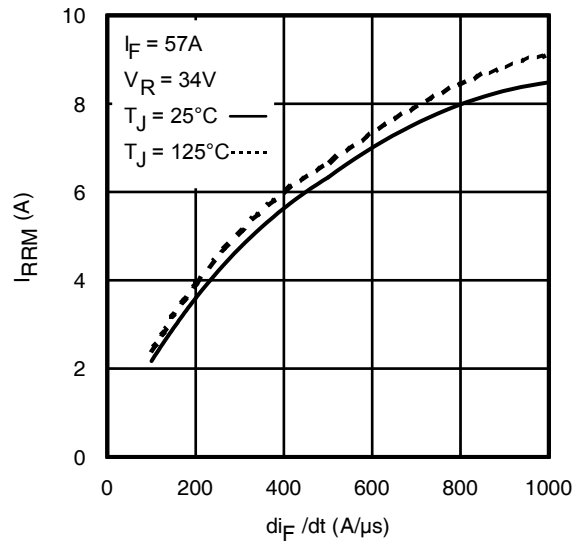


Fig 18. Typical Recovery Current vs. di_F/dt

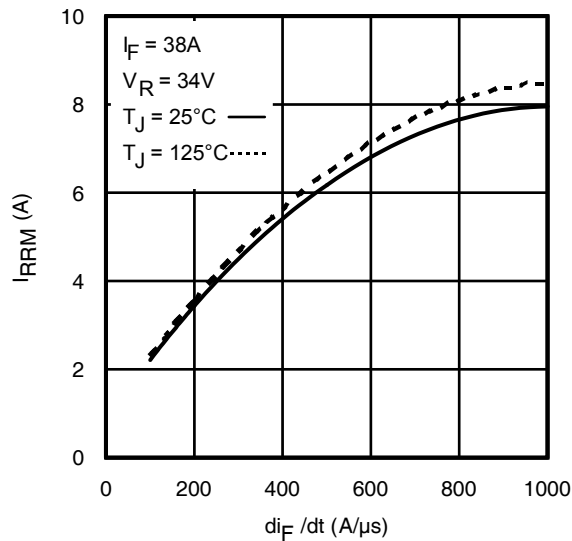


Fig 19. Typical Recovery Current vs. di_F/dt

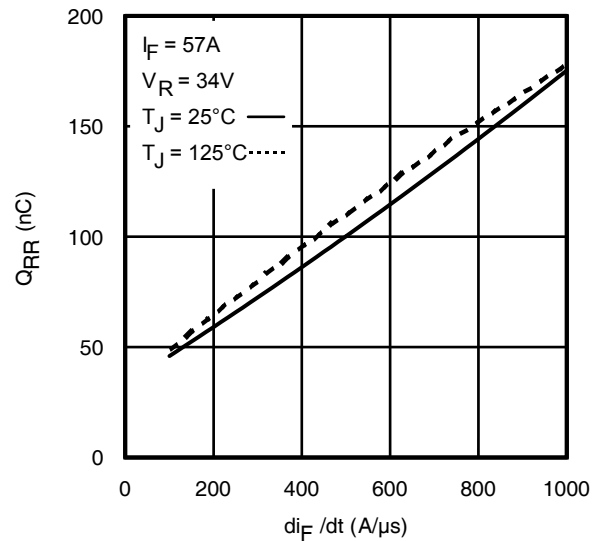


Fig 20. Typical Stored Charge vs. di_F/dt

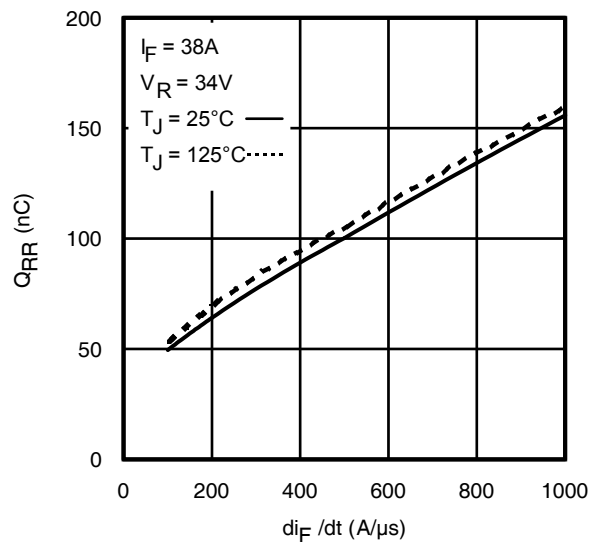
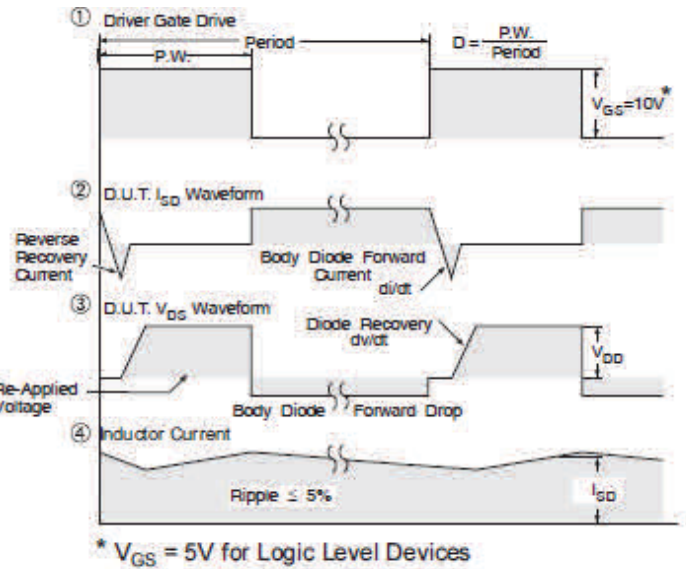
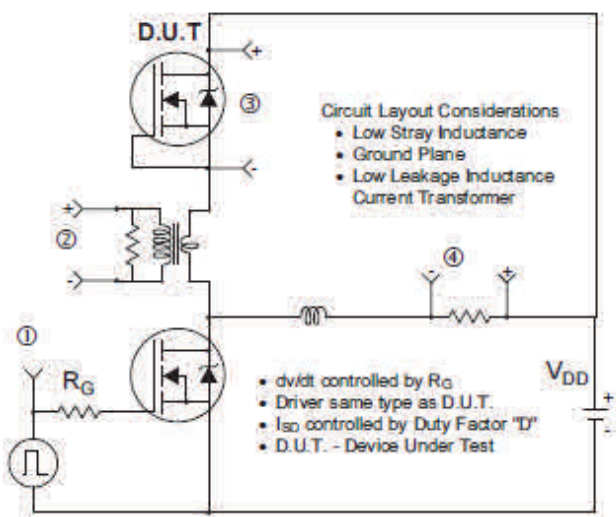
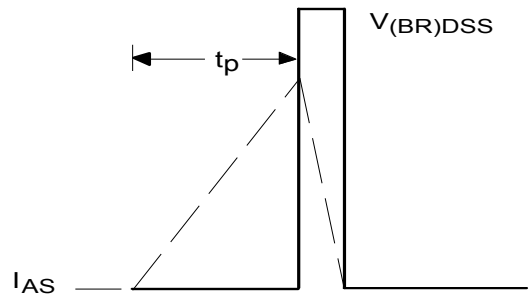
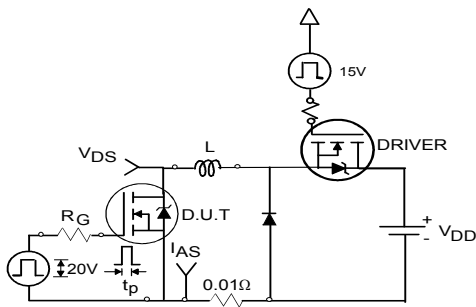
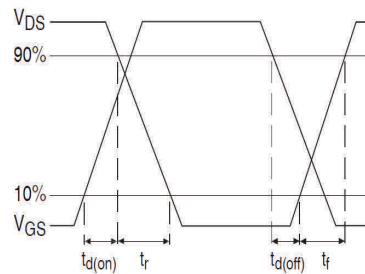
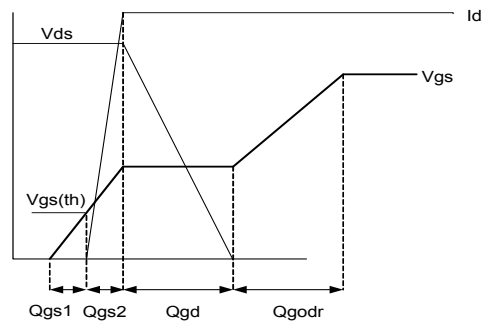
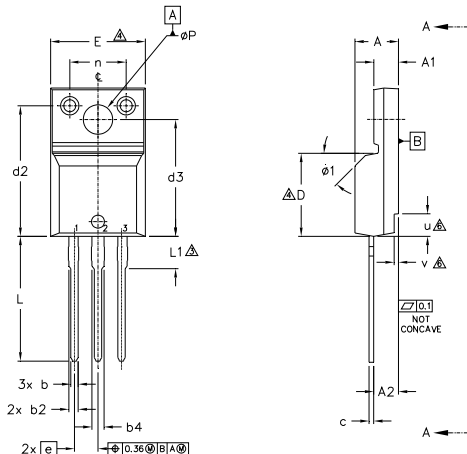


Fig 21. Typical Stored Charge vs. di_F/dt


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

Fig 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

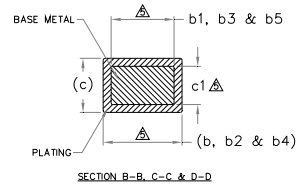
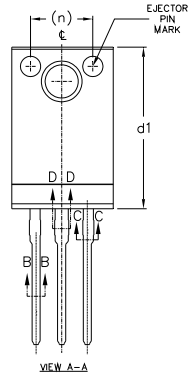
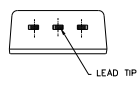
TO-220 Full-Pak Package Outline (Dimensions are shown in millimeters (inches))


- NOTES:
- 1.0 DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
 - 2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
 - 3.0 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
 - 4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTER MOST EXTREMES OF THE PLASTIC BODY.
 - 5.0 DIMENSION b1, b3, b5 & c1 APPLY TO BASE METAL ONLY.
 - 6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.
 - 7.0 CONTROLLING DIMENSION : INCHES.

- LEAD ASSIGNMENTS
- HEXFEEET
- 1.- GATE
 - 2.- DRAIN
 - 3.- SOURCE

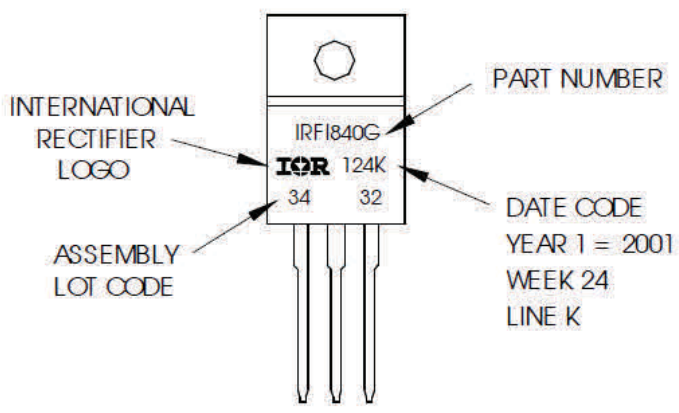
- IGBTs, CoPACK
- 1.- GATE
 - 2.- COLLECTOR
 - 3.- EMITTER

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.57	4.83	.180	.190	
A1	2.57	2.82	.101	.111	
A2	2.51	2.92	.099	.115	
b	0.61	0.94	.024	.037	
b1	0.61	0.89	.024	.035	5
b2	0.76	1.27	.030	.050	
b3	0.76	1.22	.030	.048	5
b4	1.02	1.52	.040	.060	
b5	1.02	1.47	.040	.058	5
c	0.33	0.63	.013	.025	
c1	0.33	0.58	.013	.023	5
D	8.66	9.80	.341	.386	4
d1	15.80	16.13	.622	.635	
d2	13.97	14.22	.550	.560	
d3	12.29	12.93	.484	.509	
E	9.63	10.74	.379	.423	4
e	2.54 BSC		.100 BSC		
L	13.21	13.72	.520	.540	
L1	3.10	3.68	.122	.145	3
n	6.05	6.60	.238	.260	
øP	3.05	3.45	.120	.136	
u	2.39	2.49	.094	.098	6
v	0.41	0.51	.016	.020	6
ø1	-	45°	-	45°	


TO-220 Full-Pak Part Marking Information

EXAMPLE: THIS IS AN IRFI840G
 WITH ASSEMBLY
 LOT CODE 3432
 ASSEMBLED ON WW 24, 2001
 IN THE ASSEMBLY LINE "K"

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



TO-220AB Full-Pak 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	
Moisture Sensitivity Level	TO-220 Full-Pak	N/A
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	Comments
11/18/2014	<ul style="list-style-type: none"> Updated $E_{AS (L=1mH)} = 407mJ$ on page 2 Updated note 8 “Limited by T_{Jmax}, starting $T_J = 25^{\circ}C$, $L = 1mH$, $R_G = 50\Omega$, $I_{AS} = 29A$, $V_{GS} = 10V$”. on page 2