IRFZ48

Vishay Siliconix



TO-220AB

PRODUCT SUMMARY

V_{DS} (V)

R_{DS(on)} (Ω)

Q_{gs} (nC)

Q_{gd} (nC)

Q_q (Max.) (nC)

Configuration

Power MOSFET

S

N-Channel MOSFET

0.018

60

110

29

36

Single

 $V_{GS} = 10 V$

FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- Ultra low on-resistance
- Very low thermal resistance
- 175 °C operating temperature
- Fast switching
- · Ease of paralleling
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Note

* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

DESCRIPTION

Third generation power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The TO-220AB package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 W. The low thermal resistance and low package cost of the TO-220AB contribute to its wide acceptance throughout the industry.

ORDERING INFORMATION	
Package	TO-220AB
Lead (Pb)-free	IRFZ48PbF

ABSOLUTE MAXIMUM RATINGS (T_C	= 25 C, uni	less otherwis	se noted)		-	
PARAMETER			SYMBOL	LIMIT	UNIT	
Drain-source voltage			V _{DS}	60	V	
Gate-source voltage			V _{GS}	± 20	v	
Continuous drain current	V _{GS} at 10 V	T _C = 25 °C	- I _D	50		
Continuous drain current	V _{GS} at 10 V	T _C = 100 °C		50	A	
Pulsed drain current ^a			I _{DM}	290		
Linear derating factor				1.3	W/°C	
Single pulse avalanche energy ^b			E _{AS}	100	mJ	
Repetitive avalanche current ^a			I _{AR}	50	А	
Repetitive avalanche energy ^a			E _{AR}	19	mJ	
Maximum power dissipation	T _C =	25 °C	P _D	190	W	
Peak diode recovery dV/dt ^c			dV/dt	4.5	V/ns	
Operating junction and storage temperature range			T _J , T _{stg}	- 55 to + 175	°C	
Soldering recommendations (peak temperature) ^d	For 10 s			300	1 0	
Mounting torque	6-32 or M3 screw			10	lbf ∙ in	
Mounting torque				1.1	N · m	

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)

b. V_{DD} = 25 V, starting T_J = 25 °C, L = 22 µH, R_g = 25 Ω I_{AS} = 72 A (see fig. 12)

c. $I_{SD} \le 72$ A, dl/dt ≤ 200 A/µs, $V_{DD} \le V_{DS}$, $T_J \le 175$ °C

d. 1.6 mm from case

e. Current limited by the package, (die current = 72 A)

S21-0340-Rev. C, 12-Apr-2021



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SHAY

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Static VDS VGS = 0 V, ID = 250 µA 60 - - V Orain-source breakdown voltage V_{DS} $V_{GS} = 0 V, ID = 250 µA$ 60 - - V//C Gate-source threshold voltage V_{DS} $V_{DS} = V_{CS}, ID = 250 µA$ 2.0 - 4.0 V Gate-source leakage IGSS $V_{DS} = 420$ - - ± 100 nA Zero gate voltage drain current IDSS $V_{DS} = 48 V, V_{SS} = 0 V$ - - 250 µA Drain-source on-state resistance Robin $V_{DS} = 10 V$ ID = 43 A ^b - 0.018 Ω Forward transconductance g_{rs} $V_{DS} = 25 V, I_D = 43 Ab$ - 0.018 Ω Input capacitance C_{ras} $V_{DS} = 25 V, I_D = 43 Ab$ - - 100 - Input capacitance C_{ras} $V_{DS} = 25 V, I_D = 43 Ab$ - - 110 - - 100 - - 100 - - 100 - - <th>THERMAL RESISTANCE RATI</th> <th>NGS</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>	THERMAL RESISTANCE RATI	NGS							
Case-to-sink, flat, greased surface $R_{B,CS}$ 0.50 "C/W Maximum junction-to-case (drain) $R_{B,LC}$ - 0.80 SPECIFICATIONS ($T_J = 25$ °C, unless otherwise noted) TEST CONDITIONS MIN. TYP. MAX. UNI State Drain-source breakdown voltage V_{OS} $V_{OS} = 0$, $U_J = 250 \ \mu A$ 60 - - V/V Gate-source threshold voltage V_{OS} $V_{OS} = 0.7$, $U_J = 250 \ \mu A$ 2.0 - 4.0 V Gate-source threshold voltage V_{OS} $V_{OS} = 0.7$, $U_J = 150 \ ^{\circ}C$ - 2.0 - 4.0 V Case a voltage drain current U_{DS} $V_{OS} = 0.7$, $U_J = 150 \ ^{\circ}C$ - 2.5 μ Drain-source on-state resistance $P_{OS(crit}$ $V_{OS} = 2.5$, $V_J = 43 \ A^{D}$ - 0.018 Ω Dynamic Input capacitance C_{cris} $V_{OS} = 10 \ V$ $I_D = 72 \ A, V_{OS} = 48 \ V, V_{OS} = 413 \ V$ - $210 \ -$. $210 \ -$. $220 \ -$	PARAMETER	SYMBOL	TYP.		MAX.		UNIT		
Maximum junction-to-case (drain) R_{HJC} - 0.80 SPECIFICATIONS (T _J = 25 °C, unless otherwise noted) Far. SYMBOL TEST CONDITIONS MIN. TYP. MAX. UNIT PARAMETER SYMBOL TEST CONDITIONS MIN. TYP. MAX. UNIT Static Drain-source breakdown voltage V_{DS} $V_{OS} = 0$ V, $I_D = 250 \ \mu A$ 60 - - V/V Gate-source treshold voltage V_{DS} $V_{OS} = 0.7$, $I_D = 250 \ \mu A$ 60 - 4.0 V Gate-source treshold voltage V_{DS} $V_{OS} = 0.7$, $I_D = 34.0$ 2.0 - 4.00 V Care source leakage I_{OSS} $V_{OS} = 0.7$, $I_D = 34.0^\circ$ - - 2.01 A Drain-source on-state resistance $R_{OS(w)}$ $V_{OS} = 0.7$, $I_D = 43.4^\circ$ - - 0.018 Ω Drain-source on-state resistance C_{Osa} $V_{OS} = 0.7$, $V_{OS} = 48$, I_S - - 100 - Input capacitance C_{osa} $V_{OS} = 10.V$ Inpeeer	Maximum junction-to-ambient	R _{thJA}	-		62				
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Case-to-sink, flat, greased surface	R _{thCS}	0.50 -				°C/W		
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	Maximum junction-to-case (drain)	R _{thJC}	-		0.80				
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$									
Static VDS VGS = 0 V, I_D = 250 µA 60 - - V Orain-source breakdown voltage $\Delta V_{DS}/T_J$ Reference to 25 °C, I_D = 1 mA - 0.060 - V/°C Gate-source threshold voltage V_{DS} to the shold voltage V_{CS} $V_{DS} = V_{CS}$, I_D = 250 µA 2.0 - 4.0 V Gate-source leakage I_{DSS} $V_{DS} = 0.5$, $I_D = 250 µA$ 2.0 - 4.0 V Zero gate voltage drain current I_{DSS} $V_{DS} = 60.V, V_{DS} = 0.V$ - - 250 $µA$ Drain-source on-state resistance $R_{DS(on)}$ $V_{GS} = 10.V$ $I_D = 43 A^D$ - - 0.018 Ω Dynamic Input capacitance C_{Gas} $V_{DS} = 25 V, I_D = 43 A^D$ - - 100 - Output capacitance C_{Gas} $V_{DS} = 25 V, I_D = 43 A^D$ - - 110 - - 2400 - - 1300 - pF Reverse transfer capacitance C_{Gas} $V_{CB} = 1$	SPECIFICATIONS (T _J = 25 °C, u	Inless otherw	ise noted)						
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	PARAMETER	SYMBOL	TEST	CONDITI	ONS	MIN.	TYP.	MAX.	UNIT
	Static						•		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Drain-source breakdown voltage	V _{DS}	V _{GS} = 0	V, I _D = 2	50 µA	60	-	-	V
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	V _{DS} temperature coefficient	$\Delta V_{DS}/T_{J}$	Reference to 25 °C, $I_D = 1 \text{ mA}$		-	0.060	-	V/°C	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Gate-source threshold voltage	V _{GS(th)}	$V_{DS} = V_{C}$	_{3S} , I _D = 2	50 µA	2.0	-	4.0	V
$ \begin{array}{ c c c c c c } \hline \mbox{Zero gate voltage drain current} & \mbox{Ds} = 48 V, V_{GS} = 0 V, T_J = 150 °C & - & - & 250 \\ \hline \mbox{V}_{DS} = 48 V, V_{GS} = 0 V, T_J = 150 °C & - & - & 250 \\ \hline \mbox{Drain-source on-state resistance} & R_{DS(on)} & V_{GS} = 10 V & I_D = 43 A^b & - & - & 0.018 & \Omega \\ \hline \mbox{Porward transconductance} & g_{fs} & V_{DS} = 25 V, I_D = 43 A^b & 27 & - & - & S \\ \hline \mbox{Dynmic} & & & & & & & & & & & & & & & & & & &$	Gate-source leakage	I _{GSS}	VG	_{as} = ± 20		-	-	± 100	nA
$ \begin{array}{ c c c c c c } \hline V_{DS} = 48 \ V, \ V_{OS} = 0 \ V, \ T_{J} = 150 \ ^{\circ}{\rm C} & - & - & 250 \ ^{\circ}{\rm T} \\ \hline \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$			$V_{DS} = 6$	0 V, V _{GS}	= 0 V	-	-	25	
Forward transconductance g_{fs} $V_{DS} = 25 \text{ V}, I_D = 43 \text{ Ab}$ 27 $ S$ DynamicInput capacitance C_{iss} $V_{GS} = 0 \text{ V}, V_{DS} = 25 \text{ V}, I_D = 43 \text{ Ab}$ $ S$ Output capacitance C_{oss} $V_{GS} = 0 \text{ V}, V_{DS} = 25 \text{ V}, I_D = 43 \text{ Ab}$ $ 1300$ $-$ Output capacitance C_{oss} $V_{GS} = 10 \text{ V}$ $I_D = 72 \text{ A}, V_{DS} = 48 \text{ V}, See fig. 6 and 13b$ $ 110$ Gate-drain charge Q_{gd} $V_{GS} = 10 \text{ V}$ $I_D = 72 \text{ A}, V_{DS} = 48 \text{ V}, See fig. 6 and 13b$ $ 290$ Gate-drain charge Q_{gd} $V_{GS} = 10 \text{ V}$ $I_D = 72 \text{ A}, V_{DS} = 48 \text{ V}, See fig. 6 and 13b$ $ -$ <t< td=""><td>Zero gate voltage drain current</td><td>IDSS</td><td>V_{DS} = 48 V, V_G</td><td>_{as} = 0 V,</td><td>T_J = 150 °C</td><td>-</td><td>-</td><td>250</td><td>μΑ</td></t<>	Zero gate voltage drain current	IDSS	V _{DS} = 48 V, V _G	_{as} = 0 V,	T _J = 150 °C	-	-	250	μΑ
DynamicInput capacitanceCiss $V_{GS} = 0 V$, $V_{DS} = 25 V$, f = 1.0 MHz, see fig. 5-2400-Output capacitanceCoss $r_{SS} = 25 V$, f = 1.0 MHz, see fig. 5-1300-Reverse transfer capacitanceCrss $V_{GS} = 10 V$ $I_D = 72 A$, $V_{DS} = 48 V$, see fig. 6 and 13b110Gate-source charge Q_{gd} $V_{GS} = 10 V$ $I_D = 72 A$, $V_{DS} = 48 V$, see fig. 6 and 13b110Gate-drain charge Q_{gd} $V_{GS} = 10 V$ $I_D = 72 A$, $V_{DS} = 48 V$, see fig. 6 and 13b290Gate-drain charge Q_{gd} $V_{GS} = 10 V$ $I_D = 72 A$, $V_{DS} = 48 V$, see fig. 6 and 13b36Turm-on delay time $t_{d(on)}$ $R_{g} = 9.1 \Omega$, $R_{D} = 0.34 \Omega$, see fig. 10b250-Fall time t_f $R_g = 9.1 \Omega$, $R_D = 0.34 \Omega$, see fig. 10b-250Internal drain inductance L_D Between lead, form package and center of die contact-4.5Internal source inductance L_S MOSFET symbol showing the integral reverse $p - n$ junction diode50°APulsed diode forward current a I_{SM} $T_J = 25 °C$, $I_F = 72 A$, $d/dt = 100 A/\mu s^b$ 2.0VBody diode reverse recovery time t_{rr} $T_J = 25 °C$, $I_F = 72 A$, $d/dt = 100 A/\mu s^b$ 2.0VBody diode reverse recovery charge Q_{rr} </td <td>Drain-source on-state resistance</td> <td>R_{DS(on)}</td> <td>V_{GS} = 10 V</td> <td>١</td> <td>_D = 43 A^b</td> <td>-</td> <td>-</td> <td>0.018</td> <td>Ω</td>	Drain-source on-state resistance	R _{DS(on)}	V _{GS} = 10 V	١	_D = 43 A ^b	-	-	0.018	Ω
$ \begin{array}{c c c c c c c c c } \hline Input capacitance & C_{iss} & V_{GS} = 0 V, & V_{DS} = 25 V, & f = 1.0 \ MHz, see fig. 5 & 190 & - & 190 & - & 190 & - & 110 & - & 190 & - & 110 & - & 290 & - & - & 36 & - & 100 & - & - & 100 & - & - & 100 & - & - & 36 & - & - & 36 & - & - & 36 & - & - & - & 36 & - & - & - & 36 & - & - & - & 36 & - & - & - & 36 & - & - & - & - & 36 & - & - & - & - & 36 & - & - & - & - & - & - & - & - & - & $	Forward transconductance		V _{DS} = 28	5 V, I _D =	43 A ^b	27	-	-	S
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Dynamic	l				1	I		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Input capacitance	C _{iss}	V	- 0.1/		-	2400	-	
Heverse transfer capacitance C_{rss} -190-Total gate charge Q_g Gate-source charge Q_{gs} Gate-drain charge Q_{gd} Turn-on delay time $t_{d(on)}$ Rise time t_r Turn-off delay time $t_{d(off)}$ Fall time t_r Fall time t_r Internal drain inductance L_D Internal drain inductance L_D Drain-Source Body Diode CharacteristicsContinuous source-drain diode current l_S MOSFET symbol showing the integral reverse $ r_J = 25 ^\circ$, $l_F = 72 A$, $V_{GS} = 0 ^{\circ}$ $r_J = 25 ^\circ$, $l_F = 72 A$, $dl/dt = 100 A/\mu s^b$ $r_J = 25 ^\circ$, $l_F = 72 A$, $dl/dt = 100 A/\mu s^b$ $r_J = 25 ^\circ$, $l_F = 72 A$, $dl/dt = 100 A/\mu s^b$ $r_J = 25 ^\circ$, $l_F = 72 A$, $dl/dt = 100 A/\mu s^b$ $r_J = 25 ^\circ$, $l_F = 72 A$, $dl/dt = 100 A/\mu s^b$	Output capacitance	C _{oss}	$V_{GS} = 0 V,$ $V_{DS} = 25 V,$ - 1300 -			-	pF		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Reverse transfer capacitance	C _{rss}	f = 1.0 N	/Hz, see	fig. 5	-	190	-	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Total gate charge	Qg				-	-	110	
Gate-drain charge Q_{gd} sec rig. 6 dir 1636Turn-on delay time $t_{d(on)}$ Rise time t_r Turn-off delay time $t_{d(off)}$ Fall time t_f Internal drain inductance L_D Internal source inductance L_S Drain-Source Body Diode CharacteristicsContinuous source-drain diode current I_S Pulsed diode forward current a I_S Body diode voltage V_{SD} Turn-off alge reverse recovery time t_{rr} Turn-off delay time t_{rr} Turn-off delay time t_{f} Body diode reverse recovery charge Q_{rr} Turn-off delay time t_{g} Turn-off delay time t_{g} Turn-off delay time t_{f} NosBetween lead, 6 mm (0.25°) from package and center of die contact f <t< td=""><td>Gate-source charge</td><td>-</td><td>V_{GS} = 10 V</td><td>l_D = 72</td><td>A, $V_{DS} = 48 V$,</td><td>-</td><td>-</td><td>29</td><td>nC</td></t<>	Gate-source charge	-	V _{GS} = 10 V	l _D = 72	A, $V_{DS} = 48 V$,	-	-	29	nC
$\begin{array}{c c c c c c c c } \hline Turn-on delay time & t_{d(on)} & & & & & & & & & & & & & & & & & & &$	Gate-drain charge	-		300 1	ig. 0 and 15	-	-	36	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Turn-on delay time					-	8.1	-	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Rise time		V _{DD} = 3	0 V. In =	72 A.	-	250	-	
Fall time t_f -250-Internal drain inductance L_D Between lead, 6 mm (0.25") from package and center of die contact-4.5Internal source inductance L_S L_S I_S I_S 7.5-Drain-Source Body Diode CharacteristicsContinuous source-drain diode current I_S MOSFET symbol 	Turn-off delay time	t _{d(off)}	$R_g = 9.1 \Omega$, $R_D = 0.34 \Omega$, see fig. 10^b		-	210	-	ns	
Internal drain inductanceLD6 mm (0.25") from package and center of die contact-4.5-nHInternal source inductanceLS L_S - 7.5 -nHDrain-Source Body Diode CharacteristicsContinuous source-drain diode currentISMOSFET symbol showing the integral reverse p - n junction diode 50° ABody diode reverse recovery time V_{SD} $T_J = 25 ^{\circ}C$, $I_F = 72 A$, $dI/dt = 100 A/\mu s^b$ 2.0 VContinuous diode reverse recovery charge Q_{rr} T $25 ^{\circ}C$, $I_F = 72 A$, $dI/dt = 100 A/\mu s^b$ - $120 180 ns$	Fall time					-	250	-	
Internal source inductanceLSPackage and contactImage	Internal drain inductance	L _D	$\begin{array}{c c c c c c c c c c c c c c c c c c c $						
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Internal source inductance	L _S		iter of		-	7.5	-	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Drain-Source Body Diode Characteristic	cs							
Pulsed diode forward current aIsmIntegral reverse p - n junction diode290Body diode voltage V_{SD} $T_J = 25 \ ^{\circ}C$, $I_S = 72 \ ^{o}A$, $V_{GS} = 0 \ V^b$ 2.0VBody diode reverse recovery time t_{rr} $T_J = 25 \ ^{\circ}C$, $I_F = 72 \ ^{o}A$, $dI/dt = 100 \ ^{o}A/\mu s^b$ -120180nsBody diode reverse recovery charge Q_{rr} Q_{rr} $T_J = 25 \ ^{\circ}C$, $I_F = 72 \ ^{o}A$, $dI/dt = 100 \ ^{o}A/\mu s^b$ -0.500.80 μC	Continuous source-drain diode current	١ _S	showing the integral reverse		-	-	50 ^c	A	
Body diode reverse recovery time t_{rr} $T_J = 25 \ ^{\circ}C$, $I_F = 72 \ ^{\circ}A$, $dl/dt = 100 \ ^{\circ}A/\mu s^b$ -120180nsBody diode reverse recovery charge Q_{rr} $T_J = 25 \ ^{\circ}C$, $I_F = 72 \ ^{\circ}A$, $dl/dt = 100 \ ^{\circ}A/\mu s^b$ -0.500.80 μC	Pulsed diode forward current ^a	I _{SM}			-	-	290		
Body diode reverse recovery charge Q_{rr} $T_J = 25 \text{ °C}, I_F = 72 \text{ A}, dI/dt = 100 \text{ A/µs}^b$ - 0.50 0.80 µC	Body diode voltage	V _{SD}	T _J = 25 °C, I _S	= 72 A,	$V_{GS} = 0 V^{b}$	-	-	2.0	V
Body diode reverse recovery charge Q _{rr} - 0.50 0.80 µC	Body diode reverse recovery time	t _{rr}	T 25 °C I	72 6 41/4	H - 100 A/uch	-	120	180	ns
Forward turn-on time ton Intrinsic turn-on time is negligible (turn-on is dominated by L _S and L _D)	Body diode reverse recovery charge	Q _{rr}	1 - 23 = 0, 1F = 1	2 A, U/(μι – 100 Αγμδ ^ο	-	0.50	0.80	μC
	Forward turn-on time	t _{on}	Intrinsic turn-	on time i	s negligible (turn	I-on is do	minated b	y L _S and	L _D)

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)

b. Pulse width \leq 300 $\mu s;$ duty cycle \leq 2 $\,\%$

c. Current limited by the package, (die current = 72 A)

2





TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

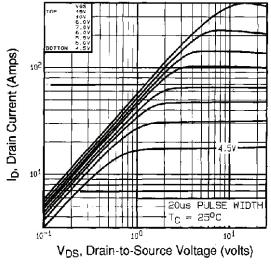


Fig. 1 - Typical Output Characteristics, T_C = 25 °C

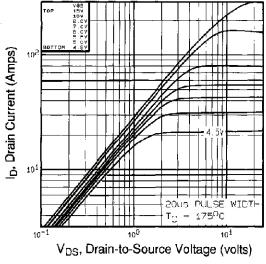
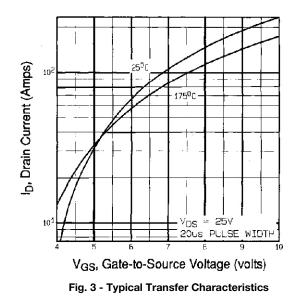


Fig. 2 - Typical Output Characteristics, $T_C = 175$ °C



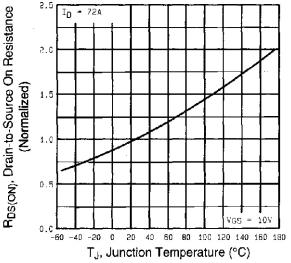


Fig. 4 - Normalized On-Resistance vs. Temperature



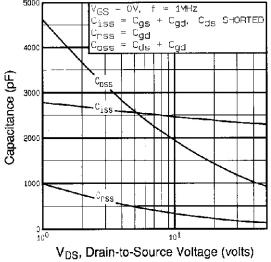


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

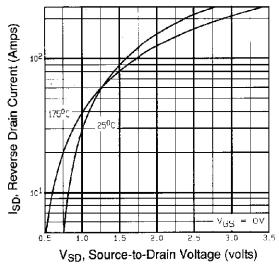


Fig. 7 - Typical Source-Drain Diode Forward Voltage

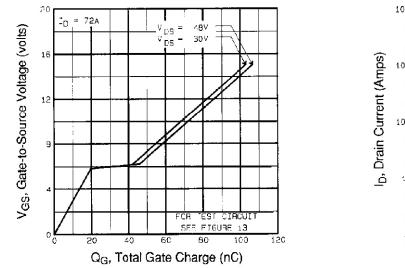
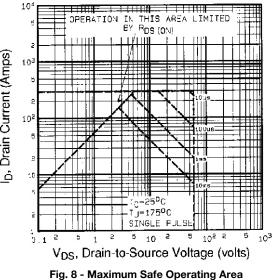


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage





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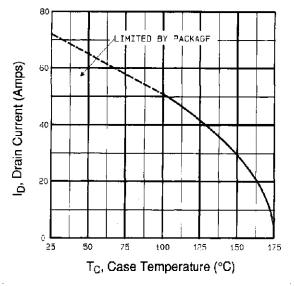


Fig. 9 - Maximum Drain Current vs. Case Temperature

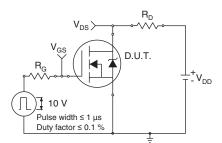


Fig. 10a - Switching Time Test Circuit

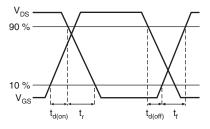


Fig. 10b - Switching Time Waveforms

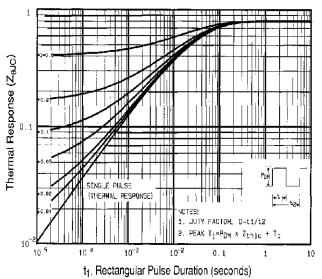


Fig. 10 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



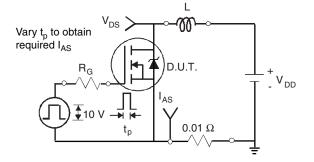


Fig. 12a - Unclamped Inductive Test Circuit

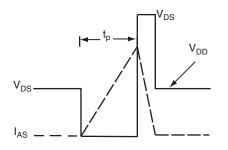


Fig. 12b - Unclamped Inductive Waveforms

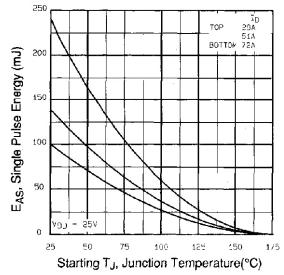


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

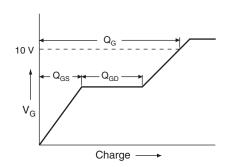


Fig. 13a - Basic Gate Charge Waveform

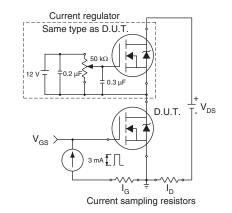
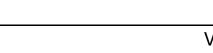
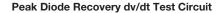


Fig. 13b - Gate Charge Test Circuit

Document Number: 91294

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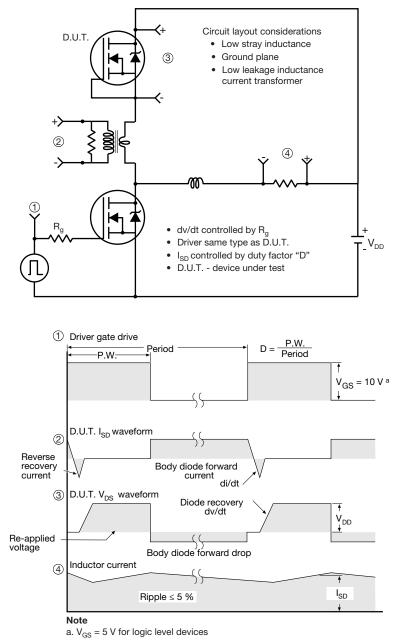


Fig. 14 - For N-Channel

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TO-220-1



DIM	MILLIN	METERS	INC	HES
DIM.	MIN.	MAX.	MIN.	MAX.
А	4.24	4.65	0.167	0.183
b	0.69	1.02	0.027	0.040
b(1)	1.14	1.78	0.045	0.070
С	0.36	0.61	0.014	0.024
D	14.33	15.85	0.564	0.624
E	9.96	10.52	0.392	0.414
е	2.41	2.67	0.095	0.105
e(1)	4.88	5.28	0.192	0.208
F	1.14	1.40	0.045	0.055
H(1)	6.10	6.71	0.240	0.264
J(1)	2.41	2.92	0.095	0.115
L	13.36	14.40	0.526	0.567
L(1)	3.33	4.04	0.131	0.159
ØP	3.53	3.94	0.139	0.155
Q	2.54	3.00	0.100	0.118

Note

• M* = 0.052 inches to 0.064 inches (dimension including protrusion), heatsink hole for HVM



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