## IRFZ48

Vishay Siliconix



**TO-220AB** 

**PRODUCT SUMMARY** 

V<sub>DS</sub> (V)

R<sub>DS(on)</sub> (Ω)

Q<sub>gs</sub> (nC)

Q<sub>gd</sub> (nC)

Q<sub>q</sub> (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			

<b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_C$	= 25 C, uni	less otherwis	se noted)		-	
PARAMETER			SYMBOL	LIMIT	UNIT	
Drain-source voltage			V <sub>DS</sub>	60	V	
Gate-source voltage			V <sub>GS</sub>	± 20	v	
Continuous drain current	V <sub>GS</sub> at 10 V	T <sub>C</sub> = 25 °C	1-	50		
		T <sub>C</sub> = 100 °C	ID	50	A	
Pulsed drain current <sup>a</sup>			I <sub>DM</sub>	290		
Linear derating factor				1.3	W/°C	
Single pulse avalanche energy <sup>b</sup>			E <sub>AS</sub>	100	mJ	
Repetitive avalanche current <sup>a</sup>			I <sub>AR</sub>	50	А	
Repetitive avalanche energy <sup>a</sup>			E <sub>AR</sub>	19	mJ	
Maximum power dissipation $T_{\rm C} = 25 ^{\circ}{\rm C}$			P <sub>D</sub>	190	W	
Peak diode recovery dV/dt <sup>c</sup>			dV/dt	4.5	V/ns	
Operating junction and storage temperature range			T <sub>J</sub> , T <sub>stg</sub>	- 55 to + 175	°C	
Soldering recommendations (peak temperature) <sup>d</sup>	For 10 s			300		
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<sub>J</sub> = 25 °C, L = 22 µH, R<sub>g</sub> = 25  $\Omega$  I<sub>AS</sub> = 72 A (see fig. 12)

c.  $I_{SD} \le 72$  A, dl/dt  $\le 200$  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)

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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 $V_{DS} = 420$ -         - $\pm 100$ 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 <sup>b</sup> -         0.018 $\Omega$ Forward transconductance $g_{rs}$ $V_{DS} = 25 V, I_D = 43 Ab$ -         0.018 $\Omega$ 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 colspan="9">THERMAL RESISTANCE RATINGS</th>	THERMAL RESISTANCE RATINGS								
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 $U_{DS}$ $V_{OS} = 0.7$ , $U_J = 150 \ ^{\circ}C$ - $2.5$ $\mu$ Drain-source on-state resistance $P_{OS(crit}$ $V_{OS} = 2.5$ , $V_J = 43 \ A^{D}$ - $0.018$ $\Omega$ Dynamic         Input capacitance $C_{cris}$ $V_{OS} = 10 \ V$ $I_D = 72 \ A, V_{OS} = 48 \ V, V_{OS} = 413 \ V$ - $210 \  I_D$ Gate-orain charge $Q_{$	PARAMETER	SYMBOL	TYP.	TYP. MAX.		UNIT			
Maximum junction-to-case (drain) $R_{HJC}$ -         0.80           SPECIFICATIONS (T <sub>J</sub> = 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 $I_{OSS}$ $V_{OS} = 0.7$ , $I_D = 34.0^\circ$ -         -         2.00         -           Drain-source on-state resistance $R_{OS(w)}$ $V_{OS} = 0.7$ , $V_{OS} = 0.7$ , $V_{OS} = 48.7$ , $V_{OS} = 0.7$ , $V_{OS} = 25.7$ , $I_D = 43.4^\circ$ -         -         0.018 $\Omega$ Drain-source on-state resistance $C_{Oss}$ $V_{OS} = 10.7$ $I_D = 72.A$ , $V_{OS} = 48.7$ , $-$ -         100         -         -         100         - </td <td>Maximum junction-to-ambient</td> <td>R<sub>thJA</sub></td> <td colspan="2" rowspan="2"></td> <td></td> <td></td> <td colspan="2" rowspan="2">°C/W</td>	Maximum junction-to-ambient	R <sub>thJA</sub>					°C/W		
$ \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 <sub>thCS</sub>							
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	Maximum junction-to-case (drain)	R <sub>thJC</sub>	- 0.80				1		
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$									
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 $\Omega$ 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 <sub>J</sub> = 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	n en		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 <sub>DS</sub>	V <sub>GS</sub> = 0	V, I <sub>D</sub> = 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 <sub>DS</sub> temperature coefficient	$\Delta V_{DS}/T_{J}$	Reference to	o 25 °C,	I <sub>D</sub> = 1 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 <sub>GS(th)</sub>	$V_{DS} = V_{C}$	<sub>3S</sub> , I <sub>D</sub> = 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 <sub>GSS</sub>	VG	<sub>as</sub> = ± 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 \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$			$V_{DS} = 6$			-	-	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 colspan="2">V<sub>DS</sub> = 48 V, V<sub>GS</sub> = 0 V, T<sub>J</sub> = 150 °C</td><td>-</td><td>-</td><td>250</td><td>μA</td></t<>	Zero gate voltage drain current	IDSS	V <sub>DS</sub> = 48 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150 °C		-	-	250	μA	
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<sub>DS(on)</sub></td> <td>V<sub>GS</sub> = 10 V</td> <td>١</td> <td><sub>D</sub> = 43 A<sup>b</sup></td> <td>-</td> <td>-</td> <td>0.018</td> <td>Ω</td>	Drain-source on-state resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V	١	<sub>D</sub> = 43 A <sup>b</sup>	-	-	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 <sub>DS</sub> = 28	5 V, I <sub>D</sub> =	43 A <sup>b</sup>	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	<b>I</b>		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Input capacitance	C <sub>iss</sub>	$V_{DS} = 25 V$ ,		-	2400	-	pF	
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 <sub>oss</sub>			-	1300	-		
$ \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 <sub>rss</sub>	f = 1.0 N			-	190	-	1
$ \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<sub>GS</sub> = 10 V</td><td>l<sub>D</sub> = 72</td><td>A, <math>V_{DS} = 48 V</math>,</td><td>-</td><td>-</td><td>29</td><td rowspan="2">nC</td></t<>	Gate-source charge	-	V <sub>GS</sub> = 10 V	l <sub>D</sub> = 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 <sub>DD</sub> = 3	Vpp = 30 V Jp = 72 A		-	250	-	1
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 showing the integral reverse $p - n$ junction diode- $I_S$ $I_S$ - $I_S$ -Body diode reverse recovery time $V_{SD}$ $T_J = 25 ^\circ$ C, $I_F = 72 $ A, $dI/dt = 100 $ A/µsb- $I_20$ 180nsBody diode reverse recovery charge $Q_{rr}$ $T_J = 25 ^\circ$ C, $I_F = 72 $ A, $dI/dt = 100 $ A/µsb- $I_20$ 180ns	Turn-off delay time	t <sub>d(off)</sub>	$R_g = 9.1 \ \Omega, R_D = 0.34 \ \Omega, see fig. 10^{b}$		-	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 $50^{\circ}$ 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 <sub>D</sub>	6 mm (0.25") from a center of a context of a		-	4.5	-		
$ \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 <sub>S</sub>			-	7.5	-	nH	
$\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 $\mu C$	Continuous source-drain diode current	١ <sub>S</sub>	showing the output of the showing the show		-	-	50 <sup>c</sup>	^	
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 $\mu C$	Pulsed diode forward current <sup>a</sup>	I <sub>SM</sub>			-	-	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 <sub>SD</sub>	$T_J = 25 \text{ °C}, I_S = 72 \text{ A}, V_{GS} = 0 \text{ V}^{b}$		-	-	2.0	V	
Body diode reverse recovery charge Q <sub>rr</sub> - 0.50 0.80 µC	Body diode reverse recovery time	t <sub>rr</sub>	- T <sub>J</sub> = 25 °C, I <sub>F</sub> = 72 A, dl/dt = 100 A/µs <sup>b</sup>		-	120	180	ns	
Forward turn-on time ton Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> and L <sub>D</sub> )	Body diode reverse recovery charge	Q <sub>rr</sub>			-	0.50	0.80	μC	
	Forward turn-on time	t <sub>on</sub>	Intrinsic turn-on time is negligible (turn-			I-on is do	minated b	y L <sub>S</sub> and	L <sub>D</sub> )

#### 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)

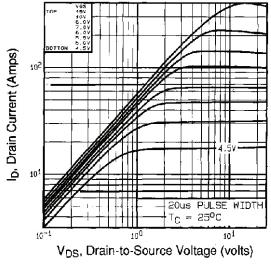


Fig. 1 - Typical Output Characteristics, T<sub>C</sub> = 25 °C

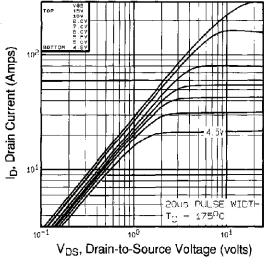
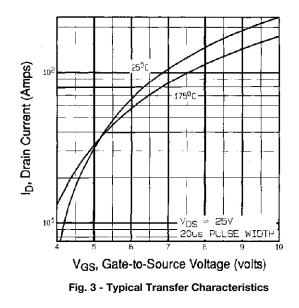


Fig. 2 - Typical Output Characteristics,  $T_C = 175$  °C



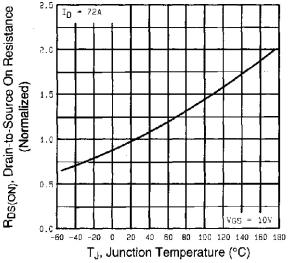


Fig. 4 - Normalized On-Resistance vs. Temperature

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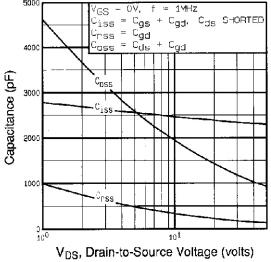


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

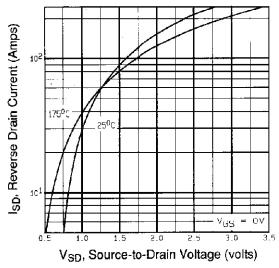


Fig. 7 - Typical Source-Drain Diode Forward Voltage

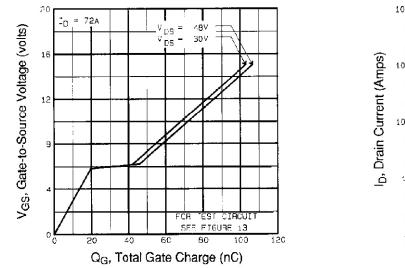
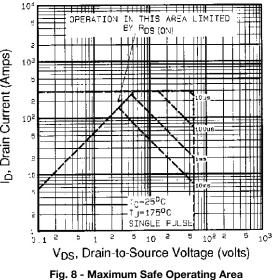


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage





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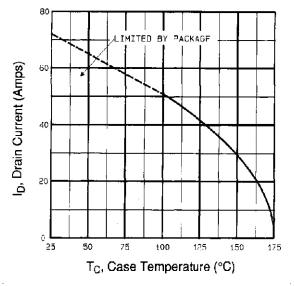


Fig. 9 - Maximum Drain Current vs. Case Temperature

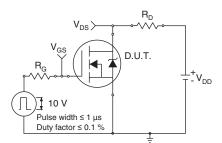


Fig. 10a - Switching Time Test Circuit

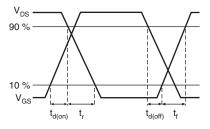


Fig. 10b - Switching Time Waveforms

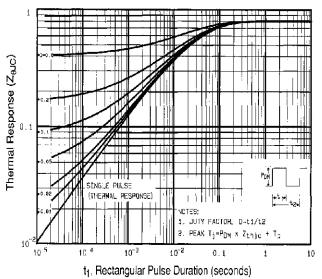


Fig. 10 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



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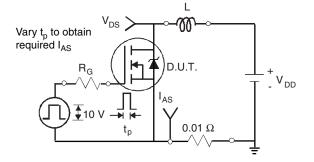


Fig. 12a - Unclamped Inductive Test Circuit

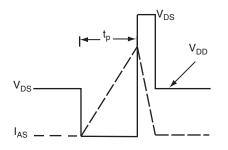


Fig. 12b - Unclamped Inductive Waveforms

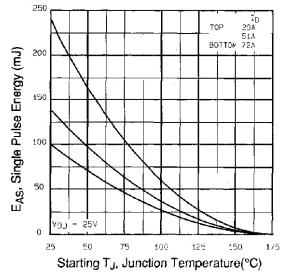


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

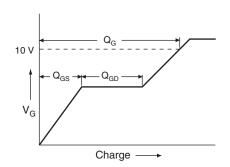


Fig. 13a - Basic Gate Charge Waveform

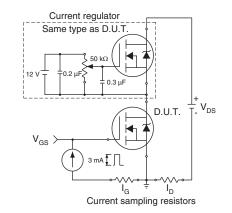
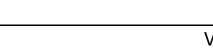


Fig. 13b - Gate Charge Test Circuit

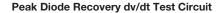
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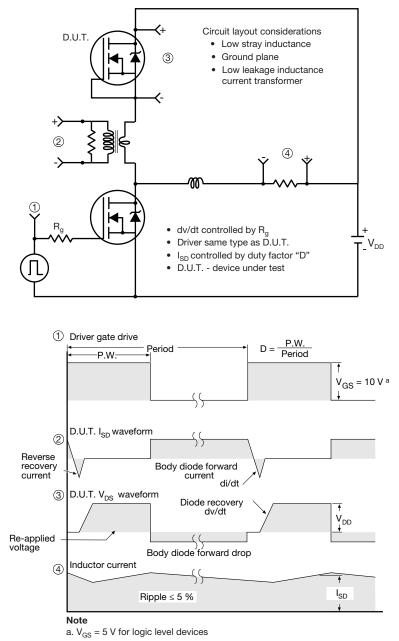


Fig. 14 - For N-Channel

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TO-220-1



DIM.	MILLIN	IETERS	INCHES		
DIN.	MIN.	MIN. MAX.		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	
ØР	3.53	3.94	0.139	0.155	
Q	2.54	3.00	0.100	0.118	
ECN: X15-0364-Rev. C, 14-Dec-15 DWG: 6031					

Note

-  $M^{\star}$  = 0.052 inches to 0.064 inches (dimension including protrusion), heatsink hole for HVM

Package Picture					
AS	3E	Xi'an			
		IRF 9510 744K AB			

Revison: 14-Dec-15

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