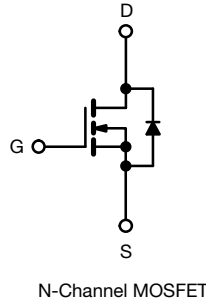
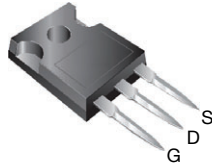


Power MOSFET

TO-247AC


FEATURES

- Superfast body diode eliminates the need for external diodes in ZVS applications
- Lower gate charge results in simpler drive requirements
- Enhanced dV/dt capabilities offer improved ruggedness
- Higher gate voltage threshold offers improved noise immunity
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


 Available
RoHS*
 Available

PRODUCT SUMMARY

V_{DS} (V)	500	
$R_{DS(on)}$ (Ω)	$V_{GS} = 10\text{ V}$	0.190
Q_g max. (nC)	150	
Q_{gs} (nC)	44	
Q_{gd} (nC)	72	
Configuration	Single	

APPLICATIONS

- Zero voltage switching SMPS
- Telecom and server power supplies
- Uninterruptible power supplies
- Motor control applications

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

ORDERING INFORMATION

Package	TO-247AC
Lead (Pb)-free	IRFP23N50LPbF


ABSOLUTE MAXIMUM RATINGS ($T_C = 25\text{ }^\circ\text{C}$, unless otherwise noted)

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-source voltage	V_{DS}	500	V
Gate-source voltage	V_{GS}	± 30	
Continuous drain current	V_{GS} at 10 V	$T_C = 25\text{ }^\circ\text{C}$	A
		$T_C = 100\text{ }^\circ\text{C}$	
Pulsed drain current ^a	I_{DM}	92	
Linear derating factor		2.9	W/ $^\circ\text{C}$
Single pulse avalanche energy ^b	E_{AS}	410	mJ
Repetitive avalanche current ^a	I_{AR}	23	A
Repetitive avalanche energy ^a	E_{AR}	37	mJ
Maximum power dissipation	$T_C = 25\text{ }^\circ\text{C}$	370	W
Peak diode recovery dV/dt ^c			
Operating junction and storage temperature range	T_J, T_{stg}	-55 to +150	$^\circ\text{C}$
Soldering recommendations (peak temperature) ^d	for 10 s	300	
Mounting torque	6-32 or M3 screw	10	
		1.1	N · m

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- Starting $T_J = 25\text{ }^\circ\text{C}$, $L = 1.5\text{ mH}$, $R_g = 25\text{ }^\circ\Omega$, $I_{AS} = 23\text{ A}$ (see fig. 12)
- $I_{SD} \leq 23\text{ A}$, $dI/dt \leq 650\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 150\text{ }^\circ\text{C}$
- 1.6 mm from case

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	R_{thJA}	-	40	°C/W
Case-to-sink, flat, greased surface	R_{thCS}	0.24	-	
Maximum junction-to-case (drain)	R_{thJC}	-	0.34	

SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Static						
Drain-source breakdown voltage	V_{DS}	$V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$	500	-	-	V
V_{DS} temperature coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}^d$	-	0.27	-	V/°C
Gate-source threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	3.0	-	5.0	V
Gate-source leakage	I_{GSS}	$V_{GS} = \pm 30\text{ V}$	-	-	± 100	nA
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 500\text{ V}$, $V_{GS} = 0\text{ V}$	-	-	50	μA
		$V_{DS} = 400\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$	-	-	2.0	mA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$ $I_D = 14\text{ A}^b$	-	0.190	0.235	Ω
Forward transconductance	g_{fs}	$V_{DS} = 50\text{ V}$, $I_D = 14\text{ A}^b$	-	9	-	S
Dynamic						
Input capacitance	C_{iss}	$V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1.0\text{ MHz}$, see fig. 5	-	3600	-	pF
Output capacitance	C_{oss}		-	380	-	
Reverse transfer capacitance	C_{rss}		-	37	-	
Output capacitance	C_{oss}	$V_{GS} = 0\text{ V}$	$V_{DS} = 1.0\text{ V}$, $f = 1.0\text{ MHz}$	-	4800	-
			$V_{DS} = 400\text{ V}$, $f = 1.0\text{ MHz}$	-	100	-
Effective output capacitance	$C_{oss\text{ eff.}}$		$V_{DS} = 0\text{ V to } 400\text{ V}^c$	-	220	-
Effective output capacitance (energy related)	$C_{oss\text{ eff. (ER)}}$		$V_{DS} = 0\text{ V to } 400\text{ V}^d$	-	160	-
Internal gate resistance	R_G	$f = 1\text{ MHz}$, open drain	-	1.2	-	Ω
Total gate charge	Q_g	$V_{GS} = 10\text{ V}$ $I_D = 23\text{ A}$, $V_{DS} = 400\text{ V}$ see fig. 6 and 13 ^b	-	-	150	nC
Gate-source charge	Q_{gs}		-	-	44	
Gate-drain charge	Q_{gd}		-	-	72	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 250\text{ V}$, $I_D = 23\text{ A}$ $R_g = 6.0$, $V_{GS} = 10\text{ V}$ see fig. 10 ^b	-	26	-	ns
Rise time	t_r		-	94	-	
Turn-off delay time	$t_{d(off)}$		-	53	-	
Fall time	t_f		-	45	-	
Drain-Source Body Diode Characteristics						
Continuous source-drain diode current	I_S	MOSFET symbol showing the integral reverse p-n junction diode 	-	-	23	A
Pulsed diode forward current ^a	I_{SM}		-	-	92	
Body diode voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}$, $I_S = 14\text{ A}$, $V_{GS} = 0\text{ V}^b$	-	-	1.5	V
Body diode reverse recovery time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}$	-	170	250	ns
		$T_J = 125\text{ }^\circ\text{C}$	-	220	330	
Body diode reverse recovery charge	Q_{rr}	$T_J = 25\text{ }^\circ\text{C}$	-	560	840	μC
		$T_J = 125\text{ }^\circ\text{C}$	-	980	1500	
Reverse recovery current	I_{RRM}	$T_J = 25\text{ }^\circ\text{C}$	-	7.6	11	A
Forward turn-on time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L_S and L_D)				

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- Pulse width $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\%$
- $C_{oss\text{ eff.}}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DS}
- $C_{oss\text{ eff. (ER)}}$ is a fixed capacitance that stores the same energy time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DS}

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

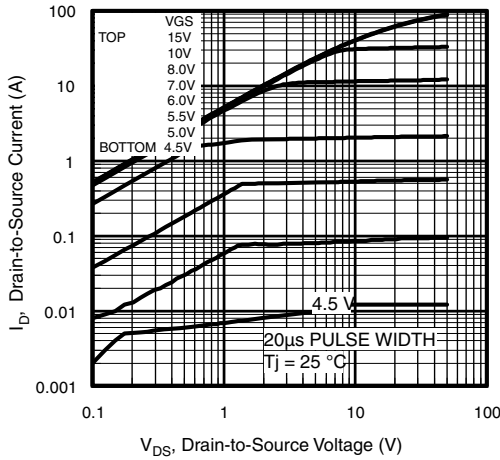


Fig. 1 - Typical Output Characteristics

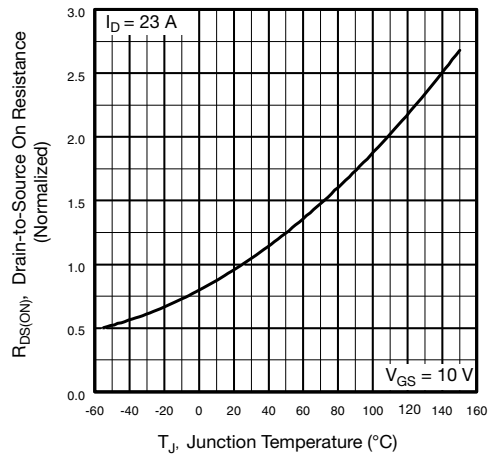


Fig. 4 - Normalized On-Resistance vs. Temperature

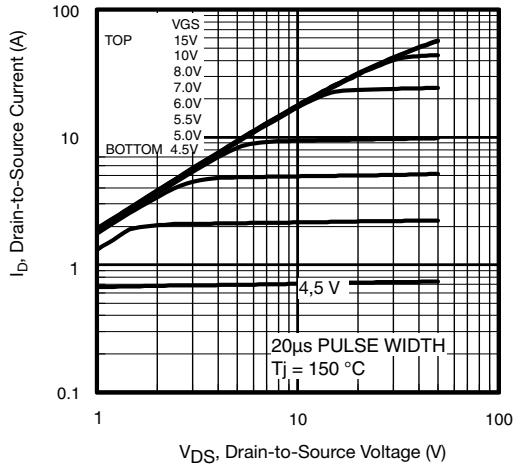


Fig. 2 - Typical Output Characteristics

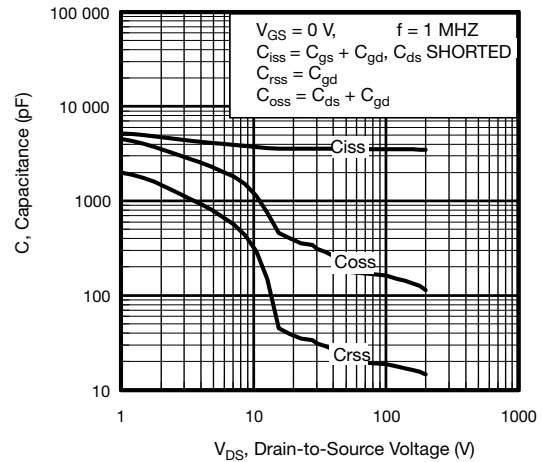


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

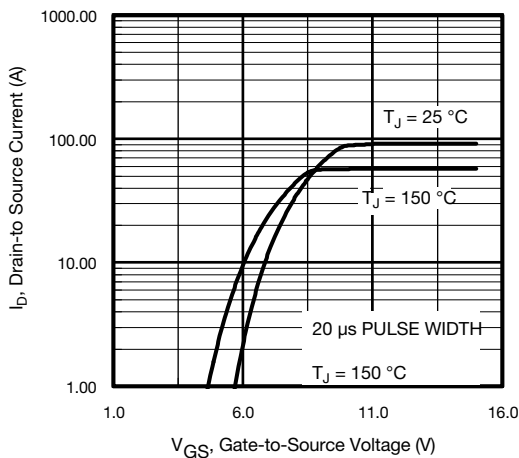


Fig. 3 - Typical Transfer Characteristics

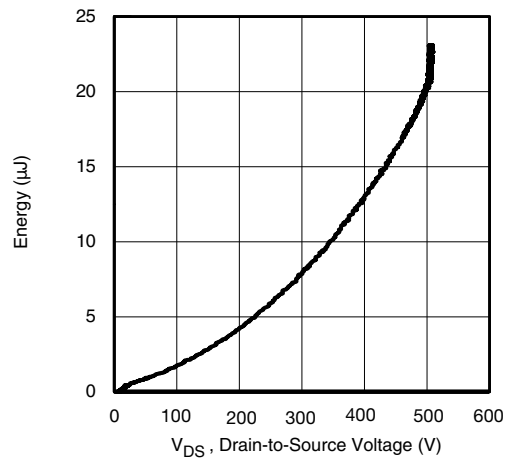


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

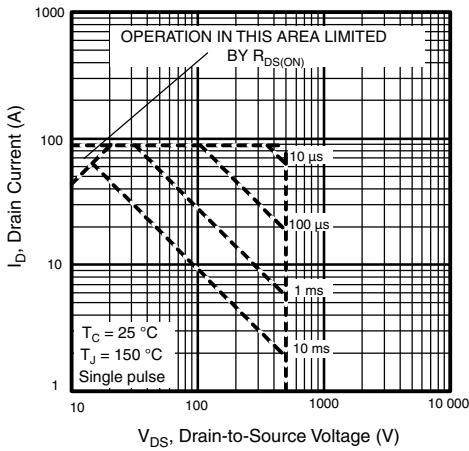


Fig. 7 - Maximum Safe Operating Area

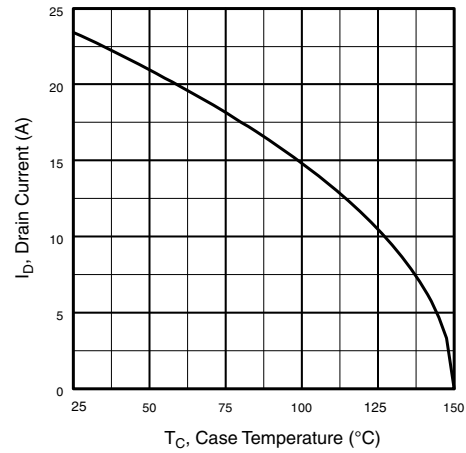


Fig. 10 - Maximum Drain Current vs. Case Temperature

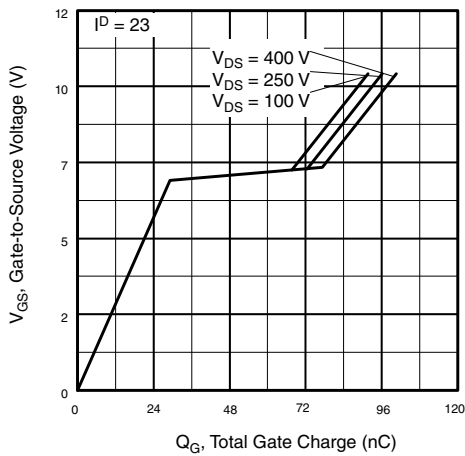


Fig. 8 - Typical Gate Charge vs. Gate-to-Source Voltage

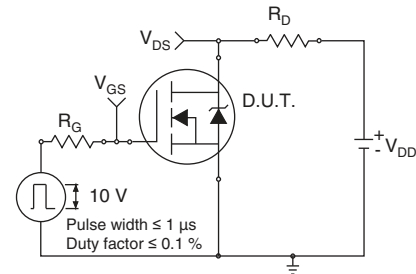


Fig. 11a - Switching Time Test Circuit

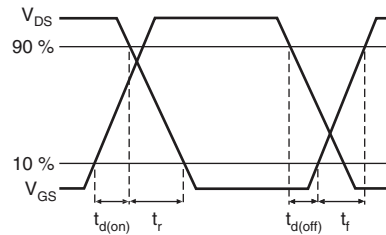


Fig. 11b - Switching Time Waveforms

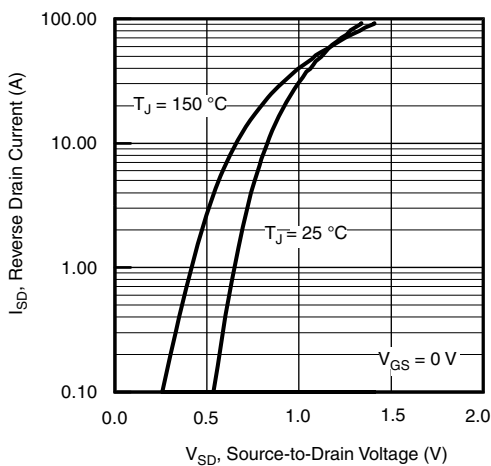


Fig. 9 - Typical Source-Drain Diode Forward Voltage

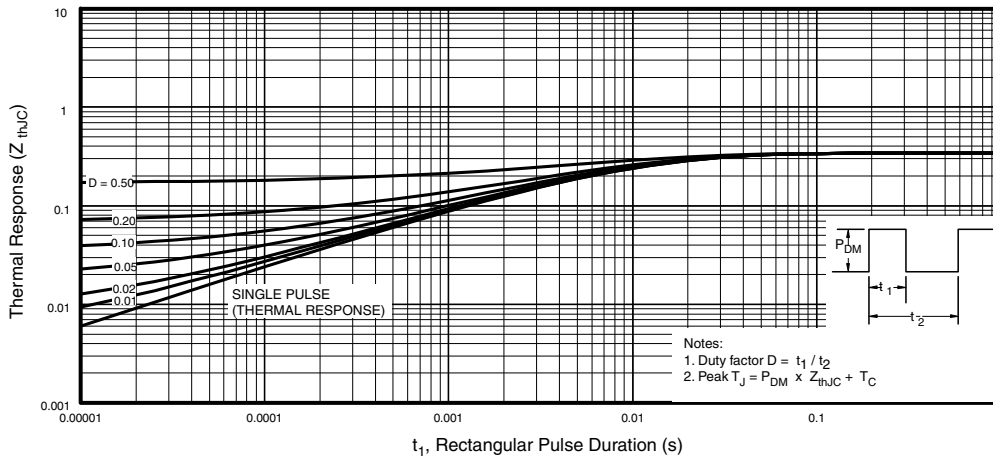


Fig. 12 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

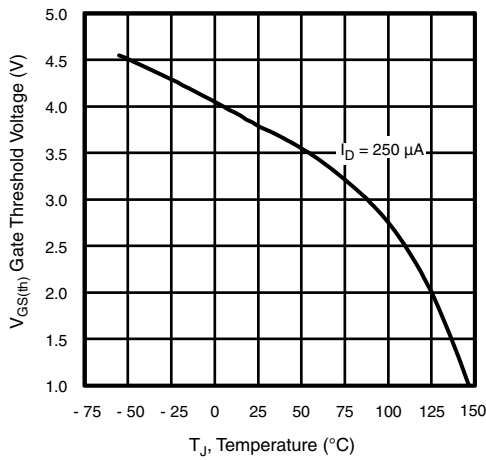


Fig. 13 - Threshold Voltage vs. Temperature

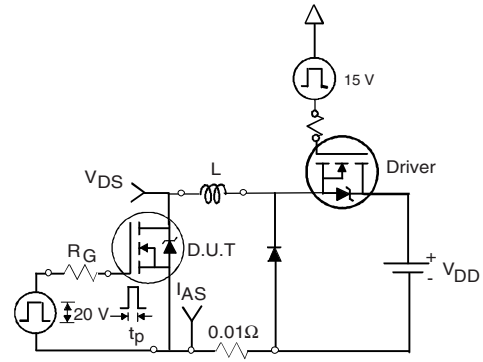


Fig. 15a - Unclamped Inductive Test Circuit

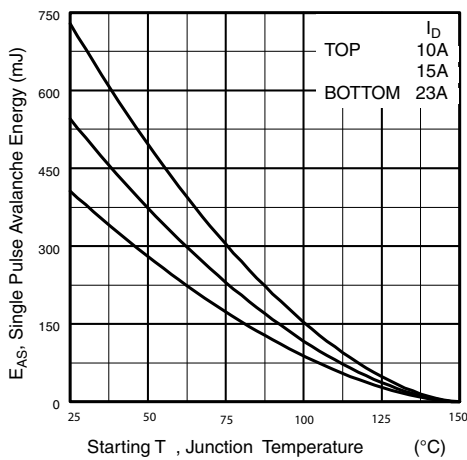


Fig. 14 - Maximum Avalanche Energy s. Drain Current

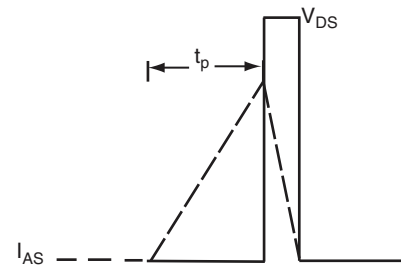


Fig. 15b - Unclamped Inductive Waveforms

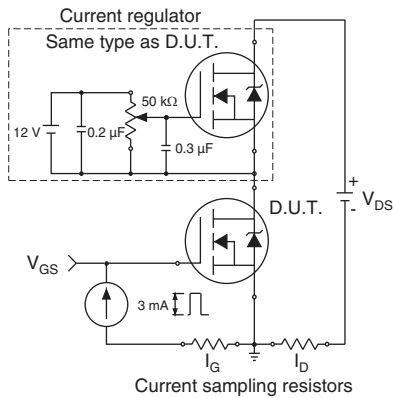


Fig. 16a - Gate Charge Test Circuit

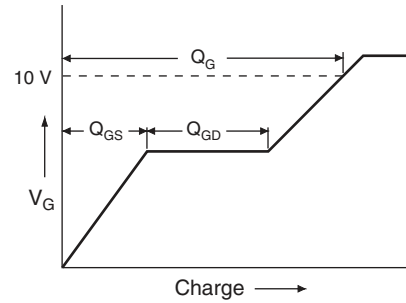
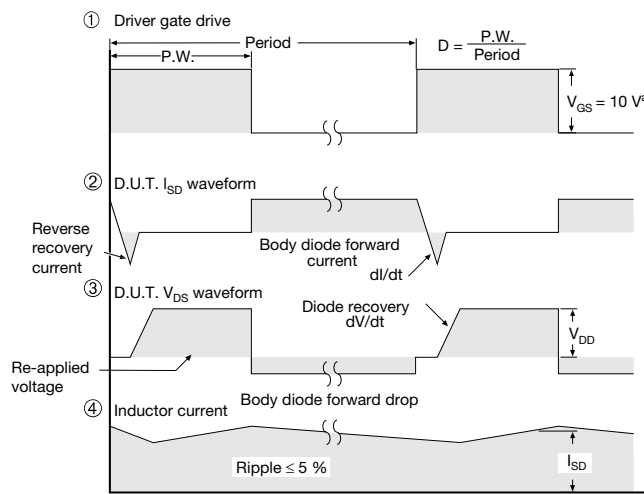
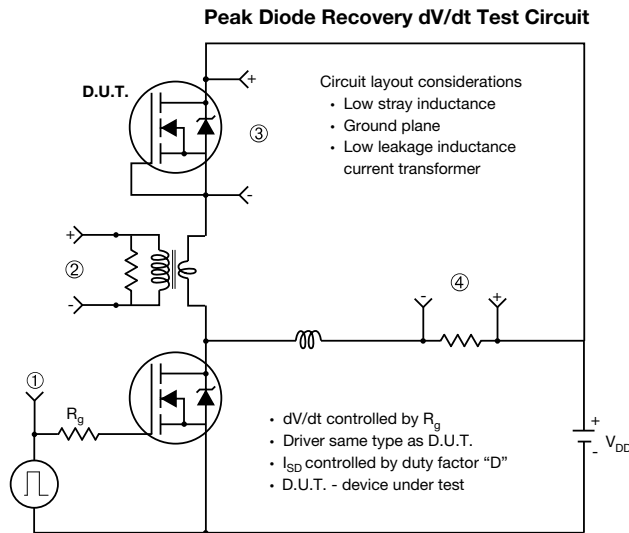


Fig. 16b - Basic Gate Charge Waveform



Note
a. $V_{GS} = 5V$ for logic level devices

Fig. 17 - For N-Channel

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?91209.



TO-247AC (High Voltage)

VERSION 1: FACILITY CODE = 9



Section C--C, D---D, E--E

DIM.	MILLIMETERS		NOTES
	MIN.	MAX.	
A	4.83	5.21	
A1	2.29	2.55	
A2	1.50	2.49	
b	1.12	1.33	
b1	1.12	1.28	
b2	1.91	2.39	6
b3	1.91	2.34	
b4	2.87	3.22	6, 8
b5	2.87	3.18	
c	0.55	0.69	6
c1	0.55	0.65	
D	20.40	20.70	4

DIM.	MILLIMETERS		NOTES
	MIN.	MAX.	
D1	16.25	16.85	5
D2	0.56	0.76	
E	15.50	15.87	4
E1	13.46	14.16	5
E2	4.52	5.49	3
e	5.44 BSC		
L	14.90	15.40	
L1	3.96	4.16	6
Ø P	3.56	3.65	7
Ø P1	7.19 ref.		
Q	5.31	5.69	
S	5.54	5.74	

Notes

- (1) Package reference: JEDEC® TO247, variation AC
- (2) All dimensions are in mm
- (3) Slot required, notch may be rounded
- (4) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm per side. These dimensions are measured at the outermost extremes of the plastic body
- (5) Thermal pad contour optional with dimensions D1 and E1
- (6) Lead finish uncontrolled in L1
- (7) Ø P to have a maximum draft angle of 1.5° to the top of the part with a maximum hole diameter of 3.91 mm
- (8) Dimension b2 and b4 does not include dambar protrusion. Allowable dambar protrusion shall be 0.1 mm total in excess of b2 and b4 dimension at maximum material condition



VERSION 2: FACILITY CODE = Y



DIM.	MILLIMETERS		NOTES
	MIN.	MAX.	
A	4.58	5.31	
A1	2.21	2.59	
A2	1.17	2.49	
b	0.99	1.40	
b1	0.99	1.35	
b2	1.53	2.39	
b3	1.65	2.37	
b4	2.42	3.43	
b5	2.59	3.38	
c	0.38	0.86	
c1	0.38	0.76	
D	19.71	20.82	
D1	13.08	-	

DIM.	MILLIMETERS		NOTES
	MIN.	MAX.	
D2	0.51	1.30	
E	15.29	15.87	
E1	13.72	-	
e	5.46 BSC		
Ø k	0.254		
L	14.20	16.25	
L1	3.71	4.29	
Ø P	3.51	3.66	
Ø P1	-	7.39	
Q	5.31	5.69	
R	4.52	5.49	
S	5.51 BSC		

Notes

- (1) Dimensioning and tolerancing per ASME Y14.5M-1994
- (2) Contour of slot optional
- (3) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outermost extremes of the plastic body
- (4) Thermal pad contour optional with dimensions D1 and E1
- (5) Lead finish uncontrolled in L1
- (6) Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")
- (7) Outline conforms to JEDEC outline TO-247 with exception of dimension c



VERSION 3: FACILITY CODE = N



MILLIMETERS		
DIM.	MIN.	MAX.
A	4.65	5.31
A1	2.21	2.59
A2	1.17	1.37
b	0.99	1.40
b1	0.99	1.35
b2	1.65	2.39
b3	1.65	2.34
b4	2.59	3.43
b5	2.59	3.38
c	0.38	0.89
c1	0.38	0.84
D	19.71	20.70
D1	13.08	-

MILLIMETERS		
DIM.	MIN.	MAX.
D2	0.51	1.35
E	15.29	15.87
E1	13.46	-
e	5.46 BSC	
k	0.254	
L	14.20	16.10
L1	3.71	4.29
N	7.62 BSC	
P	3.56	3.66
P1	-	7.39
Q	5.31	5.69
R	4.52	5.49
S	5.51 BSC	

ECN: E20-0545-Rev. F, 19-Oct-2020
 DWG: 5971

Notes

- (1) Dimensioning and tolerancing per ASME Y14.5M-1994
- (2) Contour of slot optional
- (3) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outermost extremes of the plastic body
- (4) Thermal pad contour optional with dimensions D1 and E1
- (5) Lead finish uncontrolled in L1
- (6) Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")



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