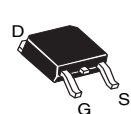
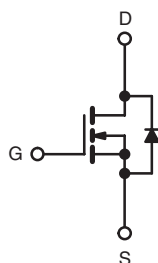
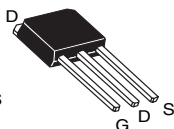


Power MOSFET

PRODUCT SUMMARY

V_{DS} (V)	200	
$R_{DS(on)}$ (Ω)	$V_{GS} = 10\text{ V}$	1.5
Q_g (Max.) (nC)	8.2	
Q_{gs} (nC)	1.8	
Q_{gd} (nC)	4.5	
Configuration	Single	

PAK
(TO-252)

PAK
(TO-251)


N-Channel MOSFET

FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- Surface Mount (IRFR210, SiHFR210)
- Straight Lead (IRFU210, SiHFU210)
- Available in Tape and Reel
- Fast Switching
- Ease of Paralleling
- Compliant to RoHS Directive 2002/95/EC



RoHS*
COMPLIANT
HALOGEN
FREE
Available

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 PAK is designed for surface mounting using vapor phase, infrared, or wave soldering techniques. The straight lead version (IRFU, SiHFU series) is for through-hole mounting applications. Power dissipation levels up to 1.5 W are possible in typical surface mount applications.

ORDERING INFORMATION

Package	PAK (TO-252)	PAK (TO-252)	PAK (TO-252)	PAK (TO-252)	PAK (TO-251)
Lead (Pb)-free and Halogen-free	SiHFR210-GE3	SiHFR210TRL-GE3 ^a	-	SiHFR210TRR-GE3 ^a	SiHFU210-GE3
Lead (Pb)-free	IRFR210PbF	IRFR210TRL-PbF ^a	IRFR210TRPbF ^a	-	IRFU210PbF
	SiHFR210-E3	SiHFR210TL-E3 ^a	SiHFR210T-E3 ^a	-	SiHFU210-E3
SnPb	IRFR210	IRFR210TRL ^a	IRFR210TR ^a	IRFR210TRR ^a	IRFU210
	SiHFR210	SiHFR210TL ^a	SiHFR210T ^a	SiHFR210TR ^a	SiHFU210

Note

a. See device orientation.

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

PARAMETER			SYMBOL	LIMIT	UNIT
Drain-Source Voltage			V _{DS}	200	V
Gate-Source Voltage			V _{GS}	± 20	
Continuous Drain Current	V _{GS} at 10 V	T _C = 25 °C	I _D	2.6	A
		T _C = 100 °C		1.7	
Pulsed Drain Current ^a			I _{DM}	10	W/°C
Linear Derating Factor				0.20	
Linear Derating Factor (PCB Mount) ^e				0.020	
Single Pulse Avalanche Energy ^b			E _{AS}	95	mJ
Avalanche Current ^a			I _{AR}	2.7	A
Repetitive Avalanche Energy ^a			E _{AR}	2.5	mJ
Maximum Power Dissipation	T _C = 25 °C		P _D	25	W
Maximum Power Dissipation (PCB Mount) ^e	T _A = 25 °C			2.5	
Peak Diode Recovery dV/dt ^c			dV/dt	5.0	V/ns
Operating Junction and Storage Temperature Range			T _J , T _{stg}	- 55 to + 150	°C
Soldering Recommendations (Peak Temperature)	for 10 s			260 ^d	

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 50\text{ V}$, starting $T_J = 25\text{ }^\circ\text{C}$, $L = 28\text{ mH}$, $R_g = 25\text{ }\Omega$, $I_{AS} = 2.6\text{ A}$ (see fig. 12).
- $I_{SD} \leq 2.6\text{ A}$, $dI/dt \leq 70\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 150\text{ }^\circ\text{C}$.
- 1.6 mm from case.
- When mounted on 1" square PCB (FR-4 or G-10 material).

* Pb containing terminations are not RoHS compliant, exemptions may apply

THERMAL RESISTANCE RATINGS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	-	110	°C/W
Maximum Junction-to-Ambient (PCB Mount) ^a	R_{thJA}	-	-	50	
Maximum Junction-to-Case (Drain)	R_{thJC}	-	-	5.0	

Note

a. When mounted on 1" square PCB (FR-4 or G-10 material).

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 V, I _D = 250 μA		200	-	-	V
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	Reference to 25 °C, I _D = 1 mA		-	0.30	-	V/°C
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA		2.0	-	4.0	V
Gate-Source Leakage	I _{GSS}	V _{GS} = ± 20 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 200 V, V _{GS} = 0 V		-	-	25	μA
		V _{DS} = 160 V, V _{GS} = 0 V, T _J = 125 °C		-	-	250	
Drain-Source On-State Resistance	R _{DS(on)}	V _{GS} = 10 V	I _D = 1.6 A ^b	-	-	1.5	Ω
Forward Transconductance	g _{fs}	V _{DS} = 50 V, I _D = 1.6 A ^b		0.80	-	-	S
Dynamic							
Input Capacitance	C _{iss}	V _{GS} = 0 V, V _{DS} = 25 V, f = 1.0 MHz, see fig. 5		-	140	-	pF
Output Capacitance	C _{oss}			-	53	-	
Reverse Transfer Capacitance	C _{rss}			-	15	-	
Total Gate Charge	Q _g	V _{GS} = 10 V	I _D = 3.3 A, V _{DS} = 160 V, see fig. 6 and 13 ^b	-	-	8.2	nC
Gate-Source Charge	Q _{gs}			-	-	1.8	
Gate-Drain Charge	Q _{gd}			-	-	4.5	
Turn-On Delay Time	t _{d(on)}	V _{DD} = 100 V, I _D = 3.3 A, R _g = 24 Ω, R _D = 30 Ω, see fig. 10 ^b		-	8.2	-	ns
Rise Time	t _r			-	17	-	
Turn-Off Delay Time	t _{d(off)}			-	14	-	
Fall Time	t _f			-	8.9	-	
Internal Drain Inductance	L _D	Between lead, 6 mm (0.25") from package and center of die contact		-	4.5	-	nH
Internal Source Inductance	L _S			-	7.5	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I _S	MOSFET symbol showing the integral reverse p - n junction diode		-	-	2.6	A
Pulsed Diode Forward Current ^a	I _{SM}			-	-	10	
Body Diode Voltage	V _{SD}	T _J = 25 °C, I _S = 2.6 A, V _{GS} = 0 V ^b		-	-	2.0	V
Body Diode Reverse Recovery Time	t _{rr}	T _J = 25 °C, I _F = 3.3 A, dI/dt = 100 A/μs ^b		-	150	310	ns
Body Diode Reverse Recovery Charge	Q _{rr}			-	0.60	1.4	μC
Forward Turn-On Time	t _{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L _S and L _D)					

Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
b. Pulse width $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\%$.

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

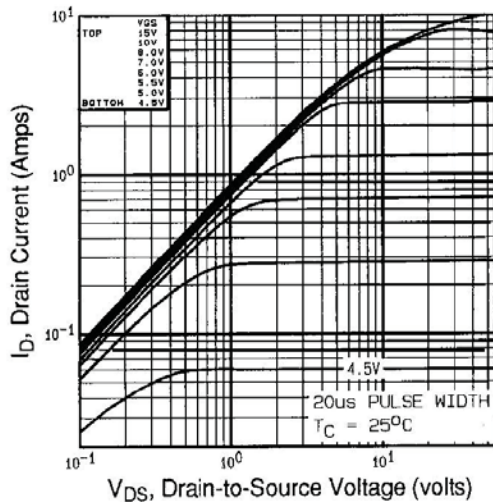


Fig. 1 - Typical Output Characteristics, $T_C = 25^\circ\text{C}$

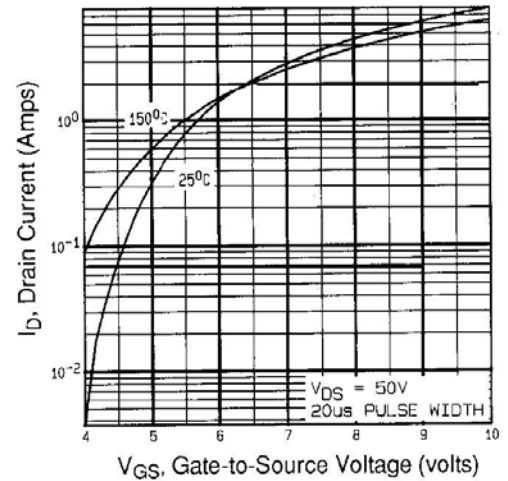


Fig. 3 - Typical Transfer Characteristics

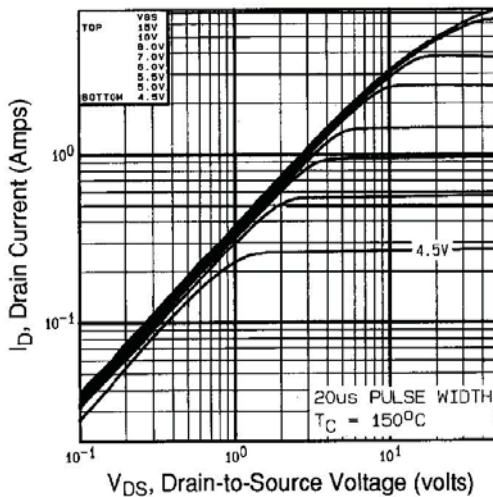


Fig. 2 - Typical Output Characteristics, $T_C = 150^\circ\text{C}$

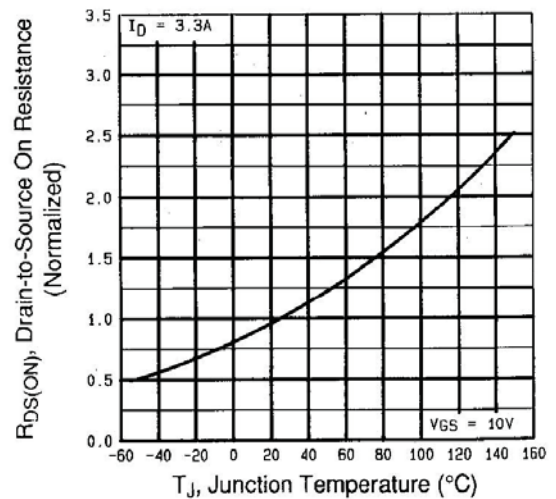


Fig. 4 - Normalized On-Resistance vs. Temperature

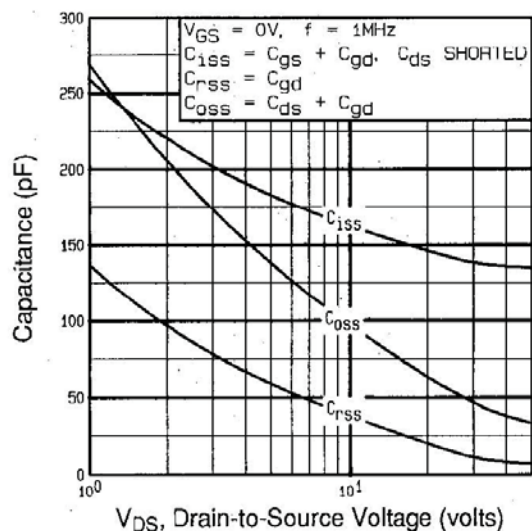


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

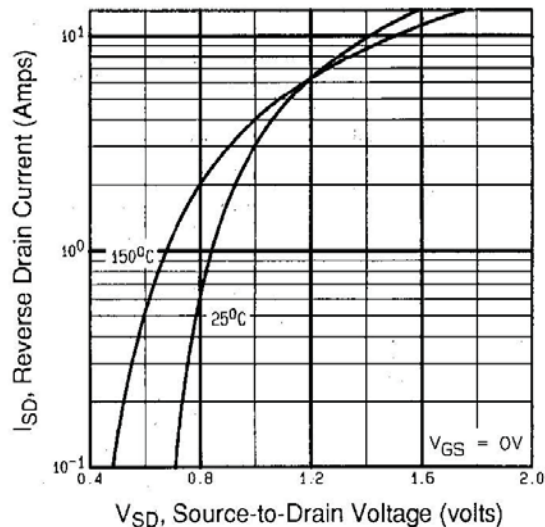


Fig. 7 - Typical Source-Drain Diode Forward Voltage

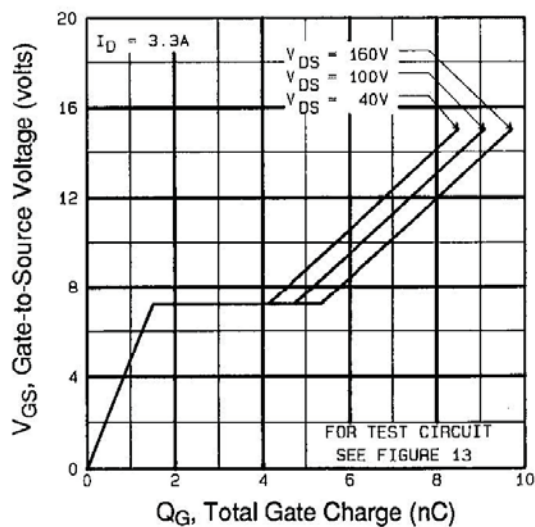


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

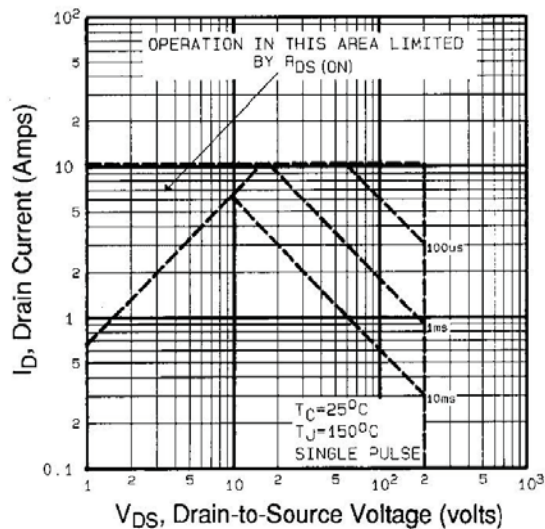


Fig. 8 - Maximum Safe Operating Area

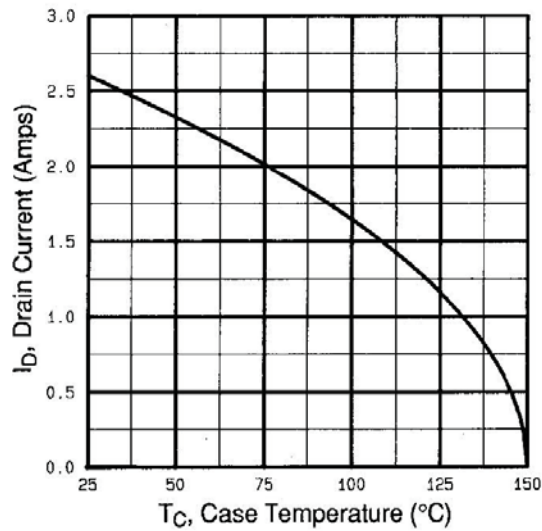


Fig. 9 - Maximum Drain Current vs. Case Temperature

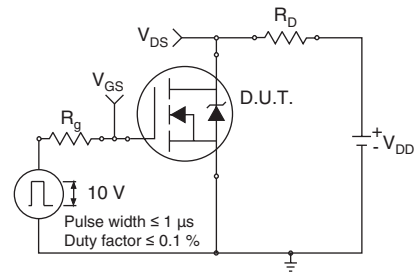


Fig. 10a - Switching Time Test Circuit

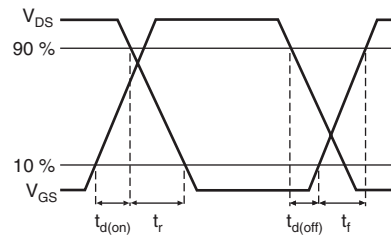


Fig. 10b - Switching Time Waveforms

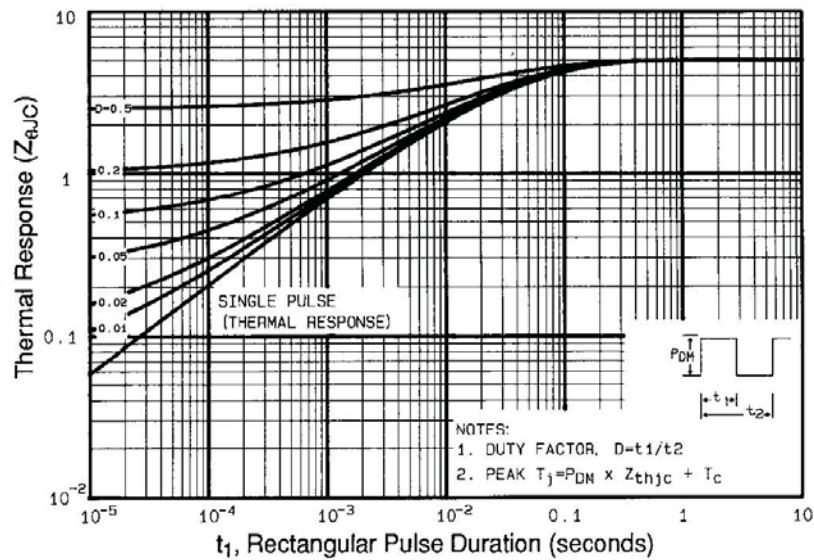


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

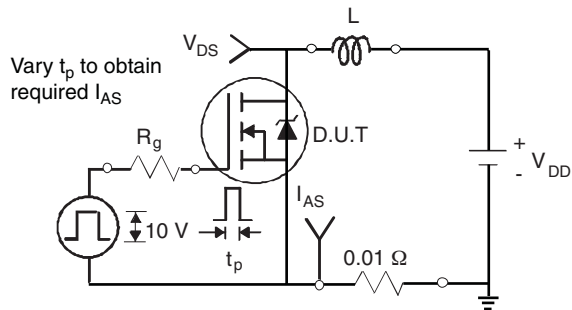


Fig. 12a - Unclamped Inductive Test Circuit

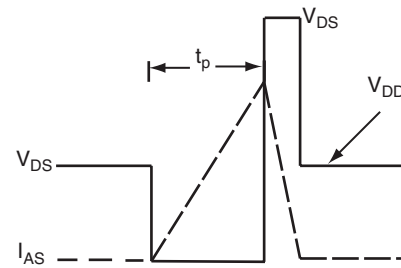


Fig. 12b - Unclamped Inductive Waveforms

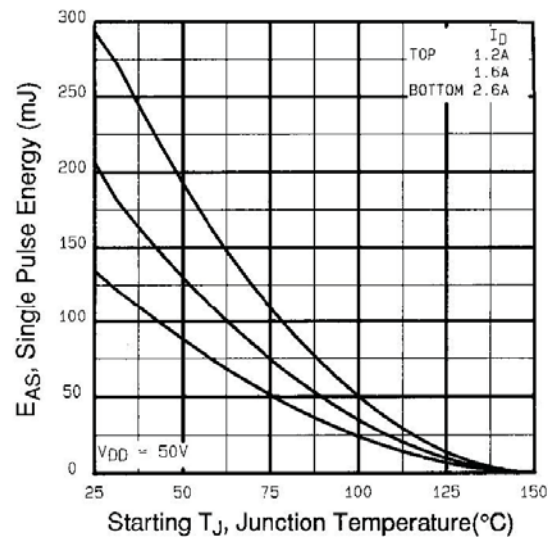


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

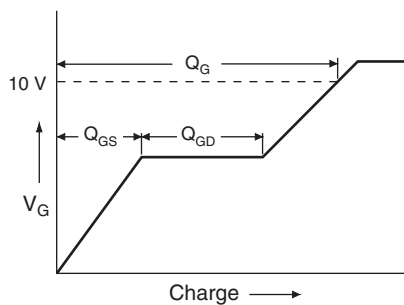


Fig. 13a - Basic Gate Charge Waveform

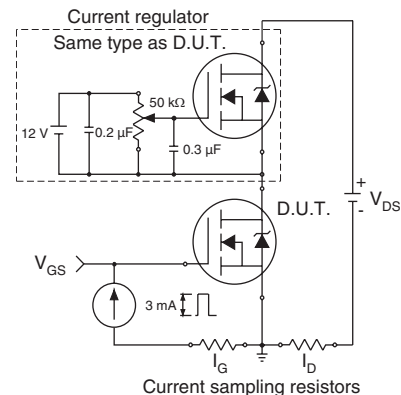
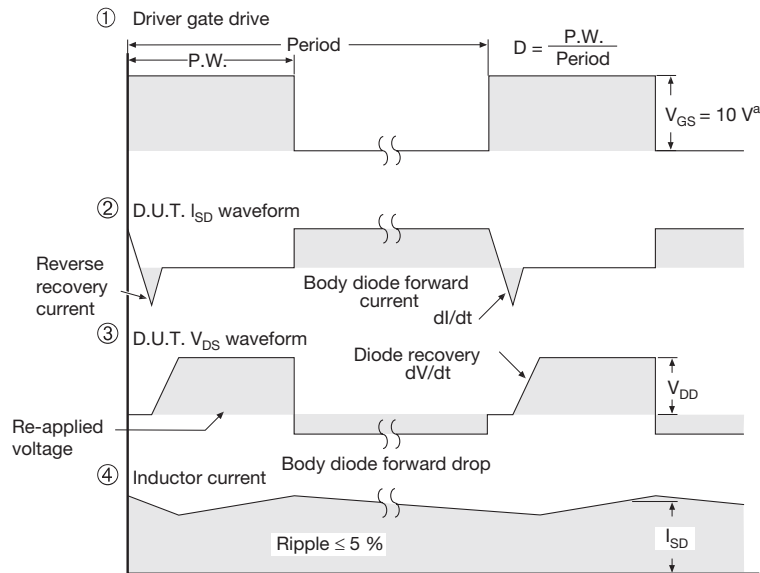
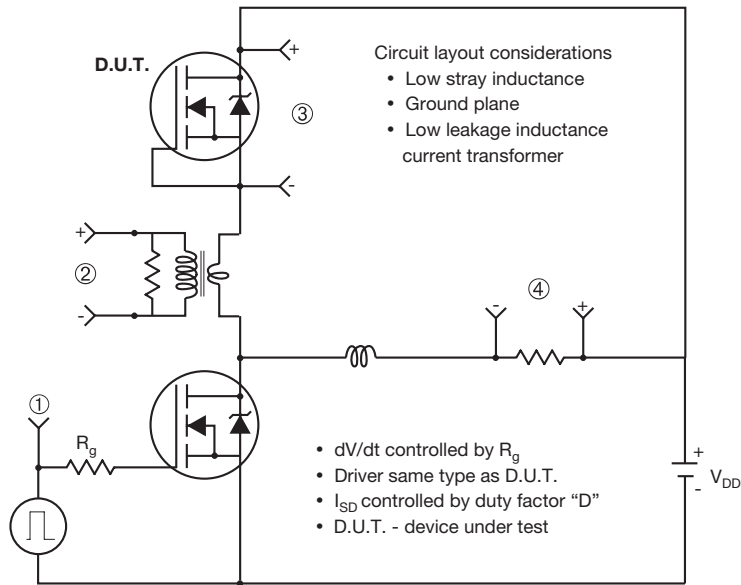


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



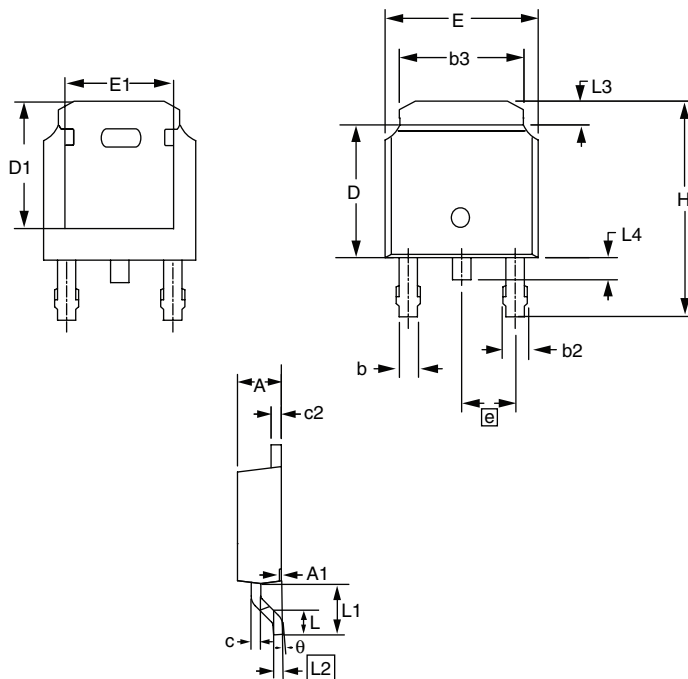
Note

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

Fig. 14 - 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?91268.

TO-252AA (HIGH VOLTAGE)



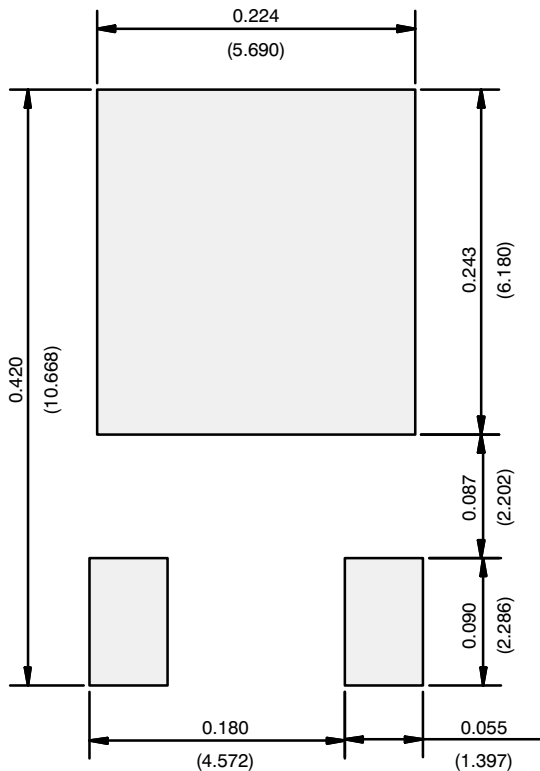
DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
E	6.40	6.73	0.252	0.265
L	1.40	1.77	0.055	0.070
L1	2.743 REF		0.108 REF	
L2	0.508 BSC		0.020 BSC	
L3	0.89	1.27	0.035	0.050
L4	0.64	1.01	0.025	0.040
D	6.00	6.22	0.236	0.245
H	9.40	10.40	0.370	0.409
b	0.64	0.88	0.025	0.035
b2	0.77	1.14	0.030	0.045
b3	5.21	5.46	0.205	0.215
e	2.286 BSC		0.090 BSC	
A	2.20	2.38	0.087	0.094
A1	0.00	0.13	0.000	0.005
c	0.45	0.60	0.018	0.024
c2	0.45	0.58	0.018	0.023
D1	5.30	-	0.209	-
E1	4.40	-	0.173	-
θ	0°	10°	0°	10°

ECN: S-81965-Rev. A, 15-Sep-08
DWG: 5973

Notes

1. Package body sizes exclude mold flash, protrusion or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 0.10 mm per side.
2. Package body sizes determined at the outermost extremes of the plastic body exclusive of mold flash, gate burrs and interlead flash, but including any mismatch between the top and bottom of the plastic body.
3. The package top may be smaller than the package bottom.
4. Dimension "b" does not include dambar protrusion. Allowable dambar protrusion shall be 0.10 mm total in excess of "b" dimension at maximum material condition. The dambar cannot be located on the lower radius of the foot.

RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)



Recommended Minimum Pads
Dimensions in Inches/(mm)

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