

Vishay Siliconix

Dual N-Channel 60-V (D-S) MOSFET

PRODUCT SUMMARY						
V _{DS} (V)	$R_{DS(on)}(\Omega)$	I _D (A) ^a	Q _g (Typ.)			
60	0.058 at V _{GS} = 10 V	5.3	13 nC			
00	0.072 at V _{GS} = 4.5 V	4.7	13110			

FEATURES

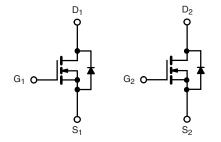
- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET® Power MOSFET



ROHS COMPLIANT HALOGEN FREE

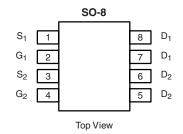
APPLICATIONS

- LCD TV CCFL Inverter
- Load Switch



N-Channel MOSFET

N-Channel MOSFET



Ordering Information: Si9945BDY-T1-GE3 (Lead (Pb)-free and Halogen-free)

ABSOLUTE MAXIMUM RATINGS Parameter	Symbol	Limit	Unit		
Drain-Source Voltage	V _{DS}	60	1		
Gate-Source Voltage	V_{GS}	± 20	V		
	T _C = 25 °C		5.3		
Continuous Dusin Comment (T., 150 °C)	T _C = 70 °C		4.3		
Continuous Drain Current (T _J = 150 °C)	T _A = 25 °C	I _D	4.3 ^{b, c}		
	T _A = 70 °C		3.4 ^{b, c}	_	
Pulsed Drain Current (10 µs Width)		I _{DM}	20	Α	
0 11 0 0 1	T _C = 25 °C	1	2.6		
Continuous Source-Drain Diode Current	T _A = 25 °C	I _S —	1.7 ^{b, c}		
Avalanche Current	L = 0 1 mH	I _{AS}	11		
Single-Pulse Avalanche Energy	L=UIIIII	E _{AS}	6.1	mJ	
	T _C = 25 °C		3.1		
Maximum Power Dissipation	T _C = 70 °C		2	10/	
	T _A = 25 °C	P _D	2 ^{b, c}	W	
	T _A = 70 °C		1.3 ^{b, c}		
Operating Junction and Storage Temperature R	T _J , T _{stg}	- 55 to 150	°C		

THERMAL RESISTANCE RATINGS						
Parameter	Symbol	Typical	Maximum	Unit		
Maximum Junction-to-Ambient ^{a, d}	R _{thJA}	55	62.5	°C/W		
Maximum Junction-to-Foot (Drain)	Steady State	R _{thJF}	33	40	O/VV	

Notes:

- a. Based on $T_C = 25$ °C.
- b. Surface Mounted on 1" x 1" FR4 board.
- c. t = 10 s
- d. Maximum under Steady State conditions is 110 $^{\circ}\text{C/W}.$

Si9945BDY

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SPECIFICATIONS T _J = 25 °C, unless otherwise noted								
Parameter	Symbol	Test Conditions	Min.	Тур.	Max.	Unit		
Static								
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0 \text{ V}, I_D = 250 \mu\text{A}$	60			V		
V _{DS} Temperature Coefficient	$\Delta V_{DS}/T_{J}$	I _D = 250 μA		55		mV/°C		
V _{GS(th)} Temperature Coefficient	$\Delta V_{GS(th)}/T_J$	i _D = 250 μA		- 6		IIIV/ C		
Cata Cauraa Threahald Valtage	V	$V_{DS} = V_{GS}, I_D = 250 \mu A$	1		3	V		
Gate-Source Threshold Voltage	V _{GS(th)}	$V_{DS} = V_{GS}$, $I_D = 5 \text{ mA}$		2.5		- V		
Gate-Source Leakage	I _{GSS}	$V_{DS} = 0 \text{ V}, V_{GS} = 20 \text{ V}$			100	nA		
Zana Cata Valtana Busin Commant		V _{DS} = 60 V, V _{GS} = 0 V			1	<u>μ</u> Α		
Zero Gate Voltage Drain Current	IDSS	$V_{DS} = 60 \text{ V}, V_{GS} = 0 \text{ V}, T_{J} = 85 ^{\circ}\text{C}$			10			
On-State Drain Current ^a	I _{D(on)}	$V_{DS} \ge 5 \text{ V}, V_{GS} = 10 \text{ V}$	20			Α		
	R _{DS(on)}	V _{GS} = 10 V, I _D = 4.3 A		0.046	0.058	Ω		
Drain-Source On-State Resistance ^a		$V_{GS} = 4.5 \text{ V}, I_D = 3.9 \text{ A}$		0.059	0.072			
Forward Transconductance ^a	9 _{fs}	V _{DS} = 15 V, I _D = 4.3 A		15		S		
Dynamic ^b					l			
Input Capacitance	C _{iss}			665		pF		
Output Capacitance	C _{oss}	V _{DS} = 15 V, V _{GS} = 0 V, f = 1 MHz		75				
Reverse Transfer Capacitance	C _{rss}	20 · GO ·		40				
		V _{DS} = 30 V, V _{GS} = 10 V, I _D = 4.3 A		13	20	nC		
Total Gate Charge	Q_g	23 7 d3 7 D		6	9			
Gate-Source Charge	Q _{gs}	Q_{GS} $V_{DS} = 30 \text{ V}, V_{GS} = 4.5 \text{ V}, I_{D} = 4.3 \text{ A}$		2.3	-			
Gate-Drain Charge	Q _{gd}	26 / GC / D		2.6				
Gate Resistance	R _g	f = 1 MHz		2		Ω		
Turn-On Delay Time	t _{d(on)}			15	25			
Rise Time	t _r	$V_{DD} = 30 \text{ V, R}_{1} = 8.8 \Omega$		65	100	-		
Turn-Off Delay Time	t _{d(off)}	$I_D \cong 3.4 \text{ A}, V_{GEN} = 4.5 \text{ V}, R_q = 1 \Omega$		15	25	-		
Fall Time	t _f	g		10	15			
Turn-On Delay Time	t _{d(on)}			10	15	ns		
Rise Time	t _r	$V_{DD} = 30 \text{ V, R}_{1} = 8.8 \Omega$		15	25	- - -		
Turn-Off Delay Time	t _{d(off)}	$I_D \cong 3.4 \text{ A}, V_{GEN} = 10 \text{ V}, R_q = 1 \Omega$		20	30			
Fall Time	t _f	SER 9		10	15			
Drain-Source Body Diode Characteristics								
Continuous Source-Drain Diode Current	I _S	T _C = 25 °C			2.6			
Pulse Diode Forward Current	I _{SM}				20	A		
Body Diode Voltage	V _{SD}	I _S = 1.7 A, V _{GS} = 0 V		0.8	1.2	V		
Body Diode Reverse Recovery Time	t _{rr}	3		30	60	ns		
Body Diode Reverse Recovery Charge	de Reverse Recovery Charge Q			32	50	nC		
Reverse Recovery Fall Time	t _a	$I_F = 1.7 \text{ A}, \text{ dI/dt} = 100 \text{ A/}\mu\text{s}, T_J = 25 °C$		25		1		
Reverse Recovery Rise Time	t _b			5		ns		
	Ū,				l			

Notes:

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

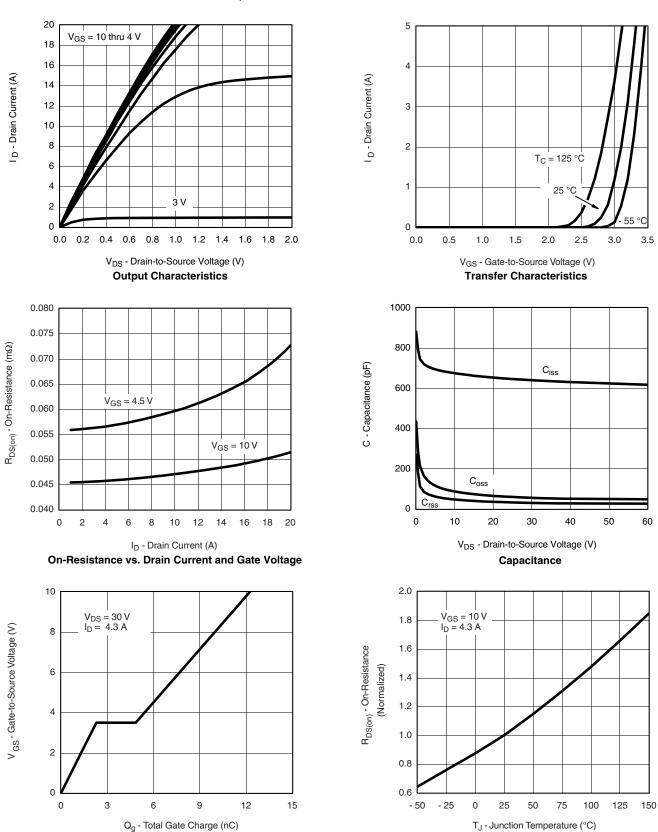
a. Pulse test; pulse width $\leq 300~\mu s,$ duty cycle $\leq 2~\%.$

b. Guaranteed by design, not subject to production testing.



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TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Gate Charge

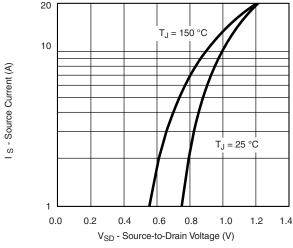
On-Resistance vs. Junction Temperature

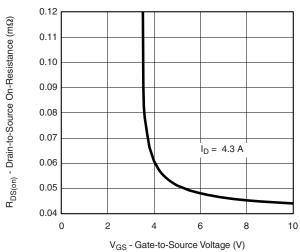
Si9945BDY

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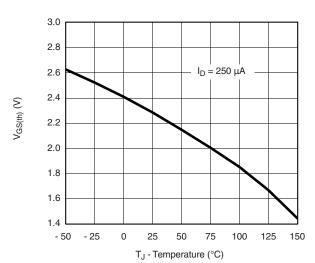
VISHAY

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

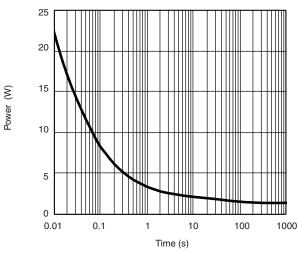




Source-Drain Diode Forward Voltage

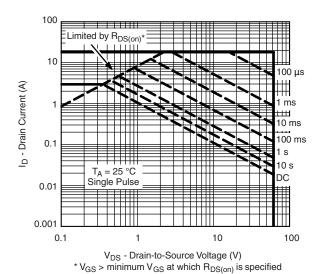


On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage

Single Pulse Power, Junction-to-Ambient

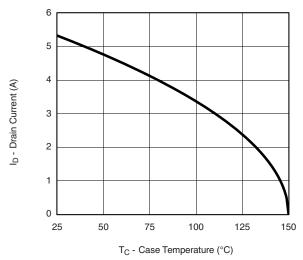


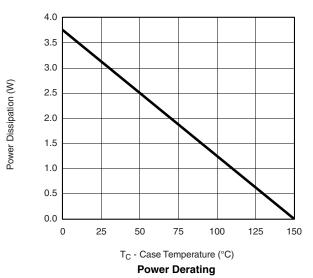
Safe Operating Area



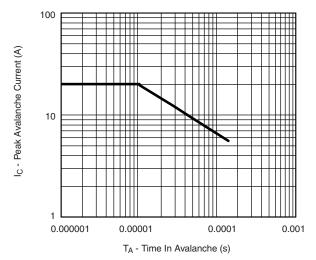
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TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted









Single Pulse Avalanche Capability

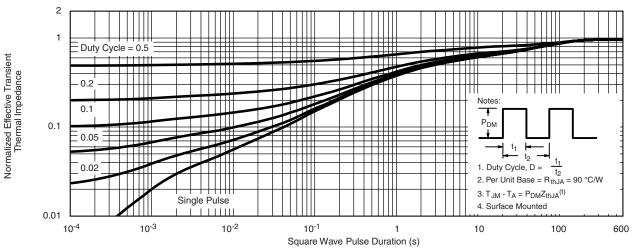
^{*} The power dissipation P_D is based on $T_{J(max)} = 150$ °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

Si9945BDY

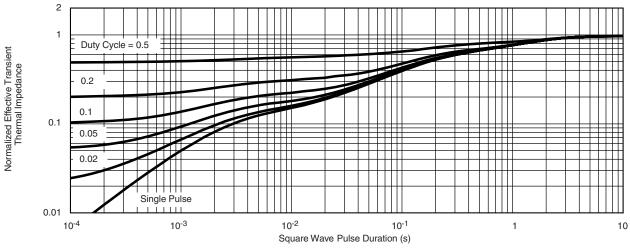
Vishay Siliconix



TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Normalized Thermal Transient Impedance, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Case

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?64737.



SOIC (NARROW): 8-LEAD JEDEC Part Number: MS-012







	MILLIMETERS INCHES			HES		
DIM	Min	Max	Min	Max		
Α	1.35	1.75	0.053	0.069		
A ₁	0.10	0.20	0.004	0.008		
В	0.35	0.51	0.014	0.020		
С	0.19	0.25	0.0075	0.010		
D	4.80	5.00	0.189	0.196		
Е	3.80	4.00	0.150	0.157		
е	1.27	1.27 BSC		0.050 BSC		
Н	5.80	6.20	0.228	0.244		
h	0.25	0.50	0.010	0.020		
L	0.50	0.93	0.020	0.037		
q	0°	8°	0°	8°		
S	0.44	0.64	0.018	0.026		
ECN: C-06527-Rev. I. 11-Sep-06						

DWG: 5498

Document Number: 71192 www.vishay.com 11-Sep-06

Mounting LITTLE FOOT®, SO-8 Power MOSFETs

Wharton McDaniel

Surface-mounted LITTLE FOOT power MOSFETs use integrated circuit and small-signal packages which have been been modified to provide the heat transfer capabilities required by power devices. Leadframe materials and design, molding compounds, and die attach materials have been changed, while the footprint of the packages remains the same.

See Application Note 826, Recommended Minimum Pad Patterns With Outline Drawing Access for Vishay Siliconix MOSFETs, (http://www.vishay.com/ppg?72286), for the basis of the pad design for a LITTLE FOOT SO-8 power MOSFET. In converting this recommended minimum pad to the pad set for a power MOSFET, designers must make two connections: an electrical connection and a thermal connection, to draw heat away from the package.

In the case of the SO-8 package, the thermal connections are very simple. Pins 5, 6, 7, and 8 are the drain of the MOSFET for a single MOSFET package and are connected together. In a dual package, pins 5 and 6 are one drain, and pins 7 and 8 are the other drain. For a small-signal device or integrated circuit, typical connections would be made with traces that are 0.020 inches wide. Since the drain pins serve the additional function of providing the thermal connection to the package, this level of connection is inadequate. The total cross section of the copper may be adequate to carry the current required for the application, but it presents a large thermal impedance. Also, heat spreads in a circular fashion from the heat source. In this case the drain pins are the heat sources when looking at heat spread on the PC board.

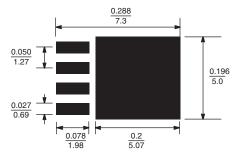


Figure 1. Single MOSFET SO-8 Pad Pattern With Copper Spreading

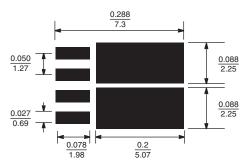


Figure 2. Dual MOSFET SO-8 Pad Pattern With Copper Spreading

The minimum recommended pad patterns for the single-MOSFET SO-8 with copper spreading (Figure 1) and dual-MOSFET SO-8 with copper spreading (Figure 2) show the starting point for utilizing the board area available for the heat-spreading copper. To create this pattern, a plane of copper overlies the drain pins. The copper plane connects the drain pins electrically, but more importantly provides planar copper to draw heat from the drain leads and start the process of spreading the heat so it can be dissipated into the ambient air. These patterns use all the available area underneath the body for this purpose.

Since surface-mounted packages are small, and reflow soldering is the most common way in which these are affixed to the PC board, "thermal" connections from the planar copper to the pads have not been used. Even if additional planar copper area is used, there should be no problems in the soldering process. The actual solder connections are defined by the solder mask openings. By combining the basic footprint with the copper plane on the drain pins, the solder mask generation occurs automatically.

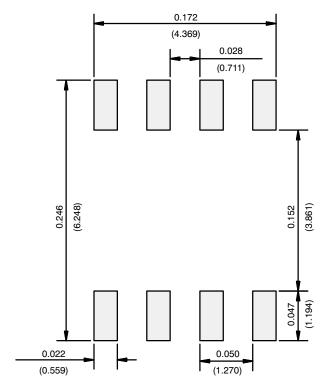
A final item to keep in mind is the width of the power traces. The absolute minimum power trace width must be determined by the amount of current it has to carry. For thermal reasons, this minimum width should be at least 0.020 inches. The use of wide traces connected to the drain plane provides a low impedance path for heat to move away from the device.

APPLICATION NOTE

Document Number: 70740 Revision: 18-Jun-07



RECOMMENDED MINIMUM PADS FOR SO-8



Recommended Minimum Pads Dimensions in Inches/(mm)

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Revision: 02-Oct-12 Document Number: 91000

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многоканальный

Общество с ограниченной ответственностью «МосЧип» ИНН 7719860671 / КПП 771901001 Адрес: 105318, г.Москва, ул.Щербаковская д.3, офис 1107

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Офис по работе с юридическими лицами:

105318, г. Москва, ул. Щербаковская д. 3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:

moschip.ru moschip.ru_6 moschip.ru_4 moschip.ru_9