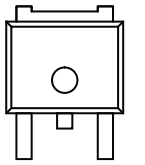
Automotive P-Channel 60 V (D-S) 175 °C MOSFET

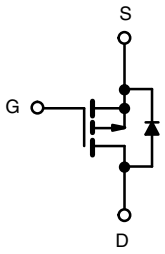
PRODUCT SUMMARY	
V_{DS} (V)	- 60
$R_{DS(on)}$ (Ω) at V_{GS} = - 10 V	0.055
$R_{DS(on)}$ (Ω) at V_{GS} = - 4.5 V	0.100
I_D (A)	- 20
Configuration	Single

TO-252



Drain Connected to Tab

Top View



P-Channel MOSFET

FEATURES

- **Halogen-free According to IEC 61249-2-21 Definition**
- TrenchFET® Power MOSFET
- Package with Low Thermal Resistance
- 100 % R_g and UIS Tested
- Compliant to RoHS Directive 2002/95/EC
- AEC-Q101 Qualified[d]

AUTOMOTIVE GRADE

RoHS COMPLIANT

HALOGEN FREE

ORDERING INFORMATION	
Package	TO-252
Lead (Pb)-free and Halogen-free	SQD19P06-60L-GE3

ABSOLUTE MAXIMUM RATINGS (T_C = 25 °C, unless otherwise noted)

PARAMETER		SYMBOL	LIMIT	UNIT
Drain-Source Voltage		V_{DS}	- 60	V
Gate-Source Voltage		V_{GS}	± 20	
Continuous Drain Current	T_C = 25 °C	I_D	- 20	A
	T_C = 125 °C		- 11	
Continuous Source Current (Diode Conduction)[a]		I_S	- 25	
Pulsed Drain Current[b]		I_{DM}	- 80	
Single Pulse Avalanche Current	L = 0.1 mH	I_{AS}	- 24	
Single Pulse Avalanche Energy		E_{AS}	28	mJ
Maximum Power Dissipation[b]	T_C = 25 °C	P_D	46	W
	T_C = 125 °C		15	
Operating Junction and Storage Temperature Range		T_J, T_{stg}	- 55 to + 175	°C

THERMAL RESISTANCE RATINGS

PARAMETER		SYMBOL	LIMIT	UNIT
Junction-to-Ambient	PCB Mount[c]	R_{thJA}	50	°C/W
Junction-to-Case (Drain)		R_{thJC}	3.2	

Notes

a. Package limited.
b. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
c. When mounted on 1" square PCB (FR-4 material).
d. Parametric verification ongoing.

THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

SPECIFICATIONS (T_C = 25 °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		- 60	-	-	V
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = - 250 µA		- 1.5	-	- 2.5	
Gate-Source Leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ± 20 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	V_{GS} = 0 V	V_{DS} = - 60 V	-	-	- 1	µA
		V_{GS} = 0 V	V_{DS} = - 60 V, T_J = 125 °C	-	-	- 50	
		V_{GS} = 0 V	V_{DS} = - 60 V, T_J = 175 °C	-	-	- 150	
On-State Drain Current[a]	$I_{D(on)}$	V_{GS} = - 10 V	$V_{DS} \leq$ - 5 V	- 20	-	-	A
Drain-Source On-State Resistance[a]	$R_{DS(on)}$	V_{GS} = - 10 V	I_D = - 19 A	-	0.046	0.055	Ω
		V_{GS} = - 10 V	I_D = - 19 A, T_J = 125 °C	-	-	0.095	
		V_{GS} = - 10 V	I_D = - 19 A, T_J = 175 °C	-	-	0.125	
		V_{GS} = - 4.5 V	I_D = - 10 A	-	0.075	0.100	
Forward Transconductance[a]	g_{fs}	V_{DS} = - 15 V, I_D = - 17 A		-	20	-	S
Dynamic[b]							
Input Capacitance	C_{iss}	V_{GS} = 0 V	V_{DS} = - 25 V, f = 1 MHz	-	1192	1490	pF
Output Capacitance	C_{oss}			-	160	200	
Reverse Transfer Capacitance	C_{rss}			-	96	120	
Total Gate Charge[c]	Q_g	V_{GS} = - 10 V	V_{DS} = - 30 V, I_D = - 19 A	-	27	41	nC
Gate-Source Charge[c]	Q_{gs}			-	3.9	-	
Gate-Drain Charge[c]	Q_{gd}			-	5.9	-	
Gate Resistance	R_g	f = 1 MHz		2.3	4.7	7.1	Ω
Turn-On Delay Time[c]	$t_{d(on)}$	V_{DD} = - 30 V, R_L = 1.6 Ω $I_D \cong$ - 19 A, V_{GEN} = - 10 V, R_g = 1 Ω		-	7	11	ns
Rise Time[c]	t_r			-	9	14	
Turn-Off Delay Time[c]	$t_{d(off)}$			-	25	38	
Fall Time[c]	t_f			-	12	18	
Source-Drain Diode Ratings and Characteristics[b]							
Pulsed Current[a]	I_{SM}			-	-	- 80	A
Forward Voltage	V_{SD}	I_F = - 10 A, V_{GS} = 0 V		-	- 0.85	- 1.5	V

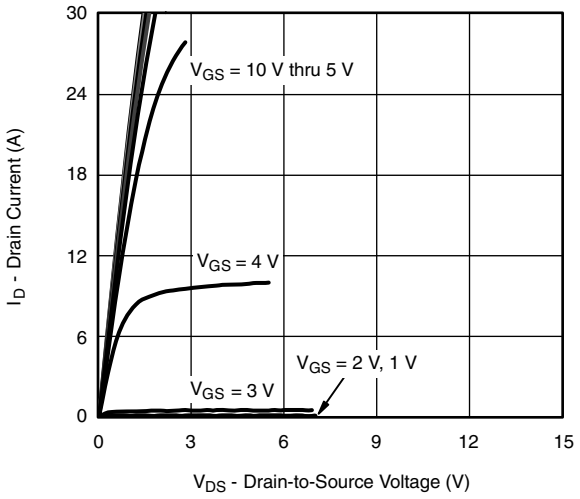
Notes

a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

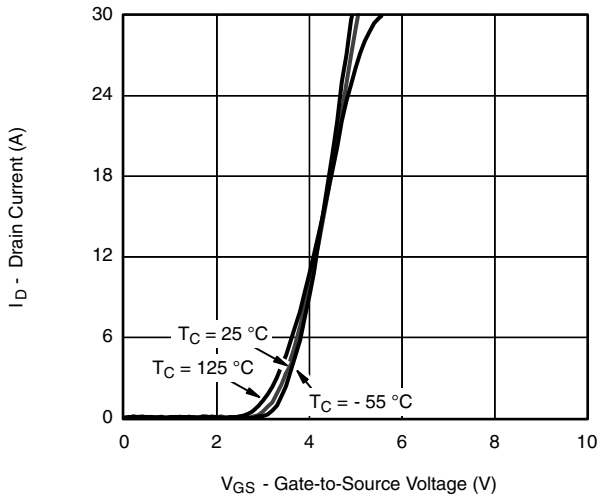
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

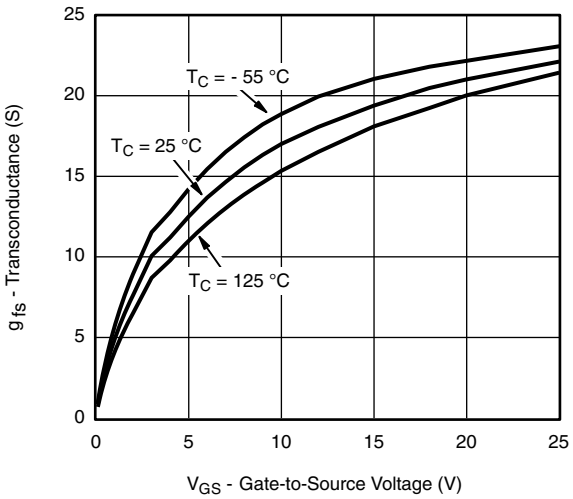
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



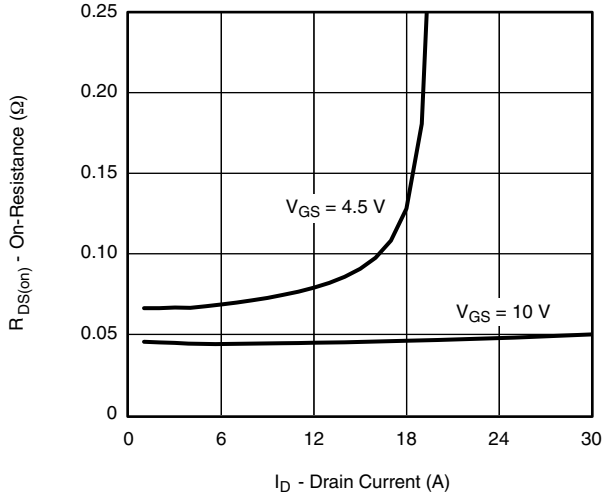
Output Characteristics



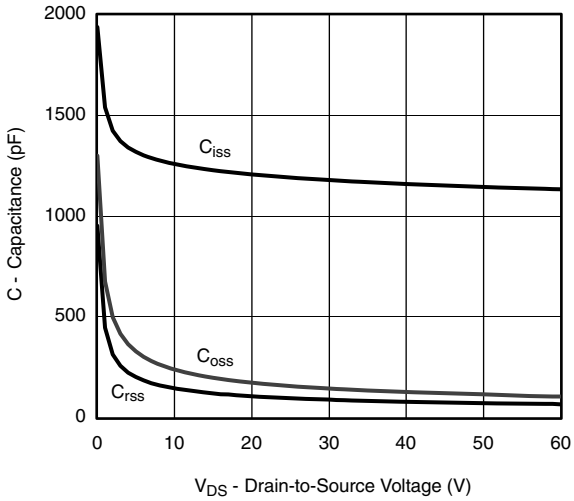
Transfer Characteristics



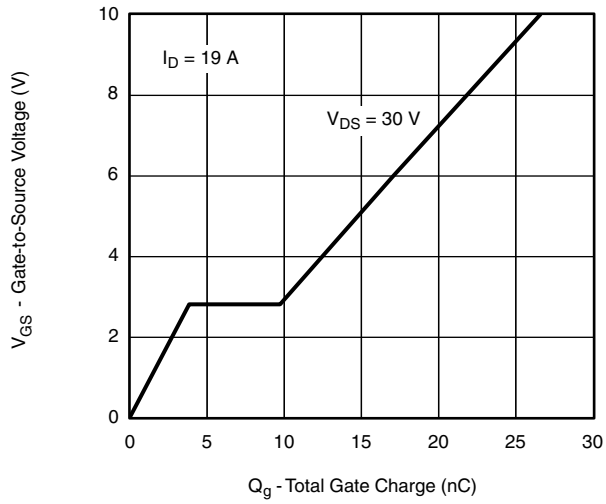
Transconductance



On-Resistance vs. Drain Current



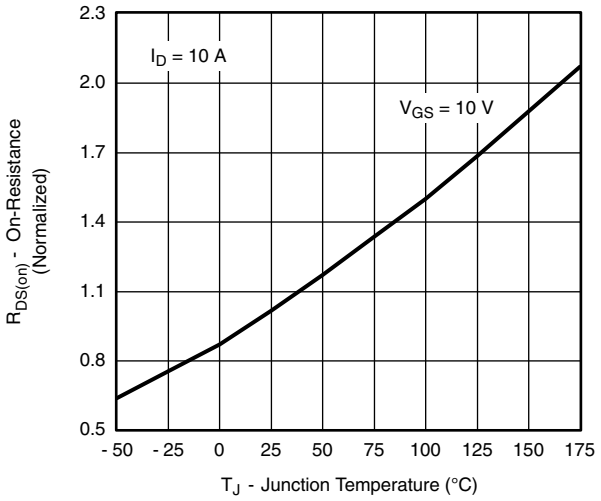
Capacitance



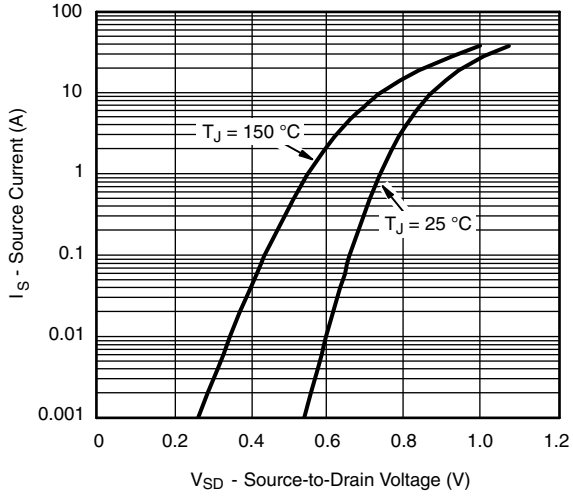
Gate Charge

THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

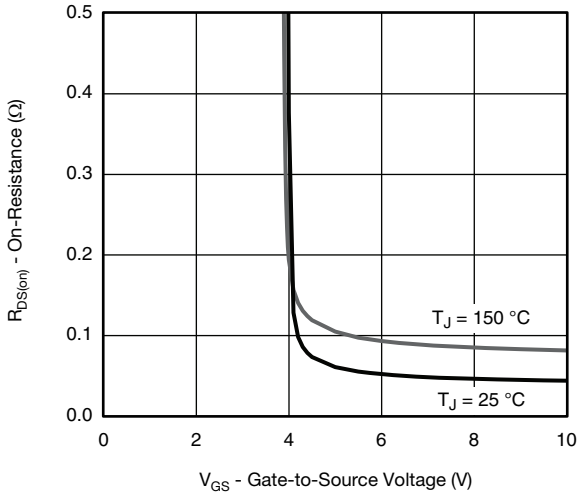
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



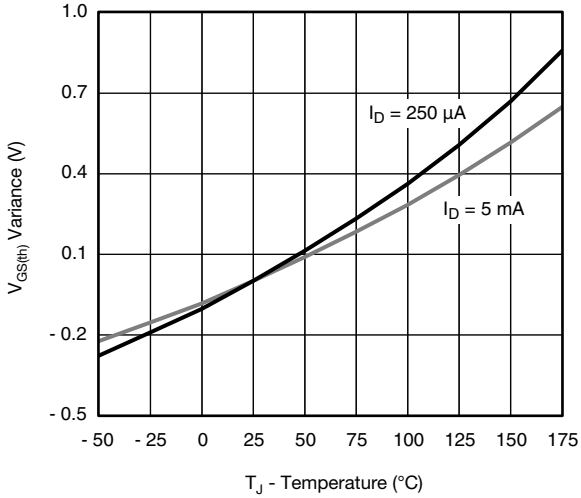
On-Resistance vs. Junction Temperature



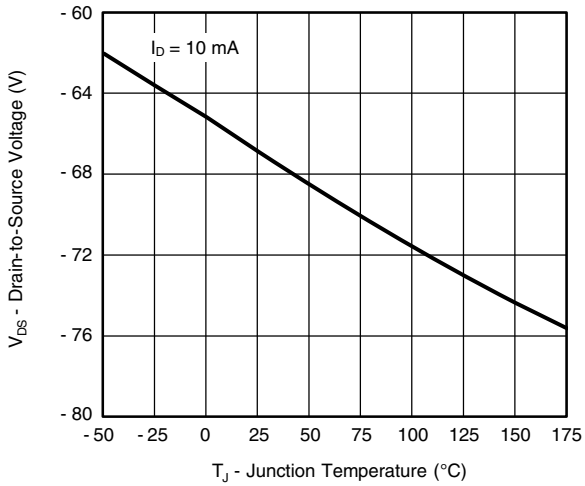
Source Drain Diode Forward Voltage



On-Resistance vs. Gate-to-Source Voltage



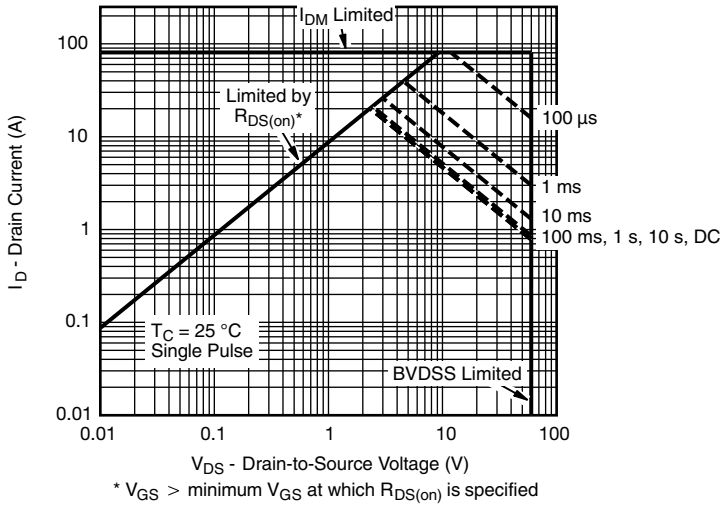
Threshold Voltage



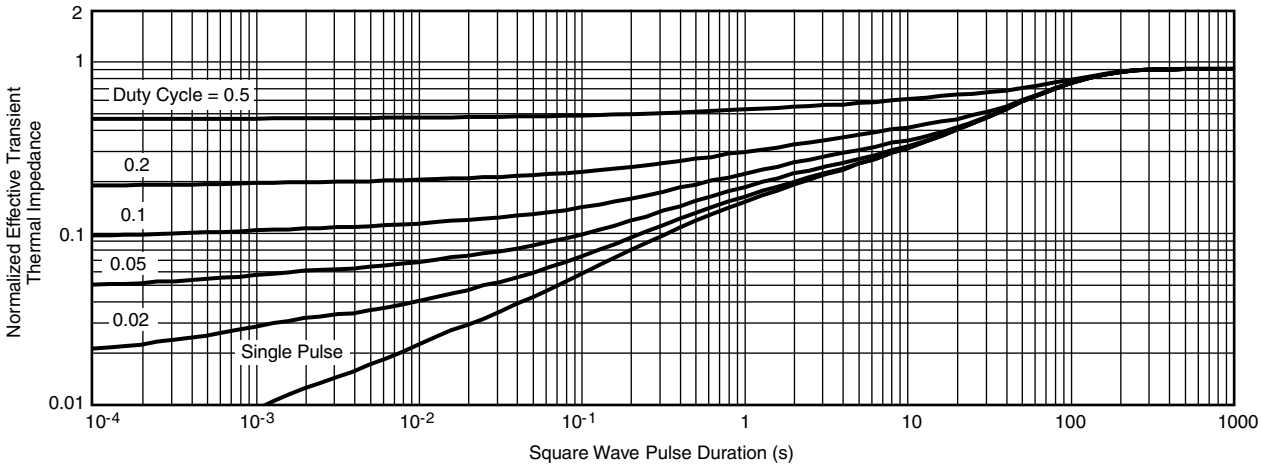
Drain Source Breakdown vs. Junction Temperature

THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

THERMAL RATINGS (T_A = 25 °C, unless otherwise noted)



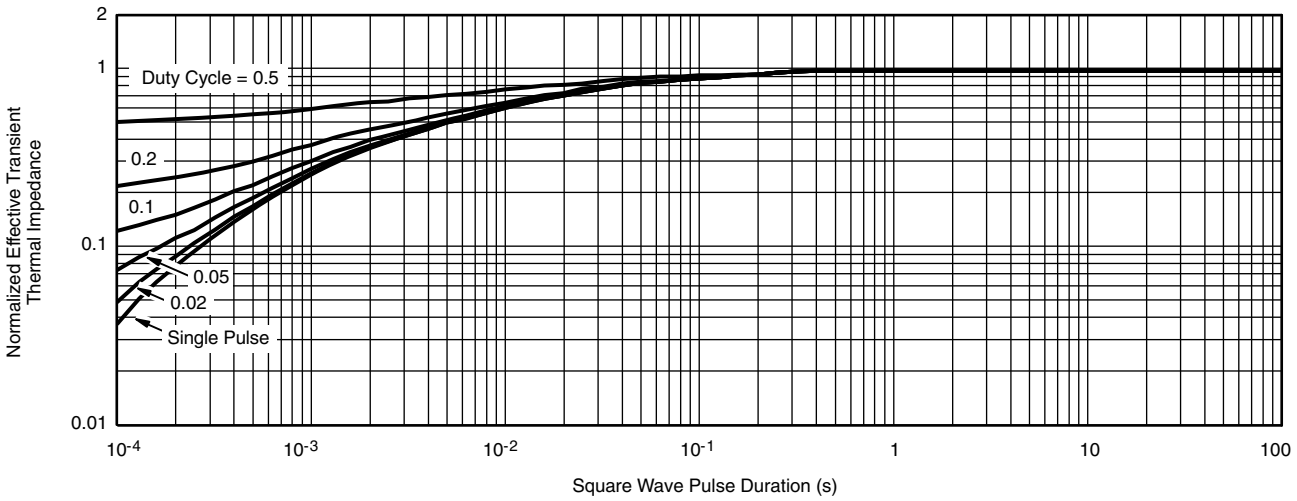
Safe Operating Area



Normalized Thermal Transient Impedance, Junction-to-Ambient

THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

THERMAL RATINGS (T_A = 25 °C, unless otherwise noted)



Normalized Thermal Transient Impedance, Junction-to-Case

Note

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Case (25 °C)

  are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

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?65158.

THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

DPAK / TO-252 and Reverse DPAK

Ordering codes for the SQ rugged series power MOSFETs in the DPAK / TO-252 and Reverse DPAK packages:

DATASHEET PART NUMBER	OLD ORDERING CODE [a]	NEW ORDERING CODE
SQD07N25-350H	SQD07N25-350H-GE3	**SQD07N25-350H_GE3**
SQD100N02-3m5L	-	**SQD100N02-3m5L_GE3**
SQD100N03-3m2L	SQD100N03-3M2L-GE3	**SQD100N03-3M2L_GE3**
SQD100N03-3m4	SQD100N03-3M4-GE3	**SQD100N03-3M4_GE3**
SQD100N04-3m6	SQD100N04-3M6-GE3	**SQD100N04-3M6_GE3**
SQD100N04-3m6L	SQD100N04-3M6L-GE3	**SQD100N04-3M6L_GE3**
SQD10N30-330H	SQD10N30-330H-GE3	**SQD10N30-330H_GE3**
SQD15N06-42L	SQD15N06-42L-GE3	**SQD15N06-42L_GE3**
SQD19P06-60L	SQD19P06-60L-GE3	**SQD19P06-60L_GE3**
SQD23N06-31L	SQD23N06-31L-GE3	**SQD23N06-31L_GE3**
SQD25N06-22L	SQD25N06-22L-GE3	**SQD25N06-22L_GE3**
SQD25N15-52	SQD25N15-52-GE3	**SQD25N15-52_GE3**
SQD30N05-20L	SQD30N05-20L-GE3	**SQD30N05-20L_GE3**
SQD40N06-14L	SQD40N06-14L-GE3	**SQD40N06-14L_GE3**
SQD40N10-25	SQD40N10-25-GE3	**SQD40N10-25_GE3**
SQD40P10-40L	SQD40P10-40L-GE3	**SQD40P10-40L_GE3**
SQD45P03-12	SQD45P03-12-GE3	**SQD45P03-12_GE3**
SQD50N04-5m6	SQD50N04-5M6-GE3	**SQD50N04-5M6_GE3**
SQD50N04-5m6L	-	**SQD50N04-5m6L_GE3**
SQD50N05-11L	SQD50N05-11L-GE3	**SQD50N05-11L_GE3**
SQD50N06-09L	SQD50N06-09L-GE3	**SQD50N06-09L_GE3**
SQD50N10-8m9L	SQD50N10-8M9L-GE3	**SQD50N10-8M9L_GE3**
SQD50P03-07	SQD50P03-07-GE3	**SQD50P03-07_GE3**
SQD50P04-13L	SQD50P04-13L-GE3	**SQD50P04-13L_GE3**
SQD50P04-09L	SQD50P04-09L-GE3	**SQD50P04-09L_GE3**
SQD50P06-15L	SQD50P06-15L-GE3	**SQD50P06-15L_GE3**
SQD50P08-25L	SQD50P08-25L-GE3	**SQD50P08-25L_GE3**
SQD50P08-28	SQD50P08-28-GE3	**SQD50P08-28_GE3**
SQD70140EL	-	**SQD70140EL_GE3**
SQD90P04-9m4L	SQD90P04-9M4L-GE3	**SQD90P04-9M4L_GE3**
SQD97N06-6m3L	SQD97N06-6M3L-GE3	**SQD97N06-6M3L_GE3**
SQR40N10-25	SQR40N10-25-GE3	**SQR40N10-25_GE3**
SQR50N04-3m8	SQR50N04-3M8-GE3	**SQR50N04-3M8_GE3**

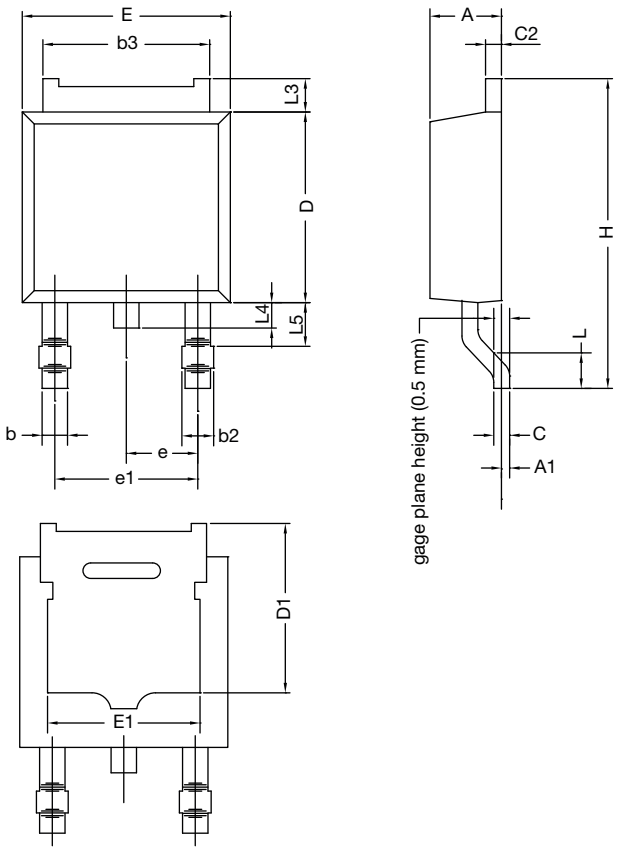
Note

a. Old ordering code is obsolete and no longer valid for new orders

For technical questions, contact: automostechsupport@vishay.com

THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

TO-252AA Case Outline



	MILLIMETERS		INCHES	
DIM.	MIN.	MAX.	MIN.	MAX.
A	2.18	2.38	0.086	0.094
A1	-	0.127	-	0.005
b	0.64	0.88	0.025	0.035
b2	0.76	1.14	0.030	0.045
b3	4.95	5.46	0.195	0.215
C	0.46	0.61	0.018	0.024
C2	0.46	0.89	0.018	0.035
D	5.97	6.22	0.235	0.245
D1	4.10	-	0.161	-
E	6.35	6.73	0.250	0.265
E1	4.32	-	0.170	-
H	9.40	10.41	0.370	0.410
e	2.28 BSC		0.090 BSC	
e1	4.56 BSC		0.180 BSC	
L	1.40	1.78	0.055	0.070
L3	0.89	1.27	0.035	0.050
L4	-	1.02	-	0.040
L5	1.01	1.52	0.040	0.060
ECN: T13-0592-Rev. A, 02-Sep-13 DWG: 6019				

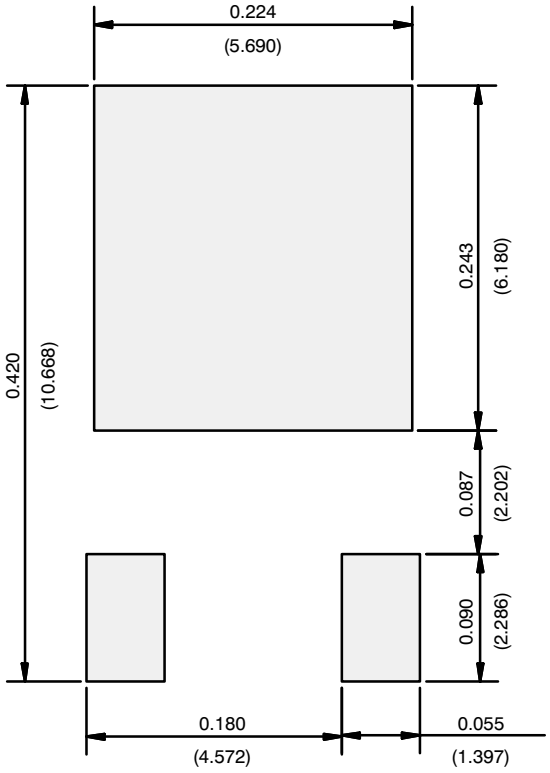
Note

- Dimension L3 is for reference only.

For technical questions, contact: pmostechsupport@vishay.com

THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)



Recommended Minimum Pads
Dimensions in Inches/(mm)

Return to Index

APPLICATION NOTE

Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, “Vishay”), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay’s knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer’s responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer’s technical experts. Product specifications do not expand or otherwise modify Vishay’s terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.