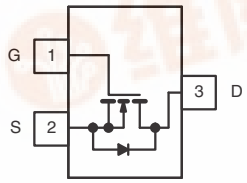
Automotive
N-Channel 20 V (D-S) 175 °C MOSFET

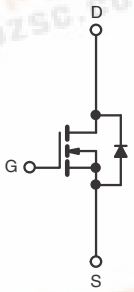
PRODUCT SUMMARY	
V_{DS} (V)	20
$R_{DS(on)}$ (Ω) at V_{GS} = 4.5 V	0.030
$R_{DS(on)}$ (Ω) at V_{GS} = 2.5 V	0.034
$R_{DS(on)}$ (Ω) at V_{GS} = 1.5 V	0.042
I_D (A)	6
Configuration	Single

TO-236
(SOT-23)



Top View
SQ2310ES*

* **Marking Code:** 8Txxx



N-Channel MOSFET

FEATURES

- **Halogen-free According to IEC 61249-2-21 Definition**
- TrenchFET® Power MOSFET
- Compliant to RoHS Directive 2002/95/EC
- AEC-Q101 Qualified[c]

AUTOMOTIVE GRADE
Pb-free
RoHS COMPLIANT
HALOGEN FREE

ORDERING INFORMATION	
Package	SOT-23
Lead (Pb)-free and Halogen-free	SQ2310ES-T1-GE3

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

PARAMETER		SYMBOL	LIMIT	UNIT
Drain-Source Voltage		V_{DS}	20	V
Gate-Source Voltage		V_{GS}	± 8	
Continuous Drain Current	T_C = 25 °C	I_D	6	A
	T_C = 125 °C		3.5	
Continuous Source Current (Diode Conduction)		I_S	2.5	
Pulsed Drain Current[a]		I_{DM}	24	
Single Pulse Avalanche Current	L = 0.1 mH	I_{AS}	10	
Single Pulse Avalanche Energy		E_{AS}	5	mJ
Maximum Power Dissipation[a]	T_C = 25 °C	P_D	2	W
	T_C = 125 °C		0.6	
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[b]	R_{thJA}	175	°C/W
Junction-to-Foot (Drain)		R_{thJF}	75	

Notes

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

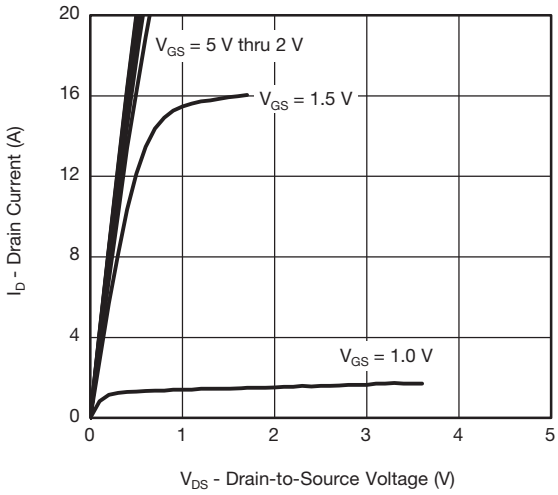
SPECIFICATIONS (T_C = 25 °C, unless otherwise noted)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**		**MIN.**	**TYP.**	**MAX.**	**UNIT**
Static							
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0 V, I_D = 250 µA		20	-	-	V
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA		0.4	0.6	1.0	
Gate-Source Leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ± 8 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	V_{GS} = 0 V	V_{DS} = 20 V	-	-	1	µA
		V_{GS} = 0 V	V_{DS} = 20 V, T_J = 125 °C	-	-	50	
		V_{GS} = 0 V	V_{DS} = 20 V, T_J = 175 °C	-	-	150	
On-State Drain Current[a]	$I_{D(on)}$	V_{GS} = 4.5 V	V_{DS} ≥ 5 V	10	-	-	A
Drain-Source On-State Resistance[a]	$R_{DS(on)}$	V_{GS} = 4.5 V	I_D = 5 A	-	0.024	0.030	Ω
		V_{GS} = 4.5 V	I_D = 5 A, T_J = 125 °C	-	-	0.045	
		V_{GS} = 4.5V	I_D = 5 A, T_J = 175 °C	-	-	0.054	
		V_{GS} = 2.5 V	I_D = 4 A	-	0.027	0.034	
		V_{GS} = 1.5 V	I_D = 2 A	-	0.034	0.042	
Forward Transconductance[b]	g_{fs}	V_{DS} = 15 V, I_D = 5 A		-	27	-	S
Dynamic[b]							
Input Capacitance	C_{iss}	V_{GS} = 0 V	V_{DS} = 10 V, f = 1 MHz	-	387	485	pF
Output Capacitance	C_{oss}			-	80	100	
Reverse Transfer Capacitance	C_{rss}			-	37	46	
Total Gate Charge[c]	Q_g	V_{GS} = 4.5 V	V_{DS} = 10 V, I_D = 5 A	-	4.5	8.5	nC
Gate-Source Charge[c]	Q_{gs}			-	0.4	-	
Gate-Drain Charge[c]	Q_{gd}			-	0.7	-	
Turn-On Delay Time[c]	$t_{d(on)}$	V_{DD} = 10 V, R_L = 2.5 Ω I_D ≅ 4 A, V_{GEN} = 4.5 V, R_g = 1 Ω		-	7	11	ns
Rise Time[c]	t_r			-	8	12	
Turn-Off Delay Time[c]	$t_{d(off)}$			-	21	32	
Fall Time[c]	t_f			-	9	14	
Source-Drain Diode Ratings and Characteristics[b]							
Pulsed Current[a]	I_{SM}			-	-	24	A
Forward Voltage	V_{SD}	I_F = 5 A, V_{GS} = 0 V		-	0.75	1.2	V

Notes

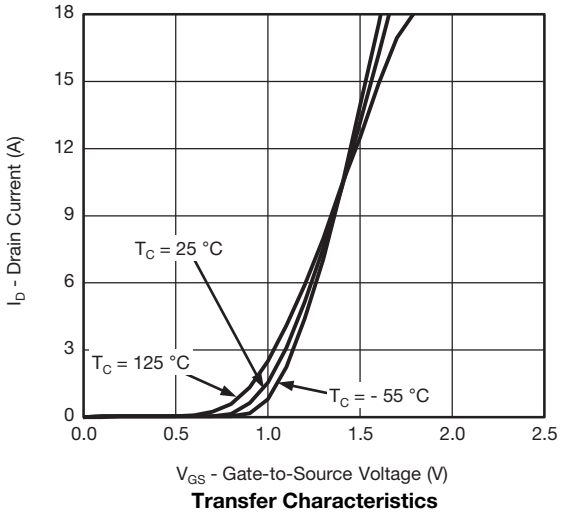
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

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.

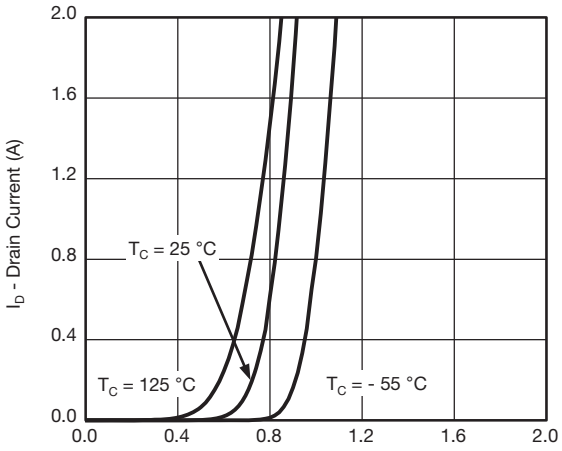
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



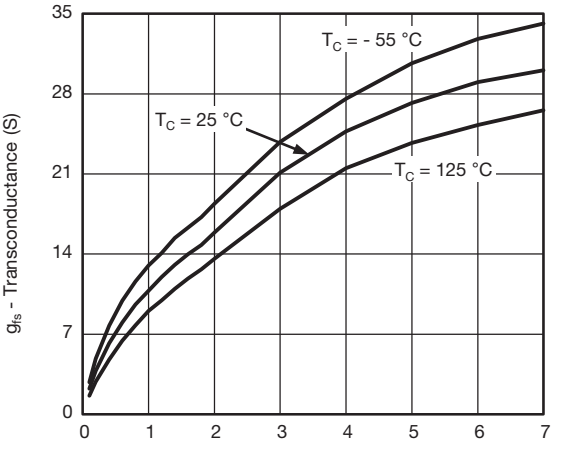
Output Characteristics



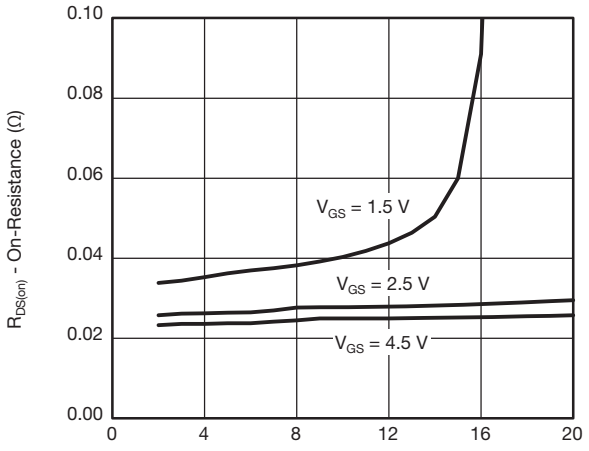
Transfer Characteristics



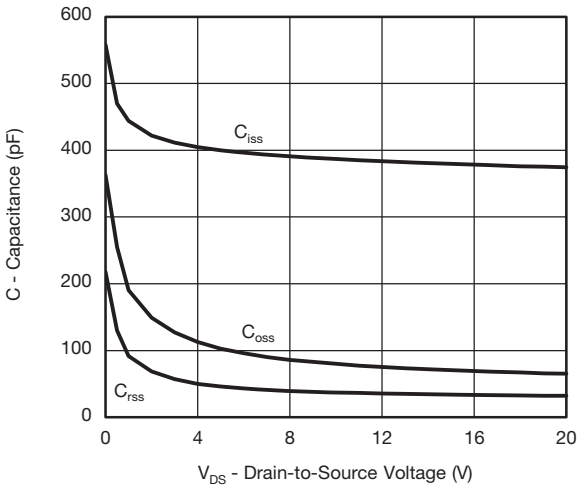
Transfer Characteristics



Transconductance

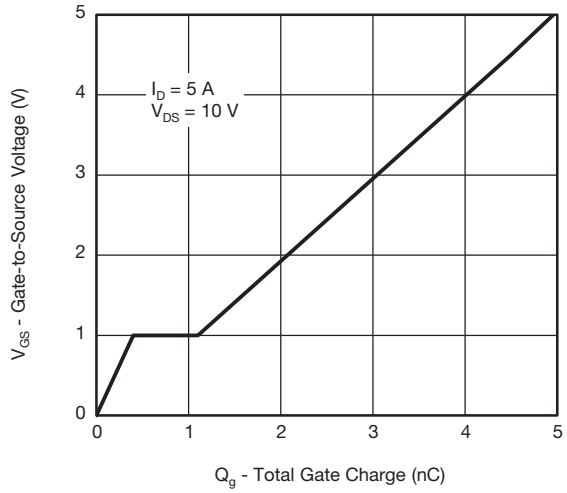


On-Resistance vs. Drain Current

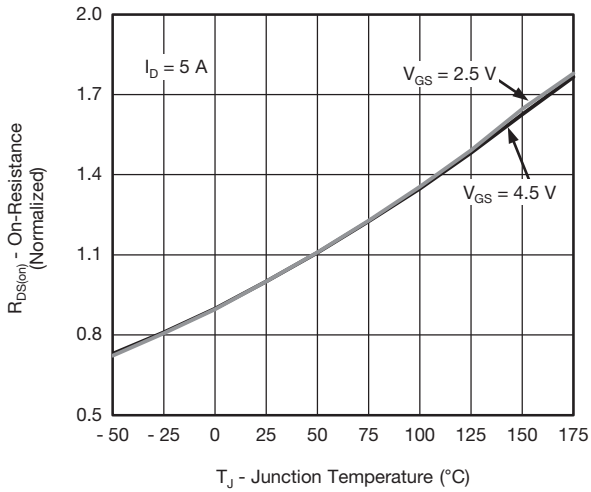


Capacitance

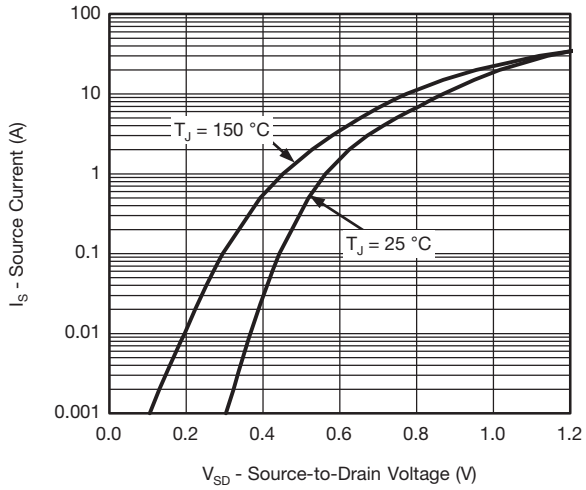
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



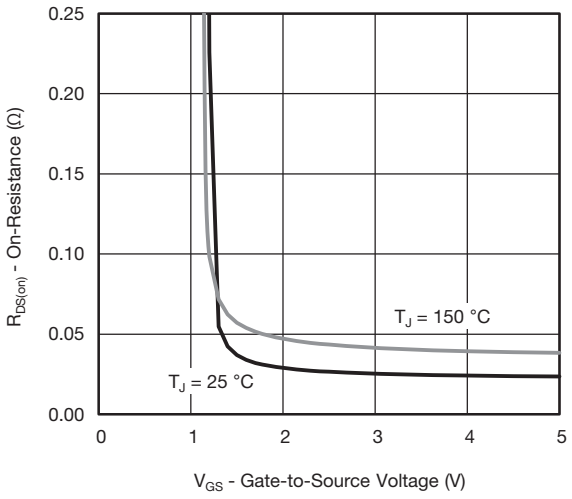
Gate Charge



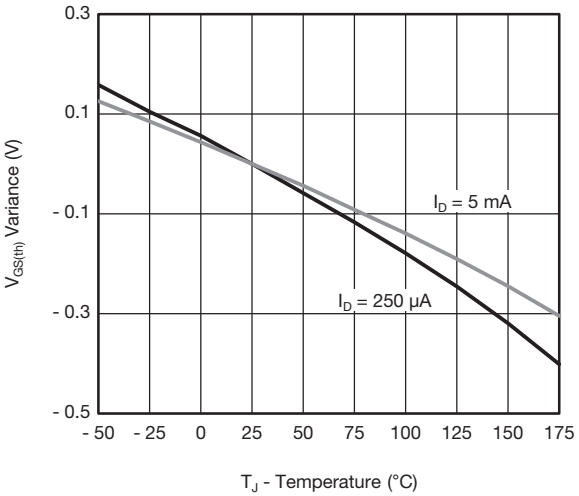
On-Resistance vs. Junction Temperature



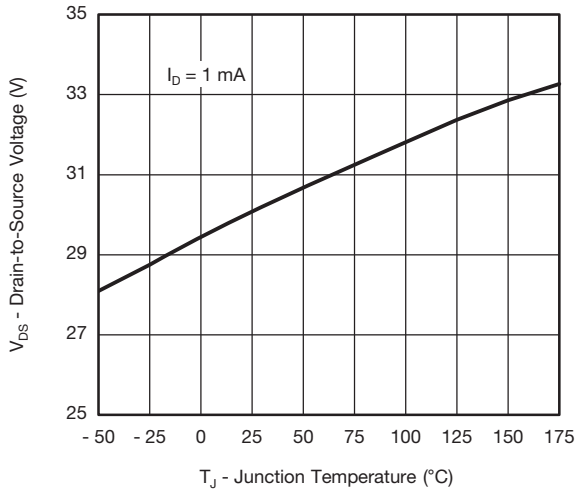
Source Drain Diode Forward Voltage



On-Resistance vs. Gate-to-Source Voltage

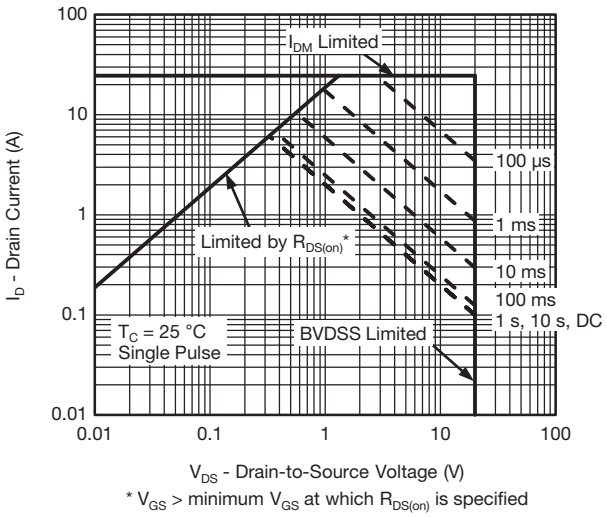


Threshold Voltage

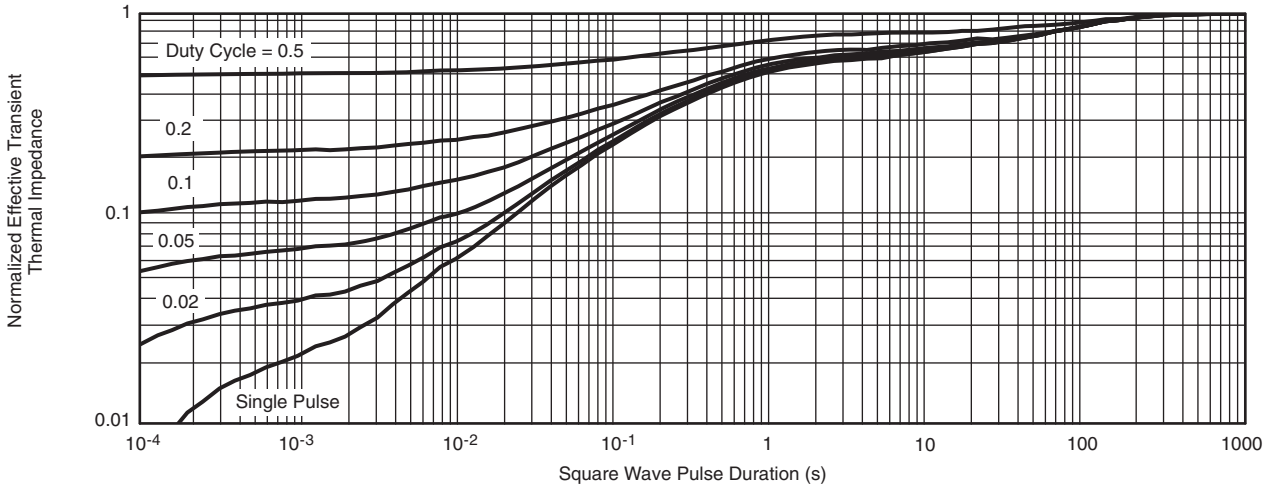


Drain Source Breakdown vs. Junction Temperature

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

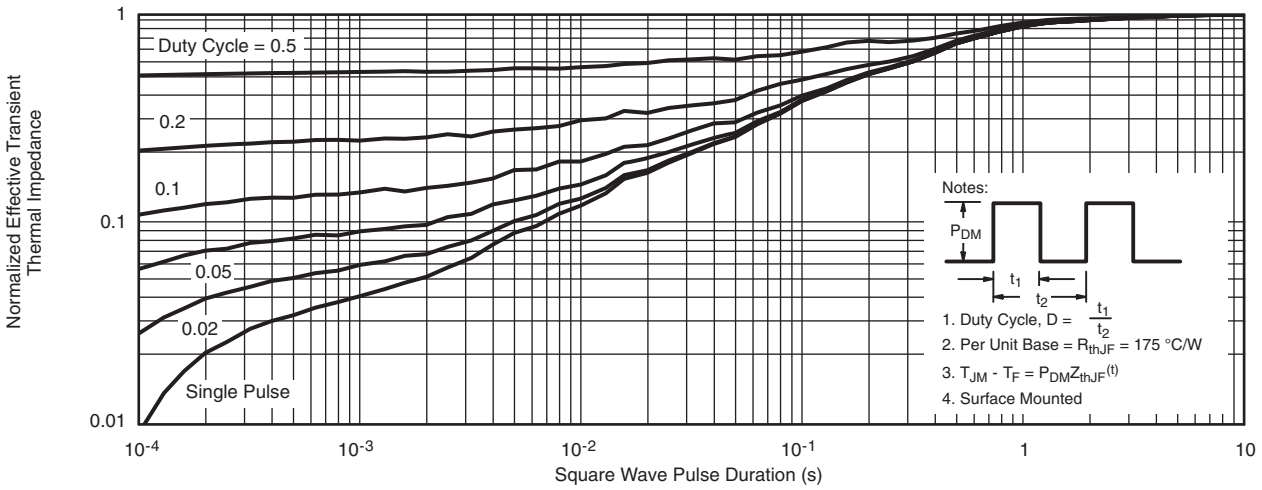


Safe Operating Area



Normalized Thermal Transient Impedance, Junction-to-Ambient

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



Normalized Thermal Transient Impedance, Junction-to-Foot

Note

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Foot (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?67036.

Disclaimer

All product specifications and data are subject to change without notice.

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 herein or in any other disclosure relating to any product.

Vishay disclaims any and all liability arising out of the use or application of any product described herein or of any information provided herein to the maximum extent permitted by law. The product specifications do not expand or otherwise modify Vishay’s terms and conditions of purchase, including but not limited to the warranty expressed therein, which apply to these products.

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.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications unless otherwise expressly indicated. Customers using or selling Vishay products not expressly indicated for use in such applications do so entirely at their own risk and agree to fully indemnify Vishay for any damages arising or resulting from such use or sale. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

Product names and markings noted herein may be trademarks of their respective owners.