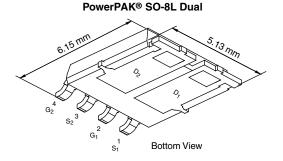
SQJ970EP



Vishay Siliconix

Automotive Dual N-Channel 40 V (D-S) 175 °C MOSFET

PRODUCT SUMMARY			
V _{DS} (V)	40		
$R_{DS(on)} (\Omega)$ at $V_{GS} = 10 V$	0.020		
$R_{DS(on)} (\Omega)$ at $V_{GS} = 4.5 V$	0.028		
I _D (A) per leg	8		
Configuration	Dual		

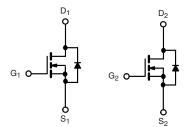


FEATURES

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



RoHS COMPLIANT HALOGEN FREE



N-Channel MOSFET N-Channel MOSFET

ORDERING INFORMATION	
Package	PowerPAK SO-8L
Lead (Pb)-free and Halogen-free	SQJ970EP-T1-GE3

PARAMETER		SYMBOL	LIMIT	UNIT	
Drain-Source Voltage		V _{DS}	40	N/	
Gate-Source Voltage		V _{GS}	± 20	V	
Continuous Drain Current ^a	T _C = 25 °C	1	8		
	T _C = 125 °C	I _D	8		
Continuous Source Current (Diode Conduction) ^a		I _S	8	А	
Pulsed Drain Current ^b		I _{DM}	32		
Single Pulse Avalanche Current	L = 0.1 mH	I _{AS}	28		
Single Pulse Avalanche Energy		E _{AS}	39	mJ	
Maximum Power Dissipation ^b	T _C = 25 °C	D	48	w	
	T _C = 125 °C	P _D	16		
Operating Junction and Storage Temperature Range		T _J , T _{stg}	- 55 to + 175	°C	
Soldering Recommendations (Peak Temperature) ^{e, f}			260		

THERMAL RESISTANCE RATINGS				
PARAMETER		SYMBOL	LIMIT	UNIT
Junction-to-Ambient	PCB Mount ^c	R _{thJA}	85	°C/W
Junction-to-Case (Drain)		R _{thJC}	3.1	C/ W

Notes

f. Rework conditions: manual soldering with a soldering iron is not recommended for leadless components.

a. Package limited.

b. Pulse test; pulse width \leq 300 µs, duty cycle \leq 2 %.

c. When mounted on 1" square PCB (FR4 material).

d. Parametric verification ongoing.

e. See solder profile (<u>www.vishay.com/doc?73257</u>). The PowerPAK SO-8L. The end of the lead terminal is exposed copper (not plated) as a result of the singulation process in manufacturing. A solder fillet at the exposed copper tip cannot be guaranteed and is not required to ensure adequate bottom side solder interconnection.

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SQJ970EP Vishay Siliconix

Static Vois $V_{GS} = 0$, $I_D = 250 \ \mu A$ 40 - - Gate-Source Threshold Voltage $V_{GS}(\mu)$ $V_{DS} = V_{GS}$, $I_D = 250 \ \mu A$ 1.5 2.0 2.5 Gate-Source Threshold Voltage I_{GSS} $V_{DS} = 0 V$, $V_{DS} = 40 V$ - - ± 100 Zero Gate Voltage Drain Current I_{DSS} $V_{GS} = 0 V$ $V_{DS} = 40 V$, $T_u = 125 \ ^{\circ}C$ - 1 On-State Drain Current ^a $I_{D(en)}$ $V_{GS} = 10 V$ $V_{DS} = 40 V$, $T_u = 175 \ ^{\circ}C$ - 150 On-State Drain Current ^a $I_{D(en)}$ $V_{GS} = 10 V$ $V_{DS} = 40 V$, $T_u = 175 \ ^{\circ}C$ - 0.016 0.020 Drain-Source On-State Resistance ^a $P_{DS(on)$ $V_{GS} = 10 V$ $I_D = 10.2 A$ - 0.022 0.028 Porturator $V_{GS} = 10 V$ $I_D = 10.2 A$, $T_u = 175 \ ^{\circ}C$ - 0.029 0.036 Forward Transconductance ^b g_{16} $V_{DS} = 10 V$ $I_D = 10.2 A$, $T_u = 175 \ ^{\circ}C$ - 0.029 0.036 Fourard Transconductance C_{15S} $V_{DS} = 10 $	PARAMETER	SYMBOL	TES	ST CONDITIONS	MIN.	TYP.	MAX.	UNIT
$ \begin{array}{c c c c c c c } \hline Gate-Source Threshold Voltage $V_{GS(th)}$ & V_{DS} = V_{GS}, I_{D} = 250 \ \mu A & 1.5 & 2.0 & 2.5 \\ \hline Gate-Source Leakage & I_{GSS} & V_{DS} = 0 \ V, V_{GS} = 20 \ V & - & - & \pm 100 \\ \hline V_{GS} = 0 \ V & V_{DS} = 40 \ V & - & - & 1 \\ \hline V_{GS} = 0 \ V & V_{DS} = 40 \ V, T_{J} = 125 \ C & - & - & 50 \\ \hline V_{GS} = 0 \ V & V_{DS} = 40 \ V, T_{J} = 125 \ C & - & - & 50 \\ \hline V_{GS} = 0 \ V & V_{DS} = 40 \ V, T_{J} = 125 \ C & - & - & 50 \\ \hline V_{GS} = 0 \ V & V_{DS} = 40 \ V, T_{J} = 125 \ C & - & - & 50 \\ \hline V_{GS} = 0 \ V & V_{DS} = 40 \ V, T_{J} = 125 \ C & - & - & 50 \\ \hline V_{GS} = 10 \ V & V_{DS} = 50 \ V \ V_{DS} = 50 \ V \ V_{DS} = 50 \ V \ V_{DS} = 0 \ V \ V_{DS} = 50 \ V \ V_{DS} = 0 \ V \ V_{DS} = 50 \ V \ V_{DS} = 0 \ V \ V_$	Static							<u> </u>
$ \begin{split} \begin{tabular}{ c c c c } \hline Gate-Source Leakage & I_{GSS} & V_{DS} = 0 \lor, V_{GS} = \pm 20 \lor, V_{GS} = \pm 20 \lor, V_{GS} = 40 \lor, V_{GS} = 10 \lor, V_{DS} = 5 \lor, V_{GS} = 10 \lor, V_{DS} = 20 \lor, V_{DS} = 10 \lor, V_{DS} = 10 \lor, V_{DS} = 10 \lor, V_{DS} = 10 \lor, V_{DS} = 20 \lor, V_{DS} = 10 \lor, V_{DS} = 20 \lor, V_{DS} = 10 \lor, V_$	Drain-Source Breakdown Voltage	V _{DS}	$V_{GS} = 0, I_D = 250 \ \mu A$		40	-	-	v
$ \begin{array}{ c c c c c } \hline \mbox{V} \mbox{V} \mbox{S} = 0 \ V & V_{DS} = 40 \ V & - & - & 1 \\ \hline \mbox{V} \mbox{S} = 0 \ V & V_{DS} = 40 \ V, \ \mbox{J} = 125 \ \mbox{C} & - & - & 50 \\ \hline \mbox{V} \mbox{V} \mbox{S} = 0 \ V & V_{DS} = 40 \ V, \ \mbox{J} = 125 \ \mbox{C} & - & - & 150 \\ \hline \mbox{V} \mbox{S} = 0 \ V & V_{DS} = 40 \ V, \ \mbox{J} = 175 \ \mbox{C} & - & - & 150 \\ \hline \mbox{V} \mbox{S} = 0 \ V & V_{DS} = 40 \ V, \ \mbox{J} = 175 \ \mbox{C} & - & - & 150 \\ \hline \mbox{V} \mbox{S} = 10 \ V & V_{DS} = 5 \ V & 30 & - & - & - & - & - & - & - & - & - & $	Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} =	$V_{DS} = V_{GS}$, $I_D = 250 \ \mu A$		2.0	2.5	
$ \begin{array}{ c c c c c c } \hline Zero Gate Voltage Drain Current & I_{DSS} & V_{GS} = 0 V & V_{DS} = 40 V, T_J = 125 \ ^{\circ}C & - & - & 50 \\ \hline V_{GS} = 0 V & V_{DS} = 40 V, T_J = 175 \ ^{\circ}C & - & - & 150 \\ \hline V_{GS} = 0 V & V_{DS} \geq 5 V & 30 & - & - & 150 \\ \hline V_{GS} = 10 V & V_{DS} \geq 5 V & 30 & - & - & 0.016 & 0.020 \\ \hline V_{GS} = 10 V & I_D = 10.2 \ ^{\circ}A & - & 0.016 & 0.020 \\ \hline V_{GS} = 10 V & I_D = 10.2 \ ^{\circ}A & - & 0.022 & 0.028 \\ \hline V_{GS} = 10 V & I_D = 10.2 \ ^{\circ}A & - & 0.022 & 0.028 \\ \hline V_{GS} = 10 V & I_D = 10.2 \ ^{\circ}A & - & 0.022 & 0.028 \\ \hline V_{GS} = 10 V & I_D = 10.2 \ ^{\circ}A & - & 0.022 & 0.028 \\ \hline V_{GS} = 10 V & I_D = 10.2 \ ^{\circ}A & - & 0.025 & 0.031 \\ \hline V_{GS} = 10 V & I_D = 10.2 \ ^{\circ}A & - & 28 & - \\ \hline Dummic^{\circ} & V_{GS} = 10 V & I_D = 10.2 \ ^{\circ}A & - & 28 & - \\ \hline Dummic^{\circ} & V_{GS} = 10 V & I_D = 10.2 \ ^{\circ}A & - & 28 & - \\ \hline Dummic^{\circ} & V_{GS} = 10 V & I_D = 10.2 \ ^{\circ}A & - & 28 & - \\ \hline Dumic^{\circ} & V_{GS} = 10 V & I_D = 10.2 \ ^{\circ}A & - & 28 & - \\ \hline Dumic^{\circ} & V_{GS} = 0 V & V_{DS} = 20 \ ^{\circ}V, \ ^{\circ}I = 1 \ ^{\circ}MHz & - & 260 \ ^{\circ}325 \ ^{\circ} & - & 130 \ ^{\circ}I65 \ ^{\circ} & - & 0.022 \ ^{\circ}I65 \ ^{\circ} & - & 0.022 \ ^{\circ}I65 \ ^{\circ$	Gate-Source Leakage	I _{GSS}	V _{DS} =	$V_{DS} = 0 V, V_{GS} = \pm 20 V$		-	± 100	nA
$ \begin{array}{ c c c c c c c } \hline V_{GS} = 0 & V & V_{DS} = 40 & V, \ T_J = 175 \ ^{\circ} C & - & - & 150 \\ \hline V_{GS} = 0 & V & V_{DS} \geq 5 & 30 & - & - & \\ \hline V_{GS} = 10 & V & V_{DS} \geq 5 & 30 & - & - & \\ \hline V_{GS} = 10 & V & I_D = 10.2 & A & - & 0.016 & 0.020 \\ \hline V_{GS} = 4.5 & I_D = 10.2 & A & - & 0.022 & 0.028 \\ \hline V_{GS} = 10 & V & I_D = 10.2 & A, \ T_J = 125 \ ^{\circ} C & - & 0.025 & 0.031 \\ \hline V_{GS} = 10 & V & I_D = 10.2 & A, \ T_J = 125 \ ^{\circ} C & - & 0.029 & 0.036 \\ \hline Forward Transconductance^b & g_{fS} & V_{DS} = 15 & V, \ I_D = 10.2 & A, \ T_J = 175 \ ^{\circ} C & - & 0.029 & 0.036 \\ \hline Forward Transconductance & C_{ISS} & V_{DS} = 15 & V, \ I_D = 10.2 & A, \ T_J = 175 \ ^{\circ} C & - & 0.029 & 0.036 \\ \hline Output Capacitance & C_{ISS} & V_{DS} = 15 & V, \ I_D = 10.2 & A & - & 28 & - \\ \hline Dynamic^b & & & & \\ \hline Input Capacitance & C_{ISS} & V_{OS} = 0 & V_{DS} = 20 & V, \ f = 1 & MHz & - & 260 & 325 \\ \hline Reverse Transfer Capacitance & C_{rss} & V_{OS} = 10 & V_{DS} = 20 & V, \ f = 1 & MHz & - & 34 & 55 \\ \hline Gate - Drain Charge^{\circ} & Q_{gd} & V_{GS} = 10 & V_{DS} = 20 & V, \ I_D = 10.2 & A & - & 5.2 & - \\ \hline Gate Resistance & R_g & f = 1 & MHz & 0.71 & 3.92 & 7.12 \\ \hline Turn-On Delay Time^{\circ} & t_{d(ori)} & V_{OD} = 20 & V, \ R_L = 20 & \Omega \\ \hline I_D \equiv 1 & A, \ V_{GS} = 10 & V, \ R_g = 1 & \Omega & 15 \\ \hline Source-Drain Diode Ratings and Characteristics^b \\ \hline Pulsed Current^a & I_{SM} & \hline \end{array}$			$V_{GS} = 0 V$	V _{DS} = 40 V	-	-	1	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Zero Gate Voltage Drain Current	I _{DSS}	$V_{GS} = 0 V$	V _{DS} = 40 V, T _J = 125 °C	-	-	50	μA
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$			$V_{GS} = 0 V$	V _{DS} = 40 V, T _J = 175 °C	-	-	150	1
$ \begin{array}{ c c c c c } \label{eq:barrier} \begin{tabular}{ c c c c c } \hline Pair Pair Pair Pair Pair Pair Pair Pair$	On-State Drain Current ^a	I _{D(on)}	$V_{GS} = 10 V$	$V_{DS} \ge 5 V$	30	-	-	Α
$ \begin{array}{ c c c c c c } \hline Prain-Source On-State Resistance^a & $P_{DS(on)}$ & $V_{GS} = 10 \ V$ & $I_D = 10.2 \ A, $T_J = 125 \ ^{\circ}C$ & $-$ & $0.025 & 0.031 \\ \hline $V_{GS} = 10 \ V$ & $I_D = 10.2 \ A, $T_J = 175 \ ^{\circ}C$ & $-$ & $0.029 & 0.036 \\ \hline $V_{GS} = 10 \ V$ & $I_D = 10.2 \ A, $T_J = 175 \ ^{\circ}C$ & $-$ & $0.029 & 0.036 \\ \hline $V_{GS} = 10 \ V$ & $I_D = 10.2 \ A, $T_J = 175 \ ^{\circ}C$ & $-$ & $0.029 & 0.036 \\ \hline $Dynamic^b$ & $V_{DS} = 15 \ V, $I_D = 10.2 \ A, $T_J = 175 \ ^{\circ}C$ & $-$ & $0.029 & 0.036 \\ \hline $Dynamic^b$ & $V_{DS} = 15 \ V, $I_D = 10.2 \ A$ & $-$ & 28 & $-$ \\ \hline $Dynamic^b$ & $V_{DS} = 10 \ V$ \\ \hline $V_{GS} = 0 \ V$ & $V_{DS} = 20 \ V, $f = 1 \ MHz$ & $-$ & 26 & $-$ & 130 & 165 \\ \hline $-$ & 10 & 15 \\ \hline $-$ & 10 &$	Drain-Source On-State Resistance ^a		$V_{GS} = 10 V$	I _D = 10.2 A	-	0.016	0.020	Ω
$ \begin{array}{ c c c c c c } \hline V_{GS} = 10 \ V & I_D = 10.2 \ A, \ I_J = 125 \ C & - & 0.025 & 0.031 \\ \hline V_{GS} = 10 \ V & I_D = 10.2 \ A, \ I_J = 125 \ C & - & 0.029 & 0.036 \\ \hline V_{GS} = 10 \ V & I_D = 10.2 \ A, \ I_J = 175 \ C & - & 0.029 & 0.036 \\ \hline Prive Transconductance^h & g_{fs} & V_{DS} = 15 \ V, \ I_D = 10.2 \ A, \ I_J = 175 \ C & - & 28 & - \\ \hline Dynamic^h & & & & & & & & & & & & & & & & \\ \hline Dynamic^b & & & & & & & & & & & & & & & & & & &$			$V_{GS} = 4.5 V$	I _D = 8.7 A	-	0.022	0.028	
$ \begin{array}{ c c c c c c } \hline Forward Transconductance^b & g_{fs} & V_{DS} = 15 \ V, \ I_D = 10.2 \ A & - & 28 & - \\ \hline \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$		RDS(on)	$V_{GS} = 10 \text{ V}$	I _D = 10.2 A, T _J = 125 °C	-	0.025	0.031	
$ \begin{array}{ c c c c c c c c } \hline \textbf{Dynamic}^b & & & & & & & & & & & & & & & & & & &$			$V_{GS} = 10 V$	I _D = 10.2 A, T _J = 175 °C	-	0.029	0.036	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Forward Transconductanceb	9 _{fs}	V _{DS} =	= 15 V, I _D = 10.2 A	-	28	-	S
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Dynamic ^b							
$\begin{array}{ c c c c c c c } \hline Reverse Transfer Capacitance & C_{rss} & & & & & & & & & & & & & & & & & & $	Input Capacitance	C _{iss}		V _{DS} = 20 V, f = 1 MHz	-	1730	2165	pF
$ \begin{array}{ c c c c c } \hline Total Gate Charge^c & Q_g & \\ \hline Gate-Source Charge^c & Q_{gs} & \\ \hline Gate-Drain Charge^c & Q_{gd} & \\ \hline Gate-Drain Charge^c & Q_{gd} & \\ \hline Gate Resistance & R_g & \\ \hline Turn-On Delay Time^c & It_{d(on)} & \\ \hline Rise Time^c & t_r & \\ \hline Turn-Off Delay Time^c & t_{d(off)} & \\ \hline Fall Time^c & t_f & \\ \hline Fall Time^c & t_f & \\ \hline Source-Drain Diode Ratings and Characteristics^b & \\ \hline Pulsed Current^a & I_{SM} & \\ \hline \end{array} \\ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Output Capacitance	C _{oss}	$V_{GS} = 0 V$		-	260	325	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Reverse Transfer Capacitance	C _{rss}			-	130	165	
$ \begin{array}{ c c c c c c c } \hline Gate-Drain Charge^c & Q_{gd} & & & & & & & & & & & & & & & & & & &$	Total Gate Charge ^c	Qg		V _{DS} = 20 V, I _D = 10.2 A	-	34	55	nC
$ \begin{array}{c c c c c c c c c } \hline Gate Resistance & R_g & f = 1 \ \text{MHz} & 0.71 & 3.92 & 7.12 \\ \hline Turn-On \ Delay \ Time^c & t_{d(on)} & & & & & & & & & & & & & & & & & & &$	Gate-Source Charge ^c	Q _{gs}	$V_{GS} = 10 V$		-	5.2	-	
$\begin{tabular}{ c c c c c } \hline Turn-On Delay Time^{C} & t_{d(on)} \\ \hline Rise Time^{C} & t_{r} & \\ \hline Turn-Off Delay Time^{C} & t_{d(off)} & \\ \hline Fall Time^{C} & t_{f} & \\ \hline \hline Source-Drain Diode Ratings and Characteristics^{b} & \\ \hline Pulsed Current^{a} & I_{SM} & \\ \hline \hline \end{tabular} & $	Gate-Drain Charge ^c	Q _{gd}			-	6.5	-	
Rise Time ^c t_r $V_{DD} = 20 \text{ V}, \text{ R}_L = 20 \Omega$ $ 8$ 12 Turn-Off Delay Time ^c $t_{d(off)}$ $I_D \cong 1 \text{ A}, \text{ V}_{GEN} = 10 \text{ V}, \text{ R}_g = 1 \Omega$ $ 50$ 75 Fall Time ^c t_f $ 10$ 15 Pulsed Current ^a I_{SM} $ 32$	Gate Resistance	Rg	f = 1 MHz		0.71	3.92	7.12	Ω
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Turn-On Delay Time ^c	t _{d(on)}			-	10	15	
Fall Time ^c t _f - 10 15 Source-Drain Diode Ratings and Characteristics ^b - - 32 Pulsed Current ^a I _{SM} - - 32	Rise Time ^c				-	8	12	- ns
Source-Drain Diode Ratings and Characteristics ^b Pulsed Current ^a I _{SM} - - 32	Turn-Off Delay Time ^c	t _{d(off)}			-	50	75	
Pulsed Current ^a I _{SM} 32	Fall Time ^c	t _f			-	10	15	
	Source-Drain Diode Ratings and Char	acteristics ^b				•		
Forward Voltage V_{SD} $I_F = 2.9 \text{ A}, V_{GS} = 0$ - 0.8 1.1	Pulsed Current ^a	I _{SM}			-	-	32	Α
	Forward Voltage	V _{SD}	$I_F = 2.9 \text{ A}, V_{GS} = 0$		-	0.8	1.1	V

Notes

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

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

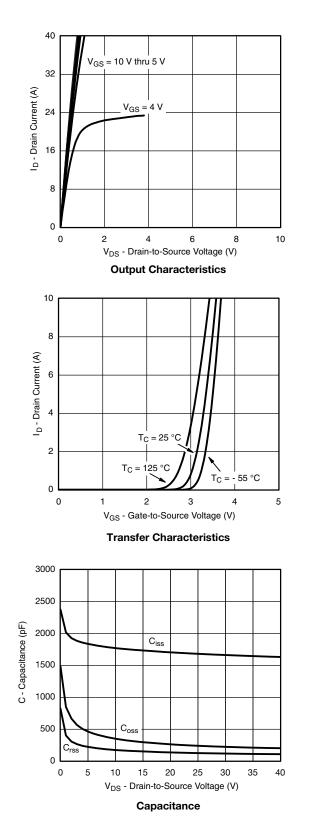
c. Independent of operating temperature.

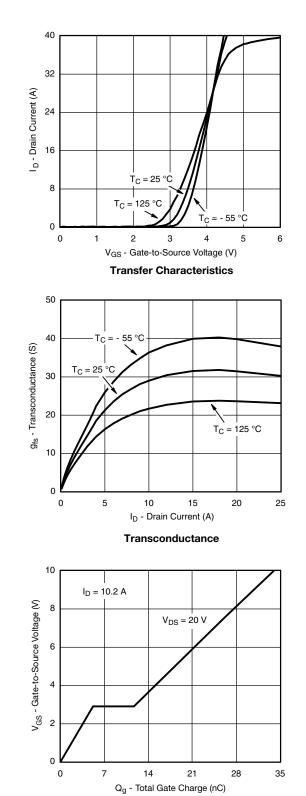
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



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TYPICAL CHARACTERISTICS ($T_A = 25 \text{ °C}$, unless otherwise noted)





Gate Charge

S11-2419-Rev. C, 19-Dec-11

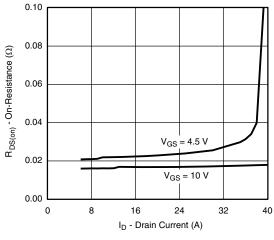
3

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S11-2419-Rev. C, 19-Dec-11

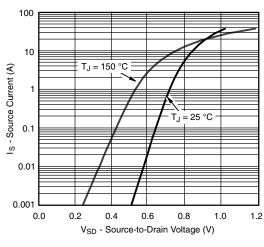
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TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)

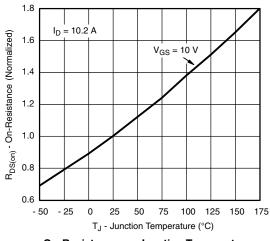


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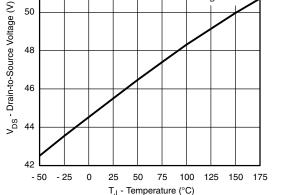
On-Resistance vs. Drain Current



Source Drain Diode Forward Voltage



On-Resistance vs. Junction Temperature



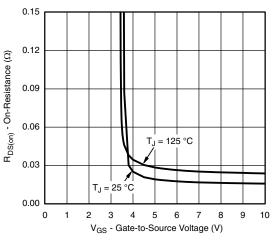
52

50

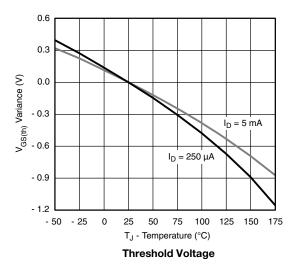
48

46

Drain-Source Breakdown vs. Junction Temperature



On-Resistance vs. Gate-to-Source Voltage



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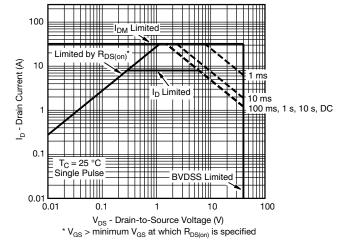
Vishay Siliconix

 $I_D = 1 \text{ mA}$

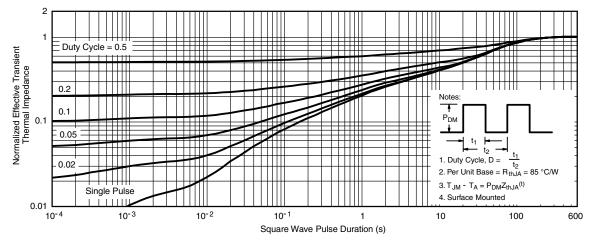


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THERMAL RATINGS ($T_A = 25 \text{ °C}$, unless otherwise noted)



Safe Operating Area



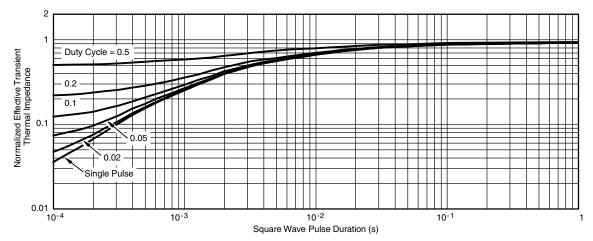
Normalized Thermal Transient Impedance, Junction-to-Ambient



SQJ970EP

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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?65282.



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