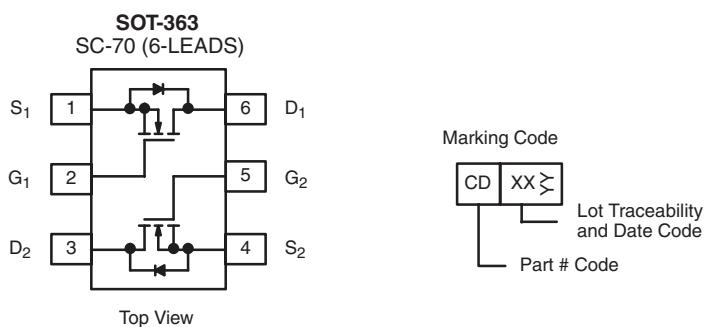


Dual N-Channel 30 V (D-S) MOSFET

PRODUCT SUMMARY			
V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A) ^a	Q_g (Typ.)
30	0.225 at $V_{GS} = 4.5$ V	1.3 ^a	1.15 nC
	0.345 at $V_{GS} = 2.5$ V	1.3 ^a	



Ordering Information: Si1970DH-T1-E3 (Lead (Pb)-free)
Si1970DH-T1-GE3 (Lead (Pb)-free and Halogen-free)

FEATURES

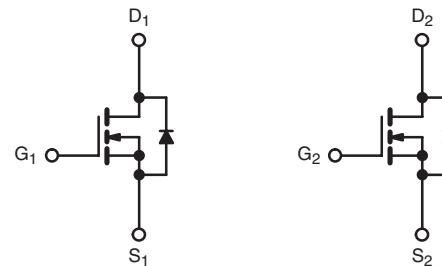
- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET® Power MOSFET
- Compliant to RoHS Directive 2002/95/EC



RoHS
COMPLIANT
HALOGEN
FREE
Available

APPLICATIONS

- Load Switch for Portable Applications



ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °C, unless otherwise noted

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V_{DS}	30	V
Gate-Source Voltage	V_{GS}	± 12	
Continuous Drain Current ($T_J = 150$ °C)	I_D	1.3 ^a	A
		1.3 ^a	
		1.3 ^a	
		1.1	
Pulsed Drain Current	I_{DM}	4	
Continuous Source-Drain Diode Current	I_S	1.0	
		0.61 ^c	
Maximum Power Dissipation	P_D	1.25	W
		0.8	
		0.74 ^{b, c}	
		0.47 ^{b, c}	
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-55 to 150	°C
Soldering Recommendations (Peak Temperature) ^{d, e}		260	

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient ^{b, f}	R_{thJA}	130	170	°C/W
Maximum Junction-to-Foot (Drain)	R_{thJF}	80	100	

Notes:

a. Package limited.

b. Surface mounted on 1" x 1" FR4 board.

c. $t = 5$ s.

d. Maximum under steady state conditions is 220 °C/W.

SPECIFICATIONS $T_J = 25^\circ\text{C}$, unless otherwise noted

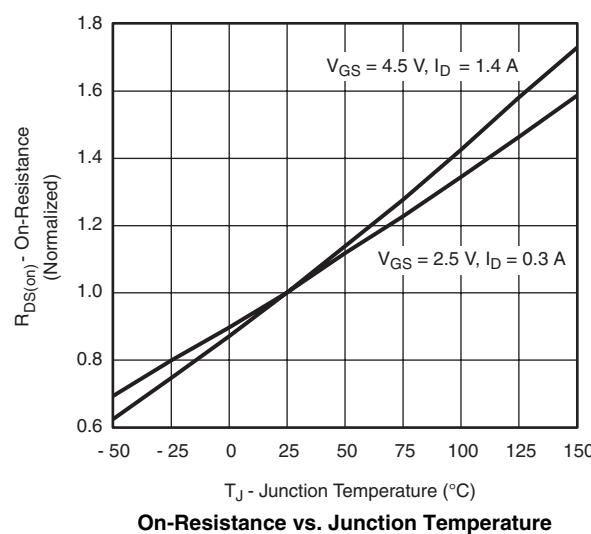
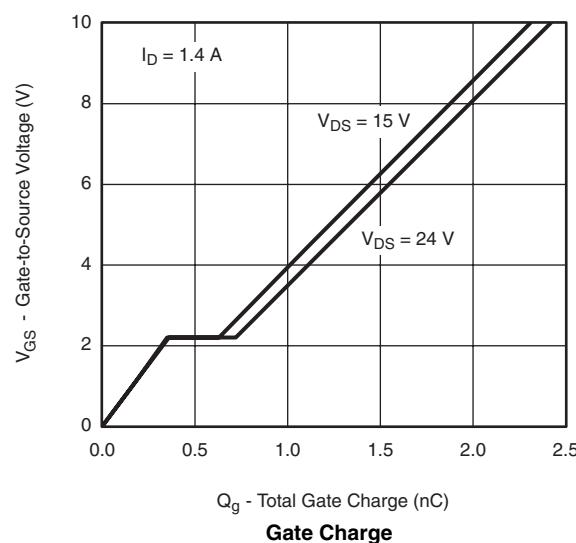
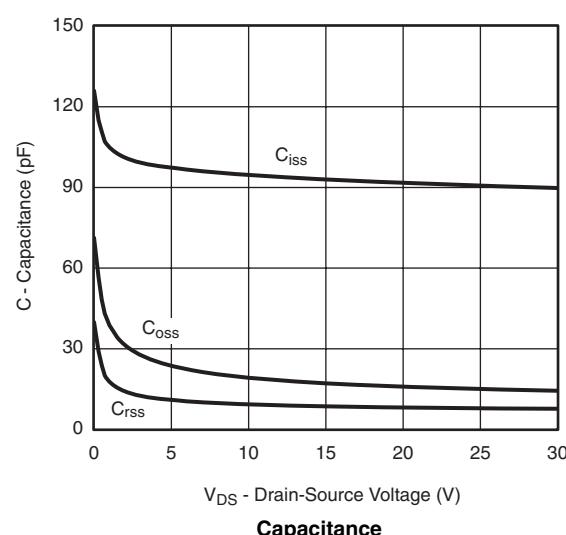
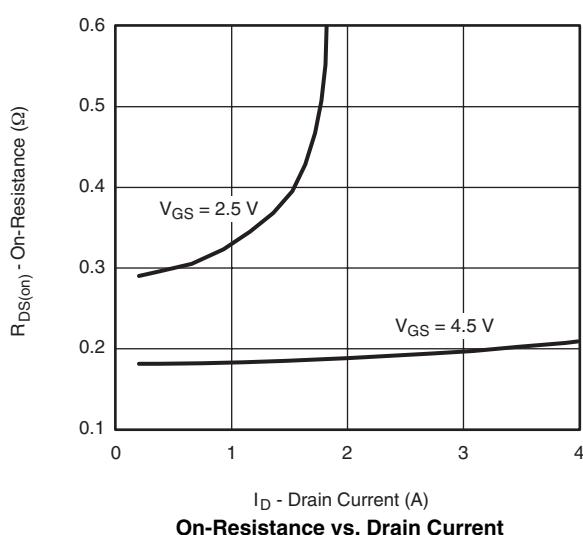
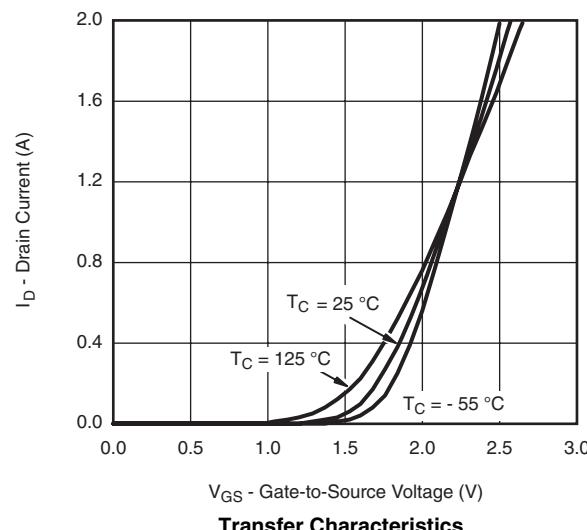
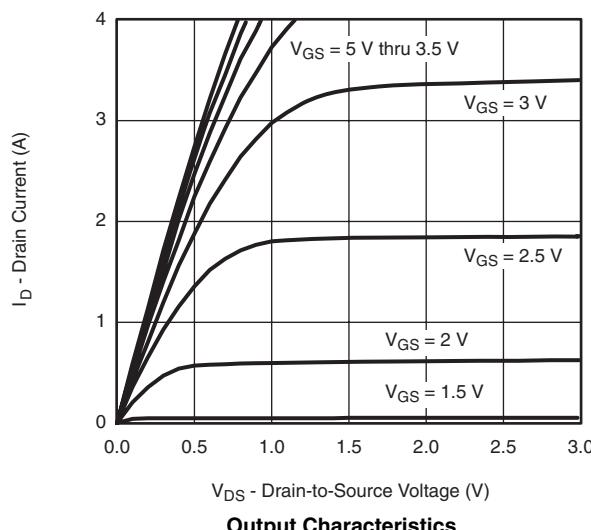
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Static						
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0 \text{ V}$, $I_D = 250 \mu\text{A}$	30			V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = 250 \mu\text{A}$		25		$\text{mV}/^\circ\text{C}$
$V_{GS(\text{th})}$ Temperature Coefficient	$\Delta V_{GS(\text{th})}/T_J$			- 3.2		
Gate-Source Threshold Voltage	$V_{GS(\text{th})}$	$V_{DS} = V_{GS}$, $I_D = 250 \mu\text{A}$	0.6		1.6	V
Gate-Source Leakage	I_{GSS}	$V_{DS} = 0 \text{ V}$, $V_{GS} = \pm 12 \text{ V}$			± 100	ns
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 30 \text{ V}$, $V_{GS} = 0 \text{ V}$			1	μA
		$V_{DS} = 30 \text{ V}$, $V_{GS} = 0 \text{ V}$, $T_J = 55^\circ\text{C}$			10	
On-State Drain Current ^a	$I_{D(\text{on})}$	$V_{DS} \leq 5 \text{ V}$, $V_{GS} = 4.5 \text{ V}$	4			A
Drain-Source On-State Resistance ^a	$R_{DS(\text{on})}$	$V_{GS} = 4.5 \text{ V}$, $I_D = 1.2 \text{ A}$		0.185	0.225	Ω
		$V_{GS} = 2.5 \text{ V}$, $I_D = 0.29 \text{ A}$		0.285	0.345	
Forward Transconductance ^a	g_{fs}	$V_{DS} = 15 \text{ V}$, $I_D = 1.2 \text{ A}$		2.5		S
Dynamic^b						
Input Capacitance	C_{iss}	$V_{DS} = 15 \text{ V}$, $V_{GS} = 0 \text{ V}$, $f = 1 \text{ MHz}$		95		pF
Output Capacitance	C_{oss}			17		
Reverse Transfer Capacitance	C_{rss}			9		
Total Gate Charge	Q_g	$V_{DS} = 15 \text{ V}$, $V_{GS} = 10 \text{ V}$, $I_D = 1.4 \text{ A}$		2.5	3.8	nC
				1.15	1.7	
Gate-Source Charge	Q_{gs}	$V_{DS} = 10 \text{ V}$, $V_{GS} = 4.5 \text{ V}$, $I_D = 1.4 \text{ A}$		0.4		nC
Gate-Drain Charge	Q_{gd}			0.3		
Gate Resistance	R_g		$f = 1 \text{ MHz}$	4		
Turn-On Delay Time	$t_{d(\text{on})}$			9	15	ns
Rise Time	t_r	$V_{DD} = 15 \text{ V}$, $R_L = 13.6 \Omega$ $I_D \geq 1.1 \text{ A}$, $V_{GEN} = 4.5 \text{ V}$, $R_g = 1 \Omega$		20	30	
Turn-Off Delay Time	$t_{d(\text{off})}$			15	25	
Fall Time	t_f			15	25	
Turn-on Delay Time	$t_{d(\text{on})}$			5	10	
Rise Time	t_r	$V_{DD} = 15 \text{ V}$, $R_L = 13.6 \Omega$ $I_D \geq 1.1 \text{ A}$, $V_{GEN} = 10 \text{ V}$, $R_g = 1 \Omega$		10	15	
Turn-Off Delay Time	$t_{d(\text{off})}$			10	15	
Fall Time	t_f			6	12	
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I_S	$T_C = 25^\circ\text{C}$			1	A
Pulse Diode Forward Current	I_{SM}				4	
Body Diode Voltage	V_{SD}	$I_S = 1.1 \text{ A}$, $V_{GS} = 0 \text{ V}$		0.85	1.2	V
Body Diode Reverse Recovery Time	t_{rr}	$I_F = 1.1 \text{ A}$, $dI/dt = 100 \text{ A}/\mu\text{s}$, $T_J = 25^\circ\text{C}$		20	40	ns
Body Diode Reverse Recovery Charge	Q_{rr}			10	20	
Reverse Recovery Fall Time	t_a			16.5		ns
Reverse Recovery Rise Time	t_b			3.5		

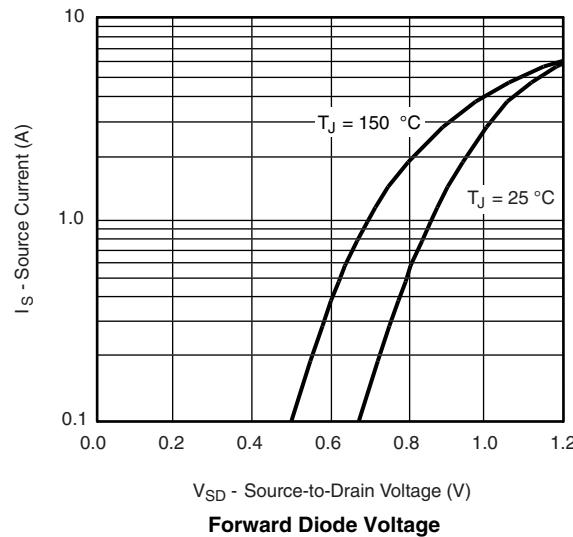
Notes:

a. Pulse test; pulse width $\leq 300 \mu\text{s}$, duty cycle $\leq 2\%$.
b. Guaranteed by design, not subject to production testing.

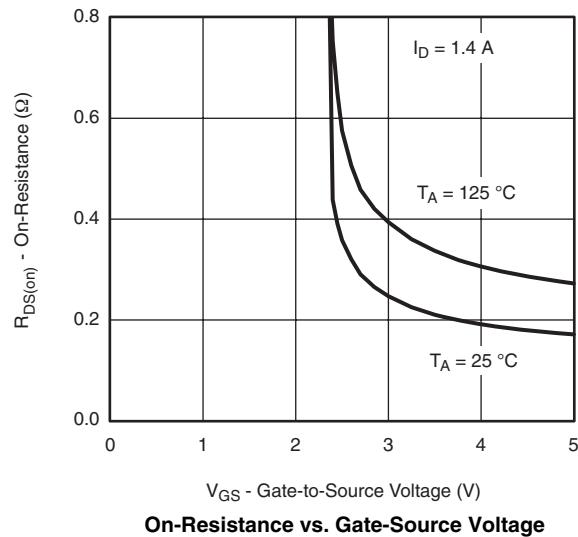
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

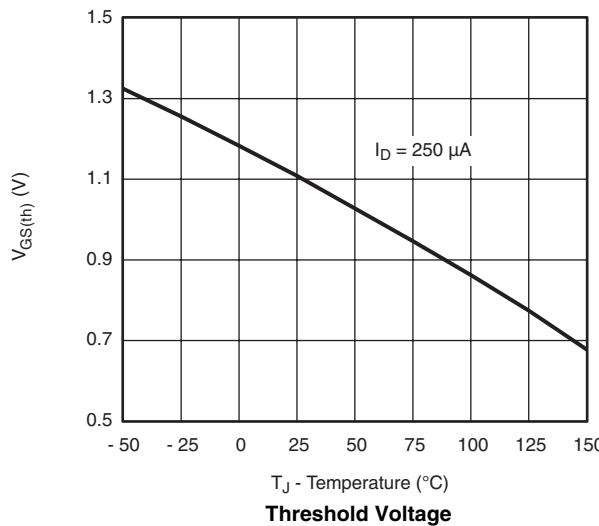


TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

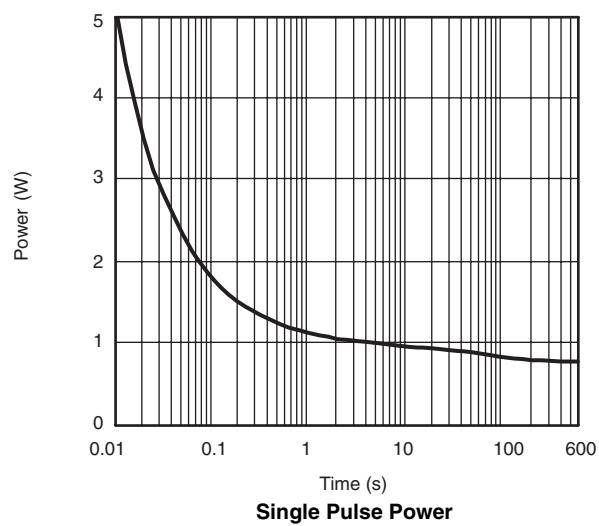
Forward Diode Voltage



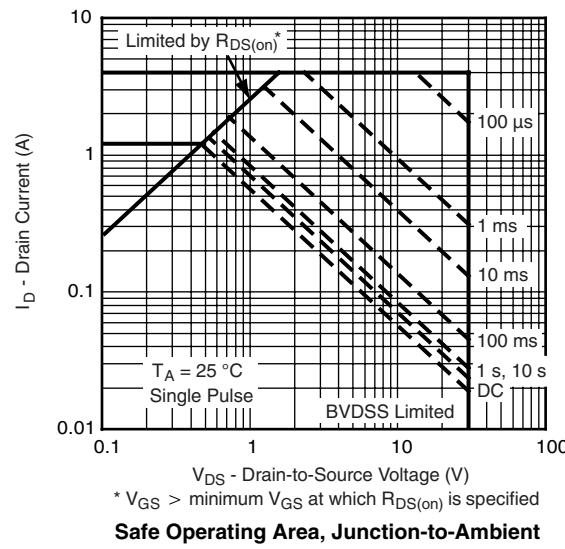
On-Resistance vs. Gate-Source Voltage



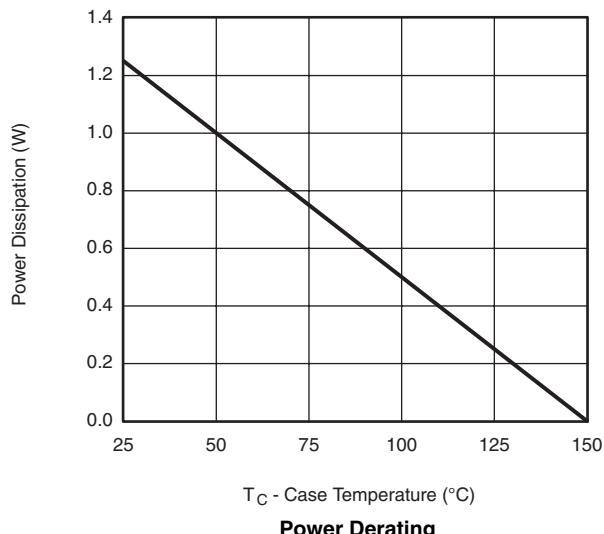
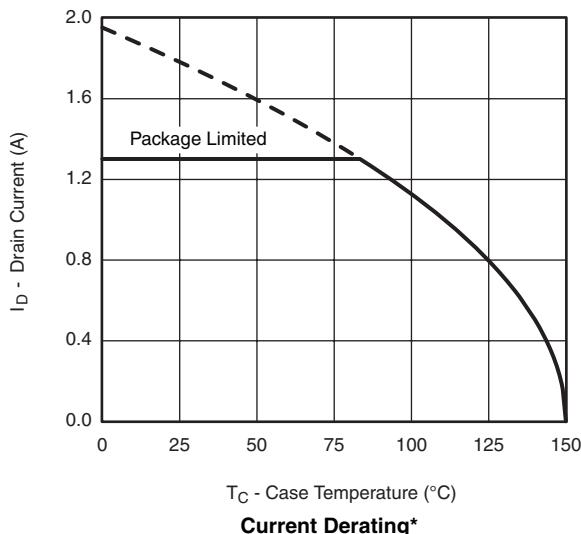
Threshold Voltage



Single Pulse Power

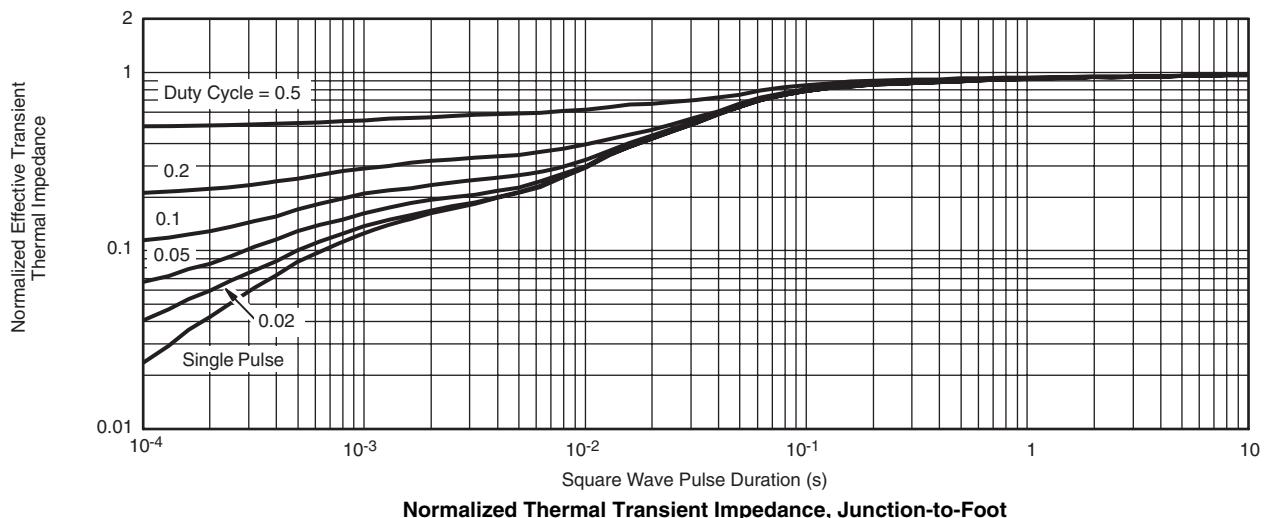
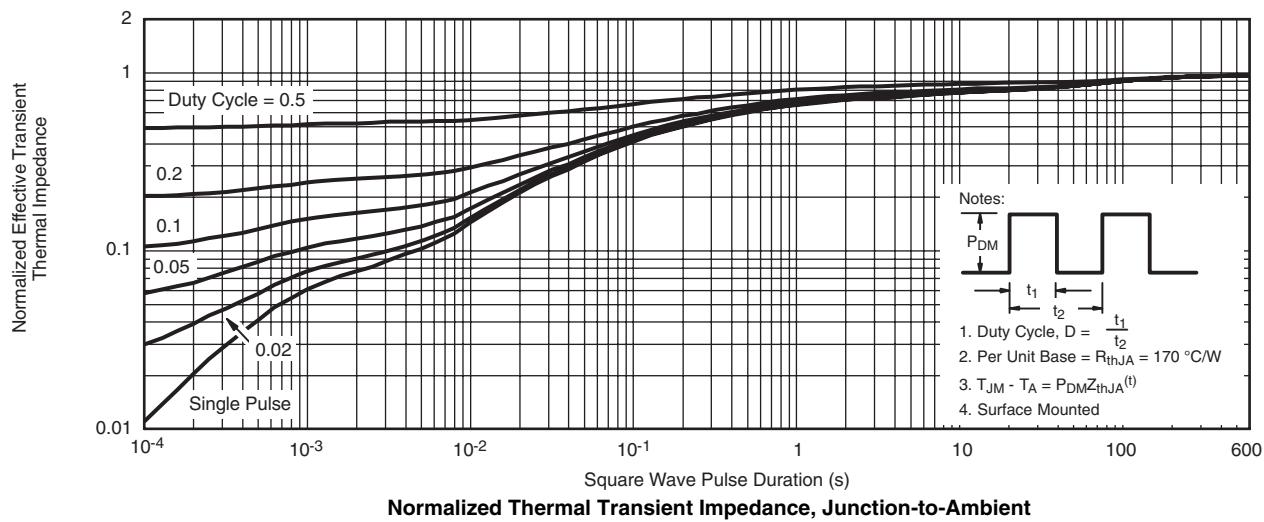
* $V_{GS} > \text{minimum } V_{GS}$ at which $R_{DS(on)}$ is specified

Safe Operating Area, Junction-to-Ambient

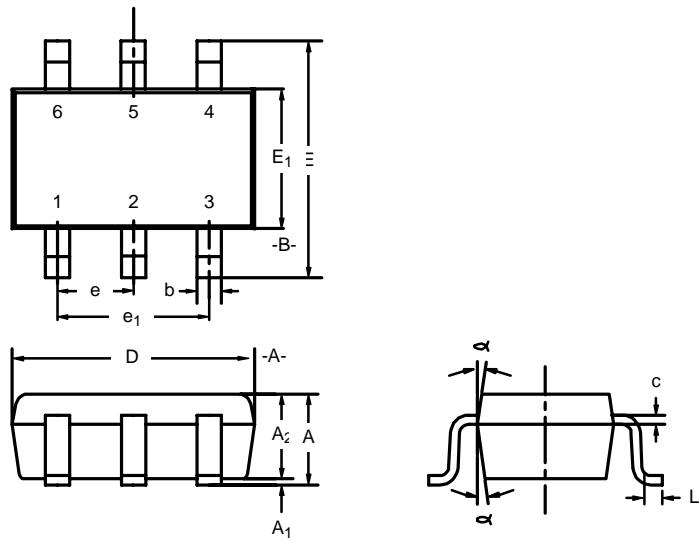
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted


* 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.

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



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SC-70: 6-LEADS


Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
A	0.90	—	1.10	0.035	—	0.043
A₁	—	—	0.10	—	—	0.004
A₂	0.80	—	1.00	0.031	—	0.039
b	0.15	—	0.30	0.006	—	0.012
c	0.10	—	0.25	0.004	—	0.010
D	1.80	2.00	2.20	0.071	0.079	0.087
E	1.80	2.10	2.40	0.071	0.083	0.094
E₁	1.15	1.25	1.35	0.045	0.049	0.053
e	0.65BSC			0.026BSC		
e₁	1.20	1.30	1.40	0.047	0.051	0.055
L	0.10	0.20	0.30	0.004	0.008	0.012
alpha	7°Nom			7°Nom		

ECN: S-03946—Rev. B, 09-Jul-01
DWG: 5550

Dual-Channel LITTLE FOOT® 6-Pin SC-70 MOSFET

Copper Leadframe Version

Recommended Pad Pattern and Thermal Performance

INTRODUCTION

The new dual 6-pin SC-70 package with a copper leadframe enables improved on-resistance values and enhanced thermal performance as compared to the existing 3-pin and 6-pin packages with Alloy 42 leadframes. These devices are intended for small to medium load applications where a miniaturized package is required. Devices in this package come in a range of on-resistance values, in n-channel and p-channel versions. This technical note discusses pin-outs, package outlines, pad patterns, evaluation board layout, and thermal performance for the dual-channel version.

PIN-OUT

Figure 1 shows the pin-out description and Pin 1 identification for the dual-channel SC-70 device in the 6-pin configuration. Both n-and p-channel devices are available in this package – the drawing example below illustrates the p-channel device.

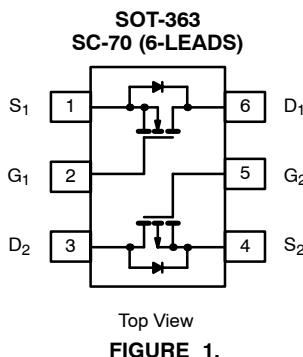


FIGURE 1.

For package dimensions see outline drawing SC-70 (6-Leads) (<http://www.vishay.com/doc?71154>)

BASIC PAD PATTERNS

See Application Note 826, *Recommended Minimum Pad Patterns With Outline Drawing Access for Vishay Siliconix MOSFETs*, (<http://www.vishay.com/doc?72286>) for the SC-70 6-pin basic pad layout and dimensions. This pad pattern is sufficient for the low-power applications for which this package is intended. Increasing the drain pad pattern (Figure 2) yields a reduction in thermal resistance and is a preferred footprint.

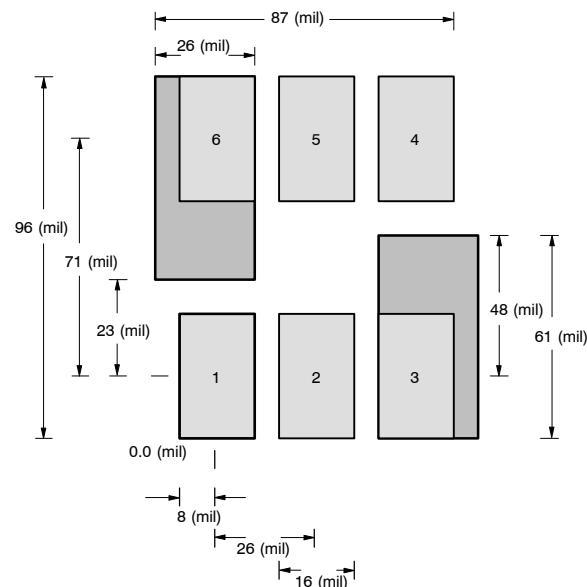


FIGURE 2. SC-70 (6 leads) Dual

EVALUATION BOARD FOR THE DUAL-CHANNEL SC70-6

The 6-pin SC-70 evaluation board (EVB) shown in Figure 3 measures 0.6 in. by 0.5 in. The copper pad traces are the same as described in the previous section, *Basic Pad Patterns*. The board allows for examination from the outer pins to the 6-pin DIP connections, permitting test sockets to be used in evaluation testing.

The thermal performance of the dual 6-pin SC-70 has been measured on the EVB, comparing both the copper and Alloy 42 leadframes. This test was then repeated using the 1-inch² PCB with dual-side copper coating.

A helpful way of displaying the thermal performance of the 6-pin SC-70 dual copper leadframe is to compare it to the traditional Alloy 42 version.

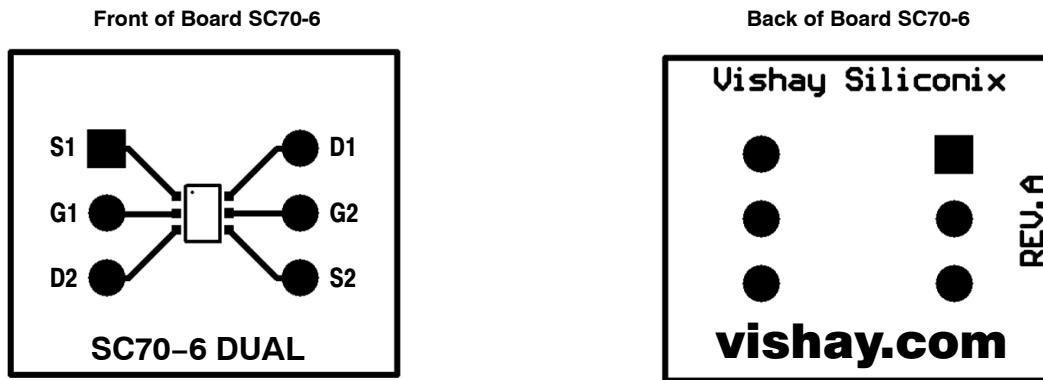


FIGURE 3.

Thermal Performance

Junction-to-Foot Thermal Resistance (the Package Performance)

Thermal performance for the dual SC-70 6-pin package is measured as junction-to-foot thermal resistance, in which the "foot" is the drain lead of the device as it connects with the body. The junction-to-foot thermal resistance for this device is typically 80°C/W, with a maximum thermal resistance of approximately 100°C/W. This data compares favorably with another compact, dual-channel package – the dual TSOP-6 – which features a typical thermal resistance of 75°C/W and a maximum of 90°C/W.

COOPER LEADFRAME

Room Ambient 25 °C	Elevated Ambient 60 °C
$P_D = \frac{T_{J(max)} - T_A}{R\theta_{JA}}$	$P_D = \frac{T_{J(max)} - T_A}{R\theta_{JA}}$
$P_D = \frac{150^\circ\text{C} - 25^\circ\text{C}}{224^\circ\text{C/W}}$	$P_D = \frac{150^\circ\text{C} - 60^\circ\text{C}}{224^\circ\text{C/W}}$
$P_D = 558 \text{ mW}$	$P_D = 402 \text{ mW}$

Although they are intended for low-power applications, devices in the 6-pin SC-70 dual-channel configuration will handle power dissipation in excess of 0.5 W.

TESTING

To further aid the comparison of copper and Alloy 42 leadframes, Figures 4 and 5 illustrate the dual-channel 6-pin SC-70 thermal performance on two different board sizes and pad patterns. The measured steady-state values of $R\theta_{JA}$ for the dual 6-pin SC-70 with varying leadframes are as follows:

LITTLE FOOT 6-PIN SC-70

	Alloy 42	Copper
1) Minimum recommended pad pattern on the EVB board (see Figure 3).	518°C/W	344°C/W
2) Industry standard 1-inch ² PCB with maximum copper both sides.	413°C/W	224°C/W

The results indicate that designers can reduce thermal resistance (θ_{JA}) by 34% simply by using the copper leadframe device as opposed to the Alloy 42 version. In this example, a 174°C/W reduction was achieved without an increase in board area. If an increase in board size is feasible, a further 120°C/W reduction can be obtained by utilizing a 1-inch² PCB area.

The Dual copper leadframe versions have the following suffix:

Dual: Si19xxEDH
Compl.: Si15xxEDH

Alloy 42 Leadframe

ALLOY 42 LEADFRAME	
Room Ambient 25 °C	Elevated Ambient 60 °C
$P_D = \frac{T_{J(max)} - T_A}{R\theta_{JA}}$	$P_D = \frac{T_{J(max)} - T_A}{R\theta_{JA}}$
$P_D = \frac{150^\circ\text{C} - 25^\circ\text{C}}{413^\circ\text{C/W}}$	$P_D = \frac{150^\circ\text{C} - 60^\circ\text{C}}{413^\circ\text{C/W}}$
$P_D = 303 \text{ mW}$	$P_D = 218 \text{ mW}$

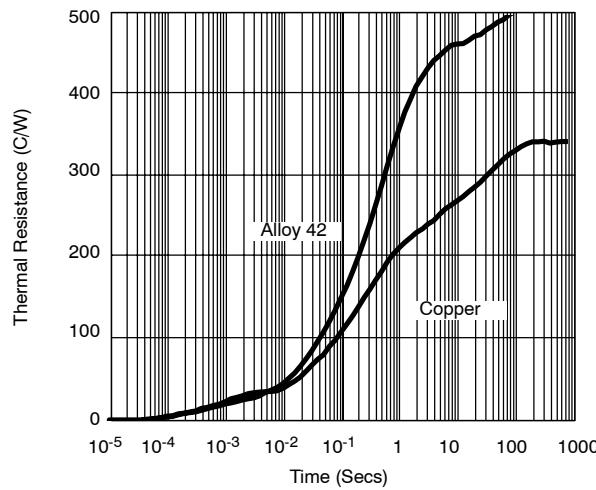


FIGURE 4. Dual SC70-6 Thermal Performance on EVB

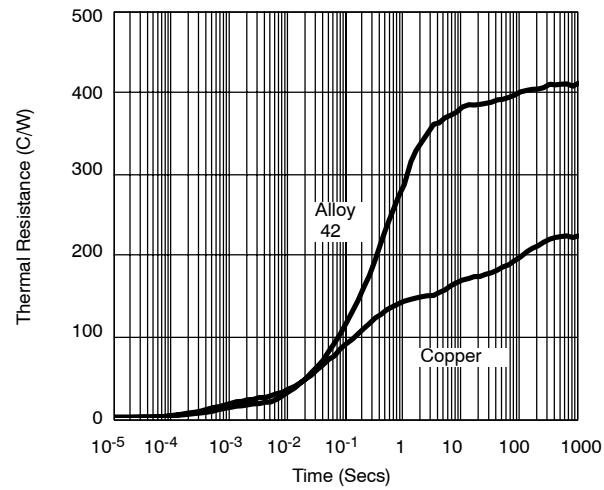
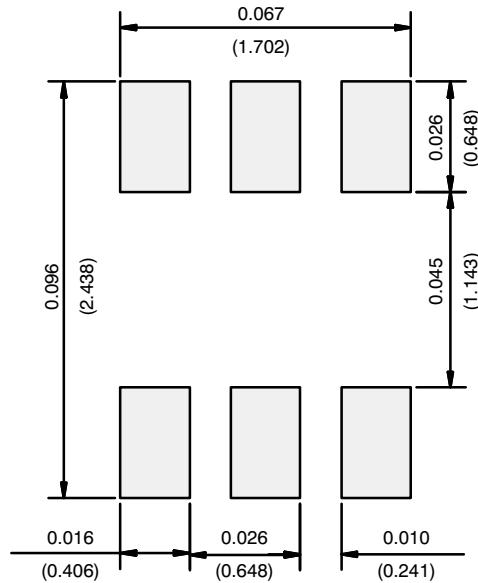


FIGURE 5. Dual SC70-6 Comparison on 1-inch² PCB

RECOMMENDED MINIMUM PADS FOR SC-70: 6-Lead



Recommended Minimum Pads
Dimensions in Inches/(mm)

[Return to Index](#)

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