Dual-Channel LITTLE FOOT® 6-Pin SC-70 MOSFET Copper Leadframe Version Recommended Pad Pattern and Thermal Performance

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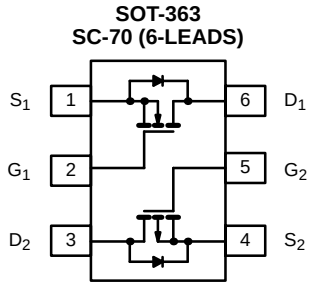
INTRODUCTION

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.

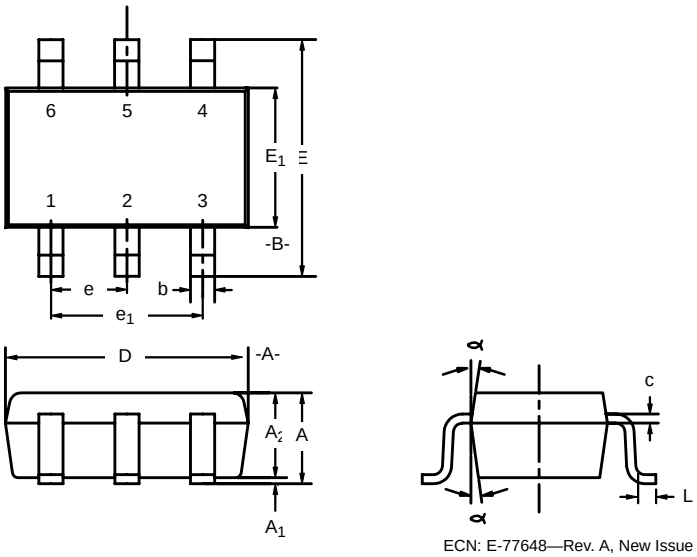


Top View

FIGURE 1.

PACKAGE DIMENSIONS

SC-70: 6-LEADS



Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
A	0.90	–	1.10	0.035	–	0.043
A_1	–	–	0.10	–	–	0.004
A_2	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	0.063	0.094
E_1	1.15	1.25	1.35	0.045	0.049	0.063
e	0.65BSC			0.026BSC		
e_1	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
α	7°Nom			7°Nom		

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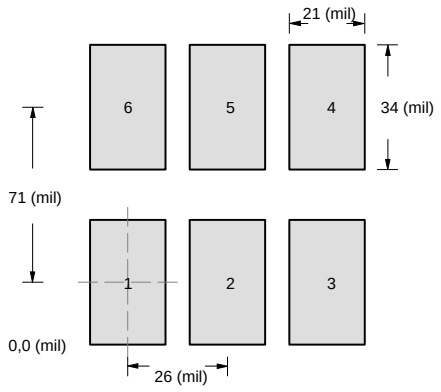


FIGURE 2. Basic Footprints

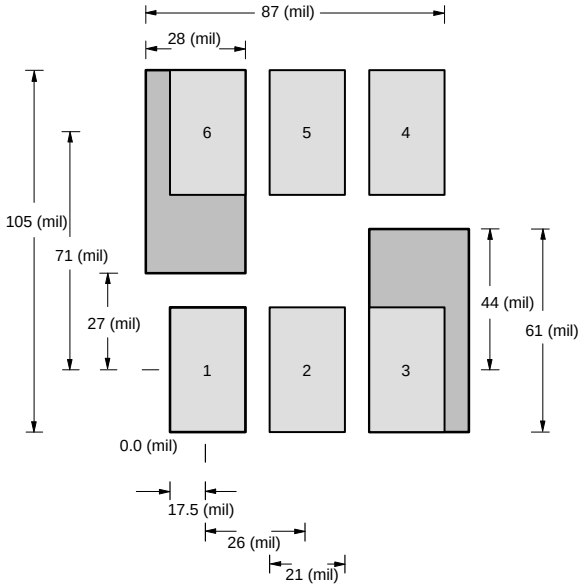


FIGURE 3. SC-70 (6 leads) Dual

BASIC PAD PATTERNS

The basic pad layout and dimensions for the 6-pin SC-70 are shown in Figure 2. This pad pattern is sufficient for the low-power applications for which this package is intended. Increasing the drain pad pattern (Figure 3) yields a reduction in thermal resistance and is a preferred footprint.

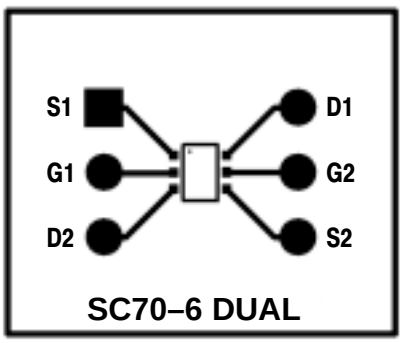
EVALUATION BOARD FOR THE DUAL-CHANNEL SC70-6

The 6-pin SC-70 evaluation board (EVB) measures 0.6 in. by 0.5 in. The copper pad traces are the same as in Figure 2. The board allows for examination from the outer pins to the 6-pin DIP connections, permitting test sockets to be used in evaluation testing.

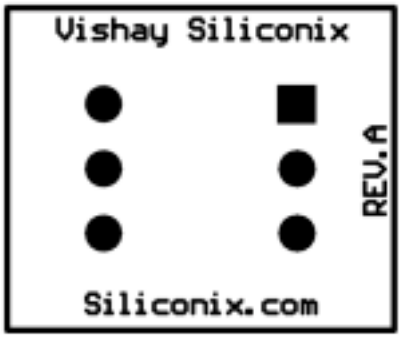
The thermal performance of the dual 6-pin SC-70 has been measured on the EVB, comparing both the copper and Alloy 42 leadframes. This test was then repeated using the 1-inch^2 PCB with dual-side copper coating.

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.

Front of Board SC70-6



Back of Board SC70-6



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.

Power Dissipation

The typical $R\theta_{JA}$ for the dual-channel 6-pin SC-70 with a copper leadframe is 224°C/W steady-state, compared to 413°C/W for the Alloy 42 version. All figures are based on the 1-inch^2 FR4 test board. The following example shows how the thermal resistance impacts power dissipation for the dual 6-pin SC-70 package at varying ambient temperatures.

Alloy 42 Leadframe

Room Ambient 25°C

$$P_D = \frac{T_{J(max)} - T_A}{R\theta_{JA}}$$

$$P_D = \frac{150^oC - 25^oC}{413^oC/W}$$

$$P = 303\ mW$$

Elevated Ambient 60°C

$$P_D = \frac{T_{J(max)} - T_A}{R\theta_{JA}}$$

$$P_D = \frac{150^oC - 60^oC}{413^oC/W}$$

$$P = 218\ mW$$

Copper Leadframe

Room Ambient 25°C

$$P_D = \frac{T_{J(max)} - T_A}{R\theta_{JA}}$$

$$P_D = \frac{150^oC - 25^oC}{224^oC/W}$$

$$P = 558\ mW$$

Elevated Ambient 60°C

$$P_D = \frac{T_{J(max)} - T_A}{R\theta_{JA}}$$

$$P_D = \frac{150^oC - 60^oC}{224^oC/W}$$

$$P_D = 402\ mW$$

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 5 and 6 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 4).	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 (θJA) 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-inch^2. PCB area.

The Dual copper leadframe versions have the following suffix:

Dual: Si19xxEDH
Compl.: Si15xxEDH

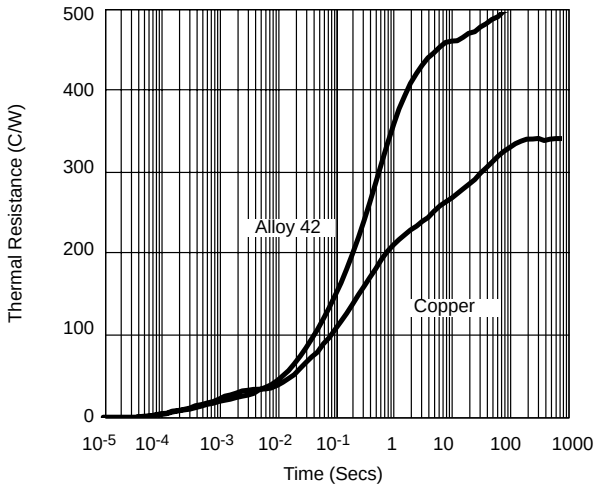


FIGURE 5. Dual SC70-6 Thermal Performance on EVB

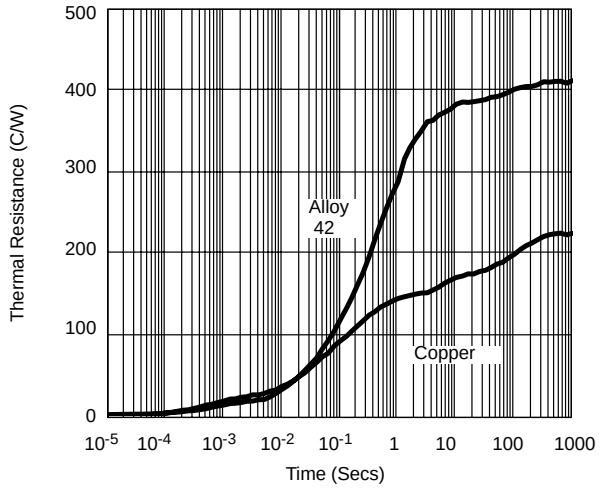


FIGURE 6. Dual SC70-6 Comparison on 1-inch^2 PCB