NVE Isolators Have Excellent Thermal Characteristics

Excellent Thermal Characteristics

NVE's award-winning Isolators have excellent thermal characteristics, enabling the devices to run at high speed and high ambient temperatures with minimal temperature rise. This provides wide operating margin and contributes to exceptional reliability. This bulletin summarizes thermal specifications, describes how thermal resistance is measured, and provides a representative thermal derating curve.

Unique Design

NVE Isolators are based on spintronics rather than semiconductors. This technology provides high channel density, precision, and low power. And unlike semiconductors, which generally have poor thermal characteristics, spintronics use nanoscale metal films with good thermal characteristics.

The device packages also contribute to thermal performance. Unlike conventional package leadframes, which contain significant percentages of iron, NVE Isolator leadframes use high-copper alloys, which have high thermal conductivity. The isolator leadframe area is maximized to enhance the radiation of heat. Finally, because their revolutionary design does not require die to be electrically insulated from the leadframe, die attach adhesives with high electrical and thermal conductivity are used.

Thermal Specifications

Typical thermal specifications for NVE's most popular packages are summarized in the following chart and table. Specifications may vary slightly between models, so refer to datasheets for exact specifications.

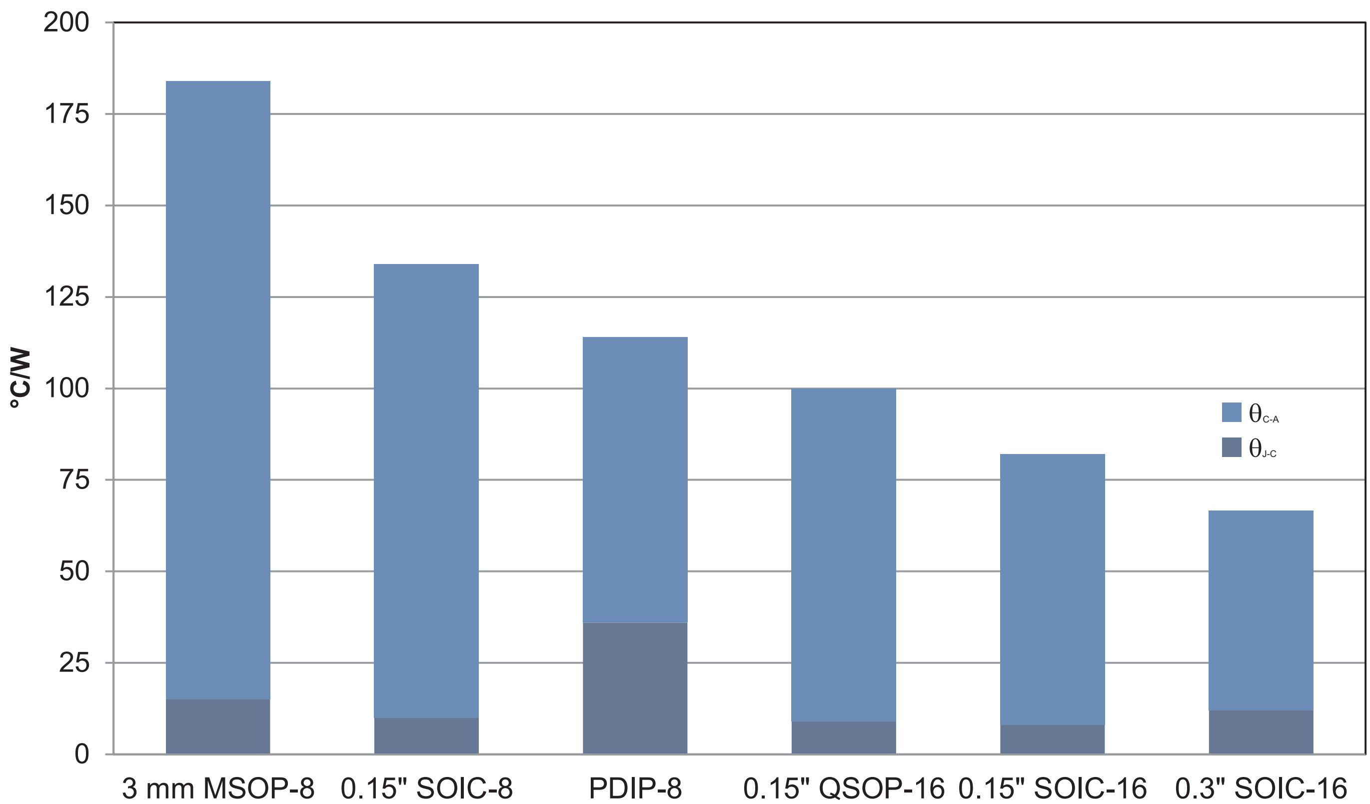

Figure 1. Thermal resistance specifications for popular NVE Isolators (double-sided PCB; free air).

Parameter	Symbol	Package	Typ.	Max.	Units	Test Conditions
Junction–Ambient Thermal Resistance	θ_{JA}	3 mm MSOP-8	184		°C/W	Double-sided PCB; free air
		0.15" SOIC-8	134			
		PDIP-8	114			
		0.15" QSOP-16	100			
		0.15" SOIC-16	82			
		0.3" SOIC-16	67			
Junction–Case (Top) Thermal Resistance	θ_{JC}	3 mm MSOP-8	15			
		0.15" SOIC-8	10			
		PDIP-8	36			
		0.15" QSOP-16	9			
		0.15" SOIC-16	8			
		0.3" SOIC-16	12			
Junction–Ambient Thermal Resistance	θ_{JA}	0.3" SOIC-16	46			2s2p PCB in free air per JESD51
Junction–Case (Top) Thermal Resistance	θ_{JC}		9			
Power Dissipation	P_D	3 mm MSOP-8		500	mW	
		0.15" SOIC-8		675		
		PDIP-8		800		
		0.15" QSOP-16		675		
		0.15" SOIC-16		700		
		0.3" SOIC-16		1300		

Table 1. Thermal specifications for popular NVE Isolator packages.

Terms and Symbols

Thermal-related terms and symbols are illustrated as follows:

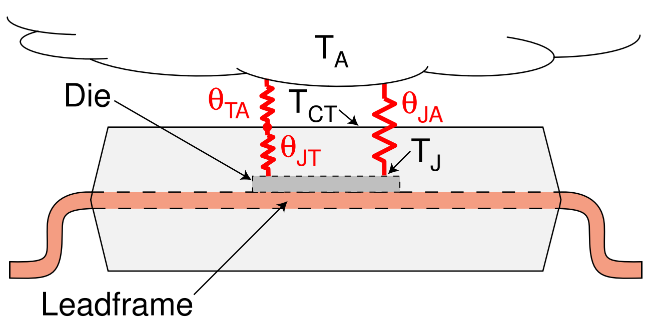

Fig. 1. Thermal-related terms and symbols.

Junction-to-ambient and junction-to-case thermal resistances are calculated as follows:

$\theta_{JA} \equiv (T_J - T_A)/P_D$;

$\theta_{JT} \equiv (T_J - T_{CT})/P_D$

Where:

θ_{JA} is the junction-to-ambient thermal resistance;

θ_{JT} is thermal resistance from the junction to the top-center of the case

T_J is the device die or junction temperature;

T_A is ambient temperature;

T_{CT} is the surface temperature of the center-top of the package; and

P_D is the total package power dissipation.

Measuring Thermal Resistance

Temperature at the top of the case can be measured with a low thermal mass thermocouple or a noncontact infrared thermometer. Measuring junction temperature, however, requires some finesse. One method is to use one of the devices' input protection diodes as a temperature sensor, taking advantage of the linear relationship between absolute temperature and the forward voltage drops of a diode with a constant-current bias. The input is reversed biased using the diode-test function of a multimeter or constant-current source measure unit as shown in Figure 2:

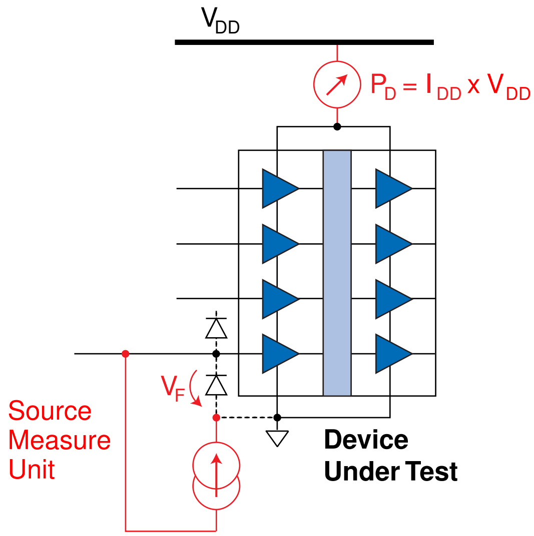

Fig. 2. Measuring thermal resistance.

V_F versus temperature is characterized in an environmental chamber at several temperatures to generate a temperature calibration curve.

Total supply current is monitored to calculate package power dissipation. Power dissipation in the Device Under Test can be varied by changing input speeds, number of active channels, and output loading.

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Derating Curves

IL200/IL700-Series Isolators have low quiescent power consumption, although like most electronic devices, power consumption increases with operating frequency and supply voltage. Because of the high speed and channel density of these isolators, temperature rise may need to be considered when running multiple channels at high speed, especially with five volt supplies and the ultraminiature QSOP package.

"T-Grade" parts have a maximum operating junction temperature of 125 °C, compared to 110 °C for standard-grade isolators, for additional margin at extreme operating conditions:

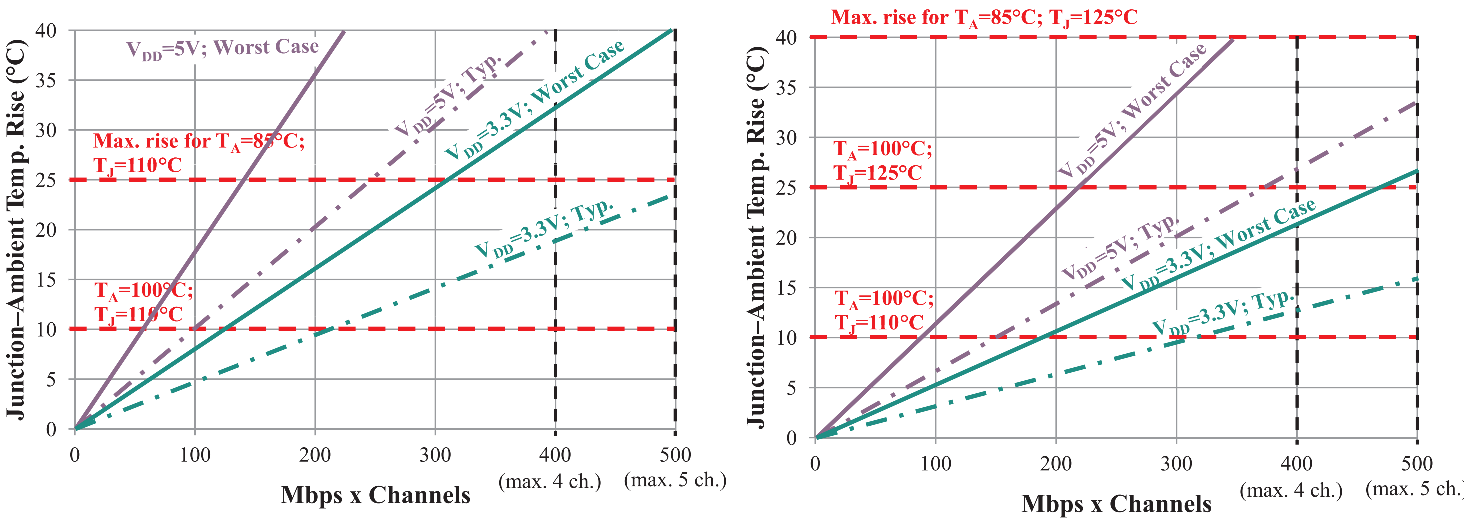

Fig. 3. IL200/IL700-Series derating curves for QSOP (left) and wide-body packages on packages (right) with double-sided boards in free air.

Better best thermal performance can be obtained with a "2s2p" four-layer board with thermal vias. This reduces junction-to-ambient thermal resistance by approximately 30%.

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