

IsoLoop Isolators Have Excellent Thermal Characteristics

Excellent Thermal Characteristics

Award-winning IsoLoop[®] 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 IsoLoop thermal specifications, describes how thermal resistance is measured, and provides a representative thermal derating curve.

Unique Design

IsoLoop 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, IsoLoop 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.

IsoLoop Thermal Specifications

Typical IsoLoop thermal specifications for NVE’s most popular package types are summarized in the following table. Specifications may vary slightly between models, so refer to datasheets for exact specifications.

Parameter	Symbol	Package	Typ.	Max.	Units	Test Conditions
Junction–Ambient Thermal Resistance	θ_{JA}	3 mm MSOP-8	80		°C/W	Soldered to double-sided board; free air
		0.15" SOIC-8	60			
		0.15" QSOP-16	60			
		0.15" SOIC-16	60			
		0.3" SOIC-16	60			
Junction–Case (Top) Thermal Resistance	Ψ_{JT}	3 mm MSOP-8	40		°C/W	Soldered to double-sided board; free air
		0.15" SOIC-8	10			
		0.15" QSOP-16	10			
		0.15" SOIC-16	10			
		0.3" SOIC-16	20			
Power Dissipation	P_D	3 mm MSOP-8		500	mW	Soldered to double-sided board; free air
		0.15" SOIC-8		675		
		0.15" QSOP-16		675		
		0.15" SOIC-16		700		
		0.3" SOIC-16		800		

Table 1. Thermal specifications for popular IsoLoop Isolator packages.

Terms and Symbols

Thermal-related terms and symbols are illustrated as follows:

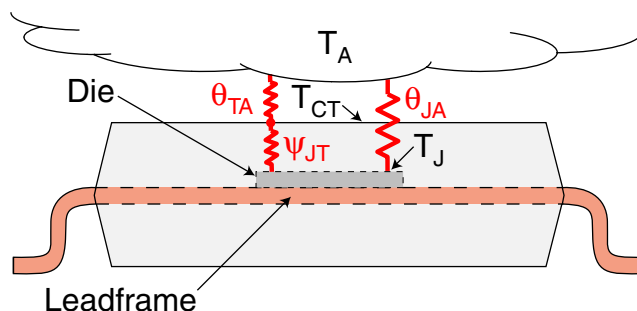


Fig. 1. Thermal-related terms and symbols.

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

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

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

Where:

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

Ψ_{JT} is thermal resistance from the junction to the top-center of the case
 (“ Ψ ” is used rather than “ θ ” to indicate thermal resistance to the **top** of the package);

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:

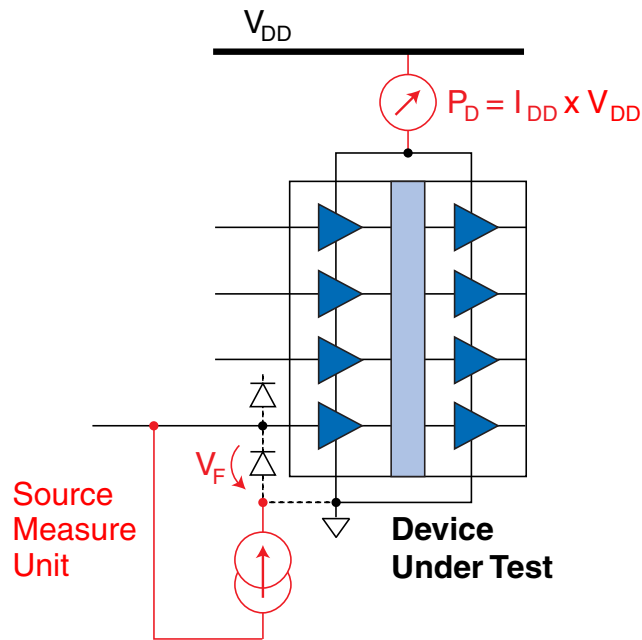


Fig. 2. Measuring thermal resistance.

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.

Thermal Resistance of Different Packages

The specifications in Table 1 show that the junction–ambient thermal resistances for SOIC-8, QSOP-16, narrow-body SOIC-16, and wide-body SOIC-16 packages are similar. This is because higher case-to-ambient thermal resistance in the smaller packages is offset by lower junction–case thermal resistances since they are thinner and have relatively large leadframe areas. This convenient coincidence allows one derating curve for four package types (MSOP packages have higher junction–ambient thermal resistances).

Derating Curves

IL200/IL700-Series Isolators have very low quiescent power consumption, but like most electronic devices, power consumption increases with operating frequency. Because of the high speed and channel density of these isolators, temperature rise should be considered when running multiple channels at high speed. Power consumption is higher at 5 volt operation than at 3.3 volts, and dynamic supply current is higher on the input side of the isolators than the output side, so thermal management can be especially important with five-volt input- side power supplies.

The derating curve for IIL200- and IL700-Series Isolators at several typical operating temperatures is as illustrated in Figure 3:

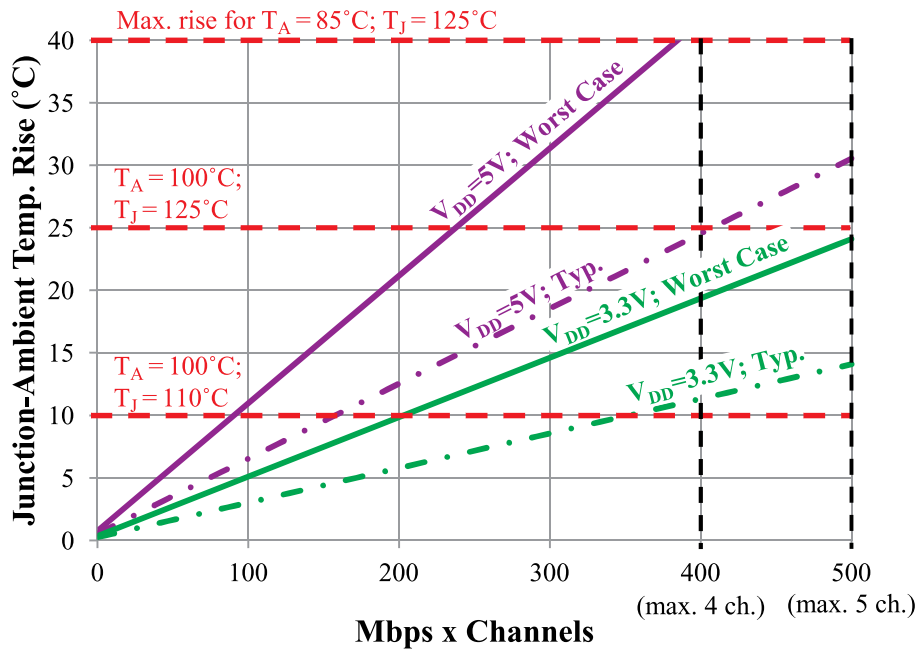


Fig. 3. IL200/IL700-Series Isolator derating curve
(SOIC-8, QSOP-16, narrow-body SOIC-16, or wide-body SOIC-16).

Conclusion—Heat Isn’t a Hot Issue With IsoLoops

In most applications thermal performance is not an issue. Standard-grade IL200/IL700-Series Isolators have a maximum junction temperature of 110°C. “T-Grade” parts have a maximum operating junction temperature of 125°C for additional margin at extreme operating conditions.

The IL200/IL700-Series Isolators were used for illustration. IL500-Series Isolators are similar, although quiescent currents are slightly higher because they have “refresh” circuitry. Digital-input isolated RS-485, RS-422, and CAN transceivers have higher quiescent currents from the transceiver functions. IL600-Series passive-input isolators and passive-input isolated transceivers have higher quiescent current but less dynamic power consumption because they are level sensitive, rather than edge sensitive.

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