

# Industrial-Temp Support vs. Screened-Industrial-Temp Support

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## Introduction

With the SSD industry moving away from 2D and toward 3D technology, 3D TLC NAND has become the choice for lower cost at higher capacity in the industrial applications. Unfortunately, for products requiring the industrial-temp support, cost may still be an issue. This paper discusses the differences between the true industrial-temp (I-temp) vs. the screened for I-temp (SI-temp) products.

In general, the typical operating temperatures defined by the storage and memory industry are as follow:

Commercial: 0°C to 70°C      Industrial: -40°C to 85°C

As defined in the datasheet, the temperature range specified will be supported. Therefore, if the product specifies its operating temperature range is -40°C to 85°C, it is guaranteed to support that industrial temperature range. There are two options for customers to acquire the industrial-temp support: screened for I-temp and true I-temp.

## Screened for I-temp (SI-temp)

For SLC and MLC products, NAND are screened and binned at the die level by manufacturers to find suitable products for I-temp use since C-temp and I-temp parts come from the same wafer and package design. SSD manufacturers have the option to purchase pre-binned NAND rated for I-temp or they can buy C-temp rated products, and then uprate and screen them for I-temp use themselves.

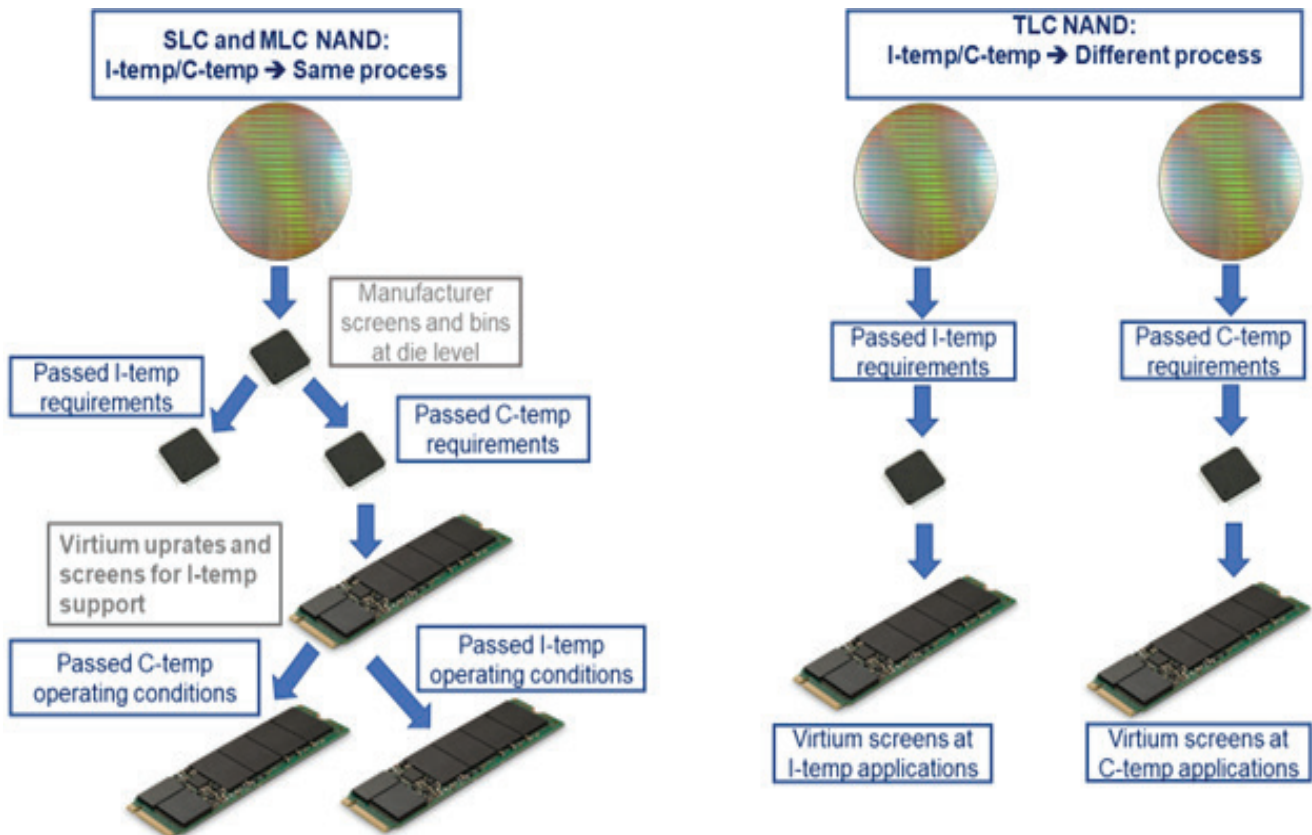
SLC and MLC NAND purchased by Virtium are uprated and screened by Virtium in the industrial temperature solution. By doing so, Virtium is able to offer customers SI-temp SSDs at a reduced cost. Virtium has verified that uprating and screening C-temp components at the system level is as effective as the I-temp components using NAND screened by the manufacturers in the industrial temperature applications. SSDs that do not pass the industrial testing requirements will be sold off as C-temp products after passing the qualifications at the commercial temperature level.

## True I-temp (I-temp)

With 3D TLC products, I-temp and C-temp die and package designs are different. NAND manufacturers currently offer NAND that has been designed for Industrial Temperature. Upgrading and screening C-temp rated NAND for I-temp support cannot be guaranteed because the NAND manufacturer is not able to do it. Therefore, OEMs that are interested in I-temp products must pay a premium.

These I-temp products have already been validated across the 125°C delta of -40°C to 85°C by the manufacturer, and screening at the industrial operating temperature is not required. However, Virtium continues to perform burn-in on all finished products at the industrial temperature range for all customers. One hundred percent production testing of the SSD at the specified temperature range provides a high level of assurance that will minimize the customer's risk of receiving units that may fail unexpectedly in the field. Virtium's process of screening out infant mortality resulted in the lowest defects per million in the industry.

The following diagram depicts the paths for obtaining I-temp support offered by Virtium.



The table below summarizes the comparisons among Virtium’s C-temp, SI-temp and I-temp SSDs.

	C-Temp	SI-Temp	I-Temp
Temp. Support Range	0°C to 70°C	-40°C to 85°C	-40°C to 85°C
Reliability Risk in Industrial Temp.	Not Suitable	SSD Manufacturer Guaranteed	NAND Manufacturer Guaranteed
2D NAND	SLC, MLC	MLC	N/A
3D NAND	MLC, TLC	MLC	TLC
Cost	C-temp < SI-temp < I-temp		

**Conclusion**

The 2D MLC technology will eventually fade out and be replaced by the 3D TLC. In the future, upgrading and screening 3D TLC will be offered by the NAND manufacturers. Until then, for customers interested in the industrial temperature range, the only option is buying the true I-temp by design.

Whether a product is screened for I-temp or true I-temp, Virtium has verified that both types can support and operate at the defined industrial temperature range of -40°C to 85°C.

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Virtium manufactures memory and storage solutions for the world's top industrial embedded OEMs. For two decades we have designed, built and supported our products in the USA - fortified by a network of global locations. Our world-class technology and unsurpassed support provide a superior customer experience that continuously results in better industrial embedded products for our increasingly interconnected world.

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