



AHV85311 NK PACKAGE: PROTECTIVE COATING GUIDELINES TO ACHIEVE REINFORCED ISOLATION AT 800 V DC BUS VOLTAGE

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INTRODUCTION

The Allegro AHV85311 is an isolated gate driver based on the Allegro Power-Thru technology. It integrates the AHV85003 and AHV85043 chipset with an isolation transformer inside the same module, available in the NK package.

The AHV85311 has an integrated isolated bias supply that achieves superior reliability with a simplified system design. Compared to discrete floating supply solutions designed for 400 V and 800 V DC bus applications—such as AI-data-center, electric-vehicle (EV), and industrial converters—the AHV85311 design requires significantly fewer external components.

Functional and basic isolation are supported by the AHV85311 NK package up to a working voltage of 1140 V rms or 1140 V DC.

For applications that require reinforced isolation, the maximum operational voltage across the insulation is 570 V rms or 570 V DC, limited by the creepage path of the device, per IEC 60664-1.

This application note describes a method to achieve reinforced isolation requirements in an 800 V system. The method uses a coating, potting compound, or encapsulant on the PCB-mounted component.

REQUIREMENTS OVERVIEW

When the device is mounted in a power converter, it must comply with relevant international standards, including:

- IEC 60664 (Insulation coordination for equipment within low-voltage supply systems) is mainly used as a reference for clearance and creepage distance calculation and verification at the system level.
- IEC 62477 (Safety requirements for power electronic converter systems and equipment) is also considered.

For an 800 V DC system specifically, per IEC 60664-1 Table F.5 “Creepage distances to avoid failure due to tracking” (2020 edition), the voltage sizing value required for the creepage-distance calculation is therefore 800 V; and, if reinforced isolation is required, the creepage-distance requirement is double the listed value.

Two additional factors influence the creepage distance: material group and pollution degree.

- The material group of an insulating material is defined according to the comparative tracking index (CTI), a characterization performed with a standard test that



Figure 1: AHV85311, NK Package

evaluates the tendency of the insulating material to form tracks when subjected to high voltage levels and contaminants. It affects the creepage-distance calculation.

- The Pollution Degree (PD) is defined as a numerical indication of the expected pollution in the microenvironment of the device. It also affects the creepage distance calculation.
 - Pollution Degree 2 (PD2)—where only nonconductive pollution occurs, except the temporary conductivity caused by occasional condensation as expected—is typically assumed for a power-converter board, in the absence of specific requirements stating otherwise.
 - Pollution Degree 1 (PD1)—where pollution is absent or only dry, nonconductive pollution occurs—can be achieved if specific protections are applied around the device to protect the microenvironment (e.g., coating, potting compound, or encapsulant).

For an 800 V DC system with basic isolation, the creepage requirements are:

- PD2, material group I: 4 mm
- PD2, material group II: 5.6 mm
- PD2, material group III: 8 mm
- PD1, all material groups: 2.4 mm

For an 800 V DC system with reinforced isolation, the creepage requirements are:

- PD2, material group I: 8 mm
- PD2, material group II: 11.2 mm
- PD2, material group III: 16 mm
- PD1, all material groups: 4.8 mm

In the preceding examples, only creepage is indicated. It is also important to consider that the creepage distance cannot be less than the clearance. This is especially important with PD1, where the required clearance distance might be comparable to the sizing value.

NOTE: Clearance is not calculated here because clearance depends on several requirements that might differ by final application (e.g., altitude or overvoltage category).

ISOLATION ON AHV85311 NK PACKAGE

At an 800 V DC bus voltage, IEC 60664-1 requires 16 mm of creepage distance for reinforced isolation across a material group III surface under PD2.

The NK package of the AHV85311 is composed of different materials with different CTI values:

- The lateral creepage path, which runs along the side of the package body (see Figure 2), is part of material group III and measures >11.4 mm. This greatly exceeds the basic isolation requirements for an 800 V DC system; however, it falls short of the 16 mm needed for reinforced isolation under PD2.
- A second path exists on the bottom side of the package, between adjacent exposed pins (see Figure 3). This pin-to-pin distance measures more than 8 mm. Because this path runs in material group I (top and bottom of the AHV85311 device package), it already satisfies the reinforced isolation creepage requirement at 800 V DC on its own.



Figure 2: AHV85311 NK Package (Side View) Showing Creepage Path in Material Group III (>11.4 mm)

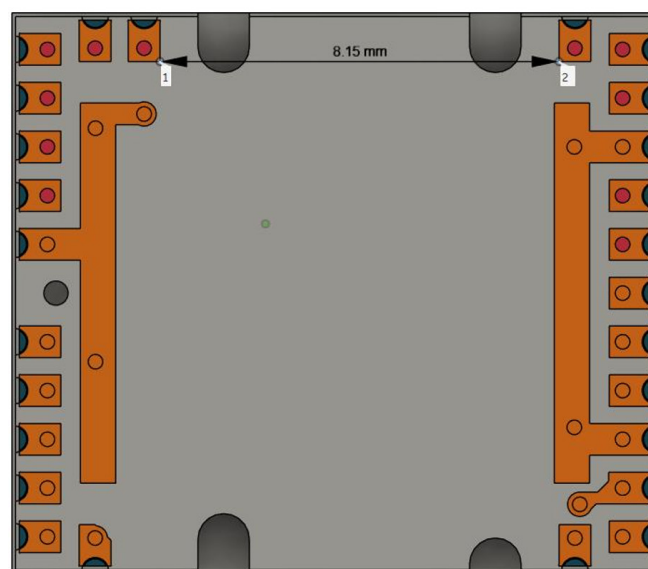


Figure 3: AHV85311 NK Package (Bottom View) Showing Creepage Path in Material Group I (> 8 mm)

The first creepage path in Figure 2 (material group III) limits the ability to achieve reinforced isolation in an 800 V DC system under PD2.

However, if the pollution degree can be changed, this limit can be changed:

- IEC 60664-3 (Part 3: Use of coating, potting or moulding for protection against pollution) specifically allows the required creepage distance for a given working voltage to be reduced by improving the local pollution degree of the micro-environment around the creepage path, from PD2 to PD1, through the use of a coating, potting compound, or encapsulant (referred to in the standard as Type 1 protection).
- IEC 62477-1 makes the same statement, allowing the use of protective coatings to reduce the pollution degree.

When a Type 1 protective coating is applied over the NK package and surrounding pads—including the conductive parts together with all the spacings between them—the applicable pollution degree for that path reduces from PD2 to PD1. Under PD1, the creepage requirement for reinforced isolation at 800 V DC on a material group III surface reduces to a level that the existing 11.4 mm physical path satisfies. This solution thereby recovers reinforced isolation compliance.

NOTE: The requirements mentioned here are relevant to the device body. The PCB footprint is not discussed because IEC 60664-1 gives dedicated requirements for printed wiring materials, and the minimum creepage distance on the PCB is not dependent on material group and is equal to the material group I requirement, 8 mm for 800 V reinforced isolation under PD2.

HOW TO APPLY PROTECTIVE COATING ON THE NK PACKAGE

To achieve reinforced isolation, a coating, potting compound, or encapsulant can be used to protect the microenvironment, according to the same standard requirements.

To apply a protective coating to the AHV85311 NK package:

1. Select the protective-coating material type to ensure full, unbroken coverage of the vertical sides as described in Step 2 and shown in Figure 4 and Figure 5.
 - This method requires the protective coating to meet the coverage and integrity requirements of IEC 60664-3 Type 1 protection.
2. Apply the material over the entire NK package.
 - Ensure full, unbroken coverage of the top and lateral sides (see Figure 4 and Figure 5).
 - Avoid bubble formation: An open void in the material re-exposes the path to the PD associated with the uncoated component.
 - Selective (robotic) dispensing or dip coating are preferred over manual methods, because both give more repeatable, void-free coverage.
3. On the surrounding PCB, extend the protective coating to provide full coverage of the pads together with the adjacent solder mask.
 - Ensure full, unbroken coverage.
 - Avoid bubble formation.
4. Verify the post-application material thickness satisfies requirements specified in the datasheet provided by the coating manufacturer.
 - If applicable, perform this verification according to material type.
5. Confirm that coverage of the area is complete and void-free.
 - For formulations with a UV-fluorescent tracer, inspect the cured coating under UV light.
 - For all other formulations, inspect the cured coating under magnification.
 - NOTE: To ensure that the applied material meets the coverage and integrity requirements, Allegro recommends that customers validate the applied material with the tests indicated in IEC 60664-3.
6. Validate coverage of the area with an inspection step during manufacturing.
 - The pollution-degree benefit described in this note depends on consistent achievement of coverage in production, not only on a qualification sample.

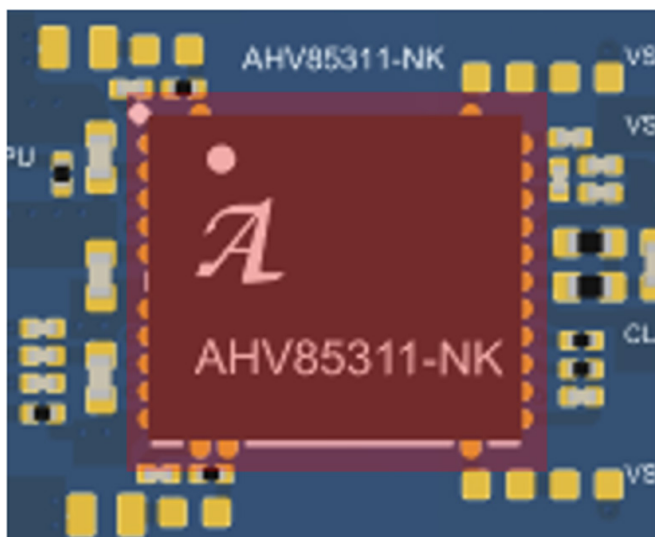


Figure 4: Minimum Coverage Area, Including Pins and Pads—Top View (Top) and Side View (Bottom)



Figure 5: Side View—Protective Material is Required to Provide Complete, Unbroken Coverage of Top and Lateral Sides

CONCLUSION

The AHV85311 NK package meets the IEC 60664-1 creepage requirements for basic and functional isolation at 800 V DC, but its lateral path in material group III is shorter than the distance required for reinforced isolation under PD2. However, application of a coating, potting compound, or encapsulant (per IEC 60664-3 Type 1 protection), reduces the effective pollution degree to PD1 and thereby recovers the margin needed to fulfil reinforced isolation at 800 V DC.

This application note has identified the limiting creepage path and has provided protective coating application guidelines for the NK package.

Revision History

Number	Date	Description	Responsibility
–	September 24, 2026	Initial release to the Allegro website	D. Cairolì

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