



YASKAWA

Protective Enclosures for Yaskawa AC Drives Application Note



1 Protective Enclosures for Yaskawa AC Drives

Yaskawa is capable of packaging Yaskawa drive products into a variety of enclosure types designed to protect electrical components from a variety of environmental conditions and to protect the user from electrical shock. Many Yaskawa enclosures are designed specifically for Yaskawa drive products to provide a cost-effective, efficient method of protection from the most common industrial and commercial environments. Yaskawa also utilizes standard commercially available enclosures.

The Yaskawa facility in Oak Creek, WI has an environmental testing lab which provides a facility to perform water and dust ingress testing along with ambient temperature testing for UL and IEC certification of enclosures. This environmental testing lab provides for efficient and cost effective testing compared to more costly use of independent labs.

Degrees of protection for electrical enclosures are defined by several standards organizations including NEMA, CSA, UL, and IEC. Unfortunately, not all standards organizations define and test the same way. The result is lack of harmonization between standards. Criteria related to allowable ingress of particle size, angle, and pressure of water source may differ between standards. Some standards organizations have attempted to harmonize testing requirements, such as NEMA and UL. However even NEMA and UL tests differ slightly, as UL tends to include more safety requirements in the testing criteria.

◆ Protected Chassis Enclosure

The Protected Chassis Enclosure is available as a factory standard for most AC drive products. However, the Protected Chassis Enclosure is not typical for applications in much of the U.S.A. This design provides limited electrical shock protection and should be mounted inside a customer-provided enclosure.

◆ NEMA 1 Enclosure

NEMA 1 protection is designed for indoor applications and provides protection against contact with live electrical components and a limited amount of falling dirt.

Most Yaskawa AC drive products sold in the U.S.A are supplied as factory standard with NEMA 1 enclosures. Larger horsepower product is provided with Protected Chassis as standard, with an available NEMA 1 kit to convert the Protected Chassis into a NEMA 1 Enclosure. The kit includes a top cover to prevent dirt and dust from falling into the drive and a ventilated cage mounted to the bottom where electrical connections are made to make the drive touch-proof.

Yaskawa offers a NEMA 1 configured enclosure where the drive and options are installed together within a single enclosure. Options may include circuit breakers, fuses, disconnects and bypass components among others. The enclosure uses ventilation slots for cooling.

◆ NEMA 3R

NEMA 3R Yaskawa-configured enclosures are designed for outdoor applications and provide protection against falling rain and sleet, and prevent damage from the formation of ice on the enclosure. Rain hoods are provided over ventilation holes with screens to prevent rain and insects from entering the cabinet. The Yaskawa enclosure also includes filters to provide some protection from ingress of dust and dirt, which is not a requirement to meet NEMA or UL specifications.

Yaskawa uses 1-2 gauge thicker sheet metal than most of the commercially available NEMA 3R enclosures, which provides a stronger, more rigid cabinet.

◆ NEMA 12 (forced ventilated, fans, and filters) FVFF

NEMA 12 FVFF is designed for indoor applications and provides limited protection against dust, falling dirt, and dripping noncorrosive liquids.

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Due to the need to keep the enclosure size small and still offer reasonable protection from dirt and dust, VFD manufacturers developed an enclosure that has been favorably accepted in the marketplace that falls between NEMA 1 and NEMA 12. Yaskawa identifies it as NEMA 12 FVFF (force ventilated, fans, and filters) and it carries a UL type 1 designation. The cabinet includes gasketed doors, ventilation slots covered with filter media, and cooling fans to provide air to cool the drive.

◆ NEMA 12

NEMA 12 is designed for indoor applications and provides a degree of protection against circulating dust, falling dirt, and noncorrosive liquids.

Yaskawa typically supplies commercially available NEMA 12 enclosures when specified. Yaskawa also provides an enclosure for the F7 Series drive for wall mounting, that carries UL Type 12 rating. Yaskawa is continually developing enclosures that meet UL Type 12 for Yaskawa A1000, P1000 and Z1000 series drives.

◆ NEMA 4/4X

NEMA 4 is designed for both indoor and outdoor applications and provides a degree of protection against falling rain, splashing and hose-directed water, and damage from ice formation. NEMA 4X also provides protection against corrosion.

Yaskawa offers a factory standard NEMA 4X design for V1000 series drives for indoor use only. All other drive products will typically require a commercially available cabinet to meet NEMA 4X specifications. The V1000 uses a coated steel cabinet for NEMA 4X. Commercially purchased NEMA 4X enclosures are typically stainless steel and NEMA 4 is typically standard steel construction.

◆ Auxiliary Cooling Devices

Yaskawa has experience with other cabinet cooling techniques as well. Air conditioning, air-to-air and air-to-water heat exchangers are available in NEMA 12, NEMA 3R, NEMA 4, and NEMA 4X and provide a solution where space is a premium or ambient temperature is higher than normal. Contact the factory if the application warrants this type of solution.

See [Table 1](#) for details for each type of enclosure available. Each organization's designation is provided along with its respective enclosure protective rating.

Table 1 Yaskawa America Inc., Common Enclosures for AC Drives

Standards Organization	Protected Chassis	NEMA 1	NEMA 3R	NEMA 12 FVFF	NEMA 12	NEMA 4	NEMA 4X
IEC	IP00	IP21	IP32	IP41	IP54	IP66	IP66
UL		Type 1	Type 3R	Type 1	Type 12	Type 4	Type 4X
Cabinet designed by	YAI	YAI	YAI	YAI	Purchased*	Purchased	Purchased**
Product	Cubes	Cubes/ Configured	Configured	Configured	Configured	Configured	Cubes**/ Configured
Intended environment	Indoor	Indoor	Outdoor	Indoor	Indoor	Indoor/Outdoor	Indoor/Outdoor
Protection		Protection against contact and limited amount of falling dirt.	Protection against falling rain, sleet, and damage by the formation of ice on the enclosure.	Limited protection against dust, falling dirt, and dripping noncorrosive liquids.	Degree of protection against circulating dust, falling dirt, and noncorrosive liquids.	Degree of protection against falling rain, splashing and hose-directed water, and damage from ice formation.	Provides same protection as NEMA 4 enclosures, plus protection against corrosion.

* F7 Configurable 230 V up to 40 Hp HD, 460V up to 75 Hp HD designed by YAI.

** V1000 NEMA 4X designed by YAI for indoor use only.

Cubes are factory standard designs.

Configured relates to Oak Creek "Value Add" product.

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YASKAWA AMERICA, INC.

In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

Specifications are subject to change without notice for ongoing product modifications and improvements.

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