PowerXL DX1 Series VFD Effective August 2024

Installation manual

EATON
Powering Business Worldwide

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Cover Photo: Eaton PowerXL DX1 Series Drive

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Table of contents

Table of contents, continued

Table of contents, continued

List of figures

List of figures, continued

List of tables

List of tables, continued

Safety

Read this manual thoroughly and make sure you understand the procedures before you attempt to install, set up, operate, or carry out any maintenance work on this PowerXL DX1 Variable Frequency Drive.

Before commencing the installation

- Disconnect the power supply of the device
- Ensure that devices cannot be accidentally restarted
- Verify isolation from the supply
- Earth and short circuit the device
- Cover or enclose any adjacent live components
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system
- Before installation and before touching the device ensure that you are free of electrostatic charge
- The functional earth (FE, PES) must be connected to the protective earth (PE) or the potential equalization. The system installer is responsible for implementing this connection
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automation functions
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation
- Suitable safety hardware and software measures should be implemented for the I/O interface so that an open circuit on the signal side does not result in undefined states in the automation devices
- Ensure a reliable electrical isolation of the extra-low voltage of the 24 V supply; only use power supply units complying with IEC 60364-4-41 (VDE 0100 Part 410) or HD384.4.41 S2; power supply shall have a maximum 60 Vdc fault limit according to SELV/PELV
- Deviations of the input voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause a restart
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed and with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings

⚠ DANGER

Dangerous electrical voltage!

- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented
- Wherever faults in the automation system may cause injury or material damage, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks, and so on)
- Depending on their degree of protection, adjustable frequency drives may contain live bright metal parts, moving or rotating components, or hot surfaces during and immediately after operation
- Removal of the required covers, improper installation, or incorrect operation of motor or adjustable frequency drive may cause the failure of the device and may lead to serious injury or damage
- The applicable national accident prevention and safety regulations apply to all work carried out on live adjustable frequency drives
- The electrical installation must be carried out in accordance with the relevant regulations (for example, with regard to cable cross sections, fuses, PE)
- Transport, installation, commissioning, and maintenance work must be carried out only by qualified personnel (IEC 60364, HD 384 and national occupational safety regulations)
- Installations containing adjustable frequency drives must be provided with additional monitoring and protective devices in accordance with the applicable safety regulations. Modifications to the adjustable frequency drives using the operating software are permitted
- All covers and doors must be kept closed during operation
- To reduce hazards for people or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or failure of the drive (increased motor speed or sudden standstill of motor). These measures include:
  a. Other independent devices for monitoring safety-related variables (speed, travel, end positions, and so on)
  b. Electrical or non-electrical system-wide measures (electrical or mechanical interlocks)
- Never touch live parts or cable connections of the adjustable frequency drive after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be live after disconnection. Fit appropriate warning signs

Definitions and symbols

⚠ DANGER

This symbol indicates high voltage. It calls your attention to items or operations that could be dangerous to you and other persons operating this equipment. Read the message and follow the instructions carefully.

⚠

This symbol is the "Safety Alert Symbol." It occurs with either of two signal words: CAUTION or WARNING, as described below.

⚠ WARNING

Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

⚠ CAUTION

Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the product. The situation described in the CAUTION may, if not avoided, lead to serious results. Important safety measures are described in CAUTION (as well as WARNING).

Hazardous high voltage

⚠ DANGER

Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock.

- **Stand on an insulating pad and make it a habit to use only one hand when checking components**
- **Always work with another person in case an emergency occurs**
- **Disconnect power before checking controllers or performing maintenance**
- **Be sure equipment is properly earthed**
- **Wear safety glasses whenever working on electronic controllers or rotating machinery**

⚠ DANGER

The components in the drive's power section remain energized after the supply voltage has been switched off. After disconnecting the supply, wait at least five minutes before removing the cover to allow the intermediate circuit capacitors to discharge.

Pay attention to hazard warnings!

⚠

Danger
5 min

⚠ DANGER

Electric shock hazard—risk of injuries! Carry out wiring work only if the unit is de-energized.

⚠ DANGER

Do not perform any modifications on the AC drive when it is connected to mains.

Warnings and cautions

⚠ WARNING

Be sure to ground the unit following the instructions in this manual. Ungrounded units may cause electric shock and/or fire.

⚠ WARNING

This equipment should only be installed, adjusted, and serviced by qualified electrical maintenance personnel familiar with the construction and operation of this type of equipment and the hazards involved. Failure to observe this precaution could result in death or severe injury.

⚠ WARNING

Components within the drive are live when it is connected to power. Contact with this voltage is extremely dangerous and may cause death or severe injury.

⚠ WARNING

Line terminals (L1, L2, L3), motor terminals (U, V, W) and the DC link/ brake resistor terminals (DC–, DC+/R+, R–) are live when the drive is connected to power, even if the motor is not running. Contact with this voltage is extremely dangerous and may cause death or severe injury.

⚠ WARNING

Even though the control I/O-terminals are isolated from line voltage, the relay outputs and other I/O-terminals may have dangerous voltage present even when the drive is disconnected from power. Contact with this voltage is extremely dangerous and may cause death or severe injury.

EMC warning and cautions

⚠ WARNING

This equipment has a large capacitive leakage current during operation, which can cause enclosure parts to be above ground potential. Proper grounding, as described in this manual, is required. Failure to observe this precaution could result in death or severe injury.

⚠ WARNING

Before applying power to this drive, make sure that the front and cable covers are closed and fastened to prevent exposure to potential electrical fault conditions. Failure to observe this precaution could result in death or severe injury.

⚠ WARNING

An upstream disconnect/protective device must be provided as required by the National Electrical Code® (NEC®). Failure to follow this precaution may result in death or severe injury.

⚠ WARNING

This drive can cause a DC current in the protective earthing conductor. Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in case of direct or indirect contact, only an RCD or RCM of Type B is allowed on the supply side of this product.

⚠ WARNING

Carry out wiring work only after the drive has been correctly mounted and secured.

⚠ WARNING

Before opening the drive covers:

- Disconnect all power to the drive, including external control power that may be present
- Wait a minimum of five minutes after all the lights on the keypad are off. This allows time for the DC bus capacitors to discharge
- A hazard voltage may still remain in the DC bus capacitors even if the power has been turned off. Confirm that the capacitors have fully discharged by measuring their voltage using a multimeter set to measure the DC voltage

Failure to follow these precautions may cause death or severe injury.

⚠ WARNING

- This type of PDS is not intended to be used on a low-voltage public network that supplies residential premises
- Radio frequency interference is expected if used on such a network
- The device has been evaluated to meet general RF exposure requirement. The device can be used in mobile/portable exposure condition without restrictions

⚠ WARNING

In a residential environment, this product may cause radio interference, in which case supplementary mitigation measures may be required.

⚠ CAUTION

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, includng interference that may cause undesired operation.

⚠ WARNING

The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electric shock, current-carrying parts and other components of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.

⚠ WARNING

Operation of this equipment requires detailed installation and operation instructions provided in the Installation/Operation manual intended for use with this product. It should be retained with this device at all times. A hard copy of this information may be ordered from literature fulfillment.

⚠ WARNING

Before servicing the drive:

- Disconnect all power to the drive, including external control power that may be present
- Place a “DO NOT TURN ON” label on the disconnect device
- Lock the disconnect device in the open position

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

The drive outputs (U, V, W) must not be connected to the input voltage or the utility line power as severe damage to the device may occur and there may be a risk of fire.

⚠ WARNING

The heat sink and/or outer enclosure may reach a high temperature.

Pay attention to hazard warnings!

Hot Surface—Risk of Burn. Do not touch!

⚠ WARNING

In a domestic environment, this product may cause radio interference, in which case supplementary mitigation measures may be required.

⚠ CAUTION

Any electrical or mechanical modification to this drive without prior written consent of manufacturer will void all warranties and may result in a safety hazard in addition and voiding of the UL® listing.

⚠ CAUTION

Install this drive on flame-resistant material such as a steel plate to reduce the risk of fire.

⚠ CAUTION

Install this drive on a perpendicular surface that is able to support the weight of the drive and is not subject to vibration, to lessen the risk of the drive falling and being damaged and/or causing personal injury.

⚠ CAUTION

Prevent foreign material such as wire clippings or metal shavings from entering the drive enclosure, as this may cause arcing damage and fire.

⚠ CAUTION

Install this drive in a well-ventilated room that is not subject to temperature extremes, high humidity, or condensation, and avoid locations that are directly exposed to sunlight, or have high concentrations of dust, corrosive gas, explosive gas, inflammable gas, grinding fluid mist, etc. Improper installation may result in a fire hazard.

⚠ CAUTION

When selecting the cable cross-section, take the voltage drop under load conditions into account. The consideration of other standards is the responsibility of the user.

The user is responsible for compliance with all international and national electrical standards in force concerning protective grounding of all equipment.

⚠ CAUTION

The specified minimum PE conductor cross-sections in this manual must be maintained.

Touch current in this equipment exceeds 3.5 mA (AC). The minimum size of the protective earthing conductor shall comply with the requirements of EN 61800-5-1 and/or the local safety regulations.

⚠ CAUTION

Touch currents in this frequency inverter are greater than 3.5 mA (AC). According to product standard IEC/EN 61800-5-1, an additional equipment grounding conductor of the same cross-sectional area as the original protective earthing conductor must be connected, or the cross-section of the equipment grounding conductor must be at least 10 mm^2 Cu. Drive requires that only copper conductor should be used.

⚠ CAUTION

Debounced inputs may not be used in the safety circuit diagram. Residual current circuit breakers (RCD) are only to be installed between the AC power supply network and the drive.

⚠ CAUTION

Debounced inputs may not be used in the safety circuit diagram. If you are connecting multiple motors on one drive, you must design the contactors for the individual motors according to utilization category AC-3.

Selecting the motor contactor is done according to the rated operational current of the motor to be connected.

⚠ CAUTION

Debounced inputs may not be used in the safety circuit diagram. A changeover between the drive and the input supply must take place in a voltage-free state.

⚠ CAUTION

Debounced inputs may not be used in the safety circuit diagram. Fire hazard!

Only use cables, protective switches, and contactors that feature the indicated permissible nominal current value.

⚠ CAUTION

Before connecting the drive to AC mains, make sure that the EMC protection class settings of the drive are appropriately made according to instructions in this manual.

⚠ CAUTION

Before connecting the drive to AC mains, make sure that the EMC protection class settings of the drive are appropriately made according to instructions in this manual.

- **If the drive is to be used in a floating distribution network, remove screws at MOV and EMC. See "Installation in Corner-Grounded Network" on Page 56 and "Installation in IT System" on Page 56 respectively**
- **Disconnect the internal EMC filter when installing the drive on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohm] power system), otherwise the system will be connected to ground potential through the EMC filter capacitors. This may cause danger, or damage the drive**
- **Disconnect the internal EMC filter when installing the drive on a corner grounded TN system, otherwise the drive will be damaged**

⚠ CAUTION

When the internal EMC filter is disconnected, the drive might not be EMC compatible.

- **Do not attempt to install or remove the MOV or EMC screws while power is applied to the drive's input terminals**

Motor and equipment safety

⚠ CAUTION

Do not perform any meggar or voltage withstand tests on any part of the drive or its components. Improper testing may result in damage.

⚠ CAUTION

Prior to any tests or measurements of the motor or the motor cable, disconnect the motor cable at the drive output terminals (U, V, W) to avoid damaging the drive during motor or cable testing.

⚠ CAUTION

Do not touch any components on the circuit boards. Static voltage discharge may damage the components.

⚠ CAUTION

Before starting the motor, check that the motor is mounted properly and aligned with the driven equipment. Ensure that starting the motor will not cause personal injury or damage equipment connected to the motor.

⚠ CAUTION

Set the maximum motor speed (frequency) in the drive according to the requirements of the motor and the equipment connected to it. Incorrect maximum frequency settings can cause motor or equipment damage and personal injury.

⚠ CAUTION

Before reversing the motor rotation direction, ensure that this will not cause personal injury or equipment damage.

⚠ CAUTION

Make sure that no power correction capacitors are connected to the drive output or the motor terminals to prevent drive malfunction and potential damage.

⚠ CAUTION

Make sure that the drive output terminals (U, V, W) are not connected to the utility line power as severe damage to the drive may occur.

⚠ CAUTION

When the control terminals of two or more drive units are connected in parallel, the auxiliary voltage for these control connections must be taken from a single source which can either be one of the units or an external supply.

⚠ CAUTION

The drive will start up automatically after an input voltage interruption if the external run command is on.

⚠ CAUTION

Do not control the motor with the disconnecting device (disconnecting means); instead, use the control panel start and stop keys and, or commands via the I/O board of the drive. The maximum allowed number of charging cycles of the DC capacitors (i.e. power-ups by applying power) is five in ten minutes.

⚠ CAUTION

Improper drive operation:

- **If the drive is not turned on for a long period, the performance of its electrolytic capacitors will be reduced**
- **If it is stopped for a prolonged period, turn the drive on at least every six months for at least 5 hours to restore the performance of the capacitors, and then check its operation. It is recommended that the drive is not connected directly to the line voltage. The voltage should be increased gradually using an adjustable AC source**

Failure to follow these instructions can result in injury and/or equipment damage.

⚠ CAUTION

The device has been evaluated to meet general RF exposure requirement. The device can be used in mobile/portable exposure condition without restrictions.

For more technical information, contact the factory or your local sales representative.

Sécurité

Lisez attentivement ce manuel et assurez-vous de bien comprendre les procédures avant d'essayer d'installer, de configurer, d'utiliser ou d'effectuer des travaux de maintenance sur ce variateur de fréquence PowerXL DX1.

Avant de commencer l'installation

- Débrancher l'alimentation de l'appareil
- S'assurer que les dispositifs ne peuvent pas être accidentellement redémarrés
- Vérifier l'isolement de l'alimentation
- Mettre l'appareil à la terre et le protéger contre les courts-circuits
- Couvrir ou enfermer tout composant sous tension adjacent
- Seul le personnel qualifié conformément à la norme EN 50110-1/-2 (VDE 0105 Partie 100) peut travailler sur cet appareil/ce système
- Avant l'installation et avant de toucher l'appareil, s'assurer de ne porter aucune charge électrostatique
- La terre fonctionnelle (FE, PSE) doit être raccordée à la terre de protection (PE) ou la compensation de potentiel. L'installateur du système a la responsabilité d'assurer cette connexion
- Les câbles de connexion et les lignes de signal doivent être installés de façon à ce que les interférences capacitives ou inductives ne compromettent pas les fonctions d'automatisation
- Installer les appareils d'automatisation et les éléments de fonctionnement associés de manière à ce qu'ils soient bien protégés contre tout fonctionnement accidentel
- Des dispositifs de sécurité matériels et logiciels appropriés doivent être utilisés en rapport avec l'interface des E/S afin qu'un circuit ouvert sur le côté signal ne résulte pas en états indéfinis dans les dispositifs d'automatisation
- Assurer une isolation électrique fiable sur le côté tension extra basse de l'alimentation 24 V. Utiliser uniquement des blocs d'alimentation conformes à la norme CEI 60364-4-41 (VDE 0100, partie 410) ou HD384.4.41 S2
- Les écarts entre la tension d'entrée et la tension nominale ne doivent pas dépasser les limites de tolérance indiquées dans les spécifications, au risque de provoquer un mauvais fonctionnement et une utilisation dangereuse du système
- Les dispositifs d'arrêt d'urgence conformes à la norme CEI/EN 60204-1 doivent être efficace dans tous les modes de fonctionnement des dispositifs d'automatisation. Le déverrouillage des dispositifs d'arrêt d'urgence ne doit pas entraîner un redémarrage

⚠ DANGER

Tension électrique dangereuse !

-
- Les dispositifs conçus pour un montage dans des boîtiers ou armoires de commande ne doivent être utilisés et contrôlés qu'après avoir été installés et avec le boîtier fermé. Les unités de bureau ou portatives ne doivent être utilisées et contrôlées que dans leurs boîtiers fermés
- Des mesures doivent être prises pour assurer un bon redémarrage des programmes interrompus après une chute ou une panne de tension. Ceci ne doit pas causer des états de fonctionnement dangereux, même pour un court laps de temps. Si nécessaire, des dispositifs d'arrêt d'urgence doivent être utilisés
- Quand des défaillances du système d'automatisation peuvent entraîner des blessures ou des dommages matériels, des mesures externes doivent être appliquées pour assurer un état de fonctionnement sans danger en cas de panne ou de mauvais fonctionnement (par exemple au moyen de disjoncteurs séparés, de verrouillages mécaniques, etc.)
- En fonction de leur degré de protection, les entraînements à fréquence variable peuvent contenir des pièces métalliques sous tension, des composants rotatifs ou en mouvement et des surfaces brûlantes, pendant le fonctionnement et immédiatement après l'arrêt
- Le retrait des protections requises, une installation incorrecte ou un mauvais fonctionnement du moteur ou de l'entraînement à fréquence variable peuvent causer la défaillance de l'appareil et entraîner des blessures graves et des dommages importants
- La réglementation nationale applicable en matière de sécurité et de prévention des accidents s'applique à tous les travaux effectués sur les entraînements à fréquence variable sous tension
- L'installation électrique doit être effectuée conformément aux réglementations applicables (par exemple, en ce qui concerne les sections transversales des câbles, les fusibles, la mise à la terre de protection)
- Le transport, l'installation, la mise en service et les travaux de maintenance doivent être effectués uniquement par un personnel qualifié (IEC 60364, HD 384 et règles de sécurité du travail)
- Les installations contenant des entraînements à fréquence variable doivent être équipées de dispositifs de surveillance et de protection, conformément aux réglementations applicables en matière de sécurité. Les modifications des entraînements à fréquence variable réalisées à l'aide du logiciel d'exploitation sont autorisées
- Toutes les protections et les portes doivent être maintenues fermées pendant le fonctionnement

- Pour réduire les risques d'accidents et de dommages matériels, l'utilisateur doit inclure dans la conception de la machine des mesures limitant les conséquences de panne ou de mauvais fonctionnement de l'entraînement (augmentation de la vitesse ou arrêt soudain du moteur). Ces mesures comprennent:

  a. Autres dispositifs indépendants de surveillance des variables en rapport avec la sécurité (vitesse, voyages, positions d'extrémité, etc.)

  b. Mesures électriques ou non électriques appliquées à l'ensemble du système (verrouillages électriques ou mécaniques)

- Ne jamais toucher les pièces sous tension ni les connexions des câbles de l'entraînement à fréquence variable après leur déconnexion de l'alimentation. En raison de la charge dans les condensateurs, ces pièces peuvent être encore sous tension après la déconnexion. Installer les panneaux d'avertissement appropriés.

Lire ce manuel en entier et s'assurer de bien comprendre les procédures avant de tenter d'installer, de configurer, d'utiliser et d'effectuer tout travail d'entretien sur cet entraînement à fréquence variable PowerXL DX1.

Définitions et symboles

⚠ DANGER

(Ce symbole indique une haute tension. Il attire l'attention sur les éléments ou les opérations qui pourraient être dangereux pour les personnes utilisant cet équipement. Lire attentivement le message et suivre attentivement les instructions.

⚠

Ce symbole est le « symbole d'alerte de sécurité ». Il accompagne les deux termes d'avertissement suivants : MISE EN GARDE ou AVERTISSEMENT, comme décrit ci-dessous.

⚠ AVERTISSEMENT

Indique une situation potentiellement dangereuse qui, si elle n'est pas évitée, peut entraîner des blessures graves ou la mort.

⚠ MISE EN GARDE

Indique une situation potentiellement dangereuse qui, si elle n'est pas évitée, peut entraîner des blessures légères à modérées et d'importants dégâts matériels. La situation décrite dans la MISE EN GARDE peut, si elle n'est pas évitée, entraîner des conséquences graves. Des mesures de sécurité importantes sont décrites dans les MISES EN GARDE (ainsi que dans les AVERTISSEMENTS).

Haute tension dangereuse

⚠ DANGER

L'équipement de contrôle du moteur et les contrôleurs électroniques sont branchés sur des tensions secteur dangereuses. Lors de l'entretien des entraînements et des contrôleurs électroniques, il peut y avoir des composants exposés avec des boîtiers ou des protubérances au niveau du potentiel du réseau ou au-dessus. Toutes les précautions doivent être prises pour se protéger contre les chocs électriques.

- **Se tenir sur un tapis isolant et prendre l'habitude de n'utiliser qu'une seule main pour vérifier les composants**
- **Toujours travailler avec une autre personne lorsqu'une situation d'urgence se produit**
- **Débrancher l'alimentation avant de vérifier les contrôleurs ou d'effectuer des travaux d'entretien**
- **S'assurer que l'équipement est correctement relié à la terre**
- **Porter des lunettes de sécurité lors des travaux sur les contrôleurs électroniques ou les machines rotatives**

⚠ DANGER

Les composants de la section d'alimentation de l'entraînement restent sous tension après la coupure de la tension d'alimentation. Après la déconnexion de l'alimentation, attendre au moins cinq minutes avant de retirer le couvercle pour permettre la décharge des condensateurs du circuit intermédiaire.

Prêter attention aux avertissements signalant des dangers !

⚠

Danger
5 min

⚠ DANGER

Risque de choc électrique - risque de blessures ! Effectuer le câblage uniquement si l'unité n'est plus sous tension.

⚠ DANGER

Ne pas effectuer de modifications sur l'entraînement CA lorsqu'il est connecté à l'alimentation secteur.

Avertissements et mises en garde

⚠ AVERTISSEMENT

S'assurer de mettre l'appareil à la terre en suivant les instructions de ce manuel. Les unités non mises à la terre peuvent causer des chocs électriques et des incendies.

⚠ AVERTISSEMENT

Cet équipement ne doit être installé, réglé et entretenu que par un personnel d'entretien électrique qualifié connaissant la construction et le fonctionnement de ce type d'équipement, ainsi que les risques encourus. Le non-respect de cette précaution peut entraîner la mort ou des blessures graves.

⚠ AVERTISSEMENT

Les composants à l'intérieur de l'entraînement sont sous tension lorsque l'entraînement est branché à l'alimentation. Le contact avec cette tension est extrêmement dangereux et peut causer la mort ou des blessures graves.

⚠ AVERTISSEMENT

Les bornes de phase (L1, L2, L3), les bornes du moteur (U, V, W) et les bornes de résistance de liaison CC/frein (DC-, DC+ /R+, R-) sont sous tension lorsque l'entraînement est branché à l'alimentation, même si le moteur ne tourne pas. Le contact avec cette tension est extrêmement dangereux et peut causer la mort ou des blessures graves.

⚠ AVERTISSEMENT

Même si les bornes E/S de commande sont isolées de la tension secteur, les sorties de relais et les autres bornes E/S peuvent présenter une tension dangereuse même lorsque l'entraînement est débranché. Le contact avec cette tension est extrêmement dangereux et peut causer la mort ou des blessures graves.

⚠ AVERTISSEMENT

Cet équipement a un grand courant de fuite capacitif pendant le fonctionnement, ce qui peut mettre les pièces du boîtier à un niveau supérieur au potentiel de terre. Une mise à la terre appropriée, telle que décrite dans ce manuel, est nécessaire. Le non-respect de cette précaution peut entraîner la mort ou des blessures graves.

⚠ AVERTISSEMENT

Avant de mettre l'entraînement sous tension, s'assurer que les protections avant et des câbles sont fermées et attachées pour empêcher l'exposition à d'éventuelles défaillances électriques. Le non-respect de cette précaution peut entraîner la mort ou des blessures graves.

⚠ AVERTISSEMENT

Un dispositif de protection/déconnexion en amont doit être fourni, tel que requis par le code électrique national (NEC®). Le non-respect de cette précaution peut entraîner la mort ou des blessures graves.

⚠ AVERTISSEMENT

Cet entraînement peut causer un courant CC dans le conducteur de mise à la terre de protection. Lorsqu'un dispositif de protection ou de surveillance à courant résiduel est utilisé pour la protection en cas de contact direct ou indirect, seul un dispositif de type B est autorisé sur le côté alimentation de ce produit.

⚠ AVERTISSEMENT

Ne travailler sur le câblage qu'après que l'entraînement a été correctement monté et attaché.

⚠ AVERTISSEMENT

Avant d'ouvrir les couvercles de l'entraînement :

- Débrancher toute l'alimentation allant à l'entraînement, y compris l'alimentation de commande externe pouvant être présente
- Attendre un minimum de cinq minutes après l'extinction de tous les voyants du clavier. Cela permet aux condensateurs de bus CC de se décharger
- Une tension dangereuse peut rester dans les condensateurs de bus CC même si l'alimentation a été coupée. Confirmer que les condensateurs sont entièrement déchargés en mesurant la tension à l'aide d'un multimètre réglé pour mesurer la tension CC

Le non-respect de cette précaution peut entraîner la mort ou des blessures graves.

⚠ AVERTISSEMENT

- Ce type de PDS (= Power Drive System) n'est pas destiné à être utilisé sur un réseau public basse tension alimentant des locaux d'habitation.
- Des interférences radioélectriques sont attendues si elles sont utilisées sur ce type de réseau.
- L'appareil a été évalué pour répondre aux exigences générales d'exposition aux RF. L'appareil peut être utilisé dans des conditions d'exposition mobiles/portables sans restrictions.

⚠ AVERTISSEMENT

Dans un environnement résidentiel, ce produit peut provoquer des interférences radio, et des mesures d'atténuation complémentaires peuvent être nécessaires.

⚠ MISE EN GARDE

Cet appareil est conforme à la partie 15 des règles FCC. Son fonctionnement est soumis aux deux conditions suivantes : (1) Cet appareil ne doit pas provoquer d'interférences nuisibles, et (2) cet appareil doit accepter toute interférence reçue, y compris les interférences susceptibles de provoquer un fonctionnement non souhaité.

⚠ AVERTISSEMENT

L'ouverture du dispositif de protection du circuit de dérivation peut indiquer que le courant de défaut a été interrompu. Pour réduire le risque d'incendie ou de choc électrique, les pièces porteuses de courant et les autres composants du contrôleur doivent être examinés et remplacés s'ils sont endommagés. Si l'élément de courant d'un relais de surcharge a grillé, le relais de surcharge doit être intégralement remplacé.

⚠ AVERTISSEMENT

Le fonctionnement de cet équipement nécessite le respect des instructions d'installation et de fonctionnement détaillées fournies dans le manuel d'installation/de fonctionnement destiné à être utilisé avec ce produit. Ce support doit être conservé avec cet appareil à tout moment.

⚠ AVERTISSEMENT

Avant de procéder à l'entretien de l'entraînement :

- **Débrancher toute l'alimentation allant à l'entraînement, y compris l'alimentation de commande externe pouvant être présente**
- **Placer une étiquette « NE PAS UTILISER » sur le dispositif de déconnexion**
- **Verrouiller le dispositif de déconnexion en position ouverte**

Le non-respect de ces instructions peut entraîner la mort ou des blessures graves.

⚠ AVERTISSEMENT

Les sorties de l'entraînement (U, V, W) ne doivent pas être connectées à la tension d'entrée ni à l'alimentation secteur, car ceci pourrait gravement endommager l'appareil et causer un incendie.

⚠ AVERTISSEMENT

Le dissipateur de chaleur et/ou le boîtier externe peuvent atteindre une température élevée.

Prêter attention aux avertissements signalant des dangers !

Surface brûlante - Risque de brûlure. NE PAS TOUCHER !!

⚠ MISE EN GARDE

Toute modification électrique ou mécanique de cet entraînement sans consentement écrit préalable annule toutes les garanties, peut entraîner un danger pour la sécurité et annuler l'homologation UL®.

⚠ MISE EN GARDE

Installer cet entraînement sur une matière résistante aux flammes, telle qu'une plaque d'acier, pour réduire les risques d'incendie.

⚠ MISE EN GARDE

Installer cet entraînement sur une surface perpendiculaire capable de supporter le poids de l'entraînement et non soumise à des vibrations afin de diminuer les risques de chute et de dommage de l'entraînement, ainsi que les risques de blessures.

⚠ MISE EN GARDE

Empêcher la pénétration de corps étrangers, tels que morceaux de fils et copeaux métalliques, dans le boîtier de l'entraînement, car ceci pourrait provoquer la formation d'un arc électrique et un incendie.

⚠ MISE EN GARDE

Installer cet entraînement dans une pièce bien aérée non soumise à des températures extrêmes, à une forte humidité ou à la condensation. Éviter les endroits directement exposés au soleil ou présentant de fortes concentrations de poussières, des gaz corrosifs, des gaz explosifs, des gaz inflammables, ou des vapeurs de liquide de meulage, etc. Une installation inadéquate peut entraîner un risque d'incendie.

⚠ MISE EN GARDE

Lors de la sélection de la section transversale des câbles, prendre en compte la chute de tension dans des conditions de charge. La prise en compte d'autres paramètres relève de la responsabilité de l'utilisateur.

Il relève de la responsabilité de l'utilisateur de respecter toutes les normes électriques nationales et internationales en vigueur concernant la mise à la terre de protection de l'ensemble de l'équipement.

⚠ MISE EN GARDE

Les spécifications minimum relatives aux sections transversales des conducteurs de terre de protection indiquées dans ce manuel doivent être respectées.

Le courant de fuite de cet équipement dépasse 3,5 mA (CA). La taille minimum du conducteur de la mise à la terre de protection doit être conforme aux exigences de la norme EN 61800-5-1 et/ou aux réglementations de sécurité locales.

⚠ MISE EN GARDE

Les courants de fuite de ce convertisseur de fréquence sont supérieures à 3,5 mA (CA). Conformément à la norme CEI/EN 61800-5-1, un conducteur de mise à la terre de l'équipement supplémentaire possédant la même superficie de coupe transversale que le conducteur de mise à la terre de protection d'origine doit être branché, ou la section transversale du conducteur de mise à la terre de l'équipement doit être d'au moins 10 mm² Cu. Seul un conducteur en cuivre doit être utilisé avec cet entraînement.

⚠ MISE EN GARDE

Les entrées anti-rebond ne sont pas permises dans le schéma du circuit de sécurité. Des disjoncteurs de courant résiduel (RCD) ne peuvent être installés qu'entre le réseau de courant alternatif et l'entraînement.

⚠ MISE EN GARDE

Les entrées anti-rebond ne sont pas permises dans le schéma du circuit de sécurité. Des disjoncteurs de courant résiduel (RCD) ne peuvent être installés qu'entre le réseau de courant alternatif et l'entraînement.

⚠ MISE EN GARDE

Les entrées anti-rebond ne sont pas permises dans le schéma du circuit de sécurité. Si plusieurs moteurs sont connectés à un entraînement, des contacteurs doivent être conçus pour les moteurs individuels conformément à la catégorie d'utilisation AC-3.

Sélectionner du contacteur du moteur en fonction du courant de fonctionnement nominal du moteur à connecter.

⚠ MISE EN GARDE

Les entrées anti-rebond ne sont pas permises dans le schéma du circuit de sécurité. Une commutation entre l'entraînement et l'alimentation d'entrée doit avoir lieu dans un état sans tension.

⚠ MISE EN GARDE

Les entrées anti-rebond ne sont pas permises dans le schéma du circuit de sécurité. Risque d'incendie !

Utiliser uniquement des câbles, des interrupteurs de protection et des contacteurs indiquant le courant nominal permis.

⚠ MISE EN GARDE

Avant de connecter l'entraînement à l'alimentation secteur CA, s'assurer que les réglages de la classe de protection CEM sont correctement effectués selon les instructions de ce manuel.

- **Si l'entraînement doit être utilisé dans un réseau de distribution flottant, retirer les vis au niveau des VOM et CEM. Voir « Installation dans un réseau à une phase connectée à la terre (corner-grounded) » à la Page 56 et « Installation dans un réseau IT » à la Page 56 respectivement**
- **Débrancher le filtre CEM interne lors de l'installation de l'entraînement sur un réseau IT (système d'alimentation non mis à la terre ou système d'alimentation électrique mis à la terre haute résistance [plus de 30 ohms]) pour ne pas que le système soit connecté au potentiel de terre via les condensateurs du filtre CEM. Ceci peut être une cause de dangers ou endommager l'entraînement**
- **Débrancher le filtre CEM interne lors de l'installation de l'entraînement sur un système TN à une phase connectée à la terre pour ne pas endommager l'entraînement**
  Remarque: Lorsque le filtre CEM interne est débranché, l'entraînement peut ne pas être conforme aux normes de compatibilité électromagnétique.
- **Ne pas tenter d'installer ou de retirer les vis des VOM et CEM lorsque l'alimentation est appliquée aux bornes d'entrée de l'entraînement.**

Sécurité du moteur et de l'équipement

⚠ MISE EN GARDE

N'effectuer aucun test de résistance de tension ou au mégohmmètre sur toute partie de l'entraînement ou de ses composants. Un test inadéquat peut entraîner des dommages.

⚠ MISE EN GARDE

Avant tout test ou mesure du moteur ou du câble du moteur, débrancher le câble du moteur au niveau des bornes de sortie de l'entraînement (U, V, W) pour éviter d'endommager ce dernier lors des tests.

⚠ MISE EN GARDE

Ne toucher aucun composant sur les cartes de circuit. Les décharges d'électricité statique peuvent endommager les composants.

⚠ MISE EN GARDE

Avant de mettre le moteur en marche, vérifier qu'il est correctement monté et aligné avec l'équipement entraîné. S'assurer que le démarrage du moteur ne risque pas de provoquer des blessures ou d'endommager l'équipement connecté au moteur.

⚠ MISE EN GARDE

Régler la vitesse maximale du moteur (fréquence) dans l'entraînement conformément aux exigences du moteur et de l'équipement qui lui est connecté. Des réglages de fréquence maximum incorrects peuvent endommager le moteur ou l'équipement et causer des blessures.

⚠ MISE EN GARDE

Avant d'inverser le sens de rotation du moteur, veiller à ce que cela ne risque pas de provoquer des blessures ou des dommages matériels.

⚠ MISE EN GARDE

S'assurer qu'aucun condensateur de correction de puissance n'est connecté à la sortie de l'entraînement ou aux bornes du moteur pour éviter un mauvais fonctionnement de l'entraînement et des dommages potentiels.

⚠ MISE EN GARDE

S'assurer que les bornes de sortie de l'entraînement (U, V, W) ne sont pas connectées à l'alimentation secteur, ce qui pourrait causer de graves dommages à l'entraînement.

⚠ MISE EN GARDE

Lorsque les bornes de commande de deux ou plusieurs unités d'entraînement sont raccordées en parallèle, la tension auxiliaire de ces connexions de commande doit être fournie par une source unique, qui peut être soit l'une des unités, soit une alimentation externe.

⚠ MISE EN GARDE

L'entraînement démarre automatiquement après une interruption de la tension d'entrée si la commande de démarrage externe est active.

⚠ MISE EN GARDE

Ne pas commander le moteur avec le dispositif de déconnexion ; à la place, utiliser les touches de marche et d'arrêt du tableau de contrôle ou les commandes du tableau des E/S de l'entraînement. Le nombre de cycles de charge maximum permis des condensateurs CC (c'est-à-dire les mises sous tension par application de puissance) est de cinq en dix minutes.

⚠ MISE EN GARDE

Fonctionnement incorrect de l'entraînement :

- **Si l'entraînement n'est pas mis en marche pendant une longue période, la performance de ses condensateurs électrolytiques sera réduite**
- **S'il est arrêté pour une période prolongée, le mettre en marche au moins tous les six mois pendant au moins 5 heures pour restaurer la performance des condensateurs, puis vérifier son fonctionnement. Il est recommandé de ne pas brancher l'entraînement directement sur la tension secteur. La tension doit être augmentée progressivement en utilisant une source CA réglable**

Le non-respect de ces instructions peut entraîner des blessures ou des dégâts matériels.

⚠ MISE EN GARDE

L'appareil a été évalué pour répondre aux exigences générales d'exposition aux radio fréquences. L'appareil peut être utilisé dans des conditions d'exposition mobiles/portables sans restrictions.

Pour plus d'informations techniques, contacter l'usine ou le représentant commercial local.

Chapter 1—PowerXL DX1 Series overview

This chapter describes the purpose and contents of this manual, the receiving inspection recommendations and the PowerXL DX1 Series Open Drive catalog numbering system.

How to use this manual

The purpose of this manual is to provide you with information necessary to install, set and customize parameters, start up, troubleshoot and maintain the PowerXL DX1 Series Variable Frequency Drive (VFD). To provide for safe installation and operation of the equipment, read the safety guidelines at the beginning of this manual and follow the procedures outlined in the following chapters before connecting power to the PowerXL DX1 Series VFD. Keep this operating manual handy and distribute to all users, technicians and maintenance personnel for reference.

Table 1. Common abbreviations

Abbreviation	Definition
CT	Constant torque with high overload rating (150%)
VT	Variable torque with low overload rating (110%)
I_H	High overload current (150%)
I_L	Low overload current (110%)
VFD	Variable Frequency Drive
RTC	Real Time Clock

Receiving and inspection

The PowerXL DX1 Series VFD has met a stringent series of factory quality requirements before shipment. It is possible that packaging or equipment damage may have occurred during shipment. After receiving your PowerXL DX1 Series VFD, please check for the following:

Check to make sure that the package includes the Instruction Leaflet, Quick Start Guide and accessory packet. The accessory packet includes:

- Rubber grommets
- Control cable grounding clamps
- Additional grounding screw

Inspect the unit to ensure it was not damaged during shipment.

Make sure that the part number indicated on the nameplate corresponds with the catalog number on your order.

If shipping damage has occurred, please contact and file a claim with the carrier involved immediately.

If the delivery does not correspond to your order, please contact your representative.

Real-time clock battery activation

To activate the real-time clock (RTC) functionality in the PowerXL DX1 Series VFD, the RTC battery (already mounted in the drive) must be enabled.

Figure 1. Battery connect

Step 1: Disassembly A cover.

Step 2: Open B cover.

Step 3: Remove the insulation.

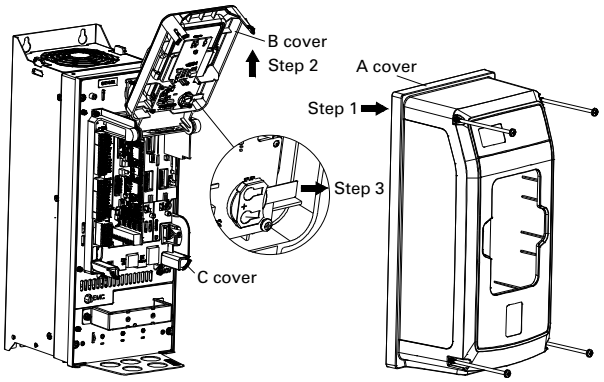


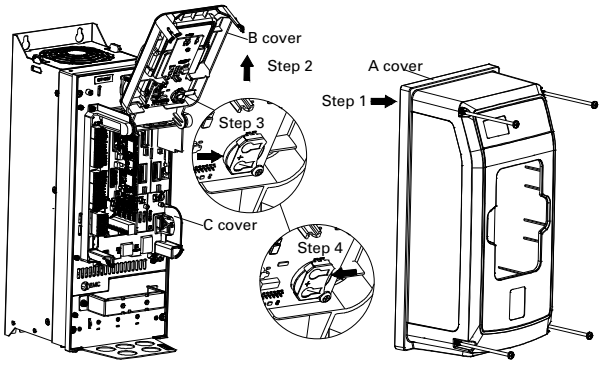
Figure 2. RTC battery replacement

Step 1: Disassembly A cover.

Step 2: Open B cover.

Step 3: Remove old battery.

Step 4: Install new battery.



Rating label

Figure 3. Rating labels—DX1

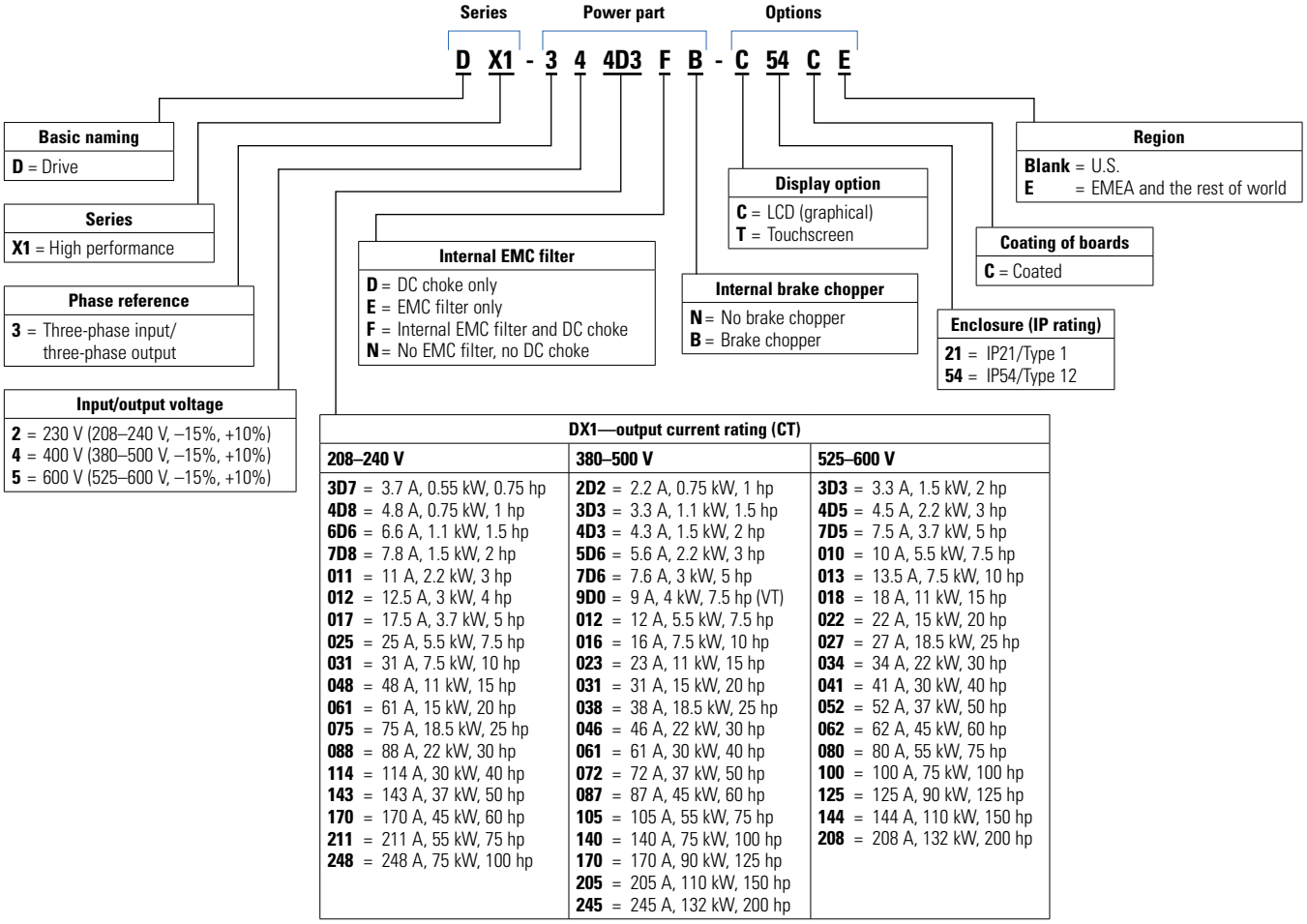
Carton labels (U.S. and Europe)

Figure 4. Carton labels—DX1

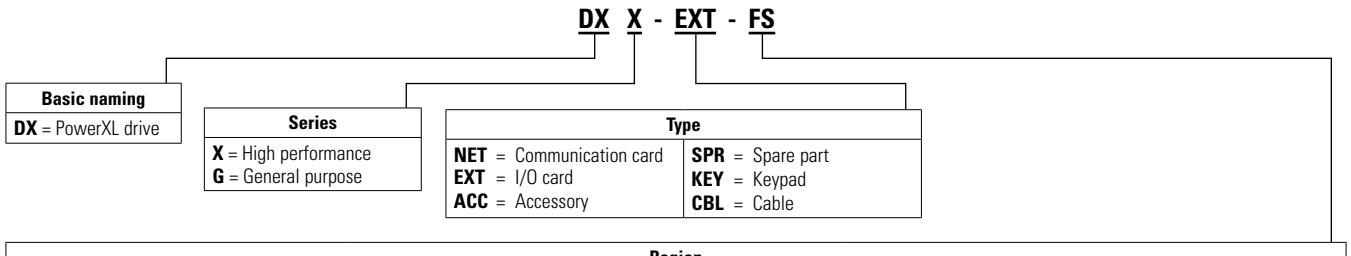
Catalog number system

Catalog number system is for illustrative purposes only and not to be used to create new catalog numbers.

Figure 5. Catalog numbering systems



DX1—output current rating (CT)		
208–240 V	**380–500 V**	**525–600 V**
3D7 = 3.7 A, 0.55 kW, 0.75 hp	**2D2** = 2.2 A, 0.75 kW, 1 hp	**3D3** = 3.3 A, 1.5 kW, 2 hp
4D8 = 4.8 A, 0.75 kW, 1 hp	**3D3** = 3.3 A, 1.1 kW, 1.5 hp	**4D5** = 4.5 A, 2.2 kW, 3 hp
6D6 = 6.6 A, 1.1 kW, 1.5 hp	**4D3** = 4.3 A, 1.5 kW, 2 hp	**7D5** = 7.5 A, 3.7 kW, 5 hp
7D8 = 7.8 A, 1.5 kW, 2 hp	**5D6** = 5.6 A, 2.2 kW, 3 hp	**010** = 10 A, 5.5 kW, 7.5 hp
011 = 11 A, 2.2 kW, 3 hp	**7D6** = 7.6 A, 3 kW, 5 hp	**013** = 13.5 A, 7.5 kW, 10 hp
012 = 12.5 A, 3 kW, 4 hp	**9D0** = 9 A, 4 kW, 7.5 hp (VT)	**018** = 18 A, 11 kW, 15 hp
017 = 17.5 A, 3.7 kW, 5 hp	**012** = 12 A, 5.5 kW, 7.5 hp	**022** = 22 A, 15 kW, 20 hp
025 = 25 A, 5.5 kW, 7.5 hp	**016** = 16 A, 7.5 kW, 10 hp	**027** = 27 A, 18.5 kW, 25 hp
031 = 31 A, 7.5 kW, 10 hp	**023** = 23 A, 11 kW, 15 hp	**034** = 34 A, 22 kW, 30 hp
048 = 48 A, 11 kW, 15 hp	**031** = 31 A, 15 kW, 20 hp	**041** = 41 A, 30 kW, 40 hp
061 = 61 A, 15 kW, 20 hp	**038** = 38 A, 18.5 kW, 25 hp	**052** = 52 A, 37 kW, 50 hp
075 = 75 A, 18.5 kW, 25 hp	**046** = 46 A, 22 kW, 30 hp	**062** = 62 A, 45 kW, 60 hp
088 = 88 A, 22 kW, 30 hp	**061** = 61 A, 30 kW, 40 hp	**080** = 80 A, 55 kW, 75 hp
114 = 114 A, 30 kW, 40 hp	**072** = 72 A, 37 kW, 50 hp	**100** = 100 A, 75 kW, 100 hp
143 = 143 A, 37 kW, 50 hp	**087** = 87 A, 45 kW, 60 hp	**125** = 125 A, 90 kW, 125 hp
170 = 170 A, 45 kW, 60 hp	**105** = 105 A, 55 kW, 75 hp	**144** = 144 A, 110 kW, 150 hp
211 = 211 A, 55 kW, 75 hp	**140** = 140 A, 75 kW, 100 hp	**208** = 208 A, 132 kW, 200 hp
248 = 248 A, 75 kW, 100 hp	**170** = 170 A, 90 kW, 125 hp	
	205 = 205 A, 110 kW, 150 hp	
	245 = 245 A, 132 kW, 200 hp	



Region		
FS = Functional safety card	**FBR10M** = 10 meters optical fiber cable	**FR1N12FK** = Frame 1 Flange Kit Type 12/IP54
ABZ = ABZ encoder card	**FBRKIT** = Optical fiber cable connector kit	**FR2N12FK** = Frame 2 Flange Kit Type 12/IP54
SABZ = Safe ABZ encoder card	**FSTB** = Functional safety card terminal block	**FR3N12FK** = Frame 3 Flange Kit Type 12/IP54
OF = Optical fiber card	**ABZTB** = ABZ encoder card terminal block	**FR4N12FK** = Frame 4 Flange Kit Type 12/IP54
EIP = Dual port EIP card	**SABZTB** = Safe ABZ encoder card terminal block	**FR5N12FK** = Frame 5 Flange Kit Type 12/IP54
PROFINET = Dual port ProfiNet card	**PCCABLE** = Serial programming kit	**FR6N12FK** = Frame 6 Flange Kit Type 12/IP54
RMTKIT = Keypad remote mounting kit	**3DI3DO1T** = 3 x DI, 3 x DO, 1 x thermistor, 24 Vdc/EXT option	**FR6N12FK-BP** = Frame 6 Flange Kit Type 12/IP54 Bulk Pack (12)
TS = Touch screen keypad kit	**1AI2AO** = 1 x AI, 2 x AO (isolated to control board) option	**FR2N12FK-BP** = Frame 2 Flange Kit Type 12/IP54 Bulk Pack (30)
LCD = Membrane switch keypad kit	**3RO** = 3 x relay dry contact (2NO + 1NO/NC) option card	**FR3N12FK-BP** = Frame 3 Flange Kit Type 12/IP54 Bulk Pack (30)
FBR1M = 1 meter optical fiber cable	**THER1** = 3 x PT100 RTD thermister input option card	**FR4N12FK-BP** = Frame 4 Flange Kit Type 12/IP54 Bulk Pack (25)
FBR5M = 5 meters optical fiber cable	**6DI** = 6 x DI 240 Vac input option card	**FR5N12FK-BP** = Frame 5 Flange Kit Type 12/IP54 Bulk Pack (20)
		FR6N12FK-BP = Frame 6 Flange Kit Type 12/IP54 Bulk Pack (12)

Power ratings and product selection

Table 2. FR1–FR6, 208–240 volt—IP21

Constant torque (CT)/high overload (I_H)				Variable torque (VT)/low overload (I_L)				
Frame size	**230 V, 50 Hz kW rating**	**230 V, 60 Hz hp**	**Current A**	**230 V, 50 Hz kW rating**	**230 V, 60 Hz hp**	**Current A**	**With LCD keypad**	**With touch screen**
FR1	0.55	0.75	3.7	0.75	1	4.8	**DX1-323D7FB-C21C**	**DX1-323D7FB-T21C**
	0.75	1	4.8	1.1	1.5	6.6	**DX1-324D8FB-C21C**	**DX1-324D8FB-T21C**
	1.1	1.5	6.6	1.5	2	7.8	**DX1-326D6FB-C21C**	**DX1-326D6FB-T21C**
	1.5	2	7.8	2.2	3	11	**DX1-327D8FB-C21C**	**DX1-327D8FB-T21C**
	2.2	3	11	2.2	3	12.5	**DX1-32011FB-C21C**	**DX1-32011FB-T21C**
FR2	3	3	12.5	3.7	5	17.5	**DX1-32012FB-C21C**	**DX1-32012FB-T21C**
		5	17.5	5.5	7.5	25	**DX1-32017FB-C21C**	**DX1-32017FB-T21C**
	5.5	7.5	25	7.5	10	31	**DX1-32025FB-C21C**	**DX1-32025FB-T21C**
FR3	7.5	10	31	11	15	48	**DX1-32031FB-C21C**	**DX1-32031FB-T21C**
	11	15	48	15	20	61	**DX1-32048FB-C21C**	**DX1-32048FB-T21C**
FR4	15	20	61	18.5	25	75	**DX1-32061FN-C21C**	**DX1-32061FN-T21C**
	15	20	61	18.5	25	75	**DX1-32061FB-C21C**	**DX1-32061FB-T21C**
	18.5	25	75	22	30	88	**DX1-32075FN-C21C**	**DX1-32075FN-T21C**
	18.5	25	75	22	30	88	**DX1-32075FB-C21C**	**DX1-32075FB-T21C**
	22	30	88	30	40	114	**DX1-32088FN-C21C**	**DX1-32088FN-T21C**
	22	30	88	30	40	114	**DX1-32088FB-C21C**	**DX1-32088FB-T21C**
FR5	30	40	114	37	50	143	**DX1-32114FN-C21C**	**DX1-32114FN-T21C**
	30	40	114	37	50	143	**DX1-32114FB-C21C**	**DX1-32114FB-T21C**
	37	50	143	45	60	170	**DX1-32143FN-C21C**	**DX1-32143FN-T21C**
	37	50	143	45	60	170	**DX1-32143FB-C21C**	**DX1-32143FB-T21C**
	45	60	170	55	75	211	**DX1-32170FN-C21C**	**DX1-32170FN-T21C**
	45	60	170	55	75	211	**DX1-32170FB-C21C**	**DX1-32170FB-T21C**
FR6	55	75	211	75	100	261	**DX1-32211FN-C21C**	**DX1-32211FN-T21C**
	55	75	211	75	100	261	**DX1-32211FB-C21C**	**DX1-32211FB-T21C**
	75	100	248	90	125	312	**DX1-32248FN-C21C**	**DX1-32248FN-T21C**
	75	100	248	90	125	312	**DX1-32248FB-C21C**	**DX1-32248FB-T21C**

Note: The same data is applicable for the EMEA and Rest of the World models (catalog numbers with an 'E' at the end)

Table 3. FR1–FR6, 208–240 volt—IP54

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)				
Frame size	**230 V, 50 Hz kW rating**	**230 V, 60 Hz hp**	**Current A**	**230 V, 50 Hz kW rating**	**230 V, 60 Hz hp**	**Current A**	**With LCD keypad**	**With touch screen**
FR1	0.55	0.75	3.7	0.75	1	4.8	**DX1-323D7FB-C54C**	**DX1-323D7FB-T54C**
	0.75	1	4.8	1.1	1.5	6.6	**DX1-324D8FB-C54C**	**DX1-324D8FB-T54C**
	1.1	1.5	6.6	1.5	2	7.8	**DX1-326D6FB-C54C**	**DX1-326D6FB-T54C**
	1.5	2	7.8	2.2	3	11	**DX1-327D8FB-C54C**	**DX1-327D8FB-T54C**
	2.2	3	11	2.2	3	12.5	**DX1-32011FB-C54C**	**DX1-32011FB-T54C**
FR2	3	3	12.5	3.7	5	17.5	**DX1-32012FB-C54C**	**DX1-32012FB-T54C**
	3	5	17.5	5.5	7.5	25	**DX1-32017FB-C54C**	**DX1-32017FB-T54C**
	5.5	7.5	25	7.5	10	31	**DX1-32025FB-C54C**	**DX1-32025FB-T54C**
FR3	7.5	10	31	11	15	48	**DX1-32031FB-C54C**	**DX1-32031FB-T54C**
	11	15	48	15	20	61	**DX1-32048FB-C54C**	**DX1-32048FB-T54C**
FR4	15	20	61	18.5	25	75	**DX1-32061FN-C54C**	**DX1-32061FN-T54C**
	15	20	61	18.5	25	75	**DX1-32061FB-C54C**	**DX1-32061FB-T54C**
	18.5	25	75	22	30	88	**DX1-32075FN-C54C**	**DX1-32075FN-T54C**
	18.5	25	75	22	30	88	**DX1-32075FB-C54C**	**DX1-32075FB-T54C**
	22	30	88	30	40	114	**DX1-32088FN-C54C**	**DX1-32088FN-T54C**
	22	30	88	30	40	114	**DX1-32088FB-C54C**	**DX1-32088FB-T54C**
FR5	30	40	114	37	50	143	**DX1-32114FN-C54C**	**DX1-32114FN-T54C**
	30	40	114	37	50	143	**DX1-32114FB-C54C**	**DX1-32114FB-T54C**
	37	50	143	45	60	170	**DX1-32143FN-C54C**	**DX1-32143FN-T54C**
	37	50	143	45	60	170	**DX1-32143FB-C54C**	**DX1-32143FB-T54C**
	45	60	170	55	75	211	**DX1-32170FN-C54C**	**DX1-32170FN-T54C**
	45	60	170	55	75	211	**DX1-32170FB-C54C**	**DX1-32170FB-T54C**
FR6	55	75	211	75	100	261	**DX1-32211FN-C54C**	**DX1-32211FN-T54C**
	55	75	211	75	100	261	**DX1-32211FB-C54C**	**DX1-32211FB-T54C**
	75	100	248	90	125	312	**DX1-32248FN-C54C**	**DX1-32248FN-T54C**
	75	100	248	90	125	312	**DX1-32248FB-C54C**	**DX1-32248FB-T54C**

Note: The same data is applicable for the EMEA and Rest of the World models (catalog numbers with an 'E' at the end)

Table 4. FR1–FR6, 380–500 volt—IP21

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)				
Frame size	**400 V, 50 Hz kW rating**	**460 V, 60 Hz hp**	**Current A**	**400 V, 50 Hz kW rating**	**460 V, 60 Hz hp**	**Current A**	**With LCD keypad**	**With touch screen**
FR1	0.75	1	2.2	1.1	1.5	3.3	**DX1-342D2FB-C21C**	**DX1-342D2FB-T21C**
	1.1	1.5	3.3	1.5	2	4.3	**DX1-343D3FB-C21C**	**DX1-343D3FB-T21C**
	1.5	2	4.3	2.2	3	5.6	**DX1-344D3FB-C21C**	**DX1-344D3FB-T21C**
	2.2	3	5.6	3.7	5	7.6	**DX1-345D6FB-C21C**	**DX1-345D6FB-T21C**
	3	5	7.6	3.7	5	9	**DX1-347D6FB-C21C**	**DX1-347D6FB-T21C**
	3	5	7.6	5.5	7.5	12	**DX1-349D0FB-C21C**	**DX1-349D0FB-T21C**
FR2	5.5	7.5	12	7.5	10	16	**DX1-34012FB-C21C**	**DX1-34012FB-T21C**
	7.5	10	16	11	15	23	**DX1-34016FB-C21C**	**DX1-34016FB-T21C**
	11	15	23	15	20	31	**DX1-34023FB-C21C**	**DX1-34023FB-T21C**
FR3	15	20	31	18.5	25	38	**DX1-34031FB-C21C**	**DX1-34031FB-T21C**
	18.5	25	38	22	30	46	**DX1-34038FB-C21C**	**DX1-34038FB-T21C**
	22	30	46	30	40	61	**DX1-34046FB-C21C**	**DX1-34046FB-T21C**
FR4	30	40	61	37	50	72	**DX1-34061FN-C21C**	**DX1-34061FN-T21C**
	30	40	61	37	50	72	**DX1-34061FB-C21C**	**DX1-34061FB-T21C**
	37	50	72	45	60	87	**DX1-34072FN-C21C**	**DX1-34072FN-T21C**
	37	50	72	45	60	87	**DX1-34072FB-C21C**	**DX1-34072FB-T21C**
	45	60	87	55	75	105	**DX1-34087FN-C21C**	**DX1-34087FN-T21C**
	45	60	87	55	75	105	**DX1-34087FB-C21C**	**DX1-34087FB-T21C**
FR5	55	75	105	75	100	140	**DX1-34105FN-C21C**	**DX1-34105FN-T21C**
	55	75	105	75	100	140	**DX1-34105FB-C21C**	**DX1-34105FB-T21C**
	75	100	140	90	125	170	**DX1-34140FN-C21C**	**DX1-34140FN-T21C**
	75	100	140	90	125	170	**DX1-34140FB-C21C**	**DX1-34140FB-T21C**
	90	125	170	110	150	205	**DX1-34170FN-C21C**	**DX1-34170FN-T21C**
	90	125	170	110	150	205	**DX1-34170FB-C21C**	**DX1-34170FB-T21C**
FR6	110	150	205	132	200	261	**DX1-34205FN-C21C**	**DX1-34205FN-T21C**
	110	150	205	132	200	261	**DX1-34205FB-C21C**	**DX1-34205FB-T21C**
	132	200	245	160	250	310	**DX1-34245FN-C21C**	**DX1-34245FN-T21C**
	132	200	245	160	250	310	**DX1-34245FB-C21C**	**DX1-34245FB-T21C**

Note: The same data is applicable for the EMEA and Rest of the World models (catalog numbers with an 'E' at the end)

Table 5. FR1–FR6, 380–500 volt—IP54

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)				
Frame size	**400 V, 50 Hz kW rating**	**460 V, 60 Hz hp**	**Current A**	**400 V, 50 Hz kW rating**	**460 V, 60 Hz hp**	**Current A**	**With LCD keypad**	**With touch screen**
FR1	0.75	1	2.2	1.1	1.5	3.3	**DX1-342D2FB-C54C**	**DX1-342D2FB-T54C**
	1.1	1.5	3.3	1.5	2	4.3	**DX1-343D3FB-C54C**	**DX1-343D3FB-T54C**
	1.5	2	4.3	2.2	3	5.6	**DX1-344D3FB-C54C**	**DX1-344D3FB-T54C**
	2.2	3	5.6	3.7	5	7.6	**DX1-345D6FB-C54C**	**DX1-345D6FB-T54C**
	3	5	7.6	3.7	5	9	**DX1-347D6FB-C54C**	**DX1-347D6FB-T54C**
	3	5	7.6	5.5	7.5	12	**DX1-349D0FB-C54C**	**DX1-349D0FB-T54C**
FR2	5.5	7.5	12	7.5	10	16	**DX1-34012FB-C54C**	**DX1-34012FB-T54C**
	7.5	10	16	11	15	23	**DX1-34016FB-C54C**	**DX1-34016FB-T54C**
	11	15	23	15	20	31	**DX1-34023FB-C54C**	**DX1-34023FB-T54C**
FR3	15	20	31	18.5	25	38	**DX1-34031FB-C54C**	**DX1-34031FB-T54C**
	18.5	25	38	22	30	46	**DX1-34038FB-C54C**	**DX1-34038FB-T54C**
	22	30	46	30	40	61	**DX1-34046FB-C54C**	**DX1-34046FB-T54C**
FR4	30	40	61	37	50	72	**DX1-34061FN-C54C**	**DX1-34061FN-T54C**
	30	40	61	37	50	72	**DX1-34061FB-C54C**	**DX1-34061FB-T54C**
	37	50	72	45	60	87	**DX1-34072FN-C54C**	**DX1-34072FN-T54C**
	37	50	72	45	60	87	**DX1-34072FB-C54C**	**DX1-34072FB-T54C**
	45	60	87	55	75	105	**DX1-34087FN-C54C**	**DX1-34087FN-T54C**
	45	60	87	55	75	105	**DX1-34087FB-C54C**	**DX1-34087FB-T54C**
FR5	55	75	105	75	100	140	**DX1-34105FN-C54C**	**DX1-34105FN-T54C**
	55	75	105	75	100	140	**DX1-34105FB-C54C**	**DX1-34105FB-T54C**
	75	100	140	90	125	170	**DX1-34140FN-C54C**	**DX1-34140FN-T54C**
	75	100	140	90	125	170	**DX1-34140FB-C54C**	**DX1-34140FB-T54C**
	90	125	170	110	150	205	**DX1-34170FN-C54C**	**DX1-34170FN-T54C**
	90	125	170	110	150	205	**DX1-34170FB-C54C**	**DX1-34170FB-T54C**
FR6	110	150	205	132	200	261	**DX1-34205FN-C54C**	**DX1-34205FN-T54C**
	110	150	205	132	200	261	**DX1-34205FB-C54C**	**DX1-34205FB-T54C**
	132	200	245	160	250	310	**DX1-34245FN-C54C**	**DX1-34245FN-T54C**
	132	200	245	160	250	310	**DX1-34245FB-C54C**	**DX1-34245FB-T54C**

Note: The same data is applicable for the EMEA and Rest of the World models (catalog numbers with an 'E' at the end)

Table 6. FR1–FR6, 600 volt—IP21

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)				
Frame size	**600 V, 50 Hz kW rating**	**600 V, 60 Hz hp**	**Current A**	**600 V, 50 Hz kW rating**	**600 V, 60 Hz hp**	**Current A**	**With LCD keypad**	**With touch screen**
FR1	1.5	2	3.3	2.2	3	4.5	**DX1-353D3FB-C21C**	**DX1-353D3FB-T21C**
	2.2	3	4.5	3.7	5	7.5	**DX1-354D5FB-C21C**	**DX1-354D5FB-T21C**
	3	5	7.5	5.5	7.5	10	**DX1-357D5FB-C21C**	**DX1-357D5FB-T21C**
FR2	5.5	7.5	10	7.5	10	13.5	**DX1-35010FB-C21C**	**DX1-35010FB-T21C**
	7.5	10	13.5	11	15	18	**DX1-35013FB-C21C**	**DX1-35013FB-T21C**
	11	15	18	15	20	22	**DX1-35018FB-C21C**	**DX1-35018FB-T21C**
FR3	15	20	22	18.5	25	27	**DX1-35022FB-C21C**	**DX1-35022FB-T21C**
	18.5	25	27	22	30	34	**DX1-35027FB-C21C**	**DX1-35027FB-T21C**
	22	30	34	30	40	41	**DX1-35034FB-C21C**	**DX1-35034FB-T21C**
FR4	30	40	41	37	50	52	**DX1-35041FN-C21C**	**DX1-35041FN-T21C**
	30	40	41	37	50	52	**DX1-35041FB-C21C**	**DX1-35041FB-T21C**
	37	50	52	45	60	62	**DX1-35052FN-C21C**	**DX1-35052FN-T21C**
	37	50	52	45	60	62	**DX1-35052FB-C21C**	**DX1-35052FB-T21C**
	45	60	62	55	75	80	**DX1-35062FN-C21C**	**DX1-35062FN-T21C**
	45	60	62	55	75	80	**DX1-35062FB-C21C**	**DX1-35062FB-T21C**
FR5	55	75	80	75	100	100	**DX1-35080FN-C21C**	**DX1-35080FN-T21C**
	55	75	80	75	100	100	**DX1-35080FB-C21C**	**DX1-35080FB-T21C**
	75	100	100	90	125	125	**DX1-35100FN-C21C**	**DX1-35100FN-T21C**
	75	100	100	90	125	125	**DX1-35100FB-C21C**	**DX1-35100FB-T21C**
	90	125	125	110	150	144	**DX1-35125FN-C21C**	**DX1-35125FN-T21C**
	90	125	125	110	150	144	**DX1-35125FB-C21C**	**DX1-35125FB-T21C**
FR6	110	150	144	132	200	208	**DX1-35144FN-C21C**	**DX1-35144FN-T21C**
	110	150	144	132	200	208	**DX1-35144FB-C21C**	**DX1-35144FB-T21C**
	132	200	208	160	250	250	**DX1-35208FN-C21C**	**DX1-35208FN-T21C**
	132	200	208	160	250	250	**DX1-35208FB-C21C**	**DX1-35208FB-T21C**

Note: The same data is applicable for the EMEA and Rest of the World models (catalog numbers with an 'E' at the end)

Table 7. FR1–FR6, 600 volt—IP54

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)				
Frame size	**600 V, 50 Hz kW rating**	**600 V, 60 Hz hp**	**Current A**	**600 V, 50 Hz kW rating**	**600 V, 60 Hz hp**	**Current A**	**With LCD keypad**	**With touch screen**
FR1	1.5	2	3.3	2.2	3	4.5	**DX1-353D3FB-C54C**	**DX1-353D3FB-T54C**
	2.2	3	4.5	3.7	5	7.5	**DX1-354D5FB-C54C**	**DX1-354D5FB-T54C**
	3	5	7.5	5.5	7.5	10	**DX1-357D5FB-C54C**	**DX1-357D5FB-T54C**
FR2	5.5	7.5	10	7.5	10	13.5	**DX1-35010FB-C54C**	**DX1-35010FB-T54C**
	7.5	10	13.5	11	15	18	**DX1-35013FB-C54C**	**DX1-35013FB-T54C**
	11	15	18	15	20	22	**DX1-35018FB-C54C**	**DX1-35018FB-T54C**
FR3	15	20	22	18.5	25	27	**DX1-35022FB-C54C**	**DX1-35022FB-T54C**
	18.5	25	27	22	30	34	**DX1-35027FB-C54C**	**DX1-35027FB-T54C**
	22	30	34	30	40	41	**DX1-35034FB-C54C**	**DX1-35034FB-T54C**
FR4	30	40	41	37	50	52	**DX1-35041FN-C54C**	**DX1-35041FN-T54C**
	30	40	41	37	50	52	**DX1-35041FB-C54C**	**DX1-35041FB-T54C**
	37	50	52	45	60	62	**DX1-35052FN-C54C**	**DX1-35052FN-T54C**
	37	50	52	45	60	62	**DX1-35052FB-C54C**	**DX1-35052FB-T54C**
	45	60	62	55	75	80	**DX1-35062FN-C54C**	**DX1-35062FN-T54C**
	45	60	62	55	75	80	**DX1-35062FB-C54C**	**DX1-35062FB-T54C**
FR5	55	75	80	75	100	100	**DX1-35080FN-C54C**	**DX1-35080FN-T54C**
	55	75	80	75	100	100	**DX1-35080FB-C54C**	**DX1-35080FB-T54C**
	75	100	100	90	125	125	**DX1-35100FN-C54C**	**DX1-35100FN-T54C**
	75	100	100	90	125	125	**DX1-35100FB-C54C**	**DX1-35100FB-T54C**
	90	125	125	110	150	144	**DX1-35125FN-C54C**	**DX1-35125FN-T54C**
	90	125	125	110	150	144	**DX1-35125FB-C54C**	**DX1-35125FB-T54C**
FR6	110	150	144	132	200	208	**DX1-35144FN-C54C**	**DX1-35144FN-T54C**
	110	150	144	132	200	208	**DX1-35144FB-C54C**	**DX1-35144FB-T54C**
	132	200	208	160	250	250	**DX1-35208FN-C54C**	**DX1-35208FN-T54C**
	132	200	208	160	250	250	**DX1-35208FB-C54C**	**DX1-35208FB-T54C**

Note: The same data is applicable for the EMEA and Rest of the World models (catalog numbers with an 'E' at the end)

DX1 replacement/option parts

Table 8. Common spares across all frames

Description	Catalog numbers All voltages (208–240 / 380–500 / 600)
PowerXL Series—DX1 encoder feedback card kits	
DX1 ABZ encoder card	**DXX-EXT-ABZ**
DX1 Safe ABZ encoder card	**DXX-EXT-SABZ**
DX1 ABZ encoder card terminal block	**DXX-ACC-ABZTB**
DX1 Safe ABZ encoder card terminal block	**DXX-ACC-SABZTB**
PowerXL Series—DX1 functional safety card kits	
DX1 functional safety card	**DXX-EXT-FS**
DX1 functional safety card terminal block	**DXX-ACC-FSTB**
PowerXL Series—DX1 communication card kits	
DX1 dual port EIP card	**DXX-NET-EIP**
DX1 dual port ProfiNet card	**DXX-NET-PROFINET**
DX1 serial programming kit	**DXX-CBL-PCCABLE**
PowerXL Series—DX1 optical fiber card kits	
DX1 optical fiber card	**DXX-EXT-OF**
DX1 1 meter optical fiber cable	**DXX-CBL-FBR1M**
DX1 5 meters optical fiber cable	**DXX-CBL-FBR5M**
DX1 10 meters optical fiber cable	**DXX-CBL-FBR10M**
DX1 optical fiber cable connector kit	**DXX-CBL-FBRKIT**
PowerXL Series—DX1 keypad kits	
DX1 touch screen keypad kit	**DXX-KEY-TS**
DX1 membrane switch keypad kit	**DXX-KEY-LCD**
DX1 keypad remote mounting kit	**DXX-KEY-RMTKIT**
PowerXL Series—DX1 IO option cards	
DX1 3 x DI, 3 x DO, 1 x thermistor, 24 Vdc/EXT option card	**DXX-EXT-3DI3DO1T**
DX1 1 x AI, 2 x AO (isolated to control board) option card	**DXX-EXT-1AI2AO**
DX1 3 x relay dry contact (2NO + 1NO/NC) option card	**DXX-EXT-3RO**
DX1 3 x PT100 RTD thermister input option card	**DXX-EXT-THER1**
DX1 6 x DI 240 Vac input option card	**DXX-EXT-6DI**
PowerXL Series—DX1 main control board kits	
DX1 control board screw type terminal blocks	**DXX-SPR-SCREWTB**
DX1 control board push-in type terminal blocks	**DXX-SPR-PUSHINTB**
DX1 main control board	**DXX-SPR-CTRLBOARD**

Table 9. Frame 1

	Catalog numbers		
Description	**208–240 volt**	**380–500 volt**	**600 volt**
DG1 Frame 1 flange kit Type 12/IP54	**DXG-ACC-FR1N12FK**	**DXG-ACC-FR1N12FK**	**DXG-ACC-FR1N12FK**
DG1 Frame 1 flange kit Type 12/IP54 bulk pack (40)	**DXG-ACC-FR1N12FK-BP**	**DXG-ACC-FR1N12FK-BP**	**DXG-ACC-FR1N12FK-BP**
DX1 230 V Frame 1 main power board (CT-3.7A, VT-4.8A)	**DXX-SPR-2FR1MPB-3D7**	—	—
DX1 230 V Frame 1 main power board (CT-4.8A, VT-6.6A)	**DXX-SPR-2FR1MPB-4D8**	—	—
DX1 230 V Frame 1 main power board (CT-6.6A, VT-7.8A)	**DXX-SPR-2FR1MPB-6D6**	—	—
DX1 230 V Frame 1 main power board (CT-7.8A, VT-11A)	**DXX-SPR-2FR1MPB-7D8**	—	—
DX1 230 V Frame 1 main power board (CT-11A, VT-12.5A)	**DXX-SPR-2FR1MPB-011**	—	—
DX1 480 V Frame 1 main power board (CT-2.2A, VT-3.3A)	—	**DXX-SPR-4FR1MPB-2D2**	—
DX1 480 V Frame 1 main power board (CT-3.3A, VT-4.6A)	—	**DXX-SPR-4FR1MPB-3D3**	—
DX1 480 V Frame 1 main power board (CT-4.3A, VT-5.6A)	—	**DXX-SPR-4FR1MPB-4D3**	—
DX1 480 V Frame 1 main power board (CT-5.6A, VT-7.6A)	—	**DXX-SPR-4FR1MPB-5D6**	—
DX1 480 V Frame 1 main power board (CT-7.6A, VT-9A)	—	**DXX-SPR-4FR1MPB-7D6**	—
DX1 480 V Frame 1 main power board (CT-9A, VT-12A)	—	**DXX-SPR-4FR1MPB-9D0**	—
DX1 575 V Frame 1 main power board (CT-3.3A, VT-4.5A)	—	—	**DXX-SPR-5FR1MPB-3D3**
DX1 575 V Frame 1 main power board (CT-4.5A, VT-7.5A)	—	—	**DXX-SPR-5FR1MPB-4D5**
DX1 575 V Frame 1 main power board (CT-7.5A, VT-10A)	—	—	**DXX-SPR-5FR1MPB-7D5**
DX1 Frame 1 EMI board	**DXG-SPR-2FR1EB**	**DXX-SPR-4FR1EB**	**DXG-SPR-5FR1EB**
DX1 Frame 1 control fan	**DXX-SPR-FR1CF**	**DXX-SPR-FR1CF**	**DXX-SPR-FR1CF**
DX1 Frame 1 main fan	**DXX-SPR-FR1FAN**	**DXX-SPR-FR1FAN**	**DXX-SPR-FR1FAN**
DX1 Frame 1 A-cover	**DXX-SPR-FR1CVR**	**DXX-SPR-FR1CVR**	**DXX-SPR-FR1CVR**
DX1 Frame 1 to Frame 4 B-cover	**DXX-SPR-BCOVER**	**DXX-SPR-BCOVER**	**DXX-SPR-BCOVER**
DX1 Frame 1 to Frame 4 C-cover	**DXX-SPR-CCOVER**	**DXX-SPR-CCOVER**	**DXX-SPR-CCOVER**
DX1 Frame 1 UL conduit plate	**DXX-SPR-FR1CPUL**	**DXX-SPR-FR1CPUL**	**DXX-SPR-FR1CPUL**
DX1 Frame 1 IEC conduit plate	**DXX-SPR-FR1CPIEC**	**DXX-SPR-FR1CPIEC**	**DXX-SPR-FR1CPIEC**
DX1 Frame 1 supplemental bag	**DXX-SPR-FR1SBAG**	**DXX-SPR-FR1SBAG**	**DXX-SPR-FR1SBAG**

Table 10. Frame 2

	Catalog numbers		
Description	**208–240 volt**	**380–500 volt**	**600 volt**
DG1 Frame 2 flange kit Type 12/IP54	**DXG-ACC-FR2N12FK**	**DXG-ACC-FR2N12FK**	**DXG-ACC-FR2N12FK**
DG1 Frame 2 flange kit Type 12/IP54 bulk pack (40)	**DXG-ACC-FR2N12FK-BP**	**DXG-ACC-FR2N12FK-BP**	**DXG-ACC-FR2N12FK-BP**
DX1 230 V Frame 2 main power board (CT-12.5A, VT-17.5A)	**DXX-SPR-2FR2MPB-012**	—	—
DX1 230 V Frame 2 main power board (CT-17.5A, VT-25A)	**DXX-SPR-2FR2MPB-017**	—	—
DX1 230 V Frame 2 main power board (CT-25A, VT-31A)	**DXX-SPR-2FR2MPB-025**	—	—
DX1 480 V Frame 2 main power board (CT-12A, VT-16A)	—	**DXX-SPR-4FR2MPB-012**	—
DX1 480 V Frame 2 main power board (CT-16A, VT-23A)	—	**DXX-SPR-4FR2MPB-016**	—
DX1 480 V Frame 2 main power board (CT-23A, VT-31A)	—	**DXX-SPR-4FR2MPB-023**	—
DX1 575 V Frame 2 main power board (CT-10A, VT-13.5A)	—	—	**DXX-SPR-5FR2MPB-010**
DX1 575 V Frame 2 main power board (CT-13.5A, VT-18A)	—	—	**DXX-SPR-5FR2MPB-013**
DX1 575 V Frame 2 main power board (CT-18A, VT-22A)	—	—	**DXX-SPR-5FR2MPB-018**
DX1 Frame 2 EMI board	**DXG-SPR-2FR2EB**	**DXX-SPR-4FR2EB**	**DXG-SPR-5FR2EB**
DX1 Frame 2 control fan	**DXX-SPR-FR2CF**	**DXX-SPR-FR2CF**	**DXX-SPR-FR2CF**
DX1 Frame 2 main fan	**DXX-SPR-FR2FAN**	**DXX-SPR-FR2FAN**	**DXX-SPR-FR2FAN**
DX1 Frame 2 A-cover	**DXX-SPR-FR2CVR**	**DXX-SPR-FR2CVR**	**DXX-SPR-FR2CVR**
DX1 Frame 1 to Frame 4 B-cover	**DXX-SPR-BCOVER**	**DXX-SPR-BCOVER**	**DXX-SPR-BCOVER**
DX1 Frame 1 to Frame 4 C-cover	**DXX-SPR-CCOVER**	**DXX-SPR-CCOVER**	**DXX-SPR-CCOVER**
DX1 Frame 2 UL conduit plate	**DXX-SPR-FR2CPUL**	**DXX-SPR-FR2CPUL**	**DXX-SPR-FR2CPUL**
DX1 Frame 2 IEC conduit plate	**DXX-SPR-FR2CPIEC**	**DXX-SPR-FR2CPIEC**	**DXX-SPR-FR2CPIEC**
DX1 Frame 2 supplemental bag	**DXX-SPR-FR2SBAG**	**DXX-SPR-FR2SBAG**	**DXX-SPR-FR2SBAG**

Table 11. Frame 3

Description	Catalog numbers		
	208–240 volt	380–500 volt	600 volt
DG1 Frame 3 flange kit Type 12/IP54	**DXG-ACC-FR3N12FK**	**DXG-ACC-FR3N12FK**	**DXG-ACC-FR3N12FK**
DG1 Frame 3 flange kit Type 12/IP54 bulk pack (40)	**DXG-ACC-FR3N12FK-BP**	**DXG-ACC-FR3N12FK-BP**	**DXG-ACC-FR3N12FK-BP**
DX1 230 V Frame 3 drive board (CT-31A, VT-48A)	**DXX-SPR-2FR3DB-031**	—	—
DX1 230 V Frame 3 drive board (CT-48A, VT-61A)	**DXX-SPR-2FR3DB-048**	—	—
DX1 480 V Frame 3 drive board (CT-31A, VT-38A)	—	**DXX-SPR-4FR3DB-031**	—
DX1 480 V Frame 3 drive board (CT-38A, VT-46A)	—	**DXX-SPR-4FR3DB-038**	—
DX1 480 V Frame 3 drive board (CT-46A, VT-61A)	—	**DXX-SPR-4FR3DB-046**	—
DX1 575 V Frame 3 drive board (CT-22A, VT-27A)	—	—	**DXX-SPR-5FR3DB-022**
DX1 575 V Frame 3 drive board (CT-27A, VT-34A)	—	—	**DXX-SPR-5FR3DB-027**
DX1 575 V Frame 3 drive board (CT-34A, VT-41A)	—	—	**DXX-SPR-5FR3DB-034**
DX1 Frame 3 EMI board	**DXG-SPR-2FR3EB**	**DXG-SPR-4FR3EB**	**DXG-SPR-5FR3EB**
DX1 Frame 3 control fan	**DXX-SPR-FR3CF**	**DXX-SPR-FR3CF**	**DXX-SPR-FR3CF**
DX1 Frame 3 main fan	**DXX-SPR-FR3FAN**	**DXX-SPR-FR3FAN**	**DXX-SPR-FR3FAN**
DX1 Frame 3 main fan module kit	**DXX-SPR-FR3FANKIT**	**DXX-SPR-FR3FANKIT**	**DXX-SPR-FR3FANKIT**
DX1 Frame 3 A-cover	**DXX-SPR-FR3CVR**	**DXX-SPR-FR3CVR**	**DXX-SPR-FR3CVR**
DX1 Frame 1 to Frame 4 B-cover	**DXX-SPR-BCOVER**	**DXX-SPR-BCOVER**	**DXX-SPR-BCOVER**
DX1 Frame 1 to Frame 4 C-cover	**DXX-SPR-CCOVER**	**DXX-SPR-CCOVER**	**DXX-SPR-CCOVER**
DX1 Frame 3 UL conduit plate	**DXX-SPR-FR3CPUL**	**DXX-SPR-FR3CPUL**	**DXX-SPR-FR3CPUL**
DX1 Frame 3 IEC conduit plate	**DXX-SPR-FR3CPIEC**	**DXX-SPR-FR3CPIEC**	**DXX-SPR-FR3CPIEC**
DX1 Frame 3 supplemental bag	**DXX-SPR-FR3SBAG**	**DXX-SPR-FR3SBAG**	**DXX-SPR-FR3SBAG**

Table 12. Frame 4

Description	Catalog numbers		
	208–240 volt	380–500 volt	600 volt
DG1 Frame 4 flange kit Type 12/IP54	**DXG-ACC-FR4N12FK**	**DXG-ACC-FR4N12FK**	**DXG-ACC-FR4N12FK**
DG1 Frame 4 flange kit Type 12/IP54 bulk pack (40)	**DXG-ACC-FR4N12FK-BP**	**DXG-ACC-FR4N12FK-BP**	**DXG-ACC-FR4N12FK-BP**
DX1 230 V Frame 4 main power board (CT-61A; VT- 75A)	**DXX-SPR-2FR4MPB-061**	—	—
DX1 230 V Frame 4 main power board (CT-75A; VT-88A)	**DXX-SPR-2FR4MPB-075**	—	—
DX1 230 V Frame 4 main power board (CT-88A; VT-114A)	**DXX-SPR-2FR4MPB-088**	—	—
DX1 480 V Frame 4 main power board (CT-61A, VT-72A)	—	**DXX-SPR-4FR4MPB-061**	—
DX1 480 V Frame 4 main power board (CT-72A, VT-87A)	—	**DXX-SPR-4FR4MPB-072**	—
DX1 480 V Frame 4 main power board (CT-87A, VT-105A)	—	**DXX-SPR-4FR4MPB-087**	—
DX1 575 V Frame 4 main power board (CT-41A, VT-52A)	—	—	**DXX-SPR-5FR4MPB-041**
DX1 575 V Frame 4 main power board (CT-52A, VT-62A)	—	—	**DXX-SPR-5FR4MPB-052**
DX1 575 V Frame 4 main power board (CT-62A, VT-80A)	—	—	**DXX-SPR-5FR4MPB-062**
DX1 Frame 4 EMI board	**DXX-SPR-2FR4EB**	**DXX-SPR-4FR4EB**	**DXX-SPR-5FR4EB**
DX1 Frame 4 control fan	**DXX-SPR-FR4CF**	**DXX-SPR-FR4CF**	**DXX-SPR-FR4CF**
DX1 Frame 4 main fan	**DXX-SPR-FR4FAN**	**DXX-SPR-FR4FAN**	**DXX-SPR-FR4FAN**
DX1 Frame 4 main fan module kit	**DXX-SPR-FR4FANKIT**	**DXX-SPR-FR4FANKIT**	**DXX-SPR-FR4FANKIT**
DX1 Frame 4 A-cover	**DXX-SPR-FR4CVR**	**DXX-SPR-FR4CVR**	**DXX-SPR-FR4CVR**
DX1 Frame 1 to Frame 4 B-cover	**DXX-SPR-BCOVER**	**DXX-SPR-BCOVER**	**DXX-SPR-BCOVER**
DX1 Frame 1 to Frame 4 C-cover	**DXX-SPR-CCOVER**	**DXX-SPR-CCOVER**	**DXX-SPR-CCOVER**
DX1 Frame 4 UL conduit plate	**DXX-SPR-FR4CPUL**	**DXX-SPR-FR4CPUL**	**DXX-SPR-FR4CPUL**
DX1 Frame 4 IEC conduit plate	**DXX-SPR-FR4CPIEC**	**DXX-SPR-FR4CPIEC**	**DXX-SPR-FR4CPIEC**
DX1 Frame 4 supplemental bag	**DXX-SPR-FR4SBAG**	**DXX-SPR-FR4SBAG**	**DXX-SPR-FR4SBAG**

Table 13. Frame 5

Description	Catalog numbers		
	208–240 volt	380–500 volt	600 volt
DG1 Frame 5 flange kit Type 12/IP54	**DXG-ACC-FR5N12FK**	**DXG-ACC-FR5N12FK**	**DXG-ACC-FR5N12FK**
DG1 Frame 5 flange kit Type 12/IP54 bulk pack (40)	**DXG-ACC-FR5N12FK-BP**	**DXG-ACC-FR5N12FK-BP**	**DXG-ACC-FR5N12FK-BP**
DX1 230 V Frame 5 main power board (CT-114A, VT-143A)	**DXX-SPR-2FR5MPB-114**	—	—
DX1 230 V Frame 5 main power board (CT-143A), VT-170A)	**DXX-SPR-2FR5MPB-143**	—	—
DX1 230 V Frame 5 main power board (CT-170A, VT-211A)	**DXX-SPR-2FR5MPB-170**	—	—
DX1 480 V Frame 5 main power board (CT-105A, VT-140A)	—	**DXX-SPR-4FR5MPB-105**	—
DX1 480 V Frame 5 main power board (CT-140A, VT-170A)	—	**DXX-SPR-4FR5MPB-140**	—
DX1 480 V Frame 5 main power board (CT-170A, VT-205A)	—	**DXX-SPR-4FR5MPB-170**	—
DX1 575 V Frame 5 main power board (CT-80A, VT-100A)	—	—	**DXX-SPR-5FR5MPB-080**
DX1 575 V Frame 5 main power board (CT-100A, VT-125A)	—	—	**DXX-SPR-5FR5MPB-100**
DX1 575 V Frame 5 main power board (CT-125A, VT-144A)	—	—	**DXX-SPR-5FR5MPB-125**
DX1 Frame 5 EMI-1 board	**DXG-SPR-2FR5E1B**	**DXX-SPR-4FR5E1B**	**DXG-SPR-5FR5E1B**
DX1 Frame 5 EMI-2 board	**DXG-SPR-2FR5E2B**	**DXX-SPR-4FR5E2B**	**DXG-SPR-5FR5E2B**
DX1 Frame 5 control fan	**DXX-SPR-FR5CF**	**DXX-SPR-FR5CF**	**DXX-SPR-FR5CF**
DX1 Frame 5 main fan	**DXX-SPR-FR5FAN**	**DXX-SPR-FR5FAN**	**DXX-SPR-FR5FAN**
DX1 Frame 5 main fan module kit	**DXX-SPR-FR5FANKIT**	**DXX-SPR-FR5FANKIT**	**DXX-SPR-FR5FANKIT**
DX1 Frame 5 A-cover	**DXX-SPR-FR5CVR**	**DXX-SPR-FR5CVR**	**DXX-SPR-FR5CVR**
DX1 Frame 5 to Frame 6 B-cover	**DXX-SPR-LBCOVER**	**DXX-SPR-LBCOVER**	**DXX-SPR-LBCOVER**
DX1 Frame 5 to Frame 6 C-cover	**DXX-SPR-LCCOVER**	**DXX-SPR-LCCOVER**	**DXX-SPR-LCCOVER**
DX1 Frame 5 UL conduit plate	**DXX-SPR-FR5CPUL**	**DXX-SPR-FR5CPUL**	**DXX-SPR-FR5CPUL**
DX1 Frame 5 supplemental bag	**DXX-SPR-FR5SBAG**	**DXX-SPR-FR5SBAG**	**DXX-SPR-FR5SBAG**

Table 14. Frame 6

Description	Catalog numbers		
	208–240 volt	380–500 volt	600 volt
DG1 Frame 6 flange kit Type 12/IP54	**DXG-ACC-FR6N12FK**	**DXG-ACC-FR6N12FK**	**DXG-ACC-FR6N12FK**
DG1 Frame 6 flange kit Type 12/IP54 bulk pack (40)	**DXG-ACC-FR6N12FK-BP**	**DXG-ACC-FR6N12FK-BP**	**DXG-ACC-FR6N12FK-BP**
DX1 230 V Frame 6 main power board (CT-211A, VT-261A)	**DXX-SPR-2FR6MPB-211**	—	—
DX1 230 V Frame 6 main power board (CT-248A, VT-312A)	**DXX-SPR-2FR6MPB-248**	—	—
DX1 480 V Frame 6 main power board (CT-205A, VT-261A)	—	**DXX-SPR-4FR6MPB-205**	—
DX1 480 V Frame 6 main power board (CT-245A, VT-310A)	—	**DXX-SPR-4FR6MPB-245**	—
DX1 575 V Frame 6 main power board (CT-144A, VT-208A)	—	—	**DXX-SPR-5FR6MPB-144**
DX1 575 V Frame 6 main power board (CT-208A, VT-250A)	—	—	**DXX-SPR-5FR6MPB-208**
DX1 Frame 6 IGBT module with drive board	**DXX-SPR-2FR6IGBT**	**DXX-SPR-4FR6IGBT**	**DXX-SPR-5FR6IGBT**
DX1 Frame 6 EMI board	**DXG-SPR-FR6EB**	**DXG-SPR-FR6EB**	**DXG-SPR-FR6EB**
DX1 Frame 6 control fan	**DXX-SPR-FR6CF**	**DXX-SPR-FR6CF**	**DXX-SPR-FR6CF**
DX1 Frame 6 main fan	**DXX-SPR-FR6FAN**	**DXX-SPR-FR6FAN**	**DXX-SPR-FR6FAN**
DX1 Frame 6 main fan module kit	**DXX-SPR-FR6FANKIT**	**DXX-SPR-FR6FANKIT**	**DXX-SPR-FR6FANKIT**
DX1 Frame 6 A-cover	**DXX-SPR-FR6CVR**	**DXX-SPR-FR6CVR**	**DXX-SPR-FR6CVR**
DX1 Frame 5 to Frame 6 B-cover	**DXX-SPR-LBCOVER**	**DXX-SPR-LBCOVER**	**DXX-SPR-LBCOVER**
DX1 Frame 5 to Frame 6 C-cover	**DXX-SPR-LCCOVER**	**DXX-SPR-LCCOVER**	**DXX-SPR-LCCOVER**
DX1 Frame 6 UL conduit plate	**DXX-SPR-FR6CPUL**	**DXX-SPR-FR6CPUL**	**DXX-SPR-FR6CPUL**
DX1 Frame 6 IEC conduit plate	**DXX-SPR-FR6CPIEC**	**DXX-SPR-FR6CPIEC**	**DXX-SPR-FR6CPIEC**
DX1 Frame 6 supplemental bag	**DXX-SPR-FR6SBAG**	**DXX-SPR-FR6SBAG**	**DXX-SPR-FR6SBAG**

Chapter 2—Engineering considerations

Introduction

This chapter describes the most important features in the energy circuit of a drive system that you should take into consideration in your project planning.

Figure 6. Drive system (PDS = power drive system)

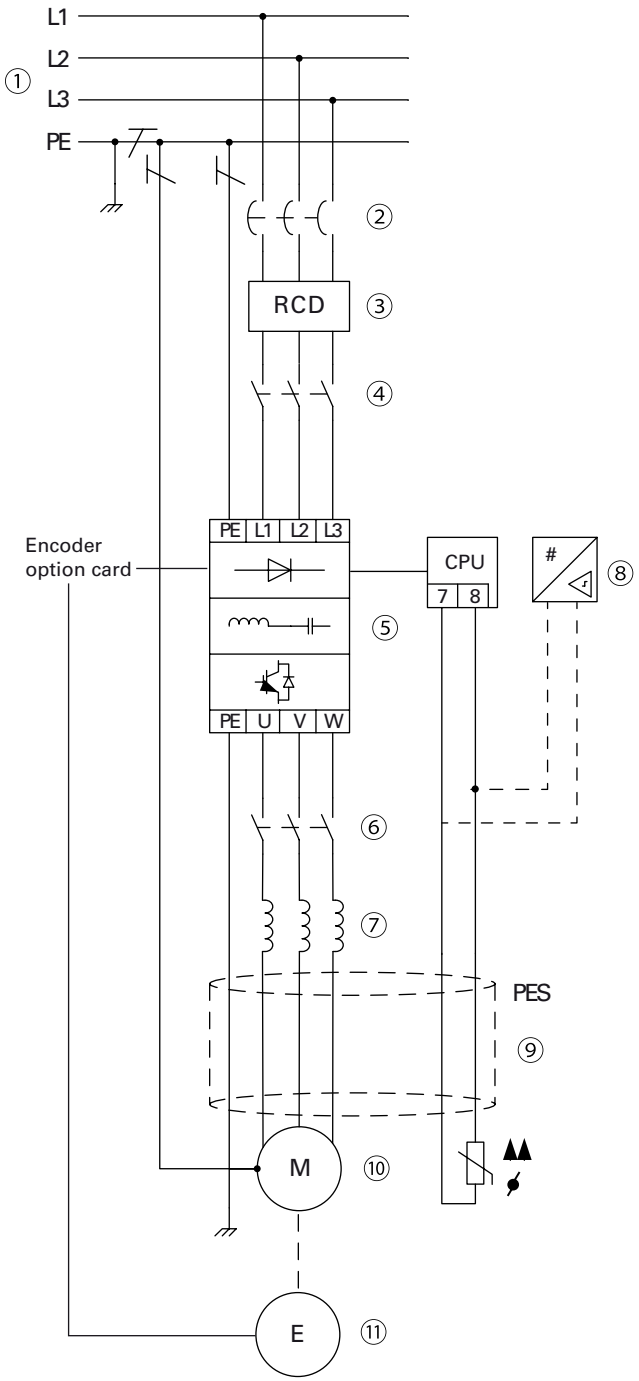


Table 15. Drive system components

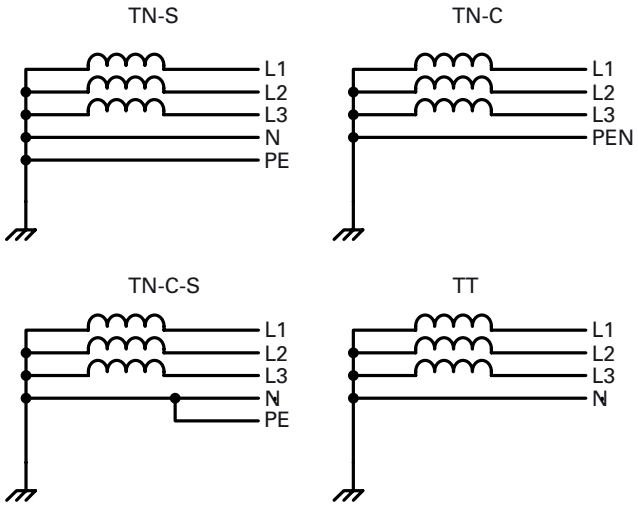
Item no.	Description
1	Power grid configuration, input voltage, input frequency, interactions with PF correction systems
2	Breakers, fuses, cable cross-sections
3	Protection of persons and animals with residual-current protective devices
4	Input contactor, disconnector
5	Variable frequency drive: mounting, installation; power connection; EMC measures; circuit examples
6	Output contactor, disconnector
7	Output reactor, dV/dT filter, sine-wave filter
8	Motor protection; thermistor (can be connected to drive directly)
9	Cable lengths, motor cables, shielding (EMC)
10	Motor and application, DC braking
11	Encoder mounted at the motor shaft non-drive end

Electrical power network

Input connection and configuration

The PowerXL DX1 Series frequency inverters can be connected and operated with all control-point grounded AC power networks (see IEC 60364 for more information).

Figure 7. AC power networks with grounded neutral point (TN-/TT networks)



The frequency inverter can be applied to all types of power networks above. If multiple frequency inverters with single-phase supplies are to be connected, a symmetrical distribution to the three external conductors shall be taken into account. In addition, the total current of all single-phase consumers is not to cause an overload of the neutral conductor (N-conductor).

The connection and operation of frequency inverters to asymmetrically grounded TN networks (phase-grounded delta network "Grounded Delta", USA) or neutral point ungrounded or high-resistance grounded (>30 ohms) IT networks is only conditionally permissible. In these networks above-mentioned, the internal interference suppression filter of frequency inverter must be disconnected (unscrew the screw marked 'EMC' and 'MOV', see **Installation in corner-grounded network and IT system on page 56**). Then the required filtering for EMC (electromagnetic compatibility) is no longer present (degrade to Class T).

Measures for EMC are mandatory in a drive system in order to meet the legal requirements for EMC and low voltage regulations.

Good grounding measures are a prerequisite for the effective insert of further measures such as shielding of filters. Without respective grounding measures, further steps are superfluous.

Input voltage and frequency

The standardized input voltages (IEC 60038, VDE017-1) for energy suppliers (EVU) guarantee the following conditions at the transition points:

- Deviation from the rated value of voltage: Max. ±10%
- Deviation in voltage phase balance: Max. ±3%
- Deviation from rated value of the frequency: Max. ±4%

The board tolerance band of the PowerXL DX1 Series frequency inverter considers the rated value for European as (EU: U_{LN} = 230 V/400 V, 50 Hz), American as (USA: U_{LN} = 240 V/480 V, 60 Hz) and Canada as (CAN: U_{LN} = 600 V, 60 Hz) standard voltages:

- 230 V, 50 Hz (EU) and 240 V, 60 Hz (USA) at DX1-32_
- 400 V, 50 Hz (EU) and 480 V, 60 Hz (USA) at DX1-34_
- 600 V, 60 Hz (CAN) at DX1-35_

For the bottom voltage value, the permitted voltage drop of 4% in the consumer circuits is also taken into account, therefore a total of U_{LN} –14%.

- 230 V device class (DX1-32_): 208 V –15% to 240 V +10% (177 V –0% to 264 V +0%)
- 400 V device class (DX1-34_): 380 V –15% to 500 V +10% (323 V –0% to 550 V +0%)
- 600 V device class (DX1-35_): 525 V –15% to 600 V +10% (446 V –0% to 660 V +0%)

The permitted frequency range is 50/60 Hz (45 Hz –0% to 66 Hz +0%).

Input voltage balance

Due to the uneven loading on the conductor, and with the direct connection of greater power ratings, deviations from the ideal voltage form and asymmetrical voltages can be caused in three-phase AC power networks. These asymmetric divergences in the input voltage can lead to different loading of the diodes in input rectifiers with three-phase supplied frequency inverters, and as a result, an advance failure of this diode.

In the project planning for the connection of three-phase supplied frequency inverters, consider only AC power networks that handle permitted asymmetric divergences in the input voltage ≤ +3%.

If this condition is not fulfilled, or symmetry at the connection location is uncertain, the use of an assigned AC choke is recommended.

Total harmonic distortion (THD)

Non-linear consumers (loads) in an AC supply system produce harmonic voltages that again result in harmonic currents. These harmonic currents at the inductive and capacitive reactances of a mains supply system produce additional voltage drops with different values that are then overlaid on the sinusoidal mains voltage and result in distortions. In supply systems, this form of "noise" can give rise to problems in an installation if the sum of the harmonics exceeds certain limit values.

Non-linear consumers (harmonics producers) include for example:

- Induction and arc furnaces, welding devices
- Current converters, rectifiers and inverters, soft starters, variable frequency drives
- Switched-mode power supply units (computers, monitors, lighting), uninterrupted power supply (UPS)

The THD value (THD = Total Harmonic Distortion) is defined in standard IEC/EN 61800-3 as the ratio of the rms value of all harmonic components to the rms value of the fundamental frequency. It is given in percent of the total value.

$$\text{THD} \quad \frac{\sqrt{U_2^2 + U_3^2 + U_4^2 + \cdots U_n^2}}{U_1} \times 100\%$$

U_1 — *fundamental component*

U_n — n^{th} *order harmonic component*

The THD value of the harmonic distortion is stated in relation to the rms value of the total signal as a percentage. On a variable frequency drive, the total harmonic distortion is around 28–36%.

To assist in the calculation of system harmonics, a Harmonic Estimation Calculator Tool is available at Eaton.com/drives.

Reactive power compensation devices

Special compensation measures on the power supply side is not required for PowerXL DX1 Series drives, which take on very little reactive power of the fundamental harmonics from the AC power supply network (cosØ ~0.98).

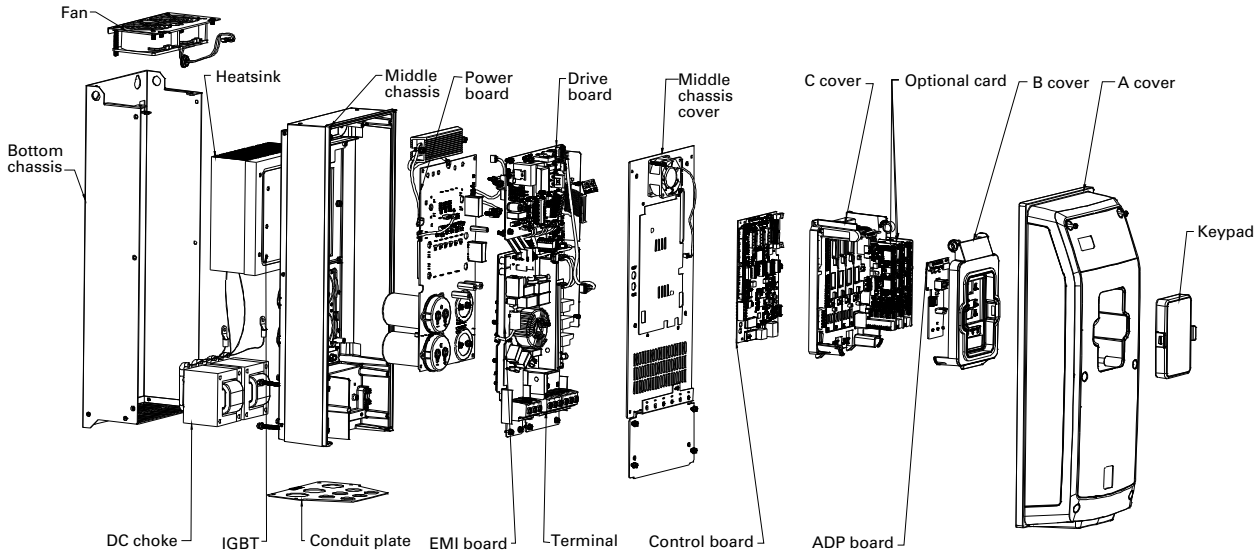
In the AC power networks with non-choked reactive current compensation devices, current deviations can enable parallel resonance and undefinable circumstances.

In the project planning for the connection of frequency inverters to AC power networks with undefined circumstances, please consider using AC chokes.

Chapter 3—Product overview

Component identification

Figure 8. Description of the PowerXL DX1 Series



Features

The PowerXL DX1 converts three-phase (or single-phase with deration) AC supply voltage into a DC voltage. The IGBT inverter section generates a PWM (pulse width modulated) three-phase AC waveform of adjustable voltage and frequency to run asynchronous or synchronous AC motors in speed or torque control modes.

Figure 9. Block diagram, elements of PowerXL DX1 frequency inverters

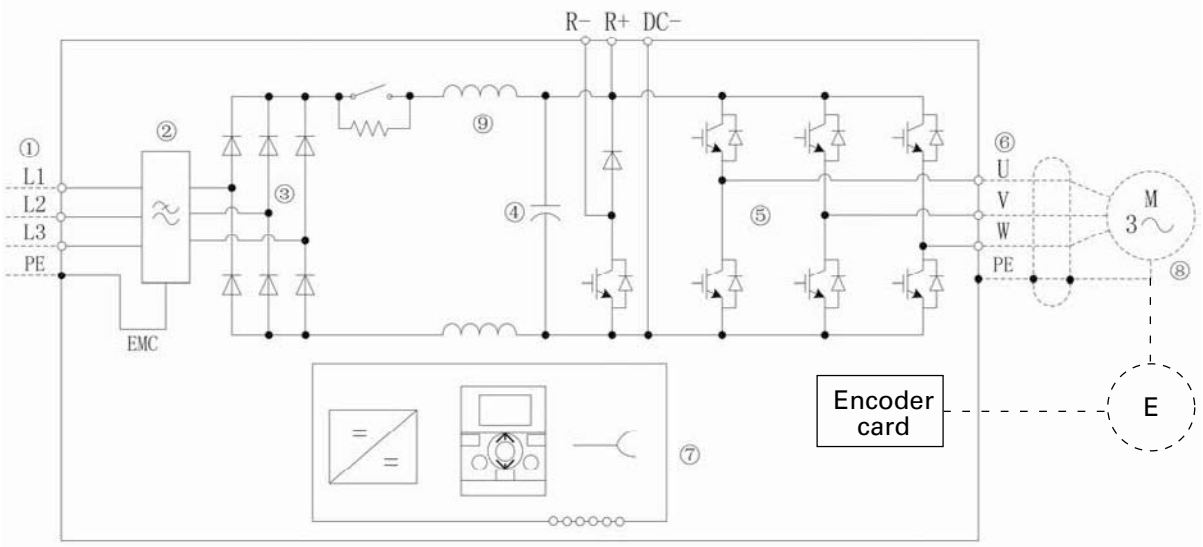


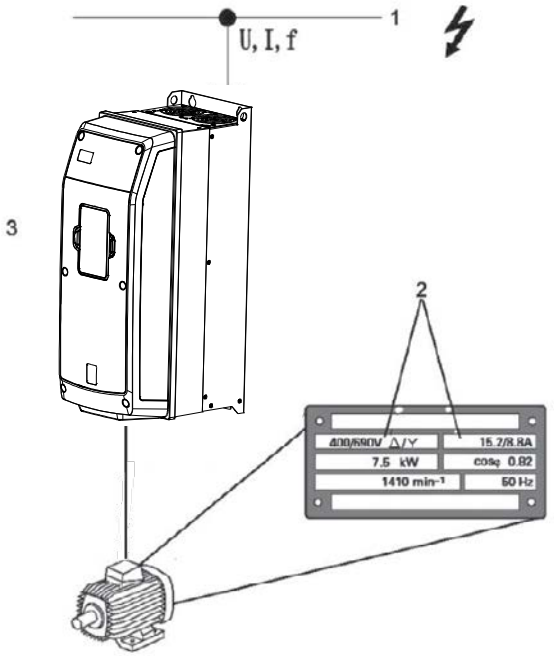
Table 16. Elements of PowerXL DX1 variable frequency drive

Item no.	Description
1	Supply L1, L2 L3, PE, input supply voltage U_{LN} = Ue at 50/60 Hz: D_1-32: 230 V class, three-phase input connection (3 AC 230 V/240 V) D_1-34: 400 V class, three-phase input connection (3 AC 400 V/480 V) D_1-35: 600 V class, three-phase input connection (3 AC 600 V)
2	Internal interference suppression filter, category C2 to IEC/EN 61800-3 EMC-connection of internal interference suppression filter to PE
3	Rectifier bridge, converts the AC voltage of the electrical network into DC voltage
4	DC link with charging resistor, capacitor and switching mode power supply unit (SMPS = Switching Mode Power Supply): DC link voltage UDC with three-phase input connection (3 AC): U_{DC} = 1.41 x U_{LN}
5	Inverter. The IGBT based inverter converts the DC voltage of the DC link (UDC) into a three-phase AC voltage (U2) with variable amplitude and frequency (f2). Sinusoidal pulse width modulation (PWM) with V/f control can be switched to speed control with slip compensation
6	Motor connection U/T1, V/T2, W/T3 with output voltage U2 (0–100% Ue) and output frequency f2 (0–400 Hz) output current (I2): D_1-32: 3.7 A to 248 A D_1-34: 2.2 A to 245 A D_1-35: 3.3 A to 208 A 100% at an ambient temperature of 122 °F (50 °C) with an overload capacity of 150% for 60 s every 600 s and a starting current of 200% for 2 s every 20 s
7	Touchscreen keypad / membrane keypad
8	Three-phase asynchronous motor, variable speed control of three-phase asynchronous motor for assigned motor shaft power values (P2): D_1-32: 0.55 kW to 75 kW (230 V, 50 Hz) or 0.75 hp to 100 hp (240 V, 60 Hz) D_1-34: 0.75 kW to 132 kW (400 V, 50 Hz) or 1 hp to 200 hp (460 V, 60 Hz) D_1-35: 1.5 kW to 132 kW (600 V, 50 Hz) or 2 hp to 200 hp (600 V, 60 Hz)
9	DC link—chokes, to minimize current harmonics
10	Encoder mounted at non-drive end (NDE) of the motor shaft (Closed Loop Control only)

Selection criteria

As shown in **Figure 10**, the variable frequency drive (VFD) **[3]** is selected according to the supply voltage U_{LN} of the input supply **[1]** and the rated current of the assigned motor **[2]**. The circuit type (Δ/Y) of the motor must be selected according to the supply voltage **[1]**. The rated output current I_e of the frequency inverter must be greater than/equal to the rated motor current.

Figure 10. Selection criteria



When selecting the drive, the following criteria must be known:

- Type of motor (three-phase asynchronous motor) or permanent magnet motor (open loop only)
- Input voltage = rated operating voltage of the motor (for example, 3 AC ~400 V)
- Rated motor current (guide value, dependent on the circuit type and the supply voltage)
- Load torque (quadratic, constant)
- Starting torque
- Ambient temperature (rated value 122 °F [50 °C])

When connecting multiple motors in parallel to the output of a VFD, the motor currents are added geometrically—separated by effective and idle current components. When you select a VFD, make sure that it can supply the total resulting current. If necessary, for dampening and compensating the deviating current values, motor reactors or sinusoidal filters must be connected between the VFD and the motor.

The parallel connection of multiple motors in the output of the VFD is only permitted with V/Hz characteristic curve control.

If you connect a motor to an operational VFD, the motor draws a multiple of its rated operational current. When you select a VFD, make sure that the starting current plus the sum of the currents of the running motors will not exceed the rated output current of the VFD.

Switching in the output of the VFD is only permitted with V/Hz characteristic curve control.

Selection criteria—option cards

The following option cards are compatible with the DX1 high-performance VFD. You may choose the option cards based on your application needs. Please review the option card slot compatibility table in **Chapter 6—Installation requirements**.

DXX-EXT-ABZ: This dual-channel standard encoder card has two incremental, quadrature encoder signals and an output channel. This card offers a selectable DC supply voltage +5 V / +15 V / +24 V to the encoders. The primary purpose of this option card is to control the motor in closed loop speed or torque control. Either of the input channels can be configured to provide motor speed feedback. The output channel can be configured to provide a pulse reference to a second drive. The pulse per revolution (PPR) of the encoders is a programmable parameter within the drive. The maximum frequency shall be 220 kHz.

DXX-EXT-SABZ: This-dual channel safety encoder card can accept one safety encoder and one standard encoder of incremental, quadrature type. Safety ABZ encoder card will have diagnostic circuits to diagnose the failure of encoder such as open wire, incorrect signal phase. The card offers a selectable supply voltage +5 Vdc / +15 Vdc / +24 Vdc. The encoder signals shall be -AA\, -BB\, -ZZ\ type with user selectable pulses per revolution (PPR) count. The pulse per revolution (PPR) of the encoders is a programmable parameter within the drive. The max communication shall be 220 kHz.

DXX-EXT-OF: This dual-channel optical fiber card offers the ability to set up two drives in master-follower control mode for speed or torque control. The frequency output channel of the card in the master drive shall be programmed as the velocity or torque reference to a follower drive. This master-follower configuration shall be daisy chained. The maximum frequency shall be 10 MHz.

DXX-NET-EIP: This dual-channel EtherNet/IP card allows a star or ring topology connection to an EtherNet/IP master, usually a programmable logic controller (PLC).

DXX-NET-PROFINET: This dual-channel Profinet card allows a star or ring topology connection to a Profinet master, usually a PLC.

DXX-EXT-FS: Functional Safety Card for machine safety functions.

DXX-EXT-3DI3DO1T: Choose this option card if any of these input/output signals are necessary for your application in addition to the standard I/Os available in the base drive.

- 3 digital inputs (24 Vdc)
- 3 digital outputs (24 Vdc)
- 1 thermistor

DXX-EXT-1AI2AO: Choose this option card if any of these input/output signals are necessary for your application in addition to the standard I/Os available in the base drive.

- 1 analog input (±10 Vdc, 0–20 mA)
- 2 analog outputs (0–10 Vdc, 0–20 mA)

DXX-EXT-3RO: Choose this option card if any of these input/output signals are necessary for your application in addition to the standard I/Os available in the base drive.

- 2 relay outputs (2 Form A)
- 1 relay output (1 Form C)

DXX-EXT-THER1: Choose this option card if any of these input/output signals are necessary for your application in addition to the standard I/Os available in the base drive.

- 3 PT100 thermistor inputs (–30 °C to +200 °C)

DXX-EXT-6DI: Choose this option card if any of these input/output signals are necessary for your application in addition to the standard I/Os available in the base drive.

- 6 digital inputs (120/240 Vac)

Proper use

The PowerXL DX1 VFDs are electrical apparatuses for controlling variable speed drives with three-phase motors. They are designed for installation in machines or for use in combination with other components within a machine or system.

After installation in a machine, the VFDs must not be taken into operation until the associated machine has been confirmed to comply with the safety requirements of EU Directives. The user of the equipment is responsible for ensuring that the machine use complies with the relevant EU Directives.

The CE markings on the PowerXL DX1 VFDs confirm that, when used in a typical drive configuration, the apparatus complies with the relevant EU Directives listed in Appendix F.

The UKCA markings on the PowerXL DX1 VFDs confirm that, when used in a typical drive configuration, the apparatus complies with the relevant UK Regulations listed in Appendix F.

In the described system configurations, PowerXL DX1 VFDs are suitable for use in public and non-public networks.

A connection to IT networks (networks without reference to earth potential) is permissible only to a limited extent, because the device's built-in filter capacitors connect the network with the earth potential (enclosure). On earth free networks, this can lead to dangerous situations or damage to the device (isolation monitoring required).

Note: When deployed in a delta secondary corner grounded system, DX1 shall function without causing any damage with the EMC and ground connections removed. However, in such instances, it will not meet the EMC specifications.

To the output of the VFD (terminals U, V, W) you must not:

- Connect a voltage or capacitive loads (for example, phase compensation capacitors)
- Connect multiple VFDs in parallel
- Make a direct connection to the input (bypass)

Observe the technical data and connection requirements. For additional information, refer to the equipment nameplate or label at the frequency inverter, and the documentation.

Maintenance and inspection

PowerXL DX1 VFDs go through rigorous testing and quality standards before shipping. However, external influences may affect the function and the lifespan of the PowerXL DX1 frequency inverter. We therefore recommend that the devices are checked regularly and the following maintenance measures are carried out at the specified intervals.

If the PowerXL DX1 VFD is damaged by external influences, contact Technical Service.

Table 17. Maintenance measures and intervals

Maintenance measure	Maintenance interval
Clean cooling vents (cooling slits)	If required
Check the fan function	6–24 months (depending on the environment)
Filter in the switching cabinet doors (see manufacturer specifications)	6–24 months (depending on the environment)
Check the tightening torques of the terminals (control signal terminals, power terminals)	Regularly
Check connection terminals and all metallic surfaces for corrosion	6–24 months (depending on the environment)

Storage

If the VFD is stored before use, suitable ambient conditions must be ensured at the site of storage:

- Storage temperature: –40 °F to +158 °F (–40 °C to +70 °C)
- Relative average air humidity: <95%, noncondensing
- To prevent damage to the DC link capacitors, storage times longer than 12 months are not recommended

Charging the internal DC link capacitors

After extended storage times or extended downtimes during which no power is supplied (>12 months), the capacitors in the internal DC link must be recharged in a controlled manner in order to prevent damage. To do this, the PowerXL DX1 variable frequency drive must be supplied with power, with a controlled DC power supply unit, via two mains DC bus connection terminals. Please consult the factory for detailed instructions.

Service and warranty

In the unlikely event that you have a problem with your PowerXL DX1 frequency inverter, please contact your local sales office.

When you call, have the following information ready:

- The exact frequency inverter part no. (see nameplate)
- The date of purchase
- A detailed description of the problem that has occurred with the frequency inverter

If some of the information printed on the nameplate is not legible, please state only the information that is clearly legible. This information can also be found on the cover of the control terminals.

Information concerning the guarantee can be found in the General Terms and Conditions of Sale.

Chapter 4—Safety and switching

Note: All following information is strongly recommended but is not necessary if sufficient system design and validation has been completed.

Fuses and cable cross-sections

The fuses and wire cross-sections allocated for power-side connections depend on the rated input current and output current of the frequency inverter (without AC choke).

⚠ CAUTION

When selecting the cable cross-section, take the voltage drop under load conditions into account.

The consideration of other standards (for example, VDE 0113 or VDE 0289) is the responsibility of the user.

The national and regional standards (for example VDE 0113, EN 60204) must be observed and the necessary approvals (for example UL) at the site of installation must be fulfilled.

When the device is operated in a UL-approved system, use only UL-approved fuses, fuse bases, and cables.

See Appendix D–Safety Instructions for UL and cUL for details.

⚠ CAUTION

The specified minimum PE conductor cross-sections in this manual must be maintained. The minimum size of the protective earthing conductor must comply with the requirements of EN 61800-5-1 and/or the local safety regulations.

Touch currents in this frequency inverter are greater than 3.5 mA (AC). According to product standard IEC/EN 61800-5-1, an additional equipment grounding conductor of the same cross-sectional area as the original protective earthing conductor must be connected, or the cross-section of the equipment grounding conductor must be at least 10 mm² Cu.

Choose the cross-section of the PE conductor in the motor lines at least as large as the cross-section of the phase lines (U, V, W).

Cables and fuses

The cross-sections of the cables and line protection fuses used must correspond with local standards.

For an installation in accordance with UL guidelines:

- Use UL listed Class J, T, CF, CC or equivalent fuses for the branch circuit protection
- Use 75 °C or higher copper wire only
- Use UL listed conduit fittings with the same type rating (Type 1/Type 12) as the enclosure

See **Appendix D—Safety instructions for UL and cUL** for details.

Use power cables with insulation according to the specified input voltages for the permanent installation. A shielded cable is not required on the input side.

A completely (360°) shielded low impedance cable is required on the motor side. The length of the motor cable depends on the RFI class and must not exceed approximately 300 ft (100 m) without additional filtering.

Residual-current device (RCD)/ ground-fault circuit interrupter (GFCI)

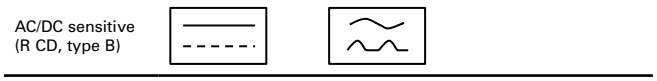
RCD/GFCI: Residual current device, residual current circuit breaker (FI circuit breaker).

Residual current circuit breakers protect persons and animals from the existence (not the origination) of impermissibly high contact voltages. They prevent dangerous, and in some cases deadly injuries caused by electrical accidents, and also serve as fire prevention.

⚠ CAUTION

This drive can cause a DC current in the protective earthing conductor. Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in case of direct or indirect contact, only an RCD or RCM of Type B is allowed on the supply side of this product.

Figure 12. Identification on the FI circuit breakers



Frequency inverters work internally with rectified AC currents. If an error occurs, the DC currents can block a type A RCD/GFCI circuit breaker from triggering and therefore disable the protective functionality.

⚠ CAUTION

Debounced inputs may not be used in the safety circuit diagram.

Residual current circuit breakers (RCD) are only to be installed between the AC power supply network and the frequency inverter.

Safety-relevant leakage currents can occur while handling and when operating the frequency inverter, if the frequency inverter is not grounded (because of a fault).

Leakage currents to ground are mainly caused by foreign capacities with frequency inverters, between the motor phases and the shielding of the motor cable and via the Y-capacitors of the RFI filter. The size of the leakage current is mainly dependent upon the:

- **length of the motor cable**
- **shielding of the motor cable**
- **height of the switching frequency of the inverter**
- **design of the RFI filter**
- **grounding measures at the site of the motor**

The leakage current to ground is greater than 3.5 mA with a frequency inverter. According to product standard IEC/EN 61800-5-1, an additional equipment grounding (PE) conductor of the same cross-sectional area as the original protective earthing conductor should be connected, or the cross-section of the equipment grounding conductor should be at least 10 mm² Cu.

Residual current circuit breakers must be suitable for:

- **the protection of installations with DC current component in case of fault scenario (RCD type B)**
- **high leakage currents**
- **brief discharges of pulse current spikes**

Leakage current

⚠ CAUTION

As shown in Table 16, the following leakage currents were detected. These values were obtained under normal operating conditions with no outside influences. Actual values will differ depending on the conditions previously explained.

Input contactor

The input contactor enables an operational switching on and off of the supply voltage for the frequency inverter, and switching off in case of a fault.

The input contactor is designed based on the input current (I_{LN}) of the frequency inverter and the utilization category AC-1 (IEC 60947). Input contactors and the assignment to PowerXL DX1 frequency inverters are explained in **Appendix A—Technical data and specifications**.

Fused disconnects

A fused disconnect switch of adequate power rating is recommended to isolate power and protect the VFD from short-circuit faults. A lock-out-tag-out (LOTO) arrangement is recommended to protect personnel during maintenance of the VFDs. Please check with the VFD ratings tables in **Appendix B—Installation guidelines** to help with the voltage and current ratings of these protection devices.

Input reactor

A 3% input reactor on the line side of a VFD can help reduce voltage and current harmonics. It also provides increased input protection for the VFD and its semiconductors from line transients.

Table 18. Motor cable length vs. output device recommendation chart

Motor cable length	<150 ft (50 m)	Up to 300 ft (100 m)	Up to 1000 ft (300 m)	Up to 15,000 ft (5000 m)
Recommended output device	None	3% output reactor	dV/dt filter	Sine wave filter

Output reactor

The output reactor is a three-phase series inductance on the load side of a VFD. It is used to reduce transient voltage (dV/dt) and peak voltages at the motor terminals. A 3% output filter is recommended for motor cable lengths up to 300 ft (100 m).

dV/dt filter

Used to reduce the transient voltage (dV/dt) at the motor terminals. Recommended for motor cable lengths over 300 ft (100 m) and up to 1000 ft (304.8 m). This option shall be mounted in the enclosure.

Sine wave filter

Sine wave filters convert the PWM waveform to near sinusoidal wave. They shall be used if the ac motor is not PWM rated or if the cable lengths are longer than 1000 ft (304.8 m).

Notes: The maximum cable distance with dV/dt and sine wave filter may vary based on site conditions.

Suggestions to limit maximum switching frequency when using sine wave filters at the drive output:

- 230 V/480 V FR1–FR5 Limit to 8 kHz
- 230 V/480 V/575 V FR6 Limit to 4 kHz
- 575 V FR1–FR5 No special limitation

EMC measures

Electrical components in a system (machine) have an interaction effect on each other. Each device not only emits interference but is also affected by it. The interference can be produced by galvanic, capacitive, and/or inductive sources, or by electromagnetic radiation. In practice, the limit between line-conducted interference and radiated emitted interference is around 30 MHz. Above 30 MHz, cables and conductors act like antennas that radiate electromagnetic waves.

Electromagnetic compatibility (EMC) for frequency controlled drives (variable frequency drives) is implemented in accordance with product standard IEC/EN 61800-3. This includes the complete power drive system (PDS), from the input supply to the motor, including all components, as well as cables. This type of drive system can consist of several individual drives.

The generic standards of the individual components in a PDS compliant with IEC/EN 61800-3 do not apply. These component manufacturers, however, must offer solutions that ensure standards-compliant use.

In Europe, maintaining the EMC guidelines is mandatory.

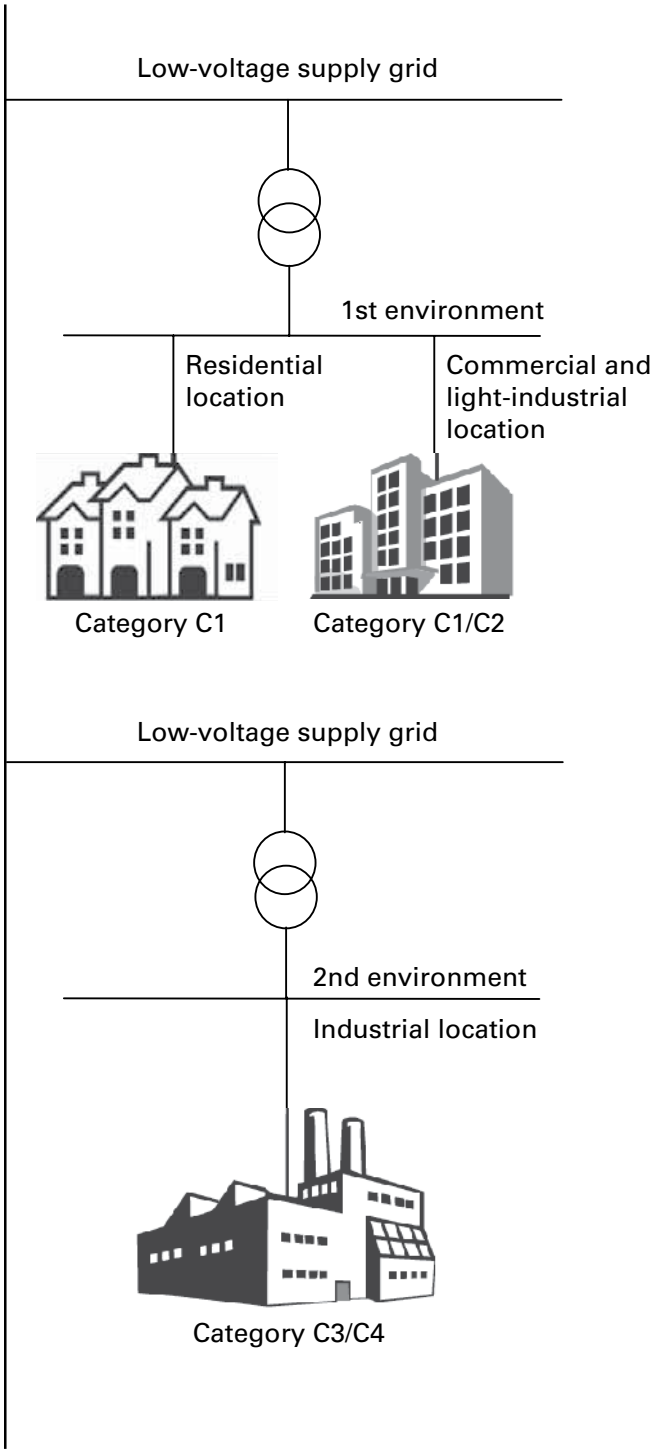
A declaration of conformity (CE) always refers to a "typical" power drive system (PDS). The responsibility to comply with the legally stipulated limit values and thus the provision of electromagnetic compatibility is ultimately the responsibility of the end user or system operator. This operator must also take measures to minimize or remove emission in the environment concerned (see **Figure 13**). He must also use means to increase the interference immunity of the devices of the system.

With their high interference immunity up to category C2, PowerXL DX1 frequency inverters are ideal for use in commercial networks (1st environment).

Table 19. Motor power cable EMC guidelines

Item	Standard
EMC (at default settings)	Immunity (EMS): IEC/EN 61800-3, 2nd environment and industrial location
	Radiated and Conducted emissions (EMI): IEC/EN 61800-3
	230/480 V series: Category C1: is possible with external filter connected to drive. Please consult factory Category C2: with internal filter maximum of 10 m motor cable length Category C3: with internal filter maximum of 50 m motor cable length
	575 V series: Category C3: with internal filter maximum of 10 m motor cable length

Figure 13. EMC measures



Chapter 5—Motor and application

Open loop control

Note: All following information is strongly recommended but is not necessary if sufficient system design and validation have been completed.

Motor selection

General recommendations for motor selection:

- Use three-phase powered asynchronous motors with short-circuit rotors and surface cooling, also called inverter motors or standard motors for the frequency-controlled drive system (PDS). Other specifications such as external rotor motors, slip-ring motors, reluctance motors, synchronous or servo motors can also be run with a frequency inverter, but normally require additional planning and discussion with the motor manufacturer
- Use only motors with at least heat class F (311 °F [155 °C] maximum steady state temperature)
- Four-pole motors are preferred (synchronous speed: 1500 min^{-1} at 50 Hz or 1800 min^{-1} at 60 Hz)
- Take the operating conditions into account for S1 operation (IEC 60034-1)
- When operating multiple motors in parallel on one frequency inverter, the motor output should not be more than three power classes apart
- Ensure that the motor is not over-dimensioned. If a motor in speed control mode is under-dimensioned, the motor rating must only be one rating level lower

Connecting motors in parallel

The PowerXL DX1 frequency inverters allow parallel operation of several motors using multi-pump application control mode:

- *Multi-purpose application: parallel control of several motors.* The sum of the motor currents plus the motors' inrush currents must be less than the frequency inverter's rated operational current
- Parallel operation at different motor speeds can be implemented only by changing the number of pole pairs and/or changing the motor's transmission ratio

⚠ CAUTION

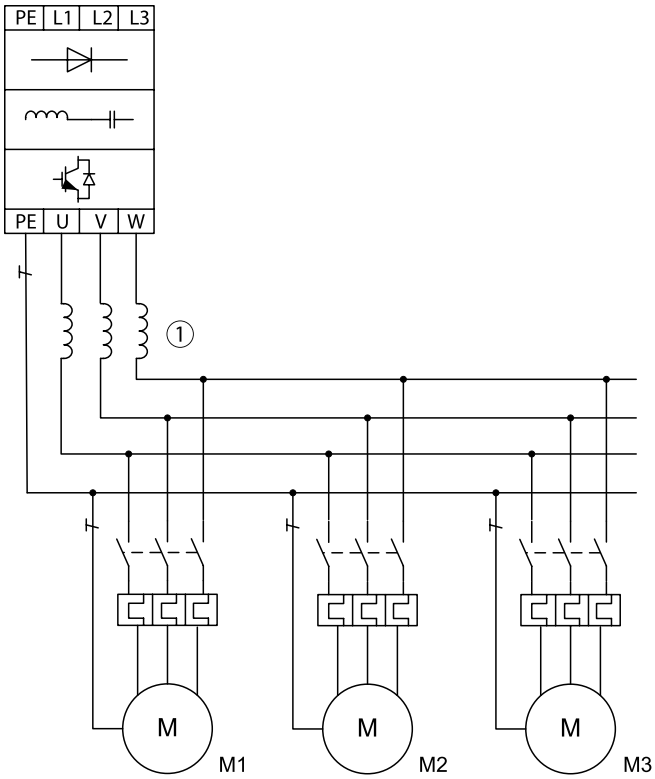
Debounced inputs may not be used in the safety circuit diagram.

If you are connecting multiple motors on one frequency inverter, you must design the contactors for the individual motors according to utilization category AC-3.

Selecting the motor contactor is done according to the rated operational current of the motor to be connected.

Parallel connection of several motors to one frequency inverter

Figure 14. Parallel connection



Connecting motors in parallel reduces the load resistance at the frequency inverter output. The total stator inductance is lower and the leakage capacity of the lines is greater. As a result, the current distortion is greater than in a single-motor circuit. To reduce the current distortion, you should use motor reactors (see ① in **Figure 14**) in the output of the frequency inverter.

The current consumption of all motors connected in parallel must not exceed the frequency inverter's rated output current I_{2N}.

Electronic motor protection cannot be used when operating the frequency inverter with several parallel connected motors. You must, however, protect each motor with thermistors and/or overload relays.

The use of a motor protective circuit breaker at the frequency inverter's output can lead to nuisance tripping.

Motor and circuit type

The motor's stator winding can be connected in a star or delta configuration, in accordance with the rated operational data on the nameplate.

Figure 15. Example of a motor ratings plate

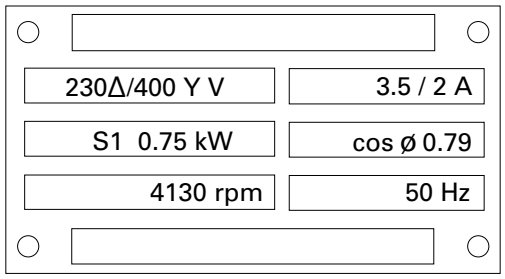
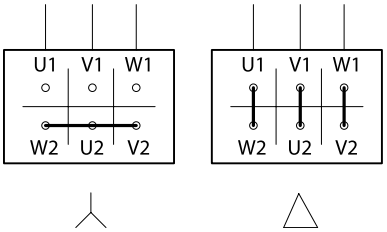


Figure 16. Star and delta circuit types



The three-phase motor with the rating plate based on **Figure 15**, can be run in a star or delta connection. The operational characteristic curve is determined by the ratio of motor voltage and motor frequency, in this case.

87 Hz characteristic curve

In the delta circuit with 400 V and 87 Hz, the motor shown in **Figure 15** was released with three times-fold output (~1.3 kW).

Because of the higher thermal loading, using only the next higher motor output according to the list (1.1 kW) is recommended. The motor (in this example) therefore still has 1.47-fold higher output compared with the listed output (0.75 kW).

With the 87 Hz characteristic curve, the motor also works in the range from 50 Hz to 87 Hz with an un-attenuated field. The pull-out torque remains at the same level as in input operation with 50 Hz.

The heat class of the motor must be at least F in 87 Hz operation.

V/Hz characteristic curve

Figure 17. V/Hz characteristic curve

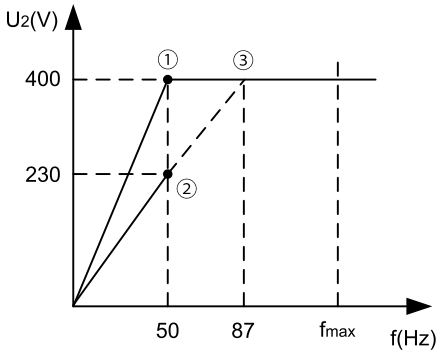


Table 20 shows the allocation of possible frequency inverters depending on the input voltage and the type of circuit.

Table 20. Assignment of frequency inverters to example motor circuit (see Figure 17)

Frequency inverters	DX1-323D7FB	DX1-343D3FB	DX1-344D3FB
Rated operational current	3.7 A	3.3 A	4.3 A
Input voltage	3 AC, 230 V	3 AC, 400 V	3 AC, 400 V
Motor circuit	Delta	Star	Delta
V/Hz characteristic curve	①	②	③
Motor current	3.5 A	2.0 A	3.5 A
Motor voltage (ratings plate)	230 V	400 V	230 V
Motor speed	1430 rpm	1430 rpm	2474 rpm ④
Motor frequency	50 Hz	50 Hz	87 Hz ③

① Delta connection: 230 V, 50 Hz.
② Star connection: 400 V, 50 Hz.
③ Delta connection: 400 V, 87 Hz.
④ Note the permitted limit values of the motor.

Bypass operation

If you want to have the option of operating the motor with the frequency inverter or directly from the input supply, the input branches must be interlocked mechanically.

⚠ CAUTION

Debounced inputs may not be used in the safety circuit diagram.

A changeover between the frequency inverter and the input supply must take place in a voltage-free state.

⚠ WARNING

The frequency inverter outputs (U, V, W) must not be connected to the input voltage (destruction of the device, risk of fire).

Figure 18. Bypass motor control (example)

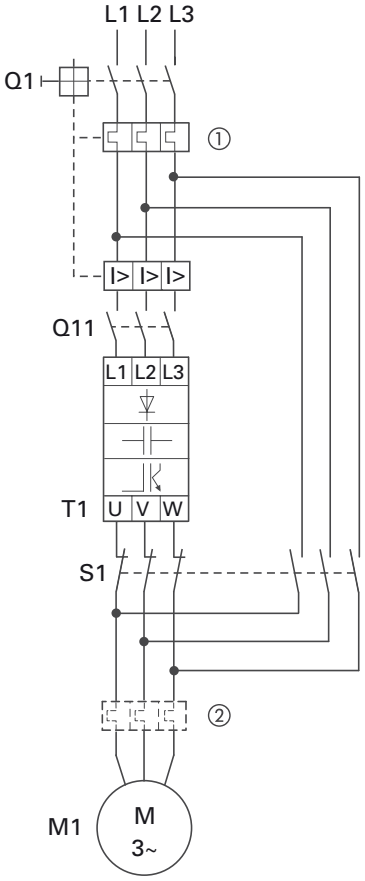


Table 21. Bypass motor control

Item No.	Description
1	Input/bypass contactor
2	Output contactor

⚠ CAUTION

Debounced inputs may not be used in the safety circuit diagram.

Switch S1 must switch only when frequency inverter T1 is at zero current.

Contactors and switches (S1) in the frequency inverter output and for the direct start must be designed based on utilization category AC-3 for the rated operational current of the motor.

Connecting EX motors

Note the following when connecting explosion-protected motors:

- The frequency inverter must be installed outside the EX area
- Note the branch- and country-specific standards for explosion-protected areas (ATEX 100 A)
- Note the standards and information of the motor manufacturer regarding operation on frequency inverters— for example, if motor reactors or sine-wave filters are specified
- Temperature monitors in the motor windings (thermistor, thermo-Click) are not to be connected directly to frequency inverters but must be connected via an approved trigger apparatus for EX areas

Closed loop control

Motor selection

PowerXL DX1 is capable of controlling precise speed or torque control of ac induction motors in closed loop. General recommendations for motor selection for closed loop operation are shown below:

- It is recommended to select a high-performance asynchronous ac motor rated for PWM voltage waveform
- Use only motors with at least heat class F (311 °F [155 °C] maximum steady-state temperature)
- For operation below base speed, select a motor of appropriate speed range such as 100:1 or 1000:1
- For applications requiring full torque at zero speed, 1000:1 speed range motor is recommended
- For closed loop applications requiring encoder feedback, multi-motor connection is not permissible; one VFD per motor is required
- Bypass operation is not recommended for closed loop applications
- Please consult with the motor manufacturer regarding the motor type based on the application requirement

Figure 19. Closed loop control

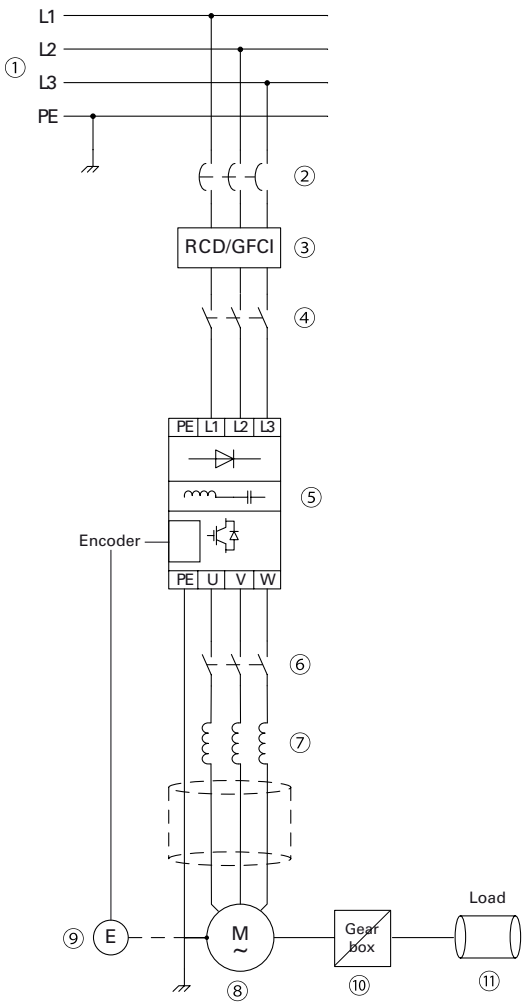


Table 22. Closed loop control

Item No.	Description
1	Power grid configuration
2	Beakers, fuses, cable cross-sections
3	Protection of persons and animals with residual current protection devices
4	Input contactor
5	Frequency inverter
6	Output contactor
7	Output reactor dV/dt filter, sinewave filter
8	AC motor (induction)
9	Incremental quadrature encoder
10	Gear box
11	Load

Encoder selection (standard and safety encoders)

- For precise speed or torque control applications, a pulse encoder needs to be mounted at the non-drive end (NDE) of the motor shaft and wired to an optional encoder card
- The encoder shall be of an incremental, quadrature type with A, A/, B, B/, Z, Z/ channels
- The encoder voltage shall be 5 Vdc to 24 Vdc. This voltage is supplied by the optional encoder card
- A 1024 PPR (pulse per revolution) is recommended but the drive option card is configurable for other PPR specifications
- Twisted pair shield cables are recommended to connect the encoder to the encoder card

Gearbox consideration

- A gearbox may be required for speed reducer applications
- Please consult with gearbox manufacturer for recommendations on the gear box type and reduction ratio

Linear speed vs. motor RPM

For linear speed control applications involving a cylindrical roll and gearbox, the following relationship is applicable:

Line Speed (Ls) = $\frac{\pi DNm}{GR}$

Where Ls = Line Speed (ex. M/min)

D = Roll diameter (ex. Meters)

Nm = Motor RPM

GR = Gear Ratio

Example:

For Ls = 100M/min; D = 0.5m; GR = 5:1;

Nm = 318.3099 RPM

Note: In many closed loop applications, precise speed control to a second decimal RPM accuracy will be necessary.

Chapter 6—Installation requirements

Note: All following information is strongly recommended but is not necessary if sufficient system design and validation have been completed.

This chapter contains all of the information required to properly install and prepare the PowerXL DX1 Series VFD for operation. The contents are listed to serve as a list of tasks needed to complete the installation. Included in this section are:

- Line (mains) and motor power wiring
- I/O control wiring

Electrical installation warnings and cautions

⚠ WARNING

Carry out wiring work only after the frequency inverter has been correctly mounted and secured.

⚠ WARNING

Electric shock hazard—risk of injuries!

Carry out wiring work only if the unit is de-energized.

⚠ CAUTION

Debounced inputs may not be used in the safety circuit diagram.

Fire hazard!

Only use cables, protective switches, and contactors that feature the indicated permissible nominal current value.

⚠ CAUTION

Debounced inputs may not be used in the safety circuit diagram.

According to product standard IEC/EN 61800-5-1, an additional equipment grounding (PE) conductor of the same cross-sectional area as the original protective earthing conductor must be connected, or the cross-section of the equipment grounding conductor must be at least 10 mm² Cu.

⚠ WARNING

The components in the drive's power section remain energized after the supply voltage has been switched off. After disconnecting the supply, wait at least five minutes before removing the cover to allow the intermediate circuit capacitors to discharge.

Pay attention to hazard warnings!

Standard mounting instructions

- Select the mounting location based on requirements listed in this chapter
- Mounting surface must be a vertical, flat, non-flammable surface
- PowerXL DX1 Series open drives may be mounted side-by-side or stacked vertically, as outlined in this chapter
- Surface must be strong enough to support the drive and not subject to excessive motion or vibration
- Mark the location of the mounting holes on the mounting surface (using the template provided on the cover of the cardboard shipping package)
- Using fasteners appropriate to your VFD and mounting surface, securely attach the VFD to the mounting surface using all four mounting hole locations

Mounting one unit above the other

When mounting one unit above the other, the lower unit air outlet must be directed away from the inlet air used by the upper one. The clearance between the upper and lower unit should equal C + D. See **Figure 19** on next page.

- Measure the mounting space to ensure that it allows the minimum space surrounding the VFD Series drive. Drive dimensions are on **Appendix C—Dimension drawings**
- Make sure the mounting surface is flat and strong enough to support the drive, is not flammable, and is not subject to excessive motion or vibration
- Ensure that the minimum airflow requirements for your drive are met at the mounting location
- Mark the location of the mounting holes on the mounting surface, refer to mounting hole dimensions in **Appendix C—Dimension drawings**
- Using fasteners appropriate to your drive and mounting surface, securely attached the drive to the mounting surface using all four screws or bolts

Mounting dimensions

Refer to **Appendix C—Dimension drawings** for drive dimensions.

Figure 19. Mounting space

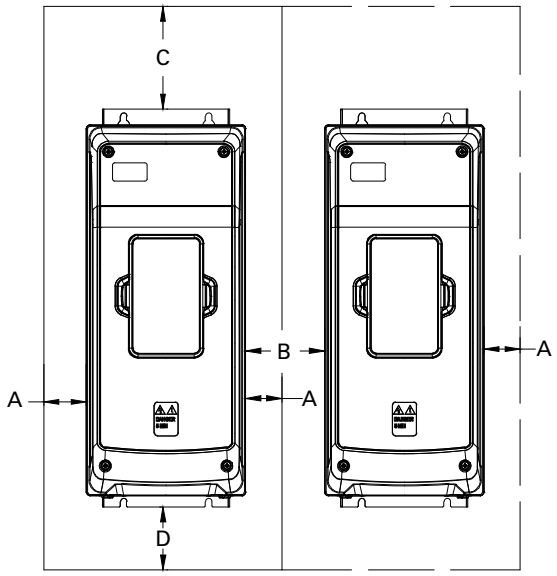


Table 23. Space requirements for mounting the PowerXL DX1 Series VFD and airflow

Approximate dimensions in inches (mm)

Frame size	A ①	B ①	C	D
FR1	0	0	3.94 (100.0)	1.97 (50.0)
FR2	0	0	6.30 (160.0)	2.36 (60.0)
FR3	0	0	7.87 (200.0)	3.15 (80.0)
FR4	0	0	11.81 (300.0)	3.94 (100.0)
FR5	3.15 (80.0)	6.30 (160.0)	11.81 (300.0)	7.87 (200.0)
FR6	0	0	15.75 (400.0)	12.99 (330.0)

① The above guidelines apply unless testing has been completed to validate a design outside of these recommendations.

Dimensions

Approximate dimensions in mm

Figure 20. Open drives FR1–FR6

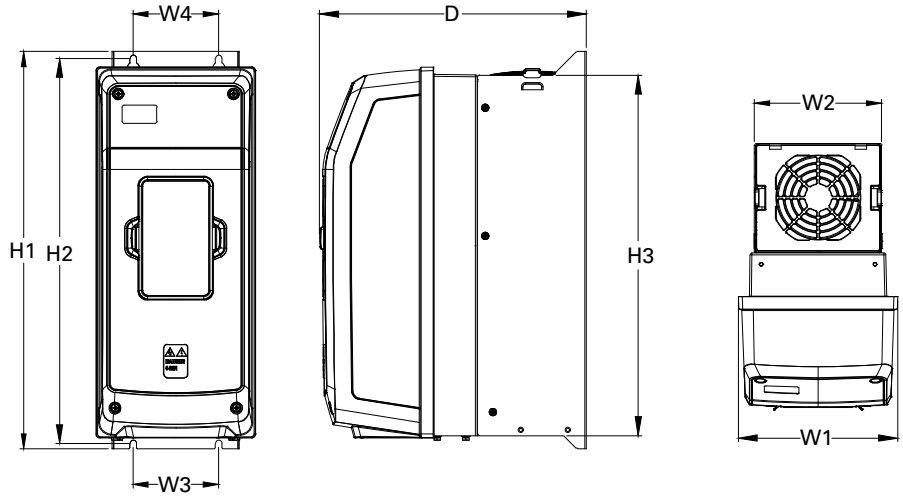


Table 24. Mounting drive dimensions

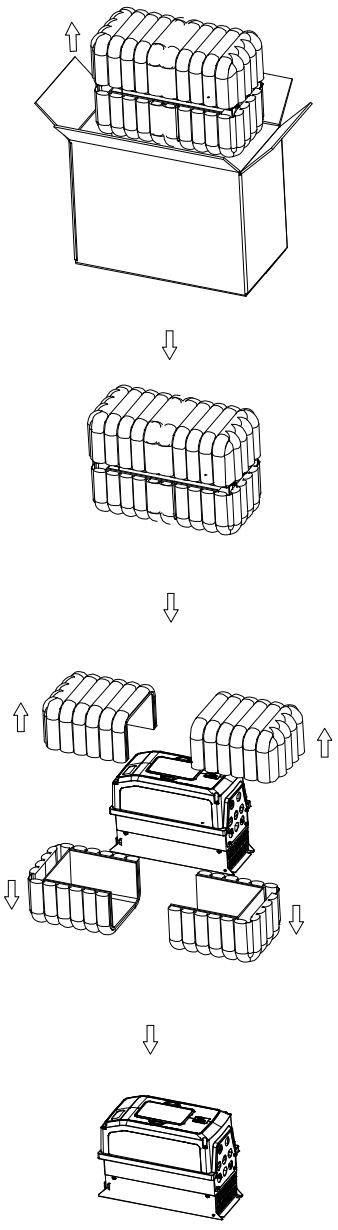
Approximate dimensions in inches (mm)

Frame size	D	H1	H2	H3	W1	W2	W3	W4	Ø	Weight lb (kg)
FR1	9.35 (237.4)	12.87 (327.0)	12.28 (312.0)	11.50 (292.0)	6.03 (153.0)	4.80 (122.0)	3.94 (100.0)	3.94 (100.0)	0.28 (7.0)	15.5 (7.0)
FR2	11.08 (281.2)	16.50 (419.0)	15.98 (406.0)	14.96 (380.0)	6.61 (168.0)	5.28 (134.0)	3.54 (90.0)	3.54 (90.0)	0.28 (7.0)	24.5 (11.0)
FR3	11.74 (298.0)	21.97 (558.0)	21.46 (545.0)	20.41 (518.5)	8.06 (205.0)	7.24 (184.0)	4.92 (125.0)	4.92 (125.0)	0.35 (9.0)	50.7 (23.0)
FR4	12.94 (328.5)	24.80 (630.0)	24.31 (617.5)	23.27 (590.7)	9.36 (238.0)	9.13 (232.0)	8.07 (205.0)	8.07 (205.0)	0.35 (9.0)	79.36 (36.0)
FR5	14.54 (369.1)	35.01 (888.5)	29.65 (753.0)	27.83 (707.0)	11.34 (288.0)	11.10 (282.0)	8.66 (220.0)	8.66 (220.0)	0.35 (9.0)	167.55 (76.0)
FR6	15.74 (399.5)	40.75 (1035.0)	33.27 (845.0)	31.38 (797.0)	19.13 (486.0)	18.90 (480.0)	15.75 (400.0)	15.75 (400.0)	0.35 (9.0)	251.32 (114.0)

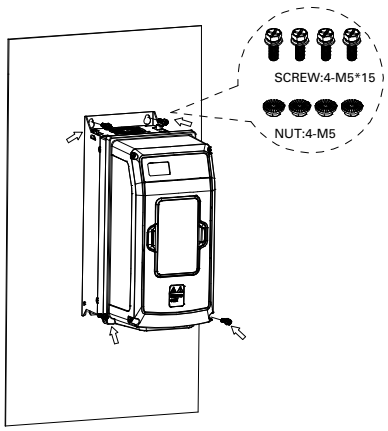
Standard drive mounting

FR1 mounting instructions

Step 1: Lift the drive out from the carton. Remove the packaging.

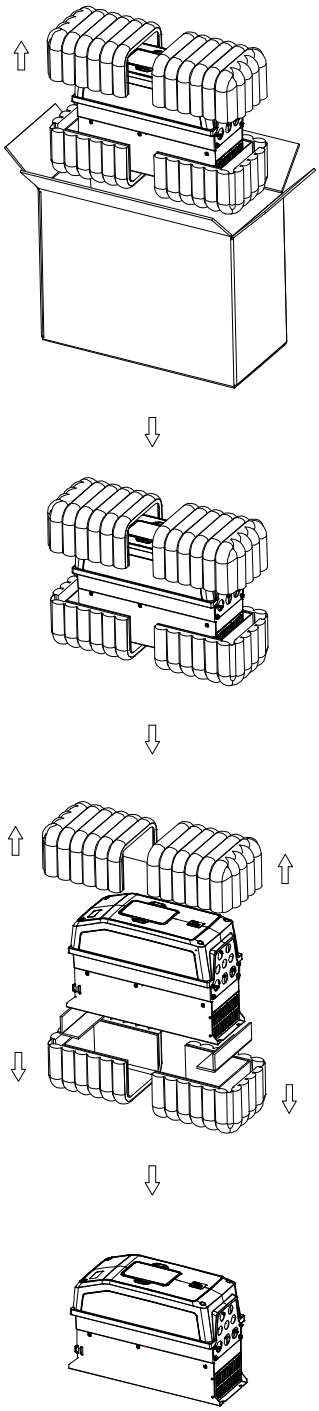


Step 2: Attach the drive to the mounting plate with four M5x15 or 3/16 inch screws and four M5 or 3/16 inch nuts. The opening dimensions on the mounting plate should follow required dimensions (refer to **Appendix C—Dimension drawings**).

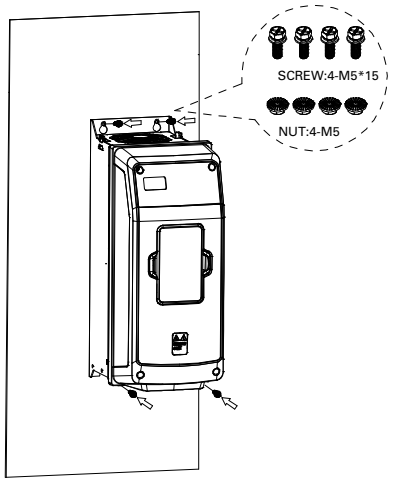


FR2 mounting instructions

Step 1: Lift the drive out from the carton. Remove the packaging.

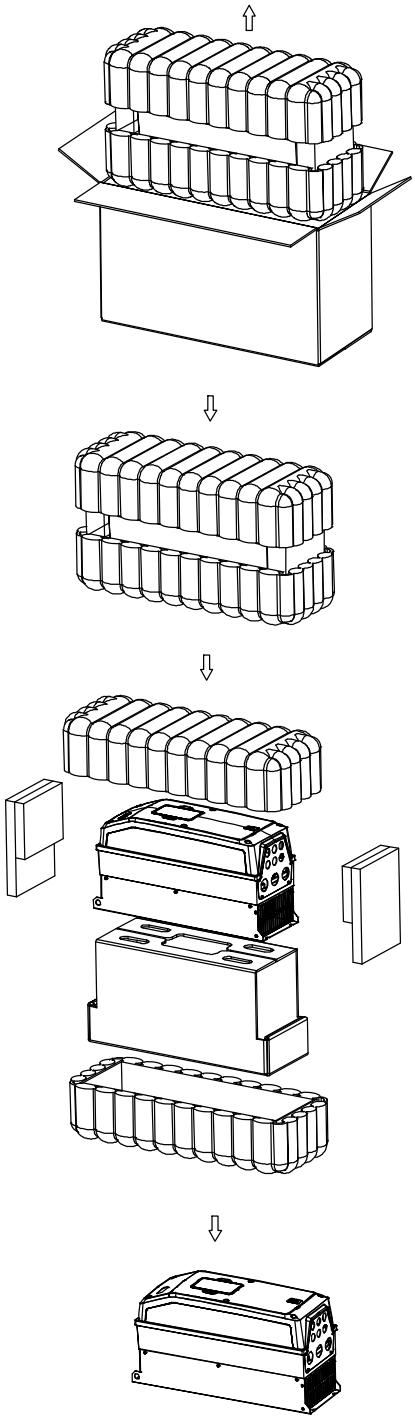


Step 2: Attach the drive to the mounting plate with four M5x15 or 3/16 inch screws and four M5 or 3/16 inch nuts. The opening dimensions on the mounting plate should follow required dimensions (refer to **Appendix C—Dimension drawings**).

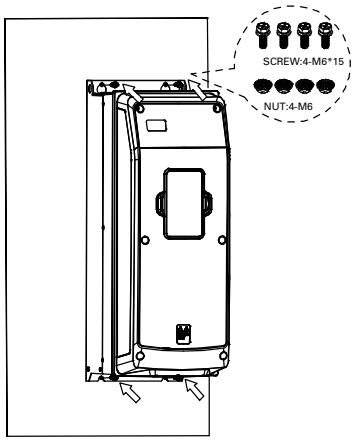


FR3 mounting instructions

Step 1: Lift the drive out of the carton. Remove the packaging.

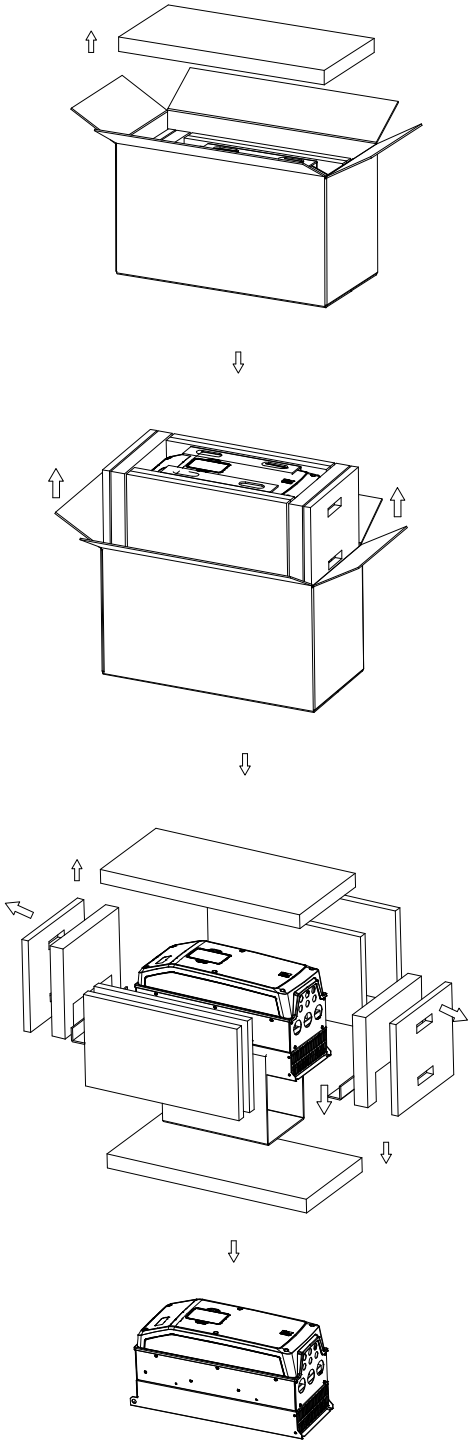


Step 2: Attach the drive to the mounting plate with four M6x15 or 1/4 inch screws and four M6 or 1/4 inch nuts. The opening dimensions on the mounting plate should follow required dimensions (refer to **Appendix C—Dimension drawings**).

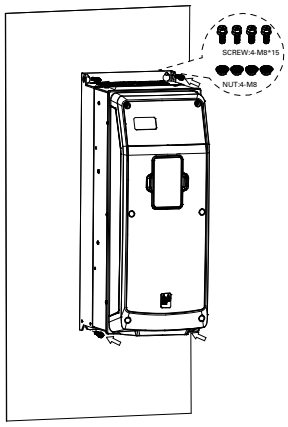


FR4 mounting instructions

Step 1: Lift the drive out of the carton with the cardboard. Remove the packaging.

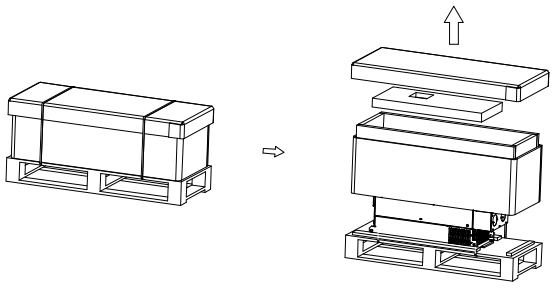


Step 2: Attach the drive to the mounting plate with four M8x15 or 3/8 inch screws and four M8 or 3/8 inch nuts. The opening dimensions on the mounting plate should follow required dimensions (refer to **Appendix C—Dimension drawings**).

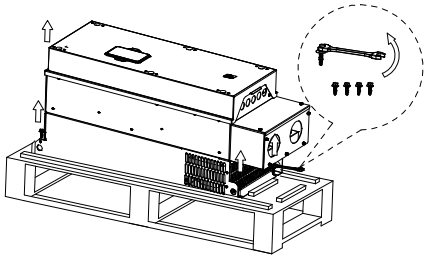


FR5 mounting instructions

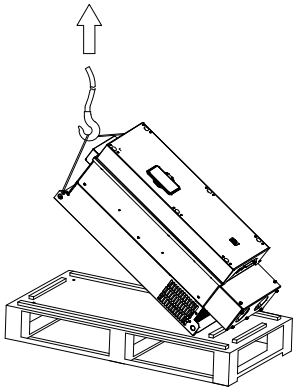
Step 1: Remove the carton from the drive.



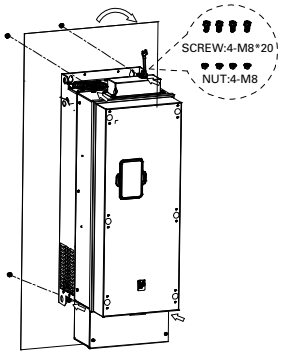
Step 2: Remove the four screws (used to fix the drive to the pallet) with an M8 or 3/8 inch wrench.



Step 3: Use a hook to lift the drive.

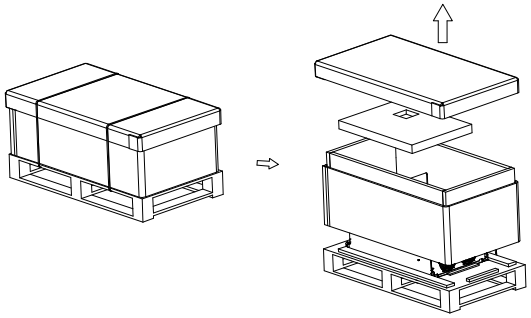


Step 4: Attach the drive to the mounting plate with four M8x20 or 3/8 inch screws and four M8 or 3/8 inch nuts with an M8 or 3/8 inch wrench. The opening dimensions on the mounting plate should follow required dimensions (refer to **Appendix C—Dimension drawings**).

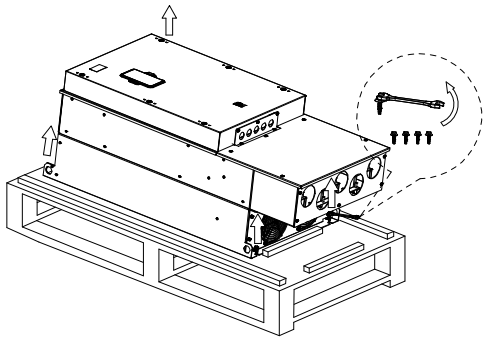


FR6 mounting instructions

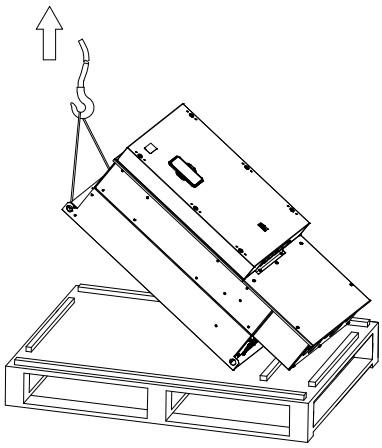
Step 1: Remove the carton from the drive.



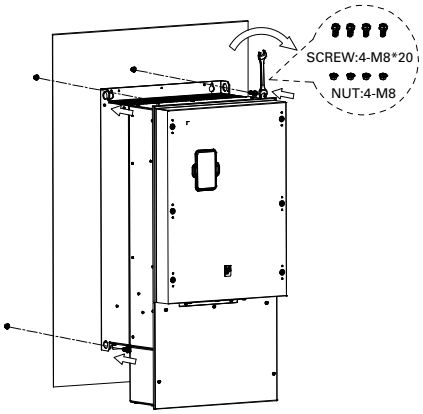
Step 2: Remove the four screws (used to fix the drive to the pallet) with an M8 or 3/8 inch wrench.



Step 3: Use a hook to lift the drive.



Step 4: Attach the drive to the mounting plate with four M8x20 or 3/8 inch screws and four M8 or 3/8 inch nuts with an M8 or 3/8 inch wrench. The opening dimensions on the mounting plate should follow required dimensions (refer to **Appendix C—Dimension drawings**).



Note: The TLK series lug from KST for connecting is recommended, but other types can be used. The rated lug hole should be 1/2 inch or 13 mm to support the FR6 stud.

Option cards installation

The PowerXL DX1 has four option slots (A, B, C and D) that can accommodate different option cards based on application needs. The figure below shows the orientation of the option card slots.

Option card assembly

Figure 21. Option card assembly

Step 1: Flip the B cover up and stop at a specific angle (120° or 150°).

Step 2: Insert the option cards to the corresponding slots according to **Table 25**. Make sure the option cards have been inserted into the slots fully.

Step 3: Flip the B cover down for snap fit with C cover to fix the option cards firmly.

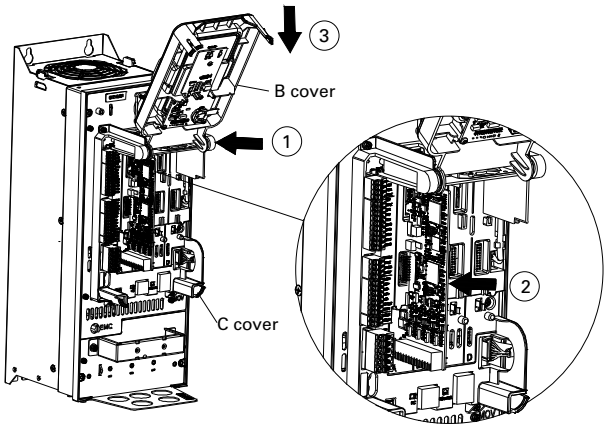


Table 25. Option card slot compatibility

Card	Slot
DXX-NET-EIP (dual port EtherNet/IP card)	D
DXX-NET-PROFINET (dual port Profinet card)	D
DXX-EXT-3DI3DO1T, DXX-EXT-1AI2AO, DXX-EXT-3RO, DXX-EXT-THER1, DXX-EXT-6DI (I/O cards)	A, B, C, D
DXX-EXT-FS (functional safety card)	B
DXX-EXT-ABZ (dual channel standard encoder card)	A
DXX-EXT-SABZ (dual channel safety encoder card)	A
DXX-EXT-OF (optical fiber card)	C

To install/remove option cards:

Step 1: Remove the A cover screws

Step 2: Lift open the control module cover.

Step 3: DX1 closed loop wiring schematic.

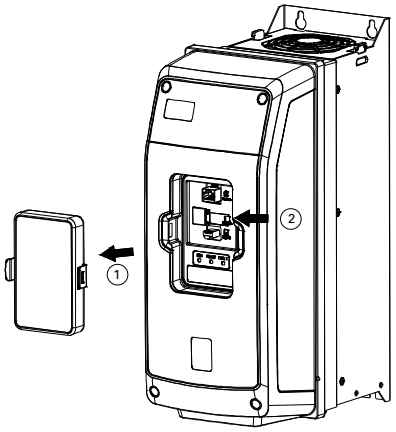
Step 4: Install/remove/reinstall the option module at the correct slot.

SD card installation

Figure 22. Insert SD card

Step 1: Take out the keypad,

Step 2: Insert SD card.



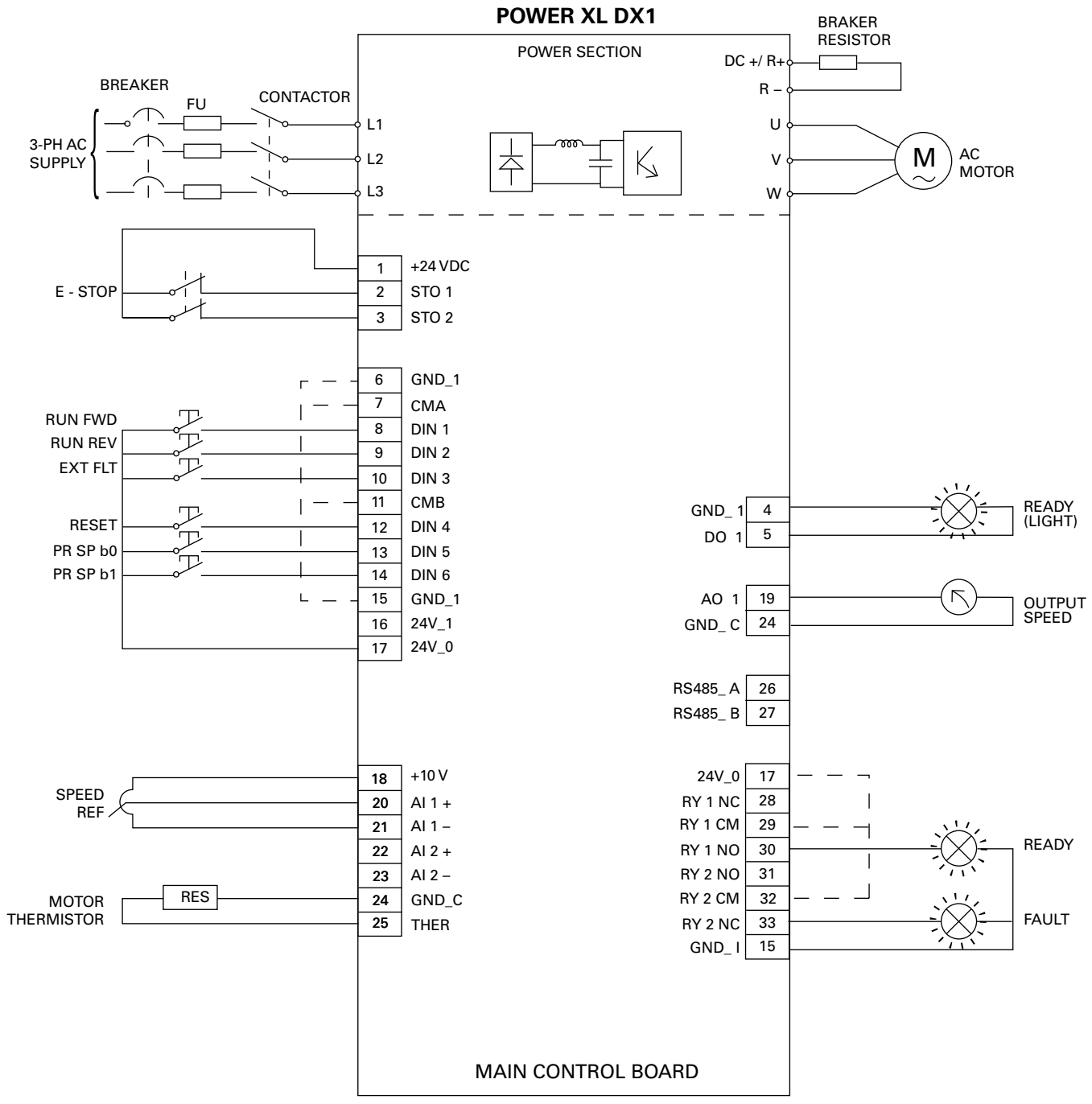
Note: When upgrading control board/touch screen keypad firmware by SD card, please do not connect network cable between drive and touch screen keypad.

Typical DX1 schematic wiring diagrams

Open loop

The wiring schematic of the DX1 for open loop connection is shown below.

Figure 23. Open loop wiring schematic diagram

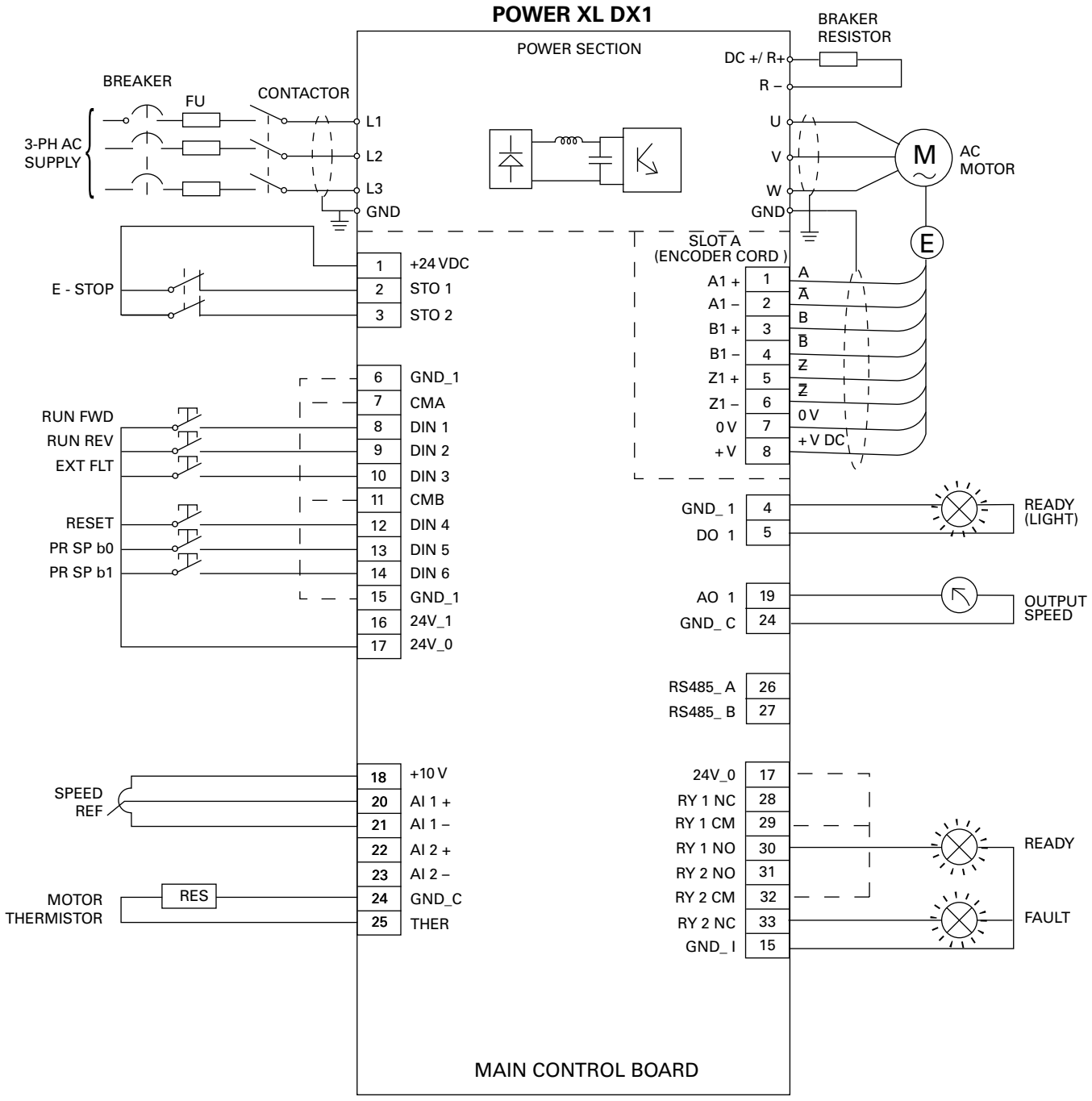


Closed loop

The wiring schematic of the DX1 for closed loop connection with encoder feedback is shown below.

Note: Please consult with the ABZ encoder option card manual for details on encoder wiring.

Figure 24. Closed loop wiring schematic diagram



Power wiring selection

Motor cable connections are made to terminals U, V, and W.

Cable selection: Power and motor leads

- Use UL approved heat-resistant copper cables only
- 75 °C or higher for all units rated
- Line voltage/mains should be Class 1 wire only outside North America
- Refer to the following tables for cable sizing guidelines
  - North America 208 V to 240 V: **Appendix B—Installation guidelines**
  - North America 380 V to 500 V: **Appendix B—Installation guidelines**
  - All other International 380 V to 600 V: **Appendix B—Installation guidelines**

Line (Mains) and motor cable installation

The input line and motor cables must be sized in accordance with the rated PowerXL DX1 VFD input and output current.

If motor temperature sensing is used for overload protection, the output cable size may be selected based on the motor specifications.

Maximum symmetrical supply current is 100,000 A RMS for all size PowerXL DX1 VFDs.

Input protection

Input protection devices are rated based on PowerXL DX1 rated input and output current. For UL and cUL/CSA, refer to **Appendix D—Safety instructions for UL and cUL** for proper sizing. For gG/gL (IEC 60269-1), refer to **Appendix B—Installation guidelines** for proper sizing.

Consult with service representative for further information about input protection requirements.

Wiring the power accessories

Input section

On the input side, you may choose to install any of the following power accessories depending on the application requirement:

- Circuit breaker
- Fused disconnect
- Reactor (AC)
- Contactor (DC)

Output section

On the output side, you may choose to install any of the following power accessories depending on the application requirement:

- Output reactor
- dV/dt filter
- Sine wave filter

The schematic diagrams in **Figure 18** and **Figure 19** show the connection diagram for these accessories. Power wire sizing shall be as recommended by **Appendix B—Installation guidelines**.

Common DC bus considerations

For tandem applications such as Winder/Unwinder where one VFD is motoring while the other is regenerating, it is possible to tie the dc bus terminals of the individual DX1 VFDs together to conserve energy. The wire current wiring shall be rated for 1.432 x the largest VFD current rating.

⚠ CAUTION

During maintenance of common DC bus connected VFDs, ensure all connected VFDs are disconnected from AC power and the DC bus capacitors are discharged before working on the VFDs.

Brake chopper connection

Dynamic braking resistor connections are made to the R+ and R- terminal on the drive. Wire size should be followed according to the wattage being transfered. Below are images of the locations for wiring.

Figure 25. Brake resistor wiring

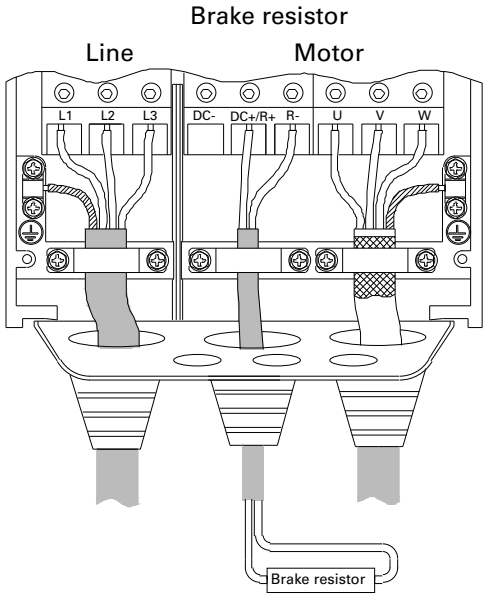
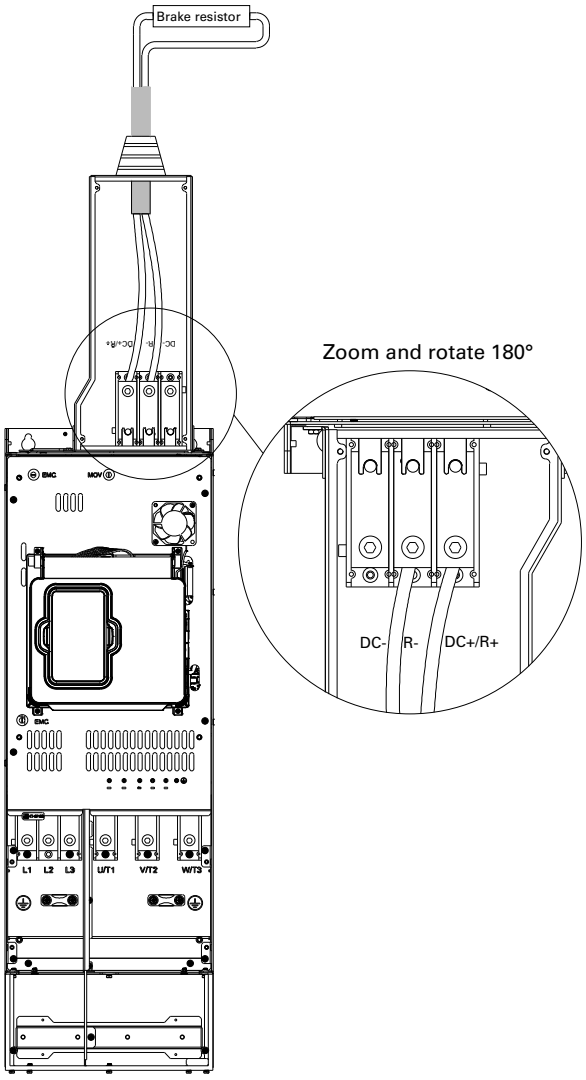


Figure 26. Brake resistor wiring (FR5 design)



Wiring the option modules

Please consult with the individual option module manual to install and wire the option modules.

Wiring the VFD

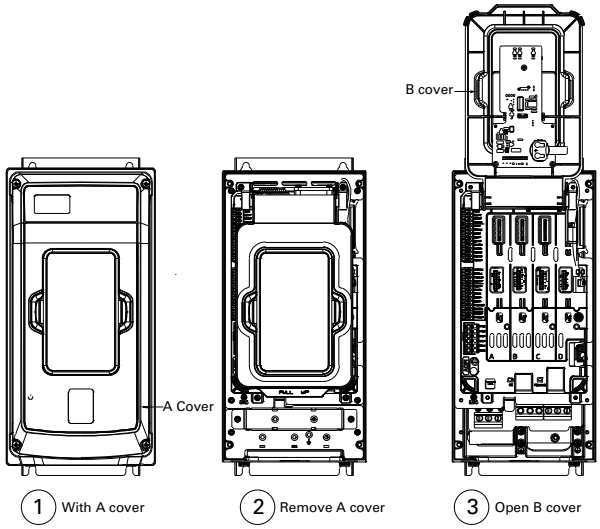
Refer to **Table 28** for maximum cable lengths by frame size.

If three or more motor cables are used, each conductor must have its own overcurrent protection.

Power wiring notice

Do not discard the plastic bag containing the wiring hardware.

Step 1: Remove the A-cover by removing four screws, then lifting the A-cover away from the base.



Wiring hardware contents (included with drive)

- European rubber grommet and flat rubber grommet (for IP54 integrity)
- Modification label
- Detachable cable clamp
- Attachable grounding strap
- Ground strap mounting screws

Power wiring/grounding

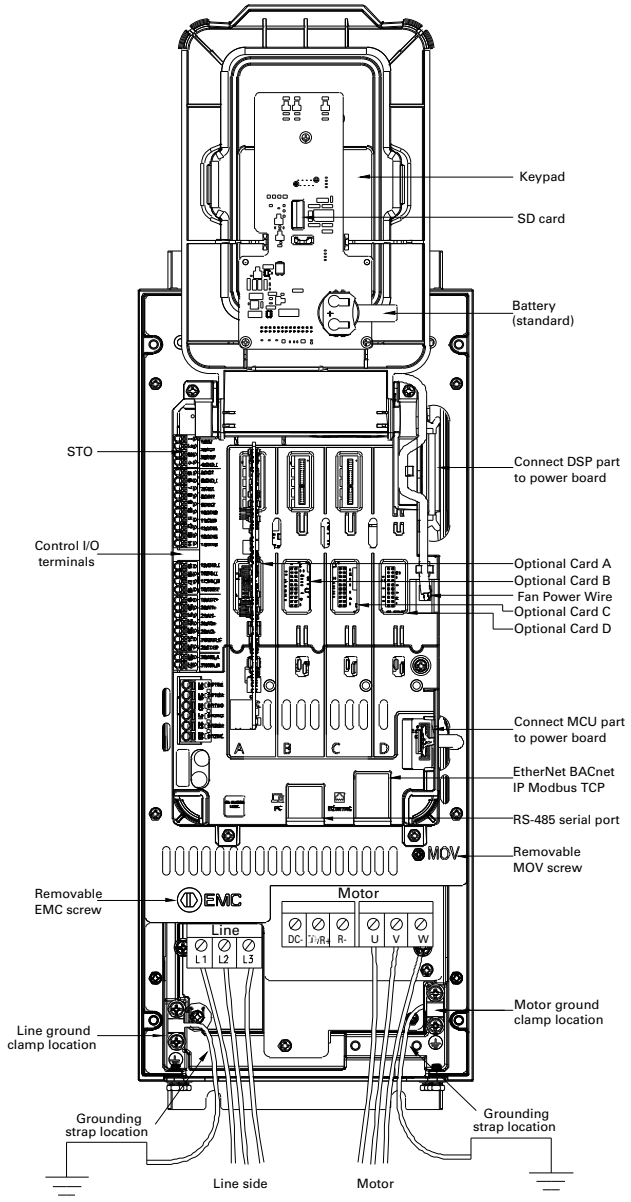
Step 2: Remove power wiring protection plate. Use power/motor cable tables on **Appendix B—Installation guidelines.**

Step 3: Add attachable grounding clamps (qty 2), one on each side of drive.

Step 4: Pass motor, input power wires/cables through base wiring plate.

Step 5: If shielded cable is used, connect the shields of input power and motor cables shields to ground.

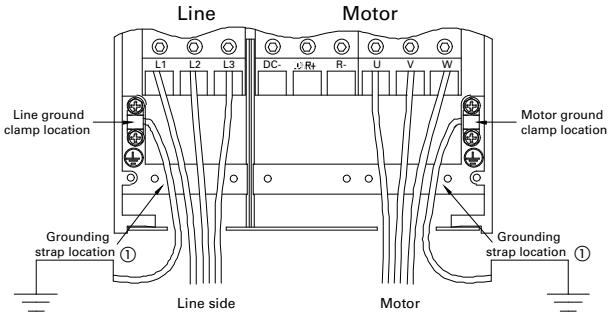
Figure 27. PowerXL DX1 variable frequency drive



Step 6: Wire power terminals (L1, L2, L3), motor terminal (U, V, W), and grounding terminals per **Figure 28**. It is recommended for power and motor leads to be in separate conduit.

To meet the UL requirements, if conduit is being used for wiring, the enclosure openings provided for conduit connections in the field shall be closed by UL listed conduit fittings with the same type rating (Type 1/Type 12) as the enclosure.

Figure 28. Ground wiring

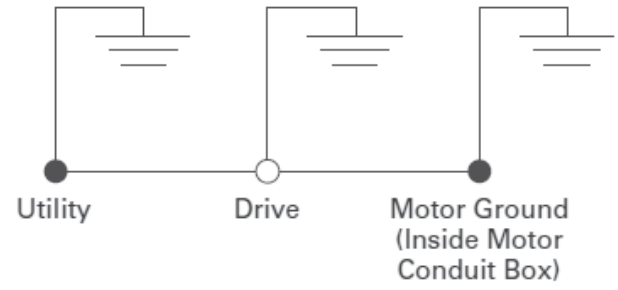


① Actual layout may vary slightly by frame.

Note: Do not wire motor leads to R+, R–. This will cause damage to the drive.

Ground wiring

- Run motor cables in separate conduit
- DO NOT RUN CONTROL WIRES in same conduit
- Cables sized per **Appendix B—Installation guidelines**
- Provide **dedicated** wire for low impedance ground between drive and motor. DO NOT USE conduit as ground
- Motor cable ground shall be terminated both at the motor and drive end

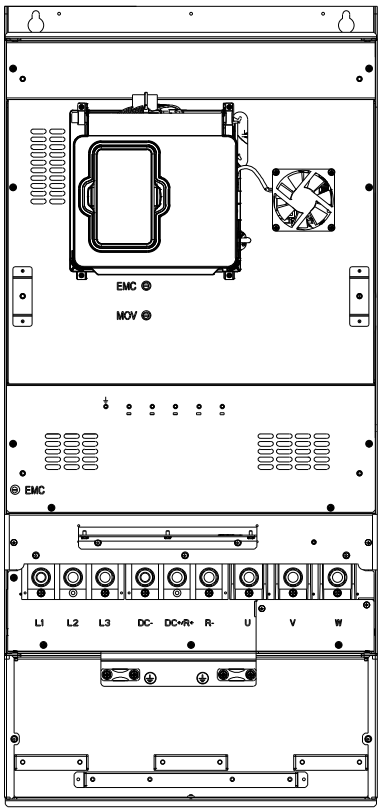


⚠ CAUTION

Improper grounding could result in damage to the motor and/or drive and could void warranty.

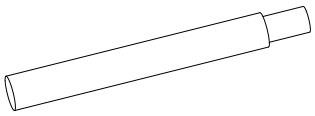
FR6 wiring

Figure 29. FR6 wiring layout

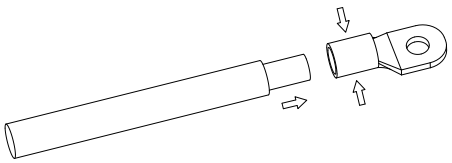


FR6 wiring process

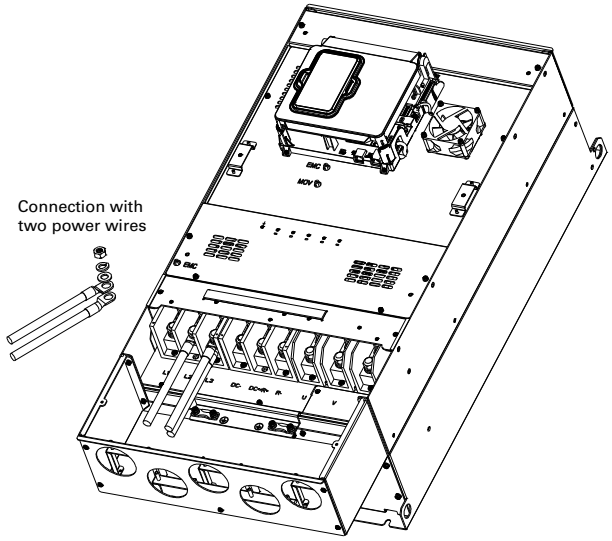
Step 1: Strip power wire jacket (Stripping length according to **Table 29**).



Step 2: Connect the power wire to a lug. Use a tool to press the wire and lug together tightly.



Step 3: Connect the power wire to the FR6 terminal block, lock the wire by a nut. Depending on the current level, one or two power wires can be connected to each pole of the terminal block.



Connection tightening torque

Table 26. Tightening torque

Frame size	Power wire lb-in (Nm)	Ground wire lb-in (Nm)	Control wire (RO) lb-in (Nm)	Control wire (others) lb-in (Nm)
FR1	5.3 (0.6)	10 (1.1)	4.5 (0.5)	2.5 (0.3)
FR2	15.6 (1.8)	10 (1.1)	4.5 (0.5)	2.5 (0.3)
FR3	33 (3.7)	10 (1.1)	4.5 (0.5)	2.5 (0.3)
FR4	95 (10.7)	14 (1.6)	4.5 (0.5)	2.5 (0.3)
FR5	354 (40)	35 (4.0)	4.5 (0.5)	2.5 (0.3)
FR6	480 (54.2)	35 (4.0)	4.5 (0.5)	2.5 (0.3)

Table 27. Spacing between parallel motor cables

Cable length	Distance between cables
Less than 164 ft (50 m)	1 ft (0.3 m)
Less than 657 ft (200 m)	3 ft (1.0 m)

Table 28. Maximum motor power cable length 230/480/575 V

Frame size	No filter	With reactor	With dV/dt filter
FR1	50 m	100 m	300 m
FR2	50 m	100 m	300 m
FR3	50 m	100 m	300 m
FR4	50 m	100 m	300 m
FR5	50 m	100 m	300 m
FR6	50 m	100 m	300 m

Figure 30. Input power and motor cable stripping lengths

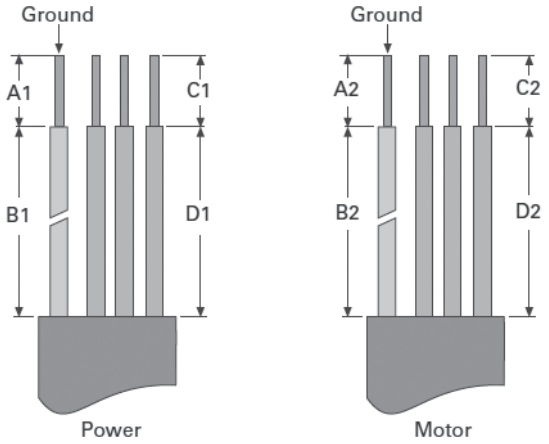


Table 29. Input power and motor cable stripping and wire lengths

Frame size	Power wiring in inches (mm)				Motor wiring in inches (mm)			
	A1	B1	C1	D1	A2	B2	C2	D2
FR1	0.39 (10)	1.77 (45)	0.39 (10)	1.38 (35)	0.39 (10)	1.77 (45)	0.39 (10)	1.38 (35)
FR2	0.59 (15)	1.77 (45)	0.59 (15)	1.77 (45)	0.59 (15)	1.57 (40)	0.59 (15)	1.57 (40)
FR3	0.59 (15)	1.57 (40)	0.59 (15)	1.97 (50)	0.59 (15)	1.57 (40)	0.59 (15)	1.97 (50)
FR4	0.98 (25)	2.56 (65)	0.98 (25)	4.72 (120)	0.98 (25)	2.56 (65)	0.98 (25)	4.72 (120)
FR5	1.10 (28)	6.10 (155)	1.10 (28)	9.45 (240)	1.10 (28)	6.10 (155)	1.10 (28)	9.45 (240)
FR6	0.98 (25)	4.72 (120)	0.98 (25)	7.87 (200)	0.98 (25)	4.72 (120)	0.98 (25)	7.87 (200)

Cable routing

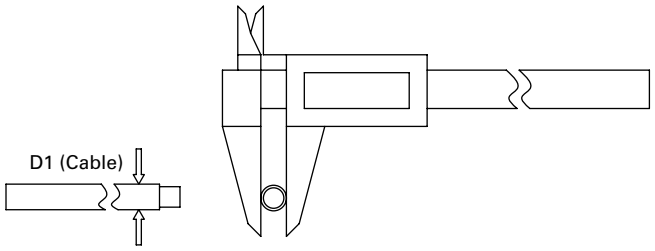
If conduit is being used for wiring, use separate conduits for line voltage (mains), motor cables, and all interface/control wiring.

To meet the UL requirements, if conduit is being used for wiring, the enclosure openings provided for conduit connections in the field shall be closed by UL listed conduit fittings with the same type rating (Type 1 / Type 12) as the enclosure.

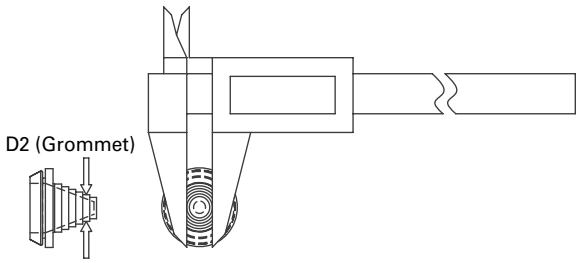
Avoid running motor cables alongside or parallel to any other wiring. If it is necessary to run motor cables with other wiring, then maintain spacing between motor cables and other wiring in accordance with **Table 27**.

Rubber grommet installation instructions

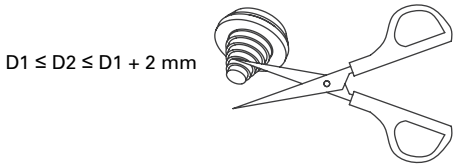
Step 1: Measure the outside diameter of the cable (D1) used to connect to the drive.



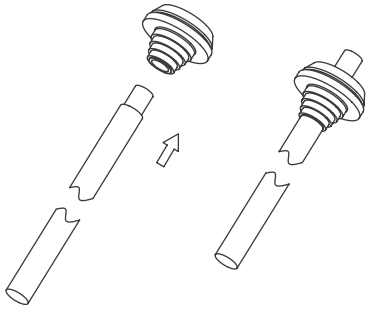
Step 2: Measure the outside diameter of the rubber grommet (D2) and select a suitable D2 (D1 ≤ D2 ≤ D1 + 2 mm).



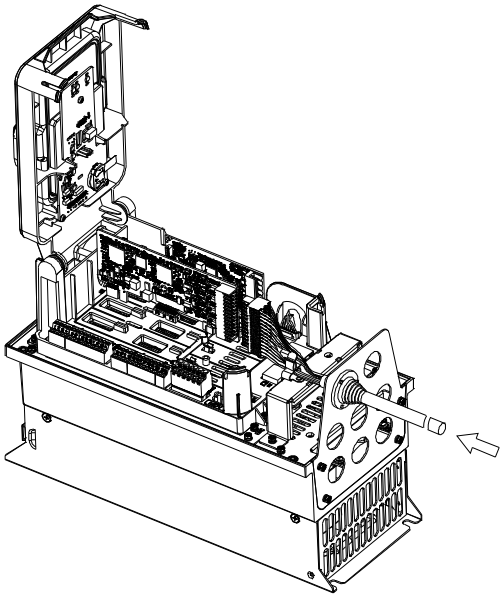
Step 3: Cut the rubber grommet at the selected diameter.



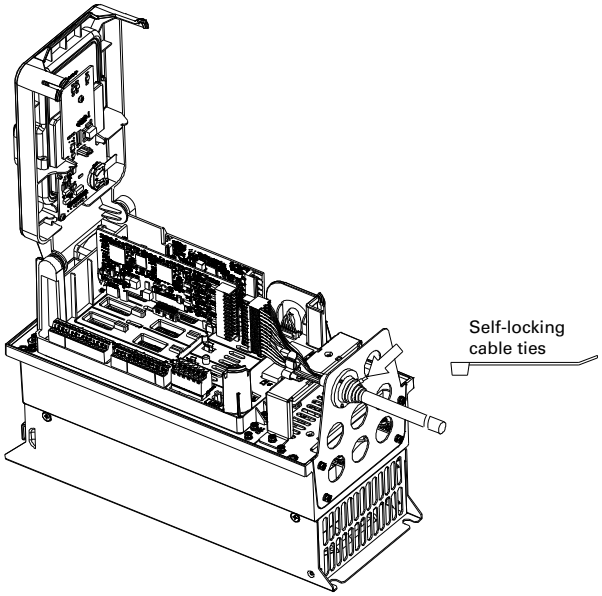
Step 4: Run the cable through the rubber grommet.



Step 5: Insert the rubber grommet into the conduit plate together with the cable.

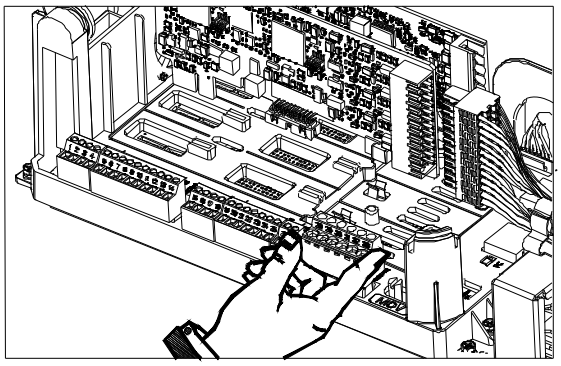


Step 6: Fasten the rubber grommet and cable with a self-locking cable tie.



Control wiring

Step 7: Wire the control terminals following the details for the specific option boards shown on the following pages.



Note: For ease of access, the board terminals blocks can be unplugged for wiring.

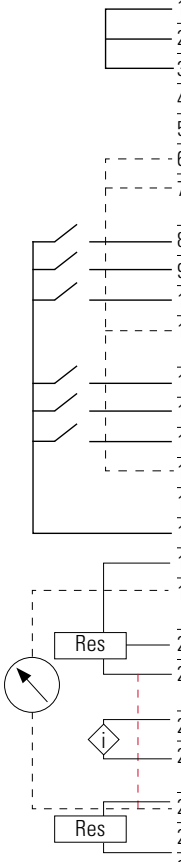
Step 8: Wire control to the control board

Note: Drive default is programmed for external interlock.

I/O connection

- Run 240 Vac and 24 Vdc control wiring in separate conduit
- Communication wire to be shielded

Table 30. DX1 I/O connection

External wiring	Pin	Signal name	Signal	Default setting	Description
	1	24V	+24 Vdc		Supply source of STO
	2	STO1	Safety torque off 1		Function safety related port, normally connect 24 V
	3	STO2	Safety torque off 2		Function safety related port, normally connect 24 V
	4	GND_I	I/O signal ground		STO ground
	5	DO1	Digital output 1	Ready	Shows the drive is ready to run
	6	GND_I	I/O signal ground		I/O ground
	7	CMA	DIN1 to DIN3 common	Grounded	Isolate from ground, could be connect to ground via parameter setting
	8	DIN1	Digital input 1	Run forward	Input starts drive in forward direction (start enable)
	9	DIN2	Digital input 2	Run reverse	Input starts drive in reverse direction (start enable)
	10	DIN3	Digital input 3	External fault	Input causes drive to fault
	11	CMB	DIN4 to DIN6 common	Grounded	Isolate from ground, could be connect to ground via parameter setting
	12	DIN4	Digital input 4	Fault reset	Input resets active faults
	13	DIN5	Digital input 5	Preset speed b0	Sets frequency output to preset speed 1
	14	DIN6	Digital input 6	Preset speed b1	Sets frequency output to preset speed 2
	15	GND_I	I/O signal ground		I/O ground
	16	24V_I	+24 Vdc input		External control voltage input
	17	24V_O	+24 Vdc output		Control voltage output (250 mA maximum)
	18	10REF	Ref. Output voltage	10 V	10 Vdc supply source
	19	AO1+	Analog output 1	Output frequency	Shows output frequency to motor 0–60 Hz (4 mA to 20 mA)
	20	AI1+	Analog input 1 +	Remote1 reference	Remote1 reference default select use analog input1
	21	AI1-	Analog input 1 -		Analog I/O ground, could be configured to disconnect from ground.
	22	AI2+	Analog input 2 +	PID feedback 1 source	PID feedback 1 source default select use analog input 2
	23	AI2-	Analog input 2 -		I/O ground, could be disconnected from ground by keypad setting
	24	GND_C	Thermistor input signal ground		Ground for reference
	25	THER	Motor thermistor		Detect the internal thermal rise and protected by drive
	26	485_A	RS-485 signal A/+	—	Fieldbus communication (Modbus, BACnet)
	27	485_B	RS-485 signal B/–	—	Fieldbus communication (Modbus, BACnet)
	28	RY1NC	Relay 1 normally closed	Run	Relay output 1 shows VFD is in a run state
	29	RY1CM	Relay 1 common		
	30	RY1NO	Relay 1 normally open		
	31	RY2NO	Relay 2 normally open		
	32	RY2CM	Relay 2 common		
	33	RY2NC	Relay 2 normally closed	Fault	Relay output 2 shows VFD is in a fault state

Parameter settings

Code	Parameter	Default	ID	Note
P3.3.1	CMA To GND_I Enable	0	3970	0 = Disabled, 1 = Enabled
P3.3.2	CMB To GND_I Enable	0	3971	0 = Disabled, 1 = Enabled
P96.4.3	RS485 Terminal Resistance Connect	0	3969	0 = No, 1=Yes
P2.2.1	AI1 Mode	1	222	0 = 0–20 mA 1 = 0 –10 V 2 = –10– +10 V
P2.2.2	AI1 Signal Range	0	175	0 = 0–100%/0–20 mA/0–10 V/–10–10 V 1 = 20–100%/4–20 mA/2–10 V/–6–10 V 2 = Customized
P2.3.1	AI2 Mode	0	223	0 = 0–20 mA 1 = 0 –10 V 2 = –10– +10 V
P2.3.2	AI2 Signal Range	1	183	0 = 0–100%/0–20 mA/0–10 V/–10–10 V 1 = 20–100%/4–20 mA/2–10 V/–6–10 V 2 = Customized

The above wiring demonstrates a SINK configuration. It is important that CMA and CMB are wired to ground (as shown by dashed line).If a SOURCE configuration is desired, wire 24 V to CMA and CMB and close the inputs to ground by parameter setting. When using the +10 V for AI1, it is important to wire AI1-to GND_C (as shown by dashed line). If using +10 V for AI1 or AI2, terminals 21, 23, and 24 need to be jumpered together.

Figure 31. Terminal block layout

24V	STO1	STO2	GND_I	DO1	GND_I	CMA	DIN1	DIN2	DIN3	CMB	DIN4	DIN5	DIN6		GND_I	24V_I	24V_O	10REF	AO1+	AI1+	AI1-	AI2+	AI2-	GND_C	THER	485_A	485_B		RY1NC	RY1CM	RY1NO	RY2NO	RY2CM	RY2NC
1	2	3	4	5	6	7	8	9	10	11	12	13	14		15	16	17	18	19	20	21	22	23	24	25	26	27		28	29	30	31	32	33

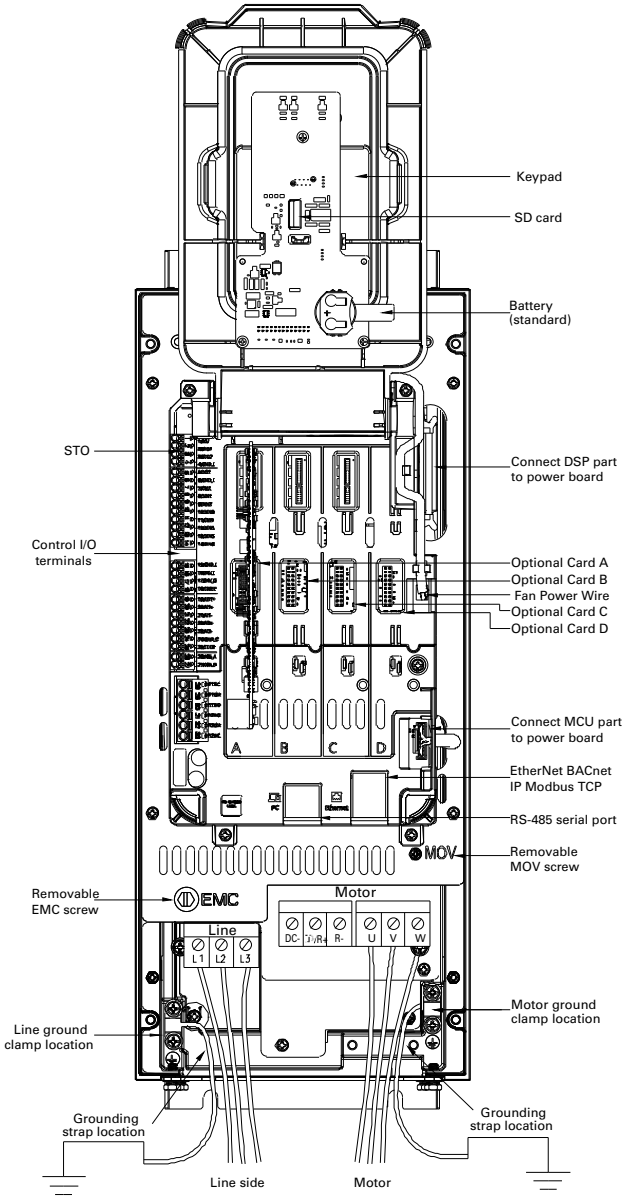
Table 31. I/O specifications

Item	Specification
Analog input (2)	Selectable for either voltage or current reference signal
	0 V to 10 V, –10 V to 10 V, 0 (4) to 20 mA; Ri – 250 ohm differential
Digital inputs (6)	Positive or negative logic; 18 Vdc to 30 Vdc, the frequency of DIN5/DIN6 can be up to 50 kHz
+24 V output	Auxiliary voltage, +24 V ±15%, total max. 250 mA on board (include optional cards)
+10 VREF	Output reference voltage, +10.3 V +3%, maximum load 10 mA
Analog outputs (1)	0 (4) to 20 mA; RL max. 500 ohm
	–10 to +10 V, 10 mA
Digital output (1)	Open drain output, 50 mA/24 V maximum
THER	Motor thermistor input, the value can be 0 to 4.7k ohm, when more than 4.7k, will trip over temp.
Relay outputs (2)	Programmable relay outputs: 2 x Form C
	Switching capacity: 30 Vdc/6 A, 120 Vac/6 A, 250 Vac/6 A
24 Vdc input	It shall be a SELV (Safety Extra Low Voltage) circuit. It shall not exceed 60 Vdc anytime.

Control board

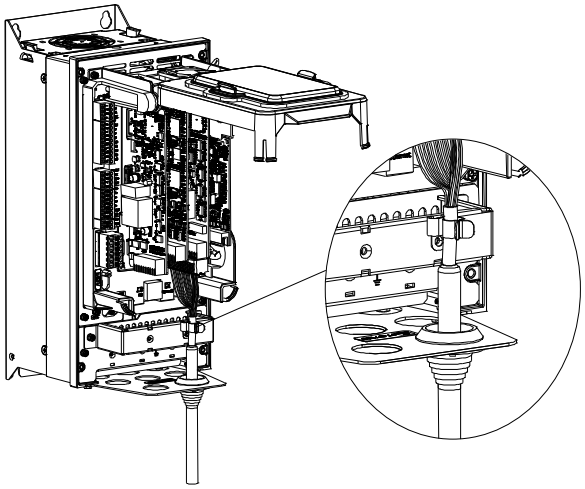
The main PowerXL DX1 Series VFD consists of a main control board, control I/O connections block and four slots for extra option boards.

Figure 32. PowerXL DX1 variable frequency drive



Note: This is a representation showing location of items. Location may be slightly different depending on frame size.

Control wiring



- All control I/O wiring is recommended to be segregated from line (mains) and motor cabling
- Control wiring shall be shielded twisted pairs to meet EMC levels required by IEC/EN 61800-3)
- Run 240 Vac and +24 Vdc control I/O in separate conduit
- Torque for RO terminals: 4.5 in-lb (0.5 Nm)
- Torque for other control terminals: 2.5 in-lb (0.3 Nm)
- Wiring or ferrule size for RO terminals: 28–12 AWG or 0.25–2.5 mm^2
- Wiring or ferrule size for other I/O terminals: 28–14 AWG or 0.25–1.5 mm^2

Safe torque off (STO)

Refer to Appendix E for details of STO.

The PowerXL DX1 Series includes Safe Torque Off (STO) functionality as standard and provides:

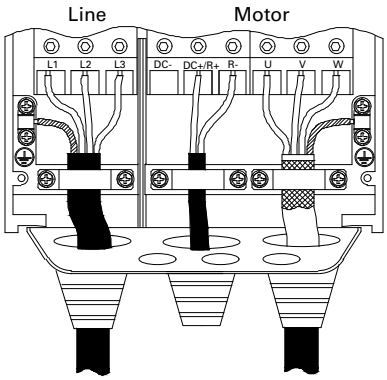
- Isolation from the control board will stop IGBT from firing
- Functional safety SIL2 certification: IEC/EN 61800-5-2 and DIN EN ISO 13849-1, category 3, Performance Level d

Connection to power section

Figure 33 shows the general connections for the frequency inverter in the power section.

Three-phase input connection

Figure 33. Connection to power section



Terminal designations in the power section

- L1, L2, L3: Connection terminals for the supply voltage (input, input voltage)
- U, V, W: Connection terminals for the three-phase line to the AC motor (output, frequency inverter)
- PE: Connection for protective ground (reference potential). PES with mounted cable routing plate for shielded cables

Ground connection

The ground connection is connected directly with the cable clamp plates.

The shielded cables between the frequency inverter and the motor should be as short as possible. Connect the shielding on both ends and over a large surface area with protective ground PES (Protective Earth Shielding). You can connect the shielding of the motor cable directly to the cable clamp plate (360 degrees coverage) with the protective ground.

The frequency inverter must always be connected to the ground potential via a grounding cable (PE).

Figure 34. Grounding parts

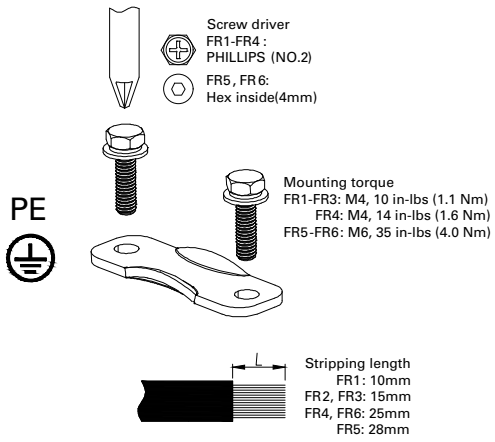
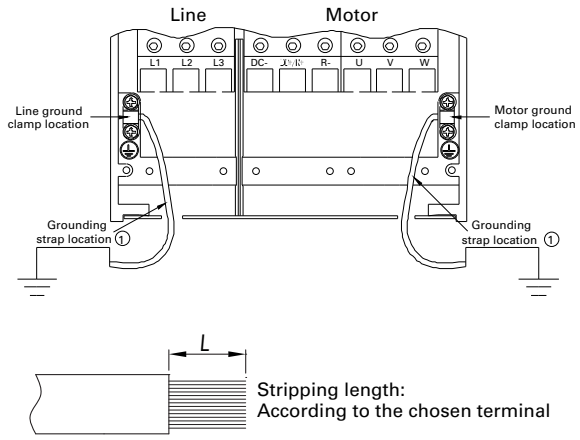


Figure 35. Grounding



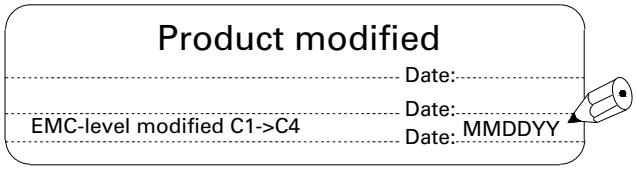
⚠ CAUTION

Before connecting the AC drive to mains, make sure that the EMC protection class settings of the drive are appropriately made.

Note: After having performed the change write "EMC level modified" on the sticker included in the PowerXL DX1 Series delivery (see **Figure 36**) and note the date. Unless already done, attach the sticker close to the name plate of the AC drive.

Product modified sticker

Figure 36. Product modified sticker



Checking the cable and motor insulation

1. Check the motor cable insulation as follows:
   - Disconnect the motor cable from terminals U, V and W of the PowerXL DX1 Series drive and from the motor
   - Measure the insulation resistance of the motor cable between each phase conductor as well as between each phase conductor and the protective ground conductor
   - The insulation resistance must be >1M ohm
2. Check the input power cable insulation as follows:
   - Disconnect the input power cable from terminals L1/N, L2/N and L3 of the PowerXL DX1 Series drive and from the utility line feeder
   - Measure the insulation resistance of the input power cable between each phase conductor as well as between each phase conductor and the protective ground conductor
   - The insulation resistance must be >1M ohm
3. Check the motor insulation as follows:
   - Disconnect the motor cable from the motor and open any bridging connections in the motor connection box
   - Measure the insulation resistance of each motor winding. The measurement voltage must equal at least the motor nominal voltage but not exceed 1000 V
   - The insulation resistance must be >1M ohm

Chapter 7—EMC installation

Note: All following information is strongly recommended but is not necessary if sufficient system design and validation has been completed.

The responsibility to meet the local system EMC limit values and electromagnetic compatibility requirements is the responsibility of the end user or the system operator. This operator must also take measures to minimize or remove emissions in the environment concerned (see **Figure 37 on page 54**). The operator must also use means to increase the interference immunity of the system devices.

In a drive system (PDS) with frequency inverters, you should take measures for electromagnetic compatibility (EMC) while doing your planning, because changes or improvements to the installation site, which are required in the installation or while mounting, are normally associated with additional higher costs.

The technology and system of a frequency inverter cause the flow of high frequency leakage current during operation. All grounding measures must therefore be implemented with low impedance connections over a large surface area.

With leakage currents greater than 3.5 mA, in accordance with VDE 0160 or EN 61800-5-1, either

- the protective conductor must have a cross-section of at least 10 mm^2
- the protective conductor must be open-circuit monitored, and the supply must be automatically disconnected in case of discontinuity of the protective earthing conductor, or
- the second protective conductor must be fitted

For an EMC-compliant installation, we recommend the following measures:

- Installation of the frequency inverter in a metallic, electrically conducting enclosure with a good connection to earth
- Shielded motor cables (short cable lengths)
- Ground all conductive components and housings in a drive system using as short a line as possible with the greatest possible cross-section (Cu-braid)

EMC measures in the control panel

For EMC-compatible installation, connect all metallic parts of the device and the switching cabinet together over broad surfaces and so that high-frequencies will be conducted. Mounting plates and cabinet doors should make good contact and be connected with short HF-braided cables. It is recommended to avoid using painted surfaces (anodized, chromized). An overview of all EMC measures is provided in **Figure 37 on page 54**.

Install the frequency inverter as directly as possible (without spacers) on a metal plate (mounting plate).

Route input and motor cables in the switch cabinet as close to the ground potential as possible. This is because free moving cables act as antennas.

When laying HF cables (for example, shielded motor cables) or suppressed cables (for example, input supply cables, control circuit and signal cables) in parallel, a minimum clearance of 11.81 in (300 mm) is recommended in order to prevent the radiation of electromagnetic energy. Separate cable routing is also recommended when large voltage potential differences are involved. Any necessary crossed cabling between the control signal and power cables should be implemented at right angles (90 degrees).

It is recommended to never lay control or signal cables in the same duct as power cables. Analog signal cables (measured, reference and correction values) should be shielded.

Earthing

The ground connection (PE) in the cabinet should be connected from the input supply to a central earth point (mounting plate). All protective conductors should be routed in star formation from this earth point and all conductive components of the PDS (frequency inverter, motor reactor, motor filter, main choke) are to be connected.

Avoid ground loops when installing multiple frequency inverters in one cabinet. Make sure that all metallic devices that are to be grounded have a broad area connection with the mounting plate.

Screen earth kit

Cables that are not shielded work like antennas (sending, receiving). Make sure that any cables that may carry disruptive signals (for example, motor cables) and sensitive cables (analog signal and measurement values) are shielded apart from one another with EMC-compatible connections.

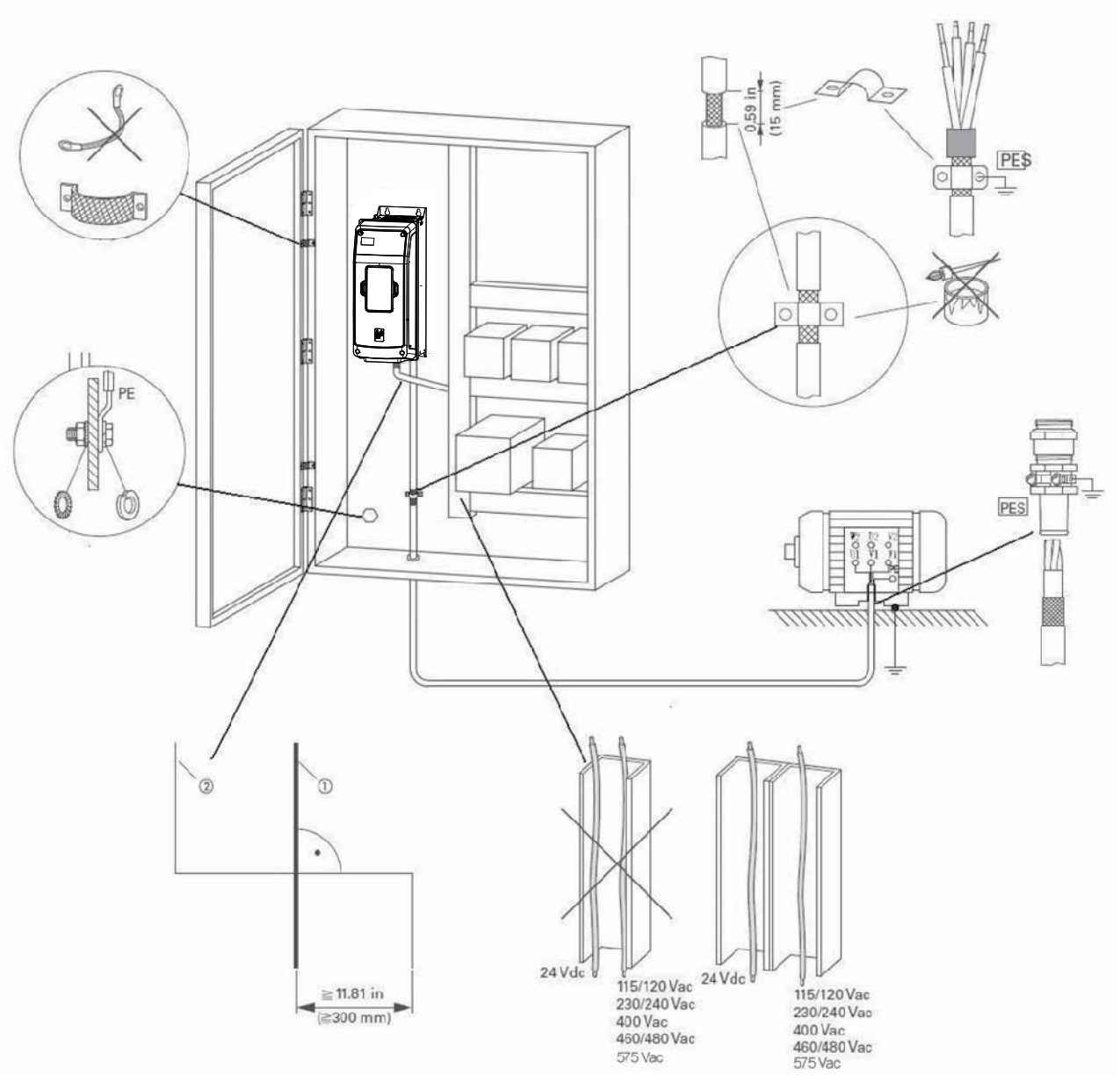
The effectiveness of the cable shield depends on a good shield connection and a low shield impedance.

It is recommended to use only shields with tinned or nickel-plated copper braiding. Braided steel shields are unsuitable.

Control and signal lines (analog, digital) should be grounded on both ends with the shielding and over a large surface area with protective ground PES. One is in the drive, one is in the immediate vicinity of the supply voltage source (PES).

Installation requirements

Figure 37. EMC-Compliant Setup—230 Vac, 460/480 Vac, 600 Vac



① Power cable: L1, L2, L3 and U, V, W.

② Control and signal lines: all lines, fieldbus connection. Large-area connection of all metallic control panel components. Mounting surfaces of frequency inverter and cable shielding must be free from paint. Connect the cable shielding in the output of the frequency inverter with a large surface area contact to the ground potential (PES). Large-area cable shield contacts with motor. Large-area earth connection of all metallic parts.

International EMC protection cable requirements

The screened cables between the variable frequency drive and the motor should be as short as possible.

- Connect the screening, on both sides and across a large area (360° overlap), to the protective earth (PE). The power screening protective earth (PES) connection should be in the immediate proximity of the variable frequency drive and directly on the motor terminal box
- Prevent the screening from becoming unbraided, e.g., by pushing the opened plastic sheath over the end of the screening or with a rubber grommet on the end of the screening. As an alternative, in addition to a broad area cable clip, you can also twist the shielding braid at the end and connect to protective ground with a cable clip. To prevent EMC disturbance, this twisted shielding connection should be made as short as possible
- Screened three- or four-wire cable is recommended for the motor cables. The green/yellow line of a four-wire cable connects the protective ground connections from the motor and the variable frequency drive and therefore minimizes the equalizing current loads on the shielding braid
- If there are additional subassemblies in a motor feeder (such as motor contactors, overload relays, motor reactor, sinusoidal filters or terminals), the shielding of the motor cable can be interrupted close to these subassemblies and connected to the mounting plate (PES) with a large area connection

Free or non-screened connection cables should not be any longer than about 300 mm.

Table 32. Cable EMC guidelines

Cable type	Category C2	Category C3
Line voltage/mains	1	1
Motor cable	3	3
Control cable	4	4

Note: See **Table 33** and **Table 34** for further information.

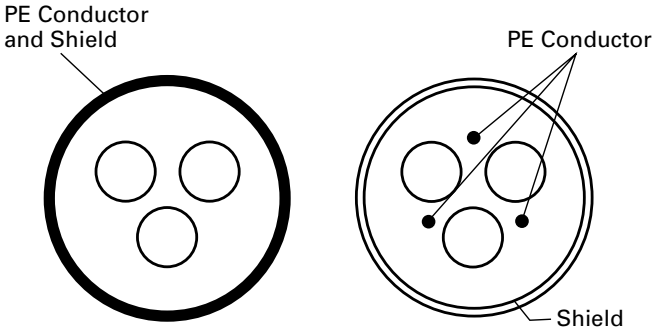
Table 33. Motor power cable EMC guidelines

Item	Standard
EMC (at default settings)	Immunity (EMS): IEC/EN 61800-3 second environment Industrial location
	Radiated and Conducted emissions (EMI): IEC/EN 61800-3
	230/480 V Series
	Category C1: is possible with cabinets and external filter connected to drive. Please consult factory.
	Category C2: with internal filter maximum of 10 m motor cable length
	Category C3: with internal filter maximum of 50 m motor cable length
	575 V Series
	Category C3: with internal filter maximum of 10 m motor cable length

Table 34. Cable categories

Cable category	Description (All cables are rated for the specific operating voltage)
1	Intended for fixed installation
2	Symmetrical power cable equipped with a concentric protection wire
3	Symmetrical power cable with compact low-impedance shield. Recommended cable transfer impedance of 1–30 MHz max. See figure below
4	Screened cable equipped with compact low-impedance shield

Figure 38. Cable description



Installation in corner-grounded network and IT system

Corner grounding and IT system are allowed for all the drive types.

In these cases, the internal EMC filters and ground-to-phase varistors shall be disconnected to prevent damage to the drive. This shall be done by removing the built-in EMC and MOV screws with a simple procedure described below.

Because the EMC filters have been removed, the EMC category will not be guaranteed any more.

⚠ WARNING

Do not perform any modifications on the AC drive when it is connected to mains.

⚠ WARNING

Electric shock hazard—risk of injuries! Carry out wiring work only if the unit is de-energized.

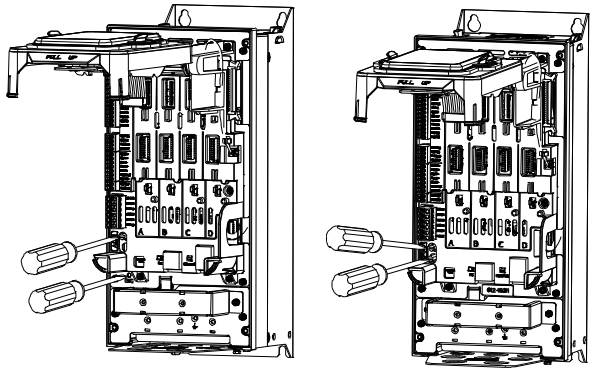
After disconnecting the supply, wait at least five minutes before removing the cover to allow the intermediate circuit capacitors to discharge.

⚠ WARNING

Failure to follow these instructions will result in death or serious injury.

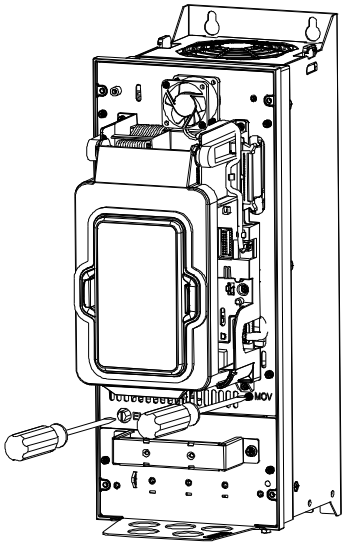
Remove the main cover of the AC drive and remove the EMC and MOV screws depending on frame size (see **Figure 39–Figure 44**). Once the screws are removed, they can be reconnected to re-engage the EMC protection.

Figure 39. Location of the EMC and MOV screws in Frame 1; remove the EMC screw for corner-grounded network



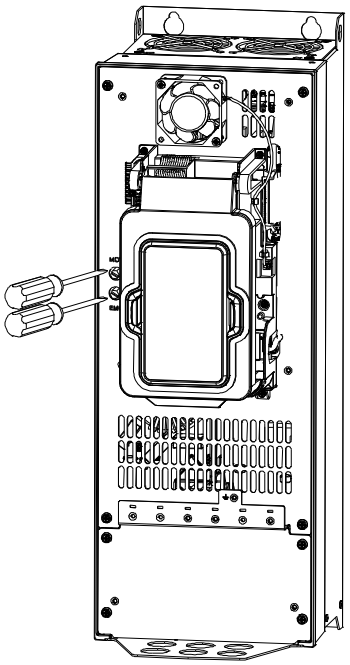
FR1 230/480 V FR1 575 V

Figure 40. Location of EMC and MOV screws in Frame 2; remove both the EMC screw and the MOV screw for corner-grounded network



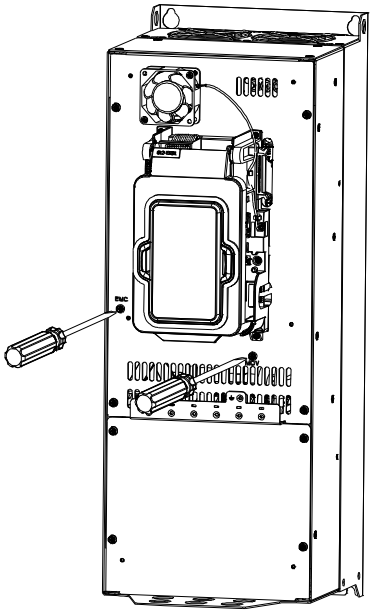
FR2

Figure 41. Location of EMC and MOV screws in Frame 3; remove both the EMC screw and the MOV screw for corner-grounded network



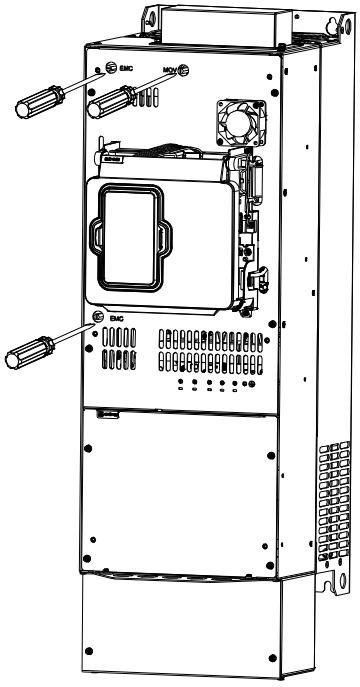
FR3

Figure 42. Location of EMC and MOV screws in Frame 4; remove both the EMC screw and the MOV screw for corner-grounded network



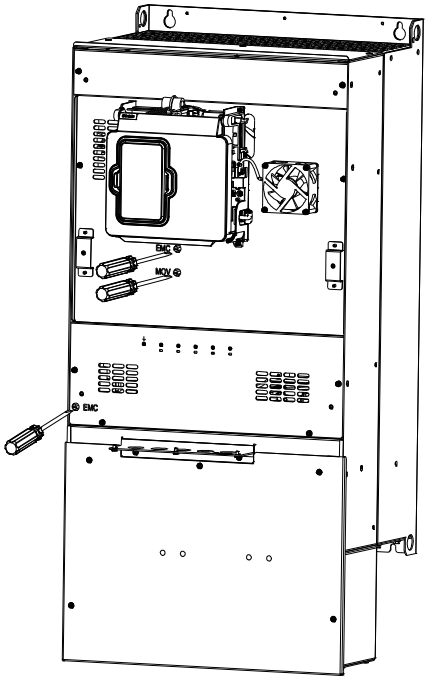
FR4

Figure 43. Location of EMC and MOV screws in Frame 5; remove both the 2 EMC screws and the 1 MOV screw for corner-grounded network



FR5

Figure 44. Location of EMC and MOV screws in Frame 6; remove both the 2 EMC screws and the 1 MOV screw for corner-grounded network



FR6

Appendix A—Technical data and specifications

Technical data

Table 35. PowerXL DX1 Series

Attribute	Description	Specification
Input ratings	Input voltage Uin	Three-phase, 208 V to 240 V, 380 V to 500 V, 525 V to 600 V, –15 to 10%
	Input frequency	50 Hz to 60 Hz (variation up to 45 Hz to 66 Hz)
	Connection to power	Once per minute or less
	Starting delay	3 s (FR1 and FR2), 4 s (FR3), 5 s (FR4), 6 s (FR5), 11 s (FR6)
	Short-circuit withstand rating	100 kAIC (fuses)
Output ratings	Output voltage	0 to Uin
	Continuous output current	I_L: ambient temperature maximum 40 °C, up to 60 °C with derating I_H: ambient temperature maximum 50 °C, up to 60 °C with derating
	Overload current	CT: 150% overload for 1 minute, 180% for 3 sec, 200% for 2 sec VT: 110% overload for 1 minute, 150% for 3 sec
	Initial output current	200% (2 s / 20 s) based of the drives rated nameplate IH current rating
	Output frequency	0–400 Hz (standard)
	Frequency resolution	0.01 Hz
Control characteristics	Control methods	Frequency control (0) Speed control (1) PM control 1 (2) PM control 2 (3) Open loop speed control (5) Open loop torque control (6) Closed loop speed control (7) Closed loop torque control (8)
	Switching frequency	230 V range: FR1–4: 1 kHz to 16 kHz FR5: 1 kHz to 12 kHz FR6: 1 kHz to 10 kHz 480 V range: FR1–3: 1 kHz to 16 kHz FR4/5: 1 kHz to 12 kHz FR6: 1 kHz to 10 kHz 230 V / 480 V defaults: FR1–3: 4 kHz FR4–5: 3.6 kHz FR6: 2 kHz 600 V range: FR1–6: 1 kHz to 6 kHz 600 V defaults: FR1–6: 1.5 kHz Automatic switching frequency derating in case of overload.
	Frequency reference	Analog input: resolution 0.1% (10-bit), accuracy +1% Analog output: resolution 0.1% (10-bit), accuracy +1% Panel reference: resolution 0.01 Hz
	Field weakening point	8 Hz to 400 Hz
	Acceleration time	0.1 s to 3000 s
	Deceleration time	0.1 s to 3000 s
	Braking torque	DC brake: 30% x Motor Rated Torque (Tn) (without brake chopper) Dynamic braking (with optional brake chopper using an external brake resistor): 100% continuous maximum rating

Table 35. PowerXL DX1 Series, continued

Attribute	Description	Specification
Ambient conditions	Ambient operating temperature	–10 °C (no frost) to +50 °C, up to +60 °C with derating (CT) –10 °C (no frost) to +40 °C, up to +60 °C with derating (VT)
	Storage temperature	–40 °C to +70 °C
	Relative humidity	0–95% RH, noncondensing, non-corrosive
	Altitude	100% load capacity (no derating) up to 3280 ft (1000 m) 1% derating for each 328 ft (100 m) above 3280 ft (1000 m) Up to 6562 ft (2000 m) (UL listing) Up to 13123 ft (4000 m) (without UL listing) If the installation site is higher than 6562 ft (2000 m) above sea level, contact your local Eaton representative for further information.
	Vibration	EN 61800-5-1/ EN 60068-2-6 10–150 Hz Displacement amplitude: 0.075 mm (peak) at 10 Hz to 57 Hz Maximum acceleration amplitude: 1 g at 57 Hz to 150 Hz
	Shock	ISTA 1 A / EN 60068-2-27 Operating: maximum 5 g, 30 ms
	Overvoltage	Overvoltage Category III
	Pollution degree	Pollution Degree 2
	Enclosure class	IP21/Type 1 IP54/Type 12
	MTBF	230 V FR1: 186,837 hours 230 V FR2: 196,257 hours 230 V FR3: 160,898 hours 230 V FR4: 178,913 hours 230 V FR5: 155,106 hours 230 V FR6: 170,557 hours 480 V FR1: 228,992 hours 480 V FR2: 221,169 hours 480 V FR3: 185,916 hours 480 V FR4: 179,937 hours 480 V FR5: 169,855 hours 480 V FR6: 173,303 hours 575 V FR1: 214,914 hours 575 V FR2: 209,985 hours 575 V FR3: 171,579 hours 575 V FR4: 170,461 hours 575 V FR5: 154,297 hours 575 V FR6: 171,701 hours
	Noise (sound pressure level)	FR1: 46.4 dB FR2: 60 dB FR3: 64.4 dB FR4: 66.4 dB FR5: 66 dB FR6: 70 dB
Standards	UL/cUL	UL 61800-5-1, CSA C22.2 No. 274-17
	LVD	IEC/EN 61800-5-1
	EMC	IEC/EN 61800-3 second environment and industrial location 230/480 V Series: Category C2 575 V Series: Category C3
	RED	EN 301489-1 V2.2.3, EN 301489-17 V 3.2.4, EN 300328 V2.2.2, EN 62479
	STO	SIL 2 / SIL CL 2 acc. to UL 61800-5-2, IEC/EN 61800-5-2, IEC/EN 61508, IEC/EN 62061 Cat.3 / PL d acc. to EN ISO 13849-1
	RoHS	EN IEC 63000
	Eco-Design	IE2 acc. to IEC/EN 61800-9-2, (90;100) losses are marked on rating labels Other details can be found at: Eaton.com/EcoDesign-VFD
	Electrostatic discharge	IEC/EN 61000-4-2,4 kV and 6 kV CD or 8 kV AD, Criterion B
	Fast transient burst	IEC/EN 61000-4-4, 2 kV/5 kHz and 100 kHz, Criterion B
	Approvals	UL, cUL, CE, UKCA, RoHS, UL Functional Safety
Fieldbus connections		Onboard: EtherNet/IP, Modbus TCP, Modbus RTU

Table 35. PowerXL DX1 Series, continued

Attribute	Description	Specification
Safety/protections	Overvoltage protection	Yes
	Overvoltage trip limit	230 V drives: 450 V 480 V drives: 900 V 600 V drives: 1100 V
	Undervoltage protection	Yes
	Undervoltage trip limit	230 V drives: 190 V 480 V drives: 350 V 600 V drives: 500 V
	Earth fault protection	Yes, Default: 15% Motor FLA Min: 0% Motor FLA Max: 30% Motor FLA
	Input phase supervision	Yes
	Motor phase supervision	Yes
	Overcurrent protection	Yes
	Unit overtemperature protection	Yes
	Motor overload protection	Yes
	Motor stall protection	Yes
	Motor underload protection	Yes
	DC bus overvoltage control	Yes
	Short-circuit protection of 24 V reference voltages	Yes
	Surge protection	Yes (Power ports: differential mode 2 kV; common mode 4 kV)
	Common coated boards	Yes (prevents corrosion)
	RTC Battery	3.0 V lithium battery (CR2032W) ROHS compliant Follow local recycling program to dispose **Note:** Only active when power removed.
Efficiency	Drive efficiency ratings	230 V drives: 97% approximately 480/600 V drives: 98% approximately

Appendix B—Installation guidelines

Cable and fuse sizing

See **page 45** for cable stripping guidelines.

Table 36. North America cable and fuse sizes—208 Vac to 240 Vac ratings

Frame size	CT ampere suffix	Input current (A)		NEC motor ampere rating (A)		Max. 50 °C output current (A)	Max. 40 °C output current (A)	Recommended fuse rating (A) (Class J/T/CF/CC)	NEC wire size (AWG) line and motor	Ground	Terminal connection size (AWG) line and motor	Ground
		(CT/I_H)	(VT/I_L)	230 V	208 V	(CT/I_H)	(VT/I_L)					
FR1	3D7	3.3	4.6	4.2	4.6	3.7	4.8	10	14	14	24-10	18-10
	4D8	4.6	6.3	6.0	6.6	4.8	6.6	15	14	14	24-10	18-10
	6D6	6.3	7.4	6.8	7.5	6.6	7.8	15	14	14	24-10	18-10
	7D8	7.4	10.6	9.6	10.6	7.8	11	20	14	12	24-10	18-10
	011	10.6	12	—	—	11	12.5	20	12	12	24-10	18-10
FR2	012	12	17	15.2	16.7	12.5	17.5	30	10	10	20-6	12-6
	017	17	24	22	24.2	17.5	25	40	8	10	20-6	12-6
	025	24	29	28	30.8	25	31	50	8	10	20-6	12-6
FR3	031	29	45	42	46.2	31	48	80	6	8	20-2	14-4
	048	45	57	54	59.4	48	61	100	4	8	20-2	14-4
FR4	061	57	70	68	74.8	61	75	125	3	6	6-1/0	10-1/0
	075	70	82	80	88	75	88	150	2	6	6-1/0	10-1/0
	088	82	106	104	114	88	114	175	1/0	6	6-1/0	10-1/0
FR5	114	106	133	130	143	114	143	225	3/0	4	1/0-350 kcmil	8-250 kcmil
	143	133	158	154	169	143	170	250	4/0	4	1/0-350 kcmil	8-250 kcmil
	170	158	189	192	211	170	211	300	300 kcmil	4	1/0-350 kcmil	8-250 kcmil
FR6	211	197	243	248	273	211	261	400	2*2/0	3	2*(1/0-300 kcmil)	3-300 kcmil
	248	231	291	312	343	248	312	450	2*4/0	2	2*(1/0-300 kcmil)	3-300 kcmil

Table 37. International cable and fuse sizes—208 Vac to 240 Vac ratings

Frame size	CT ampere suffix	Input current (A)		Max. 50 °C output current (A) (CT/I_H)	Max. 40 °C output current (A) (VT/I_L)	Recommended fuse rating (A) (gG/gL)	Mains and motor cable Cu (mm^2)	Terminal cable size	
		(CT/I_H)	(VT/I_L)					Main terminal Cu (mm^2)	Earth terminal Cu (mm^2)
FR1	3D7	3.3	4.6	3.7	4.8	10	3*1.5+1.5	0.2–6	0.75–6
	4D8	4.6	6.3	4.8	6.6	12	3*1.5+1.5	0.2–6	0.75–6
	6D6	6.3	7.4	6.6	7.8	12	3*1.5+1.5	0.2–6	0.75–6
	7D8	7.4	10.6	7.8	11	20	3*1.5+1.5	0.2–6	0.75–6
	011	10.6	12	11	12.5	20	3*1.5+1.5	0.2–6	0.75–6
FR2	012	12	17	12.5	17.5	32	3*2.5+2.5	0.5–16	4–16
	017	17	24	17.5	25	40	3*4+4	0.5–16	4–16
	025	24	29	25	31	50	3*6+6	0.5–16	4–16
FR3	031	29	45	31	48	80	3*16+16	0.5–35	2.5–25
	048	45	57	48	61	100	3*16+16	0.5–35	2.5–25
FR4	061	57	70	61	75	125	3*25+16	16–50	6–50
	075	70	82	75	88	160	3*35+16	16–50	6–50
	088	82	106	88	114	200	3*50+25	16–50	6–50
FR5	114	106	133	114	143	224	3*70+35	50–185	10–120
	143	133	158	143	170	250	3*95+50	50–185	10–120
	170	158	189	170	211	315	3*150+95	50–185	10–120
FR6	211	197	243	211	261	400	2*(3*70+35)	2*(50–150)	25–150
	248	231	291	248	312	450	2*(3*95+50)	2*(50–150)	25–150

Table 38. North America cable and fuse sizes—380 Vac to 500 Vac ratings

Frame size	CT ampere suffix	Input current (A)		NEC motor ampere rating (A) at 460 V	Max. 50 °C output current (A)	Max. 40 °C output current (A)	Recommended fuse rating (A) (Class J/T/CF/CC)	NEC wire size (AWG) line and motor	Ground	Terminal connection size (AWG) line and motor	Ground
		(CT/I_H)	(VT/I_L)		(CT/I_H)	(VT/I_L)					
FR1	2D2	2.1	3.2	3	2.2	3.3	6	14	14	26-10	18-10
	3D3	3.2	4.2	3.4	3.3	4.3	10	14	14	26-10	18-10
	4D3	4.2	5.4	4.8	4.3	5.6	10	14	14	26-10	18-10
	5D6	5.4	7.3	7.6	5.6	7.6	15	14	14	26-10	18-10
	7D6	7.3	8.8	—	7.6	9	20	14	12	26-10	18-10
	9D0	8.8	11.6	11	9	12	20	12	12	26-10	18-10
FR2	012	11.6	15.4	14	12	16	30	12	10	20-6	12-6
	016	15.4	22	21	16	23	40	10	10	20-6	12-6
	023	22	29	27	23	31	50	8	10	20-6	12-6
FR3	031	29	36	34	31	38	60	8	10	20-2	14-4
	038	36	43	40	38	46	70	6	8	20-2	14-4
	046	43	57	52	46	61	100	4	8	20-2	14-4
FR4	061	57	67	65	61	72	125	3	6	6-1/0	10-1/0
	072	67	81	77	72	87	150	2	6	6-1/0	10-1/0
	087	81	98	96	87	105	175	1/0	6	6-1/0	10-1/0
FR5	105	98	131	124	105	140	225	3/0	4	1/0-350 kcmil	8-250 kcmil
	140	131	158	156	140	170	250	4/0	4	1/0-350 kcmil	8-250 kcmil
	170	158	189	180	170	205	300	300 kcmil	4	1/0-350 kcmil	8-250 kcmil
FR6	205	194	247	240	205	261	400	2*2/0	3	2*(1/0-300 kcmil)	3-300 kcmil
	245	232	293	302	245	310	450	2*4/0	2	2*(1/0-300 kcmil)	3-300 kcmil

Table 39. International cable and fuse sizes—380 Vac to 500 Vac ratings

Frame size	CT ampere suffix	Input current (A)		Max. 50 °C output current (A)	Max. 40 °C output current (A)	Recommended fuse rating (gG/gL)	Mains and motor cable Cu (mm^2)	Terminal cable size	
		(CT/I_H)	(VT/I_L)	(CT/I_H)	(VT/I_L)			Main terminal Cu (mm^2)	Earth terminal Cu (mm^2)
FR1	2D2	2.1	3.2	2.2	3.3	10	3*1.5+1.5	0.2–6	0.75–6
	3D3	3.2	4.2	3.3	4.3	10	3*1.5+1.5	0.2–6	0.75–6
	4D3	4.2	5.4	4.3	5.6	10	3*1.5+1.5	0.2–6	0.75–6
	5D6	5.4	7.3	5.6	7.6	16	3*1.5+1.5	0.2–6	0.75–6
	7D6	7.3	8.8	7.6	9	20	3*1.5+1.5	0.2–6	0.75–6
	9D0	8.8	11.6	9	12	20	3*1.5+1.5	0.2–6	0.75–6
FR2	012	11.6	15.4	12	16	32	3*2.5+2.5	0.5–16	4–16
	016	15.4	22	16	23	40	3*4+4	0.5–16	4–16
	023	22	29	23	31	50	3*6+6	0.5–16	4–16
FR3	031	29	36	31	38	63	3*10+10	0.5–35	2.5–25
	038	36	43	38	46	80	3*16+16	0.5–35	2.5–25
	046	43	57	46	61	100	3*16+16	0.5–35	2.5–25
FR4	061	57	67	61	72	125	3*25+16	16–50	6–50
	072	67	81	72	87	160	3*35+16	16–50	6–50
	087	81	98	87	105	200	3*50+25	16–50	6–50
FR5	105	98	131	105	140	224	3*70+35	50–185	10–120
	140	131	158	140	170	250	3*95+50	50–185	10–120
	170	158	189	170	205	315	3*120+70	50–185	10–120
FR6	205	194	247	205	261	400	2*(3*70+35)	2*(50–150)	25–150
	245	232	293	245	310	450	2*(3*95+50)	2*(50–150)	25–150

Table 40. North America cable and fuse sizes—525 Vac to 600 Vac ratings

Frame size	CT ampere suffix	Input current (A)		NEC motor ampere rating (A) at 575 V	Max. 50 °C output current (A)	Max. 40 °C output current (A)	Recommended fuse rating (A) (Class J/T/CF/CC)	NEC wire size (AWG) line and motor	Ground	Terminal connection size (AWG) line and motor	Ground
		(CT/I_H)	(VT/I_L)		(CT/I_H)	(VT/I_L)					
FR1	3D3	3.2	4.3	3.9	3.3	4.5	10	14	14	26–10	18–10
	4D5	4.3	7.3	6.1	4.5	7.5	15	14	14	26–10	18–10
	7D5	7.3	9.6	9	7.5	10	20	14	12	26–10	18–10
FR2	010	9.6	13	11	10	13.5	30	12	10	20–6	12–6
	013	13	17	17	13.5	18	35	10	10	20–6	12–6
	018	17	21	22	18	22	45	10	10	20–6	12–6
FR3	022	21	26	27	22	27	50	8	10	20–2	14–4
	027	26	32	32	27	34	60	8	10	20–2	14–4
	034	32	39	41	34	41	70	6	8	20–2	14–4
FR4	041	39	49	52	41	52	80	4	8	6–1/0	10–1/0
	052	49	58	62	52	62	100	4	8	6–1/0	10–1/0
	062	58	75	77	62	80	125	2	6	6–1/0	10–1/0
FR5	080	75	94	99	80	100	175	1/0	6	1/0–350 kcmil	8–250 kcmil
	100	94	117	125	100	125	200	2/0	6	1/0–350 kcmil	8–250 kcmil
	125	117	134	144	125	144	225	3/0	4	1/0–350 kcmil	8–250 kcmil
FR6	144	141	203	192	144	208	350	2*1/0	3	2*(1/0–300 kcmil)	3–300 kcmil
	208	203	244	242	208	250	450	2*2/0	2	2*(1/0–300 kcmil)	3–300 kcmil

Table 41. International cable and fuse sizes—525 Vac to 600 Vac ratings

Frame size	CT ampere suffix	Input current (A)		Max. 50 °C output current (A) (CT/I_H)	Max. 40 °C output current (A) (VT/I_L)	Recommended fuse rating (gG/gL)	Mains and motor cable Cu (mm^2)	Terminal cable size	
		(CT/I_H)	(VT/I_L)					Main terminal Cu (mm^2)	Earth terminal Cu (mm^2)
FR1	3D3	3.2	4.3	3.3	4.5	10	3*1.5+1.5	0.2–6	0.75–6
	4D5	4.3	7.3	4.5	7.5	16	3*1.5+1.5	0.2–6	0.75–6
	7D5	7.3	9.6	7.5	10	20	3*1.5+1.5	0.2–6	0.75–6
FR2	010	9.6	13	10	13.5	32	3*2.5+2.5	0.5–16	4–16
	013	13	17	13.5	18	35	3*2.5+2.5	0.5–16	4–16
	018	17	21	18	22	40	3*4+4	0.5–16	4–16
FR3	022	21	26	22	27	50	3*6+6	0.5–35	2.5–25
	027	26	32	27	34	63	3*10+10	0.5–35	2.5–25
	034	32	39	34	41	80	3*10+10	0.5–35	2.5–25
FR4	041	39	49	41	52	80	3*16+16	16–50	6–50
	052	49	58	52	62	100	3*16+16	16–50	6–50
	062	58	75	62	80	125	3*25+16	16–50	6–50
FR5	080	75	94	80	100	160	3*50+25	50–185	10–120
	100	94	117	100	125	200	3*70+35	50–185	10–120
	125	117	134	125	144	224	3*70+35	50–185	10–120
FR6	144	141	203	144	208	355	2*(3*50+25)	2*(50–150)	25–150
	208	203	244	208	250	400	2*(3*70+35)	2*(50–150)	25–150

Temperature deratings

When using the PowerXL DX1 drives at elevated temperatures, derating is required to size the drive and maintain proper cooling. The following procedures and tables describe the process of derating and choosing the correct drive.

Procedure

Certain operating parameters and conditions are required for correct derating. These are: voltage, torque application (variable or constant), operating temperature, enclosure rating, switching frequency, required amperage.

Follow the below steps to correctly derate the PowerXL DX1 drives.

(Example requirement: Select a VFD catalog number for 480 V DX1 at 4 kHz switching frequency for a 75 A constant torque (CT) application)

1. Find the derating table (**Table 42**–**Table 47**) for the voltage and torque application.
   ex.: 480 V, Constant Torque = **Table 42**
2. Within the table, find the sections of rows for the application temperature and column for the switching frequency.
   ex.) 50 °C section, 4 kHz column
3. Look at all the frame sizes and find the frame size for your required amperage.
   ex.: FR1 = 9 A (@ 100%)
   FR2 = 23 A (100%)
   FR3 = 46 A (100%)
   FR4 = 85.1 A (97.8%) ← this is the frame size required for the 75 A application
   FR5 = 165 A (97.1%)
   FR6 = 192.5 A (78.6%)
4. Take the derating % for that frame size and go to the catalog tables (**Table 2**–**Table 6**). Derate each option within that frame size to find the correct drive.
   ex.: In this case, the frame size to look at is FR4 and the derating percentage is 97.8%
   DX1-34061FB-C21C: nominal current 61 A, derated to 97.8% = 59.7 A
   DX1-34072FB-C21C: nominal current 72 A, derated to 97.8% = 70.4 A
   DX1-34087FB-C21C: nominal current 87 A, derated to 97.8% = 85.1 A ← this is the drive to select

Table 42. 480 V temperature derating (CT)

Shading indicates default switching frequency for each frame size.

Frame size	Temp. (°C)	Maximum rated current amperes, (percentage of rated current) Switching frequency (kHz) 1	2	3	3.6	4	5	6	7	8	9	10	11	12	13	14	15	16
Input voltage—380 Vac to 500 Vac, 50/60 Hz, three-phase																		
FR1	40 °C	9 A (100%)	9 A (100%)	9 A (100%)	9 A (100%)	9 A (100%)	9 A (100%)	9 A (100%)	8.7 A (96.2%)	8.3 A (92.4%)	8 A (88.7%)	7.6 A (84.9%)	7.3 A (81.1%)	7 A (77.3%)	6.6 A (73.6%)	6.3 A (69.8%)	5.9 A (66%)	5.6 A (62.2%)
	45 °C	9 A (100%)	9 A (100%)	9 A (100%)	9 A (100%)	9 A (100%)	9 A (100.%)	9 A (100%)	8.6 A (95%)	8.1 A (90%)	7.7 A (85%)	7.2 A (80%)	6.8 A (75%)	6.3 A (70%)	5.9 A (65%)	5.4 A (60%)	5 A (55%)	4.5 A (50%)
	50 °C	9 A (100%)	9 A (100%)	9 A (100%)	9 A (100%)	9 A (100%)	9 A (100%)	9 A (100%)	8.4 A (93.8%)	7.9 A (87.6%)	7.3 A (81.3%)	6.8 A (75.1%)	6.2 A (68.9%)	5.6 A (62.7%)	5.1 A (56.4%)	4.5 A (50.2%)	4 A (44%)	3.4 A (37.8%)
	55 °C	8.2 A (90.6%)	8.2 A (90.6%)	8.2 A (90.6%)	8.2 A (90.6%)	8.2 A (90.6%)	7.9 A (88.1%)	7.7 A (85.7%)	7.2 A (80.1%)	6.7 A (74.6%)	6.2 A (69%)	5.7 A (63.4%)	5.2 A (57.9%)	4.7 A (52.3%)	4.2 A (46.7%)	3.7 A (41.1%)	3.2 A (35.6%)	2.7 A (30%)
	60 °C	7.3 A (81.1%)	7.3 A (81.1%)	7.3 A (81.1%)	7.3 A (81.1%)	7.3 A (81.1%)	6.9 A (76.2%)	6.4 A (71.3%)	6 A (66.3%)	5.5 A (61.4%)	5.1 A (56.6%)	4.7 A (51.7%)	4.2 A (46.8%)	3.8 A (41.9%)	3.3 A (36.9%)	2.9 A (32%)	2.4 A (27.1%)	2 A (22.2%)
FR2	40 °C	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	21.8 A (94.8%)	20.6 A (89.6%)	19.4 A (84.3%)	18.2 A (79.1%)	17 A (73.9%)	15.8 A (68.7%)	14.6 A (63.5%)	13.4 A (58.3%)	12.2 A (53%)	11 A (47.8%)
	45 °C	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	22.46 A (97.7%)	21.92 A (95.3%)	20.78 A (90.3%)	19.64 A (85.4%)	18.49 A (80.4%)	17.35 A (75.4%)	16.21 A (70.5%)	15.07 A (65.5%)	13.93 A (60.6%)	12.79 A (55.6%)	11.64 A (50.6%)	10.5 A (45.7%)
	50 °C	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	21.92 A (95.3%)	20.83 A (90.6%)	19.75 A (85.9%)	18.67 A (81.2%)	17.58 A (76.4%)	16.5 A (71.7%)	15.42 A (67%)	14.33 A (62.3%)	13.25 A (57.6%)	12.17 A (52.9%)	11.08 A (48.2%)	10 A (43.5%)
	55 °C	20.65 A (89.8%)	20.65 A (89.8%)	20.65 A (89.8%)	20.65 A (89.8%)	20.65 A (89.8%)	19.6 A (85.2%)	18.54 A (80.6%)	17.49 A (76%)	16.44 A (71.5%)	15.38 A (66.9%)	14.33 A (62.3%)	13.28 A (57.7%)	12.22 A (53.1%)	11.17 A (48.6%)	10.11 A (44%)	9.06 A (39.4%)	8 A (34.8%)
	60 °C	18.3 A (79.6%)	18.3 A (79.6%)	18.3 A (79.6%)	18.3 A (79.6%)	18.3 A (79.6%)	17.28 A (75.1%)	16.25 A (70.7%)	15.23 A (66.2%)	14.2 A (61.7%)	13.18 A (57.3%)	12.15 A (52.8%)	11.13 A (48.4%)	10.1 A (43.9%)	9.08 A (39.5%)	8.05 A (35%)	7.03 A (30.6%)	6 A (26.1%)
FR3	40 °C	46 A (100%)	46 A (100%)	46 A (100%)	46 A (100%)	46 A (100%)	44.17 A (96%)	42.33 A (92%)	40.5 A (88%)	38.67 A (84.1%)	36.83 A (80.1%)	35 A (76.1%)	33.17 A (72.1%)	31.33 A (68.1%)	29.5 A (64.1%)	27.67 A (60.2%)	25.83 A (56.2%)	24 A (52.2%)
	45 °C	46 A (100%)	46 A (100%)	46 A (100%)	46 A (100%)	46 A (100%)	43.96 A (95.6%)	41.92 A (91.1%)	39.88 A (86.7%)	37.84 A (82.3%)	35.79 A (77.8%)	33.75 A (73.4%)	31.71 A (68.9%)	29.67 A (64.5%)	27.63 A (60.1%)	25.59 A (55.6%)	23.54 A (51.2%)	21.5 A (46.7%)
	50 °C	46 A (100%)	46 A (100%)	46 A (100%)	46 A (100%)	46 A (100%)	43.75 A (95.1%)	41.5 A (90.2%)	39.25 A (85.3%)	37 A (80.4%)	34.75 A (75.5%)	32.5 A (70.7%)	30.25 A (65.8%)	28 A (60.9%)	25.75 A (56%)	23.5 A (51.1%)	21.25 A (46.2%)	19 A (41.3%)
	55 °C	41 A (89.1%)	41 A (89.1%)	41 A (89.1%)	41 A (89.1%)	41 A (89.1%)	38.84 A (84.4%)	36.67 A (79.7%)	34.5 A (75%)	32.34 A (70.3%)	30.17 A (65.6%)	28 A (60.9%)	25.84 A (56.2%)	23.67 A (51.5%)	21.5 A (46.7%)	19.34 A (42%)	17.17 A (37.3%)	15 A (32.6%)
	60 °C	36 A (78.3%)	36 A (78.3%)	36 A (78.3%)	36 A (78.3%)	36 A (78.3%)	33.92 A (73.7%)	31.83 A (69.2%)	29.75 A (64.7%)	27.67 A (60.2%)	25.58 A (55.6%)	23.5 A (51.1%)	21.42 A (46.6%)	19.33 A (42%)	17.25 A (37.5%)	15.17 A (33%)	13.08 A (28.4%)	11 A (23.9%)
FR4	40 °C	87 A (100%)	87 A (100%)	87 A (100%)	87 A (100%)	85.33 A (98.1%)	81.16 A (93.3%)	76.98 A (88.5%)	72.8 A (83.7%)	68.63 A (78.9%)	64.45 A (74.1%)	60.27 A (69.3%)	56.1 A (64.5%)	51.92 A (59.7%)	47.74 A (54.9%)	43.57 A (50.1%)	39.39 A (45.3%)	35.21 A (40.5%)
	45 °C	87 A (100%)	87 A (100%)	87 A (100%)	87 A (100%)	85.215 A (97.9%)	80.755 A (92.8%)	76.285 A (87.7%)	71.82 A (82.6%)	67.355 A (77.4%)	62.89 A (72.3%)	58.42 A (67.1%)	53.96 A (62%)	49.49 A (56.9%)	45.025 A (51.8%)	40.56 A (46.6%)	36.095 A (41.5%)	31.625 A (36.4%)
	50 °C	87 A (100%)	87 A (100%)	87 A (100%)	87 A (100%)	85.1 A (97.8%)	80.35 A (92.4%)	75.59 A (86.9%)	70.84 A (81.4%)	66.08 A (76%)	61.33 A (70.5%)	56.57 A (65%)	51.82 A (59.6%)	47.06 A (54.1%)	42.31 A (48.6%)	37.55 A (43.2%)	32.8 A (37.7%)	28.04 A (32.2%)
	55 °C	78.5 A (90.2%)	78.5 A (90.2%)	78.5 A (90.2%)	78.5 A (90.2%)	76.71 A (88.2%)	72.23 A (83%)	67.75 A (77.9%)	63.27 A (72.7%)	58.78 A (67.6%)	54.31 A (62.4%)	49.82 A (57.3%)	45.34 A (52.1%)	40.86 A (47%)	36.38 A (41.8%)	31.9 A (36.7%)	27.42 A (31.5%)	22.93 A (26.4%)
	60 °C	70 A (80.5%)	70 A (80.5%)	70 A (80.5%)	70 A (80.5%)	68.32 A (78.5%)	64.11 A (73.7%)	59.9 A (68.9%)	55.69 A (64%)	51.48 A (59.2%)	47.28 A (54.3%)	43.07 A (49.5%)	38.86 A (44.7%)	34.65 A (39.8%)	30.44 A (35%)	26.24 A (30.2%)	22.03 A (25.3%)	17.82 A (20.5%)
FR5	40 °C	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	166.24 A (97.8%)	156.84 A (92.3%)	147.43 A (86.7%)	138.03 A (81.2%)	128.62 A (75.7%)	119.22 A (70.1%)	109.81 A (64.6%)	100.41 A (59.1%)	91 A (53.5%)	—	—	—	—
	45 °C	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	165.62 A (97.4%)	154.67 A (91%)	143.72 A (84.5%)	132.77 A (78.1%)	121.81 A (71.7%)	110.86 A (65.2%)	99.91 A (58.8%)	88.96 A (52.3%)	78 A (45.9%)	—	—	—	—
	50 °C	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	165 A (97.1%)	152.5 A (89.7%)	140 A (82.4%)	127.5 A (75%)	115 A (67.6%)	102.5 A (60.3%)	90 A (52.9%)	77.5 A (45.6%)	65 A (38.2%)	—	—	—	—
	55 °C	142 A (83.5%)	142 A (83.5%)	142 A (83.5%)	142 A (83.5%)	138.07 A (81.2%)	128.25 A (75.4%)	118.43 A (69.7%)	108.61 A (63.9%)	98.79 A (58.1%)	88.96 A (52.3%)	79.14 A (46.6%)	69.32 A (40.8%)	59.5 A (35%)	—	—	—	—
	60 °C	114 A (67.1%)	114 A (67.1%)	114 A (67.1%)	114 A (67.1%)	111.14 A (65.4%)	104 A (61.2%)	96.85 A (57%)	89.71 A (52.8%)	82.57 A (48.6%)	75.42 A (44.4%)	68.28 A (40.2%)	61.14 A (36%)	54 A (31.8%)	—	—	—	—
FR6	40 °C	245 A (100%)	245 A (100%)	228.75 A (93.4%)	219 A (89.4%)	212.5 A (86.7%)	196.25 A (80.1%)	180 A (73.5%)	166.67 A (68%)	153.33 A (62.6%)	140 A (57.1%)	126.67 A (51.7%)	—	—	—	—	—	—
	45 °C	245 A (100%)	245 A (100%)	223.75 A (91.3%)	211 A (86.1%)	202.5 A (82.7%)	181.25 A (74%)	160 A (65.3%)	148.34 A (60.5%)	136.67 A (55.8%)	125 A (51%)	113.34 A (46.3%)	—	—	—	—	—	—
	50 °C	245 A (100%)	245 A (100%)	218.75 A (89.3%)	203 A (82.9%)	192.5 A (78.6%)	166.25 A (67.9%)	140 A (57.1%)	130 A (53.1%)	120 A (49%)	110 A (44.9%)	100 A (40.8%)	—	—	—	—	—	—
	55 °C	215 A (87.8%)	215 A (87.8%)	190.63 A (77.8%)	177.5 A (72.4%)	168.75 A (68.9%)	146.88 A (60%)	125 A (51%)	115.67 A (47.2%)	106.34 A (43.4%)	97 A (39.6%)	87.67 A (35.8%)	—	—	—	—	—	—
	60 °C	185 A (75.5%)	185 A (75.5%)	162.5 A (66.3%)	152 A (62%)	145 A (59.2%)	127.5 A (52%)	110 A (44.9%)	101.33 A (41.4%)	92.67 A (37.8%)	84 A (34.3%)	75.33 A (30.7%)	—	—	—	—	—	—

Table 43. 480 V temperature derating (VT)

Shading indicates default switching frequency for each frame size.

Frame size	Temp. (°C)	Maximum rated current amperes, (percentage of rated current) Switching frequency (kHz) 1	2	3	3.6	4	5	6	7	8	9	10	11	12	13	14	15	16
Input voltage—380 Vac to 500 Vac, 50/60 Hz, three-phase																		
FR1	40 °C	12 A (100%)	12 A (100%)	12 A (100%)	12 A (100%)	12 A (100%)	12 A (100%)	12 A (100%)	11.4 A (95%)	10.8 A (90%)	10.2 A (85%)	9.6 A (80%)	9 A (75%)	8.4 A (70%)	7.8 A (65%)	7.2 A (60%)	6.6 A (55%)	6 A (50%)
	45 °C	11 A (91.7%)	11 A (91.7%)	11 A (91.7%)	11 A (91.7%)	11 A (91.7%)	11 A (91.7%)	11 A (91.7%)	10.5 A (87.5%)	9.9 A (82.5%)	9.4 A (78.3%)	8.8 A (73.3%)	8.3 A (69.2%)	7.8 A (65%)	7.2 A (60%)	6.7 A (55.8%)	6.1 A (50.8%)	5.6 A (46.7%)
	50 °C	10 A (83.3%)	10 A (83.3%)	10 A (83.3%)	10 A (83.3%)	10 A (83.3%)	10 A (83.3%)	10 A (83.3%)	9.5 A (79.2%)	9 A (75%)	8.5 A (70.8%)	8 A (66.7%)	7.6 A (63.3%)	7.1 A (59.2%)	6.6 A (55%)	6.1 A (50.8%)	5.6 A (46.7%)	5.1 A (42.5%)
	55 °C	8.7 A (72.5%)	8.7 A (72.5%)	8.7 A (72.5%)	8.7 A (72.5%)	8.7 A (72.5%)	8.5 A (70.8%)	8.3 A (69.2%)	7.9 A (65.8%)	7.4 A (61.7%)	7 A (58.3%)	6.6 A (55%)	6.2 A (51.7%)	5.7 A (47.5%)	5.3 A (44.2%)	4.9 A (40.8%)	4.4 A (36.7%)	4 A (33.3%)
	60 °C	7.3 A (60.8%)	7.3 A (60.8%)	7.3 A (60.8%)	7.3 A (60.8%)	7.3 A (60.8%)	6.9 A (57.5%)	6.6 A (55%)	6.2 A (51.7%)	5.8 A (48.3%)	5.4 A (45%)	5.1 A (42.5%)	4.7 A (39.2%)	4.3 A (35.8%)	3.9 A (32.5%)	3.6 A (30%)	3.2 A (26.7%)	2.8 A (23.3%)
FR2	40 °C	31 A (100%)	31 A (100%)	31 A (100%)	31 A (100%)	31 A (100%)	29.5 A (95.2%)	28.1 A (90.6%)	26.6 A (85.8%)	25.2 A (81.3%)	23.7 A (76.5%)	22.2 A (71.6%)	20.8 A (67.1%)	19.3 A (62.3%)	17.9 A (57.7%)	16.4 A (52.9%)	14.9 A (48.1%)	13.5 A (43.5%)
	45 °C	28 A (90.3%)	28 A (90.3%)	28 A (90.3%)	28 A (90.3%)	28 A (90.3%)	26.7 A (86.1%)	25.4 A (81.9%)	24.1 A (77.7%)	22.8 A (73.5%)	21.4 A (69%)	20.1 A (64.8%)	18.8 A (60.6%)	17.5 A (56.5%)	16.2 A (52.3%)	14.9 A (48.1%)	13.5 A (43.5%)	12.2 A (39.4%)
	50 °C	25 A (80.6%)	25 A (80.6%)	25 A (80.6%)	25 A (80.6%)	25 A (80.6%)	23.8 A (76.8%)	22.7 A (73.2%)	21.5 A (69.4%)	20.3 A (65.5%)	19.1 A (61.6%)	18 A (58.1%)	16.8 A (54.2%)	15.6 A (50.3%)	14.4 A (46.5%)	13.3 A (42.9%)	12.1 A (39%)	10.9 A (35.2%)
	55 °C	24 A (77.4%)	24 A (77.4%)	24 A (77.4%)	24 A (77.4%)	24 A (77.4%)	22.8 A (73.5%)	21.6 A (69.7%)	20.4 A (65.8%)	19.1 A (61.6%)	17.9 A (57.7%)	16.7 A (53.9%)	15.5 A (50%)	14.2 A (45.8%)	13 A (41.9%)	11.8 A (38.1%)	10.6 A (34.2%)	9.3 A (30%)
	60 °C	23 A (74.2%)	23 A (74.2%)	23 A (74.2%)	23 A (74.2%)	23 A (74.2%)	21.7 A (70%)	20.4 A (65.8%)	19.2 A (61.9%)	17.9 A (57.7%)	16.6 A (53.5%)	15.3 A (49.4%)	14.1 A (45.5%)	12.8 A (41.3%)	11.5 A (37.1%)	10.2 A (32.9%)	9 A (29%)	7.7 A (24.8%)
FR3	40 °C	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	58.4 A (95.7%)	55.8 A (91.5%)	53.1 A (87%)	50.5 A (82.8%)	47.9 A (78.5%)	45.3 A (74.3%)	42.6 A (69.8%)	40 A (65.6%)	37.4 A (61.3%)	34.8 A (57%)	32.1 A (52.6%)	29.5 A (48.4%)
	45 °C	55.5 A (91%)	55.5 A (91%)	55.5 A (91%)	55.5 A (91%)	55.5 A (91%)	53.1 A (87%)	50.6 A (83%)	48.1 A (78.9%)	45.7 A (74.9%)	43.3 A (71%)	40.8 A (66.9%)	38.3 A (62.8%)	35.9 A (58.9%)	33.5 A (54.9%)	31 A (50.8%)	28.5 A (46.7%)	26.1 A (42.8%)
	50 °C	50 A (82%)	50 A (82%)	50 A (82%)	50 A (82%)	50 A (82%)	47.7 A (78.2%)	45.4 A (74.4%)	43.1 A (70.7%)	40.9 A (67%)	38.6 A (63.3%)	36.3 A (59.5%)	34 A (55.7%)	31.7 A (52%)	29.5 A (48.4%)	27.2 A (44.6%)	24.9 A (40.8%)	22.6 A (37%)
	55 °C	45 A (73.8%)	45 A (73.8%)	45 A (73.8%)	45 A (73.8%)	45 A (73.8%)	42.9 A (70.3%)	40.7 A (66.7%)	38.6 A (63.3%)	36.5 A (59.8%)	34.3 A (56.2%)	32.2 A (52.8%)	30 A (49.2%)	27.9 A (45.7%)	25.8 A (42.3%)	23.6 A (38.7%)	21.5 A (35.2%)	19.3 A (31.6%)
	60 °C	40 A (65.6%)	40 A (65.6%)	40 A (65.6%)	40 A (65.6%)	40 A (65.6%)	38 A (62.3%)	36 A (59%)	34 A (55.7%)	32 A (52.5%)	30 A (49.2%)	28 A (45.9%)	26 A (42.6%)	24 A (39.3%)	22 A (36.1%)	20 A (32.8%)	18 A (29.5%)	16 A (26.2%)
FR4	40 °C	105 A (100%)	105 A (100%)	105 A (100%)	105 A (100%)	103 A (98.1%)	97.9 A (93.2%)	92.8 A (88.4%)	87.7 A (83.5%)	82.6 A (78.7%)	77.5 A (73.8%)	72.4 A (69%)	67.4 A (64.2%)	62.3 A (59.3%)	57.2 A (54.5%)	52.1 A (49.6%)	47 A (44.8%)	41.9 A (39.9%)
	45 °C	98.5 A (93.8%)	98.5 A (93.8%)	98.5 A (93.8%)	98.5 A (93.8%)	96.5 A (91.9%)	91.6 A (87.2%)	86.7 A (82.6%)	81.7 A (77.8%)	76.8 A (73.1%)	71.8 A (68.4%)	66.9 A (63.7%)	62 A (59%)	57.1 A (54.4%)	52.2 A (49.7%)	47.2 A (45%)	42.3 A (40.3%)	37.3 A (35.5%)
	50 °C	91.96 A (87.6%)	91.96 A (87.6%)	91.96 A (87.6%)	91.96 A (87.6%)	90 A (85.7%)	85.2 A (81.1%)	80.5 A (76.7%)	75.7 A (72.1%)	70.9 A (67.5%)	66.1 A (63%)	61.4 A (58.5%)	56.6 A (53.9%)	51.8 A (49.3%)	47.1 A (44.9%)	42.3 A (40.3%)	37.5 A (35.7%)	32.7 A (31.1%)
	55 °C	81 A (77.1%)	81 A (77.1%)	81 A (77.1%)	81 A (77.1%)	79.2 A (75.4%)	74.7 A (71.1%)	70.2 A (66.9%)	65.7 A (62.6%)	61.2 A (58.3%)	56.7 A (54%)	52.3 A (49.8%)	47.8 A (45.5%)	43.3 A (41.2%)	38.8 A (37%)	34.3 A (32.7%)	29.8 A (28.4%)	25.3 A (24.1%)
	60 °C	70 A (66.7%)	70 A (66.7%)	70 A (66.7%)	70 A (66.7%)	68.3 A (65%)	64.1 A (61%)	59.9 A (57%)	55.7 A (53%)	51.5 A (49%)	47.3 A (45%)	43.1 A (41%)	38.9 A (37%)	34.7 A (33%)	30.5 A (29%)	26.3 A (25%)	22.1 A (21%)	17.9 A (17%)
FR5	40 °C	205 A (100%)	205 A (100%)	205 A (100%)	205 A (100%)	199.9 A (97.5%)	187.2 A (91.3%)	174.4 A (85.1%)	161.7 A (78.9%)	149 A (72.7%)	136.2 A (66.4%)	123.5 A (60.2%)	110.7 A (54%)	98 A (47.8%)	—	—	—	—
	45 °C	187.5 A (91.5%)	187.5 A (91.5%)	187.5 A (91.5%)	187.5 A (91.5%)	182.8 A (89.2%)	171 A (83.4%)	159.1 A (77.6%)	147.3 A (71.9%)	135.5 A (66.1%)	123.6 A (60.3%)	111.8 A (54.5%)	99.9 A (48.7%)	88.1 A (43%)	—	—	—	—
	50 °C	170 A (82.9%)	170 A (82.9%)	170 A (82.9%)	170 A (82.9%)	165.6 A (80.8%)	154.7 A (75.5%)	143.8 A (70.1%)	132.8 A (64.8%)	121.9 A (59.5%)	111 A (54.1%)	100.1 A (48.8%)	89.1 A (43.5%)	78.2 A (38.1%)	—	—	—	—
	55 °C	148 A (72.2%)	148 A (72.2%)	148 A (72.2%)	148 A (72.2%)	144.3 A (70.4%)	134.9 A (65.8%)	125.5 A (61.2%)	116.1 A (56.6%)	106.7 A (52%)	97.3 A (47.5%)	87.9 A (42.9%)	78.5 A (38.3%)	69.1 A (33.7%)	—	—	—	—
	60 °C	126 A (61.5%)	126 A (61.5%)	126 A (61.5%)	126 A (61.5%)	122.9 A (60%)	115 A (56.1%)	107.1 A (52.2%)	99.3 A (48.4%)	91.4 A (44.6%)	83.6 A (40.8%)	75.7 A (36.9%)	67.9 A (33.1%)	60 A (29.3%)	—	—	—	—
FR6	40 °C	310 A (100%)	310 A (100%)	286.18 A (92.3%)	271.88 A (87.7%)	262.35 A (84.6%)	238.53 A (76.9%)	214.7 A (69.3%)	199.27 A (64.3%)	183.83 A (59.3%)	168.4 A (54.3%)	152.97 A (49.3%)	—	—	—	—	—	—
	45 °C	293.85 A (94.8%)	293.85 A (94.8%)	270.44 A (87.2%)	256.39 A (82.7%)	247.03 A (79.7%)	223.62 A (72.1%)	200.2 A (64.6%)	185.35 A (59.8%)	170.5 A (55%)	155.65 A (50.2%)	140.8 A (45.4%)	—	—	—	—	—	—
	50 °C	277.7 A (89.6%)	277.7 A (89.6%)	254.7 A (82.2%)	240.9 A (77.7%)	231.7 A (74.7%)	208.7 A (67.3%)	185.7 A (59.9%)	171.43 A (55.3%)	157.17 A (50.7%)	142.9 A (46.1%)	128.63 A (41.5%)	—	—	—	—	—	—
	55 °C	260.25 A (84%)	260.25 A (84%)	236.77 A (76.4%)	222.67 A (71.8%)	213.28 A (68.8%)	189.79 A (61.2%)	166.3 A (53.6%)	152.75 A (49.3%)	139.2 A (44.9%)	125.65 A (40.5%)	112.1 A (36.2%)	—	—	—	—	—	—
	60 °C	242.8 A (78.3%)	242.8 A (78.3%)	218.83 A (70.6%)	204.44 A (65.9%)	194.85 A (62.9%)	170.88 A (55.1%)	146.9 A (47.4%)	134.07 A (43.2%)	121.23 A (39.1%)	108.4 A (35%)	95.57 A (30.8%)	—	—	—	—	—	—

Table 44. 230 V temperature derating (CT)

Shading indicates default switching frequency for each frame size.

Frame size	Temp. (°C)	Maximum rated current amperes, (percentage of rated current) Switching frequency (kHz) 1	2	3	3.6	4	5	6	7	8	9	10	11	12	13	14	15	16
Input voltage—208 Vac to 240 Vac, 50/60 Hz, three-phase																		
FR1	40 °C	11 A (100%)	11 A (100%)	11 A (100%)	11 A (100%)	11 A (100%)	10.83 A (98.5%)	10.67 A (97%)	10.5 A (95.5%)	10.33 A (93.9%)	10.17 A (92.5%)	10 A (90.9%)	9.83 A (89.4%)	9.67 A (87.9%)	9.5 A (86.4%)	9.33 A (84.8%)	9.17 A (83.4%)	9 A (81.8%)
	45 °C	11 A (100%)	11 A (100%)	11 A (100%)	11 A (100%)	11 A (100%)	10.76 A (97.8%)	10.51 A (95.5%)	10.27 A (93.4%)	10.02 A (91.1%)	9.78 A (88.9%)	9.53 A (86.6%)	9.29 A (84.5%)	9.04 A (82.2%)	8.8 A (80%)	8.55 A (77.7%)	8.31 A (75.5%)	8.06 A (73.3%)
	50 °C	11 A (100%)	11 A (100%)	11 A (100%)	11 A (100%)	11 A (100%)	10.68 A (97.1%)	10.35 A (94.1%)	10.03 A (91.2%)	9.71 A (88.3%)	9.38 A (85.3%)	9.06 A (82.4%)	8.74 A (79.5%)	8.41 A (76.5%)	8.09 A (73.5%)	7.77 A (70.6%)	7.44 A (67.6%)	7.12 A (64.7%)
	55 °C	9.75 A (88.6%)	9.75 A (88.6%)	9.75 A (88.6%)	9.75 A (88.6%)	9.75 A (88.6%)	9.48 A (86.2%)	9.2 A (83.6%)	8.93 A (81.2%)	8.66 A (78.7%)	8.38 A (76.2%)	8.11 A (73.7%)	7.84 A (71.3%)	7.56 A (68.7%)	7.29 A (66.3%)	7.01 A (63.7%)	6.74 A (61.3%)	6.46 A (58.7%)
	60 °C	8.5 A (77.3%)	8.5 A (77.3%)	8.5 A (77.3%)	8.5 A (77.3%)	8.5 A (77.3%)	8.28 A (75.3%)	8.05 A (73.2%)	7.83 A (71.2%)	7.6 A (69.1%)	7.38 A (67.1%)	7.15 A (65%)	6.93 A (63%)	6.7 A (60.9%)	6.48 A (58.9%)	6.25 A (56.8%)	6.03 A (54.8%)	5.8 A (52.7%)
FR2	40 °C	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	24.38 A (97.5%)	23.75 A (95%)	23.13 A (92.5%)	22.5 A (90%)	21.88 A (87.5%)	21.25 A (85%)	20.63 A (82.5%)	20 A (80%)
	45 °C	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	24.7 A (98.8%)	24.4 A (97.6%)	23.79 A (95.2%)	23.18 A (92.7%)	22.57 A (90.3%)	21.95 A (87.8%)	21.34 A (85.4%)	20.73 A (82.9%)	20.12 A (80.5%)	19.5 A (78%)
	50 °C	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	24.4 A (97.6%)	23.8 A (95.2%)	23.2 A (92.8%)	22.6 A (90.4%)	22 A (88%)	21.4 A (85.6%)	20.8 A (83.2%)	20.2 A (80.8%)	19.6 A (78.4%)	19 A (76%)
	55 °C	23.75 A (95%)	23.75 A (95%)	23.75 A (95%)	23.75 A (95%)	23.75 A (95%)	23.75 A (95%)	23.75 A (95%)	23.08 A (92.3%)	22.4 A (89.6%)	21.73 A (86.9%)	21.05 A (84.2%)	20.38 A (81.5%)	19.7 A (78.8%)	19.03 A (76.1%)	18.35 A (73.4%)	17.68 A (70.7%)	17 A (68%)
	60 °C	22.5 A (90%)	22.5 A (90%)	22.5 A (90%)	22.5 A (90%)	22.5 A (90%)	22.5 A (90%)	22.5 A (90%)	21.75 A (87%)	21 A (84%)	20.25 A (81%)	19.5 A (78%)	18.75 A (75%)	18 A (72%)	17.25 A (69%)	16.5 A (66%)	15.75 A (63%)	15 A (60%)
FR3	40 °C	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)
	45 °C	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	47.57 A (99.1%)	47.13 A (98.2%)	46.69 A (97.3%)	46.25 A (96.4%)	45.82 A (95.5%)	45.38 A (94.5%)	44.94 A (93.6%)	44.5 A (92.7%)
	50 °C	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	47.13 A (98.2%)	46.25 A (96.4%)	45.38 A (94.5%)	44.5 A (92.7%)	43.63 A (90.9%)	42.75 A (89.1%)	41.88 A (87.3%)	41 A (85.4%)
	55 °C	46 A (95.8%)	46 A (95.8%)	46 A (95.8%)	46 A (95.8%)	46 A (95.8%)	45.34 A (94.5%)	44.67 A (93.1%)	44 A (91.7%)	43.34 A (90.3%)	42.23 A (88%)	41.13 A (85.7%)	40.03 A (83.4%)	38.92 A (81.1%)	37.82 A (78.8%)	36.71 A (76.5%)	35.61 A (74.2%)	34.5 A (71.9%)
	60 °C	44 A (91.7%)	44 A (91.7%)	44 A (91.7%)	44 A (91.7%)	44 A (91.7%)	42.67 A (88.9%)	41.33 A (86.1%)	40 A (83.3%)	38.67 A (80.6%)	37.33 A (77.8%)	36 A (75%)	34.67 A (72.2%)	33.33 A (69.4%)	32 A (66.7%)	30.67 A (63.9%)	29.33 A (61.1%)	28 A (58.3%)
FR4	40 °C	88 A (100%)	88 A (100%)	88 A (100%)	88 A (100%)	87.26 A (99.2%)	85.4 A (97%)	83.55 A (94.9%)	81.69 A (92.8%)	79.84 A (90.7%)	77.98 A (88.6%)	76.13 A (86.5%)	74.27 A (84.4%)	72.42 A (82.3%)	70.56 A (80.2%)	68.71 A (78.1%)	66.86 A (76%)	65 A (73.9%)
	45 °C	88 A (100%)	88 A (100%)	88 A (100%)	88 A (100%)	87.1 A (99%)	84.84 A (96.4%)	82.58 A (93.8%)	80.32 A (91.3%)	78.07 A (88.7%)	75.81 A (86.1%)	73.55 A (83.6%)	71.29 A (81%)	69.04 A (78.5%)	66.77 A (75.9%)	64.52 A (73.3%)	62.26 A (70.8%)	60 A (68.2%)
	50 °C	88 A (100%)	88 A (100%)	88 A (100%)	88 A (100%)	86.94 A (98.8%)	84.27 A (95.8%)	81.61 A (92.7%)	78.95 A (89.7%)	76.29 A (86.7%)	73.63 A (83.7%)	70.97 A (80.6%)	68.31 A (77.6%)	65.65 A (74.6%)	62.98 A (71.6%)	60.32 A (68.5%)	57.66 A (65.5%)	55 A (62.5%)
	55 °C	79 A (89.8%)	79 A (89.8%)	79 A (89.8%)	79 A (89.8%)	78.12 A (88.8%)	75.9 A (86.3%)	73.68 A (83.7%)	71.46 A (81.2%)	69.24 A (78.7%)	67.03 A (76.2%)	64.81 A (73.6%)	62.59 A (71.1%)	60.38 A (68.6%)	58.15 A (66.1%)	55.94 A (63.6%)	53.72 A (61%)	51.5 A (58.5%)
	60 °C	70 A (79.5%)	70 A (79.5%)	70 A (79.5%)	70 A (79.5%)	69.29 A (78.7%)	67.52 A (76.7%)	65.74 A (74.7%)	63.97 A (72.7%)	62.19 A (70.7%)	60.42 A (68.7%)	58.65 A (66.6%)	56.87 A (64.6%)	55.1 A (62.6%)	53.32 A (60.6%)	51.55 A (58.6%)	49.77 A (56.6%)	48 A (54.5%)
FR5	40 °C	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	163.5 A (96.2%)	157 A (92.4%)	150.5 A (88.5%)	144 A (84.7%)	137.5 A (80.9%)	131 A (77.1%)	—	—	—	—
	45 °C	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	168 A (98.8%)	163 A (95.9%)	158 A (92.9%)	149.75 A (88.1%)	141.5 A (83.2%)	133.25 A (78.4%)	125 A (73.5%)	116.75 A (68.7%)	108.5 A (63.8%)	—	—	—	—
	50 °C	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	166 A (97.6%)	156 A (91.8%)	146 A (85.9%)	136 A (80%)	126 A (74.1%)	116 A (68.2%)	106 A (62.4%)	96 A (56.5%)	86 A (50.6%)	—	—	—	—
	55 °C	145 A (85.3%)	145 A (85.3%)	145 A (85.3%)	145 A (85.3%)	141.81 A (83.4%)	133.84 A (78.7%)	125.86 A (74%)	117.88 A (69.3%)	109.91 A (64.7%)	101.93 A (60%)	93.95 A (55.3%)	85.98 A (50.6%)	78 A (45.9%)	—	—	—	—
	60 °C	120 A (70.6%)	120 A (70.6%)	120 A (70.6%)	120 A (70.6%)	117.62 A (69.2%)	111.67 A (65.7%)	105.71 A (62.2%)	99.76 A (58.7%)	93.81 A (55.2%)	87.86 A (51.7%)	81.9 A (48.2%)	75.95 A (44.7%)	70 A (41.2%)	—	—	—	—
FR6	40 °C	248 A (100%)	248 A (80%)	239.2 A (77.2%)	233.92 A (75.5%)	230.4 A (74.3%)	221.6 A (71.5%)	212.8 A (68.6%)	204 A (65.8%)	195.2 A (63%)	186.4 A (60.1%)	177.6 A (57.3%)	—	—	—	—	—	—
	45 °C	248 A (80%)	248 A (80%)	238.2 A (76.8%)	232.32 A (74.9%)	228.4 A (73.7%)	218.6 A (70.5%)	208.8 A (67.4%)	199 A (64.2%)	189.2 A (61%)	179.4 A (57.9%)	169.6 A (54.7%)	—	—	—	—	—	—
	50 °C	248 A (80%)	248 A (80%)	237.2 A (76.5%)	230.72 A (74.4%)	226.4 A (73%)	215.6 A (69.5%)	204.8 A (66.1%)	194 A (62.6%)	183.2 A (59.1%)	172.4 A (55.6%)	161.6 A (52.1%)	—	—	—	—	—	—
	55 °C	229 A (73.9%)	229 A (73.9%)	217.26 A (70.1%)	210.22 A (67.8%)	205.52 A (66.3%)	193.79 A (62.5%)	182.05 A (58.7%)	170.31 A (54.9%)	158.57 A (51.2%)	146.83 A (47.4%)	135.09 A (43.6%)	—	—	—	—	—	—
	60 °C	210 A (67.7%)	210 A (67.7%)	197.32 A (63.7%)	189.71 A (61.2%)	184.64 A (59.6%)	171.97 A (55.5%)	159.29 A (51.4%)	146.61 A (47.3%)	133.93 A (43.2%)	121.26 A (39.1%)	108.58 A (35%)	—	—	—	—	—	—

Table 45. 230 V temperature derating (VT)

Shading indicates default switching frequency for each frame size.

Frame size	Temp. (°C)	Maximum rated current amperes, (percentage of rated current) Switching frequency (kHz) 1	2	3	3.6	4	5	6	7	8	9	10	11	12	13	14	15	16
Input voltage—200 Vac to 264 Vac, 50/60 Hz, three-phase																		
FR1	40 °C	12.5 A (100%)	12.5 A (100%)	12.5 A (100%)	12.5 A (100%)	12.5 A (100%)	12.21 A (97.7%)	11.92 A (95.4%)	11.63 A (93%)	11.34 A (90.7%)	11.05 A (88.4%)	10.76 A (86.1%)	10.47 A (83.8%)	10.18 A (81.4%)	9.89 A (79.1%)	9.6 A (76.8%)	9.31 A (74.5%)	9.02 A (72.2%)
	45 °C	12.5 A (100%)	12.5 A (100%)	12.5 A (100%)	12.5 A (100%)	12.5 A (100%)	12.15 A (97.2%)	11.8 A (94.4%)	11.45 A (91.6%)	11.1 A (88.8%)	10.75 A (86%)	10.4 A (83.2%)	10.05 A (80.4%)	9.7 A (77.6%)	9.35 A (74.8%)	9 A (72%)	8.65 A (69.2%)	8.3 A (66.4%)
	50 °C	12.5 A (100%)	12.5 A (100%)	12.5 A (100%)	12.5 A (100%)	12.5 A (100%)	12.09 A (96.7%)	11.68 A (93.4%)	11.27 A (90.2%)	10.86 A (86.9%)	10.45 A (83.6%)	10.04 A (80.3%)	9.62 A (77%)	9.21 A (73.7%)	8.8 A (70.4%)	8.39 A (67.1%)	7.98 A (63.8%)	7.57 A (60.6%)
	55 °C	10.75 A (86%)	10.75 A (86%)	10.75 A (86%)	10.75 A (86%)	10.75 A (86%)	10.47 A (83.8%)	10.16 A (81.3%)	9.86 A (78.9%)	9.56 A (76.5%)	9.26 A (74.1%)	8.95 A (71.6%)	8.65 A (69.2%)	8.35 A (66.8%)	8.04 A (64.3%)	7.74 A (61.9%)	7.44 A (59.5%)	7.14 A (57.1%)
	60 °C	9 A (72%)	9 A (72%)	9 A (72%)	9 A (72%)	9 A (72%)	8.84 A (70.7%)	8.64 A (69.1%)	8.45 A (67.6%)	8.25 A (66%)	8.06 A (64.5%)	7.86 A (62.9%)	7.67 A (61.4%)	7.48 A (59.8%)	7.28 A (58.2%)	7.09 A (56.7%)	6.89 A (55.1%)	6.7 A (53.6%)
FR2	40 °C	31 A (100%)	31 A (100%)	31 A (100%)	31 A (100%)	31 A (100%)	31 A (100%)	31 A (100%)	30.25 A (97.6%)	29.5 A (95.2%)	28.75 A (92.7%)	28 A (90.3%)	27.25 A (87.9%)	26.5 A (85.5%)	25.75 A (83.1%)	25 A (80.6%)	24.25 A (78.2%)	23.5 A (75.8%)
	45 °C	28.75 A (92.7%)	28.75 A (92.7%)	28.75 A (92.7%)	28.75 A (92.7%)	28.75 A (92.7%)	28.75 A (92.7%)	28.75 A (92.7%)	28.1 A (90.6%)	27.45 A (88.5%)	26.8 A (86.5%)	26.15 A (84.4%)	25.5 A (82.3%)	24.85 A (80.2%)	24.2 A (78.1%)	23.55 A (76%)	22.9 A (73.9%)	22.25 A (71.8%)
	50 °C	26.5 A (85.5%)	26.5 A (85.5%)	26.5 A (85.5%)	26.5 A (85.5%)	26.5 A (85.5%)	26.5 A (85.5%)	26.5 A (85.5%)	25.95 A (83.7%)	25.4 A (81.9%)	24.85 A (80.2%)	24.3 A (78.4%)	23.75 A (76.6%)	23.2 A (74.8%)	22.65 A (73.1%)	22.1 A (71.3%)	21.55 A (69.5%)	21 A (67.7%)
	55 °C	24.75 A (79.8%)	24.75 A (79.8%)	24.75 A (79.8%)	24.75 A (79.8%)	24.75 A (79.8%)	24.75 A (79.8%)	24.75 A (79.8%)	24.13 A (77.8%)	23.5 A (75.8%)	22.88 A (73.8%)	22.25 A (71.8%)	21.63 A (69.8%)	21 A (67.7%)	20.38 A (65.7%)	19.75 A (63.7%)	19.13 A (61.7%)	18.5 A (59.7%)
	60 °C	23 A (74.2%)	23 A (74.2%)	23 A (74.2%)	23 A (74.2%)	23 A (74.2%)	23 A (74.2%)	23 A (74.2%)	22.3 A (71.9%)	21.6 A (69.7%)	20.9 A (67.4%)	20.2 A (65.2%)	19.5 A (62.9%)	18.8 A (60.6%)	18.1 A (58.4%)	17.4 A (56.1%)	16.7 A (53.9%)	16 A (51.6%)
FR3	40 °C	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)
	45 °C	58 A (95.1%)	58 A (95.1%)	58 A (95.1%)	58 A (95.1%)	58 A (95.1%)	57.59 A (94.4%)	57.17 A (93.7%)	56.75 A (93%)	56.34 A (92.4%)	55.92 A (91.7%)	55.5 A (91%)	55.09 A (90.3%)	54.67 A (89.6%)	54.25 A (88.9%)	53.84 A (88.3%)	53.42 A (87.6%)	53 A (86.9%)
	50 °C	55 A (90.2%)	55 A (90.2%)	55 A (90.2%)	55 A (90.2%)	55 A (90.2%)	54.17 A (88.8%)	53.33 A (87.4%)	52.5 A (86.1%)	51.67 A (84.7%)	50.83 A (83.3%)	50 A (82%)	49.17 A (80.6%)	48.33 A (79.2%)	47.5 A (77.9%)	46.67 A (76.5%)	45.83 A (75.1%)	45 A (73.8%)
	55 °C	50 A (82%)	50 A (82%)	50 A (82%)	50 A (82%)	50 A (82%)	48.96 A (80.3%)	47.92 A (78.6%)	46.88 A (76.9%)	45.84 A (75.1%)	44.79 A (73.4%)	43.75 A (71.7%)	42.71 A (70%)	41.67 A (68.3%)	40.63 A (66.6%)	39.59 A (64.9%)	38.54 A (63.2%)	37.5 A (61.5%)
	60 °C	45 A (73.8%)	45 A (73.8%)	45 A (73.8%)	45 A (73.8%)	45 A (73.8%)	43.75 A (71.7%)	42.5 A (69.7%)	41.25 A (67.6%)	40 A (65.6%)	38.75 A (63.5%)	37.5 A (61.5%)	36.25 A (59.4%)	35 A (57.4%)	33.75 A (55.3%)	32.5 A (53.3%)	31.25 A (51.2%)	30 A (49.2%)
FR4	40 °C	114 A (100%)	114 A (100%)	114 A (100%)	114 A (100%)	113.16 A (99.3%)	111.07 A (97.4%)	108.97 A (95.6%)	106.87 A (93.7%)	104.78 A (91.9%)	102.68 A (90.1%)	100.58 A (88.2%)	98.49 A (86.4%)	96.39 A (84.6%)	94.29 A (82.7%)	92.19 A (80.9%)	90.1 A (79%)	88 A (77.2%)
	45 °C	107 A (93.9%)	107 A (93.9%)	107 A (93.9%)	107 A (93.9%)	106.1 A (93.1%)	103.84 A (91.1%)	101.58 A (89.1%)	99.32 A (87.1%)	97.07 A (85.1%)	94.81 A (83.2%)	92.55 A (81.2%)	90.3 A (79.2%)	88.04 A (77.2%)	85.78 A (75.2%)	83.52 A (73.3%)	81.26 A (71.3%)	79 A (69.3%)
	50 °C	100 A (87.7%)	100 A (87.7%)	100 A (87.7%)	100 A (87.7%)	99.03 A (86.9%)	96.61 A (84.7%)	94.19 A (82.6%)	91.77 A (80.5%)	89.35 A (78.4%)	86.94 A (76.3%)	84.52 A (74.1%)	82.1 A (72%)	79.68 A (69.9%)	77.26 A (67.8%)	74.84 A (65.6%)	72.42 A (63.5%)	70 A (61.4%)
	55 °C	94 A (82.5%)	94 A (82.5%)	94 A (82.5%)	94 A (82.5%)	92.9 A (81.5%)	90.16 A (79.1%)	87.42 A (76.7%)	84.68 A (74.3%)	81.94 A (71.9%)	79.2 A (69.5%)	76.46 A (67.1%)	73.71 A (64.7%)	70.97 A (62.3%)	68.23 A (59.9%)	65.49 A (57.4%)	62.74 A (55%)	60 A (52.6%)
	60 °C	88 A (77.2%)	88 A (77.2%)	88 A (77.2%)	88 A (77.2%)	86.77 A (76.1%)	83.71 A (73.4%)	80.65 A (70.7%)	77.58 A (68.1%)	74.52 A (65.4%)	71.45 A (62.7%)	68.39 A (60%)	65.32 A (57.3%)	62.26 A (54.6%)	59.19 A (51.9%)	56.13 A (49.2%)	53.06 A (46.5%)	50 A (43.9%)
FR5	40 °C	211 A (100%)	211 A (100%)	211 A (100%)	211 A (100%)	207.48 A (98.3%)	198.67 A (94.2%)	189.86 A (90%)	181.05 A (85.8%)	172.24 A (81.6%)	163.43 A (77.5%)	154.62 A (73.3%)	145.81 A (69.1%)	137 A (64.9%)	—	—	—	—
	45 °C	190.5 A (90.3%)	190.5 A (90.3%)	190.5 A (90.3%)	190.5 A (90.3%)	187.22 A (88.7%)	179 A (84.8%)	170.79 A (80.9%)	162.58 A (77.1%)	154.36 A (73.2%)	146.15 A (69.3%)	137.93 A (65.4%)	129.72 A (61.5%)	121.5 A (57.6%)	—	—	—	—
	50 °C	170 A (80.6%)	170 A (80.6%)	170 A (80.6%)	170 A (80.6%)	166.95 A (79.1%)	159.33 A (75.5%)	151.71 A (71.9%)	144.1 A (68.3%)	136.48 A (64.7%)	128.86 A (61.1%)	121.24 A (57.5%)	113.62 A (53.8%)	106 A (50.2%)	—	—	—	—
	55 °C	152.5 A (72.3%)	152.5 A (72.3%)	152.5 A (72.3%)	152.5 A (72.3%)	149.54 A (70.9%)	142.13 A (67.4%)	134.71 A (63.8%)	127.31 A (60.3%)	119.9 A (56.8%)	112.49 A (53.3%)	105.07 A (49.8%)	97.66 A (46.3%)	90.25 A (42.8%)	—	—	—	—
	60 °C	135 A (64%)	135 A (64%)	135 A (64%)	135 A (64%)	132.12 A (62.6%)	124.92 A (59.2%)	117.71 A (55.8%)	110.51 A (52.4%)	103.31 A (49%)	96.11 A (45.5%)	88.9 A (42.1%)	81.7 A (38.7%)	74.5 A (35.3%)	—	—	—	—
FR6	40 °C	312 A (100%)	312 A (100%)	301.23 A (96.5%)	294.77 A (94.5%)	290.46 A (93.1%)	279.69 A (89.6%)	268.92 A (86.2%)	258.15 A (82.7%)	247.38 A (79.3%)	236.61 A (75.8%)	225.84 A (72.4%)	—	—	—	—	—	—
	45 °C	281 A (90.1%)	281 A (90.1%)	270.62 A (86.7%)	264.4 A (84.7%)	260.24 A (83.4%)	249.86 A (80.1%)	239.48 A (76.8%)	229.1 A (73.4%)	218.72 A (70.1%)	208.33 A (66.8%)	197.95 A (63.4%)	—	—	—	—	—	—
	50 °C	250 A (80.1%)	250 A (80.1%)	240.01 A (76.9%)	234.02 A (75%)	230.02 A (73.7%)	220.03 A (70.5%)	210.03 A (67.3%)	200.04 A (64.1%)	190.05 A (60.9%)	180.05 A (57.7%)	170.06 A (54.5%)	—	—	—	—	—	—
	55 °C	241.5 A (77.4%)	241.5 A (77.4%)	229.01 A (73.4%)	221.51 A (71%)	216.51 A (69.4%)	204.01 A (65.4%)	191.51 A (61.4%)	179.01 A (57.4%)	166.52 A (53.4%)	154.01 A (49.4%)	141.52 A (45.4%)	—	—	—	—	—	—
	60 °C	233 A (74.7%)	233 A (74.7%)	218 A (69.9%)	209 A (67%)	202.99 A (65.1%)	187.99 A (60.3%)	172.99 A (55.4%)	157.98 A (50.6%)	142.98 A (45.8%)	127.97 A (41%)	112.97 A (36.2%)	—	—	—	—	—	—

Table 46. 575 V temperature derating (CT)

Shading indicates default switching frequency for each frame size.

Frame size	Temp. (°C)	Maximum rated current amperes, (percentage of rated current) Switching frequency (kHz) 1	1.5	2	3	4	5	6
Input voltage—500 Vac to 660 Vac, 50/60 Hz, three-phase								
FR1	40 °C	7.5 A (100%)	7.5 A (100%)	7.5 A (100%)	7.5 A (100%)	6.5 A (86.7%)	5.5 A (73.3%)	4.5 A (60%)
	45 °C	7.5 A (100%)	7.5 A (100%)	7.5 A (100%)	7.5 A (100%)	6.25 A (83.3%)	5 A (66.7%)	3.75 A (50%)
	50 °C	7.5 A (100%)	7.5 A (100%)	7.5 A (100%)	7.5 A (100%)	6 A (80%)	4.5 A (60%)	3 A (40%)
	55 °C	6.25 A (83.3%)	6.25 A (83.3%)	6.25 A (83.3%)	6.25 A (83.3%)	5.1 A (68%)	3.95 A (52.7%)	2.8 A (37.3%)
	60 °C	5 A (66.7%)	5 A (66.7%)	5 A (66.7%)	5 A (66.7%)	4.2 A (56%)	3.4 A (45.3%)	2.6 A (34.7%)
FR2	40 °C	18 A (100%)	18 A (100%)	18 A (100%)	18 A (100%)	16.83 A (93.5%)	15.67 A (87.1%)	14.5 A (80.6%)
	45 °C	18 A (100%)	18 A (100%)	18 A (100%)	18 A (100%)	16.42 A (91.2%)	14.84 A (82.4%)	13.25 A (73.6%)
	50 °C	18 A (100%)	18 A (100%)	18 A (100%)	18 A (100%)	16 A (88.9%)	14 A (77.8%)	12 A (66.7%)
	55 °C	15.5 A (86.1%)	15.5 A (86.1%)	15.17 A (84.3%)	14.5 A (80.6%)	12.84 A (71.3%)	11.17 A (62.1%)	9.5 A (52.8%)
	60 °C	13 A (72.2%)	13 A (72.2%)	12.33 A (68.5%)	11 A (61.1%)	9.67 A (53.7%)	8.33 A (46.3%)	7 A (38.9%)
FR3	40 °C	34 A (100%)	34 A (100%)	33.78 A (99.4%)	33.33 A (98%)	32.89 A (96.7%)	32.45 A (95.4%)	32 A (94.1%)
	45 °C	34 A (100%)	34 A (100%)	33.39 A (98.2%)	32.17 A (94.6%)	30.95 A (91%)	29.73 A (87.4%)	28.5 A (83.8%)
	50 °C	34 A (100%)	34 A (100%)	33 A (97.1%)	31 A (91.2%)	29 A (85.3%)	27 A (79.4%)	25 A (73.5%)
	55 °C	30.5 A (89.7%)	30.5 A (89.7%)	29.34 A (86.3%)	27 A (79.4%)	24.67 A (72.6%)	22.34 A (65.7%)	20 A (58.8%)
	60 °C	27 A (79.4%)	27 A (79.4%)	25.67 A (75.5%)	23 A (67.6%)	20.33 A (59.8%)	17.67 A (52%)	15 A (44.1%)
FR4	40 °C	62 A (100%)	62 A (100%)	60.67 A (97.9%)	58 A (93.5%)	55.33 A (89.2%)	52.67 A (85%)	50 A (80.6%)
	45 °C	62 A (100%)	62 A (100%)	59.79 A (96.4%)	55.35 A (89.3%)	50.92 A (82.1%)	46.49 A (75%)	42.05 A (67.8%)
	50 °C	62 A (100%)	62 A (100%)	58.9 A (95%)	52.7 A (85%)	46.5 A (75%)	40.3 A (65%)	34.1 A (55%)
	55 °C	56.4 A (91%)	56.4 A (91%)	53.71 A (86.6%)	48.34 A (78%)	42.96 A (69.3%)	37.58 A (60.6%)	32.2 A (51.9%)
	60 °C	50.8 A (81.9%)	50.8 A (81.9%)	48.52 A (78.3%)	43.97 A (70.9%)	39.41 A (63.6%)	34.86 A (56.2%)	30.3 A (48.9%)
FR5	40 °C	125 A (100%)	125 A (100%)	118.22 A (94.6%)	104.66 A (83.7%)	91.11 A (72.9%)	77.55 A (62%)	63.99 A (51.2%)
	45 °C	125 A (100%)	125 A (100%)	117.84 A (94.3%)	103.5 A (82.8%)	89.17 A (71.3%)	74.84 A (59.9%)	60.5 A (48.4%)
	50 °C	125 A (100%)	125 A (100%)	117.45 A (94%)	102.34 A (81.9%)	87.23 A (69.8%)	72.12 A (57.7%)	57 A (45.6%)
	55 °C	115 A (92%)	115 A (92%)	107.89 A (86.3%)	93.67 A (74.9%)	79.45 A (63.6%)	65.23 A (52.2%)	51 A (40.8%)
	60 °C	105 A (84%)	105 A (84%)	98.33 A (78.7%)	85 A (68%)	71.67 A (57.3%)	58.34 A (46.7%)	45 A (36%)
FR6	40 °C	208 A (100%)	208 A (100%)	192 A (92.3%)	160 A (76.9%)	135.33 A (65.1%)	110.67 A (53.2%)	86 A (41.3%)
	45 °C	208 A (100%)	208 A (100%)	187.67 A (90.2%)	147 A (70.7%)	123 A (59.1%)	99 A (47.6%)	75 A (36.1%)
	50 °C	208 A (100%)	208 A (100%)	183.33 A (88.1%)	134 A (64.4%)	110.67 A (53.2%)	87.33 A (42%)	64 A (30.8%)
	55 °C	174 A (83.7%)	174 A (83.7%)	155 A (74.5%)	117 A (56.3%)	97 A (46.6%)	77 A (37%)	57 A (27.4%)
	60 °C	140 A (67.3%)	140 A (67.3%)	126.67 A (60.9%)	100 A (48.1%)	83.33 A (40.1%)	66.67 A (32.1%)	50 A (24%)

Table 47. 575 V temperature derating (VT)

Shading indicates default switching frequency for each frame size.

Frame size	Temp. (°C)	Maximum rated current amperes, (percentage of rated current) Switching frequency (kHz) 1	1.5	2	3	4	5	6
Input voltage—500 Vac to 660 Vac, 50/60 Hz, three-phase								
FR1	40 °C	10 A (100%)	10 A (100%)	10 A (100%)	10 A (100%)	8.33 A (83.3%)	6.67 A (66.7%)	5 A (50%)
	45 °C	9 A (90%)	9 A (90%)	9 A (90%)	9 A (90%)	7.42 A (74.2%)	5.84 A (58.4%)	4.25 A (42.5%)
	50 °C	8 A (80%)	8 A (80%)	8 A (80%)	8 A (80%)	6.5 A (65%)	5 A (50%)	3.5 A (35%)
	55 °C	6.65 A (66.5%)	6.65 A (66.5%)	6.65 A (66.5%)	6.65 A (66.5%)	5.52 A (55.2%)	4.39 A (43.9%)	3.25 A (32.5%)
	60 °C	5.3 A (53%)	5.3 A (53%)	5.3 A (53%)	5.3 A (53%)	4.53 A (45.3%)	3.77 A (37.7%)	3 A (30%)
FR2	40 °C	22 A (100%)	22 A (100%)	22 A (100%)	22 A (100%)	20 A (90.9%)	18 A (81.8%)	16 A (72.7%)
	45 °C	21 A (95.5%)	21 A (95.5%)	21 A (95.5%)	21 A (95.5%)	18.97 A (86.2%)	16.94 A (77%)	14.9 A (67.7%)
	50 °C	20 A (90.9%)	20 A (90.9%)	20 A (90.9%)	20 A (90.9%)	17.93 A (81.5%)	15.87 A (72.1%)	13.8 A (62.7%)
	55 °C	17.5 A (79.5%)	17.5 A (79.5%)	17.1 A (77.7%)	16.3 A (74.1%)	14.47 A (65.8%)	12.64 A (57.5%)	10.8 A (49.1%)
	60 °C	15 A (68.2%)	15 A (68.2%)	14.2 A (64.5%)	12.6 A (57.3%)	11 A (50%)	9.4 A (42.7%)	7.8 A (35.5%)
FR3	40 °C	41 A (100%)	41 A (100%)	41 A (100%)	41 A (100%)	37.9 A (92.4%)	35 A (85.4%)	32 A (78%)
	45 °C	37.5 A (91.5%)	37.5 A (91.5%)	37.5 A (91.5%)	37.5 A (91.5%)	34.45 A (84%)	31.45 A (76.7%)	28.5 A (69.5%)
	50 °C	34 A (82.9%)	34 A (82.9%)	34 A (82.9%)	34 A (82.9%)	31 A (75.6%)	27.9 A (68%)	25 A (61%)
	55 °C	30.5 A (74.4%)	30.5 A (74.4%)	30.5 A (74.4%)	30.5 A (74.4%)	27 A (65.9%)	23.4 A (57.1%)	20 A (48.8%)
	60 °C	27 A (65.9%)	27 A (65.9%)	27 A (65.9%)	27 A (65.9%)	23 A (56.1%)	18.9 A (46.1%)	15 A (36.6%)
FR4	40 °C	80 A (100%)	80 A (100%)	80 A (100%)	80 A (100%)	70 A (87.5%)	60 A (75%)	50 A (62.5%)
	45 °C	75 A (93.8%)	75 A (93.8%)	75 A (93.8%)	75 A (93.8%)	64.8 A (81%)	54.6 A (68.3%)	44.4 A (55.5%)
	50 °C	70 A (87.5%)	70 A (87.5%)	70 A (87.5%)	70 A (87.5%)	59.6 A (74.5%)	49.2 A (61.5%)	38.8 A (48.5%)
	55 °C	64 A (80%)	64 A (80%)	64 A (80%)	64 A (80%)	54.6 A (68.3%)	45.2 A (56.5%)	35.8 A (44.8%)
	60 °C	58 A (72.5%)	58 A (72.5%)	58 A (72.5%)	58 A (72.5%)	49.6 A (62%)	41.2 A (51.5%)	32.8 A (41%)
FR5	40 °C	144 A (100%)	144 A (100%)	144 A (100%)	128 A (88.9%)	112 A (77.8%)	96 A (66.7%)	80 A (55.6%)
	45 °C	134.5 A (93.4%)	134.5 A (93.4%)	134.5 A (93.4%)	118.5 A (82.3%)	102.5 A (71.2%)	86.5 A (60.1%)	70.5 A (49%)
	50 °C	125 A (86.8%)	125 A (86.8%)	125 A (86.8%)	109 A (75.7%)	93 A (64.6%)	77 A (53.5%)	61 A (42.4%)
	55 °C	115 A (79.9%)	115 A (79.9%)	115 A (79.9%)	100 A (69.4%)	85 A (59%)	70 A (48.6%)	55 A (38.2%)
	60 °C	105 A (72.9%)	105 A (72.9%)	105 A (72.9%)	91 A (63.2%)	77 A (53.5%)	63 A (43.8%)	49 A (34%)
FR6	40 °C	250 A (100%)	250 A (100%)	234 A (93.6%)	202 A (80.8%)	170 A (68%)	138 A (55.2%)	106 A (42.4%)
	45 °C	229 A (91.6%)	229 A (91.6%)	211.34 A (84.5%)	176 A (70.4%)	149 A (59.6%)	122 A (48.8%)	95 A (38%)
	50 °C	208 A (83.2%)	208 A (83.2%)	188.67 A (75.5%)	150 A (60%)	128 A (51.2%)	106 A (42.4%)	84 A (33.6%)
	55 °C	184 A (73.6%)	184 A (73.6%)	167.67 A (67.1%)	135 A (54%)	113.17 A (45.3%)	91.34 A (36.5%)	69.5 A (27.8%)
	60 °C	160 A (64%)	160 A (64%)	146.67 A (58.7%)	120 A (48%)	98.33 A (39.3%)	76.67 A (30.7%)	55 A (22%)

Heat loss data

Table 48. 230 V heat loss data

Frame size	CT ampere suffix	VT ampere suffix	230 V, 60 Hz	
			VT/I_L (110%) Pv (W)	CT/I_H (150%) Pv (W)
1	3D7	4D8	69	56
	4D8	6D6	86	65
	6D6	7D8	95	82
	7D8	011	125	94
	011	012	145	121
2	012	017	185	131
	017	025	277	186
	025	031	344	259
3	031	048	448	280
	048	061	620	460
4	061	075	660	540
	075	088	780	638
	088	114	1110	801
5	114	143	1138	893
	143	170	1422	1146
	170	211	1875	1453
6	211	261	2252	1735
	248	312	2854	2262

Table 49. 400 V heat loss data

Frame size	CT ampere suffix	VT ampere suffix	400 V, 50 Hz		460 V, 60 Hz	
			VT/I_L (110%) Pv (W)	CT/I_H (150%) Pv (W)	VT/I_L (110%) Pv (W)	CT/I_H (150%) Pv (W)
1	2D2	3D3	46	31	47	31
	3D3	4D3	59	45	62	48
	4D3	5D6	76	58	80	62
	5D6	7D6	98	75	105	77
	7D6	9D0	119	99	127	108
	9D0	012	164	113	188	134
2	012	016	195	156	213	169
	016	023	270	170	280	217
	023	031	408	271	406	282
3	031	038	480	385	506	414
	038	046	570	445	628	479
	046	061	815	564	838	595
4	061	072	745	650	780	696
	072	087	935	745	1002	800
	087	105	1208	941	1272	1002
5	105	140	1314	1023	1468	1142
	140	170	1774	1435	1825	1439
	170	205	2237	1681	2214	1796
6	205	261	2614	2011	2884	2153
	245	310	3345	2511	3543	2611

Table 50. 575 V heat loss data

Frame size	CT ampere suffix	VT ampere suffix	575 V, 60 Hz	
			VT/I_L (110%) Pv (W)	CT/I_H (150%) Pv (W)
1	3D3	4D5	62	45
	4D5	7D5	103	62
	7D5	010	145	104
2	010	013	183	144
	013	018	231	174
	018	022	296	232
3	022	027	340	301
	027	034	490	370
	034	041	570	464
4	041	052	616	485
	052	062	741	612
	062	80	986	723
5	80	100	1009	831
	100	125	1321	1063
	125	144	1504	1385
6	144	208	2680	1792
	208	250	3356	2721

Table 51. Heat loss FR1~FR6

Frame size	Heat loss (W) IP54/IP21 version	
	Fans start	Fans stop
230 V idle		
FR1	22.2	19
FR2	30	19
FR3	47	21
FR4	83	21
FR5	110	30
FR6	311	66
480 V idle		
FR1	27.8	24.5
FR2	32	21
FR3	68	31
FR4	95	30
FR5	120	38
FR6	309	83
575 V idle		
FR1	26.6	23.9
FR2	32.5	22.7
FR3	72.0	24.0
FR4	91.0	32.0
FR5	113.6	30.7
FR6	335	106

Brake resistor sizing

Table 52. Brake resistor sizing data

	230 V		460 V		600 V	
Frame size	Brake chopper nominal current at 80 °C (A)	Minimum resistance (Ohm)	Brake chopper nominal current at 80 °C (A)	Minimum resistance (Ohm)	Brake chopper nominal current at 80 °C (A)	Minimum resistance (Ohm)
FR1	30.0	30.0	25.0	63.0	26.0	100.0
FR2	78.0	20.0	78.0	42.0	41.0	30.0
FR3	100.0	10.0	100.0	14.0	100.0	18.0
FR4	200.0	3.3	200.0	6.5	200.0	9.0
FR5	400.0	1.4	450.0	3.3	400.0	7.0
FR6	600.0	1.4	600.0	3.3	450.0	2.5

Efficiency ratings

Table 53. 230 V FR1—4 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	0.284	0.230	0.054	19.01%	0.674	80.99%
50%	0.966	0.898	0.068	7.02%	0.847	92.98%
90%	1.541	1.468	0.073	4.74%	0.881	95.26%
100%	1.729	1.654	0.075	4.33%	0.894	95.67%
50% torque						
10%	0.426	0.362	0.064	15.02%	0.722	84.98%
50%	1.411	1.328	0.083	5.88%	0.906	94.12%
90%	2.337	2.245	0.092	3.94%	0.917	96.06%
100%	2.593	2.498	0.095	3.68%	0.919	96.32%
100% torque						
10%	0.772	0.682	0.089	11.60%	0.788	88.40%
50%	2.215	2.100	0.115	5.19%	0.929	94.81%
90%	3.833	3.691	0.142	3.70%	0.935	96.30%
100%	4.144	3.999	0.145	3.50%	0.933	96.50%

Note: All 10% speed is taken at 5 Hz.

Table 54. 230 V FR2—10 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	0.500	0.402	0.098	19.62%	0.622	80.38%
50%	1.624	1.520	0.103	6.36%	0.782	93.64%
90%	2.774	2.664	0.110	3.96%	0.879	96.04%
100%	3.013	2.904	0.109	3.62%	0.890	96.38%
50% torque						
10%	0.877	0.756	0.121	13.81%	0.714	86.19%
50%	2.961	2.806	0.155	5.22%	0.889	94.78%
90%	5.053	4.883	0.170	3.37%	0.929	96.63%
100%	5.578	5.402	0.177	3.17%	0.934	96.83%
100% torque						
10%	1.871	1.651	0.220	11.76%	0.823	88.24%
50%	5.815	5.518	0.297	5.10%	0.939	94.90%
90%	9.982	9.637	0.345	3.45%	0.958	96.55%
100%	10.244	9.900	0.344	3.36%	0.957	96.64%

Note: All 10% speed is taken at 5 Hz.

Table 55. 230 V FR3—20 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	0.953	0.822	0.131	13.75%	0.712	86.25%
50%	3.073	2.898	0.175	5.70%	0.827	94.30%
90%	5.040	4.850	0.190	3.77%	0.896	96.23%
100%	5.542	5.345	0.197	3.55%	0.904	96.45%
50% torque						
10%	1.739	1.527	0.212	12.18%	0.757	87.82%
50%	5.884	5.603	0.281	4.78%	0.911	95.22%
90%	9.285	8.985	0.301	3.24%	0.936	96.76%
100%	10.208	9.902	0.306	3.00%	0.937	97.00%
100% torque						
10%	3.660	3.282	0.378	10.32%	0.858	89.68%
50%	10.816	10.313	0.503	4.65%	0.940	95.35%
90%	18.787	18.181	0.606	3.23%	0.948	96.77%
100%	20.056	19.436	0.620	3.09%	0.949	96.91%

Note: All 10% speed is taken at 5 Hz.

Table 56. 230 V FR4—40 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	2.335	1.991	0.344	14.73%	0.755	85.27%
50%	8.597	8.253	0.344	4.00%	0.891	96.00%
90%	15.062	14.618	0.444	2.95%	0.933	97.05%
100%	15.861	15.418	0.443	2.79%	0.935	97.21%
50% torque						
10%	3.283	2.912	0.371	11.30%	0.774	88.70%
50%	12.517	11.983	0.534	4.27%	0.924	95.73%
90%	21.316	20.718	0.598	2.81%	0.949	97.19%
100%	22.099	21.499	0.600	2.72%	0.950	97.28%
100% torque						
10%	5.963	5.312	0.651	10.92%	0.831	89.08%
50%	21.284	20.338	0.946	4.44%	0.947	95.56%
90%	37.138	36.021	1.117	3.01%	0.964	96.99%
100%	37.820	36.710	1.110	2.93%	0.969	97.07%

Note: All 10% speed is taken at 5 Hz.

Table 57. 230 V FR5—75 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	3.501	3.039	0.462	13.20%	0.716	86.80%
50%	14.134	13.580	0.554	3.92%	0.887	96.08%
90%	24.488	23.875	0.613	2.50%	0.929	97.50%
100%	26.281	25.668	0.613	2.33%	0.937	97.67%
50% torque						
10%	5.670	4.934	0.736	12.98%	0.762	87.02%
50%	21.877	21.000	0.877	4.01%	0.928	95.99%
90%	37.683	36.708	0.975	2.59%	0.950	97.41%
100%	39.399	38.419	0.980	2.49%	0.951	97.51%
100% torque						
10%	10.906	9.557	1.349	12.37%	0.863	87.63%
50%	39.175	37.548	1.627	4.15%	0.948	95.85%
90%	68.046	66.164	1.882	2.77%	0.966	97.23%
100%	69.383	67.508	1.875	2.70%	0.966	97.30%

Note: All 10% speed is taken at 5 Hz.

Table 58. 230 V FR6—125 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	4.840	4.014	0.826	17.07%	0.723	82.93%
50%	18.189	17.215	0.974	5.35%	0.875	94.65%
90%	31.270	30.212	1.058	3.38%	0.917	96.62%
100%	34.724	33.657	1.067	3.07%	0.922	96.93%
50% torque						
10%	7.887	6.796	1.091	13.83%	0.768	86.17%
50%	30.266	28.931	1.335	4.41%	0.917	95.59%
90%	52.235	50.762	1.473	2.82%	0.935	97.18%
100%	56.694	55.200	1.494	2.64%	0.936	97.36%
100% torque						
10%	15.758	13.768	1.990	12.63%	0.865	87.37%
50%	56.436	54.010	2.426	4.30%	0.936	95.70%
90%	98.750	95.948	2.802	2.84%	0.940	97.16%
100%	104.914	102.060	2.854	2.72%	0.939	97.28%

Note: All 10% speed is taken at 5 Hz.

Table 59. 400 V FR1—7.5 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	0.429	0.372	0.057	13.29%	0.691	86.71%
50%	1.824	1.741	0.083	4.55%	0.801	95.45%
90%	3.093	3.002	0.091	2.94%	0.900	97.06%
100%	3.447	3.356	0.091	2.64%	0.908	97.36%
50% torque						
10%	0.620	0.552	0.068	10.97%	0.720	89.03%
50%	2.457	2.357	0.100	4.07%	0.855	95.93%
90%	4.200	4.090	0.110	2.62%	0.926	97.38%
100%	4.619	4.507	0.112	2.42%	0.932	97.58%
100% torque						
10%	1.075	0.983	0.092	8.56%	0.759	91.44%
50%	3.709	3.569	0.140	3.77%	0.910	96.23%
90%	6.439	6.278	0.161	2.50%	0.942	97.50%
100%	6.963	6.799	0.164	2.36%	0.943	97.64%

Note: All 10% speed is taken at 5 Hz.

Table 60. 400 V FR2—20 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	0.474	0.349	0.125	26.37%	0.495	73.63%
50%	1.461	1.322	0.139	9.51%	0.689	90.49%
90%	4.683	4.534	0.149	3.18%	0.800	96.82%
100%	5.806	5.652	0.154	2.65%	0.842	97.35%
50% torque						
10%	1.280	1.107	0.173	13.52%	0.670	86.48%
50%	5.342	5.141	0.201	3.76%	0.819	96.24%
90%	9.505	9.286	0.219	2.30%	0.907	97.70%
100%	10.009	9.787	0.222	2.22%	0.912	97.78%
100% torque						
10%	3.130	2.826	0.304	9.71%	0.753	90.29%
50%	11.110	10.748	0.362	3.26%	0.915	96.74%
90%	17.832	17.428	0.404	2.27%	0.935	97.73%
100%	18.208	17.8	0.408	2.24%	0.936	97.76%

Note: All 10% speed is taken at 5 Hz.

Table 61. 400 V FR3—40 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	1.844	1.58	0.264	14.32%	0.659	85.68%
50%	7.409	7.101	0.308	4.16%	0.775	95.84%
90%	13.185	12.855	0.33	2.50%	0.861	97.50%
100%	14.358	14.022	0.336	2.34%	0.875	97.66%
50% torque						
10%	3.003	2.667	0.336	11.19%	0.705	88.81%
50%	11.877	11.473	0.404	3.40%	0.847	96.60%
90%	19.868	19.431	0.437	2.20%	0.912	97.80%
100%	20.442	20.002	0.44	2.15%	0.913	97.85%
100% torque						
10%	6.154	5.572	0.582	9.46%	0.763	90.54%
50%	22.115	21.397	0.718	3.25%	0.917	96.75%
90%	35.805	34.988	0.817	2.28%	0.945	97.72%
100%	35.95	35.135	0.815	2.27%	0.943	97.73%

Note: All 10% speed is taken at 5 Hz.

Table 62. 400 V FR4—75 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	2.154	1.929	0.225	10.46%	0.650	89.54%
50%	7.011	6.645	0.366	5.22%	0.740	94.78%
90%	11.435	11.045	0.390	3.41%	0.780	96.59%
100%	13.560	13.176	0.384	2.83%	0.790	97.17%
50% torque						
10%	3.756	3.373	0.383	10.21%	0.690	89.79%
50%	15.649	15.045	0.604	3.86%	0.820	96.14%
90%	26.882	26.233	0.649	2.41%	0.890	97.59%
100%	29.821	29.175	0.646	2.16%	0.910	97.84%
100% torque						
10%	6.901	6.223	0.678	9.83%	0.740	90.17%
50%	31.386	30.307	1.079	3.44%	0.910	96.56%
90%	54.929	53.719	1.210	2.20%	0.940	97.80%
100%	59.441	58.233	1.208	2.03%	0.950	97.97%

Note: All 10% speed is taken at 5 Hz.

Table 63. 400 V FR5—150 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	3.531	3.118	0.413	11.70%	0.6416	88.30%
50%	14.505	13.847	0.658	4.54%	0.7595	95.46%
90%	24.526	23.833	0.693	2.83%	0.817	97.17%
100%	27.264	26.575	0.689	2.53%	0.8348	97.47%
50% torque						
10%	6.234	5.662	0.572	9.18%	0.6952	90.82%
50%	27.506	26.596	0.91	3.31%	0.8316	96.69%
90%	45.589	44.636	0.953	2.09%	0.8954	97.91%
100%	51.297	50.346	0.951	1.85%	0.905	98.15%
100% torque						
10%	13.413	12.153	1.26	9.39%	0.7574	90.61%
50%	62.522	60.517	2.005	3.21%	0.9155	96.79%
90%	109.298	107.068	2.23	2.04%	0.944	97.96%
100%	117.791	115.554	2.237	1.90%	0.9452	98.10%

Note: All 10% speed is taken at 5 Hz.

Table 64. 400 V FR6—250 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	7.351	6.442	0.909	12.37%	0.699	87.63%
50%	30.288	29.117	1.171	3.87%	0.803	96.13%
90%	50.985	49.735	1.25	2.45%	0.887	97.55%
100%	56.368	55.123	1.245	2.21%	0.896	97.79%
50% torque						
10%	12.292	11.068	1.224	9.96%	0.73	90.04%
50%	50.706	49.109	1.597	3.15%	0.891	96.85%
90%	87.617	85.878	1.739	1.98%	0.928	98.02%
100%	96.15	94.393	1.757	1.83%	0.927	98.17%
100% torque						
10%	24.451	22.167	2.284	9.34%	0.782	90.66%
50%	95.24	92.235	3.005	3.16%	0.932	96.84%
90%	166.981	163.649	3.332	2.00%	0.943	98.00%
100%	179.135	175.79	3.345	1.87%	0.941	98.13%

Note: All 10% speed is taken at 5 Hz.

Table 65. 575 V FR1—7.5 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	0.28	0.228	0.052	18.57%	0.55	81.43%
50%	1.243	1.182	0.061	4.91%	0.727	95.09%
90%	2.059	1.993	0.066	3.21%	0.763	96.79%
100%	2.525	2.457	0.068	2.69%	0.789	97.31%
50% torque						
10%	0.528	0.466	0.062	11.74%	0.648	88.26%
50%	2.322	2.244	0.078	3.36%	0.781	96.64%
90%	3.9	3.814	0.086	2.21%	0.868	97.79%
100%	4.315	4.229	0.086	1.99%	0.878	98.01%
100% torque						
10%	1.239	1.146	0.093	7.51%	0.73	92.49%
50%	4.393	4.273	0.12	2.73%	0.891	97.27%
90%	7.62	7.481	0.139	1.82%	0.929	98.18%
100%	8.12	7.975	0.145	1.79%	0.929	98.21%

Note: All 10% speed is taken at 5 Hz.

Table 66. 575 V FR2—20 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	0.565	0.492	0.073	12.91%	0.603	87.09%
50%	2.200	2.102	0.098	4.47%	0.734	95.53%
90%	3.697	3.591	0.106	2.87%	0.768	97.13%
100%	4.120	4.012	0.108	2.62%	0.778	97.38%
50% torque						
10%	0.971	0.880	0.091	9.38%	0.667	90.62%
50%	3.792	3.670	0.121	3.20%	0.775	96.80%
90%	6.576	6.444	0.132	2.00%	0.838	98.00%
100%	7.192	7.060	0.132	1.83%	0.855	98.17%
100% torque						
10%	2.249	2.069	0.179	7.98%	0.735	92.02%
50%	10.211	9.766	0.445	4.36%	0.901	95.64%
90%	17.335	17.016	0.319	1.84%	0.933	98.16%
100%	18.634	18.337	0.296	1.59%	0.934	98.41%

Note: All 10% speed is taken at 5 Hz.

Table 67. 575 V FR3—40 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	1.600	1.435	0.165	10.31%	0.670	89.69%
50%	6.467	6.269	0.198	3.06%	0.760	96.94%
90%	10.952	10.733	0.219	2.00%	0.810	98.00%
100%	12.226	12.004	0.222	1.81%	0.830	98.19%
50% torque						
10%	2.346	2.126	0.221	9.41%	0.690	90.59%
50%	10.810	10.497	0.313	2.89%	0.800	97.11%
90%	17.818	17.488	0.330	1.85%	0.890	98.15%
100%	19.089	18.757	0.333	1.74%	0.890	98.26%
100% torque						
10%	4.081	3.730	0.350	8.59%	0.870	91.41%
50%	18.650	18.168	0.482	2.58%	0.890	97.42%
90%	32.656	32.099	0.557	1.70%	0.930	98.30%
100%	34.299	33.729	0.570	1.66%	0.930	98.34%

Note: All 10% speed is taken at 5 Hz.

Table 68. 575 V FR4—75 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	2.221	1.946	0.275	12.38%	0.644	87.62%
50%	10.331	10.017	0.314	3.04%	0.75	96.96%
90%	17.913	17.575	0.338	1.89%	0.817	98.11%
100%	19.659	19.334	0.325	1.65%	0.828	98.35%
50% torque						
10%	4.107	3.696	0.411	10.01%	0.6859	89.99%
50%	18.406	17.914	0.492	2.67%	0.8166	97.33%
90%	32.043	31.514	0.529	1.65%	0.898	98.35%
100%	34.542	34.011	0.531	1.54%	0.905	98.46%
100% torque						
10%	9.4689	8.739	0.7299	7.71%	0.739	92.29%
50%	35.68	34.817	0.863	2.42%	0.9069	97.58%
90%	63.158	62.16	0.998	1.58%	0.9342	98.42%
100%	65.368	64.382	0.986	1.51%	0.9329	98.49%

Note: All 10% speed is taken at 5 Hz.

Table 69. 575 V FR5—150 hp efficiency rating

Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	4.398	4.046	0.352	8.00%	0.655	92.00%
50%	17.057	16.570	0.487	2.85%	0.761	97.15%
90%	30.052	29.559	0.493	1.64%	0.846	98.36%
100%	31.701	31.228	0.474	1.49%	0.851	98.51%
50% torque						
10%	8.455	7.841	0.614	7.26%	0.706	92.74%
50%	32.733	31.962	0.771	2.36%	0.859	97.64%
90%	57.450	56.614	0.836	1.46%	0.915	98.54%
100%	61.324	60.485	0.839	1.37%	0.919	98.63%
100% torque						
10%	16.994	15.925	1.068	6.29%	0.763	93.71%
50%	64.798	63.371	1.427	2.20%	0.920	97.80%
90%	113.931	112.328	1.603	1.41%	0.941	98.59%
100%	118.897	117.393	1.504	1.26%	0.944	98.74%

Note: All 10% speed is taken at 5 Hz.

Table 70. 575 V FR6—250 hp efficiency rating

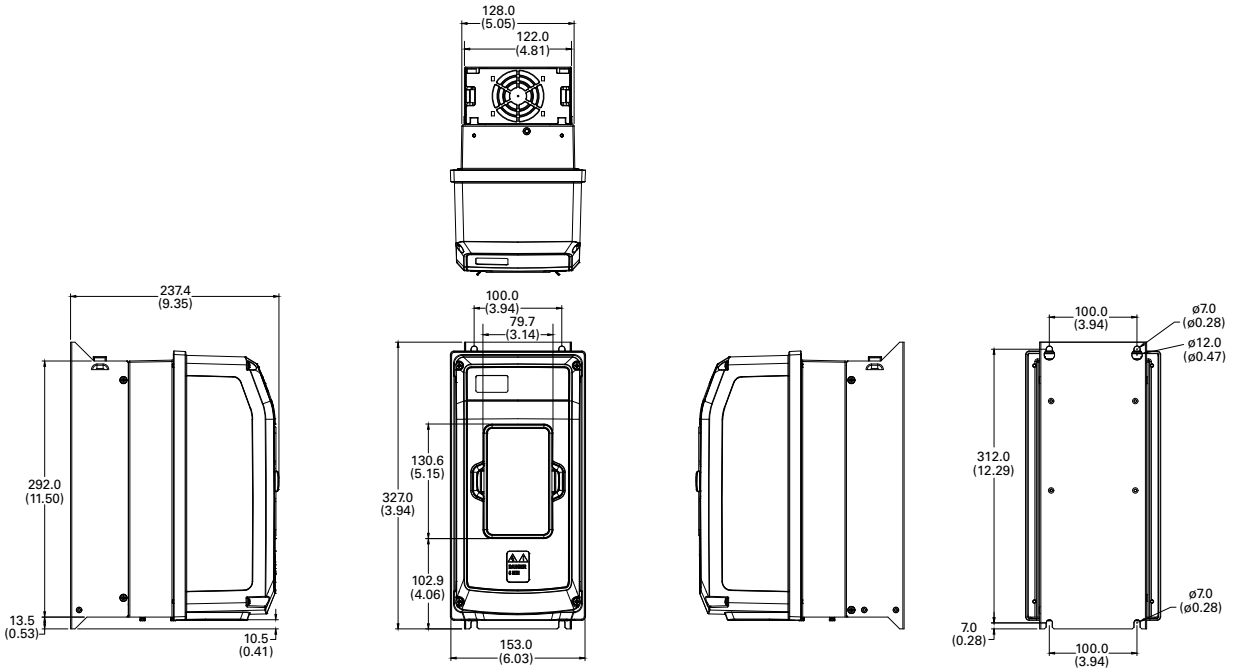
Speed	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
25% torque						
10%	7.836	6.878	0.958	12.23%	0.689	87.77%
50%	30.641	29.432	1.209	3.95%	0.782	96.05%
90%	48.755	47.519	1.236	2.54%	0.841	97.46%
100%	56.254	55.008	1.246	2.21%	0.868	97.79%
50% torque						
10%	13.712	12.420	1.292	9.42%	0.725	90.58%
50%	58.619	56.932	1.687	2.88%	0.868	97.12%
90%	99.374	97.606	1.768	1.78%	0.915	98.22%
100%	107.264	105.491	1.773	1.65%	0.920	98.35%
100% torque						
10%	26.874	24.540	2.334	8.68%	0.772	91.32%
50%	114.753	111.638	3.115	2.71%	0.924	97.29%
90%	200.581	197.198	3.383	1.69%	0.938	98.31%
100%	209.020	205.664	3.356	1.61%	0.940	98.39%

Note: All 10% speed is taken at 5 Hz.

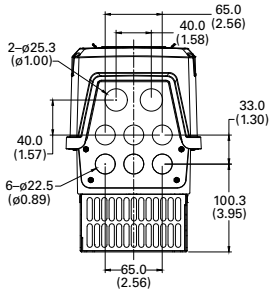
Appendix C—Dimension drawings

Approximate dimensions in mm (inches)

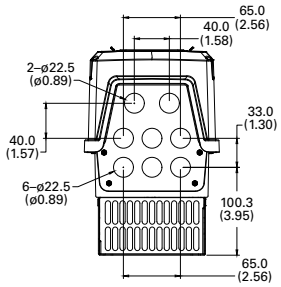
Figure 45. FR1 dimension drawing

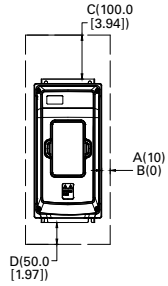


IP21/IP54 Metric



Type 1/12 UL

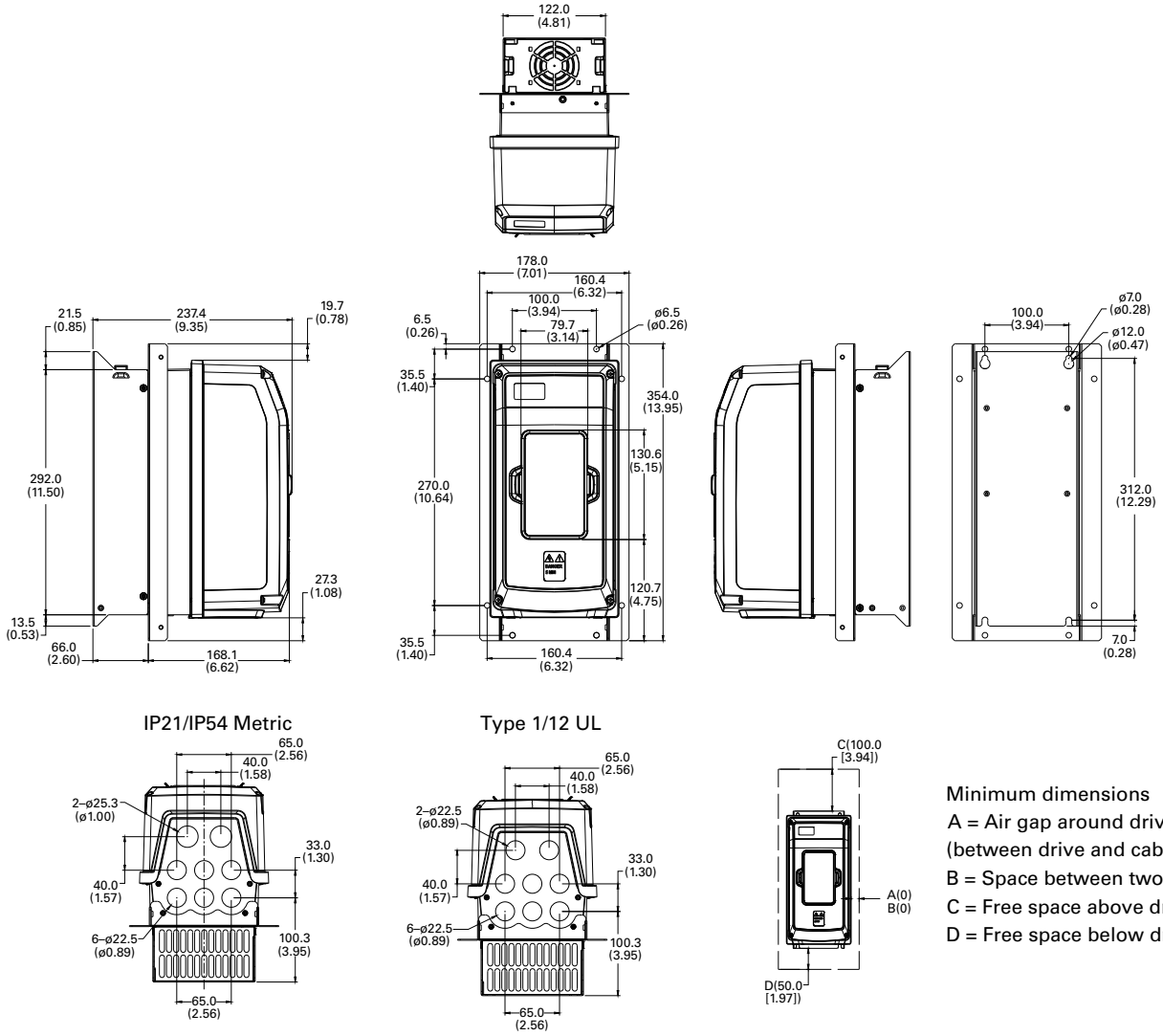




Minimum dimensions
A = Air gap around drive
(between drive and cabinet)
B = Space between two drives
C = Free space above drive
D= Free space below drive

Approximate dimensions in mm (inches)

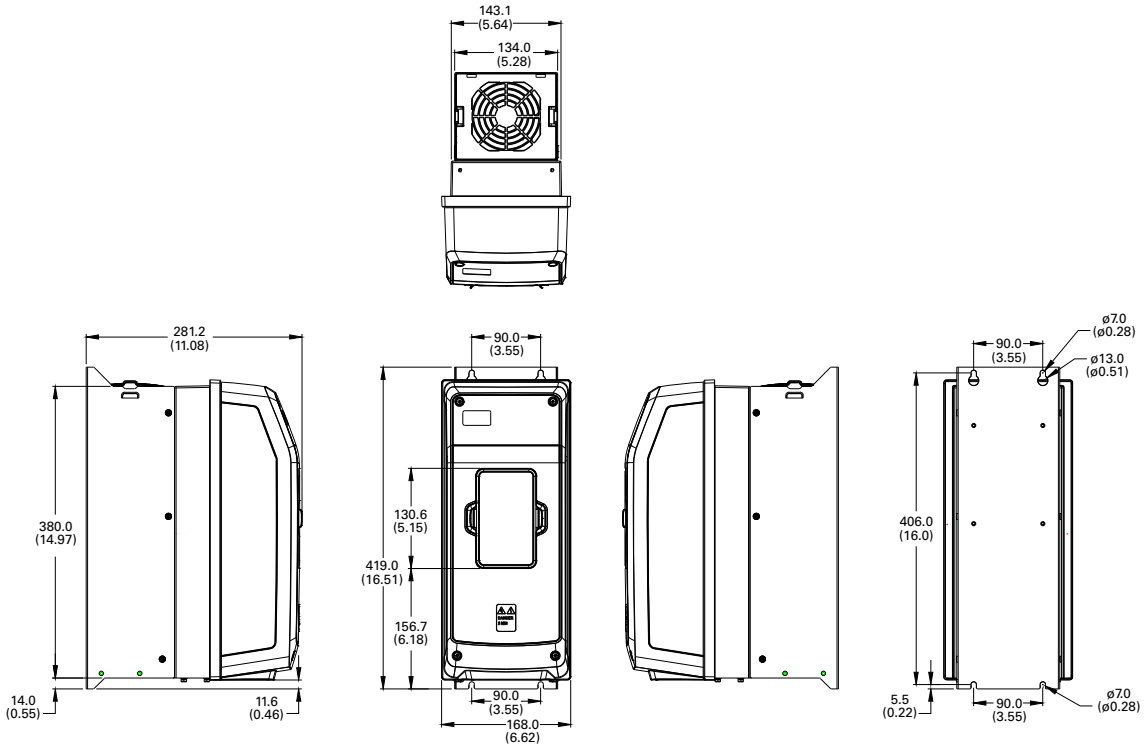
Figure 46. FR1 dimension drawing flange mount



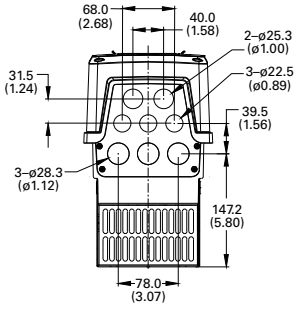
Minimum dimensions
A = Air gap around drive
(between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

Approximate dimensions in mm (inches)

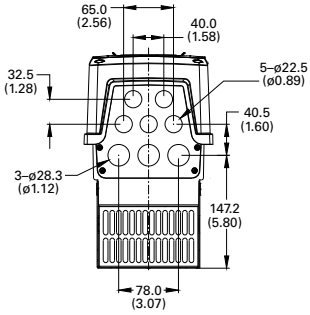
Figure 47. FR2 dimension drawing

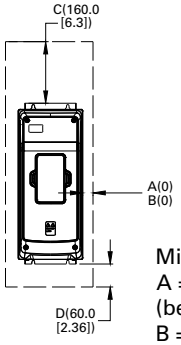


IP21/IP54 Metric



Type 1/12 UL

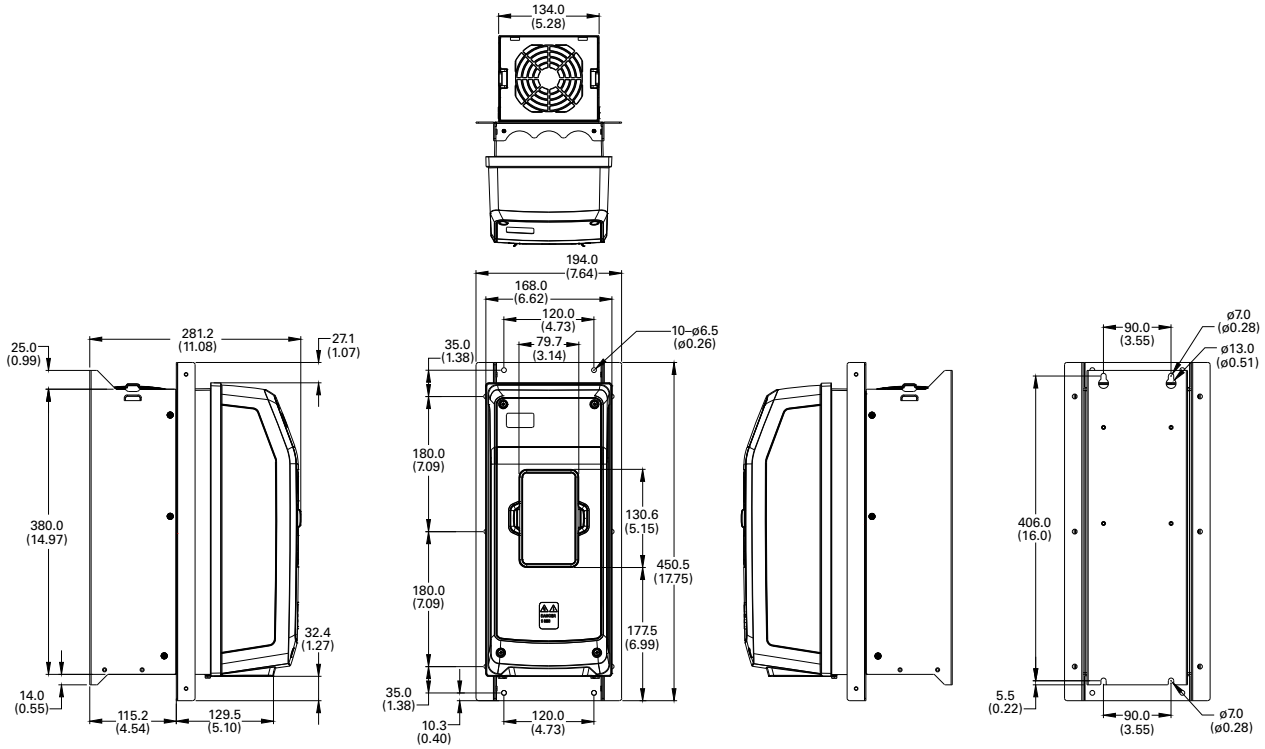




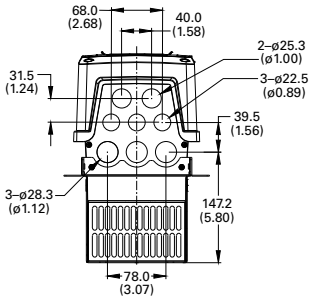
Minimum dimensions
A = Air gap around drive (between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

Approximate dimensions in mm (inches)

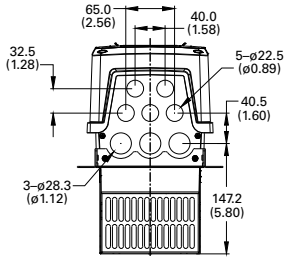
Figure 48. FR2 dimension drawing flange mount

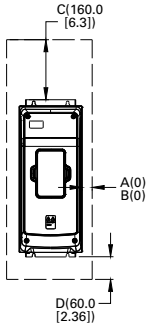


IP21/IP54 Metric



Type 1/12 UL

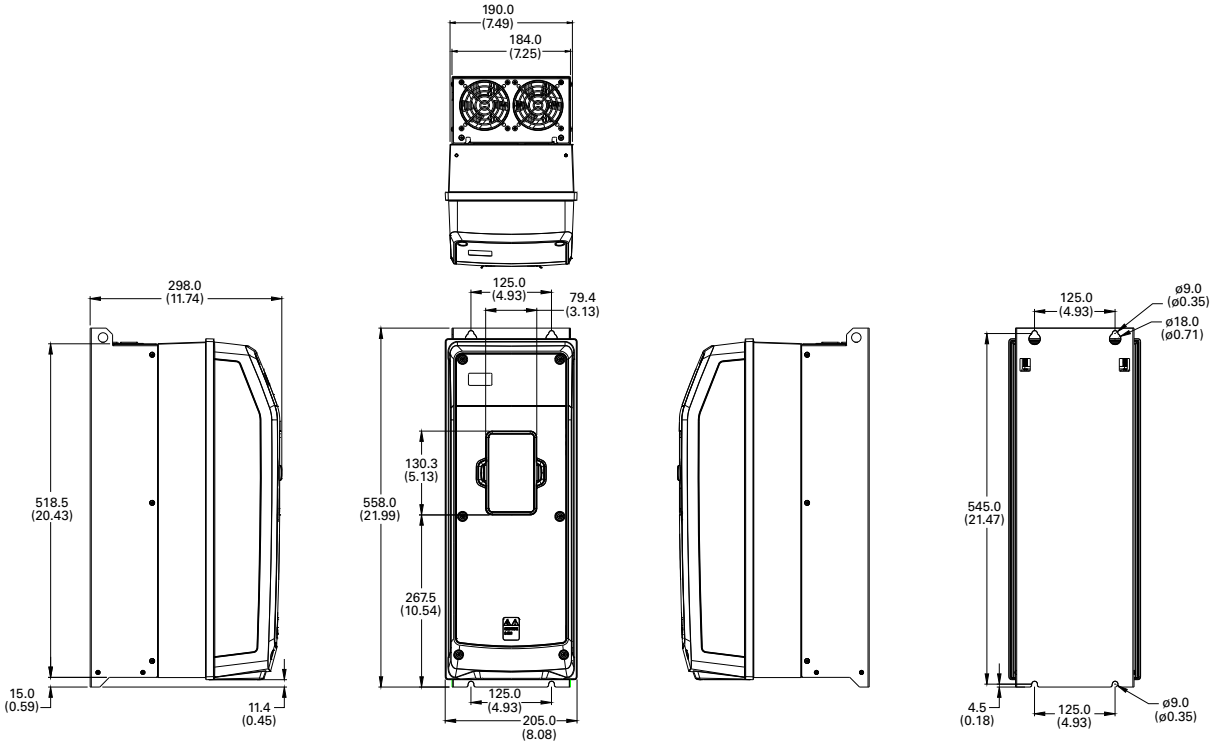




Minimum dimensions
A = Air gap around drive (between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

Approximate dimensions in mm (inches)

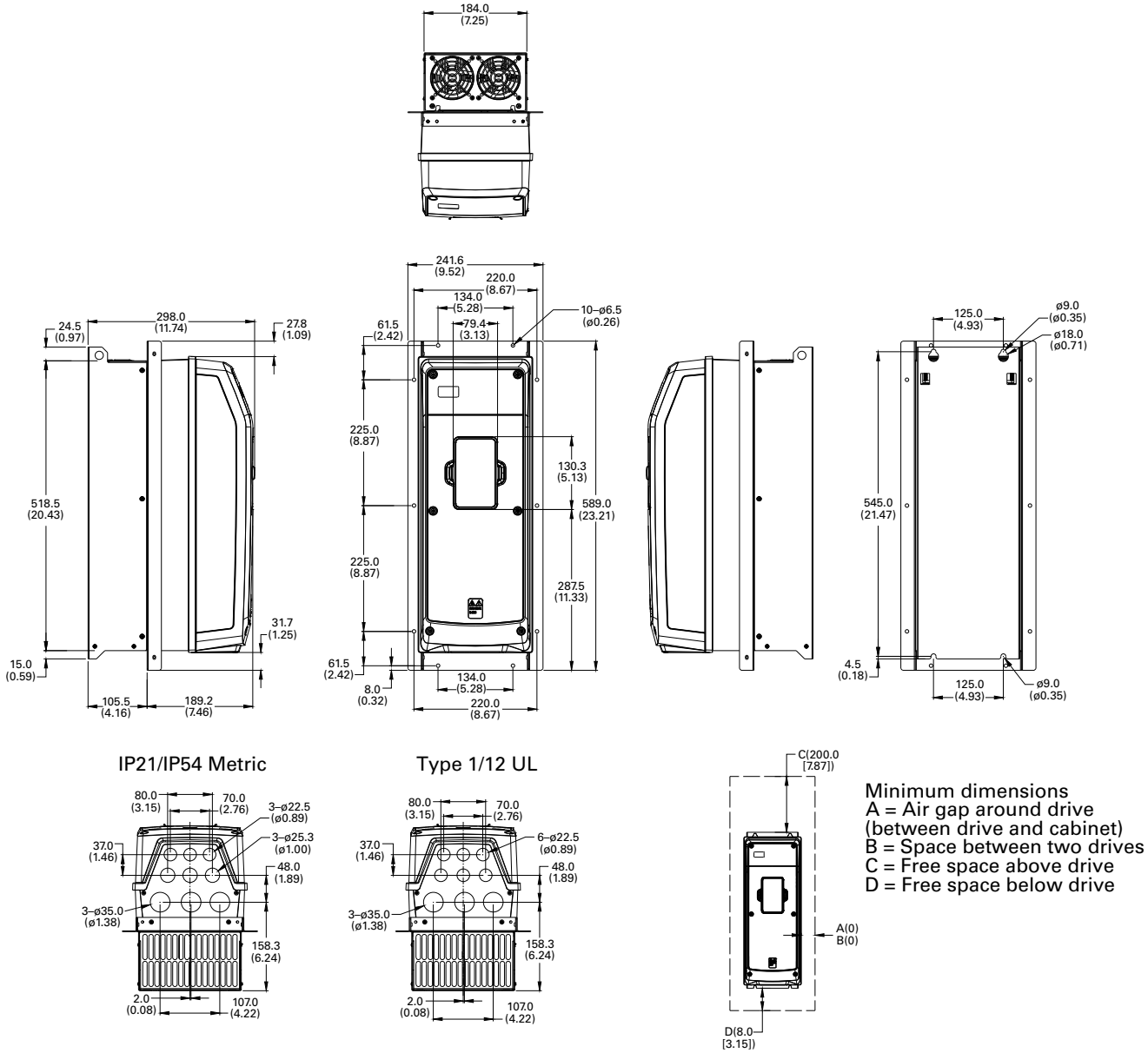
Figure 49. FR3 dimension drawing



Minimum dimensions
A = Air gap around drive
(between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

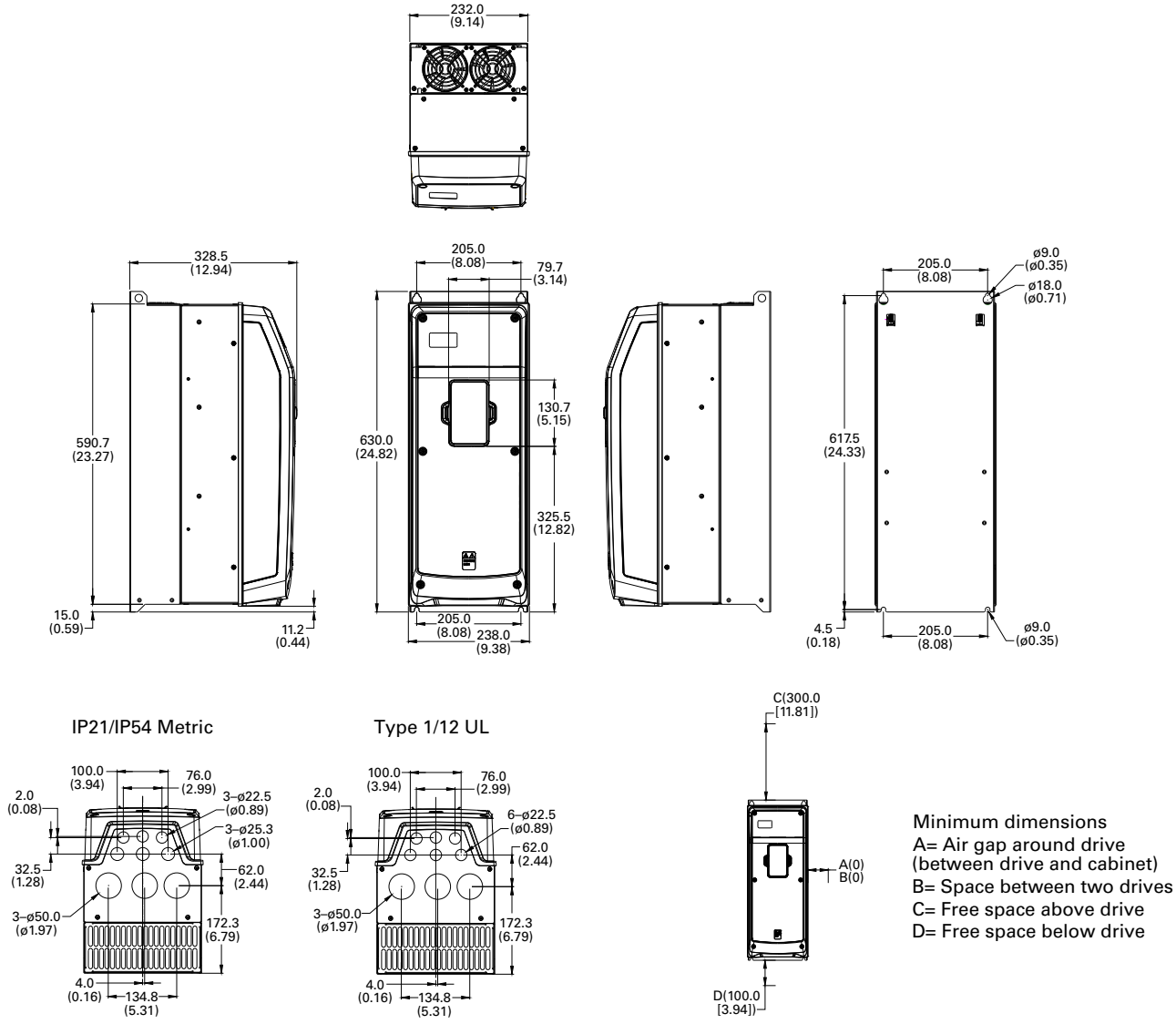
Approximate dimensions in mm (inches)

Figure 50. FR3 dimension drawing flange mount



Approximate dimensions in mm (inches)

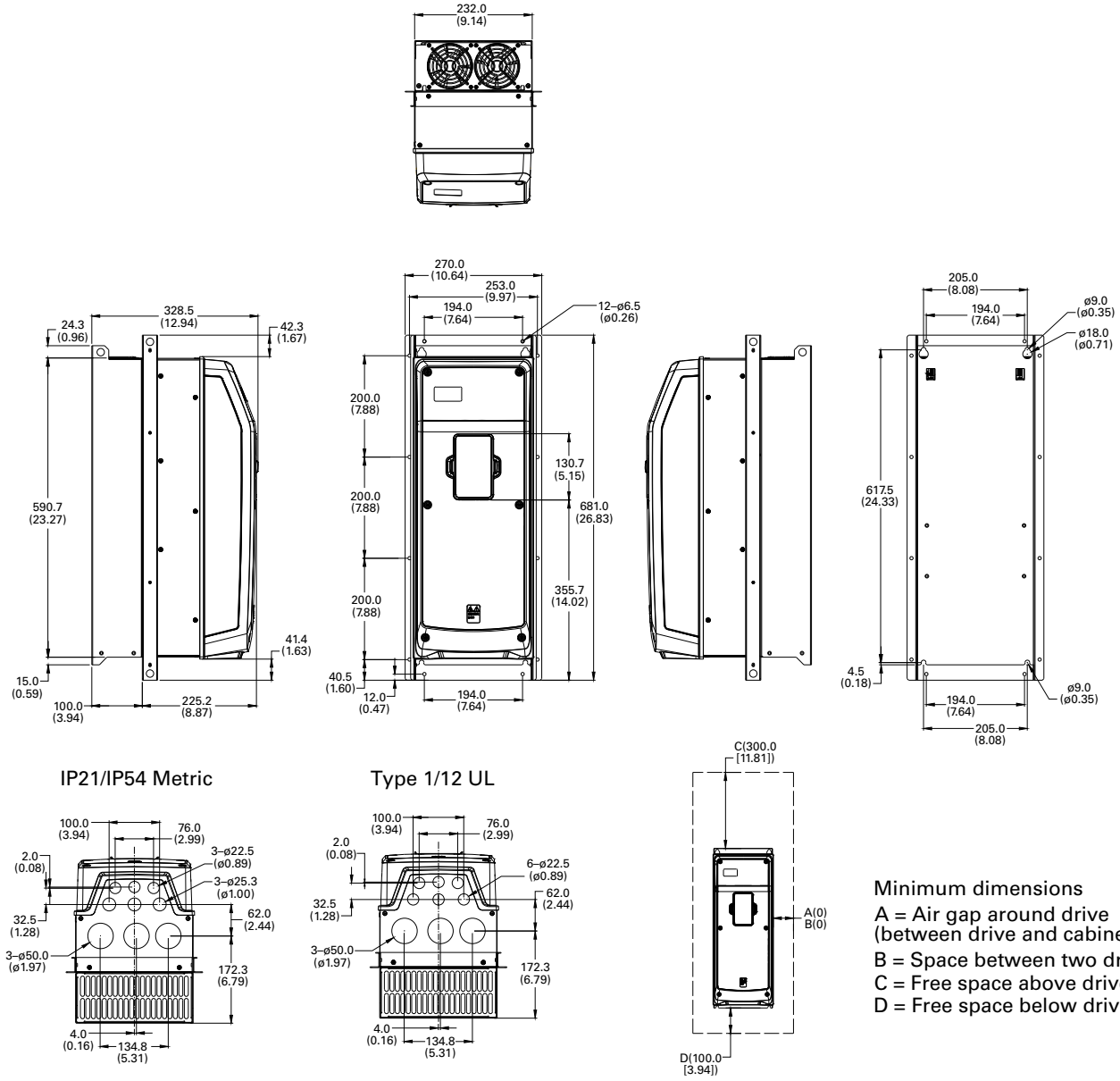
Figure 51. FR4 dimension drawing



Minimum dimensions
A= Air gap around drive
(between drive and cabinet)
B= Space between two drives
C= Free space above drive
D= Free space below drive

Approximate dimensions in mm (inches)

Figure 52. FR4 dimension drawing flange mount



Minimum dimensions

A = Air gap around drive (between drive and cabinet)

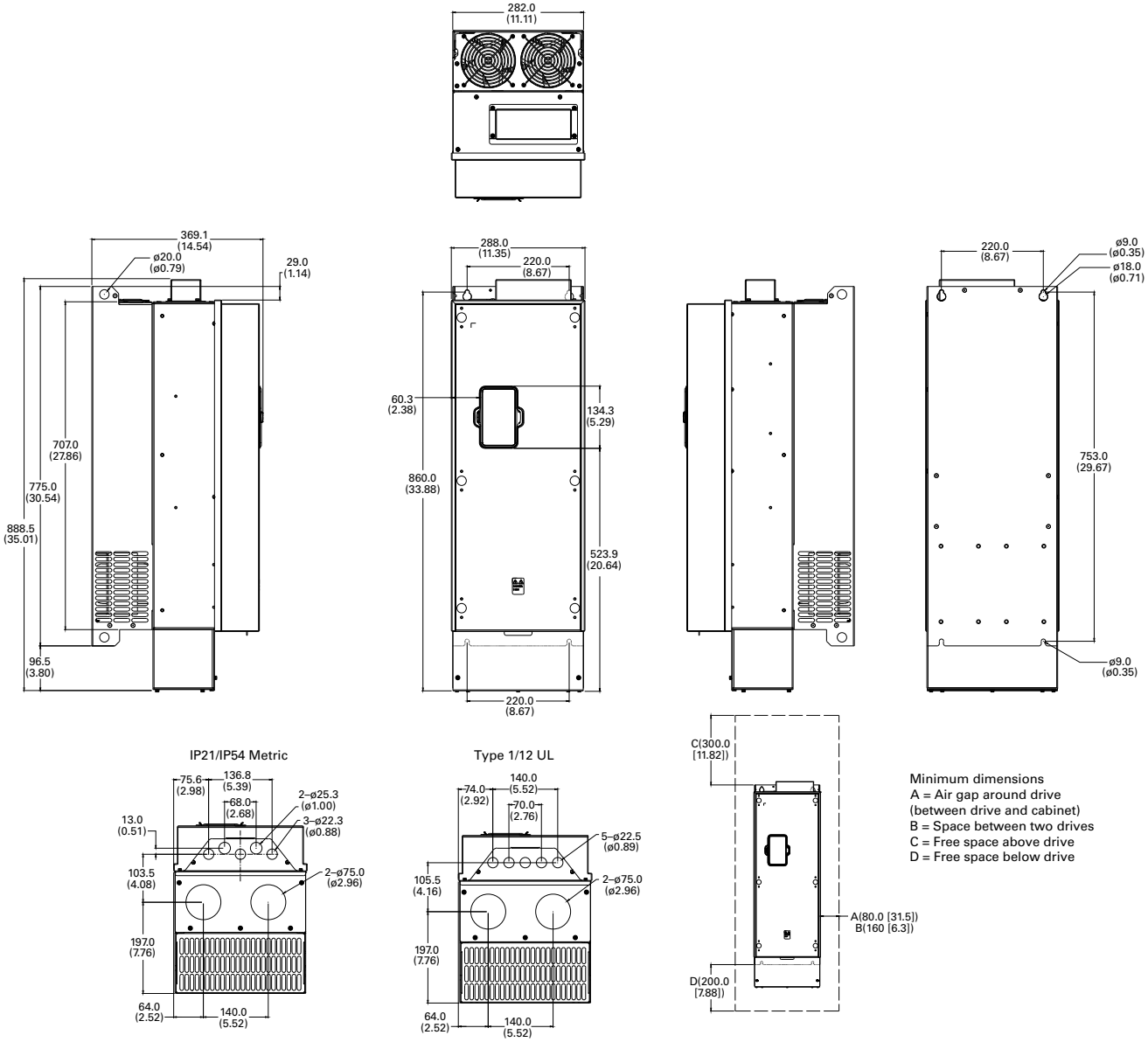
B = Space between two drives

C = Free space above drive

D = Free space below drive

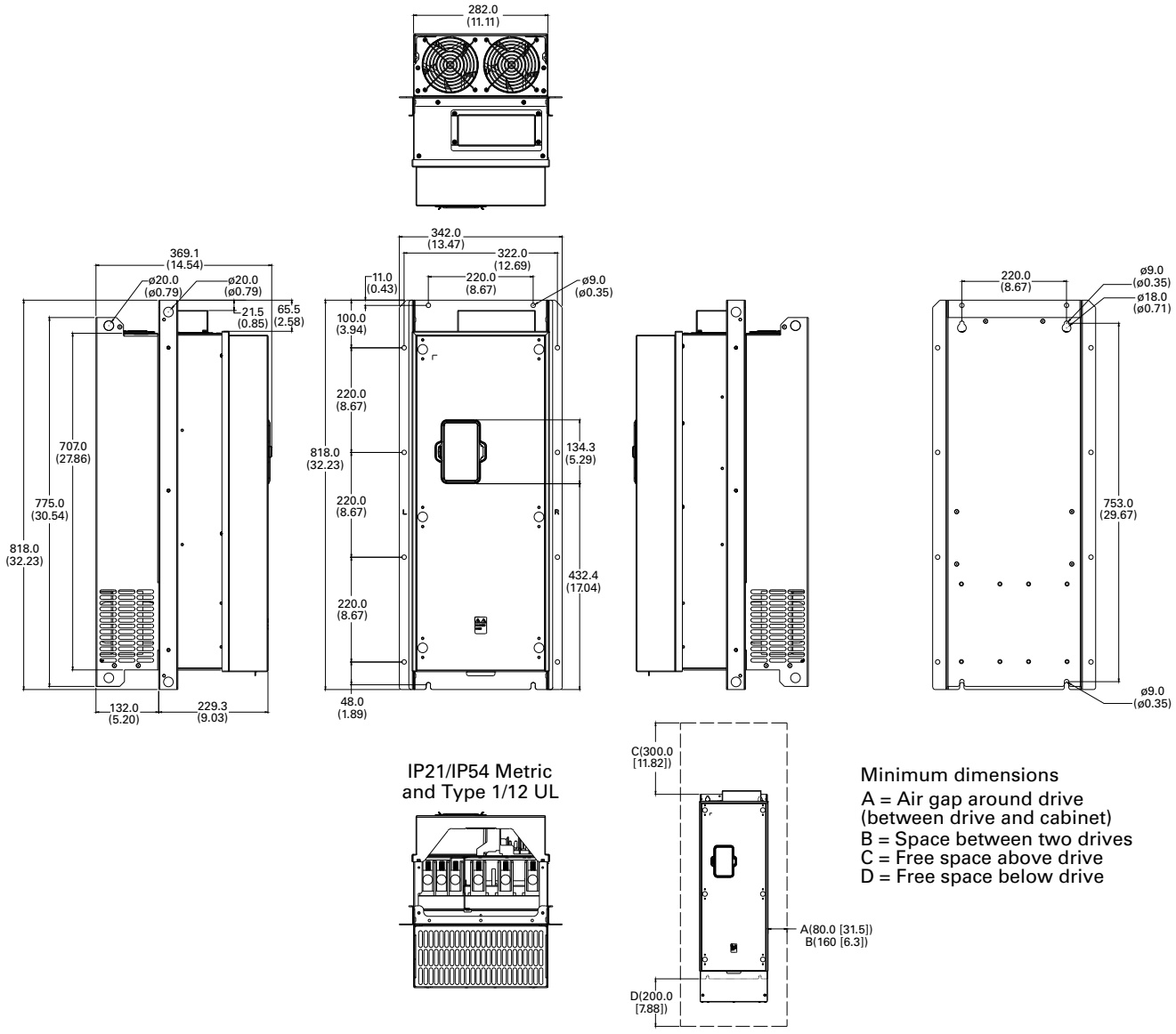
Approximate dimensions in mm (inches)

Figure 53. FR5 dimension drawing



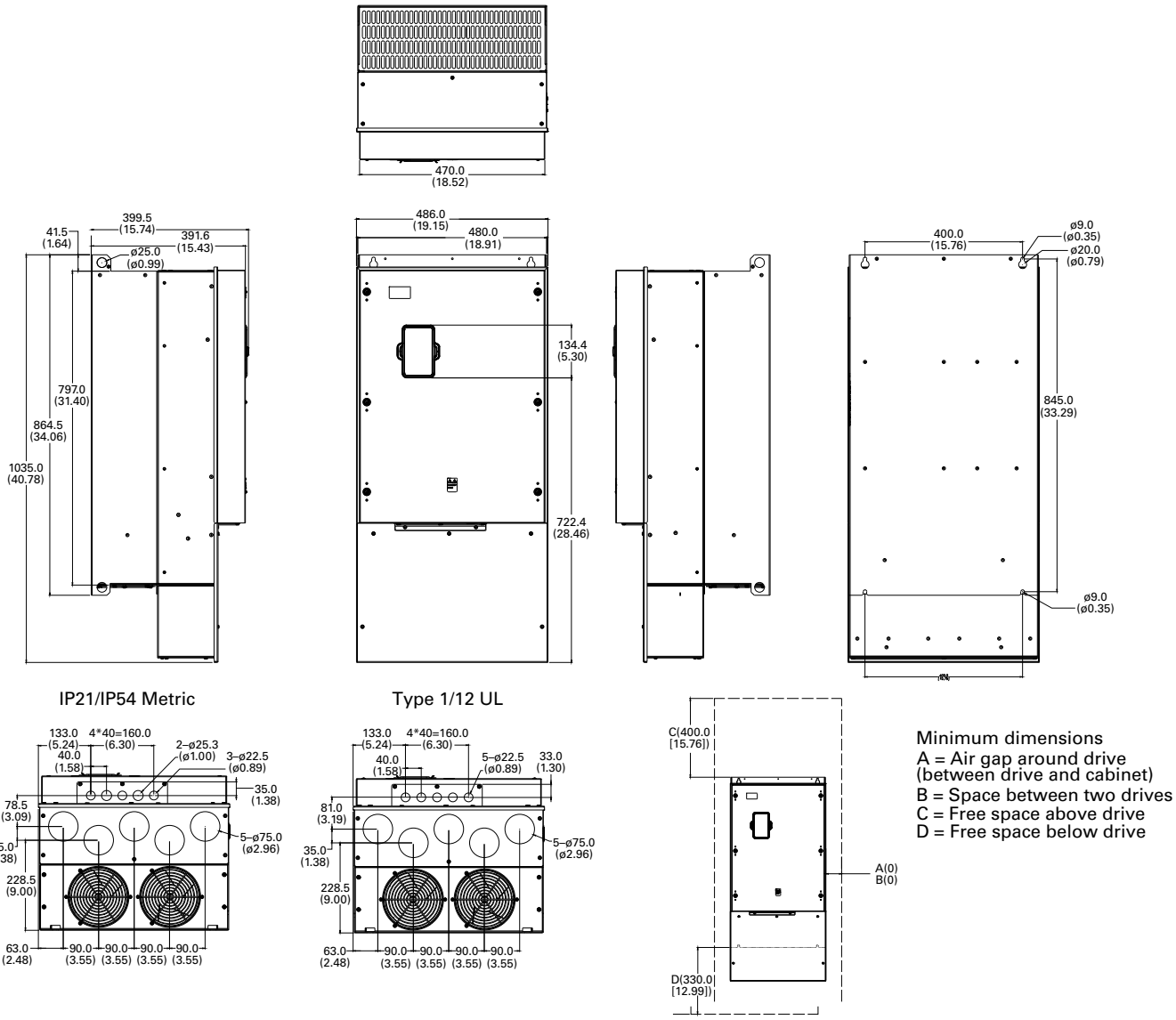
Approximate dimensions in mm (inches)

Figure 54. FR5 dimension drawing flange mount



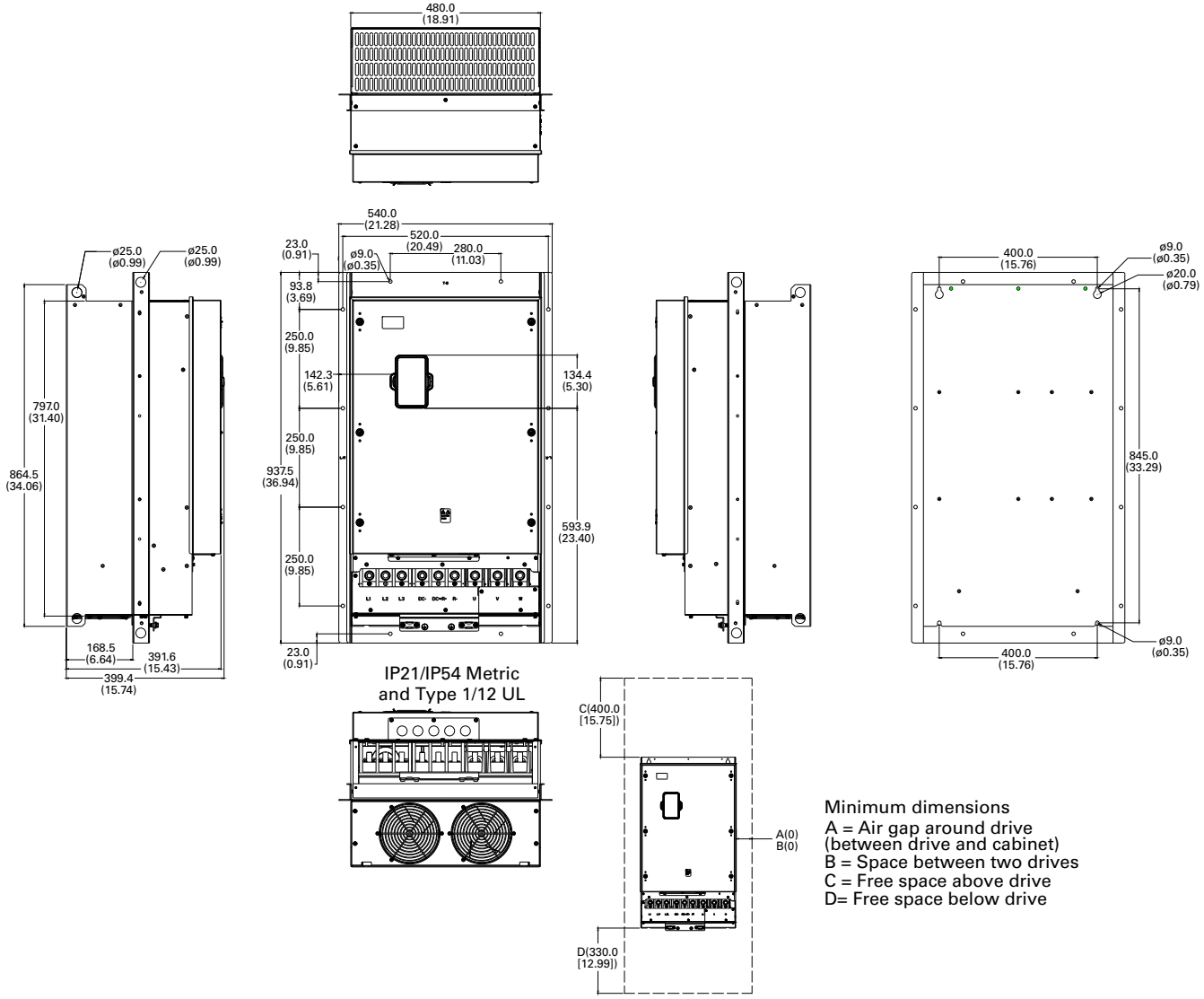
Approximate dimensions in mm (inches)

Figure 55. FR6 dimensional drawing



Approximate dimensions in mm (inches)

Figure 56. FR6 dimensional drawing flange mount



Minimum dimensions
A = Air gap around drive
(between drive and cabinet)
B = Space between two drives
C = Free space above drive
D= Free space below drive

Appendix D—Safety instructions for UL and cUL

⚠ CAUTION

The UL and cUL compliance can be maintained only if this drive is installed according to the requirements of Appendix D —Safety Instructions for UL and cUL. Failure to follow these instructions may result in UL and cUL non-compliance.

UL standards compliance

This drive is certified in accordance with UL 61800-5-1 and CSA C22.2 No. 274-17 and is found to comply with these requirements. To ensure continued compliance when using this drive or when using it in combination with other equipment, meet the following conditions.

General

This drive shall be applied in accordance with the specifications detailed in **Table 15**.

Overvoltage category

To comply with standard CSA C22.2 No. 274-17 requirement, the following applies to cUL applications:

- This drive should be installed in environment of Overvoltage Category III
- **For 480 V Series**: It is recommended that transient surge suppression be installed on the line side of this equipment and be rated 500 V (phase to ground), suitable for Overvoltage Category III, and shall provide protection for a rated impulse withstand voltage peak of 6 kV
- **For 230 V Series**: It is recommended that transient surge suppression be installed on the line side of this equipment and be rated 240 V (phase to ground), suitable for Overvoltage Category III, and provide protection for a rated impulse withstand voltage peak of 4 kV
- **For 575 V Series:** It is recommended that transient surge suppression be installed on the line side of this equipment and be rated 600 V (phase to ground), suitable for Overvoltage Category III, and shall provide protection for a rated impulse withstand voltage peak of 6 kV

Motor overload and over-temperature protection

This drive provides solid-state motor overload protection. The solid-state motor overload protection limit is adjustable, see the drives application manual for more details.

This drive can accept and act upon a signal from a thermal sensor or switch embedded in the motor or from an external protective relay to achieve the motor over temperature protection. Therefore, in order to achieve the motor over temperature protection, a sensor from the motor will be needed.

Branch circuit short circuit protection

Integral solid-state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes.

480 V Drive Series are suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 500 volts maximum, when protected by UL and cUL/CSA Listed Class J, T, CF, CC or equivalent fuses, with an A.I.C. rating of 100 kA minimum.

Refer to the following information for recommended ratings. See **Table 71**.

Table 71. Protection ratings—480 V drive series

Frame size	DX1 catalog number	Maximum fuse rating ①
1	**DX1-342D2xx-xxxxx**	600 V, 6 A
	DX1-343D3xx-xxxxx	600 V, 10 A
	DX1-344D3xx-xxxxx	600 V, 10 A
	DX1-345D6xx-xxxxx	600 V, 15 A
	DX1-347D6xx-xxxxx	600 V, 20 A
	DX1-349D0xx-xxxxx	600 V, 20 A
2	**DX1-34012xx-xxxxx**	600 V, 30 A
	DX1-34016xx-xxxxx	600 V, 40 A
	DX1-34023xx-xxxxx	600 V, 50 A
3	**DX1-34031xx-xxxxx**	600 V, 60 A
	DX1-34038xx-xxxxx	600 V, 70 A
	DX1-34046xx-xxxxx	600 V, 100 A
4	**DX1-34061xx-xxxxx**	600 V, 125 A
	DX1-34072xx-xxxxx	600 V, 150 A
	DX1-34087xx-xxxxx	600 V, 175 A
5	**DX1-34105xx-xxxxx**	600 V, 225 A
	DX1-34140xx-xxxxx	600 V, 250 A
	DX1-34170xx-xxxxx	600 V, 300 A
6	**DX1-34205xx-xxxxx**	600 V, 400 A
	DX1-34245xx-xxxxx	600 V, 450 A

① These ratings are based on the largest wire size designed for the given Frame. Please verify your protection protects your wire sizing. See Appendix B for recommended fuse and wire size.

230 V Drive Series are suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 240 volts maximum when protected by UL and cUL/CSA Listed Class J, T, CF, CC or equivalent fuses, with an A.I.C. rating of 100 kA minimum.

Refer to the following information for recommended ratings. See **Table 72**.

Table 72. Protection ratings—230 V drive series

Frame size	DX1 catalog number	Maximum fuse rating ①
1	**DX1-323D7xx-xxxxx**	600 V, 10 A
	DX1-324D8xx-xxxxx	600 V, 15 A
	DX1-326D6xx-xxxxx	600 V, 15 A
	DX1-327D8xx-xxxxx	600 V, 20 A
	DX1-32011xx-xxxxx	600 V, 20 A
2	**DX1-32012xx-xxxxx**	600 V, 30 A
	DX1-32017xx-xxxxx	600 V, 40 A
	DX1-32025xx-xxxxx	600 V, 50 A
3	**DX1-32031xx-xxxxx**	600 V, 80 A
	DX1-32048xx-xxxxx	600 V, 100 A
4	**DX1-32061xx-xxxxx**	600 V, 125 A
	DX1-32075xx-xxxxx	600 V, 150 A
	DX1-32088xx-xxxxx	600 V, 175 A
5	**DX1-32114xx-xxxxx**	600 V, 225 A
	DX1-32143xx-xxxxx	600 V, 250 A
	DX1-32170xx-xxxxx	600 V, 300 A
6	**DX1-32211xx-xxxxx**	600 V, 400 A
	DX1-32248xx-xxxxx	600 V, 450 A

① These ratings are based on the largest wire size designed for the given Frame. Please verify your protection protects your wire sizing. See Appendix B for recommended fuse and wire size.

575 V Drive Series are suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 600 volts maximum, when protected by UL and cUL/CSA Listed Class J, T, CF, CC or equivalent fuses, with an A.I.C. rating of 100 kA minimum.

Refer to the following information for recommended ratings. See **Table 73**.

Table 73. Protection ratings—575 V drive series

Frame size	DX1 catalog number	Maximum fuse rating ①
1	**DX1-353D3xx-xxxxx**	600 V, 10 A
	DX1-354D5xx-xxxxx	600 V, 15 A
	DX1-357D5xx-xxxxx	600 V, 20 A
2	**DX1-35010xx-xxxxx**	600 V, 30 A
	DX1-35013xx-xxxxx	600 V, 35 A
	DX1-35018xx-xxxxx	600 V, 45 A
3	**DX1-35022xx-xxxxx**	600 V, 50 A
	DX1-35027xx-xxxxx	600 V, 60 A
	DX1-35034xx-xxxxx	600 V, 70 A
4	**DX1-35041xx-xxxxx**	600 V, 80 A
	DX1-35052xx-xxxxx	600 V, 100 A
	DX1-35062xx-xxxxx	600 V, 125 A
5	**DX1-35080xx-xxxxx**	600 V, 175 A
	DX1-35100xx-xxxxx	600 V, 200 A
	DX1-35125xx-xxxxx	600 V, 225 A
6	**DX1-35144xx-xxxxx**	600 V, 350 A
	DX1-35208xx-xxxxx	600 V, 450 A

① These ratings are based off the largest wire size designed for the given Frame. Please verify your protection protects your wire sizing. See Appendix B for recommended fuse and wire size.

Field wiring

- The field-installed conductors for this drive should be 75 °C or higher copper wire
- The enclosure openings provided for conduit connections in the field shall be closed by UL Listed conduit fittings with same type rating as the enclosure (Type 1/Type 12)

Line and motor wiring

For 480 V Drive Series, required line and motor wire torque, type and size range are listed in **Table 74**.

Table 74. Required line and motor wire torque (480 V)

DX1 catalog number	Terminal type	Required torque (in-lb)	Required wire range
FR1			
DX1-342D2xx-xxxxx	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	5.3	14–10 AWG
DX1-343D3xx-xxxxx		5.3	14–10 AWG
DX1-344D3xx-xxxxx		5.3	14–10 AWG
DX1-345D6xx-xxxxx		5.3	14–10 AWG
DX1-347D6xx-xxxxx		5.3	14–10 AWG
DX1-349D0xx-xxxxx		5.3	12–10 AWG
FR2			
DX1-34012xx-xxxxx	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	15.6	12–6 AWG
DX1-34016xx-xxxxx		15.6	10–6 AWG
DX1-34023xx-xxxxx		15.6	8–6 AWG
FR3			
DX1-34031xx-xxxxx	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	33	8–2 AWG
DX1-34038xx-xxxxx		33	6–2 AWG
DX1-34046xx-xxxxx		33	4–2 AWG
FR4			
DX1-34061xx-xxxxx	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	95	3–1/0 AWG
DX1-34072xx-xxxxx		95	2–1/0 AWG
DX1-34087xx-xxxxx		95	1/0 AWG
FR5			
DX1-34105xx-xxxxx	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	354	3/0 AWG–350 kcmil
DX1-34140xx-xxxxx		354	4/0 AWG–350 kcmil
DX1-34170xx-xxxxx		354	300–350 kcmil
FR6			
DX1-34205xx-xxxxx	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	480	2*(2/0–300 kcmil)
DX1-34245xx-xxxxx		480	2*(4/0–300 kcmil)
All frame sizes (FR1–FR6)			
All models	Control terminal block—RO terminals	4.5	26–12 AWG
	Control terminal block—others	2.5	28–16 AWG

For 230 V Drive Series, required line and motor wire torque, type and size range are listed in **Table 75**.

Table 75. Required line and motor wire torque (230 V)

DX1 catalog number	Terminal type	Required torque (in-lb)	Required wire range
FR1			
DX1-323D7xx-xxxxx	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	5.3	14–10 AWG
DX1-324D8xx-xxxxx		5.3	14–10 AWG
DX1-326D6xx-xxxxx		5.3	14–10 AWG
DX1-327D8xx-xxxxx		5.3	14–10 AWG
DX1-32011xx-xxxxx		5.3	12–10 AWG
FR2			
DX1-32012xx-xxxxx	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	15.6	10–6 AWG
DX1-32017xx-xxxxx		15.6	8–6 AWG
DX1-32025xx-xxxxx		15.6	8–6 AWG
FR3			
DX1-32031xx-xxxxx	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	33	6–2 AWG
DX1-32048xx-xxxxx		33	4–2 AWG
FR4			
DX1-32061xx-xxxxx	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	95	3–1/0 AWG
DX1-32075xx-xxxxx		95	2–1/0 AWG
DX1-32088xx-xxxxx ①		95	1/0 AWG
FR5			
DX1-32114xx-xxxxx	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	354	3/0 AWG–350 kcmil
DX1-32143xx-xxxxx		354	4/0 AWG–350 kcmil
DX1-32170xx-xxxxx		354	300–350 kcmil
FR6			
DX1-32211xx-xxxxx	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	480	2*(2/0–300 kcmil)
DX1-32248xx-xxxxx		480	2*(4/0–300 kcmil)
All frame sizes (FR1–FR6)			
All models	Control terminal block—RO terminals	4.5	26–12 AWG
	Control terminal block—others	2.5	28–16 AWG

① The line and motor wire size for DX1-32088xx-xxxx can only be 1/0 AWG.

For 575 V Drive Series, required line and motor wire torque, type and size range are listed in **Table 76**.

Table 76. Required line and motor wire torque (575 V)

DX1 catalog number	Terminal type	Required torque (in-lb)	Required wire range
FR1			
DX1-353D3xx-xxxxx	L1, L2, L3, DC+, DC-, R+, R-, U, V, W	5.3	14–10 AWG
DX1-354D5xx-xxxxx		5.3	14–10 AWG
DX1-357D5xx-xxxxx		5.3	14–10 AWG
FR2			
DX1-35010xx-xxxxx	L1, L2, L3, DC+, DC-, R+, R-, U, V, W	15.6	12–6 AWG
DX1-35013xx-xxxxx		15.6	10–6 AWG
DX1-35018xx-xxxxx		15.6	10–6 AWG
FR3			
DX1-35022xx-xxxxx	L1, L2, L3, DC+, DC -, R+, R-, U, V, W	33	8–2 AWG
DX1-35027xx-xxxxx		33	8–2 AWG
DX1-35034xx-xxxxx		33	6–2 AWG
FR4			
DX1-35041xx-xxxxx	L1, L2, L3, DC+, DC-, R+, R-, U, V, W	95	4–1/0 AWG
DX1-35052xx-xxxxx		95	4–1/0 AWG
DX1-35062xx-xxxxx		95	2–1/0 AWG
FR5			
DX1-35080xx-xxxxx	L1, L2, L3, DC+, DC-, R+, R-, U, V, W	354	1/0 AWG–350 kcmil
DX1-35100xx-xxxxx		354	2/0 AWG–350 kcmil
DX1-35125xx-xxxxx		354	3/0 AWG–350 kcmil
FR6			
DX1-35144xx-xxxxx	L1, L2, L3, DC+, DC-, R+, R-, U, V, W	480	2*(1/0–300 kcmil)
DX1-35208xx-xxxxx		480	2*(2/0–300 kcmil)
All frame sizes (FR1–FR6)			
All models	Control terminal block—RO terminals	4.5	26–12 AWG
	Control terminal block—others	2.5	28–16 AWG

Grounding

For 480 V Drive Series, required grounding wire torque, type and size range are listed in **Table 77**.

Table 77. Required grounding wire torque (480 V)

DX1 catalog number	Terminal type	Required torque (in-lb)	Required wire range
FR1			
DX1-342D2xx-xxxxx	Grounding terminal	10	14–10 AWG
DX1-343D3xx-xxxxx		10	14–10 AWG
DX1-344D3xx-xxxxx		10	14–10 AWG
DX1-345D6xx-xxxxx		10	14–10 AWG
DX1-347D6xx-xxxxx		10	12–10 AWG
DX1-349D0xx-xxxxx		10	12–10 AWG
FR2			
DX1-34012xx-xxxxx	Grounding terminal	10	10–6 AWG
DX1-34016xx-xxxxx		10	10–6 AWG
DX1-34023xx-xxxxx		10	10–6 AWG
FR3			
DX1-34031xx-xxxxx	Grounding terminal	10	10–4 AWG
DX1-34038xx-xxxxx		10	8–4 AWG
DX1-34046xx-xxxxx		10	8–4 AWG
FR4			
DX1-34061xx-xxxxx	Grounding erminal	14	6–1/0 AWG
DX1-34072xx-xxxxx		14	6–1/0 AWG
DX1-34087xx-xxxxx		14	6–1/0 AWG
FR5			
DX1-34105xx-xxxxx	Grounding terminal	35	4 AWG–250 kcmil
DX1-34140xx-xxxxx		35	4 AWG–250 kcmil
DX1-34170xx-xxxxx		35	4 AWG–250 kcmil
FR6			
DX1-34205xx-xxxxx	Grounding terminal	35	3–300 kcmil
DX1-34245xx-xxxxx		35	2–300 kcmil

For 230 V Drive Series, required grounding wire torque, type and size range are listed in **Table 78**.

Table 78. Required grounding wire torque (230 V)

DX1 catalog number	Terminal type	Required torque (in-lb)	Required wire range
FR1			
DX1-323D7xx-xxxxx	Grounding terminal	10	14–10 AWG
DX1-324D8xx-xxxxx		10	14–10 AWG
DX1-326D6xx-xxxxx		10	14–10 AWG
DX1-327D8xx-xxxxx		10	12–10 AWG
DX1-32011xx-xxxxx		10	12–10 AWG
FR2			
DX1-32012xx-xxxxx	Grounding terminal	10	10–6 AWG
DX1-32017xx-xxxxx		10	10–6 AWG
DX1-32025xx-xxxxx		10	10–6 AWG
FR3			
DX1-32031xx-xxxxx	Grounding terminal	10	8–4 AWG
DX1-32048xx-xxxxx		10	8–4 AWG
FR4			
DX1-32061xx-xxxxx	Grounding terminal	14	6–1/0 AWG
DX1-32075xx-xxxxx		14	6–1/0 AWG
DX1-32088xx-xxxxx		14	6–1/0 AWG
FR5			
DX1-32114xx-xxxxx	Grounding terminal	35	4 AWG–250 kcmil
DX1-32143xx-xxxxx		35	4 AWG–250 kcmil
DX1-32170xx-xxxxx		35	4 AWG–250 kcmil
FR6			
DX1-32211xx-xxxxx	Grounding terminal	35	3–300 kcmil
DX1-32248xx-xxxxx		35	2–300 kcmil

For 575 V Drive Series, required grounding wire torque, type and size range are listed in **Table 79**.

Table 79. Required grounding wire torque (575 V)

DX1 catalog number	Terminal type	Required torque (in-lb)	Required wire range
FR1			
DX1-353D3xx-xxxxx	Grounding terminal	10	14–10
DX1-354D5xx-xxxxx		10	14–10
DX1-357D5xx-xxxxx		10	12–10
FR2			
DX1-35010xx-xxxxx	Grounding terminal	10	10–6
DX1-35013xx-xxxxx		10	10–6
DX1-35018xx-xxxxx		10	10–6
FR3			
DX1-35022xx-xxxxx	Grounding terminal	10	10–4
DX1-35027xx-xxxxx		10	10–4
DX1-35034xx-xxxxx		10	8–4
FR4			
DX1-35041xx-xxxxx	Grounding terminal	14	8–1/0
DX1-35052xx-xxxxx		14	8–1/0
DX1-35062xx-xxxxx		14	6–1/0
FR5			
DX1-35080xx-xxxxx	Grounding terminal	35	6 AWG–250 kcmil
DX1-35100xx-xxxxx		35	6 AWG–250 kcmil
DX1-35125xx-xxxxx		35	4 AWG–250 kcmil
FR6			
DX1-35144xx-xxxxx	Grounding terminal	35	3–300 kcmil
DX1-35208xx-xxxxx		35	2–300 kcmil

Appendix E—STO function

Description of safety function

Safety function and safe state

The STO (Safe Torque Off) function of PowerXL DX1 Series AC drive is implemented only by hardware and no software is involved to perform the STO function.

The STO function is available for operator to turn off the motor torque. It is intended to be used in the safety-related applications up to SIL 2 / SIL CL 2 acc. to UL 61800-5-2, IEC/EN 61800-5-2, IEC/EN 61508 and IEC/EN 62061, and up to Cat. 3 / PL d acc. to EN ISO 13849-1.

Safety function

The power that can cause rotation (or motion in the case of a linear motor) shall be switched off from the motor when demanded.

Safe state

The safe state is shut down of motor torque.

System response time

The time from STO terminal input to removal of motor torque is ≤ 35 ms.

Table 80. Safety-related parameters

Operation mode	FR1–FR6
Operation mode	High demand
Safety integrity level	SIL 2 / SIL CL 2
Systematic capability	SC 2
Safety architecture	1oo1 and 1oo2 mixed
Category	3
Performance level	d
HFT	1oo1 part: 0 1oo2 part: 1
SFF of each element	1oo1 part: > 90% 1oo2 part: > 60%
PFDAVG	4.09 E^{-5}
PFH	4.55 E^{-10}
MTTFd	528 years
Proof Test Interval (PTI)	20 years
MTTR	24 hours
λ (total failures)	552.57 FIT
λ_S (safe failures)	411.43 FIT
λ_{DD} (dangerous detected failures)	139.72 FIT
λ_{DU} (dangerous undetected failures)	1.41 FIT

Note: 1 FIT = 10^{-9}/h.

All the previously mentioned safety-related parameters are calculated based on the assumptions:

- Failure rate of each component is based on the Siemens SN29500 database
- Component failure rates are constant over the life of the device
- Operating at a maximum ambient temperature of 50 °C
- The equal distribution is used for the failure modes ratio of each component

⚠ WARNING

The above mentioned parameters are calculated without considering failure rates of external devices, e.g., buttons, power supply, etc.

Safety architecture and reliability block diagram

Figure 57. Functional block diagram

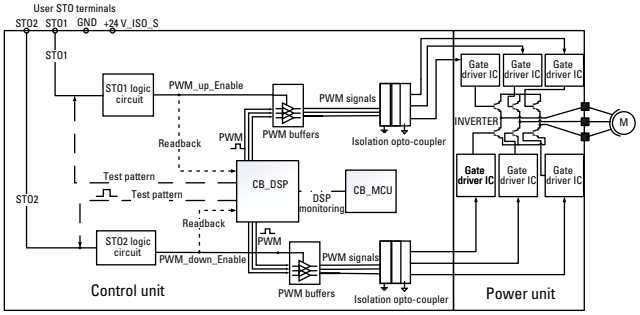


Figure 58. Reliability block diagram

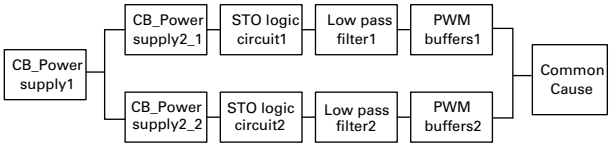


Table 81. Power supply and input/output

Power supply	230 V series: 150–450 Vdc
	480 V series: 300–900 Vdc
	575 V series: 450–1100 Vdc
Overvoltage category	III
STO input signal voltage without demand	18 Vdc ~ 27.3 Vdc
STO input signal voltage when demand	< 5 Vdc

Table 82. Environmental and EMC conditions

Environmental		
Ambient operating temperature	–10 °C (no frost) to +50 °C, up to +60 °C with derating (CT) –10 °C (no frost) to +40 °C, up to +60 °C with derating (VT)	
Storage temperature	–40 °C to +70 °C	
Relative humidity	0 to 95% RH, noncondensing, non-corrosive	
Altitude	100% load capacity (no derating) up to 1000 m; 1% derating per 100 m up to 2000 m	
Vibration	IEC/EN 61800-5-2, IEC/EN 61800-5-1, IEC 60068-2-6 (Test Fc) Drive mounted as normal use Power supply connected and drive operating normally Sinusoidal motion Vibration amplitude/acceleration: 10 Hz ≤ f ≤57 Hz: 0.075 mm amplitude 57 Hz < f ≤ 150 Hz: 1 g Vibration duration: 1oct/min, 10 sweep cycles per axis on each of 3 mutually perpendicular axes	
Shock	IEC/EN 61800-5-2, IEC 60068-2-27 Drive mounted as normal use Power supply connected and drive operating normally Half sine pulse motion Peak acceleration 5 g with duration 30 ms Total 18 shocks for 3 mutually perpendicular axes and 6 directions	
Enclosure class	UL Type 1 / IP21 UL Type 12 / IP54	
EMC	IEC/EN 61800-5-2, IEC/EN 61800-3 2nd environment, industrial location	
	230/480 V series:	C2 @ 10 m (with internal filter) C3 @ 50 m (with internal filter)
	575 V series:	C3 @ 10 m (with internal filter)

Applicable standards

UL 61800-5-2:2022
Adjustable speed electrical power drive systems
Part 5-2: Safety requirements—Functional

UL 61800-5-1:2022
Adjustable speed electrical power drive systems
Part 5-1: Safety requirements—Electrical, thermal and energy

EN 61800-5-2:2007 / EN 61800-5-2:2017
Adjustable speed electrical power drive systems
Part 5-2: Safety requirements—Functional

EN 61800-5-1: 2007+A1:2017+A11:2021
Adjustable speed electrical power drive systems
Part 5-1: Safety requirements—Electrical, thermal and energy

EN IEC 61800-3:2018 / EN IEC 61800-3:2023
Adjustable speed electrical power drive systems
Part 3: EMC requirements and specific test methods

EN ISO 13849-1:2015 / EN ISO 13849-1:2023
Safety of Machinery—Safety Related Parts of Control Systems
Part 1: General principles for design

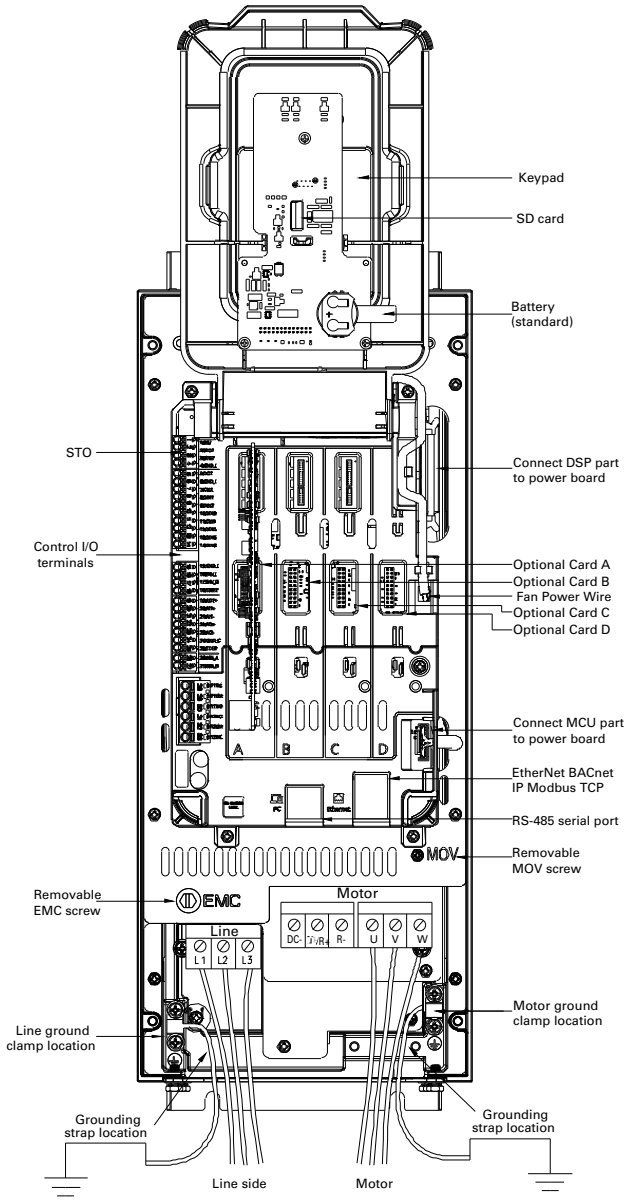
EN 61508, Parts 1-7:2010
Functional safety of electrical/electronic/programmable electronic safety-related systems

EN IEC 62061:2021
Safety of machinery—Functional safety of safety-related electrical, electronic and programmable electronic control systems

Requirement for installation, commission, maintenance

A four-pin terminal block in control board (STO in **Figure 59**) is used for customer to connect emergency stop switch, safety relay or PLC, and so on.

Figure 59. STO terminal block in PowerXL DX1 control board



When finished the installation, the STO function shall be verified. Refer to **Figure 60** for the detailed wiring method. The emergency stop switch for STO shall be closed state normally.

The STO function shall be verified every day according to following steps:

- Apply main power to DX1.
- Run the motor and wait until the motor operating stably
- Open the switch of STO1 or STO2, both "STO Fault" and "Safety Torque Off" shall be triggered and the motor shut down. Fault codes are FC 23 and FC 66
- Closed STO1 and STO2 switches
- Reset the fault
- Restart motor and wait until the motor operating stably
- Open the switches of STO1 and STO2 at the same time, only "Safety Torque Off" shall be triggered and the motor shut down. Fault code is FC 66
- Closed STO1 and STO2 switches. Test finished

Notes:

- STO fault indicates two different fault types. One is the drive internal circuit fault and the other is the case that two STO input signals are not consistent within 300 ms.
- If the customer needs more detailed information or the test result is mismatched, please contact the factory or your local Eaton sales representative.

The STO terminal block shall be short circuited by jumper if user doesn't need STO function. If the function is used by customer, the STO terminal block shall be connected to emergency stop switch, safety relay or PLC, and so on. The STO function needs to be always on, which means the idle-current principle shall be followed by the end user.

Fault exclusion measures against short circuit fault between STO1/STO2 and power supply 24 Vdc must be implemented at application level, according to applicable requirement/ standards, e.g., EN ISO 13849-2:2012.

For the requirements of fault exclusion measures against short circuits between two adjacent tracks/pads of internal PCB according to EN ISO 13849-2:2012, some measures shall be implemented at application level, i.e., this device shall be installed in a cabinet with at least IP54.

⚠ WARNING

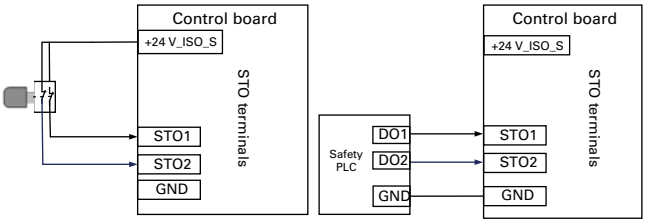
Any circuit connected to the STO terminal block shall be SELV or PELV circuit.

STO1 and STO2 shall be both connected with the independent output of the safety elements.

The STO terminal block is a fixed connection and cannot be disconnected without a tool. Installation manual defines the control wiring stripping length to ensure no bare conductor exposed after wiring.

The safety function STO is not equivalent to the safety function "safe off" of IEC/EN 60204-1 since it does not provide any galvanic insulation. This means that the motor terminals can still have dangerous voltage when in STO state.

Figure 60. STO wiring diagram



Requirements of proof test

This device shall be subjected to a proof test at least once every 20 years. Please contact the factory or your local Eaton sales representative.

Appendix F—Certification and compliance information

UL/cUL certificate of compliance

In accordance with: UL and cUL

Certificate number: E134360

Based on compliance with standards:

- UL 61800-5-1
- CSA C22.2 No. 274-17

CE declaration of conformity

In accordance with:

2014/35/EU	Low Voltage Directive (LVD)
2014/30/EU	EMC Directive (EMC)
2011/65/EU	RoHS Directive (RoHS)
2009/125/EC	Ecodesign Directive (Eco-Design)
2014/53/EU	Radio Emission Directive (RED)

UKCA declaration of conformity

In accordance with:

2016 No.1101	Electrical Equipment (Safety) Regulations 2016
2016 No.1091	Electromagnetic Compatibility Regulations 2016
2012 No.3032	Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
2021 No.745	Ecodesign for Energy-Related Products and Energy Information Regulations 2021
2017 No.1206	Radio Equipment Regulations 2017

Both based on compliance with standards:

- EN 61800-5-1:2007+A1:2017+A11:2021
- EN IEC 61800-3:2018
- EN IEC 61800-3:2023
- EN 61800-9-2:2017
- EN 61800-5-2:2007
- EN 61800-5-2:2017
- EN ISO 13849-1:2015
- EN ISO 13849-1:2023
- EN 61508, Part 1-7:2010
- EN IEC 62061:2021
- EN 301489-1 V2.2.3:2019
- EN 301489-17 V 3.2.4:2020
- EN 300328 V2.2.2:2019
- EN 62479:2010

Eco-design information

IE2 acc. to EN 61800-9-2
(90;100) losses are marked on rating labels

Other details can be found at:
Eaton.com/EcoDesign-VFD or as in below:

Eaton.com/EcoDesign-VFD
MZ040046EN

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