PowerXL FR7 and FR8 Series VFD

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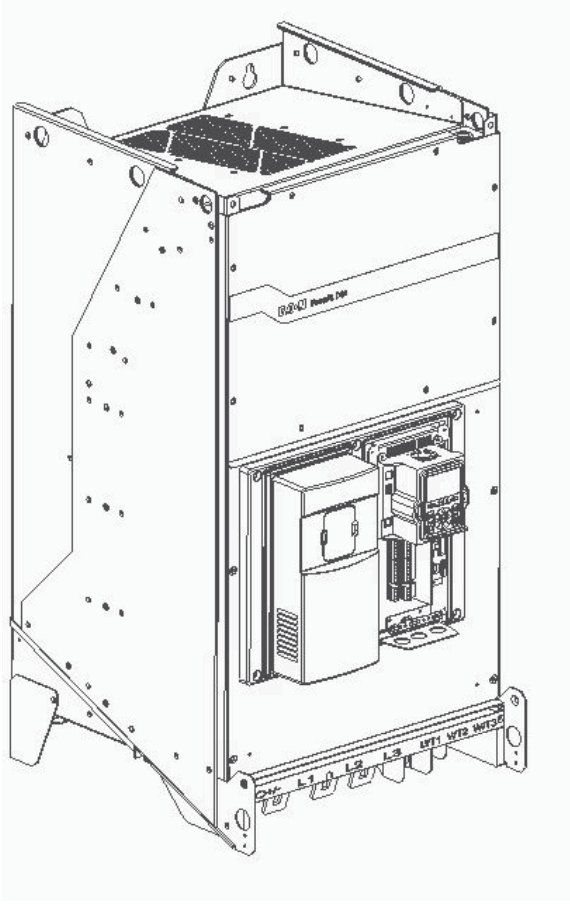
Installation manual



Powering Business Worldwide

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Cover Photo: Eaton PowerXL FR7 and FR8 Series Drive

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Safety

WARNING!
DANGEROUS ELECTRICAL VOLTAGE!

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
- 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
- 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:
- Other independent devices for monitoring safety-related variables (speed, travel, end positions, and so on)
- 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

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 FR7 and FR8 Adjustable Frequency Drive.

Definitions and symbols

WARNING

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

WARNING

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**

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!

DANGER
5 MIN

WARNING

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

WARNING

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.

⚠ 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 Electric 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

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. This information is provided on the CD-ROM, floppy diskette(s) or other storage device included in the container this device was packaged in. it should be retained with this device at all times. A hard copy of this information may be ordered from Eaton 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 Eaton 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.

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.

- 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

NOTE

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

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

Sécurité

AVERTISSEMENT !
TENSION ÉLECTRIQUE DANGEREUSE !

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
- 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:
  - Autres dispositifs indépendants de surveillance des variables en rapport avec la sécurité (vitesse, voyages, positions d'extrémité, etc.)
  - 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 FR7 and FR8.

Définitions et symboles

AVERTISSEMENT

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

AVERTISSEMENT

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**

AVERTISSEMENT

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

AVERTISSEMENT

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

AVERTISSEMENT

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

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. Ces informations sont fournies sur le CD-ROM, la disquette ou tout autre périphérique de stockage inclus dans l'emballage contenant ce dispositif. Ce support doit être conservé avec cet appareil à tout moment. Une copie papier de ces informations peut être commandée auprès du service de documentation Eaton.

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 d'Eaton 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 mm^2 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. 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.

- 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.

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

Chapter 1—PowerXL FR7 and FR8 Series overview

This chapter describes the purpose and contents of this manual, the receiving inspection recommendations and the PowerXL FR7 and FR8 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 Eaton PowerXL FR7 and FR8 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 FR7 and FR8 Series VFD. Keep this operating manual handy and distribute to all users, technicians and maintenance personnel for reference.

Receiving and inspection

The PowerXL FR7 and FR8 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 FR7 and FR8 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:

- Control cable grounding clamps
- Additional grounding screw

The contents of the delivery, FR7

- The IP00 drive module with an integrated control unit

The contents of the delivery, FR8

- The IP00 drive module: 2 power units, 1 of them with an integrated control unit
- A DC link cable
- A set of optical fibre cables

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 Eaton Electrical representative.

Real time clock battery activation

To activate the real time clock (RTC) functionality in the PowerXL FR7 and FR8 Series VFD, the RTC battery (already mounted in the drive) must be connected to the control board.

Simply remove the primary drive cover, locate the RTC battery directly below the keypad, and connect the white 2-wire connector to the receptacle on the control board.

Figure 1. RTC Battery connection

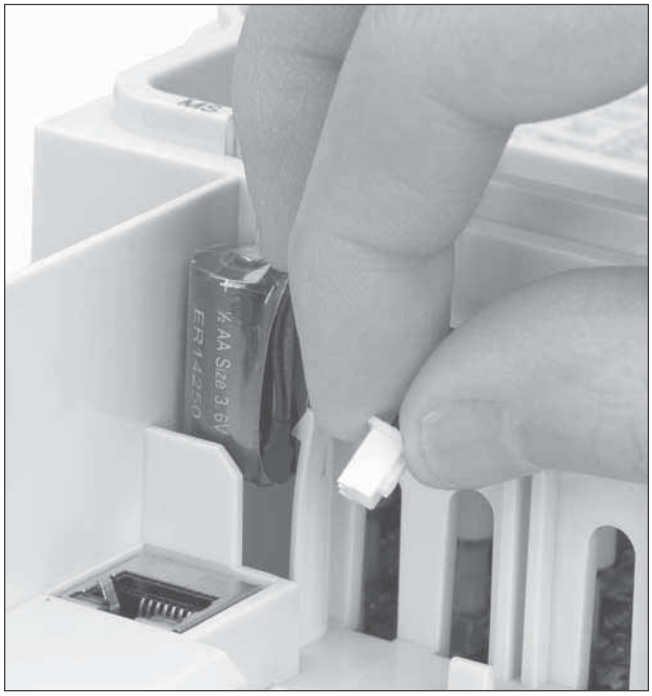
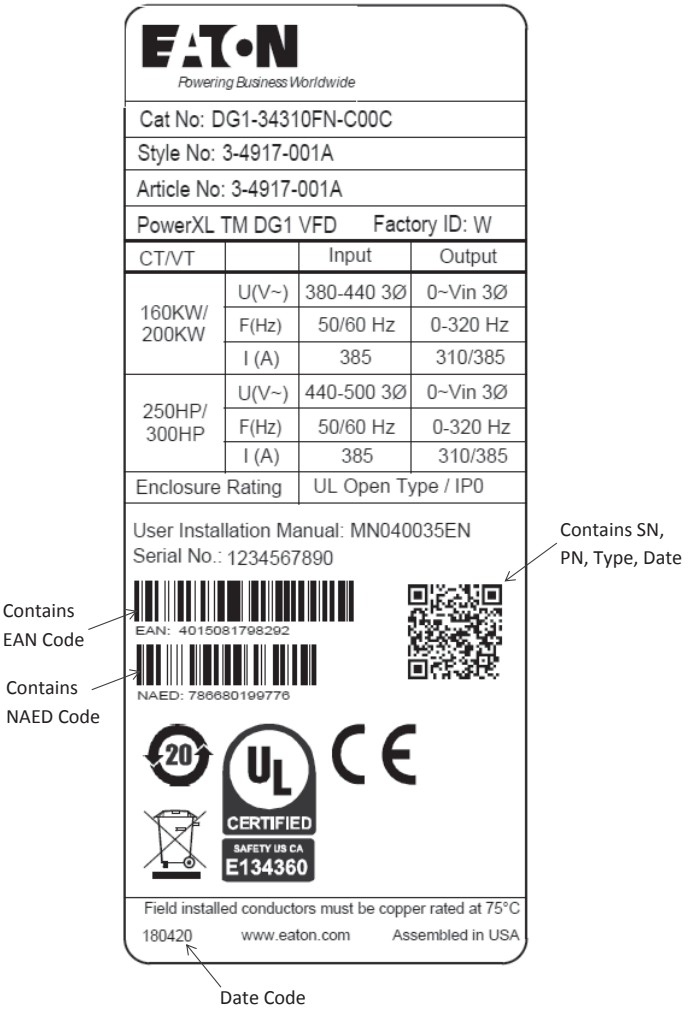


Table 1. Common abbreviations

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

Rating label

Figure 2. Rating label



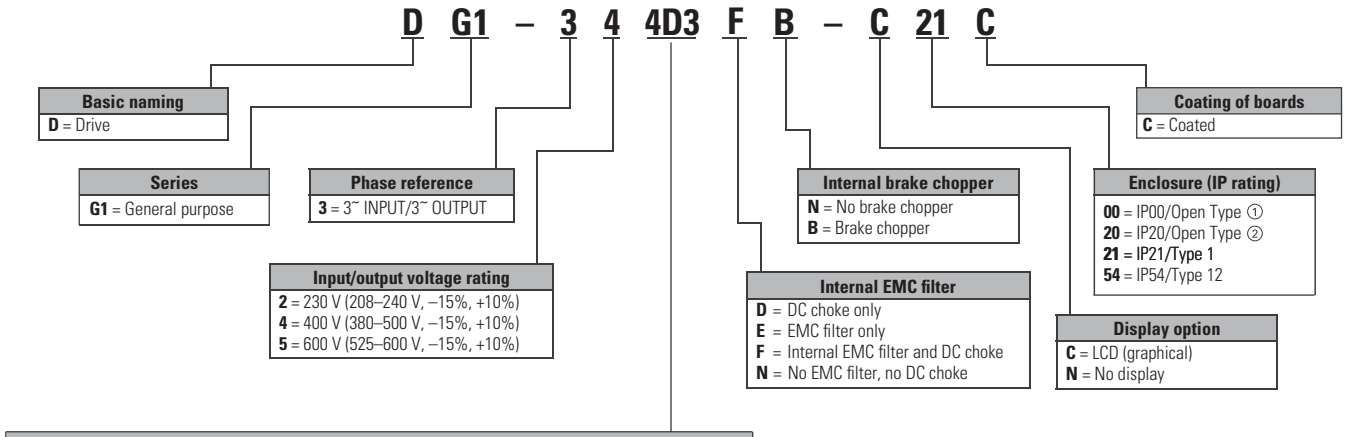
Carton labels (U.S. and Europe)

Same as rating label shown above.

Catalog number system

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

Figure 3. Catalog numbering system



DG1—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, 5 hp (VT)	**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	**261** = 261 A, 187 kW, 250 hp
	205 = 205 A, 110 kW, 150 hp	**325** = 325 A, 224 kW, 300 hp
	245 = 245 A, 132 kW, 200 hp	**385** = 385 A, 224 kW, 300 hp
	310 = 310 A, 160 kW, 250 hp	**416** = 416 A, 298 kW, 400 hp
	385 = 385 A, 200 kW, 300 hp	**460** = 460 A, 336 kW, 450 hp
	460 = 460 A, 250 kW, 350 hp	**520** = 520 A, 373 kW, 500 hp
	520 = 520 A, 250 kW, 450 hp	**590** = 590 A, 448 kW, 600 hp
	590 = 590 A, 315 kW, 500 hp	**650** = 650 A, 485 kW, 650 hp
	650 = 650 A, 355 kW, 500 hp	**820** = 820 A, 597 kW, 800 hp (VT)
	730 = 730 A, 400 kW, 600 hp	
	820 = 820 A, 450 kW, 700 hp	
	920 = 920 A, 500 kW, 800 hp	
	1K0 = 1180 A, 630 kW, 1000 hp (VT)	

① IP00 FR7 and FR8 is not available for 230 V input product or with the PowerXL DH1 product.
② IP20 FR0 will be available in June 2018.

Power ratings and product selection

PowerXL Series drives—380–500 Volt

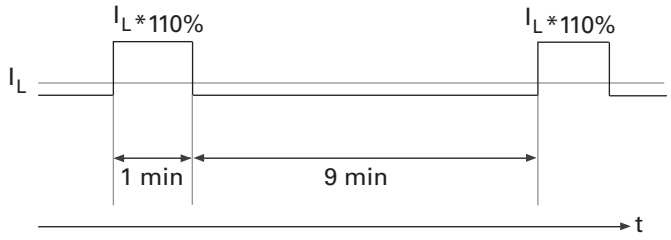
Table 2. Type 0/IP00

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)			
Frame size	**400 V, 50 Hz kW rating**	**480 V, 60 Hz hp**	**Current A**	**400 V, 50 Hz kW rating**	**480 V, 60 Hz hp**	**Current A**	**Catalog number**
FR7	160	250	311	200	300	385	**DG1-34310FN-C00C**
	200	300	385	250	350	460	**DG1-34385FN-C00C**
	250	350	460	250	450	520	**DG1-34460FN-C00C**
	250	450	520	315	500	590	**DG1-34520FN-C00C**
FR8	315	500	590	355	500	650	**DG1-34590FN-C00C**
	355	500	650	400	600	730	**DG1-34650FN-C00C**
	400	600	730	450	700	820	**DG1-34730FN-C00C**
	450	700	820	500	800	920	**DG1-34820FN-C00C**
	500	800	920	560	900	1040	**DG1-34920FN-C00C**
	500	800	920	630	1000	1180	**DG1-341K0FN-C00C**

Overload capability

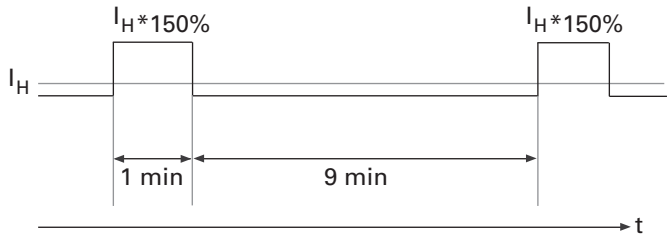
The **low overload** means that if 110% of the continuous current (I_L) is necessary for 1 minute each 10 minutes, the remaining 9 minutes must be approximately 98% of I_L or less. This is to make sure that the output current is not more than I_L during the duty cycle.

Figure 4. Low overload



The **high overload** means that if 150% of the continuous current (I_H) is necessary for 1 minute each 10 minutes, the remaining 9 minutes must be approximately 92% of I_H or less. This is to make sure that the output current is not more than I_H during the duty cycle.

Figure 5. High overload



For more information, refer to the standard IEC 61800-2 (IEC:1998).

PowerXL Series drives—525–600 Volt

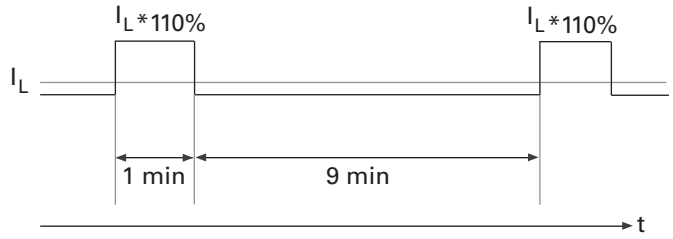
Table 3. Type 0/IP00

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)			
Frame size	600 V, 60 Hz kW rating	600 V, 60 Hz hp	Current A	600 V, 60 Hz kW rating	600 V, 60 Hz hp	Current A	Catalog number
FR7	187	250	261	224	300	325	**DG1-35261FN-C00C**
	224	300	325	298	400	385	**DG1-35325FN-C00C**
	224	300	385	336	450	416	**DG1-35385FN-C00C**
FR8	298	400	416	336	450	460	**DG1-35416FN-C00C**
	336	450	460	373	500	520	**DG1-35460FN-C00C**
	373	500	520	448	600	590	**DG1-35520FN-C00C**
	448	600	590	485	650	650	**DG1-35590FN-C00C**
	485	650	650	522	700	750	**DG1-35650FN-C00C**
	485	650	650	597	800	820	**DG1-35820FN-C00C**

Overload capability

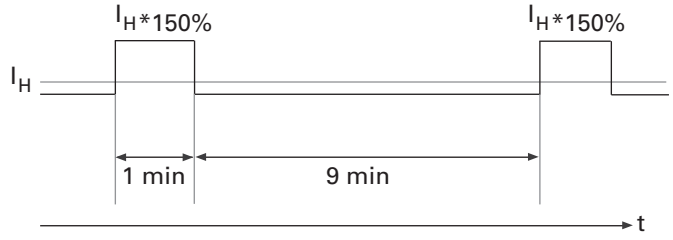
The **low overload** means that if 110% of the continuous current (I_L) is necessary for 1 minute each 10 minutes, the remaining 9 minutes must be approximately 98% of I_L or less. This is to make sure that the output current is not more than I_L during the duty cycle.

Figure 6. Low overload



The **high overload** means that if 150% of the continuous current (I_H) is necessary for 1 minute each 10 minutes, the remaining 9 minutes must be approximately 92% of I_H or less. This is to make sure that the output current is not more than I_H during the duty cycle.

Figure 7. High overload



For more information, refer to the standard IEC 61800-2 (IEC:1998).

Replacement parts

Table 4. Frames 7 and 8

Description	Catalog number 480 V	Catalog number 600 V
Standard keypad	**DXG-KEY-LCD**	**DXG-KEY-LCD**
Control module kit with keypad ①	**DXG-SPR-HPCTRLKIT**	**DXG-SPR-HPCTRLKIT**
Control board cover	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**
Control fan	**DXG-SPR-4FR1CF**	**DXG-SPR-4FR1CF**
Terminal block	**DXG-SPR-FR1TB**	**DXG-SPR-FR1TB**
RTC battery		
Interconnect cable		

① Factory recommended spare parts.

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 8. Drive system (PDS = power drive system)

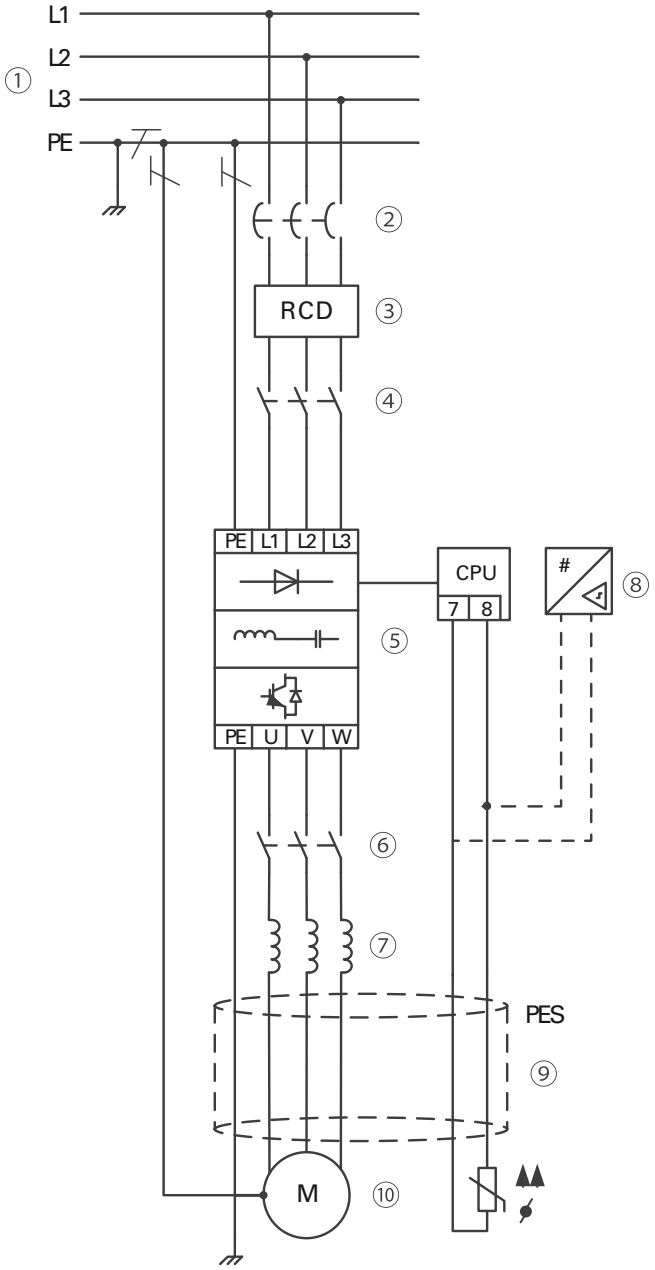


Table 5. Drive system components

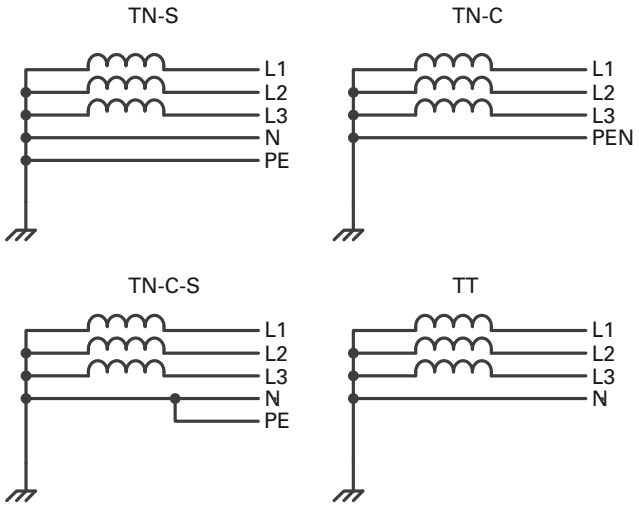
Item no.	Description
1	Power grid configuration, input voltage, input frequency, interactions with PF correction systems
2	Breakers, fuses, cable cross-sections
3	Protection of persons and animals with residual-current protective devices
4	Input contactor, disconnector
5	Frequency inverter: mounting, 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, parallel operation of multiple motors on a VFD, bypass circuit, DC braking

Electrical power network

Input connection and configuration

The PowerXL FR7 and FR8 Series frequency inverters can be connected and operated with all control-point grounded AC power networks (see IEC 60364 for more information).

Figure 9. 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', see "Installation in IT System" on **Page 51**). 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 FR7 and FR8 frequency inverter considers the rated value for
European as (EU: U_{LN} = 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:

- 400 V, 50 Hz (EU) and 480 V, 60 Hz (USA) at DG1-34_
- 600 V, 60 Hz (CAN) at DG1-35_

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%.

- 400 V device class (DG1-34_): 380 V –15% to 500 V +10% (323 V –0% to 550 V +0%)
- 600 V device class (DG1-35_): 600 V –15% to 600 V +10% (446 V –0% to 759 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.

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

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 www.eaton.com/drives.

Reactive power compensation devices

Special compensation measures on the power supply side is not required for PowerXL FR7 and FR8 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

Features

The PowerXL FR7 and FR8 frequency inverter converts the voltage and frequency of an existing AC network into a DC voltage. This DC voltage is used to generate a three-phase AC voltage with adjustable frequency and assigned amplitude values for the variable speed control of three-phase asynchronous motors.

Figure 10. Block diagram, elements of PowerXL FR7 and FR8 frequency inverters

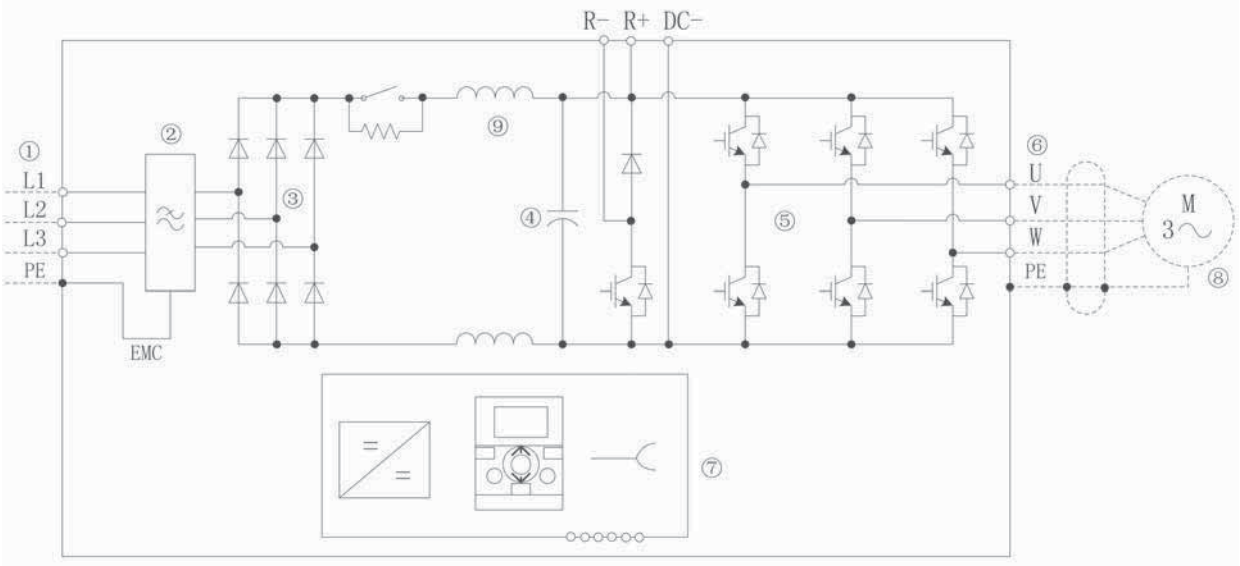


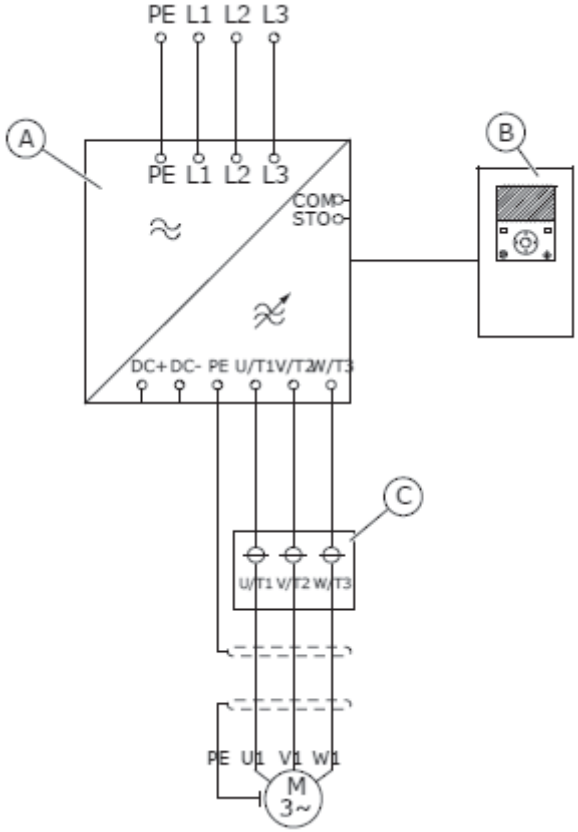
Table 6. Elements of PowerXL FR7 and FR8 frequency inverters

Item no.	Description
1	Supply L1, L2 L3, PE, input supply voltage U_{LN} = Ue at 50/60 Hz: DG1-34: 400 V class, three-phase input connection (3 AC 400 V/480 V) DG1-35: 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 (0–320 Hz) output current (I2): 100% at an ambient temperature of 104 °F (40 °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	Keypad with control buttons, graphic display, control voltage, control signal terminals, micro-switches, and interface for the PC interface module (option)
8	Three-phase asynchronous motor, variable speed control of three-phase asynchronous motor for assigned motor shaft power values (P2)
9	DC link—chokes, to minimize current harmonics

General installation information

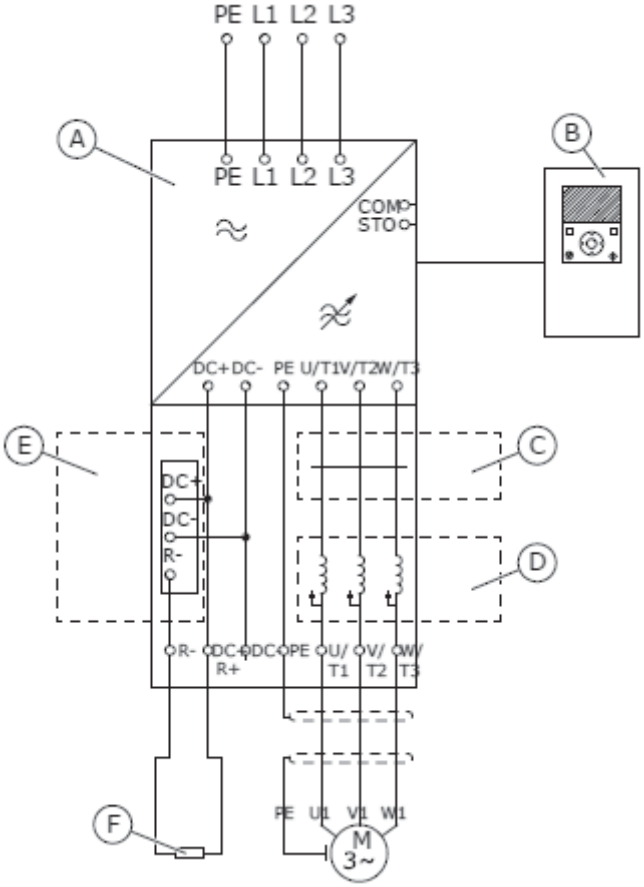
FR7 circuit diagrams

Figure 11. Main circuit diagram, FR7 without options module and options



A. Power unit
B. Control unit
C. Optional external power connection block (+PCTB)

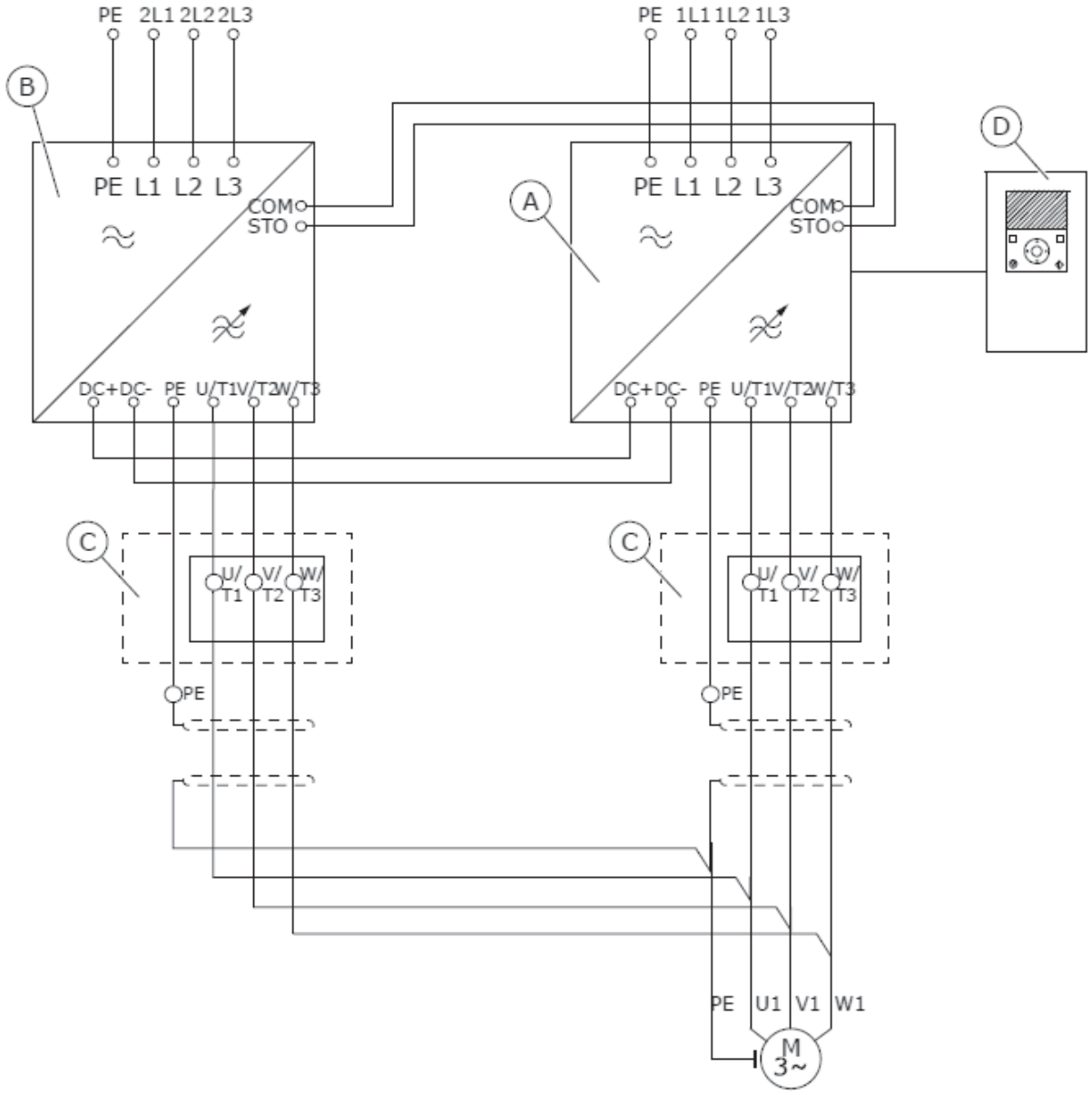
Figure 12. Main circuit diagram, FR7 with options module and options



A. Power unit
B. Control unit
C. Optional common mode filter
D. Optional du/dt filter
E. Optional brake chopper
F. Brake resistor

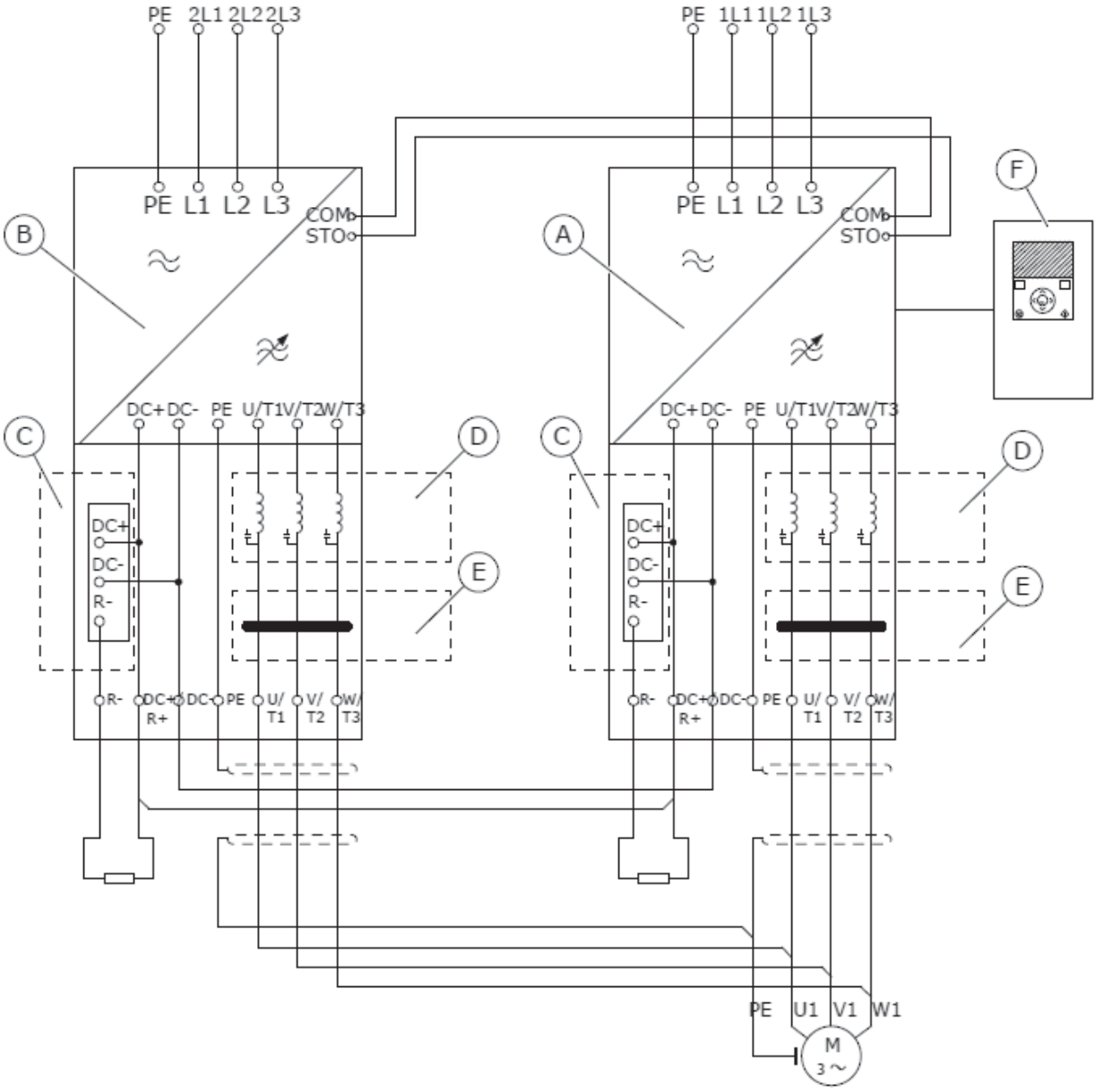
FR8 circuit diagrams

Figure 13. Main circuit diagram, FR8 without options module and options



A. Power unit 1
B. Power unit 2
C. Optional external power connection blocks (+PCTB)
D. Control unit
E. Symmetrical motor cabling. The cables must have the same length from the power unit to a common point of coupling

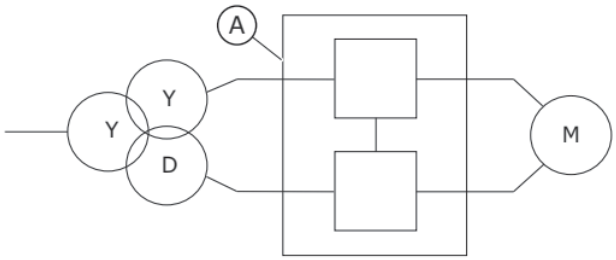
Figure 14. Main circuit diagram, FR8 with options module and options



A. Power unit 1
B. Power unit 2
C. Optional brake choppers
D. Optional common mode filter
E. Optional du/dt filter
F. Control unit
G. Symmetrical motor cabling. The cables must have the same length from the power unit to a common point of coupling

12-pulse operation

Figure 15. 12-pulse operation of FR8



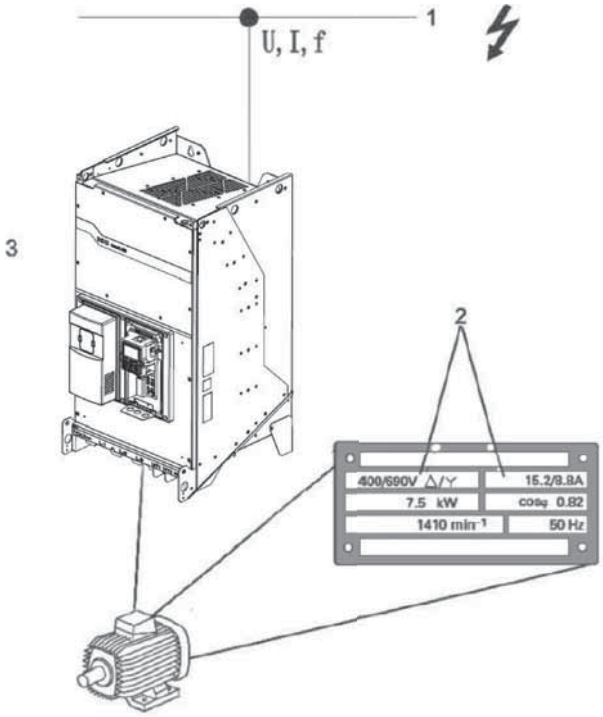
FR8 drive

With FR8 you can also use a 12-pulse connection to reduce the harmonics level in the supply side of the drive. In the 12-pulse connection, the parallel drives are cabled to the transformer's secondary windings that have a 30-degree phase shift.

Selection criteria

The frequency inverter **[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 16. Selection criteria



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

- Type of motor (three-phase asynchronous motor)
- 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 frequency inverter, the motor currents are added geometrically—separated by effective and idle current components. When you select a frequency inverter, 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 frequency inverter and the motor.

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

If you connect a motor to an operational frequency inverter, the motor draws a multiple of its rated operational current. When you select a frequency inverter, 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 frequency inverter.

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

Proper use

The PowerXL FR7 and FR8 frequency inverters are electrical apparatus 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 frequency inverters must not be taken into operation until the associated machine has been confirmed to comply with the safety requirements of Machinery Safety Directive (MSD) 2006/42 EC (meets the requirements of EN 60204). 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 FR7 and FR8 frequency inverter confirm that, when used in a typical drive configuration, the apparatus complies with the European Low Voltage Directive (LVD) and the EMC Directives (Directive 2014/35/EU and Directive 2014/30/EU.

In the described system configurations, PowerXL FR7 and FR8 frequency inverters 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).

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

- connect a voltage or capacitive loads (for example, phase compensation capacitors)
- connect multiple frequency inverters 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.

Any other usage constitutes improper use.

Maintenance and inspection

PowerXL FR7 and FR8 frequency inverters are maintenance free. However, external influences may affect the function and the lifespan of the PowerXL FR7 and FR8 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 FR7 and FR8 frequency inverter is damaged by external influences, contact Eaton Technical Service.

Table 7. Maintenance intervals and tasks

Maintenance interval	Maintenance task
Regularly	Do a check of the tightening torques of the terminals.
	Do a check of the filters.
6–24 months (The interval is different in different environments.)	Do a check of the mains and motor cable terminals and the control terminals.
	Make sure that the cooling fan operates correctly.
	Make sure that there is no corrosion on the terminals, the busbars or other surfaces.
	Do a check of the door filters of the cabinet.
	Do a check of the internal filter of the power unit.
24 months (The interval is different in different environments.)	Clean the heatsink and the cooling tunnel.
6–10 years	Replace the main fan.
	Replace the internal fans if the drive has them.
	Replace the fan power supply.
10 years	Replace the battery of the RTC. The battery is optional.

Storage

If the frequency inverter 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 (EN 50178)
- To prevent damage to the DC link capacitors, storage times longer than 12 months are not recommended

Service and warranty

In the unlikely event that you have a problem with your PowerXL FR7 and FR8 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 Eaton 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 mm^2 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

We recommend the fuse type gG/gL (IEC 60269-1) for mains fuses (-F1). Use only fuses that have a sufficient voltage rating according to the mains voltage. Do not use larger fuses than what is recommended in **Table 8**. The fuses are selected for short circuit protection only.

Make sure that the operation time of the fuse is less than 0.4 seconds. The operation time agrees with the fuse type and the impedance of the supply circuit.

The drive must be protected with fast-acting R-type fuses (-FC1) (see **Table 27** and **Table 32**). Do not use other fuses than these.

No fuses are included in the delivery (-F1 or -FC1).

The table also shows the typical symmetrically shielded copper and aluminum types of the cables that can be used with the AC drive.

For an installation in accordance with UL guidelines:

- Use UL listed Class RK5, J, T 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.

The dimensions of the cables agree with the requirements of the standards EN 60204-1 and IEC 60364-5-52: 2001.

- The cables are PVC-isolated
- The maximum ambient temperature is +30 °C
- The maximum temperature of the cable surface is +70 °C
- The maximum number of parallel cables on a ladder type tray is 9 side by side

In other conditions, when you select the dimensions of the cables, refer to local safety regulations, the input voltage and the load current of the drive.

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)

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 mm^2 Cu.

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 (ILN) of the frequency inverter and the utilization category AC-1 (IEC 60947). Input contactors and the assignment to PowerXL FR7 and FR8 frequency inverters are explained in **Appendix A**.

While planning the project, make sure that inching operation is not done via the input contactor of the frequency inverter on frequency-controlled drives, but through a controller input of the frequency inverter.

The maximum permitted operating frequency of the input voltage with the PowerXL FR7 and FR8 frequency inverter is one time per minute (normal operation).

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.

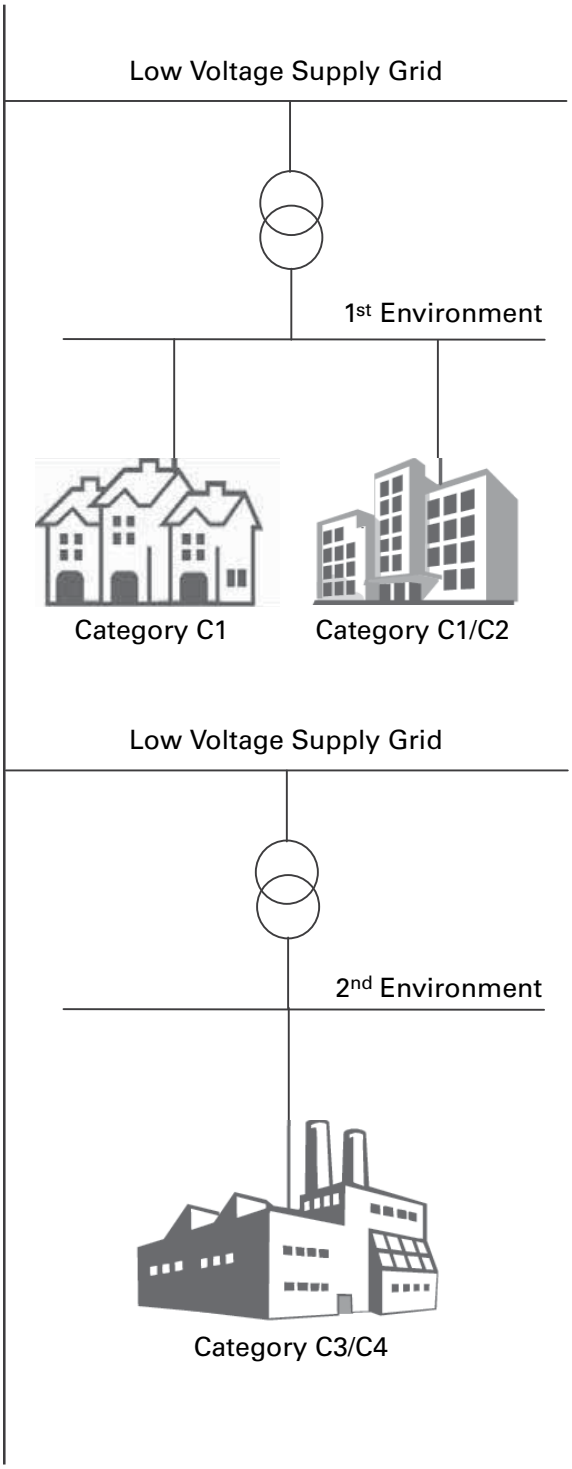
A declaration of conformity (CE) always refers to a "typical" power drive system (PDS). The responsibility to comply with the legally stipulated limit values and thus the provision of electromagnetic compatibility is ultimately the responsibility of the end user or system operator. This operator must also take measures to minimize or remove emission in the environment concerned (see **Figure 17**). The operator 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 FR7 and FR8 frequency inverters are ideal for use in commercial networks (1st environment).

Table 8. Motor power cable EMC guidelines

Item	Directive
Product	IEC 61800-2
Safety	UL 508C, IEC/EN 61800-5-1
EMC (at default settings)	Immunity (EMS): IEC/EN 61800-3, 2nd environment
	Radiated and Conducted emissions (EMI): IEC/EN 61800-3
	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 17. EMC measures



Chapter 5—Motor and application

Note: All following information is strongly recommended but is not necessary if sufficient system design and validation has 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 FR7 and FR8 frequency inverters allow parallel operation of several motors using multi-pump application control mode:

- *Multi-pump application: several motors with the same or different rated operational data.* The sum of all motor currents must be less than the frequency inverter's rated operational current
- *Multi-pump 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

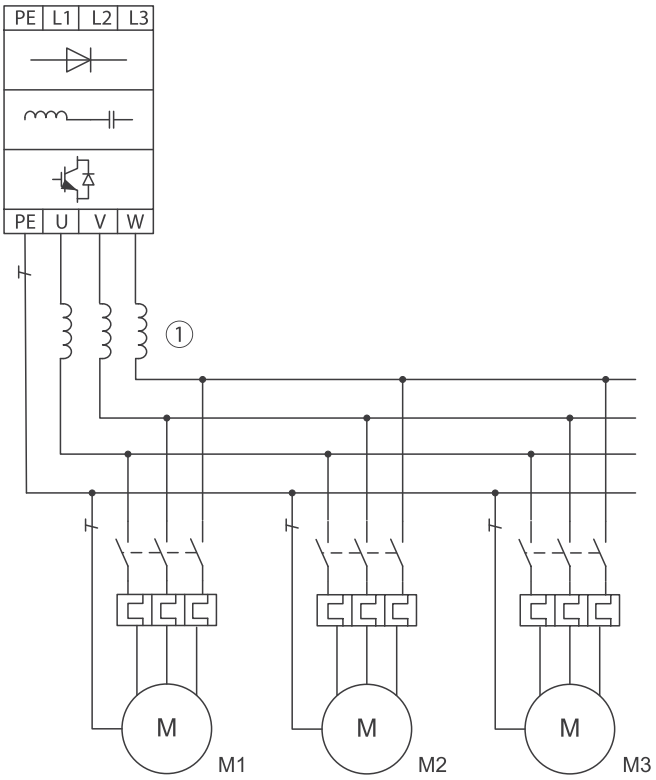
Debounced inputs may not be used in the safety circuit diagram.

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 18. 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 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 18**) 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.

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 19. Example of a motor ratings plate

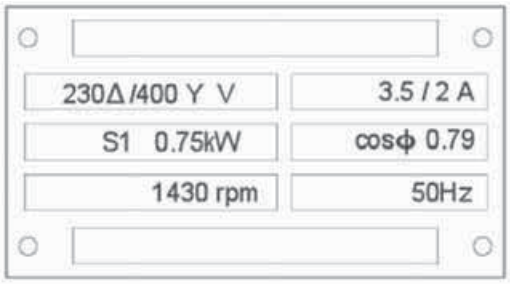
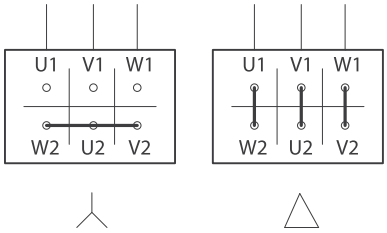


Figure 20. Star and delta circuit types



The three-phase motor with the rating plate based on **Figure 20**, 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 20** 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 21. V/Hz characteristic curve

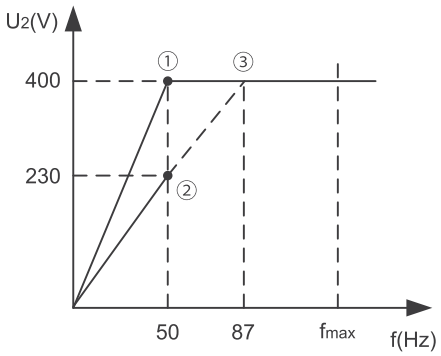


Table 9 shows the allocation of possible frequency inverters depending on the input voltage and the type of circuit.

Table 9. Assignment of frequency inverters to example motor circuit (see Figure 21)

Frequency inverters	DG1-343D3FB	DG1344D3FB
Rated operational current	3.3 A	4.3 A
Input voltage	3 AC, 400 V	3 AC, 400 V
Motor circuit	Star	Delta
V/Hz characteristic curve	①	②
Motor current	2.0 A	3.5 A
Motor voltage (ratings plate)	400 V	230 V
Motor speed	1430 min-1	2474 min-1 ③
Motor frequency	50 Hz	87 Hz ②

Notes: ① Star connection: 400 V, 50 Hz.
② Delta connection: 400 V, 87 Hz
③ 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 22. Bypass motor control (example)

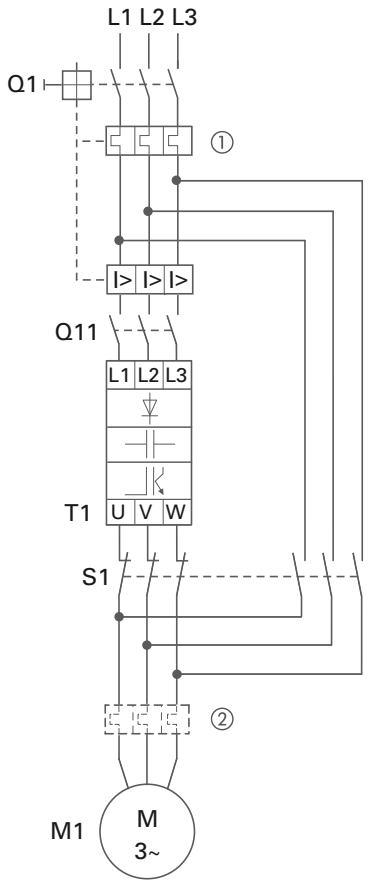


Table 10. Bypass motor control

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

Chapter 6—Installation requirements

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

This chapter contains all of the information required to properly install and prepare the PowerXL FR7 and FR8 Series VFD for operation. The contents are listed to serve as a list of tasks needed to complete the installation.

The AC drives that are described in this manual have the enclosure class IP00. You must install them in a cabinet or other enclosure that has a correct level of protection against the ambient conditions in the installation area. Make sure that the cabinet gives protection against water, humidity, dust and other contaminations. The cabinet must also be sufficiently strong for the weight of the IP00 drive module and other devices. When you prepare the installation, obey the local regulations.

The optional external power connection block enables the connection of 3 motor cables to 1 terminal. It is also easier to connect large motor cables when you have this option.

The external power connection block is a loose option, install it near the IP00 drive module. The cables between the motor cable terminals of the drive and the external power connection block are not included in the delivery.

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 mm^2 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
- 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

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 23** on next page.

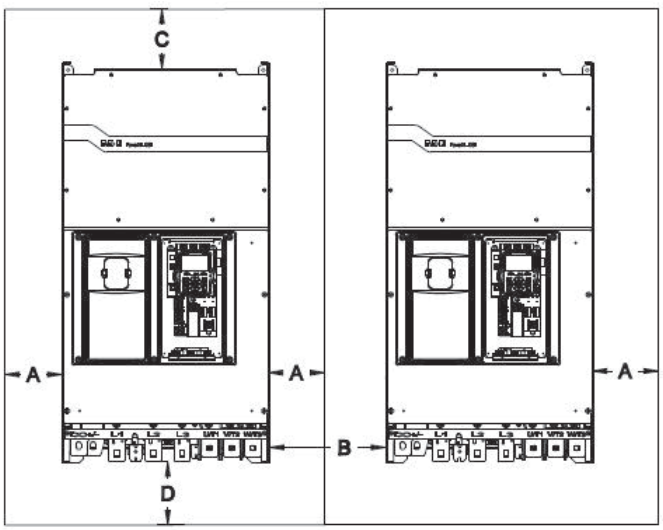
1. Measure the mounting space to ensure that it allows the minimum space surrounding the VFD Series drive. Drive dimensions are on **Appendix C.**
2. Make sure the mounting surface is flat and strong enough to support the drive, is not flammable, and is not subject to excessive motion or vibration.
3. Ensure that the minimum airflow requirements for your drive are met at the mounting location.
4. Mark the location of the mounting holes on the mounting surface, using the template provided on the cover of the cardboard shipping package.
5. 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

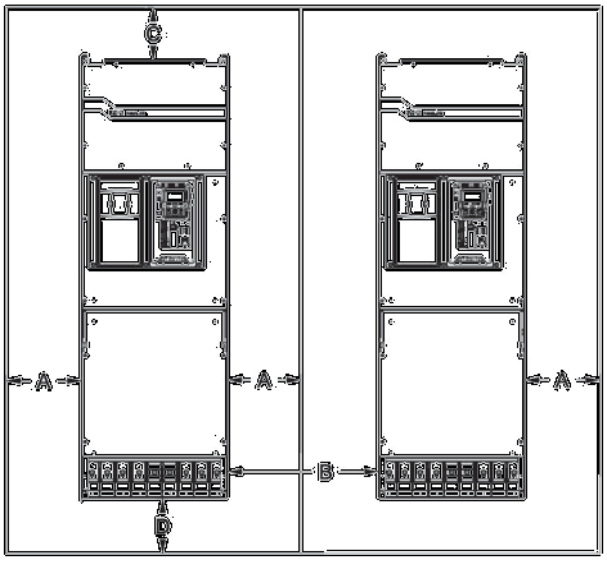
Refer to **Appendix C** for drive dimensions.

Figure 23. Mounting space

Note: The maximum length of the fiber optic cable between the 2 units is 3 m or 36 in.



Non-brake chopper option



Brake chopper option

Table 11. Space requirements for mounting the PowerXL Series FR7 and FR8 VFD and airflow

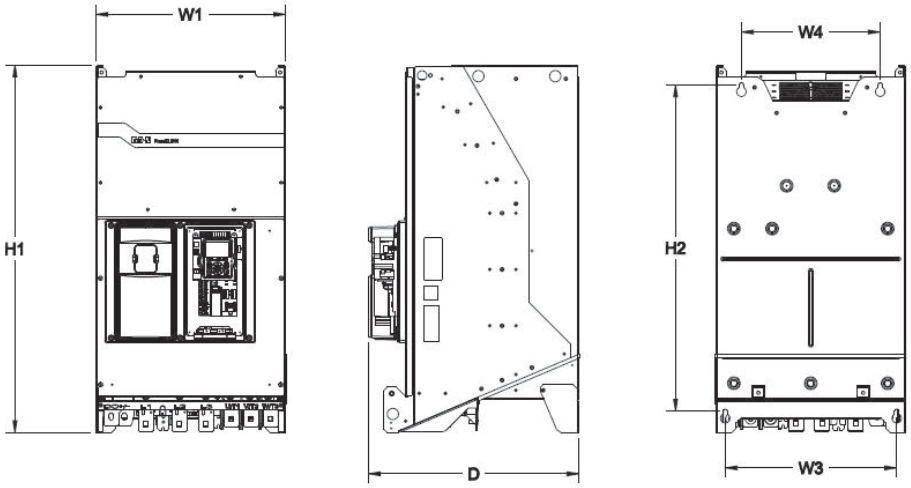
Frame size	Voltage	A ① In (mm)	B ① In (mm)	C In (mm)	D In (mm)	Cooling air required CFM (m^3/h) ②	Surface area of air intake holes (in^2/cm^2) ③
FR7	480 Vac	0.79 (20)	1.58 (40)	3.94 (100)	1.97 (50)	824 (1400)	93 (600)
	600 Vac						
FR8	480 Vac	1.18 (30)	2.36 (60)	6.30 (160)	2.36 (60)	2x824 (2x1400)	2x93 (2x600)
	600 Vac						

Notes: ① Minimum clearances A and B for drives with Type 12 (IP54) enclosure is 0 mm (in).
② The above guidelines apply unless testing has been completed to validate a design outside of these recommendations. This quantity of cooling air is sufficient for the AC drive. If you have other devices that cause power losses inside the cabinet, or if you use more filters (for example to have a higher level of protection), you must increase the surface area of the air intake holes.
③ The surface area is the total area of the openings, not the surface area of, for example, a grill.

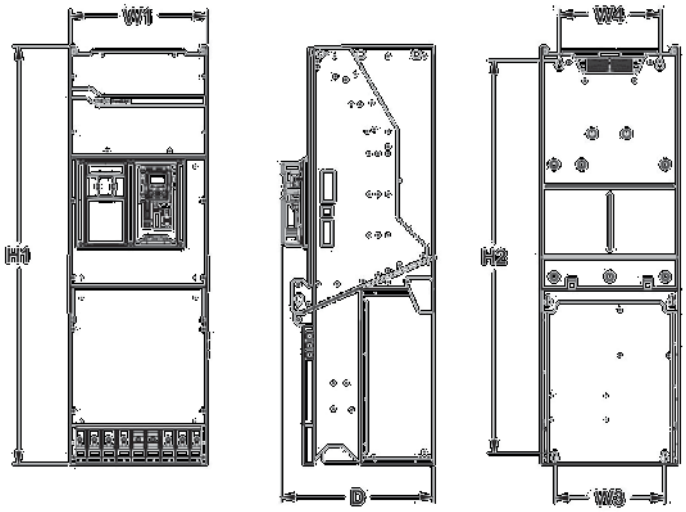
Dimensions

Approximate dimensions in mm

Figure 24. Type 00 open drives



Non-brake chopper option



Brake chopper option

Table 12. Mounting drive dimensions

	Approximate dimensions in inches (mm)							
Frame size	**D**	**H1**	**H2**	**W1**	**W3**	**W4**	**Ø**	**Weight Lb (kg)**
FR7/8	22.07 (561)	38.58 (980)	34.25 (870)	19.92 (506)	15.91 (404)	14.57 (370)	0.98 (25)	452 (205)
FR7/8 with output box	22.07 (561)	60.55 (1538)	56.81 (1442)	19.92 (506)	15.91 (404)	14.57 (370)	0.98 (25)	904 (410)

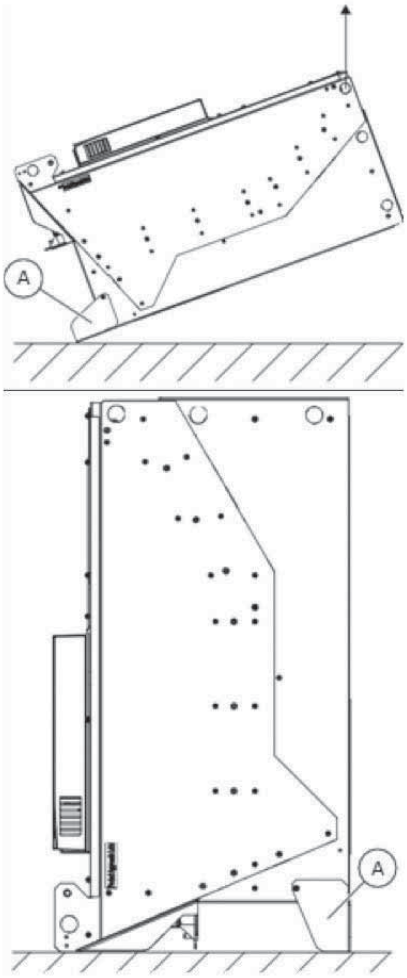
Note: FR8 is 2 FR7 coupled together.

Standard drive mounting

FR7 and FR8 mounting instructions

Lifting the IP00 drive module, FR7 or FR8 without the options module

Step 1: Make sure that the support is attached to the bottom of the drive. It gives the terminals protection when you lift the drive or put it vertically on the floor.



A. Support/fixing bracket

Step 2: Lift the drive with a lifting device. Put the lifting hooks in the holes on the top of the cabinet. The maximum lifting angle is 60 degrees.

Step 3: After the lifting, you can remove the support if necessary. You can also use it as a fixing bracket.

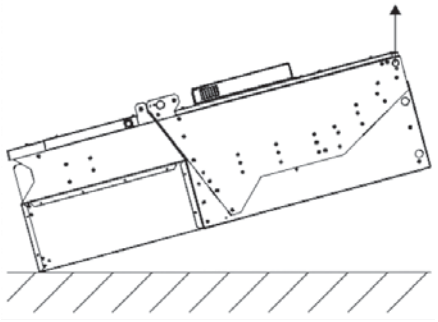
Lifting the IP00 drive module, FR7 or FR8 with the options module

Step 1: Remove the drive from the package.

Step 2: Use a lifting device that is sufficiently strong for the weight of the drive.

Step 3: Put the lifting hooks in the holes on the top of the cabinet.

Step 4: Lift the drive into a vertical position.



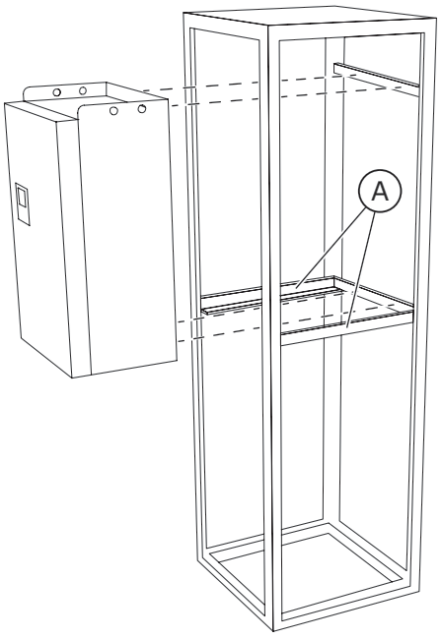
Step 5: The maximum lifting angle is 60 degrees.

Install the AC drive in a vertical position at the rear plane of the cabinet. We recommend that you attach rails on the sides inside the cabinet. The rails make the drive more stable and the servicing easier.

Installing the IP00 drive module into the cabinet

Installing the FR7 or FR8 IP00 drive module without the options module

Step 1: We recommend that you install the IP00 drive module on rails inside the cabinet.



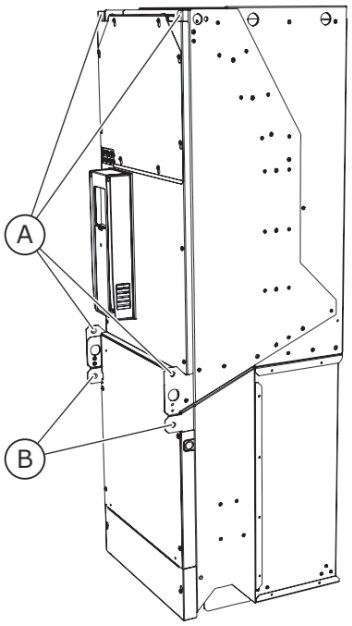
A. Support/fixing bracket

Step 2: Use fixing points to attach the IP00 drive module into the cabinet. See the locations of the fixing points in *Chapter 4—Mounting dimensions*.

Installing the FR7 or FR8 IP00 drive module with the options module

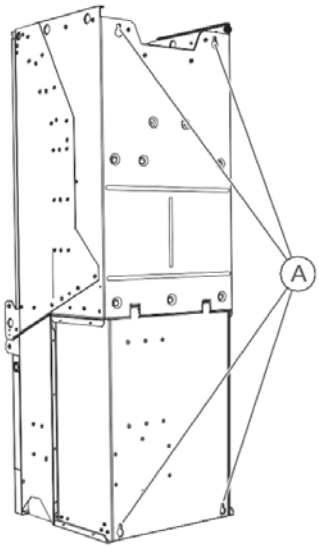
The drawing below shows a recommended installation of the IP00 drive module with an options module into the cabinet.

Step 1: Use the fixing points at the front of the drive.



A. Front fixing points
B. Fixing points of the options module. These are important for a safe maintenance if the IP00 drive module is removed.

Step 2: Use the fixing points at the rear of the drive.



A. Rear fixing points

Cooling and free space around the AC drive

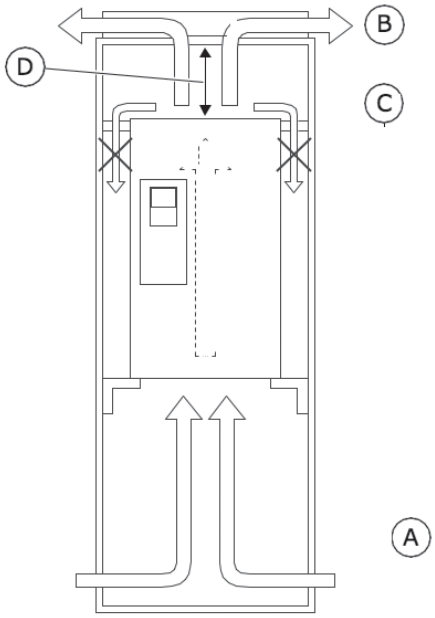
The AC drive produces heat in operation. The fan circulates air and decreases the temperature of the drive. Make sure that there is sufficiently free space around the drive.

Some free space in front of the drive is also necessary for maintenance. You must be able to open the cabinet door. When you have 2 or more drives, you can install them side by side.

Make sure that the temperature of the cooling air does not become higher than the maximum ambient operating temperature or lower than the minimum ambient operating temperature of the drive.

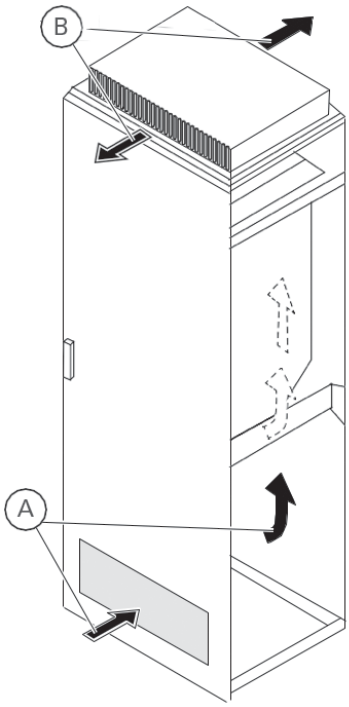
The air must move freely and efficiently through the cabinet and the drive. There must be a minimum of 20 cm (7.87 in) of space above the drive without obstacles that can stop the airflow. Make sure that the hot air goes out of the cabinet and does not come back into the cabinet.

Figure 25. Correct circulation of cooling air inside the cabinet



A. Cool air going in
B. Hot air coming out
C. Install shields to prevent recirculation of hot air inside the cabinet.
D. Minimum 7.87 in (200 mm)

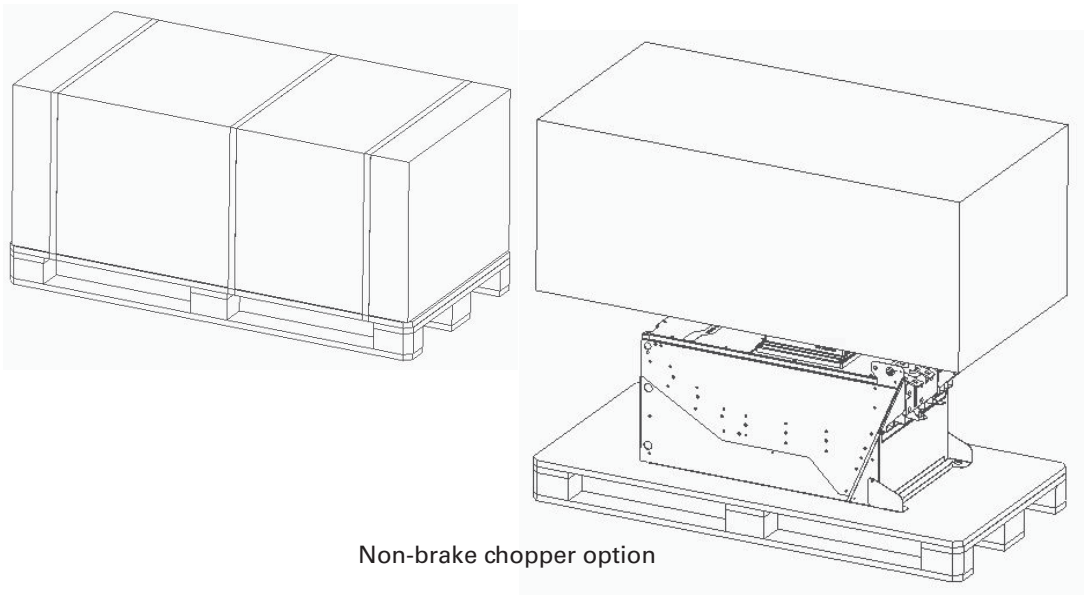
Figure 26. Cooling air must move freely inside the cabinet



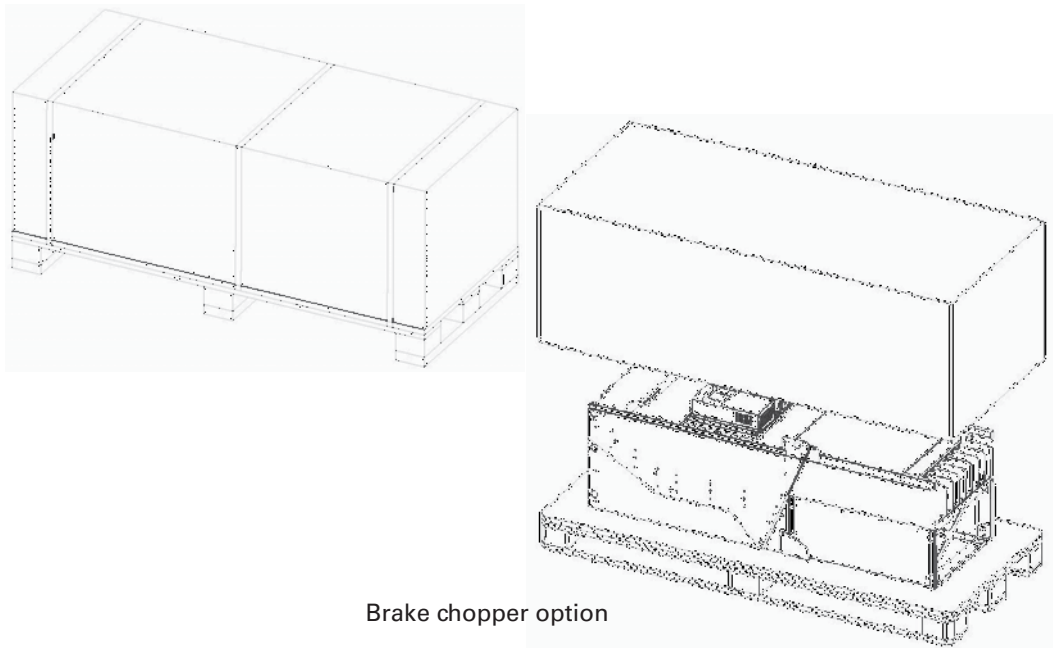
A. Cool air going in
B. Hot air coming out

FR7 and FR8 mounting instructions

Step 1: Remove the carton from the drive.

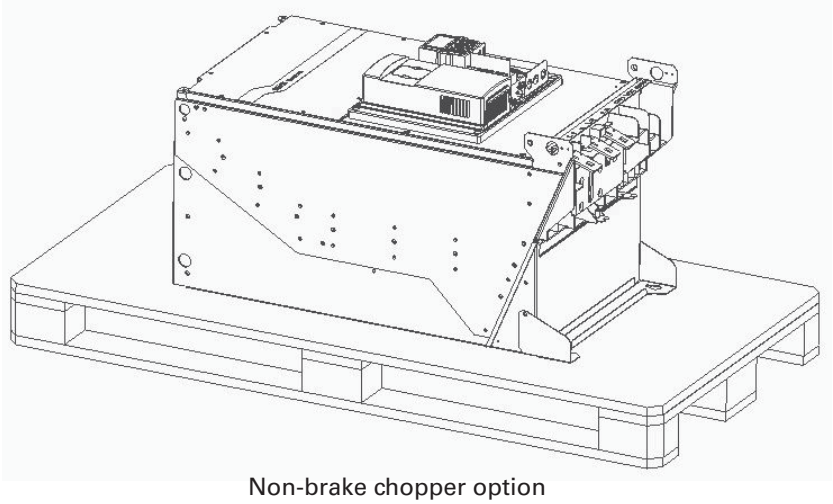


Non-brake chopper option

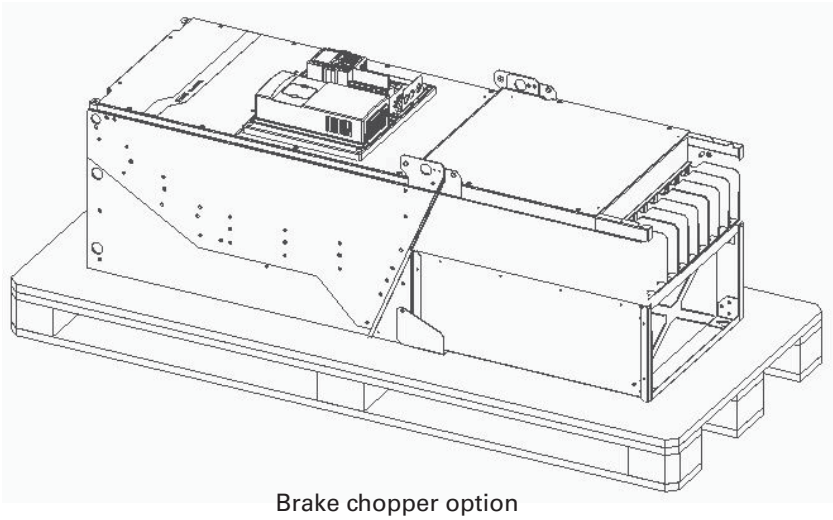


Brake chopper option

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

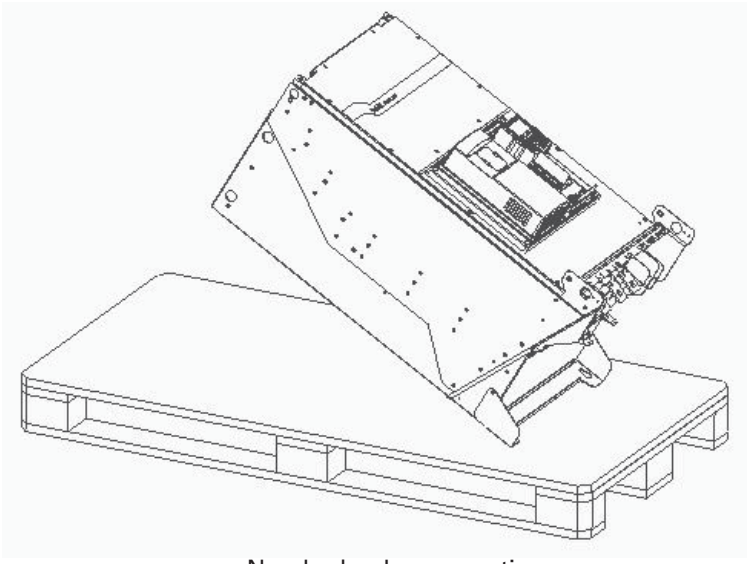


Non-brake chopper option

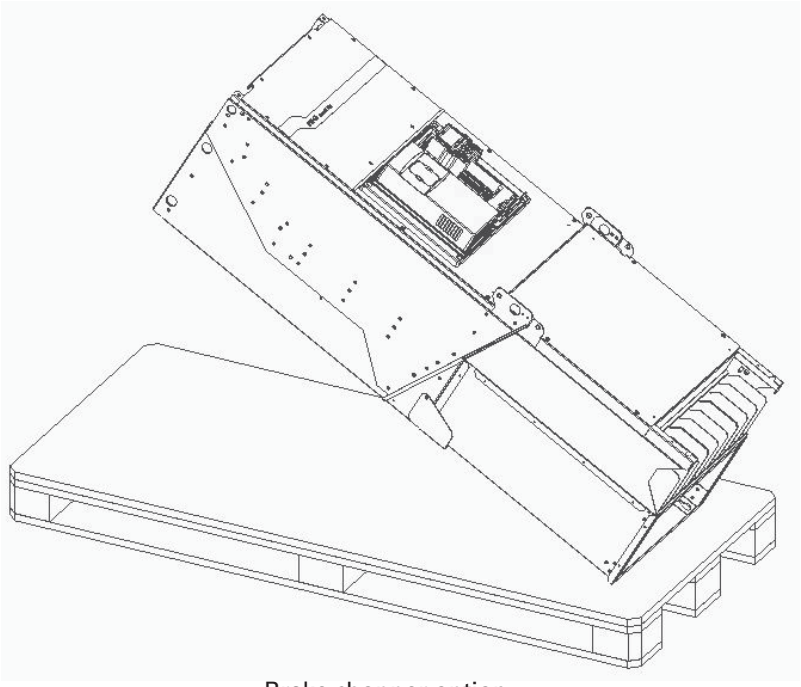


Brake chopper option

Step 3: Use a hook to lift the drive.

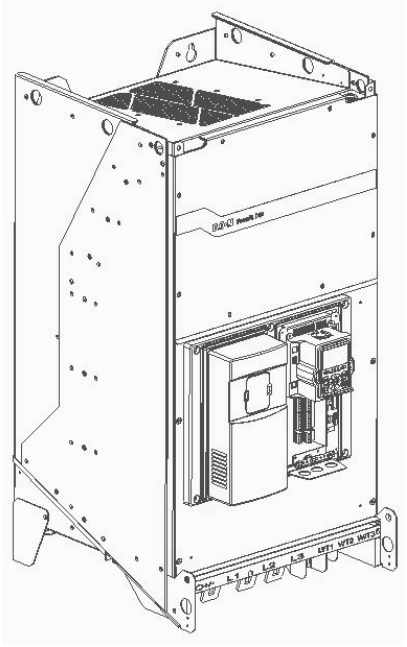


Non-brake chopper option

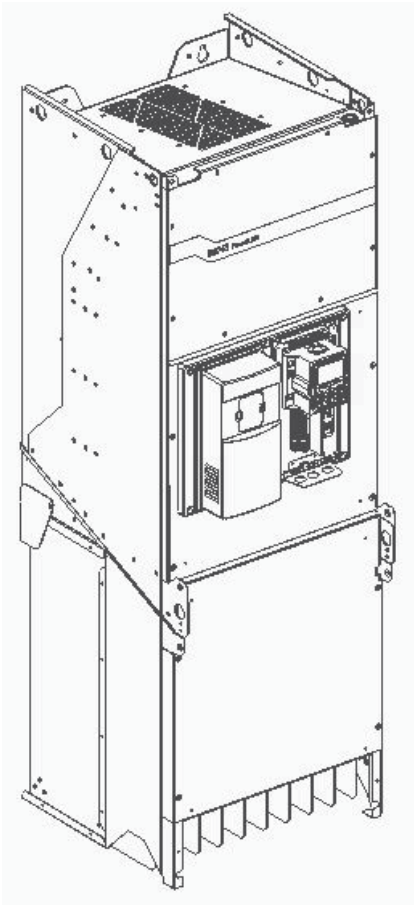


Brake chopper option

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 the drive mounting template printed on the outside carton).



Non-brake chopper option



Brake chopper option

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
- 70 °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**
  - North America 380 V to 500 V: **Appendix B**
  - All other International 380 V to 600 V: **Appendix B**

Line (Mains) and motor cable installation

The input line and motor cables must be sized in accordance with the rated PowerXL FR7 and FR8 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 FR7 and FR8 VFDs.

Input protection

Input protection devices are rated based on PowerXL FR7 and FR8 rated input and output current. For UL and cUL/CSA, refer to **Appendix D** for proper sizing. For gG/gL (IEC 60269-1), refer to **Appendix B** for proper sizing.

Consult with Eaton for further information about input protection requirements.

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.

Table 13. Minimum distances between cables in long parallel lines

Distance between cables [m]	Length of shielded cable [m]	Distance between (ft)	Length of shielded cable (ft)
0.3	≤ 50	1.0	≤ 164.0
1.0	≤ 200	3.3	≤ 656.1

- The maximum length of shielded motor cables is 200 m (MR8–MR12)
- Only use symmetrically shielded motor cables
- If the cable insulation checks are necessary, see **page 43** for instructions

Table 14. Maximum motor power cable length 480/575 V ①

Frame size	Maximum cable length
FR7	50 m (323 ft)
FR8	200 m (656 ft)

Note: ① Lengths above are without EMC considerations.

Table 15. Motor power cable EMC guidelines

Item	Directive
Product	IEC 61800-2
Safety	UL 508C, IEC/EN 61800-5-1
EMC (at default settings)	Immunity (EMS): IEC/EN 61800-3, 2nd environment
	Radiated and Conducted emissions (EMI): IEC/EN 61800-3
	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

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 13**.

Wiring the VFD

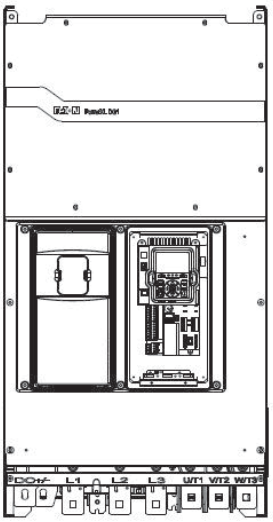
Refer to **Table 14** for maximum cable lengths by frame size.

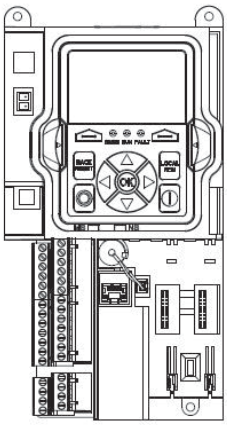
If three or more motor cables are used, each conductor must have its own overcurrent protection.

Power wiring notice

Do not discard the plastic bag containing the wiring hardware.

1. See the lug locations located at the bottom of the unit.



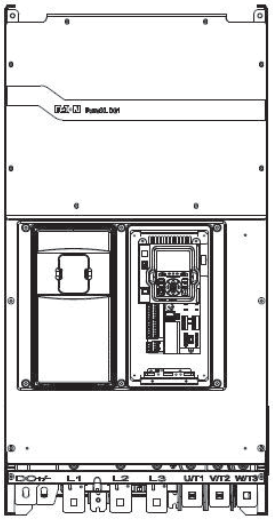


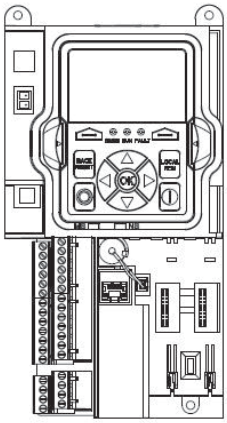
Wiring hardware contents (included with drive)

- Modification label
- Detachable cable clamp
- Attachable grounding strap
- Ground strap mounting screws

Power wiring/grounding

2. Remove power wiring protection plate. Use power/motor cable tables on **Appendix B**.
3. Add attachable grounding clamps (qty 2), one on each side of drive.
4. If shielded cable is used, connect the shields of input power and motor cables shields to ground.

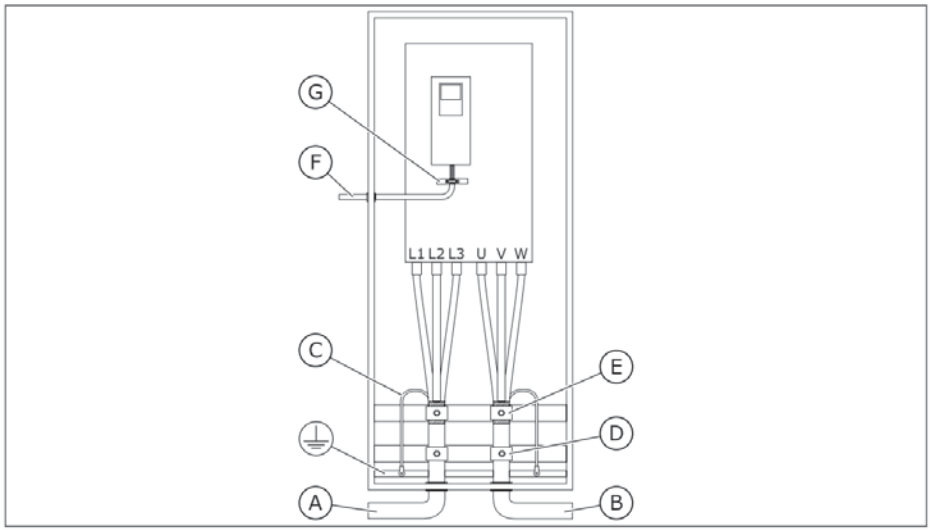




5. Wire power terminals (L1, L2, L3), motor terminal (U, V, W), and grounding terminals per **Figure 27**. It is recommended for power and motor leads to be in separate conduit.

   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 as the enclosure.

Figure 27. Ground wiring



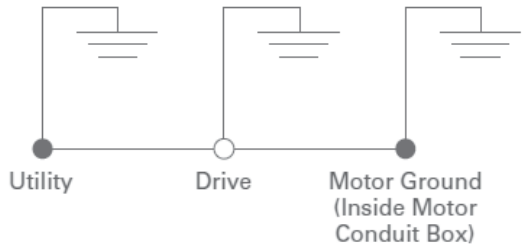
A. The mains cables
B. The motor cables
C. The grounding conductor
D. Pull relief
E. The grounding clamp for cable shield, 360° grounding
F. The control cable
G. The grounding bar of the control cable

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

Note: Actual layout may vary slightly by frame.

Ground wiring

- Run motor cables in separate conduit
- DO NOT RUN CONTROL WIRES in same conduit
- Cables sized per **Appendix B**
- Provide **dedicated** wire for low impedance ground between drive and motor. DO NOT USE conduit as ground



CAUTION

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

Control wiring

6. Wire the control terminals following the details for the specific option boards shown on the following pages

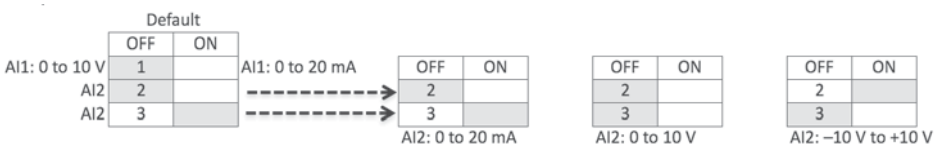
Note: For ease of access, the board terminals blocks can be unplugged for wiring.

7. Wire control to the control board

I/O Connection

- Run AC power wires and 24 Vdc control wiring in separate conduit
- Communication wire to be shielded

Table 16. I/O connection



External Wiring	Pin	Signal name	Signal	Default setting	Description
	1	+10 V	Ref. Output voltage	—	10 Vdc supply source
	2	AI1+	Analog input 1	0–10 V	Voltage speed reference (programmable to 4 mA to 20 mA)
	3	AI1–	Analog input 1 ground	—	Analog input 1 common (ground)
	4	AI2+	Analog input 2	4 Ma to 20 ma	Current speed reference (programmable to 0–10 v)
	5	AI2–	Analog input 2 ground	—	Analog input 2 common (ground)
	6	GND	I/O signal ground	—	I/O ground for reference and control
	7	DIN5	Digital input 5	Preset speed b0	Sets frequency output to preset speed 1
	8	DIN6	Digital input 6	Preset speed b1	Sets frequency output to preset speed 2
	9	DIN7	Digital input 7	Emergency stop (ti–)	Input forces VFD output to shut off
	10	DIN8	Digital input 8	Force remote (ti+)	Input takes VFD from local to remote
	11	CMB	Di5 to di8 common	Grounded	Allows source input
	12	GND	I/O signal ground	—	I/O ground for reference and control
	13	24 V	+24 Vdc output	—	Control voltage output (100 mA max.)
	14	DO1	Digital output 1	Ready	Shows the drive is ready to run
	15	24 Vo	+24 Vdc output	—	Control voltage output (100 mA max.)
	16	GND	I/O signal ground	—	I/O ground for reference and control
	17	AO1+	Analog output 1	Output frequency	Shows output frequency to motor 0–60 hz (4 mA to 20 mA)
	18	AO2+	Analog output 2	Motor current	Shows motor current of motor 0–fla (4 mA to 20 mA)
	19	24 Vi	+24 Vdc input	—	External control voltage input
	20	DIN1	Digital input 1	Run forward	Input starts drive in forward direction (start enable)
	21	DIN2	Digital input 2	Run reverse	Input starts drive in reverse direction (start enable)
	22	DIN3	Digital input 3	External fault	Input causes drive to fault
	23	DIN4	Digital input 4	Fault reset	Input resets active faults
	24	CMA	Di1 to di4 common	Grounded	Allows source input
	25	A/+	Rs-485 signal a	—	Fieldbus communication (modbus, bacnet)
	26	B/–	Rs-485 signal b	—	Fieldbus communication (modbus, bacnet)
	27	R3NO	Relay 3 normally open	At speed	Relay output 3 shows VFD is at ref. Frequency
	28	R1NC	Relay 1 normally closed	Run	Relay output 1 shows VFD is in a run state
	29	R1CM	Relay 1 common		
	30	R1NO	Relay 1 normally open		
	31	R3CM	Relay 3 common	At speed	Relay output 3 shows VFD is at ref. Frequency
	32	R2NC	Relay 2 normally closed	Fault	Relay output 2 shows VFD is in a fault state
	33	R2CM	Relay 2 common		
	34	R2NO	Relay 2 normally open		

Note: 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. When using the +10 V for AI1, it is important to wire AI1—to ground (as shown by dashed line). If using +10 V for AI1 or AI2, terminals 3, 5, and 6 need to be jumpered together.

Figure 28. Terminal block layout

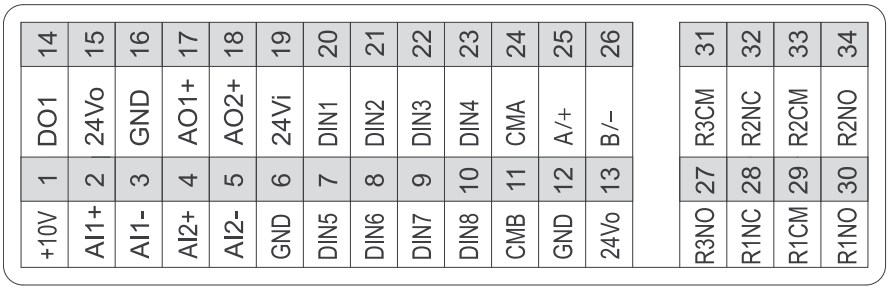
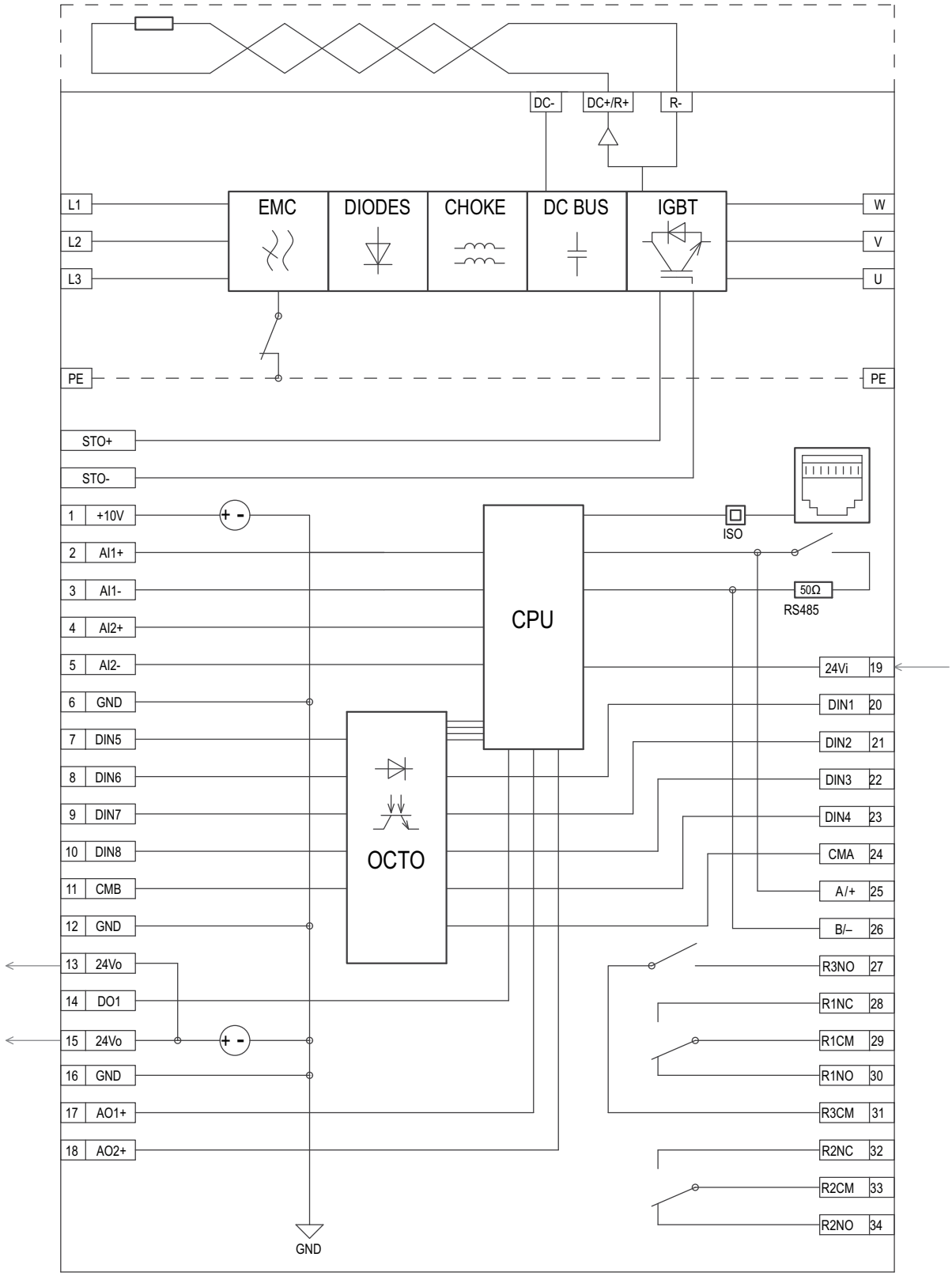


Table 17. I/O specifications

Item	Specification
Analog input 1	Selectable for either voltage or current reference signal
	0 to 10 V, 0 (4) to 20 mA; R_i – 250 ohm differential
Analog input 2	Selectable for either voltage or current reference signal
	0 to 10 V, –10 to 10 V, 0 (4) to 20 mA; R_i – 250 ohm differential
Digital inputs (8)	Positive or negative logic; 18 to 30 Vdc, one input can be used as thermistor input
+24 V output	Auxiliary voltage, +24 V ±15%, total max. 250 mA on board (include optional cards)
+10 VREF	Output reference voltage, +10 V +3%, max. load 10 mA
Analog outputs	0 (4) to 20 mA; R_L max. 500 ohm
	0 to 10 V, 10 mA
Digital output	Open collector output, 50 mA/48 V for CE, 50 mA/36 V for UL
Relay outputs (3)	Programmable relay outputs: 2 x form c (relay 1 and relay 2) and 1 x form a (relay 3), relay 3 can be used as thermistor output
	Switching capacity: 24 Vdc/6 A, 48 Vdc/2 A, 240 Vac/6 A, 125 Vdc/0.4 A

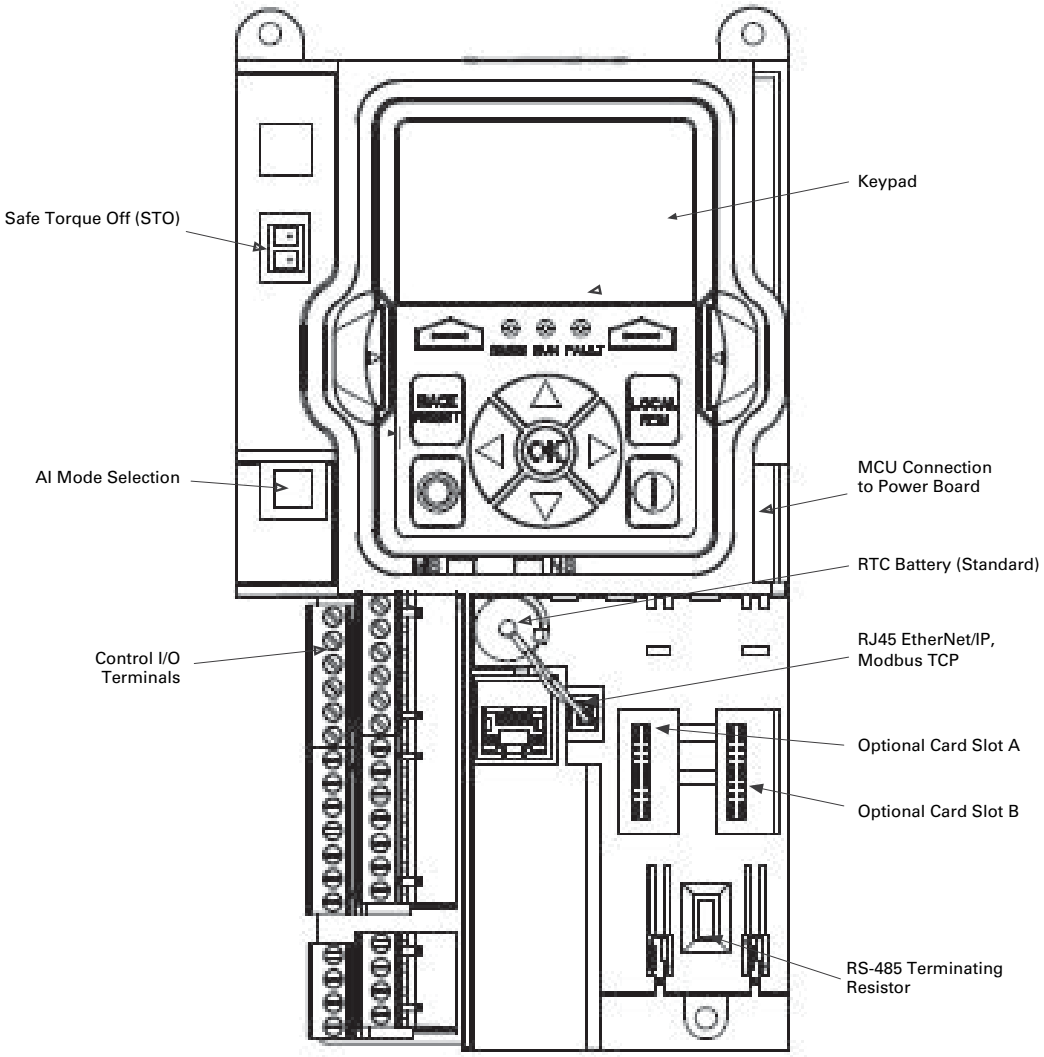
Figure 29. Basic internal control wiring diagram



Control board

The main PowerXL FR7 and FR8 Series VFD consists of a main control board, control I/O connections block and two slots for extra option boards.

Figure 30. FR7 and FR8 series adjustable frequency drive



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 (2004) + A1 (2012)
- Run AC power wire and +24 Vdc control I/O in separate conduit
- Control I/O terminals must be tightened to 4.5 in-lb (0.5 Nm)
- Wiring or ferrule size: 28~12 (Sol) AWG, 30~12 (Str) AWG, or 0.2~2.5 mm^2

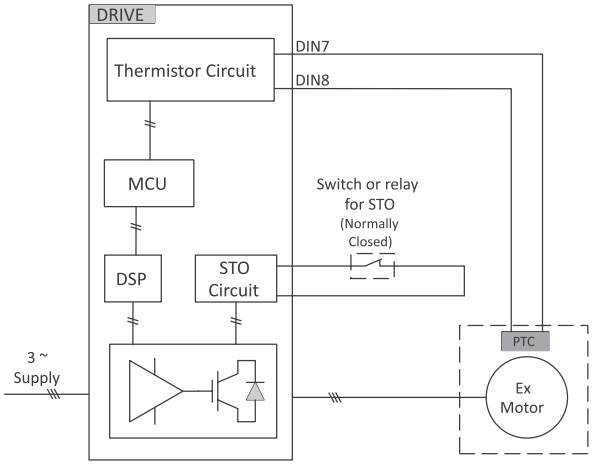
Safe torque off (STO)

Refer to Appendix E for details of STO.

The PowerXL FR7 and FR8 includes Safe Torque Off (STO) functionality as standard and provides:

- Isolation from the control board will stop IGBT from firing
- Functional safety SIL1 certification: IEC/EN 61800-5-2 and DIN EN ISO 13849 Category 1, Performance Level C

Figure 31. Thermistor/STO wiring diagram



Switch

In **Figure 31**, the activation switch would represent a component such as a manual operated switch and Emergency stop push button or the contacts of a safety relay or safety PLC.

Cable type

It is recommended to use double-shielded twisted-pair cable.

Maximum cable lengths:

- 300 m (984 ft) between activation switch and control board
- 60 m (200 ft) between multiple drives

Grounding

Grounds between the drive and the activation switch should be connected to the drive end. Grounds between two drives should only be grounded to a signal drive.

Figure 32. Example of wiring an STO with the internal 24 V supply

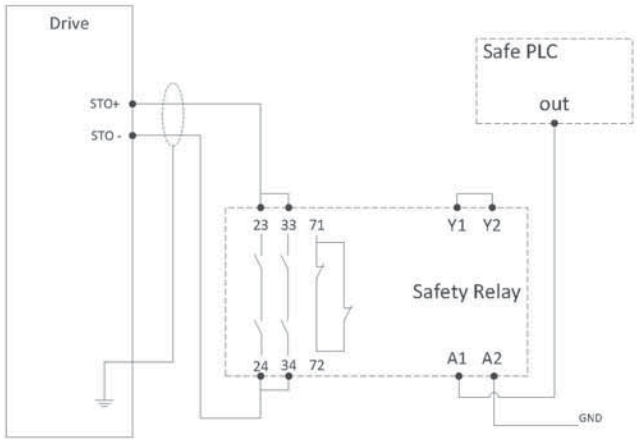
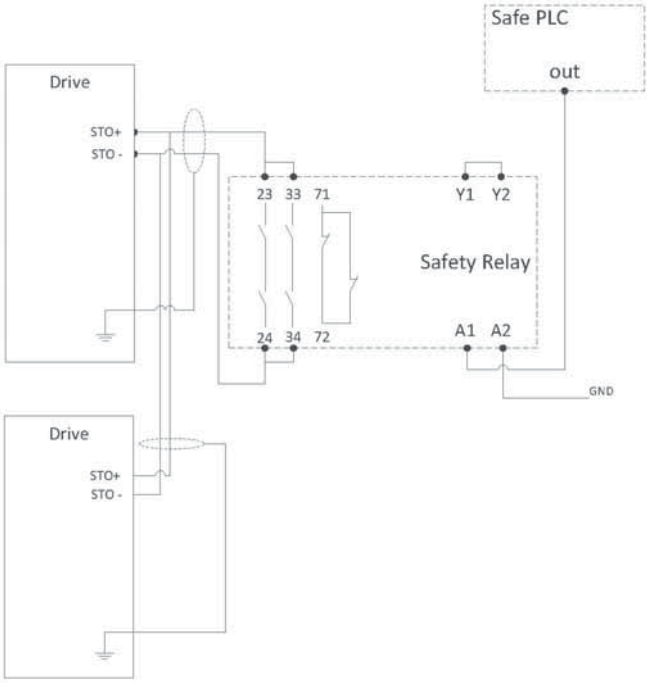


Figure 33. Example of wiring an STO with the internal 24 V supply to multiple drives

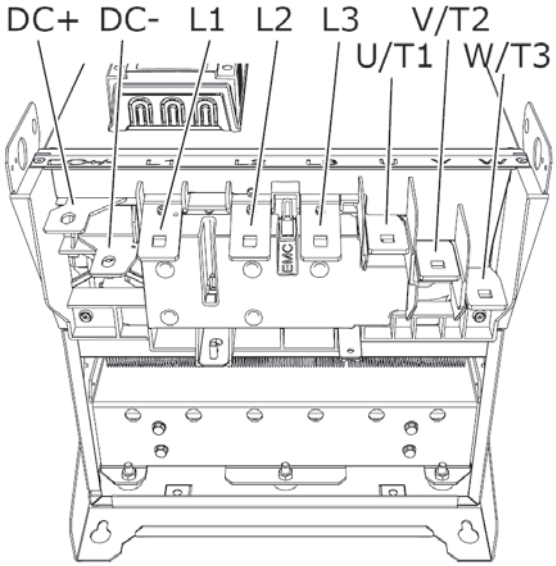


Connection to power section

Figure 32 shows the general connections for the frequency inverter in the power section.

Three-phase input connection

Figure 34. 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 AC drive must always be grounded with a grounding conductor that is connected to the grounding terminal that is identified with the symbol ⏚. Not using a grounding conductor can cause damage to the drive.

The touch current of the drive is more than 3.5 mA AC. The standard EN 61800-5-1 tells that 1 or more of these conditions for the protective circuit must be true.

The connection must be fixed.

A. The protective grounding conductor must have a cross-sectional area of minimum 10 mm^2 Cu or 16 mm^2 Al.

   OR

B. There must be an automatic disconnection of the mains, if the protective grounding conductor breaks. See *Chapter 6—Power cabling*.

   OR

C. There must be a terminal for a second protective grounding conductor in the same cross-sectional area as the first protective grounding conductor.

Table 18. Protective grounding conductor cross-section

Cross-sectional area of phase conductors (S) [mm^2]	Minimum cross-sectional area of protective grounding conductor in question [mm^2]
$S \leq 16$	S
$16 < S \leq 35$	16
$35 < S$	S/2

The values of the table are valid only if the protective grounding conductor is made of the same metal as the phase conductors. If this is not so, the cross-sectional area of the protective grounding conductor must be determined in a manner that produces a conductance equivalent to that which results from the application of this table.

The cross-sectional area of each protective grounding conductor that is not a part of the mains cable or the cable enclosure, must be a minimum of:

- 2.5 mm^2 if there is mechanical protection, and
- 4 mm^2 if there is not mechanical protection. If you have cord-connected equipment, make sure that the protective grounding conductor in the cord is the last conductor to be interrupted, if the strain-relief mechanism breaks.

Obey the local regulations on the minimum size of the protective grounding conductor.

Using an RCD or an RCM device

The drive can cause a current in the protective grounding conductor. You can use a residual current-operated protective (RCD) device, or a residual current-operated monitoring (RCM) device to give protection against a direct or an indirect contact. Use a type B RCD or RCM device on the mains side of the drive.

⚠ 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 FR7 and FR8 delivery (see **Figure 33**) and note the date. Unless already done, attach the sticker close to the name plate of the AC drive.

Product modified sticker

Figure 35. 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 FR7 and FR8 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 FR7 and FR8 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 36** on **Page 45**). 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 36** on **Page 45**.

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.

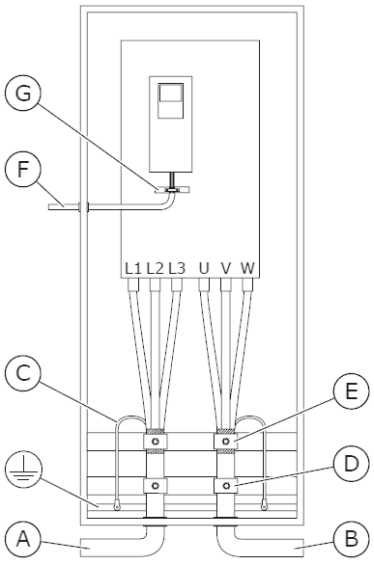
The effectiveness of the cable shield depends on a good shield connection and a low shield impedance.

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 one end, in the immediate vicinity of the supply voltage source (PES).

Installation requirements

Figure 36. EMC-Compliant Setup—460/480 Vac, 600 Vac



A. Mains cables
B. Motor cables
C. Grounding conductor
D. Pull relief
E. Grounding clamp for cable shield, 360° grounding
F. Control cable
G. Grounding bar of the control cable

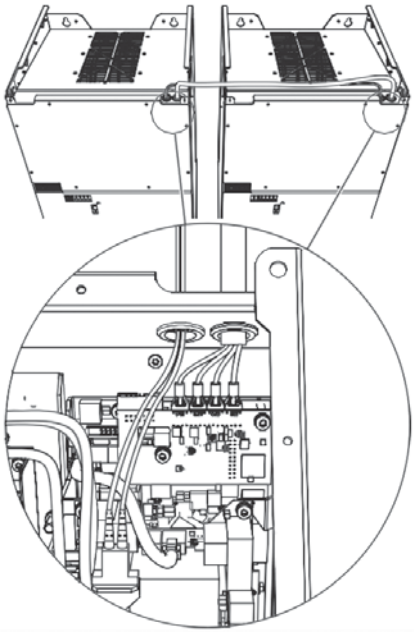
- Only use symmetrically EMC shielded motor cables
- The maximum length of shielded motor cables is 200 m (FR7-FR8)
- If the cable insulation checks are necessary, see **Appendix B** for instructions
- If the motor cables are in long parallel lines with other cables, obey the minimum distances
- The minimum distances are also valid between the motor cables and the signal cables of other systems

Enclosure sizes FR7 and FR8

The enclosure size FR8 includes 2 power units.

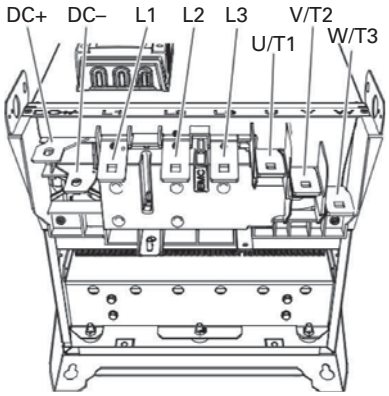
Connecting the 2 power units with an optical fiber cable, FR8

1. Remove the service lid of each power unit.
2. Connect the power units together with the optical fiber cable.



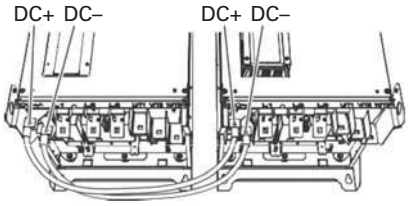
Cable installation without the options module

1. Find the motor cable terminals.



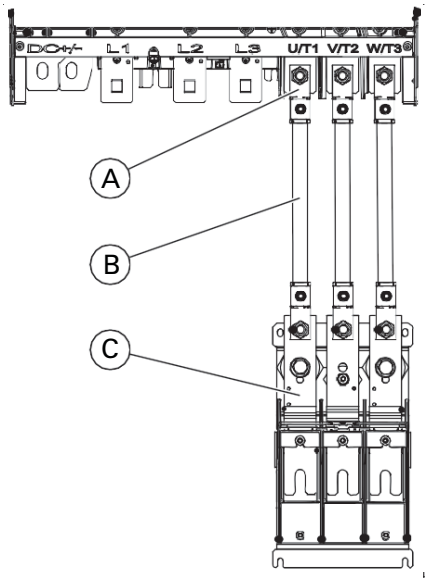
2. In FR8, connect the DC terminals of the 2 power units with the DC link cable. Connect the DC+ terminals together, and the DC- terminals together.

   The DC link cable is included in the delivery.



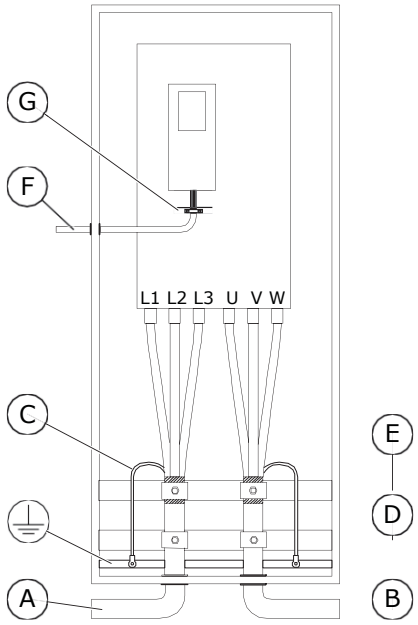
3. Use the external power connection block (+PCTB) if you have it.

   For FR8, there are 2 external power connection blocks.



A. Terminals U, V, W
B. Power cable (not included in delivery of the option)
C. External power connection block

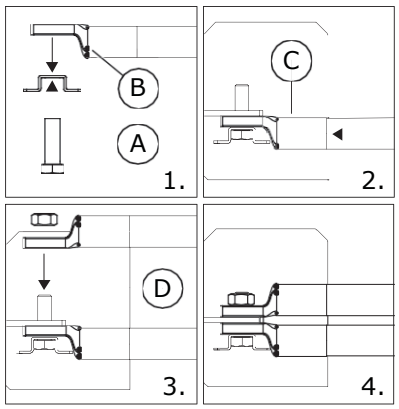
4. Connect the cables. The picture shows an example of good cabling.
   a) Connect the phase conductors of the mains cable and of the motor cable into the correct terminals. If you use a brake resistor cable, connect its conductors into the correct terminals.
   b) Attach the grounding conductor of each cable to a grounding terminal with a grounding clamp for grounding conductor.
   c) Make sure that the external grounding conductor is connected to the grounding bar. See **Chapter 2**.
   d) See the correct tightening torques on **Page 66**.



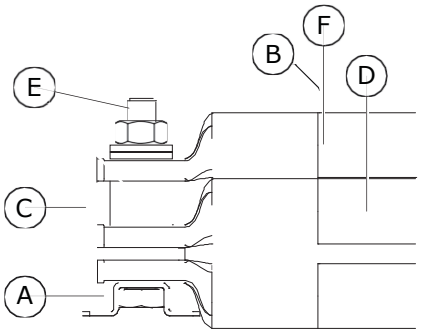
A. Mains cables
B. Motor cables
C. Grounding conductor
D. Pull relief
E. Grounding clamp for cable shield, 360° grounding
F. Control cable
G. Grounding bar of the control cable

5. If you use many cables on one connector, put the cable lugs on top of each other.

- The pictures show the connection in FR7 and FR8.
- The bolt holder of the connector keeps the bolt still when you turn the nut.



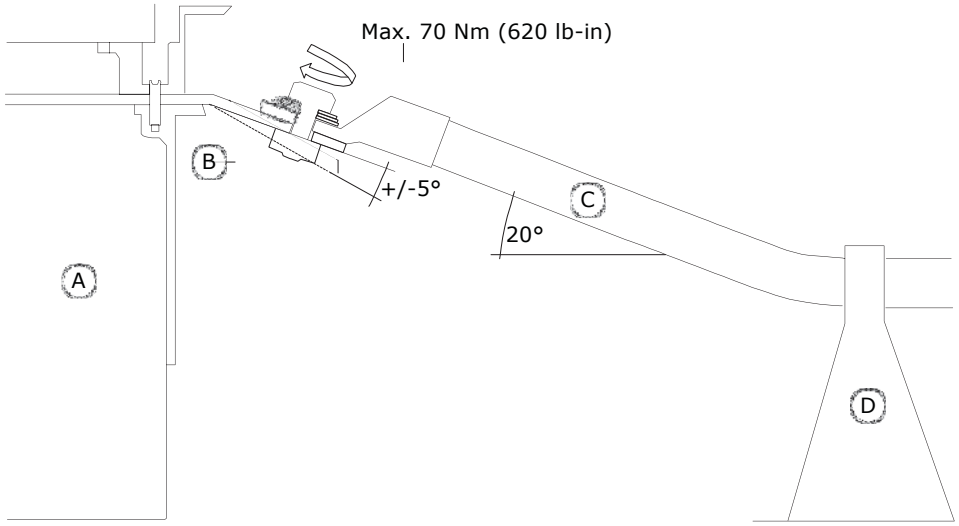
A. Bolt holder of the connector
B. First cable lug
C. Connector
D. Second cable lug



A. Bolt holder of the connector
B. First cable lug
C. Connector
D. Second cable lug
E. Connection bush
F. Third cable lug

6. To make EMC grounding, expose the shield of all 3 motor cables and make a 360-degree connection between the cable and the grounding clamp for cable shield.
7. Attach the terminal cover, and then the options module cover.
8. Make sure that the grounding conductor is connected to the motor and also to the terminals that are identified with ⏚.
   a) To obey the requirements of the standard EN 61800-5-1, obey the instructions in Chapter 2 "Grounding and earth fault protection".

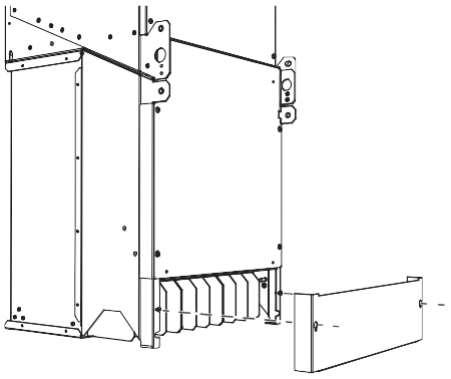
Figure 37. Mechanical support for cables when the drive does not have the options module



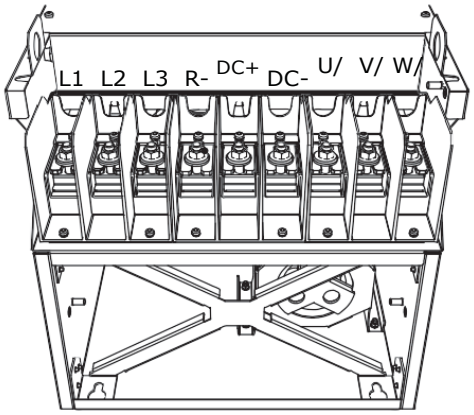
A. AC drive
B. Connection busbar; terminals L1, L2, L3, U/T1, V/T2, W/T3
C. Power cable
D. Cable support

Cable installation with the options module

1. Loosen the screws of the terminal cover and remove it.

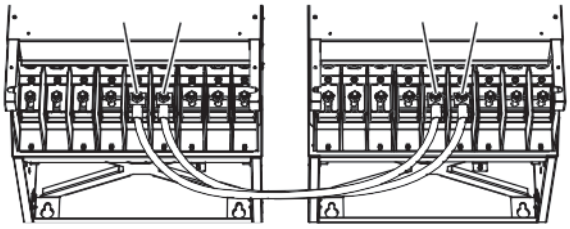


2. Find the motor cable terminals.

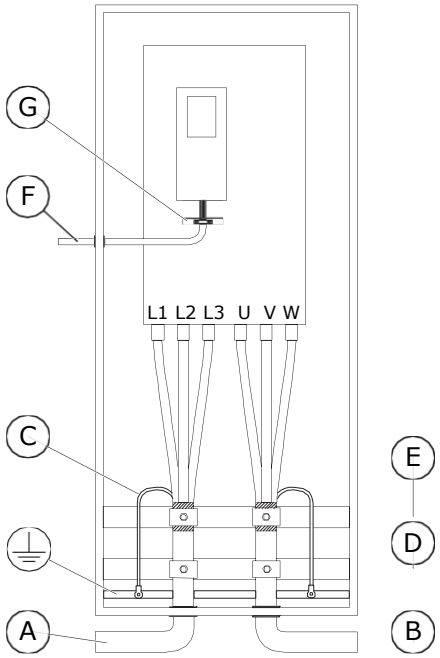


3. In FR8, connect the DC terminals of the 2 power units with the DC link cable. Connect the DC+ terminals together, and the DC- terminals together.

   The DC link cable is included in the delivery.



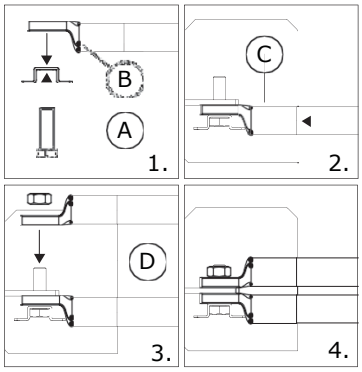
4. Connect the cables. The picture shows an example of good cabling.
   a) Connect the phase conductors of the mains cable and of the motor cable into the correct terminals. If you use a brake resistor cable, connect its conductors into the correct terminals.
   b) Attach the grounding conductor of each cable to a grounding terminal with a grounding clamp for grounding conductor.
   c) Make sure that the external grounding conductor is connected to the grounding bar. See **Chapter 2**.
   d) See the correct tightening torques on **Page 66**.



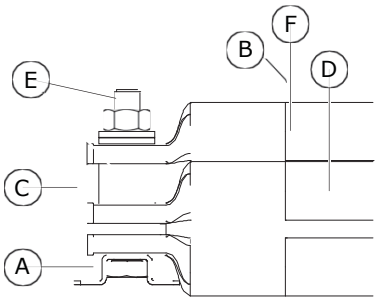
A. Mains cables
B. Motor cables
C. Grounding conductor
D. Pull relief
E. Grounding clamp for cable shield, 360° grounding
F. Control cable
G. Grounding bar of the control cable

5. If you use many cables on one connector, put the cable lugs on top of each other.

- The pictures show the connection in FR7 and FR8.
- The bolt holder of the connector keeps the bolt still when you turn the nut.



A. Bolt holder of the connector
B. First cable lug
C. Connector
D. Second cable lug



A. Bolt holder of the connector
B. First cable lug
C. Connector
D. Second cable lug
E. Connection bush
F. Third cable lug

6. To make EMC grounding, expose the shield of all 3 motor cables and make a 360-degree connection between the cable and the grounding clamp for cable shield.
7. Attach the terminal cover, and then the options module cover.
8. Make sure that the grounding conductor is connected to the motor and also to the terminals that are identified with ⏚.
   a) To obey the requirements of the standard EN 61800-5-1, obey the instructions in **Chapter 2** "Grounding and earth fault protection".

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 19. 1st Environment 2nd environment EMC levels according to EN 61800-3 (2004)

Cable Type	Category C2	Category C3	Category C4①
Line voltage/mains	1	1	1
Motor cable	3②	2	2
Control cable	4	4	4

Notes: ① For installations in IT systems, it is necessary to modify the EMC protection to EMC level C4. See the following page for the procedure.
② 360° earthing of the shield with cable glands in motor end needed for EMC Level C2.

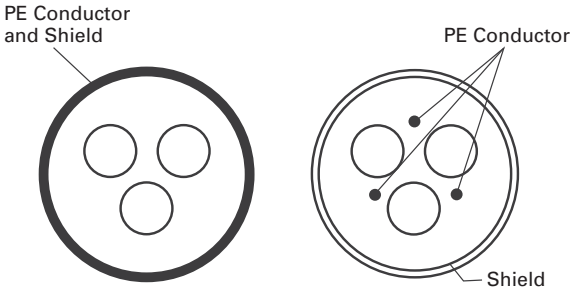
Table 20. Motor power cable EMC guidelines

Item	Directive
Product	IEC 61800-2
Safety	UL 508C, IEC/EN 61800-5-1
EMC (at default settings)	Immunity (EMS): IEC/EN 61800-3, 2nd environment
	Radiated and Conducted emissions (EMI): IEC/EN 61800-3
	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

Table 21. 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 38**.
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 circumstances, the EMC protection class must be changed to level C4.

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

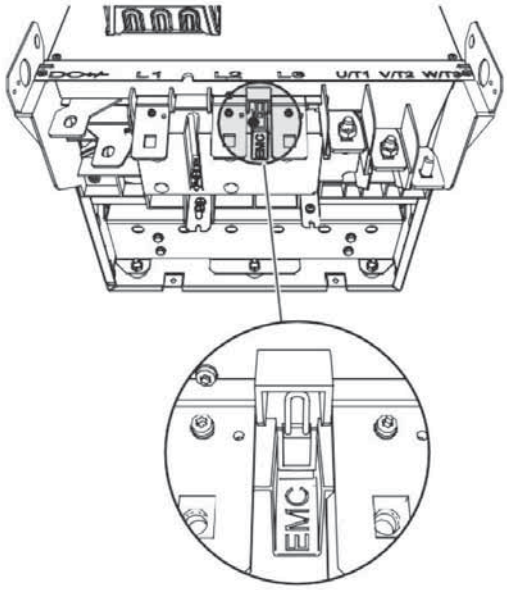
Failure to follow these instructions will result in death or serious injury.

EMC jumper in FR7 and FR8

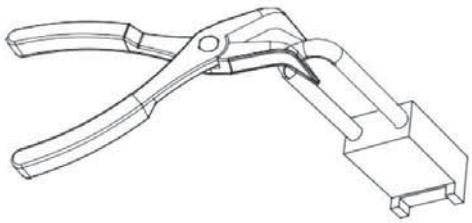
Change the EMC protection of the AC drive from level C3 to level C4. In FR8, the 2 power units must have the same EMC protection level.

Finding the EMC jumper, without the options module

1. Find the EMC jumper between the terminals L2 and L3.

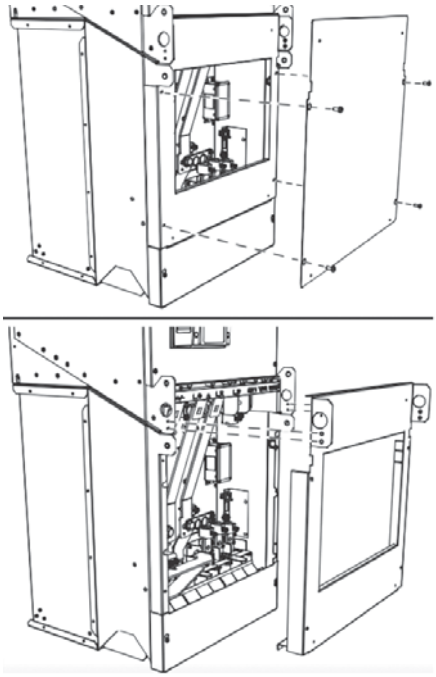


2. Remove the EMC jumper.

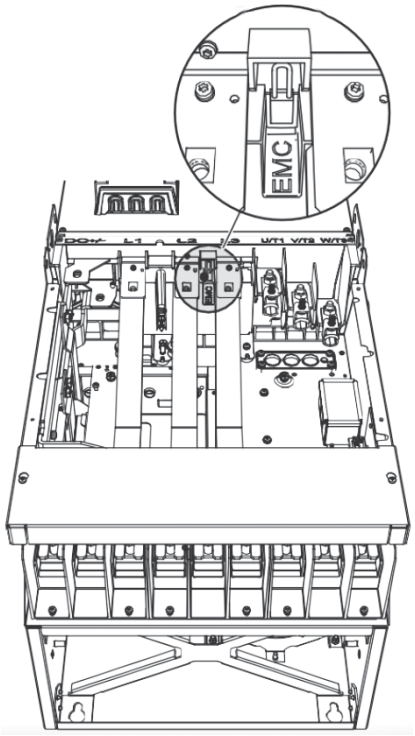


Finding the EMC jumper, with the options module

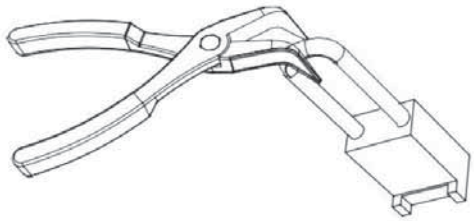
1. Remove the covers of the options module.



2. Find the EMC jumper between the terminals L2 and L3.



3. Remove the EMC jumper.



Appendix A—Technical data and specifications

Technical data

Table 22. PowerXL Series—FR7 and FR8

Attribute	Description	Specification
Input ratings	Input voltage Uin	380 V to 500 V, 525 V to 600 V, –10 to 10%
	Input frequency	50 Hz to 60 Hz (variation up to 47.5 Hz to 66 Hz), –5 to 10%
	Connection to power	Once per minute or less
	Starting delay	12 s (FR7 and FR8)
	Short-circuit withstand rating	65 kAIC fuses, mains type TN, TT and IT
Output ratings	Output voltage	0 to Uin
	Continuous output current	I_L: ambient temperature maximum 40 °C, up to 50 °C with derating (1.5%/1 °C), overload 1.1 x I_L (1 min./10 min.) I_H: ambient temperature maximum 40 °C, up to 50 °C with derating (1.5%/1 °C), overload 1.5 x I_H (1 min./10 min.) I_H in 600 V drives: ambient temperature maximum 40 °C, overload 1.5 x I_H (1 min./10 min.)
	Overload current	150% respectively 110% (1 min./10 min.)
	Output frequency	0–320 Hz (standard)
	Frequency resolution	0.01 Hz
Control characteristics	Control methods	Frequency control Speed control Open-loop speed control Open-loop torque control
	Switching frequency (FR7 and FR8)	480 V range: 1.5 kHz to 6 kHz 480 V defaults: 2 kHz 600 V range: 1.5 kHz to 6 kHz 600 V defaults: 2 kHz For a product that is configured C4 installation on IT network, the maximum switching frequency is limited to default 2 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% (Analog 10-bit), accuracy ±1% Panel reference: resolution 0.01 Hz
	Field weakening point	8 Hz to 320 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
Ambient conditions	Ambient operating temperature	–10 °C (no frost) to +40 °C, up to +50 °C with derating (CT) –10 °C (no frost) to +40 °C, up to +50 °C with derating (VT)
	Storage temperature	–40 °C to +70 °C
	Relative humidity	0–95% RH, noncondensing, non-corrosive
	Air quality: • Chemical vapors • Mechanical particles	Tested according to IEC 60068-2-60 Test Key: Flowing mixed gas corrosion test, Method 1 (H2S [hydrogen sulfide] and SO2 [sulfur dioxide]) Designed according to: IEC 60721-3-3, unit in operation, class 3C2 IEC 60721-3-3, unit in operation, class 3S2
	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) Maximum altitudes: • 208–240 V: 4000 m (TN and IT systems) • 380–500 V: 4000 m (TN and IT systems) • 380–500 V: 2000 m (corner-grounded network) • 525–600 V: 2000 m (TN and IT systems, no corner grounding) Voltage for relay outputs: • Up to 3000 m : Allowed up to 240 V • 3000–4000 m: Allowed up to 120 V Corner-grounding: • Up to 2000 m only (Requires a change in the EMC level from C3 to C4)

Table 22. PowerXL Series—FR7 and FR8, continued

Attribute	Description	Specification
Ambient conditions, continued	Vibration: • EN 61800-5-1 • EN 60068-2-6	5–150 Hz Displacement amplitude 0.5 mm (peak) at 5 to 22.29 Hz Maximum acceleration amplitude 1 G at 22.29 to 150 Hz
	Shock: • EN 60068-2-27	Storage and shipping: maximum 4 G, 11 ms (in package)
	Overvoltage	Overvoltage Category III
	Pollution degree	Pollution Degree 2
	Enclosure class	IP00/ UL Open Type
	Immunity	Fulfills IEC/EN 61800-3 (2004) + A1 (2012), first and second environment
	MTBF	FR7: 20,857 hours FR8: 10,429 hours
	Noise	FR7/FR8: 75 dB
Standards	Safety	UL 508C, CSA C22.2 No. 274-13 and EN 61800-5-1
	EMC	EMC (at default settings) Immunity (EMS): IEC/EN 61800-3, 2nd environment Radiated and Conducted emissions (EMI): IEC/EN 61800-3 480 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
	Electrostatic discharge	Second environment, IEC 61000-4-2, 4 kV CD or 8 kV AD, Criterion B
	Fast transient burst	Second environment, IEC 61000-4-4, 2 kV/5 kHz, Criterion B
	Approvals	CE, UL and cUL, RoHS (see nameplate for more detailed approvals)
Fieldbus connections		Onboard: EtherNet/IP, Modbus® TCP, Modbus RTU, BACnet
Safety/protections	Overvoltage protection	Yes, depends on mains voltage (0.8775 x mains voltage)
	Overvoltage trip limit	480 V drives: 911 V 600 V drives: 1094 V
	Undervoltage protection	Yes, depends on mains voltage (0.8775 x mains voltage)
	Undervoltage trip limit	480 V drives: 370 V 600 V drives: 550 V
	Earth fault protection	Yes, default shall be 20% of rated I_H in 1 s and 40% of rated I_H in 10 ms 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, the motor overload protection activates at 110% of the full load current
	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 (differential mode 2 kV; common mode 4 kV 480 V drives: 320 Vac, 3000 A 600 V drives: 385 Vac, 3000 A
	Common coated boards	Yes (prevents corrosion)
	RTC battery	3.6V Lithium Battery (Able ER14250) ROHS compliant Follow local recycling program to dispose. 10,000 hour life *Only active when power removed
Efficiency	Drive efficiency ratings	Efficiency ratings shall be at least 97% for all frame sizes and voltage levels

Appendix B—Installation guidelines

Cable and fuse sizing

Table 23. North American cable and fuse sizes—380 Vac to 500 Vac ratings

Frame size	Amp suffix	460 V input current (CT/I_H)	460 V input current (VT/I_L)	Current (CT/I_H) at 50 °C	Current (VT/I_L) at 40 °C	Recommended fuse rating	NEC wire size (AWG) Line and motor	Terminal connection size (AWG) Line and motor bolt size	Ground bolt size
FR7	0130	311	385	310	385	500	2x250 kcmil	1 AWG–350 kcmil	1 AWG–350 kcmil
	0385	391	460	385	460	600	2x350 kcmil	1 AWG–350 kcmil	1 AWG–350 kcmil
	0460	459	520	460	520	700	3x4/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0520	515	590	520	590	800	3x250 kcmil	1 AWG–350 kcmil	1 AWG–350 kcmil
FR8	0590	587	648	590	650	2x400	4x4/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0650	642	724	650	730	2x500	4x300	1 AWG–350 kcmil	1 AWG–350 kcmil
	0730	731	822	730	820	2x600	4x350	1 AWG–350 kcmil	1 AWG–350 kcmil
	0820	815	916	820	920	2x600	6x4/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0920	908	1030	920	1040	2x600	6x250	1 AWG–350 kcmil	1 AWG–350 kcmil
	1040	908	1164	1050	1180	2x700	6x300	1 AWG–350 kcmil	1 AWG–350 kcmil

Notes: ① Line and motor cable size is selected according to UL 508C Table 40.3 for copper conductor rated 75 °C. Use only with copper wire rated 75 °C here. Size requirements for other different wire types are defined in the National Electrical Code, ANSI/NFPA 70.

② Earthing conductor size is determined by the maximum overcurrent device rating used ahead of the drive according to UL 508C Table 6.4.

③ If power cubes or bypass are used, a UL listed Class J, T, or equivalent fuse is recommended.

Table 24. International cable and fuse sizes—380 Vac to 500 Vac ratings

Frame size	Amp suffix	Input current (CT/I_H)	Input current (VT/I_L)	Current (CT/I_H) at 50 °C	Current (VT/I_L) at 40 °C	Recommended fuse rating	Line and motor	Line and motor bolt size	Ground bolt size
FR7	0385	311	385	310	385	400	2x(3x120+70)(Cu) 2x(3x185+57)(Al)	M12	M8
	0460	391	460	385	460	500	2x(3x185+95)(Cu) 2x(3x240+572)(Al)	M12	M8
	0520	459	520	460	520	630	2x(3x185+95)(Cu) 2x(3x150+41)(Al)	M12	M8
	0590	515	590	520	590	630	2x(3x240+120)(Cu) 2x(3x185+57)(Al)	M12	M8
FR8	0650	587	648	590	650	2x355	4x(3x95+50)(Cu) 4x(3x120+41)(Al)	M12	M8
	0730	642	724	650	730	2x400	4x(3x95+50)(Cu) 4x(3x150+41)(Al)	M12	M8
	0820	731	822	730	820	2x500	4x(3x120+70)(Cu) 4x(3x185+57)(Al	M12	M8
	920	815	916	820	920	2x500	4x(3x150+70)(Cu) 4x(3x240+72)(Al)	M12	M8
	1040	908	1030	920	1040	2x630	4x(3x185+95)(Cu) 6x(3x150+41)(Al)	M12	M8
	1180	908	1164	1040	1180	2x630	4x(3x240+120)(Cu) 6x(3x185 +57)(Al)	M12	M8

Notes: ① Line and motor cable size is selected according to IEC 60364–5–52:2009 Table B.52.4 for copper conductor with PVC insulation with a wiring condition of ambient temperature 30 °C in air and an installation method of "B2" (cables in conduit and cable trunking systems). For other wiring conditions, please refer to the standard of IEC 60364–5–52:2009 for suitable cable sizes.

② Earthing conductor size is determined by the cross–sectional area of phase conductors according to IEC/EN61800–5–1:2007 Table 5. So if phase conductor size is changed, earthing conductor size should also be changed accordingly.

③ If power cubes or bypass are used, a Class gG/gL fuse is recommended.

Table 25. North American cable and fuse sizes—525 Vac to 690 Vac ratings

Frame size	Amp suffix	690 V input current (CT/I_H)	690 V input current (VT/I_L)	Current (CT/I_H) at 50 °C	Current (VT/I_L) at 40 °C	Recommended fuse rating	NEC wire size (AWG) Line and motor	Terminal connection size (AWG) Line, DC bus and motor bolt size	Ground bolt size
FR7	0261	223	272	208	261	500	2x250 kcmil	1 AWG–350 kcmil	1 AWG–350 kcmil
	0325	269	330	261	325	600	2x350 kcmil	1 AWG–350 kcmil	1 AWG–350 kcmil
	0385	327	385	325	385	700	3x4/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0416	382	415	385	416	800	3x250 kcmil	1 AWG–350 kcmil	1 AWG–350 kcmil
FR8	0460	433	477	416	460	2x400	4x4/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0520	472	532	460	520	2x500	4x300	1 AWG–350 kcmil	1 AWG–350 kcmil
	0590	527	597	520	590	2x600	4x350	1 AWG–350 kcmil	1 AWG–350 kcmil
	0650	591	653	590	650	2x600	6x4/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0750	646	747	650	750	2x600	6x250	1 AWG–350 kcmil	1 AWG–350 kcmil
	0820	739	813	650	820	2x700	6x300	1 AWG–350 kcmil	1 AWG–350 kcmil

Notes: ① Line and motor cable size is selected according to UL 508C Table 40.3 for copper conductor rated 75 °C. Use only with copper wire rated 75 °C here. Size requirements for other different wire types are defined in the National Electrical Code, ANSI/NFPA 70.
② Earthing conductor size is determined by the maximum overcurrent device rating used ahead of the drive according to UL 508C Table 6.4.
③ If power cubes or bypass are used, a UL listed Class J, T, or equivalent fuse is recommended.

Table 26. International cable and fuse sizes—525 Vac to 600 Vac ratings

Frame size	Amp suffix	Input current (CT/I_H)	Input current (VT/I_L)	Current (CT/I_H) at 50 °C	Current (VT/I_L) at 40 °C	Recommended fuse rating	Line and motor	Line, DC bus and motor bolt size	Ground bolt size
FR7	0261	223	272	208	261	315	3x185+95 2x(3x95+29)	M12	M8
	0325	269	330	261	325	355	3x240+120 2x(3x120+41)	M12	M8
	0385	327	386	325	385	400	2x(3x120+70) 2x(3x185+57)	M12	M8
	0416	382	415	385	416	450	2x(3x120+70) 2x(3x185+57)	M12	M8
FR8	0460	433	477	416	460	2x315	2x(3x150+70) 2x(3x240+72)	M12	M8
	0520	472	532	460	520	2x315	2x(3x185+95) 4x(3x95+29)	M12	M8
	0590	527	597	520	590	2x315	4x(3x70+35) 4x(3x120+41)	M12	M8
	0650	591	653	590	650	2x355	4x(3x95+50) 4x(3x150+41)	M12	M8
	0750	646	747	650	750	2x400	4x(3x120+70) 4x(3x150+41)	M12	M8
	0820	739	813	750	820	2x425	4x(3x120+70) 4x(3x185+57)	M12	M8

Notes: ① Line and motor cable size is selected according to IEC 60364–5–52:2009 Table B.52.4 for copper conductor with PVC insulation with a wiring condition of ambient temperature 30 °C in air and an installation method of "B2" (cables in conduit and cable trunking systems). For other wiring conditions, please refer to the standard of IEC 60364–5–52:2009 for suitable cable sizes.
② Earthing conductor size is determined by the cross–sectional area of phase conductors according to IEC/EN 61800–5–1:2007 Table 5. So if phase conductor size is changed, earthing conductor size should also be changed accordingly.
③ If power cubes or bypass are used, a Class gG/gL fuse is recommended.

Table 27. Drive fuses, 380–500 V, Mersen

Enclosure size	Type	IL [A]	Fuse catalog number	Fuse rating [A]	Number of fuses needed	Fuse size	Minimum prospective short circuit current
FR7	0385	385	**NH2UD69V700PV**	700	3	2	5700
	0460	460	**NH3UD69V900PV**	900	3	3	7000
	0520	520	**NH3UD69V1000PV**	1000	3	3	8600
	0590	590	**PC73UD90V10CPA**	1000	3	3	13000
FR8	0650	650	**NH2UD69V630PV**	630	6	2	5000
	0730	730	**NH2UD69V700PV**	700	6	2	5700
	0820	820	**NH3UD69V900PV**	900	6	3	7000
	0920	920	**NH3UD69V1000PV**	1000	6	3	8600
	1040	1040	**NH3UD69V1000PV**	1000	6	3	8600
	1180	1180	**PC73UD90V10CPA**	1000	6	3	13000

Table 28. Drive fuses, 525–600 V, Mersen

Enclosure size	Type	IL [A]	Fuse catalog number	Fuse rating [A]	Number of fuses needed	Fuse size	Minimum prospective short circuit current
FR7	0261	261	**NH2UD69V400PV**	400	3	2	2800
	0325	325	**NH2UD69V500PV**	500	3	2	3300
	0385	385	**NH2UD69V630PV**	630	3	2	5000
	0416	416	**NH3UD69V900PV**	900	3	3	7100
FR8	0460	460	**NH2UD69V400PV**	400	6	2	2400
	0520	520	**NH2UD69V450PV**	450	6	2	2800
	0590	590	**NH2UD69V500PV**	500	6	2	3300
	0650	650	**NH2UD69V550PV**	550	6	3	4000
	0750	750	**NH2UD69V630PV**	630	6	2	5000
	0820	820	**NH3UD69V900PV**	900	6	3	7100

Table 29. Drive fuses, 380–500 V, Bussmann

Enclosure size	Type	IL [A]	Fuse catalog number	Fuse rating [A]	Number of fuses needed	Fuse size	Minimum prospective short circuit current
FR7	0385	385	**170M5814D**	800	3	2	5750
	0460	460	**170M6814D**	1000	3	3	7500
	0520	520	**170M6892D**	1100	3	3	8500
	0590	590	**170M8554D**	1250	3	3	10500
FR8	0650	650	**170M5814D**	800	6	2	5750
	0730	730	**170M5814D**	800	6	2	5750
	0820	820	**170M6813D**	900	6	3	6000
	0920	920	**170M6814D**	1000	6	3	7500
	1040	1040	**170M6892D**	1100	6	3	8500
	1180	1180	**170M8554D**	1250	6	3	10500

Table 30. Drive fuses, 525–600 V, Bussmann

Enclosure size	Type	IL [A]	Fuse catalog number	Fuse rating [A]	Number of fuses needed	Fuse size	Minimum prospective short circuit current
FR7	0261	261	**170M5811D**	550	3	2	3400
	0325	325	**170M5813D**	700	3	2	4800
	0385	385	**170M5814D**	800	3	2	5750
	0416	416	**170M6814D**	1000	3	3	7500
FR8	0460	460	**170M5811D**	550	6	2	3400
	0520	520	**170M5812D**	630	6	2	4000
	0590	590	**170M5813D**	700	6	2	4800
	0650	650	**170M5813D**	700	6	2	4800
	0750	750	**170M5814D**	800	6	2	5750
	0820	820	**170M6813D**	900	6	3	6000

Table 31. Drive fuses in North America, 380–500 V, Mersen

Enclosure size	Type	IL [A]	Fuse catalog number	Fuse rating [A]	Number of fuses needed	Fuse size	Minimum prospective short circuit current
FR7	0385	385	**PC32UD69V630TF**	630	3	32	4700
	0460	460	**PC32UD69V700TF**	700	3	32	5700
	0520	520	**PC32UD69V900TF**	900	3	32	8200
	0590	590	**PC32UD69V1000TF**	1000	3	32	9600
FR8	0650	650	**PC32UD69V630TF**	630	6	32	4700
	0730	730	**PC32UD69V630TF**	630	6	32	4700
	0820	820	**PC32UD69V700TF**	700	6	32	5700
	0920	920	**PC32UD69V800TF**	800	6	32	6800
	1040	1040	**PC32UD69V900TF**	900	6	32	8200
	1180	1180	**PC32UD69V1000TF**	1000	6	32	9600

Table 32. Drive fuses in North America, 525–600 V, Mersen

Enclosure size	Type	IL [A]	Fuse catalog number	Fuse rating [A]	Number of fuses needed	Fuse size	Minimum prospective short circuit current
FR7	0261	261	**PC32UD69V450TF**	450	3	32	3000
	0325	325	**PC32UD69V500TF**	500	3	32	3400
	0385	385	**PC32UD69V630TF**	630	3	32	4700
	0416	416	**PC32UD69V700TF**	700	3	32	5700
FR8	0460	460	**PC32UD69V450TF**	450	6	32	3000
	0520	520	**PC32UD69V450TF**	450	6	32	3000
	0590	590	**PC32UD69V500TF**	500	6	32	3400
	0650	650	**PC32UD69V550TF**	550	6	32	3900
	0750	750	**PC32UD69V630TF**	630	6	32	4700
	0820	820	**PC32UD69V700TF**	700	6	32	5700

Temperature deratings

When using the PowerXL FR7 and FR8 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.

IL current: –10 °C (no frost)...+40 °C

IH current: –10 °C (no frost)...+40 °C

Maximum operating temperature: (up to) +50 °C with derating (1.5%/1 °C)

Heat loss data

Table 33. 400 V, 50 Hz heat loss data

Frame size	VT/I_L (110%) Pv (W)	CT/I_H (150%) Pv (W)	Standby Pv (W)	Catalog number
FR7	5465	—	108	**DG1-34310FN-C00C**
	5465	—	108	**DG1-34385FN-C00C**
	7528	—	108	**DG1-34460FN-C00C**
	7528	—	108	**DG1-34520FN-C00C**
FR8	8076	—	215	**DG1-34590FN-C00C**
	9755	—	215	**DG1-34650FN-C00C**
	11316	—	215	**DG1-34730FN-C00C**
	13190	—	215	**DG1-34820FN-C00C**
	15638	—	215	**DG1-34920FN-C00C**
	18776	—	215	**DG1-341K0FN-C00C**

Table 34. 600 V, 60 Hz heat loss data

Frame size	600 V, 60 Hz VT/I_L (110%) Pv (W)	CT/I_H (150%) Pv (W)	Standby Pv (W)	Catalog number
FR7	5402	—	146	**DG1-35261FN-C00C**
	6781	—	146	**DG1-35325FN-C00C**
	7570	—	146	**DG1-35385FN-C00C**
FR8	7703	—	291	**DG1-35416FN-C00C**
	8932	—	291	**DG1-35460FN-C00C**
	10486	—	291	**DG1-35520FN-C00C**
	11929	—	291	**DG1-35590FN-C00C**
	14574	—	291	**DG1-35650FN-C00C**
	16617	—	291	**DG1-35820FN-C00C**

Table 35. 480 V idle heat loss FR1~FR6

	Heat loss (W)			
	IP54 version		IP21 version	
	Fans start	Fans stop	Fans start	Fans stop
FR1	20.49	17.33	17.56	15.1
FR2	29.76	19.5	24.89	15.75
FR3	46.63	24.12	46.63	24.12
FR4	79.67	24.42	79.67	24.42
FR5	102.83	30.74	102.83	30.74
FR6	305.9	62.45	305.9	62.45

Table 36. 575 V idle heat loss FR1~FR6

	Heat loss (W)			
	IP54 version		IP21 version	
	Fans start	Fans stop	Fans start	Fans stop
FR1	22.2	18.96	20.97	18.08
FR2	33.56	23.19	32.09	20.96
FR3	52.96	26.41	52.96	26.41
FR4	84.42	24.65	84.42	24.65
FR5	97.37	27.23	97.37	27.23
FR6	317.63	84.3	317.63	84.3

Brake resistor sizing data

Table 37. Recommended brake resistor types and calculated resistance of the drive, 380–500 V

Enclosure size	Duty cycle		Minimum resistance [Ω]	Brake power @ 845 Vdc
FR7	Light duty	BRR 0520 LD 5	1.4	400
	Heavy duty	BRR 0520 HD 5		
FR8	Light duty	BRR 0520 LD 5	2 x 1.4 ①	800
	Heavy duty	BRR 0520 HD 5		

Note: ① FR8 must have 2 brake resistors.

Table 38. Brake resistor cables, 380–500 V

Enclosure size	Type	IL [A]	Brake resistor cable (Cu) [mm²]	Brake resistor cable (Cu) [AWG/ kcmil]
FR7	0385	385	2x(3x95+50)	2x4/0
	0460	460		
	0520	520	2x(3x120+70)	2x250
	0590	590		
FR8	0650	650	4x(3x95+50)	4x4/0
	0730	730		
	0820	820		
	0920	920		
	1040	1040	4x(3x120+70)	4x250
	1180	1180		

Note: One of the cable conductors stays unconnected. Use a symmetrically shielded cable, same type as the mains and motor cables.

Table 39. Recommended brake resistor types and calculated resistance of the drive, 525–600 V

Enclosure size	Duty cycle	Type of brake resistor	Resistance [Ω]	Minimum resistance [Ω]	Brake power @ 1014 Vdc
FR7	Light duty	Light duty	BRR 0416 LD 6	2.5	335
	Heavy duty	Heavy duty	BRR 0416 HD 6		
FR8	Light duty	Light duty	BRR 0416 LD 6	2 x 2.5 ①	597
	Heavy duty	Heavy duty	BRR 0416 HD 6		

Note: ① FR8 must have 2 brake resistors.

Table 40. Brake resistor cables, 525–600 V

Enclosure size	Type	IL [A]	Brake resistor cable (Cu) [mm²]	Brake resistor cable (Cu) [AWG/ kcmil]
FR7	0261	261	2x(3x70+35)	2x4/0
	0325	325		
	0385	385	2x(3x95+50)	2x250
	0416	416		
FR8	0460	460	4x(3x70+35)	4x4/0
	0520	520		
	0590	590		
	0650	650		
	0750	750	4x(3x95+50)	4x250
	0820	820		

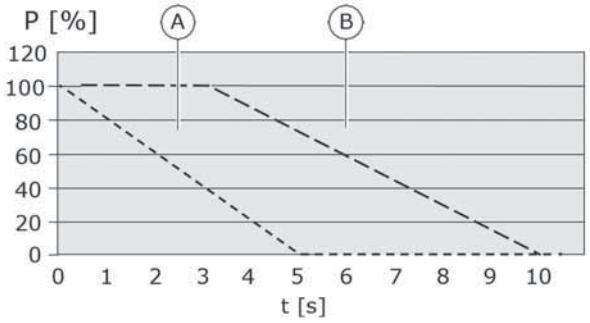
Notes: One of the cable conductors stays unconnected. Use a symmetrically shielded cable, same type as the mains and motor cables.

Brake chopper

Enclosure size FR8 includes 2 power units, each of which has a brake chopper.
Brake choppers must have their own brake resistors.

- Light duty cycle is for brake resistor cyclic use (1 LD pulse in a 120-second period).
  Light duty resistor is rated for a 5-second ramp from full power to 0.
- Heavy duty cycle is for brake resistor cyclic use (1 HD pulse in a 120-second period).
  Heavy duty resistor is rated for a 3-second full power braking with a 7-second ramp to 0.

Figure 39. LD and HD pulses



A. Light duty

B. Heavy duty

Efficiency ratings

Table 41. 400 V FR7—450 hp efficiency rating

	25% Current			50% Current			100% Current		
	Relative Loss (%)	Absolute Loss (W)	Efficiency (%)	Relative Loss (%)	Absolute Loss (W)	Efficiency (%)	Relative Loss (%)	Absolute Loss (W)	Efficiency (%)
10% Speed	0.45	1,849	82.9	0.7	2,880	86.1	1.38	5,632	86.3
50% Speed	0.54	2,201	95.3	0.78	3,209	96.5	1.57	6,418	96.5
90% Speed	—	—	—	0.88	3,616	97.8	1.84	7,528	97.7
100% Speed	—	—	—	0.88	3,616	98	1.84	7,528	97.9

Table 42. 400 V FR8—800 hp efficiency rating

	25% Current			50% Current			100% Current		
	Relative Loss (%)	Absolute Loss (W)	Efficiency (%)	Relative Loss (%)	Absolute Loss (W)	Efficiency (%)	Relative Loss (%)	Absolute Loss (W)	Efficiency (%)
10% Speed	0.57	4,661	79.3	0.85	6,922	83.8	1.83	14,971	82.6
50% Speed	0.61	4,965	94.7	0.93	7,581	95.9	2.02	16,551	95.6
90% Speed	—	—	—	1.03	8,397	97.5	2.3	18,776	97.2
100% Speed	—	—	—	1.03	8,397	97.7	2.3	18,776	97.4

Table 43. 600 V FR7—300 hp efficiency rating

	25% Current			50% Current			100% Current		
	Relative Loss (%)	Absolute Loss (W)	Efficiency (%)	Relative Loss (%)	Absolute Loss (W)	Efficiency (%)	Relative Loss (%)	Absolute Loss (W)	Efficiency (%)
10% Speed	0.44	2,177	83.3	0.63	3,147	87.3	1.34	6,640	86.7
50% Speed	0.45	2,242	96	0.66	3,289	97.1	1.38	6,867	96.9
90% Speed	—	—	—	0.71	3,542	98.2	1.52	7,570	98.1
100% Speed	—	—	—	0.71	3,542	98.4	1.52	7,570	98.3

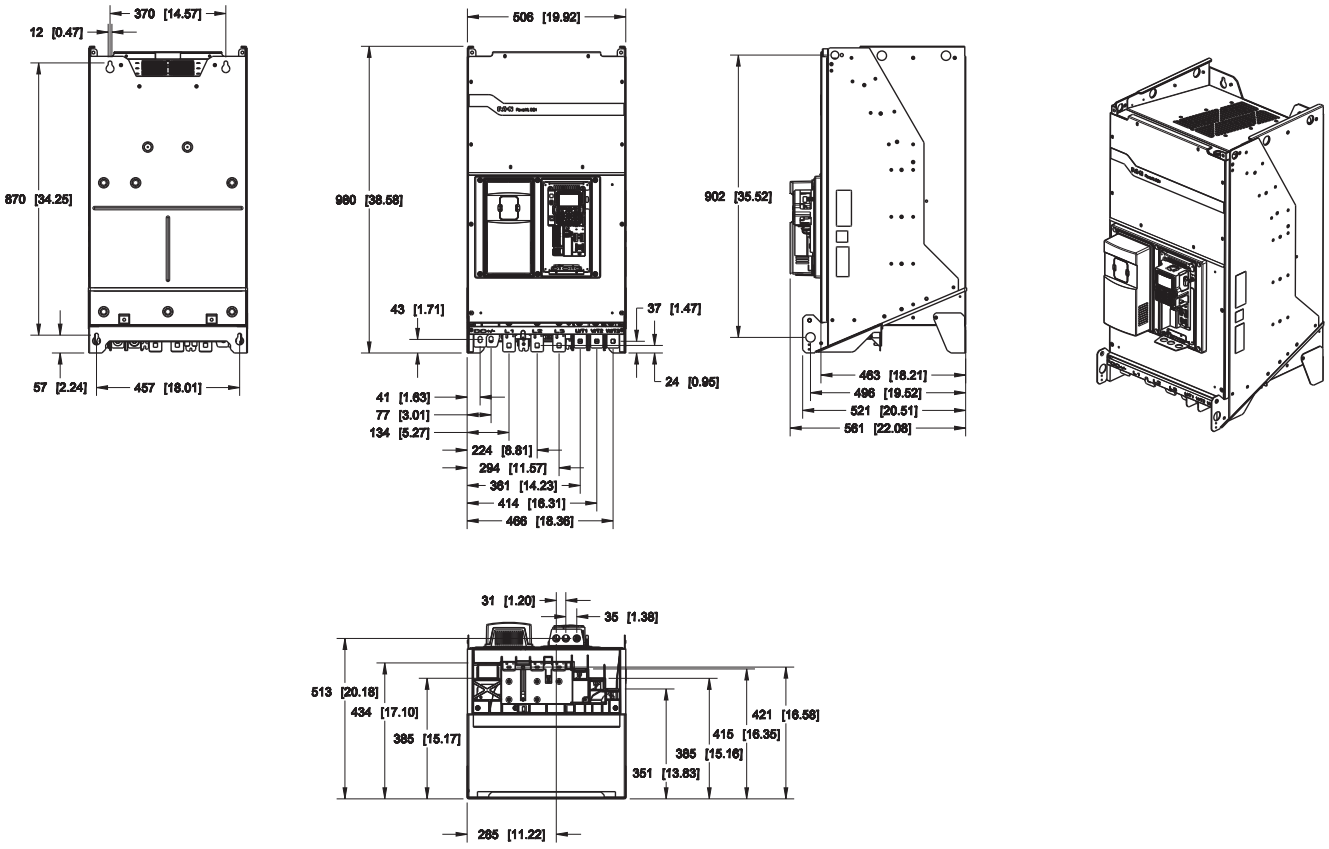
Table 44. 600 V FR8—650 hp efficiency rating

	25% Current			50% Current			100% Current		
	Relative Loss (%)	Absolute Loss (W)	Efficiency (%)	Relative Loss (%)	Absolute Loss (W)	Efficiency (%)	Relative Loss (%)	Absolute Loss (W)	Efficiency (%)
10% Speed	0.47	4,567	82.4	0.69	6,754	86.4	1.51	14,781	85.2
50% Speed	0.48	4,696	95.8	0.72	7,036	96.8	1.56	15,240	96.5
90% Speed	—	—	—	0.77	7,532	98.1	1.7	16,617	97.9
100% Speed	—	—	—	0.77	7,532	98.3	1.7	16,617	98.1

Appendix C—Dimension drawings

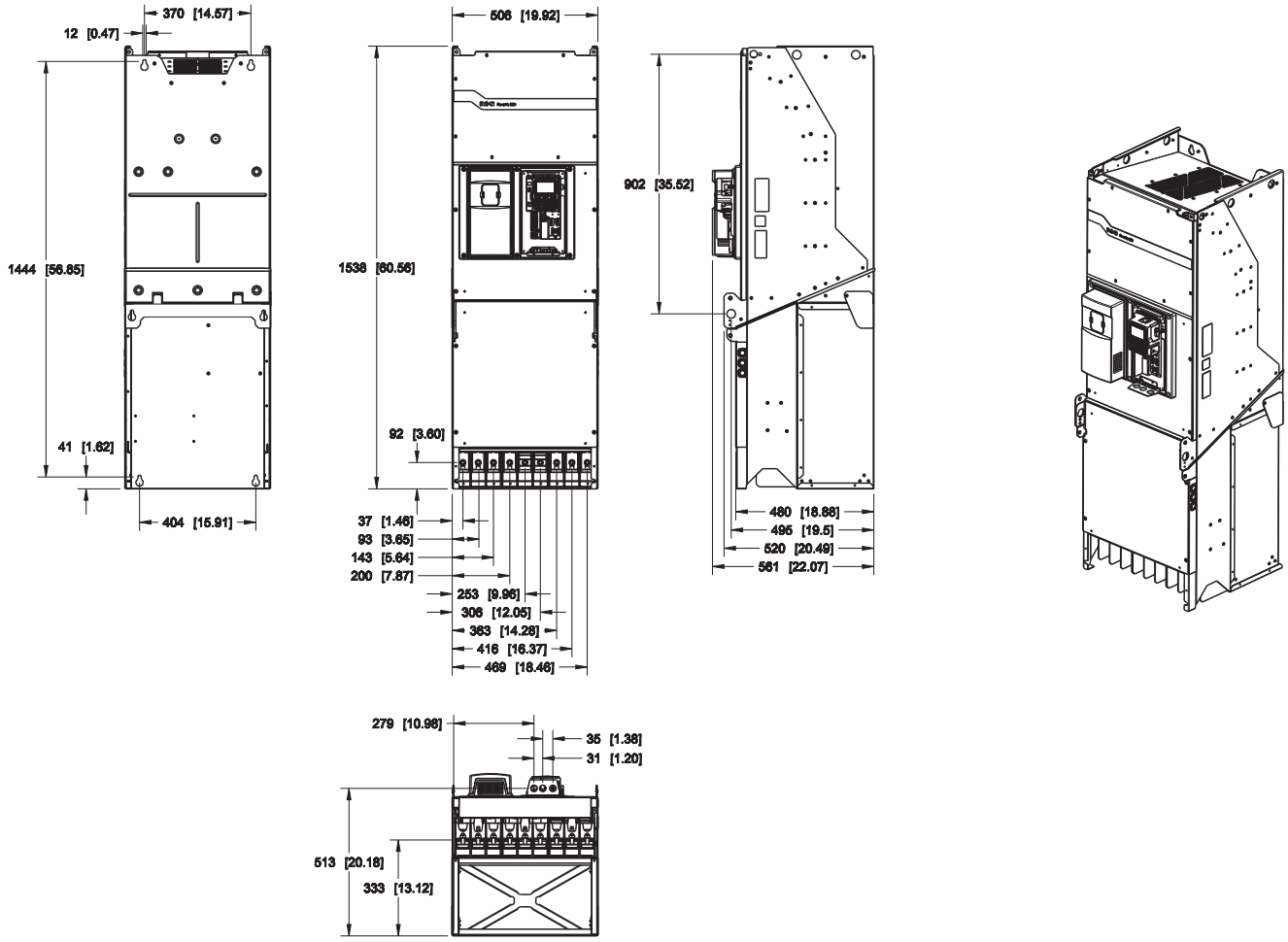
Approximate Dimensions in Inches (mm)

Figure 40. FR7 and FR8 Dimension drawing IP00 without chopper



Approximate Dimensions in Inches (mm)

Figure 41. FR7 and FR8 Dimension drawing IP00 with chopper



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 tested in accordance with UL 508C and CSA C22.2 No. 274-13 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 **Chapter 7**.

Overvoltage category

To comply with standard CSA C22.2 No. 274-13 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 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 MN040004EN—PowerXL FR7 and FR8 Application Manual for 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.

Tightening torques

Table 45. Tightening torques of the terminals, FR7 or FR8 without options module

Enclosure size	Tightening torque			
	Mains and motor cable terminals		Grounding terminals	
	[Nm]	in-lb	[Nm]	in-lb
FR7	55–70 ①	490–620 ①	20	177
FR8	55–70 ①	490–620 ①	20	177

Note: ① Counter torque is required.

Table 46. Tightening torques of the terminals, FR7 or FR8 with options module

Enclosure size	Tightening torque			
	Mains and motor cable terminals		Grounding terminals	
	[Nm]	in-lb	[Nm]	in-lb
FR7	55–70	490–620	20	177
FR8	55–70	490–620	20	177

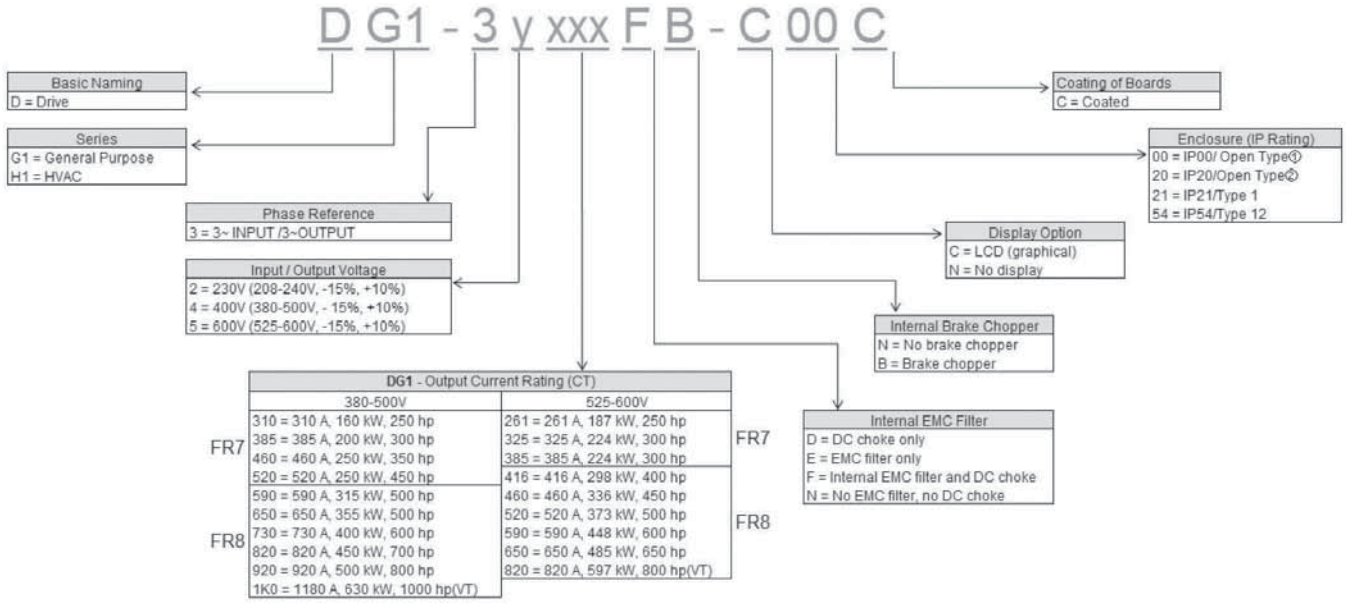
Appendix E—STO function

Description of safety function

Scope

This appendix covers the "Safe Torque Off (STO)" safety function for DG1 series AC drive FR7 and FR8, which include the catalog numbers of DG1-3yxxxFB-C00C and DG1-3yxxxFN-C00C shown as below.

Figure 42. Catalog number example



Safety function and safe state

Safety function

The STO function of DG1 series AC drive FR7 and FR8 is implemented by hardware and software. 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 1 / SIL CL 1 acc. to IEC 61800-5-2, IEC 61508 and IEC 62061, and up to Cat. 2 / PL c acc. to 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 demand.

Safe state

The safe state is the power supply of motor is switched off.

System response time

The time from the operator presses the emergency stop button to the motor power supply switched off is ≤ 20 ms.

Table 47. Safety related parameters

DG1 Series AC drive	FR7	FR8
Operation mode	High demand	High demand
Safety integrity level	SIL 1 / SIL CL 1	SIL 1 / SIL CL 1
Systematic capability	SC 1	SC 1
Safety architecture	1oo1	1oo1
Category	2	2
Performance Level	c	c
HFT	0	0
PFD_{AVG}	1.22E-04 (at PTI=20 years, 0.122% of SIL1)	1.27E-04 (at PTI=20 years, 0.127% of SIL1)
PFH	1.39E-09 (0.0139% of SIL1)	1.45E-09 (0.0145% of SIL1)
MTTFd	2534 years (High)	1088 years (High)
Proof Test Interval (PTI)	20 years	20 years
MRT	0 Hour	0 Hour
MTTR	0 Hour	0 Hour

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

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

- Failure rate of each component is based on the Siemens SN29500 data base
- Component failure rates are constant over the life of the device
- Operating at a maximum ambient temperature of 60 °C
- The equal distribution is used for the failure modes ratio of each component

INFORMATION

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

Safety architecture and reliability block diagram

Figure 43. Functional block diagram of FR7 and FR8

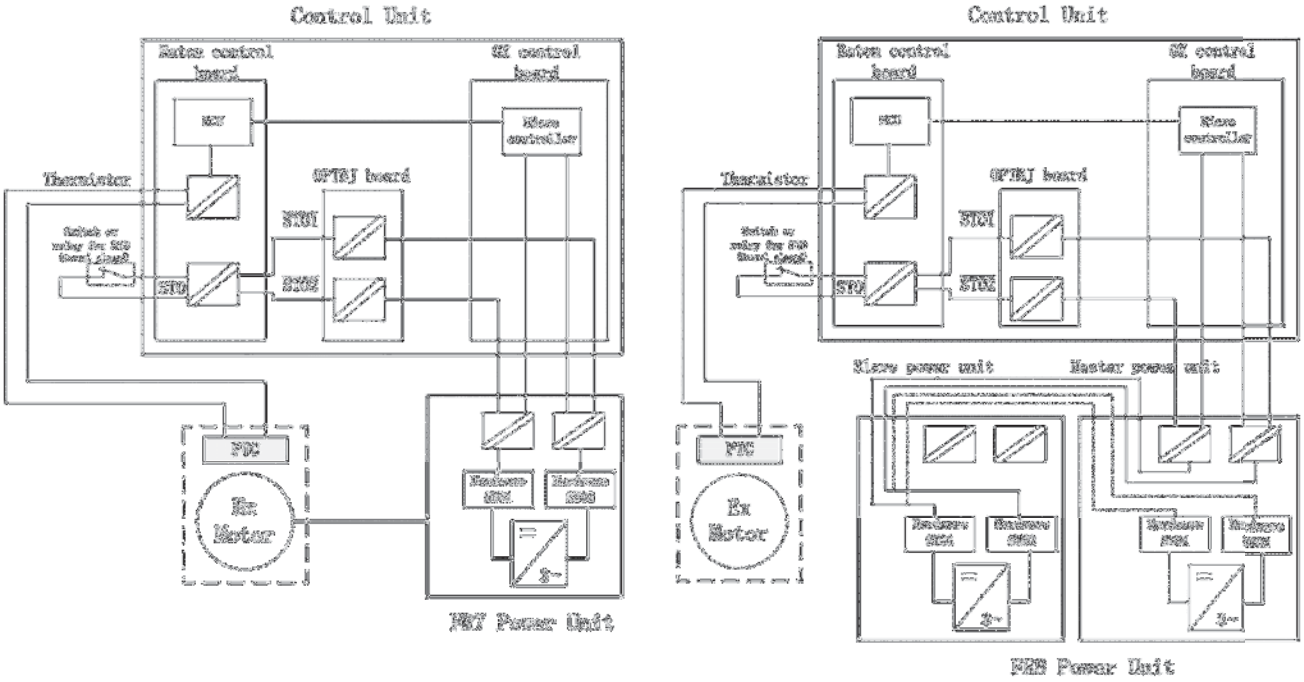


Figure 44. Reliability block diagram

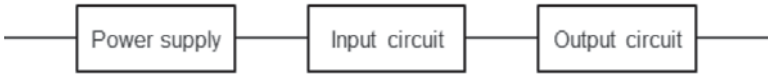


Table 48. Power supply and input/output

Supply	Description
Auxiliary power supply	480 V series: 300–900 Vdc
	575 V series: 450-–1100 Vdc
Overvoltage category	III
STO input signal voltage without demand	24 Vdc ±20%
STO input signal voltage when demand	< 0.55 Vdc

Table 49. Environmental and EMC conditions

Item	Description
Environmental	
Ambient operating temperature	–10 °C (no frost) to +40 °C, up to +50 °C with derating (CT) –10 °C (no frost) to +40 °C, up to +50 °C with derating (VT)
Storage temperature	–40 °C to 70 °C
Relative humidity	0–95% RH, noncondensing, non-corrosive
Air quality	Chemical vapors: IEC 60721-3-3, unit in operation, class 3C2; Mechanical particles: IEC 60721-3-3, unit in operation, class 3S2
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) Maximum altitudes: • 380–500 V: 4000 m (TN and IT systems) • 380–500 V: 2000 m (Corner-grounded network) • 525–600 V: 2000 m (TN and IT systems, no corner grounding)
Vibration	EN 61800-5-1, EN 60068-2-6; 5-150 Hz Displacement amplitude 0.5 mm (peak) at 5 to 22.29 Hz, Maximum acceleration amplitude 1G at 22.29 to 150 Hz
Shock	EN 60068-2-27 Storage and shipping: maximum 4 G, 11 ms (in package)
Enclosure Class	IP00 / UL Open Type
EMC	
Immunity (EMS)	IEC/EN 61800-3, 2nd environment IEC/EN 61326-3-1
Emissions (EMI)	IEC/EN 61800-3, Category C3, if the drive is correctly installed. The drive can be modified from Category C3 to C4 for IT networks and corner grounding TN system by removing the EMC jumper. The IP00 / UL Open Type drive has by default Category C4.

Applicable standards

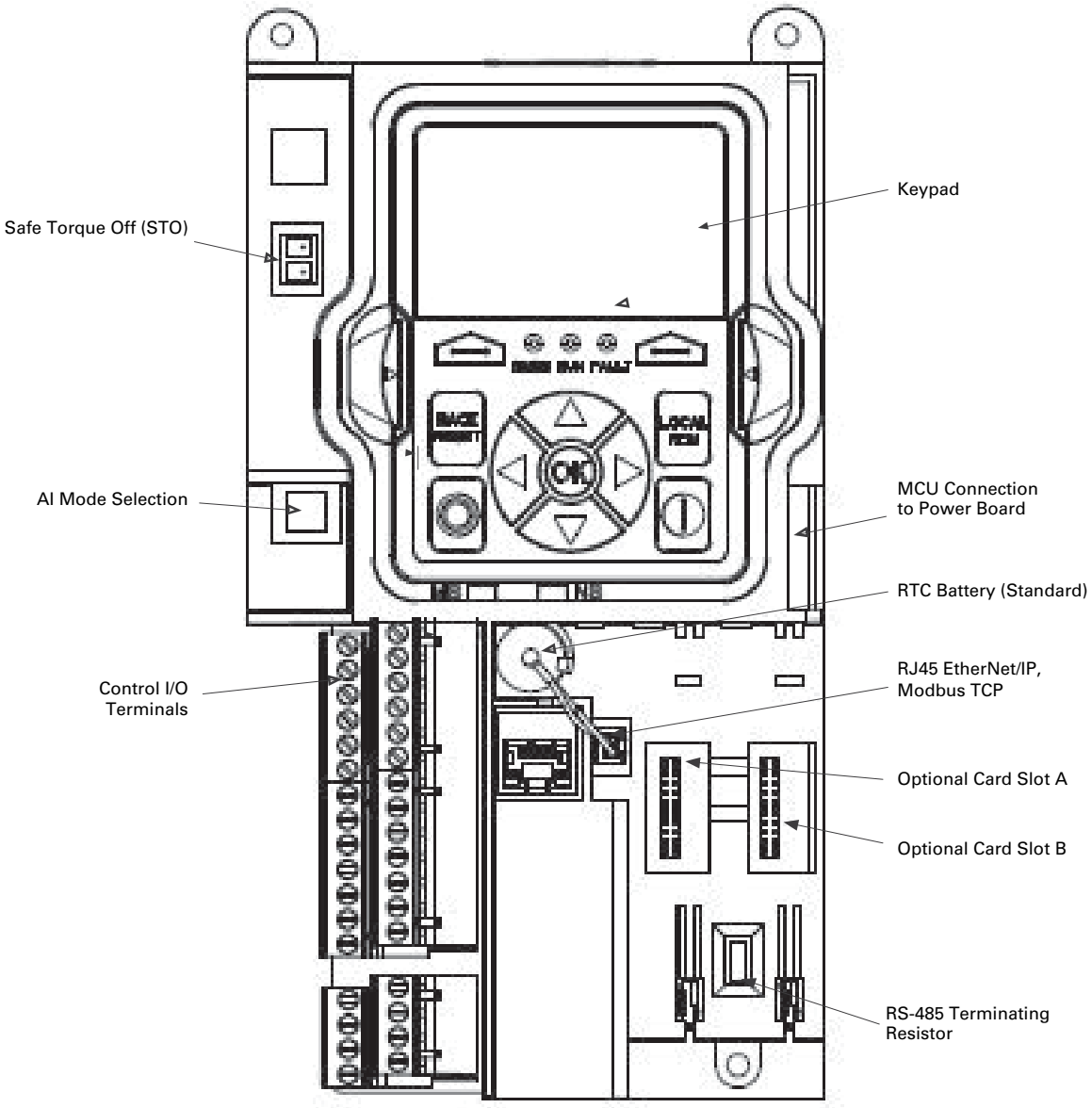
Table 50. Applicable standards

Standard
EN 61800-5-2:2007 Adjustable speed electrical power drive systems Part 5-2: Safety requirements – Functional
EN 61800-5-1:2007 (as far as applicable) Adjustable speed electrical power drive systems Part 5-1: Safety requirements – Electrical, thermal and energy
EN 61800-3:2004 + A1:2012 (as far as applicable) Adjustable speed electrical power drive systems Part 3: EMC requirements and specific test methods
EN ISO 13849-1:2008 + AC:2009 Safety of Machinery – Safety Related Parts of Control Systems Part 1: General principles for design
EN 62061:2005 + AC2010 + A1:2013 Safety of Machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems
IEC 61508 Parts 1-7:2010 Functional safety of electrical/electronic/programmable electronic safety-related systems
IEC 60204-1:2006 + A1:2009 + AC:2010 (in extracts) Safety of Machinery – Electrical Equipment of Machines Part 1: General Requirements
EN 61326-3-1:2008 Electrical equipment for measurement, control and laboratory use – EMC requirements Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications

Requirements for installation, commission, and maintenance

A two-pin terminal block in control board (STO in **Figure 45**) is used for customer to connect emergency stop switch, safety relay or PLC, and so on.

Figure 45. STO terminal block in DG1 control board



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.

Requirements for proof test

- This device must be subjected to a full test at least once every 20 years
- The STO function must be verified
- The system response time must be verified to check whether it is still ≤ 20 ms

Appendix F—UL certificate of compliance

UL certificate of compliance

Certificate Number: 20180316-134360

Report Reference: E134360-20180315

Issued to: Eaton Corp

In accordance with UL 61800-5-1, Standard for Power Conversion Equipment and CAN/CSA C22.2 No. 274-13, Adjustable Speed Drives. See UL report for additional details.

CE declaration of conformance

In accordance with the following standards:

2014/35/EU Low Voltage Directive

2014/30/EU EMC Directive

2011/65/EU RoHS Directive

based on compliance with European standard(s):

EN 61800-5-1:2007

EN 61800-3:2004 + A1:2012

EN 50581:2012

Visit www.eaton.com/dg1 > Documentation > Certifications for additional details.

Appendix G—Maintenance mains, FR7 and FR8

Maintenance intervals

To make sure that the drive operates correctly and has a long life, we recommend that you do regular maintenance. Refer to **Table 517**.

It is no necessary to replace the main capacitors of the drive, because they are a thin film type capacitor.

WARNING

Do not make changes in the AC drive when it is connected to mains. The components of the drive are live when the drive is connected to mains.

Table 51. Maintenance intervals and tasks

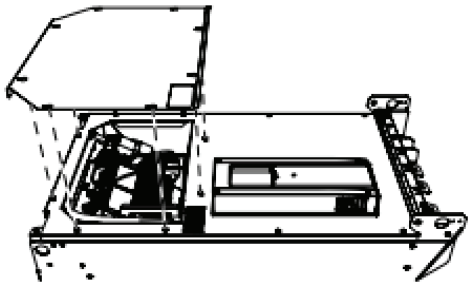
Maintenance interval	Maintenance task
Regularly	Check the tightening torques of the terminals. Check the filters.
6–24 months (The interval is different in different environments)	Check the mains and motor cable terminals and the control terminals. Make sure the cooling fan operates correctly. Make sure there is no corrosion on the terminals, the bus bars or other surfaces. Check the cabinet door filters. Check internal filter of the power unit.
24 months (The interval is different in different environments)	Clean the heatsink and the cooling tunnel.
6–10 years	Replace the main fan. Replace the internal fans (if unit has them). Replace the fan power supply.
10 years	Replace the RTC battery. (Battery is optional).

Replacing the fans in FR7 and FR8

Following are instructions for replacing the fans in the drives.

Replacing the main fan assembly, FR7 and FR8

1. Loosen the 8 screws and lift off the service lid.

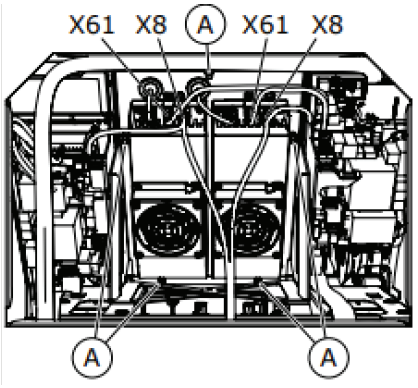


2. Disconnect the cables from each fan power supply.

   a) Disconnect the fan driver cable from connector X61.

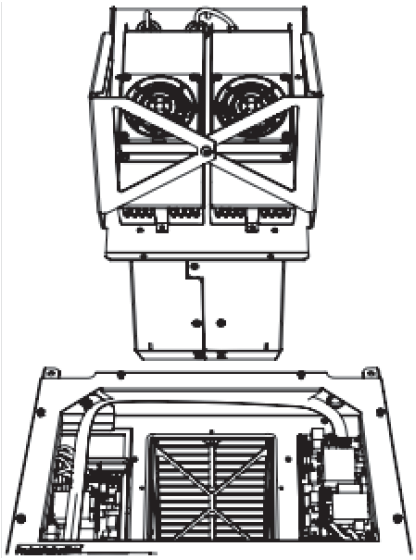
   b) Disconnect the DC supply cable from connector X8.

   Remove the 5 screws.



A. 5 screws

3. Pull out the whole fan assembly. The assembly weighs approximately 11 kg.



4. Replace the main fan assembly. Attach it with the screws.
5. Connect the cables and attach the service lid.

Replacing the fan power supplies, FR7 and FR8

You can replace only one or both of the power supplies.

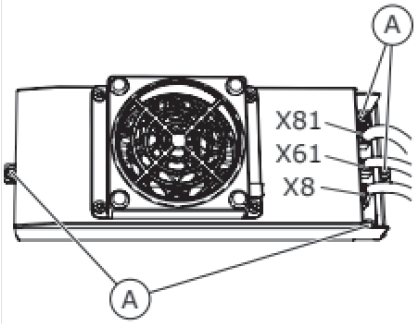
1. Remove the main fan assembly. See the previous instructions.
2. Disconnect the following.

   a) Disconnect the fan supply cable from connector X81.

   b) Disconnect the fan driver cable from connector X61.

   c) Disconnect the DC supply cable from connector X8.

   Remove the 4 screws from each supply.



A. 4 screws

3. Replace the fan power supplies.
4. Attach the screws, connect the cables, and re-assemble the drive.

Downloading the software

When it is necessary to get a new version of the software of the drive, obey these instructions. For more information, speak to the manufacturer.

Before you start to download the software, read these warnings and the warnings and cautions in **Chapter 2**.

WARNING

Do no touch the internal components or the circuit boards of the drive when the drive is connected to the mains. These components are live. A contact with this voltage is very dangerous.

WARNING

Do not make connections to or from the AC drive when it is connected to the mains. There is a dangerous voltage.

WARNING

To do work on the connections of the drive, disconnect the drive from the mains. Wait 5 minutes before you open the cabinet door or the cover of the drive. Then use a measuring device to make sure that there is no voltage. The connections of the drive are live 5 minutes after it is disconnected from the mains.

WARNING

Before you do electrical work, make sure that there is no voltage.

Downloading with mains, FR7 and FR8

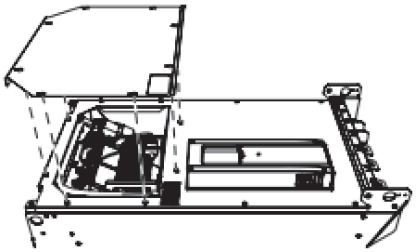
When the drive is supplied from mains, you can download a new software with the Eaton MaxLoad PC tool and a CAB-USB/RS-485 cable.

1. To download a new software, connect the PC into the control panel connector with the RS-485 cable.

Downloading without mains, FR7 and FR8

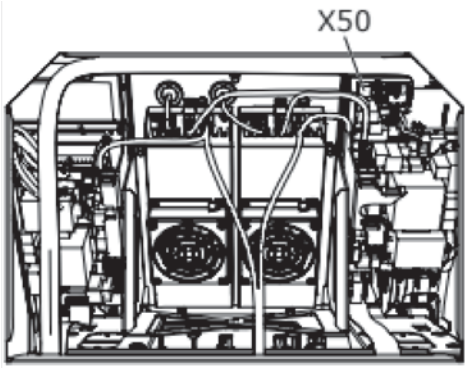
When the drive is not supplied from mains, use an external 24 Vdc power supply to do power-up to the control unit. In FR7, the external 24 Vdc does power up to the control unit, and in FR8, it does power up to the control unit and the measurement board(s). After the power-up, you can download the software.

1. Requirements for the 24 Vdc power supply:
   - A voltage accuracy ±10%
   - FR7: >2000 mA
   - FR8: >4000 mA



2. In FR7 and FR8, loosen the service lid screws and remove the lid.
   - In FR8, there are two power units. Complete steps 2 and 3 for the two power units.
3. In FR7 and FR8, connect an external 24 Vdc into the connector X50 on the measurement board. The connector pins are X50-22 (+) and X50-23 (–).
   - In FR8, connect the external 24 Vdc to the two X50 connectors

Note: The size of the power supply wire for the external 24 Vdc must be a minimum of 1 mm^2. The length of the wire from the 24 Vdc power supply to the X50 connectors and to the control unit connectors must be a maximum of 3 m (9.84 ft).



4. In all enclosure sizes, do power-up to the external 24 Vdc power supply.
5. Remove the control panel. Connect the PC to the control panel connector in the control unit with a CAB-USB/RS-485 cable.
6. Start the Eaton MaxLoader PC tool.
7. Start the software download.
8. After the downloading is complete, disconnect the PC and attach the control panel into the control unit.
9. Do power-down to the external 24 Vdc power supply.
10. In FR7 and FR8, remove the external 24 Vdc wires from the X50 connector of the measurement board. In FR8, there are two X50 connectors.
11. In FR7 and FR8, attach the service lid. In FR8, there are two service lids.
12. After the downloading procedure is complete, start the Startup Wizard (see Application Manual).

⚠ WARNING

Before you connect the drive to the mains, make sure that the front cover and the cable cover of the drive are closed. The connections of the AC drive are live when the drive is connected to the mains.

We make what matters work.*

* At Eaton, we believe that power is a fundamental part of just about everything people do. Technology, transportation, energy and infrastructure—these are things the world relies on every day. That's why Eaton is dedicated to helping our customers find new ways to manage electrical, hydraulic and mechanical power more efficiently, safely and sustainably. To improve people's lives, the communities where we live and work, and the planet our future generations depend upon. Because that's what really matters. And we're here to make sure it works.

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