**Variable Speed Drive Series III** Effective September 2018

# Communication manual


Johnson Controls

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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 24V 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 variable 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 variable 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.**

### ⚠ 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!**

### ⚠ CAUTION

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

### ⚠ CAUTION

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

**⚠ CAUTION**

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

**⚠ CAUTION**

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

**⚠ CAUTION**

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

**⚠ CAUTION**

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

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

**⚠ CAUTION**

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

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

**⚠ CAUTION**

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

**⚠ CAUTION**

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

**⚠ CAUTION**

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

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

**⚠ CAUTION**

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

**⚠ CAUTION**

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

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

**⚠ CAUTION**

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

- If the drive is to be used in a floating distribution network, remove screws at MOV and EMC
- 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.**

# 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.

## 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.**

## ⚠ 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 fabricar 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.

- Si l'entraînement doit être utilisé dans un réseau de distribution flottant, retirer les vis au niveau des VOM et CEM. Voir « Installation dans un réseau à une phase connectée à la terre (corner-grounded)
- 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

**Note:** 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.**

# Variable Speed Drive Series III Overview

This series overview describes the purpose and contents of this manual, the receiving inspection recommendations and the Variable Speed Drive Series III 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 Variable Speed Drive Series III 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 Variable Speed Drive Series III VFD. Keep this operating manual handy and distribute to all users, technicians and maintenance personnel for reference.

## Receiving and inspection

The Variable Speed Drive Series III 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 Variable Speed Drive Series III VFD, please check for the following:

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

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

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

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

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

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

**Note:** Do not destroy the packing. The template printed on the protective cardboard can be used for marking the mounting points of the Variable Speed Drive Series III VFD on the wall or in a cabinet.

## Real time clock battery activation

To activate the real time clock (RTC) functionality in the Variable Speed Drive Series III 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 (150%) |
| $I_L$ | Low Overload (110%) |
| RTC | Real Time Clock |
| VFD | Variable Frequency Drive |

## Rating label

**Figure 2. Rating label (VS3)**


## General information

The Variable Speed Drive Series III provides a wide selection of option boards to increase the number and type of control inputs and outputs (I/O) and communication interfaces to provide the versatility required for today's demanding motor control applications.

The input and output capability is designed with modularity in mind, comprised of option boards, each having its own input and output configuration. The control unit is designed to accept a total of two boards, the boards provide standard analog and digital inputs and outputs, fieldbus capability, and application specific hardware.

The basic, expander and adapter boards are installed in board slots, which are parts of the control board. The I/O boards are interchangeable between different members of the Variable Speed Drive Series III.

## Option Card Slots

The control board is located inside the control unit of the Variable Speed Drive Series III. There are two slots, labeled A and B, on the control board. The different option boards can be added to any slots. For more information, see "Variable Speed Drive Series III Option Board Summary." When the Variable Speed Drive Series III is assembled at the factory, no option boards are installed in slots A and B. If an incorrect board is plugged into either slot, the board will not work, but there is no danger to personal or for equipment damage.

**Figure 3. Variable Speed Drive Series III control board**

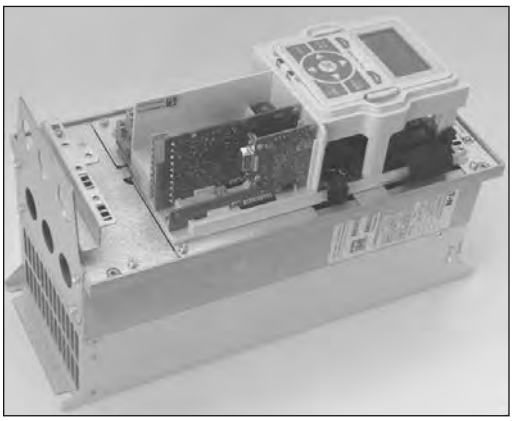
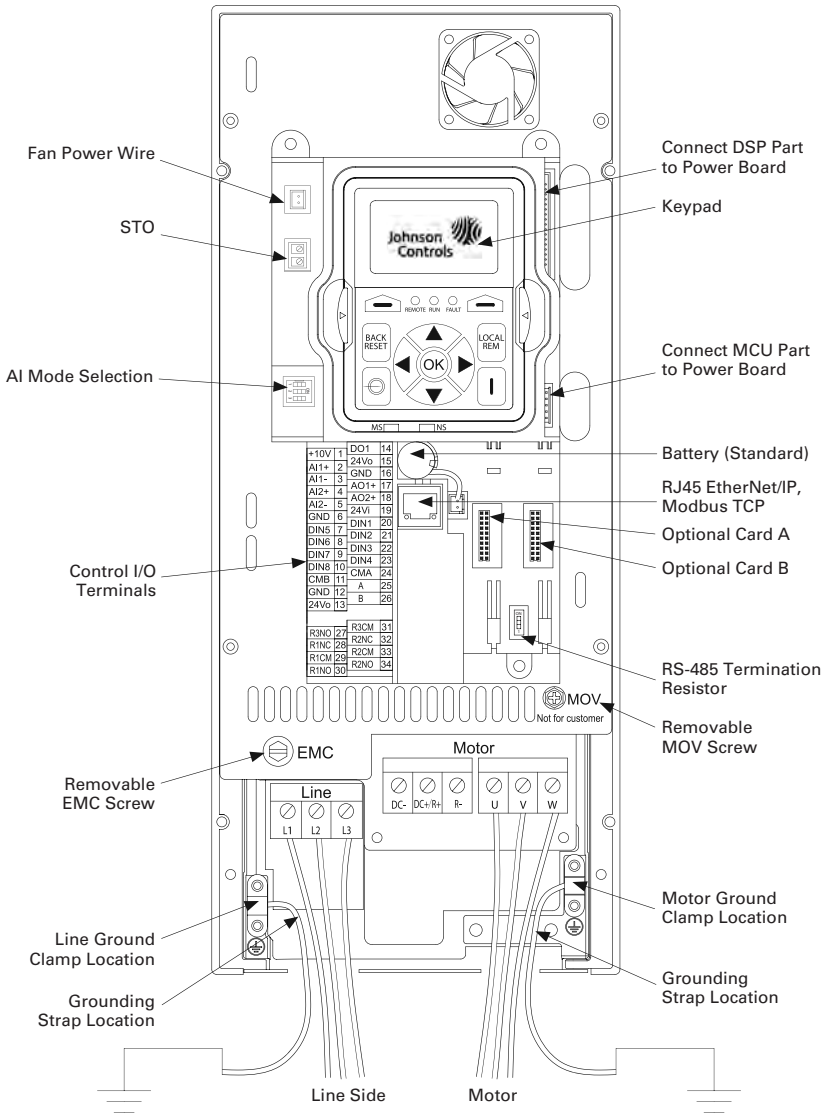


**Figure 4. Variable Speed Drive Series III control board location**

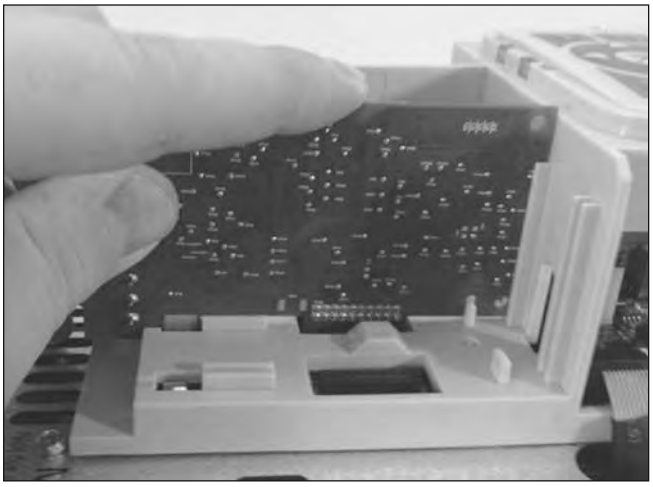


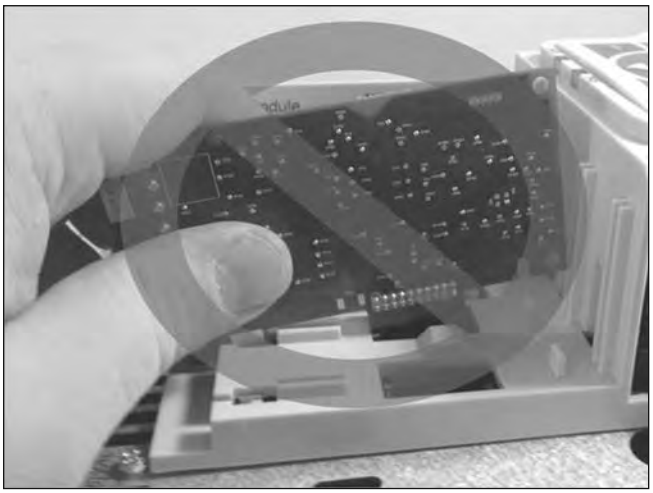
## Installing Variable Speed Drive Series III option board

Remove Utility line and control power from the drive. Install the option board in one of the slots available on the control board. To insert and remove the board, hold it in a horizontally straight position to avoid twisting the connector pins.

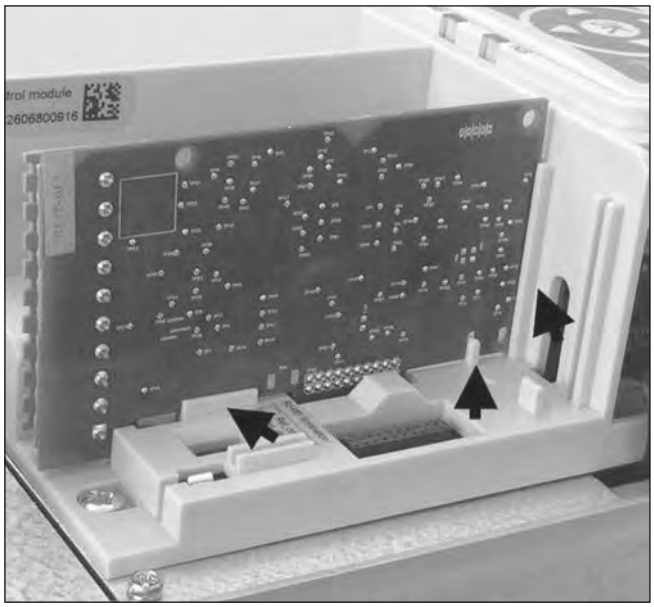
**⚠ CAUTION**

To prevent board damage, option cards and fieldbus boards must not be installed, removed or replaced while utility line or control power is applied to the drive.





Verify the board fits tightly in the metal clamp and plastic groove. If the board seems to be difficult to install in the slot, you should confirm that you are using one of the allowed slots for the option board.



**Note:** Check that the DIP switch settings on the board correspond to your need.

## Control wiring

Digital I/O and 24 Vdc can use Stranded Cu or Solid Cu wire as specified below. Analog signal PT100 must use shielded cables. **Table 2** shows the wire sizes available. I/O terminals allow for 5.00 mm connectors.

**Table 2. Wire sizes**

| Wire type | Wire size | Terminal torque |
|---|---|---|
| Solid Cu –90 °C | 12–28 AWG (0.2~2.5 $mm^2$) | 4.5 in-lb (0.5 Nm) |
| Stranded Cu –90 °C | 12–30 AWG (0.2~2.5 $mm^2$) | 4.5 in-lb (0.5 Nm) |

## EMC directive

For the electrical equipment installed in the EMC, directive states that the equipment must not disturb the environment and must be immune to other electromagnetic disturbances in the environment. **Table 3** indicates the requirements for the control wiring to meet this directive.

**Table 3. Control wiring requirements**

| Item | Directive |
|---|---|
| Product | IEC 61800-2 |
| Safety | UL 508C, IEC / EN 61800-5-1 |
| EMC (at default settings) | Immunity: EN / IEC 61800-3, 2nd environment |
| | Radiated emissions: EN / IEC 61800-3 (Transient Testing included), 1st environment |
| | Conducted emissions: EN / IEC 61800-3 |
| | Category C1: is possible with external filter connected to drive. Please consult factory |
| | Category C2: with internal filter maximum of 10m motor cable length (FR0: This is obtained with 2 turns on a ferrite core and using metal ground plate) |
| | Category C3: with internal filter maximum of 50m motor cable length (FR0: This is obtained with no ferrite core and metal plate) |

## Control cable grounding

It is recommended that the shielded cables be grounded as shown in **Figure 6**. Strip the cable insulation required allowing attachment to the frame with the grounding clamp.

**Figure 5. Control cable grounding**

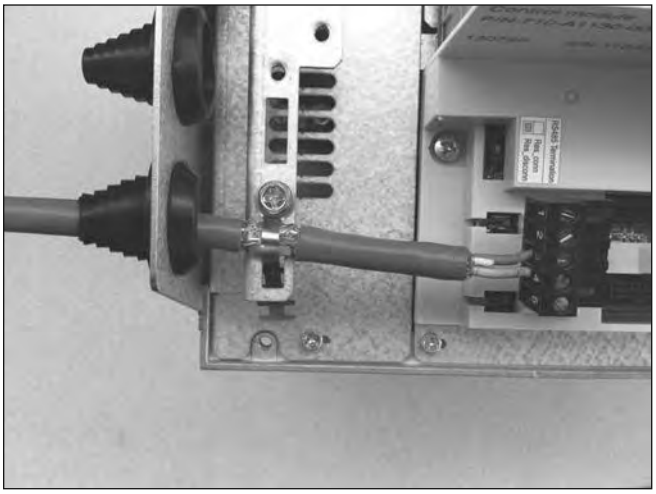


**Table 4. Variable Speed Drive Series III—option boards**

**DX H – NET – PROFB**

| Basic naming | Series | Type | Function |
|---|---|---|---|
| **DX** = Variable Speed Drive Series III | **G** = General purpose | **NET** = Communication card<br>**EXT** = I/O card<br>**ACC** = Accessory<br>**SPR** = Spare part<br>**KEY** = Keypad<br>**CBL** = Cable | **PROFB** = PROFIBUS |

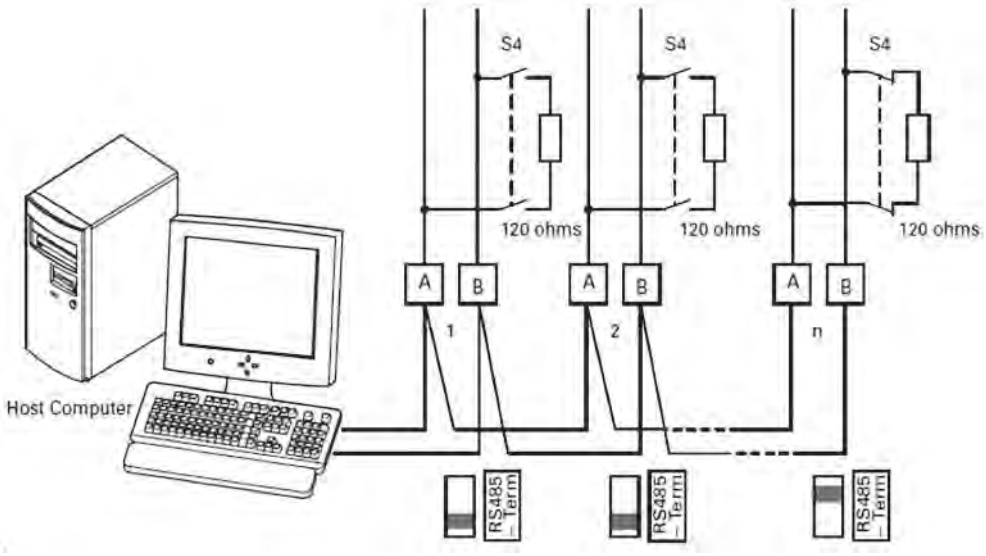
**Table 5. Variable Speed Drive Series III protocols**

| Protocols | VS3 | On Board/Option Module |
|---|---|---|
| Modbus RTU | ■ | On Board |
| BACnet MSTP | ■ | On Board |
| Modbus TCP | ■ | On Board |
| PROFIBUS | ■ | Option Module |
| BACnet IP | ■ | On Board |

# Modbus RTU On-Board Communications

The drive product can be controlled via Modbus® RTU through the on-board RS-485 terminals.

**Figure 6. Connection diagram**




The figure shows a typical arrangement with a host computer (master) and any number maximum 31 subordinate of frequency inverters. Each frequency inverter has a unique address in the network. This addressing is executed individually for each VFD via the communication parameters.

The electrical connection between master and the subordinates connected in parallel are implemented via the serial interface A-B (A = positive, B = negative) with a shielded RS-485 twisted pair cable.

## Modbus RTU specifications

## Communication board connections

**Table 6. Connections**

| Item | Description |
|---|---|
| Interface | |
| Data Transfer Method | RS-485, half-duplex |
| Transfer Cable | Twisted pair (1 pair and shield) |
| Electrical Isolation | |

## Communications

**Table 7. Communications**

| Item | Description |
|---|---|
| Modbus RTU | As described in "Modicon Modbus Protocol Reference Guide" found at. http.//public.modicon.com/ |
| Baud Rate | 9600,19200,38400,57600,115200 |
| Addresses | 1 to 247 |

## Connections

The RS-485 communication port is connected via the A and B terminals on the drives control board.

**Figure 7. Terminal wiring**

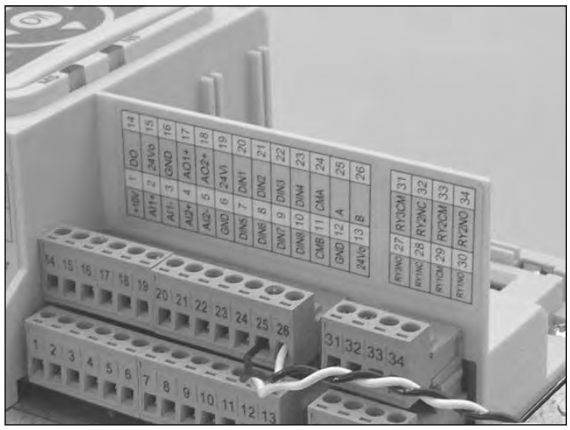
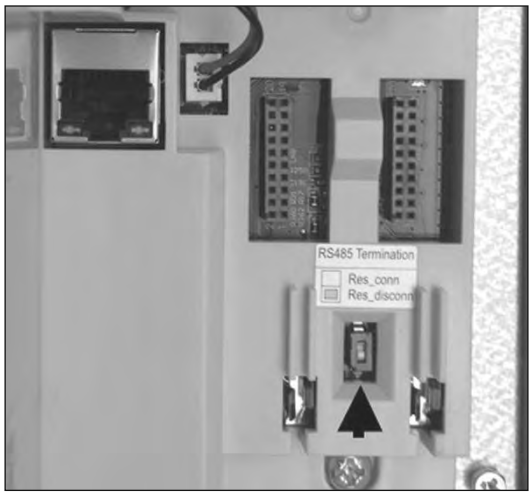
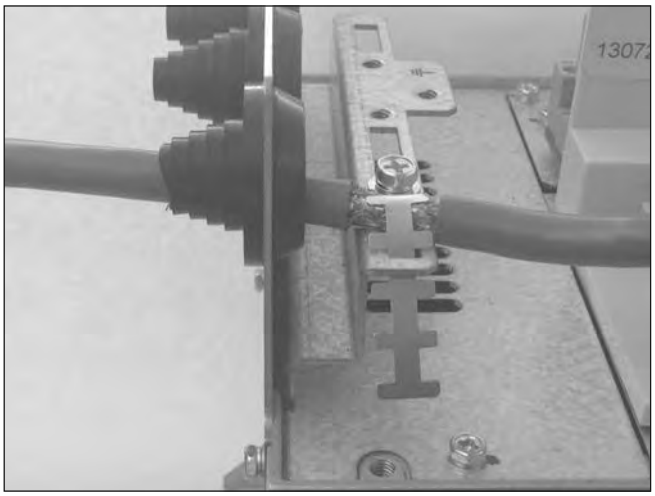



**Figure 8. Termination resistor and shielding**



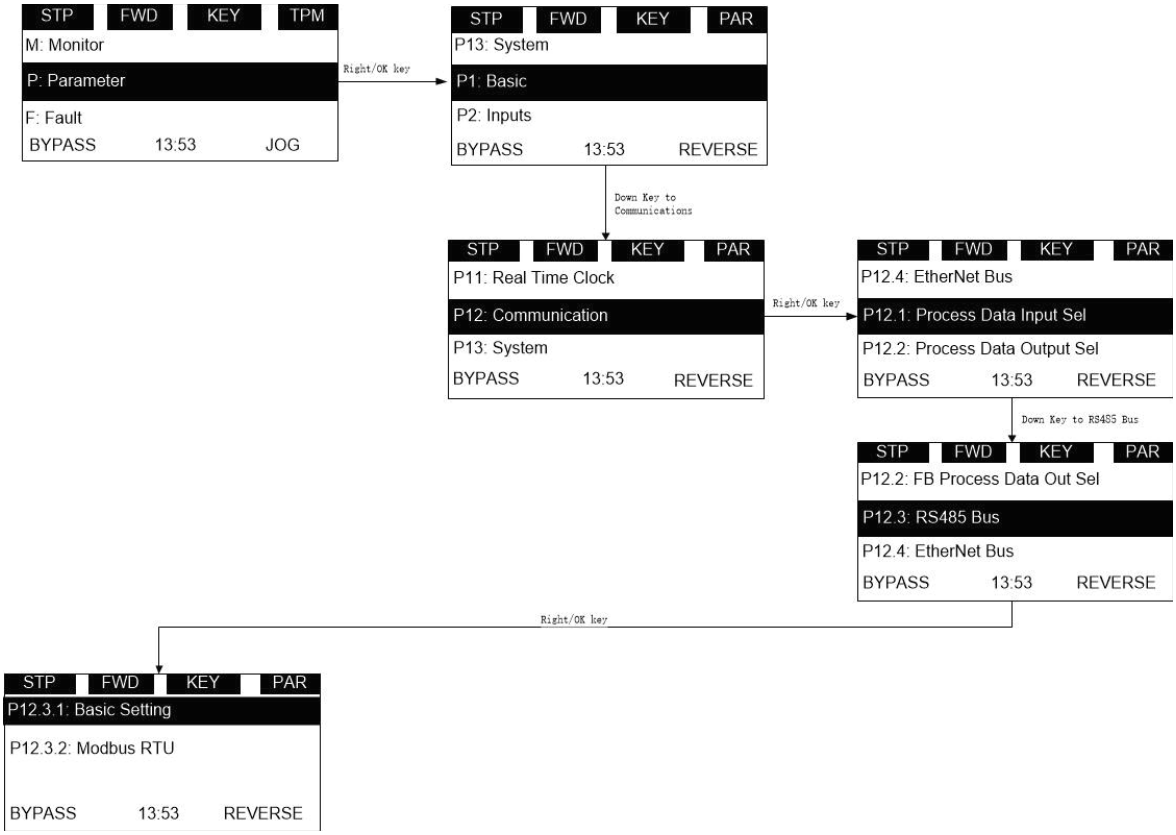
## Commissioning

### RS-485 communication parameters

To commission the RS-485 communication board, enter the Keypad menu as described below.

Change the Modbus RTU commissioning parameter values.

**Figure 9. VS3 keypad navigation to RS-485 menu**




In this menu you will be able to scroll through the below settings to setup the communication protocol.

**Table 8. Modbus RTU**

| VS3 code | Parameter | Min. | Max. | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|
| P12.3.1.1 | RS485 comm set | | | | 0 | 586 | 0 = Modbus RTU<br>1 = BACnet® MS/TP<br>2 = SA Bus |
| P12.3.2.1 | Subordinate address | 1 | 247 | | 1 | 587 | |
| P12.3.2.2 | Baud rate | | | | 1 | 584 | 0 = 9600<br>1 = 19200<br>2 = 38400<br>3 = 57600<br>4 = 115200 |
| P12.3.2.3 | Parity type | | | | 2 | 585 | 0 = None, 2 Stop Bits<br>1 = Odd, 1 Stop Bit<br>2 = Even, 1 Stop Bit |
| P12.3.2.4 | Protocol status | | | | 0 | 588 | 0 = Initial<br>1 = Stopped<br>2 = Operational<br>3 = Faulted |
| P12.3.2.5 | Subordinate busy | | | | 0 | 589 | 0 = Not Busy<br>1 = Busy |
| P12.3.2.6 | Modbus RTU/BACNet Fault Response | 0 | 1 | | 0 | 2516 | 0 = In Fieldbus Control<br>1 = in all Control |

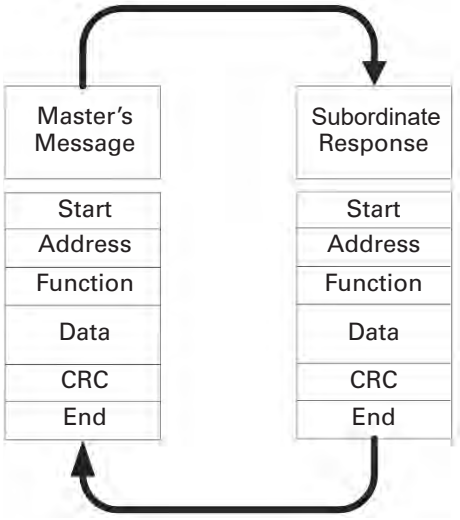
The parameters of every device must be set before connecting to the bus. Each parameter must be the same as the master configuration.

## Modbus communication standards

The Modbus protocol is an industrial communications and distributed control system to integrate PLCs, computers, terminals, and other monitoring, sensing and control devices. Modbus is a Master-Subordinate communications protocol. The Master controls all serial activity by selectively polling one or more subordinate devices. The protocol provides for one master device and up to 247 subordinate devices on a common line. Each device is assigned an address to distinguish it from all other connected devices. The Modbus protocol uses the master-Subordinate technique, in which only one device (the master) can initiate a transaction. The other devices (the subordinates) respond by supplying the requested data to the master, or by taking the action requested in the query. The master can address individual subordinates or initiate a broadcast message to all subordinates. Subordinates return a message ("response") to queries that are addressed to them individually. Responses are not returned to broadcast queries from the master.

A transaction comprises a single query and single response frame or a single broadcast frame. The transaction frames are defined below.

**Figure 10. The basic structure of a modbus frame**




Valid subordinate device addresses are in the range of 0–247 decimal. The individual subordinate devices are assigned addresses in the range of 1–247. A master addresses a subordinate by placing the subordinate address in the address field of the message. When the subordinate sends its response, it places its own address in this address field of the response to let the master know which subordinate is responding.

The function code field of a message frame contains two characters (ASCII) or eight bits (RTU). Valid codes are in the range of 1–255 decimal. When a message is sent from a master to a subordinate device, the function code field tells the subordinate what kind of action to perform.

Examples are to read the ON/OFF states of a group of discrete coils or inputs; to read the data contents of a group of registers; to read the diagnostic status of the subordinate; to write to designated coils or registers; or to allow loading, recording or verifying the program within the subordinate.

When the subordinate responds to the master, it uses the function code field to indicate either a normal (error-free) response or that some kind of error occurred (called an exception response). For a normal response, the subordinate simply echoes the original function code. For an exception response, the subordinate returns a code that is equivalent to the original function code with its most significant bit set to a logic state of 1.

The data field is constructed using sets of two hexadecimal digits, in the range of 00 to FF hexadecimal. These can be made from a pair of ASCII characters, or from one RTU character, according to the network's serial transmission mode.

The data field of messages sent from a master to subordinate devices contains additional information that the subordinate must use to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled, and the count of actual data bytes in the field.

If no error occurs, the data field of a response from a subordinate to a master contains the data requested. If an error occurs, the field contains an exception code that the master application can use to determine the next action to be taken.

Two kinds of checksum are used for standard Modbus networks. The error checking field contents depend upon the transmission method that is being used.

## Supported functions

**Table 9. Functions**

| Function code | Description |
|---|---|
| 0x01 | Read coils |
| 0x02 | Read discrete inputs |
| 0x03 | Read holding registers |
| 0x04 | Read input registers |
| 0x05 | Write single coil |
| 0x06 | Write single register |
| 0x07 | Read exception status |
| 0x08 | Read diagnostics<br>(Only support 0x00 return query data) |
| 0x0F | Write multiple coils |
| 0x10 | Write multiple registers |
| 0x17 | Read/write multiple registers |
| 0x2B/0x0E | Read device identity |

**Note:** Note: Broadcasting can be used with codes 0x05, 0x06, 0x0F and 0x10.

Example of the request to read coils 2000–2003 from subordinate device 18.

**Table 10. Request to read coils**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x01 | |
| Start address High | 0x07 | Starting address 0x07D0 hex (= 2000) |
| Start address Low | 0xD0 | |
| Number of coils High | 0x00 | Number of coils 0x0003 hex (= 3) |
| Number of coils Low | 0x03 | |
| CRC High | 0x7E | |
| CRC Low | 0x25 | |

Example of the request to read Discrete Inputs 2000–2003 from Subordinate device 18.

**Table 11. Request to read discrete inputs**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x02 | |
| Start address High | 0x07 | Starting address 0x07D0 hex (= 2000) |
| Start address Low | 0xD0 | |
| Number of Discrete Inputs High | 0x00 | Number of Discrete Inputs 0x0003 hex (= 3) |
| Number of Discrete Inputs Low | 0x03 | |
| CRC High | 0x3A | |
| CRC Low | 0x25 | |

Example of the request to read Holding Registers 2000–2003 from Subordinate device 18.

**Table 12. Request to read holding registers**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x03 | |
| Start address High | 0x07 | Starting address 0x07D0 hex (= 2000) |
| Start address Low | 0xD0 | |
| Number of Holding Registers High | 0x00 | Number of Holding Registers 0x0003 hex (= 3) |
| Number of Holding Registers Low | 0x03 | |
| CRC High | 0x07 | |
| CRC Low | 0xE5 | |

Example of the request to read Input Registers 2000–2003 from Subordinate device 18.

**Table 13. Request to read input registers**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x04 | |
| Start address High | 0x07 | Starting address 0x07D0 hex (= 2000) |
| Start address Low | 0xD0 | |
| Number of Input Registers High | 0x00 | Number of Input Registers 0x0003 hex (= 3) |
| Number of Input Registers Low | 0x03 | |
| CRC High | 0xB2 | |
| CRC Low | 0x25 | |

Example of the request to read exception status from Subordinate device 18.

**Table 14. Request to read exception status**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x07 | |
| CRC High | 4C | |
| CRC Low | D2 | |

Example of Read Diagnostics from Subordinate address 18.

**Table 15. Read diagnostics**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x08 | |
| Sub function High | 0x00 | Sub function code 0x0000 (= 0) |
| Sub function Low | 0x00 | Note. Only support sub function code 0x0000 |
| Data High | 0xA5 | Data 0xA5A5 (= 42405) |
| Data Low | 0xA5 | |
| CRC High | 0x59 | |
| CRC Low | 0x83 | |

Example of the request to write single coil 2000 from subordinate device 18, the output value is 65280.

**Table 16. Request to write single coil**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x05 | |
| Output address High | 0x07 | Starting address 0x07D0 hex (= 2000) |
| Output address Low | 0xD0 | |
| Output value High | 0xFF | Output value 0xFF00 hex (= 65280) |
| Output value Low | 0x00 | Note. Output value is 0x0000 or 0xFF00 |
| CRC High | 0x8E | |
| CRC Low | 0x14 | |

Example of the request to write single register 2000 from Subordinate device 18, the output value is 5.

**Table 17. Request to write single register**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x06 | |
| Output address High | 0x07 | Starting address 0x07D0 hex (= 2000) |
| Output address Low | 0xD0 | |
| Output value High | 0x00 | Output value 0x0005 hex (= 5) |
| Output value Low | 0x05 | |
| CRC High | 0x4B | |
| CRC Low | 0xE7 | |

Example of Write coils 19–28 from Subordinate device 18.

**Table 18. Write coils 19–28**

| Item | Code | Description |
|---|---|---|
| Subordinate Address | 0x12 | |
| Function code | 0x0F | |
| Starting Address High | 0x00 | Starting Address 0x0013 (= 19) |
| Starting Address Low | 0x13 | |
| Quantity of Outputs High | 0x00 | Quantity of Outputs 0x000A (= 10) |
| Quantity of Outputs Low | 0x0A | |
| Bye Count | 0x02 | |
| Outputs Value High | 0xCD | |
| Outputs Value Low | 0x01 | |
| CRC High | 0xAB | |
| CRC Low | 0xFB | |

**Note:** The binary outputs in the previous example correspond to the outputs in the following way.

**Binary bits and corresponding outputs**

| **Bit** | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Output** | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | — | — | — | — | — | 28 | 27 |

Example of write Holding registers 2000-2001 from subordinate device 18.

**Table 19. Request to write holding registers**

| Item | Code | Description |
|---|---|---|
| Subordinate Address | 0x12 | |
| Function code | 0x10 | |
| Starting Address High | 0x07 | Starting Address 0x07D0 (= 2000) |
| Starting Address Low | 0xD0 | |
| Quantity of Outputs High | 0x00 | Quantity of Outputs 0x0002 (= 2) |
| Quantity of Outputs Low | 0x02 | |
| Bye Count | 0x04 | |
| Outputs Value High | 0x00 | |
| Outputs Value Low | 0x01 | |
| Outputs Value High | 0x00 | |
| Outputs Value Low | 0x02 | |
| CRC High | 0x53 | |
| CRC Low | 0x46 | |

## Modbus registers

The variables and fault codes as well as the parameters can be read and written from Modbus. The parameter addresses are determined in the application. Every parameter and actual value have been given an ID number in the application. The ID numbering of the parameter as well as the parameter ranges and steps can be found in the application manual in question. The parameter value shall be given without decimals.

All values can be read with function codes 3 and 4 (all registers are 3X and 4X reference). Modbus registers are mapped to drive IDs as follows.

**Table 20. Index table**

| ID | Modbus register | Group | R/W |
|---|---|---|---|
| 1–98 | 40001–40098 (30001–30098) | Actual Values | 1/1 |
| 100 | 40099 (30099) | Fault Code | 1/1 |
| 101–1999 | 40101–41999 (30101–31999) | Parameters | 1/1 |
| 2004–2011 | 42004–42011 (32004–32011) | Process Data In | 1/1 |
| 2104–2111 | 42104–42111 (32104–32111) | Process Data Out | 1/1 |

## Process data

The process data fields are used to control the drive (e.g., Run, Stop, Reference, Fault Reset) and to quickly read actual values (e.g., Output frequency, Output current, Fault code). The fields are structured as follows.

**Table 21. Process data subordinate → master (max. 22 bytes)**

| ID | Modbus register | Group | Range/Type |
|---|---|---|---|
| 2101 | 32101, 42101 | FB Status Word | Binary coded |
| 2102 | 32102, 42102 | FB General Status Word | Binary coded |
| 2103 | 32103, 42103 | FB Actual Speed | 0–100.00% |
| 2104 | 32104, 42104 | FB Process Data Out 1 | |
| 2105 | 32105, 42105 | FB Process Data Out 2 | |
| 2106 | 32106, 42106 | FB Process Data Out 3 | |
| 2107 | 32107, 42107 | FB Process Data Out 4 | |
| 2108 | 32108, 42108 | FB Process Data Out 5 | |
| 2109 | 32109, 42109 | FB Process Data Out 6 | |
| 2110 | 32110, 42110 | FB Process Data Out 7 | |
| 2111 | 32111, 42111 | FB Process Data Out 8 | |

**Table 22. Process data master →subordinate (max. 22 bytes)**

| ID | Modbus register | Group | Range/Type |
|---|---|---|---|
| 2001 | 32001, 42001 | FB Control Word | Binary coded |
| 2002 | 32002, 42002 | FB General Control Word | Binary coded |
| 2003 | 32003, 42003 | FB Speed Reference | 0–100.00% Hz |
| 2004 | 32004, 42004 | FB Process Data In 1 | Integer 16 |
| 2005 | 32005, 42005 | FB Process Data In 2 | Integer 16 |
| 2006 | 32006, 42006 | FB Process Data In 3 | Integer 16 |
| 2007 | 32007, 42007 | FB Process Data In 4 | Integer 16 |
| 2008 | 32008, 42008 | FB Process Data In 5 | Integer 16 |
| 2009 | 32009, 42009 | FB Process Data In 6 | Integer 16 |
| 2010 | 32010, 42010 | FB Process Data In 7 | Integer 16 |
| 2011 | 32011, 42011 | FB Process Data In 8 | Integer 16 |

The use of process data depends on the application. In a typical situation, the device is started and stopped with the Control Word (CW) written by the Master and the Rotating speed is set with Reference (REF). With PD1–PD8 the device can be given other reference values (e.g., Torque reference). With the Status Word (SW) read by the Master, the status of the device can be seen. Actual Value (ACT) and PD1–PD8 show the other actual values.

## Process data in

This register range is reserved for the control of the VFD. Process Data In is located in range ID 2001–2099. The registers are updated every 10 ms. See table below.

**Table 23. Fieldbus basic input table**

| ID | Modbus register | Group | Range/Type |
|---|---|---|---|
| 2001 | 32001, 42001 | FB Control Word | Binary coded |
| 2002 | 32002, 42002 | FB General Control Word | Binary coded |
| 2003 | 32003, 42003 | FB Speed Reference | 0–100.00% |
| 2004 | 32004, 42004 | FB Process Data In 1 | Integer 16 |
| 2005 | 32005, 42005 | FB Process Data In 2 | Integer 16 |
| 2006 | 32006, 42006 | FB Process Data In 3 | Integer 16 |
| 2007 | 32007, 42007 | FB Process Data In 4 | Integer 16 |
| 2008 | 32008, 42008 | FB Process Data In 5 | Integer 16 |
| 2009 | 32009, 42009 | FB Process Data In 6 | Integer 16 |
| 2010 | 32010, 42010 | FB Process Data In 7 | Integer 16 |
| 2011 | 32011, 42011 | FB Process Data In 8 | Integer 16 |

**Note:** For FB Process Data In, see section below on Process Data IN.

## Control word

The drive uses 16 bits as shown below. These bits are application specific.

**Binary bits and corresponding outputs**

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ① | ① | ① | ① | ① | ① | FB Ref | FB Ctrl | Bypass | FB DI 4 | FB DI 3 | FB DI 2 | FB DI 1 | Fault Reset | Reverse | RUN |

**Note:**
① The bit is not used.

**Table 24. FB control word**

| Bit | Description Value = 0 | Value = 1 |
|---|---|---|
| 0 | Drive Output Off | Drive Output On |
| 1 | Clockwise Rotation | Counter Clockwise |
| 2 | No Reset | Fault Reset |
| 3 | FB INDATA1 Off | FB INDATA1 On |
| 4 | FB INDATA2 Off | FB INDATA2 On |
| 5 | FB INDATA3 Off | FB INDATA3 On |
| 6 | FB INDATA4 Off | FB INDATA4 On |
| 7 | Bypass Relay Disable | Bypass Relay Enable |
| 8 | FB Control Off | FB Control On |
| 9 | FB Reference Off | FB Reference On |
| 10–15 | Not in use | Not in use |

## FB General Control Word

The Variable Speed Drive Series III does not use the FB General Control Word. The main control word is used to provide commands to the drive.

**Speed reference**

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MSB | — | — | — | — | — | — | — | — | — | — | — | — | — | — | LSB |

This is the Reference 1 to the VFD. Used normally as Speed reference.

The scaling on this value is 0–100.00% of the Maximum Frequency. The 0 to 100.00% is represented by 0 to 10,000 value indicating 0 or 0% as Minimum Frequency and 10,000 or %100.00 as Maximum Frequency. This value has 2 decimal places in it.

## Process data in 1 to 8

Process Data In values 1 to 8 can be used in applications for various purposes. See Process Data IN section for setup.

## Process data out

This register range is normally used to fast monitoring of the VFD. Process Data Out is located in range ID 2101–2199. See table below.

**Table 25. Fieldbus basic output table**

| ID | Modbus Register | Group | Range/Type |
|---|---|---|---|
| 2101 | 32101, 42101 | FB Status Word | Binary coded |
| 2102 | 32102, 42102 | FB General Status Word | Binary coded |
| 2103 | 32103, 42103 | FB Actual Speed | % |
| 2104 | 32104, 42104 | FB Process Data Out 1 | |
| 2105 | 32105, 42105 | FB Process Data Out 2 | |
| 2106 | 32106, 42106 | FB Process Data Out 3 | |
| 2107 | 32107, 42107 | FB Process Data Out 4 | |
| 2108 | 32108, 42108 | FB Process Data Out 5 | |
| 2109 | 32109, 42109 | FB Process Data Out 6 | |
| 2110 | 32110, 42110 | FB Process Data Out 7 | |
| 2111 | 32111, 42111 | FB Process Data Out 8 | |

### FB Status Word

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| — | — | — | — | — | — | — | — | — | — | — | Direction | Fault | Direction | Running | Ready |

Information about the status of the device and messages is indicated in the FB Status Word. The FB Status Word is composed of 16 bits that have the following meanings.

**Table 26. FB Status Word Bit Descriptions**

| Bit | Description Value = 0 | Value = 1 |
|---|---|---|
| 0 | Not Ready | Ready |
| 1 | STOP | RUN |
| 2 | Clockwise | Counterclockwise |
| 3 | — | Faulted |
| 4 | — | Warning |
| 5 | Ref. frequency not reached | Ref. frequency reached |
| 6 | Bypass not activated | Bypass activated |
| 7 | Run disable | Run Enable |
| 8 | Not in use | Not in use |
| 9–15 | Not in use | Not In use |

**Table 27. FB general status word**

| Bit | Description Value = 0 | Value = 1 |
|---|---|---|
| 0 | Not Ready | Ready |
| 1 | Stop | Run |
| 2 | Clockwise | Counter Clockwise |
| 3 | No Fault | Fault |
| 4 | No Warning | Warning |
| 5 | Ref. Frequency Not Reached | Ref. Frequency Reached |
| 6 | Ref > 0 Speed | Ref = 0 speed |
| 7 | Motor Flux Off | Motor Flux On ① |
| 8 | Motor Speed Limit On | Motor Speed Limit Off ① |
| 9 | Encoder Direction Off | Encoder Direction On ① |
| 10 | Under Voltage Fast Stop Off | Under Voltage Fast Stop On ① |
| 11 | DC Brake Off | DC Brake On |
| 12 | FB Ref Not Enable | FB Ref Enabled |
| 13 | Motor Start Delay Off | Motor Start Delay On |
| 14 | Remote Not Enable | Remote Enable |
| 15 | FB WD Pulse Not Enabled | FB WD Pulse Enable ① |

**Note:**
① The bit is not used.

### Speed reference

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MSB | — | — | — | — | — | — | — | — | — | — | — | — | — | — | LSB |

This is the Actual Speed of the motor. This value comes back in the form of %.

## Process data out 1 to 8

Process Data Out values 1 to 8 can be used in application for various purposes. See below tables for additional information.

## Process data OUT (subordinate -> master)

The fieldbus master can read the VFD actual values using process data variables. The applications use process data as follows. These values are selectable via the Fieldbus Process Data parameter group. These values would correspond to the Modbus ID value. See **Appendix A** for Parameter ID table showing values can be set.

**Table 28. Process data OUT**

| Id | Data | Value | Default value | Default para | Unit | Scale |
|---|---|---|---|---|---|---|
| 2104 | Process Data OUT 1 | -32768–32767 | 1 | Output Frequency | Hz | |
| 2105 | Process Data OUT 2 | -32768–32767 | 2 | Motor Speed | RPM | |
| 2106 | Process Data OUT 3 | -32768–32767 | 3 | Motor Current | A | |
| 2107 | Process Data OUT 4 | -32768–32767 | 4 | Motor Torque | % | |
| 2108 | Process Data OUT 5 | -32768–32767 | 5 | Motor Power | % | |
| 2109 | Process Data OUT 6 | -32768–32767 | 6 | Motor Voltage | V | |
| 2110 | Process Data OUT 7 | -32768–32767 | 7 | DC Link Voltage | V | |
| 2111 | Process Data OUT 8 | -32768–32767 | 28 | Latest Fault Code | — | |

## Process data IN (master → subordinate)

Control Word, Reference and Process Data are used with All-in-One applications as follows.

**Table 29. Process data IN**

| ID | Data | Value | Unit | Scale |
|---|---|---|---|---|
| 2003 | Reference | Speed Reference | Hz | 0.01 |
| 2001 | Control Word | — | — | — |
| 2004 | Process Data IN1 | ① | % | 0.01% |
| 2005 | Process Data IN2 | ① | % | 0.01% |
| 2006 | Process Data IN3 | ① | % | 0.01% |
| 2007 | Process Data IN4 | ① | % | 0.01% |
| 2008 | Process Data IN5 | ① | % | 0.01% |
| 2009 | Process Data IN6 | ① | % | 0.01% |
| 2010 | Process Data IN7 | ① | % | 0.01% |
| 2011 | Process Data IN8 | ① | % | 0.01% |

**Note:**
① Process Data IN1 through Process Data IN8 change based off the selected application. See **Appendix B** for layout.

## Startup test

Select Fieldbus (Bus/Comm) as the active control and reference place.

1. Set FB control word (Modbus Address 42001) value to 301hex
2. The drive status is RUN
3. Set FB Speed reference (Modbus Address 42003) value to 5000 (= 50.00%)
4. The Actual value is 5000 and the output frequency is 50.00%
5. Set FB control word (Modbus Address 42001) value to 300hex
6. The drive status is STOP

# Modbus TCP On-Board communications

## Modbus/TCP specifications

**Table 30. Modbus/TCP technical data**

| General | Description | Specification |
|---|---|---|
| Ethernet connections | Interface | RJ-45 connector |
| Communications | Transfer cable | Shielded twisted pair |
| | Speed | 10/100 Mb |
| | Duplex | Half/full |
| | Default IP–address Mode | DHCP with Auto-IP |
| Default static IP configurations | Default static IP address | 192.168.1.254 |
| | Default Network Mask | 255.255.255.0 |
| | Default Gateway Address | 192.168.1.1 |

## Modbus/TCP protocol

Modbus/TCP is a variant of the Modbus family. It is a manufacturer-independent protocol for monitoring and controlling automatic devices. Modbus/TCP is a client-server protocol. The client makes queries to the server by sending "request" messages to the server's TCP port 502. The server answers client queries with "response" messages. The term "client" can refer to a master device that runs queries. Correspondingly, the term "server" refers to a subordinate device that serves the master device by answering its queries. Both the request and the response messages are composed as follows.

Byte 0. Transaction ID High

Byte 1. Transaction ID Low

Byte 2. Protocol ID High

Byte 3. Protocol ID Low

Byte 4. Length field High

Byte 5. Length field Low

Byte 6. Unit identifier

Byte 7. Modbus function code

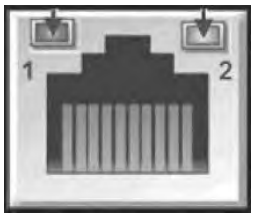
Byte 8. Data (of variable length)

## Modbus/TCP vs. Modbus RTU

Compared to the Modbus RTU protocol, the Modbus/TCP differs mostly in error checking and subordinate addresses. As the TCP already includes an efficient error checking function, the Modbus/TCP protocol does not include a separate CRC field. In addition to the error checking functionality, the TCP is responsible for resending packets and for splitting long messages so that they fit the TCP frames. The subordinate address field of the Modbus/RTU is named as the unit identifier field in Modbus/TCP, and it is only used when one IP address stands for several endpoints.

## Hardware specifications

### Ethernet port LED indications




### Ethernet LED

1. Ethernet Link Status
2. Ethernet Link Speed

**Table 31. Ethernet LED description**

| LED | Meaning |
|---|---|
| Ethernet link status | Flashes with Ethernet message activity. |
| Ethernet link speed | Displays the link speed.<br>Yellow LED on the Ethernet Jack is ON when link speed is 100 mbps<br>Yellow LED on the Ethernet Jack is OFF when link speed is 10 mbps |

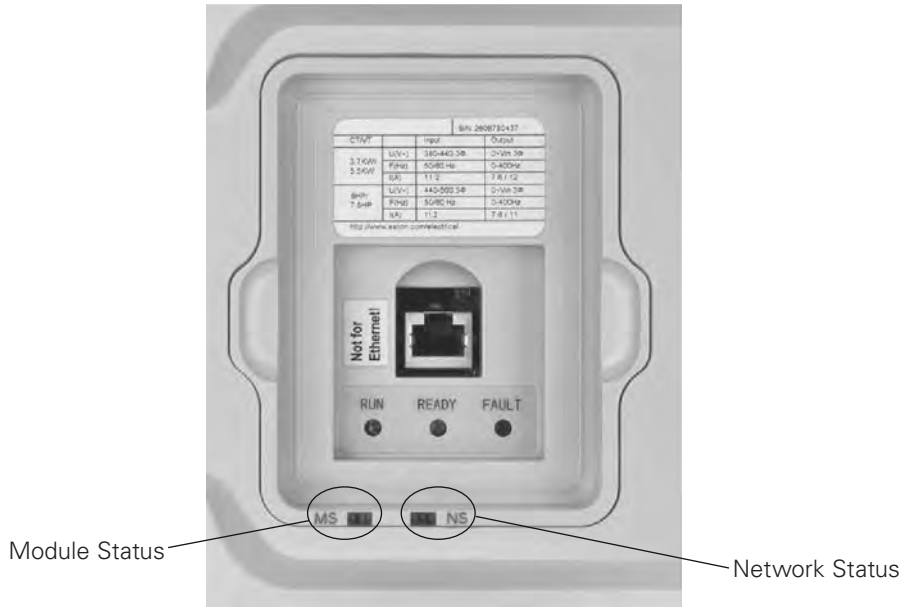
### Ethernet LED indications at power up

When the drive is powered up, an indicator test will be performed. To allow a visual inspection, the following sequence will be performed.

1. Turn first indicator Green, all other indicators off
2. Leave first indicator on Green for approximately 0.25 second
3. Turn first indicator on Red for approximately 0.25 second
4. Turn first indicator on Green
5. Turn second indicator (if present) on Green for approximately 0.25 second
6. Turn second indicator (if present) on Red for approximately 0.25 second
7. Turn second indicator (if present) Off

If other indicators are present, test each indicator in sequence as prescribed by the second indicator above. If a Module Status indicator is present, it will be the first indicator in the sequence, followed by any Network Status indicators present. After completion of this power up test, the indicator(s) will turn to a normal operational state.

**Figure 11. Module and network status**




## Module status indications

Represents the state of the drive.

**Table 32. Module status LED description**

| Indicator state | Summary | Meaning |
|---|---|---|
| Steady Off | No power | No power is supplied to the device. |
| Steady Green | Device operational | Device is operating correctly. |
| Flashing Green ① | Standby | Device has not been configured. |
| Flashing Red ① | Minor fault | Device has detected a recoverable minor fault.<br>Note. An incorrect or inconsistent configuration would be considered a minor fault.<br>Also check that on clearing the fault, it turns off. |
| Steady Red | Major fault | Device has detected a non-recoverable major fault. |
| Flashing Green/Red ① | Self-test | Device is performing its power up testing. |

① Flash rate is 1 flash per second.

## Network status indications

Represents the state of the Ethernet port network interface.

**Table 33. Network status LED description**

| Indicator state | Summary | Meaning |
|---|---|---|
| Steady Off | Not powered, no IP address | Device is powered off, or is powered on but with no IP address configured (Interface Configuration attribute of the TCP/IP Interface Object). |
| Flashing Green ① | No connections | An IP address is configured, but no CIP connections are established, and an Exclusive Owner connection has not timed out. |
| Steady Green | Connected | At least one CIP connection (any transport class) is established, and an Exclusive Owner connection has not timed out. |
| Flashing Red ① | Connection timeout | Device is powered on and an exclusive Owner connection has timed out. It returns to steady green only when all timed out Exclusive Owner connections are established. |
| Steady Red | Major fault | Device has detected a non-recoverable major fault. |
| Flashing Green/Red ① | Self-test | Device is performing its power up testing. |

① Flash rate is 1 flash per second.

## Commissioning

## Connections and wiring

The Ethernet port supports 10/100 Mb speeds in both full and half-duplex modes. The boards must be connected to the Ethernet network with a shielded CAT-5e cable.
A crossover cable (at least CAT-5e cable with STP, shielded twisted pair) may be needed if you want to connect the EtherNet/IP board directly to the master appliance.

Use only industrial standard components in the network and avoid complex structures to minimize the length of response time and the amount of incorrect dispatches.
It is often a good practice to use a subnet that is different from other devices not related to the drive control.

**Figure 12. CAT-5e cable**

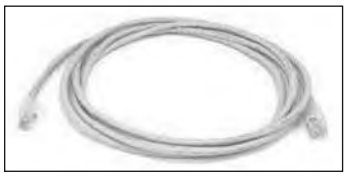
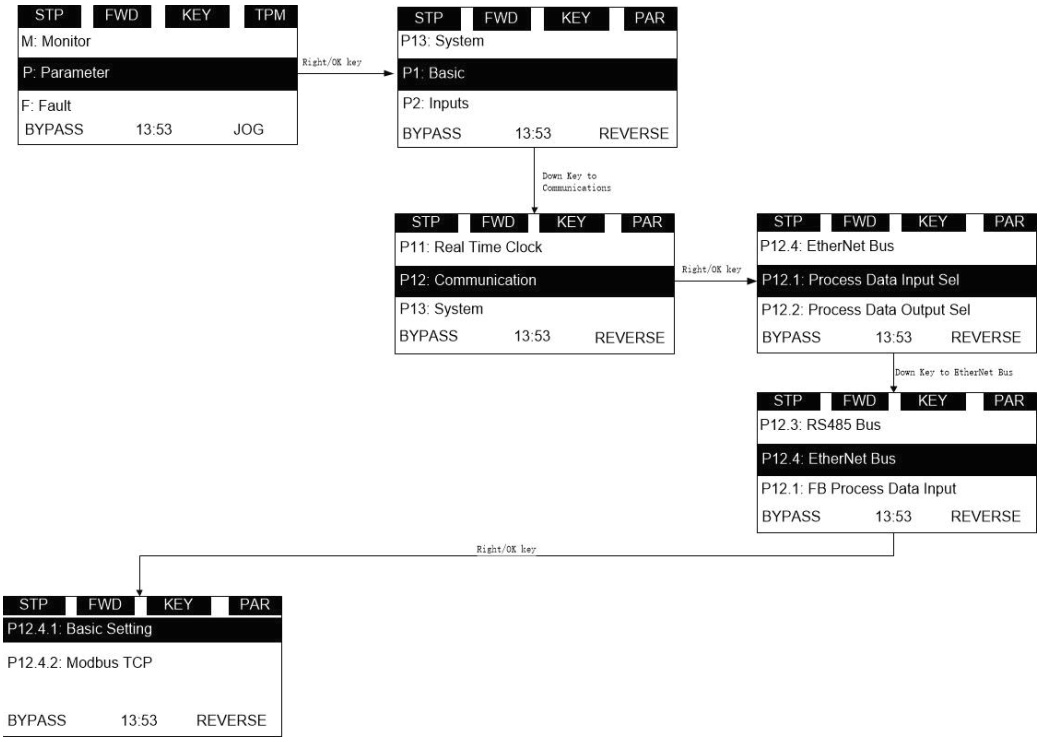


**Figure 13. VS3 keypad navigation to ethernet comm settings**




In this menu you will be able to scroll through the below settings to setup the communication protocol.

**Table 34. EtherNet/IP / Modbus TCP**

| VS3 code | Parameter | Min. | Max. | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|
| P12.4.1.1 | IP Address Mode | | | | 1 | 1500 | 0 = Static IP<br>1 = DHCP with AutoIP |
| P12.4.1.2 | Active IP Address | | | | | 1507 | |
| P12.4.1.3 | Active Subnet Mask | | | | | 1509 | |
| P12.4.1.4 | Active Default Gateway | | | | | 1511 | |
| P12.4.1.5 | MAC Address | | | | | 1513 | |
| P12.4.1.6 | Static IP Address | | | | 192.168.1.254 | 1501 | |
| P12.4.1.7 | Static Subnet Mask | | | | 255.255.255.0 | 1503 | |
| P12.4.1.8 | Static Default Gateway | | | | 192.168.1.1 | 1505 | |
| P12.4.1.9 | Enable BACnet IP | 0 | 1 | | 0 | 1725 | 0 = Disable<br>1 = Enable |
| P12.4.2.1 | Connection Limit | 0 | 5 | | 5 | 609 | |
| P12.4.2.2 | Modbus TCP Unit ID | | | | 1 | 610 | |
| P12.4.2.3 | Comm Timeout Modbus TCP | | | ms | 10000 | 611 | |
| P12.4.2.4 | Protocol Status | | | | 0 | 612 | 0 = Stopped<br>1 = Operational<br>2 = Faulted |
| P12.4.2.5 | Modbus TCP Fault Response | 0 | 1 | | 0 | 2517 | 0 = In Fieldbus Control<br>1 = In all Control |

## DHCP

The EtherNet/IP communication supports DHCP for easier network configuration. Dynamic Host Configuration Protocol (DHCP) is a network protocol that is used to configure network devices so that they can communicate on an IP network. As a DHCP client, the EtherNet/IP negotiates with the DHCP server to determine its IP address and obtain any other initial configuration details it needs for network operation.

## IP address

IP is divided into four parts. (Part = Octet) Default Static IP Address is 192.168.1.254

## Communication timeout

Defines how much time can pass from the last received message from the client device before fieldbus fault is generated. Default communication timeout is 10 seconds.

**Note:** If the network cable is broken from the EtherNet/IP port, a fieldbus error is generated immediately.

## Static IP address

In most cases the user may want to establish a Static IP Address for the EtherNet/IP based on their network configuration.

Static IP address default configurations are as defined in "EtherNet/IP network settings" table, provided in "Connections and Wiring" section.

The user can manually define the network address for the EtherNet/IP as long as all units connected to the network are given the same network portion of the address. In these situations, the user will need to manually set the IP Address in the device by using the drive keypad. Be aware that overlapping IP addresses can cause conflicts between devices on the network. For more information about selecting IP addresses, contact your network administrator.

## Unit identifier

The Unit Identifier used in Modbus TCP is used for the Modbus protocol in place of the subordinate address used in Modbus RTU. This Unit Identifier is used to communicate via devices such as bridges, routers and gateways that use a single IP address to support multiple independent Modbus end units.

## Manual IP address configuration

## Using the Variable Speed Drive Series III keypad

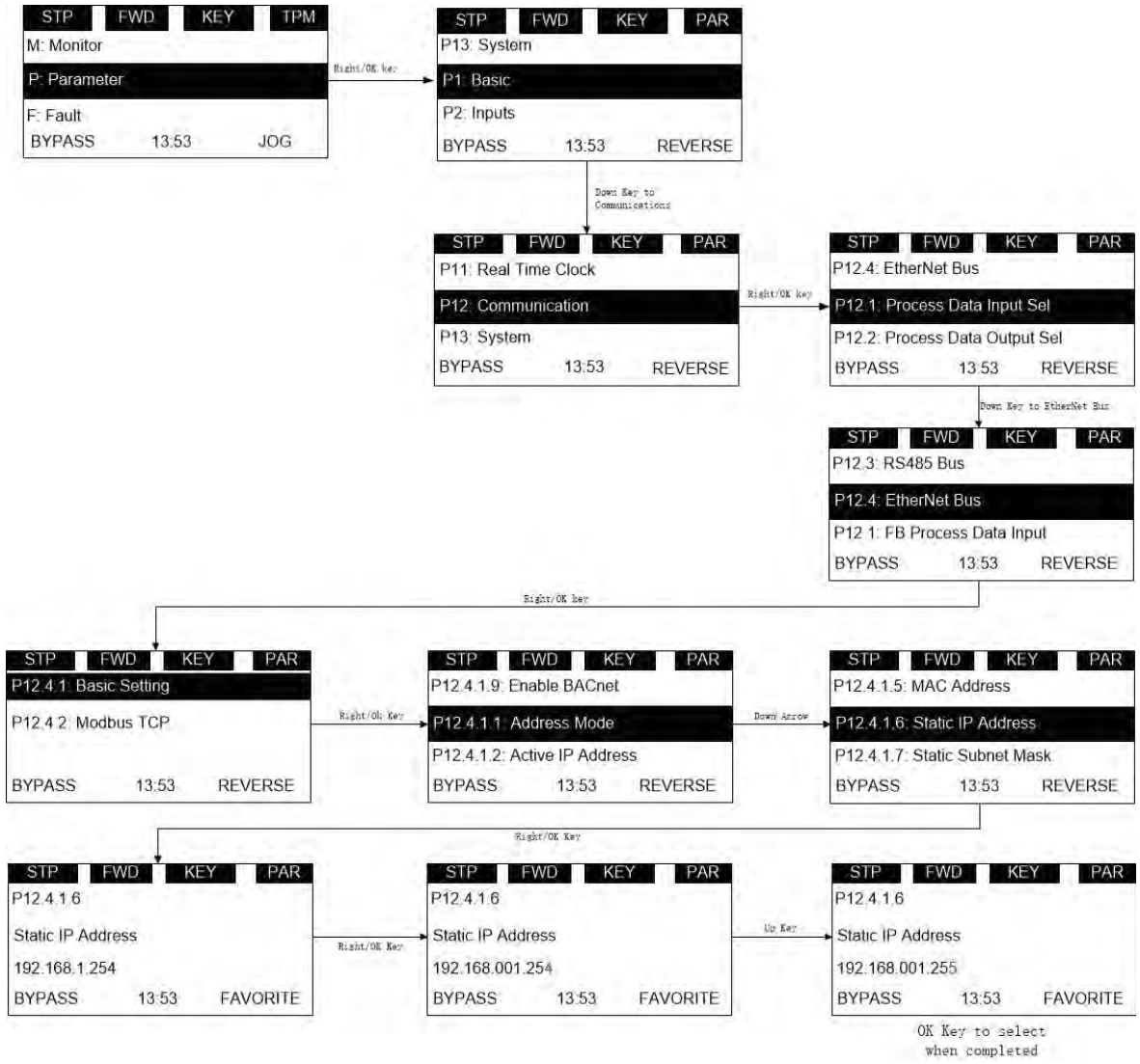
Using the Drive Keypad to set the IP Address manually in the device.

1. Select IP addressing mode as Static IP. Static IP mode configurations will be loaded.

**Note:** Change in IP address mode will require drive to power cycle to get this change effective. Also ensure device MAC address.

**Figure 14. VS3 Static IP mode**

**Figure 15. VS3 Static IP address**




2. Using the drive keypad, set the IP address in the device to the desired address setting by.
   a. Setting Static IP Address
   b. Setting Static Subnet Mask
   c. Setting Static Default Gateway
   d. Setting Modbus TCP Unit ID
3. Make note of the changed IP Address.
4. Using drive keypad, read "Active IP Address", "Active Subnet Mask", "Active Default Gateway" parameters to ensure that IP address has been set to desired IP address.

## Modbus communication standards

Example of the request to read coils 2000–2003 from Subordinate device 18.

**Table 35. Request to read coils**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x01 | |
| Start address High | 0x07 | Starting address 0x07D0 hex (= 2000) |
| Start address Low | 0xD0 | |
| Number of coils High | 0x00 | Number of coils 0x0003 hex (= 3) |
| Number of coils Low | 0x03 | |
| CRC High | 0x7E | |
| CRC Low | 0x25 | |

Example of the request to read Discrete Inputs 2000–2003 from Subordinate device 18.

**Table 36. Request to read discrete inputs**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x02 | |
| Start address High | 0x07 | Starting address 0x07D0 hex (= 2000) |
| Start address Low | 0xD0 | |
| Number of Discrete Inputs High | 0x00 | Number of Discrete Inputs 0x0003 hex (= 3) |
| Number of Discrete Inputs Low | 0x03 | |
| CRC High | 0x3A | |
| CRC Low | 0x25 | |

Example of the request to read Holding Registers 2000–2003 from Subordinate device 18.

**Table 37. Request to read holding registers**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x03 | |
| Start address High | 0x07 | Starting address 0x07D0 hex (= 2000) |
| Start address Low | 0xD0 | |
| Number of Holding Registers High | 0x00 | Number of Holding Registers 0x0003 hex (= 3) |
| Number of Holding Registers Low | 0x03 | |
| CRC High | 0x07 | |
| CRC Low | 0xE5 | |

Example of the request to read Input Registers 2000–2003 from Subordinate device 18.

**Table 38. Request to read input registers**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x04 | |
| Start address High | 0x07 | Starting address 0x07D0 hex (= 2000) |
| Start address Low | 0xD0 | |
| Number of Input Registers High | 0x00 | Number of Input Registers 0x0003 hex (= 3) |
| Number of Input Registers Low | 0x03 | |
| CRC High | 0xB2 | |
| CRC Low | 0x25 | |

Example of the request to read exception status from Subordinate device 18.

**Table 39. Request to read exception status**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x07 | |
| CRC High | 4C | |
| CRC Low | D2 | |

Example of Read Diagnostics from Subordinate address 18.

**Table 40. Read diagnostics**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x08 | |
| Sub function High | 0x00 | Sub function code 0x0000 (= 0) |
| Sub function Low | 0x00 | Note. Only support sub function code 0x0000 |
| Data High | 0xA5 | Data 0xA5A5 (= 42405) |
| Data Low | 0xA5 | |
| CRC High | 0x59 | |
| CRC Low | 0x83 | |

Example of the request to write single coil 2000 from Subordinate device 18, the output value is 1.

**Table 41. Request to write single coil**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x05 | |
| Output address High | 0x07 | Starting address 0x07D0 hex (= 2000) |
| Output address Low | 0xD0 | |
| Output value High | 0xFF | Output value 0xFF00 hex (= 65280) |
| Output value Low | 0x00 | Note. Output value is 0x0000 or 0xFF00 |
| CRC High | 0x8E | |
| CRC Low | 0x14 | |

Example of the request to write single register 2000 from Subordinate device 18, the output value is 5.

**Table 42. Request to write single register**

| Item | Code | Description |
|---|---|---|
| Subordinate address | 0x12 | |
| Function code | 0x06 | |
| Output address High | 0x07 | Starting address 0x07D0 hex (= 2000) |
| Output address Low | 0xD0 | |
| Output value High | 0x00 | Output value 0x0005 hex (= 5) |
| Output value Low | 0x05 | |
| CRC High | 0x4B | |
| CRC Low | 0xE7 | |

Example of Write coils 19–28 from Subordinate device 18.

**Table 43. Write coils 19–28**

| Item | Code | Description |
|---|---|---|
| Subordinate Address | 0x12 | |
| Function code | 0x0F | |
| Starting Address High | 0x00 | Starting Address 0x0013 (= 19) |
| Starting Address Low | 0x13 | |
| Quantity of Outputs High | 0x00 | Quantity of Outputs 0x000A (= 10) |
| Quantity of Outputs Low | 0x0A | |
| Bye Count | 0x02 | |
| Outputs Value High | 0xCD | |
| Outputs Value Low | 0x01 | |
| CRC High | 0xAB | |
| CRC Low | 0xFB | |

**Note:** The binary outputs in the previous example correspond to the outputs in the following way.

**Binary bits and corresponding outputs**

| **Bit** | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Output** | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | — | — | — | — | — | — | 28 | 27 |

Example of write Holding registers 2000–2001 from Subordinate device 18.

**Table 44. Write holding registers**

| Item | Code | Description |
|---|---|---|
| Subordinate Address | 0x12 | |
| Function code | 0x10 | |
| Starting Address High | 0x07 | Starting Address 0x07D0 (= 2000) |
| Starting Address Low | 0xD0 | |
| Quantity of Outputs High | 0x00 | Quantity of Outputs 0x0002 (= 2) |
| Quantity of Outputs Low | 0x02 | |
| Bye Count | 0x04 | |
| Outputs Value High | 0x00 | |
| Outputs Value Low | 0x01 | |
| Outputs Value High | 0x00 | |
| Outputs Value Low | 0x02 | |
| CRC High | 0x53 | |
| CRC Low | 0x46 | |

## Modbus registers

The variables and fault codes as well as the parameters can be read and written from Modbus. The parameter addresses are determined in the application. Every parameter and actual value have been given an ID number in the application. The ID numbering of the parameter as well as the parameter ranges and steps can be found in the application manual in question. The parameter value shall be given without decimals.

All values can be read with function codes 3 and 4 (all registers are 3X and 4X reference). Modbus registers are mapped to drive IDs as follows.

**Table 45. Index table**

| ID | Modbus register | Group | R/W |
|---|---|---|---|
| 1–98 | 40001–40098 (30001–30098) | Actual Values | 1/1 |
| 100 | 40099 (30099) | Fault Code | 1/1 |
| 101–1999 | 40101–41999 (30101–31999) | Parameters | 1/1 |
| 2004–2011 | 42004–42011 (32004–32011) | Process Data In | 1/1 |
| 2104–2111 | 42104–42111 (32104–32111) | Process Data Out | 1/1 |

## Process data

The process data fields are used to control the drive (e.g., Run, Stop, Reference, Fault Reset) and to quickly read actual values (e.g., Output frequency, Output current, Fault code). The fields are structured as follows.

**Table 46. Process data subordinate → master (max. 22 bytes)**

| ID | Modbus register | Group | Range/Type |
|---|---|---|---|
| 2101 | 32101, 42101 | FB Status Word | Binary coded |
| 2102 | 32102, 42102 | FB General Status Word | Binary coded |
| 2103 | 32103, 42103 | FB Actual Speed | 0–100.00% |
| 2104 | 32104, 42104 | FB Process Data Out 1 | |
| 2105 | 32105, 42105 | FB Process Data Out 2 | |
| 2106 | 32106, 42106 | FB Process Data Out 3 | |
| 2107 | 32107, 42107 | FB Process Data Out 4 | |
| 2108 | 32108, 42108 | FB Process Data Out 5 | |
| 2109 | 32109, 42109 | FB Process Data Out 6 | |
| 2110 | 32110, 42110 | FB Process Data Out 7 | |
| 2111 | 32111, 42111 | FB Process Data Out 8 | |

**Table 47. Process data master →subordinate (max. 22 bytes)**

| ID | Modbus register | Group | Range/Type |
|---|---|---|---|
| 2001 | 32001, 42001 | FB Control Word | Binary coded |
| 2002 | 32002, 42002 | FB General Control Word | Binary coded |
| 2003 | 32003, 42003 | FB Speed Reference | 0–100.00% |
| 2004 | 32004, 42004 | FB Process Data In 1 | Integer 16 |
| 2005 | 32005, 42005 | FB Process Data In 2 | Integer 16 |
| 2006 | 32006, 42006 | FB Process Data In 3 | Integer 16 |
| 2007 | 32007, 42007 | FB Process Data In 4 | Integer 16 |
| 2008 | 32008, 42008 | FB Process Data In 5 | Integer 16 |
| 2009 | 32009, 42009 | FB Process Data In 6 | Integer 16 |
| 2010 | 32010, 42010 | FB Process Data In 7 | Integer 16 |
| 2011 | 32011, 42011 | FB Process Data In 8 | Integer 16 |

The use of process data depends on the application. In a typical situation, the device is started and stopped with the ControlWord (CW) written by the Master and the Rotating speed is set with Reference (REF). With PD1–PD8 the device can be given other reference values (e.g., Torque reference). With the StatusWord (SW) read by the Master, the status of the device can be seen. Actual Value (ACT) and PD1–PD8 show the other actual values.

## Process data in

This register range is reserved for the control of the VFD. Process Data In is located in range ID 2001–2099. The registers are updated every 10 ms. See table below.

**Table 48. Fieldbus basic input table**

| ID | Modbus register | Group | Range/Type |
|---|---|---|---|
| 2001 | 32001, 42001 | FB Control Word | Binary coded |
| 2002 | 32002, 42002 | FB General Control Word | Binary coded |
| 2003 | 32003, 42003 | FB Speed Reference | 0–100.00% |
| 2004 | 32004, 42004 | FB Process Data In 1 | Integer 16 |
| 2005 | 32005, 42005 | FB Process Data In 2 | Integer 16 |
| 2006 | 32006, 42006 | FB Process Data In 3 | Integer 16 |
| 2007 | 32007, 42007 | FB Process Data In 4 | Integer 16 |
| 2008 | 32008, 42008 | FB Process Data In 5 | Integer 16 |
| 2009 | 32009, 42009 | FB Process Data In 6 | Integer 16 |
| 2010 | 32010, 42010 | FB Process Data In 7 | Integer 16 |
| 2011 | 32011, 42011 | FB Process Data In 8 | Integer 16 |

## FB control word

The drive uses 16 bits as shown below. These bits are application specific.

**Binary bits and corresponding outputs**

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ① | ① | ① | ① | ① | ① | FB Ref | FB Ctrl | BYS | FB DIN 4 | FB DIN 3 | FB DIN 2 | FB DIN 1 | F_RST | DIR | RUN |

**Note:**
① The bit is not used.

## FB general control word

The drive does not use the FB General Control Word. The main control word is used to provide commands to the drive.

**Table 49. FB control word**

| Bit | Description value = 0 | Value = 1 |
|---|---|---|
| 0 | Drive Output Off | Drive Output On |
| 1 | Clockwise Rotation | Counter Clockwise |
| 2 | No Reset | Fault Reset |
| 3 | FB INDATA1 Off | FB INDATA1 On |
| 4 | FB INDATA2 Off | FB INDATA2 On |
| 5 | FB INDATA3 Off | FB INDATA3 On |
| 6 | FB INDATA4 Off | FB INDATA4 On |
| 7 | Bypass Relay Disable | Bypass Relay Enable |
| 8 | FB Control Off | FB Control On |
| 9 | FB Reference Off | FB Reference On |
| 10–15 | Not in use | Not in use |

**Speed reference**

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MSB | — | — | — | — | — | — | — | — | — | — | — | — | — | — | LSB |

This is the Reference 1 to the VFD. Used normally as Speed reference.

The scaling on this value is 0–100.00% of the Maximum Frequency (P1.2). The 0 to 100.00% is represented by 0 to 10,000 value indicating 0 or 0% as Minimum Frequency (P1.1) and 10,000 or %100.00 as Maximum Frequency (P1.2). This value has 2 decimal places in it.

## Process data in 1 to 8

Process Data In values 1 to 8 can be used in applications for various purposes. See below Process Data IN section for setup.

## Process data out

This register range is normally used to fast monitoring of the VFD. Process Data Out is located in range ID 2101–2199. See table below.

**Table 50. Fieldbus basic output table**

| ID | Modbus register | Group | Range/Type |
|---|---|---|---|
| 2101 | 32101, 42101 | FB Status Word | Binary coded |
| 2102 | 32102, 42102 | FB General Status Word | Binary coded |
| 2103 | 32103, 42103 | FB Actual Speed | % |
| 2104 | 32104, 42104 | FB Process Data Out 1 | |
| 2105 | 32105, 42105 | FB Process Data Out 2 | |
| 2106 | 32106, 42106 | FB Process Data Out 3 | |
| 2107 | 32107, 42107 | FB Process Data Out 4 | |
| 2108 | 32108, 42108 | FB Process Data Out 5 | |
| 2109 | 32109, 42109 | FB Process Data Out 6 | |
| 2110 | 32110, 42110 | FB Process Data Out 7 | |
| 2111 | 32111, 42111 | FB Process Data Out 8 | |

**FB status word**

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| — | — | — | — | — | — | — | — | RUNEN | BYS | AREF | WARN | FLT | DIR | RUN | RDY |

Information about the status of the device and messages is indicated in the Status Word. The Status Word is composed of 16 bits that have the following meanings.

**Table 51. FB status word bit descriptions**

| Bit | Description Value = 0 | Value = 1 |
|---|---|---|
| 0 | Not Ready | Ready |
| 1 | STOP | RUN |
| 2 | Clockwise | Counterclockwise |
| 3 | — | Faulted |
| 4 | — | Warning |
| 5 | Ref. frequency not reached | Ref. frequency reached |
| 6 | Bypass not activated | Bypass activated |
| 7 | Run disable | Run Enable |
| 8 | Not in use | Not in use |
| 9–15 | Not in use | Not In use |

**Table 52. FB general status word**

| Bit | Description value = 0 | Value = 1 |
|---|---|---|
| 0 | Not Ready | Ready |
| 1 | Stop | Run |
| 2 | Clockwise | Counter Clockwise |
| 3 | No Fault | Fault |
| 4 | No Warning | Warning |
| 5 | Ref. Frequency Not Reached | Ref. Frequency Reached |
| 6 | Ref > 0 Speed | Ref = 0 speed |
| 7 | Motor Flux Off | Motor Flux On ① |
| 8 | Motor Speed Limit On | Motor Speed Limit Off ① |
| 9 | Encoder Direction Off | Encoder Direction On ① |
| 10 | Under Voltage Fast Stop Off | Under Voltage Fast Stop On ① |
| 11 | DC Brake Off | DC Brake On |
| 12 | FB Ref Not Enable | FB Ref Enabled |
| 13 | Motor Start Delay Off | Motor Start Delay On |
| 14 | Remote Not Enable | Remote Enable |
| 15 | FB WD Pulse Not Enabled | FB WD Pulse Enable ① |

① Indicates the bit is not used.

**Actual speed**

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MSB | — | — | — | — | — | — | — | — | — | — | — | — | — | — | LSB |

This is the Actual Speed of the motor.This value comes back in the form of %

## Process data out 1 to 8

Process Data Out values 1 to 8 can be used in application for various purposes. See below tables for additional information.

## Process data OUT (subordinate⟶ master)

The fieldbus master can read the VFD's actual values using process data variables. Variable Speed Drive Series III applications use process data as follows. These values are selectable via the Fieldbus Process Data parameter group. These values would correspond to the Modbus ID value. See **Appendix A** for Parameter ID table showing values can be set.

**Table 53. Process data OUT**

| ID | Data | Value | Default value | Default para | Unit | Scale |
|---|---|---|---|---|---|---|
| 2104 | Process Data OUT 1 | -32768–32767 | 1 | Output Frequency | Hz | |
| 2105 | Process Data OUT 2 | -32768–32767 | 2 | Motor Speed | RPM | |
| 2106 | Process Data OUT 3 | -32768–32767 | 3 | Motor Current | A | |
| 2107 | Process Data OUT 4 | -32768–32767 | 4 | Motor Torque | % | |
| 2108 | Process Data OUT 5 | -32768–32767 | 5 | Motor Power | % | |
| 2109 | Process Data OUT 6 | -32768–32767 | 6 | Motor Voltage | V | |
| 2110 | Process Data OUT 7 | -32768–32767 | 7 | DC Link Voltage | V | |
| 2111 | Process Data OUT 8 | -32768–32767 | 28 | Latest Fault Code | — | |

## Process data IN (master →subordinate)

Control Word, Reference and Process Data are used with All-in-One applications as follows.

**Table 54. Process data IN**

| ID | Data | Value | Unit | Scale |
|---|---|---|---|---|
| 2003 | Reference | Speed Reference | % | 0.01 |
| 2001 | Control Word | — | — | — |
| 2004 | Process Data IN1 | ① | % | 0.01% |
| 2005 | Process Data IN2 | ① | % | 0.01% |
| 2006 | Process Data IN3 | ① | % | 0.01% |
| 2007 | Process Data IN4 | ① | % | 0.01% |
| 2008 | Process Data IN5 | ① | % | 0.01% |
| 2009 | Process Data IN6 | ① | % | 0.01% |
| 2010 | Process Data IN7 | ① | % | 0.01% |
| 2011 | Process Data IN8 | ① | % | 0.01% |

① Process Data IN1 through Process Data IN8 change based off the selected application. See **Appendix B** for layout.

# BACnet MS/TP—On-Board Communication

BACnet stands for Building Automation and Control Networks. It is the common name for the communication standard ISO 16484-5 which defines the methods and the protocol for cooperating building automation devices to communicate. Devices can be designed to operate using BACnet communication protocol as well as utilizing BACnet protocol to communicate between systems. BACnet is an internationally accepted protocol for building automation (such as lightning control, air conditioning and heating automation) and control over a communications network. BACnet provides a method by which computer-based control equipment, from different manufacturers can work together, or "interoperate." For this to be achieved, components must be able to exchange and understand BACnet data messages. Your drive is equipped with BACnet support as standard.

### BACnet MS/TP specifications

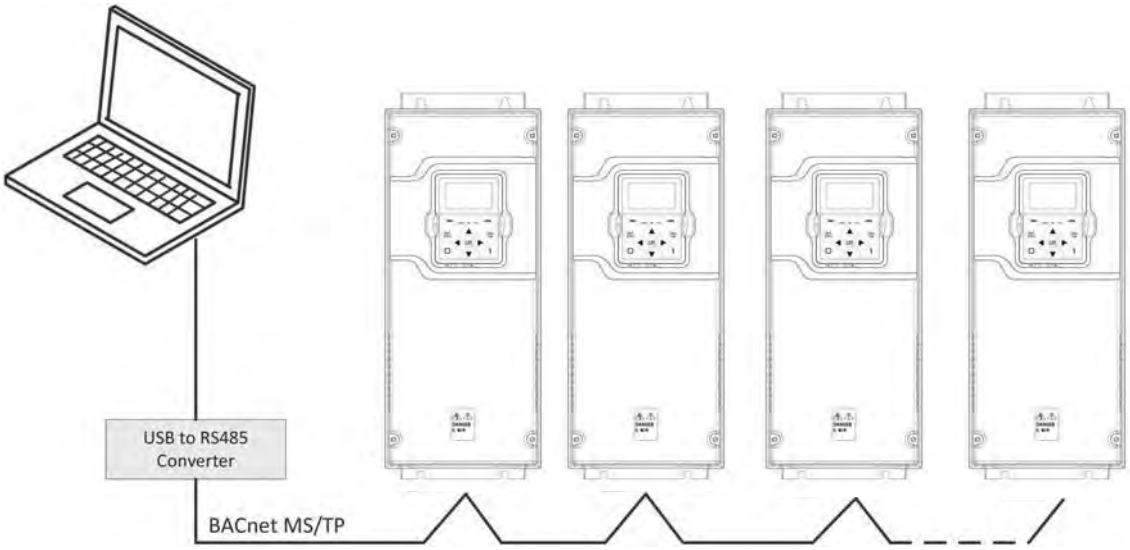
**Table 55. BACnet MS/TP technical data**

| Item | Description |
|---|---|
| Interface | RS-485 |
| Data transfer method | RS-485, half-duplex |
| Transfer cable | STP (Shielded Twisted Pair), type Belden or similar |
| Connection: Electrical isolation | Communication: Functional |
| Connection: BACnet MS/TP | Communication: As described in ANSI/ ASHRAE Standards 135-2004 |
| Connection: Baud rate | Communication: 9600, 19200, 38400, 76800, 115200 |

## *BACnet MS/TP connections*

The control board is located inside the control unit of the drive.

**Figure 16. Principal example diagram**



### Prepare for use through MS/TP

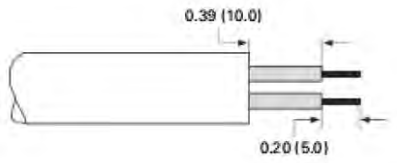
1. Open the cover of the AC drive.

**⚠ WARNING**

**The relay outputs and other I/O-terminals may have a dangerous control voltage present even when drive is disconnected from mains.**

2. Locate the components that you will need on the drive to connect and run the BACnet cables.
3. Strip about 0.59 in (15 mm) of the RS-485 cable and cut off the grey cable shield. Remember to do this for both bus cables (except for the last device). Leave no more than 0.39 in (10 mm) of the cable outside the terminal block and strip the cables at about 0.20 in (5 mm) to fit in the terminals. See illustration below.

**Figure 17. Stripping the cable**

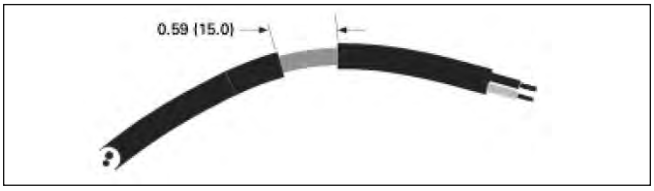



Also strip the cable now at such a distance from the terminal that you can fix it to the frame with the grounding clamp. Strip the cable at a maximum length of 0.59 in (15 mm).

**⚠ IMPORTANT**

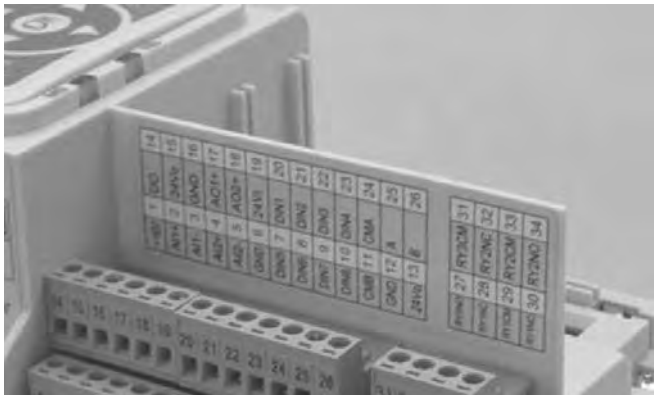
**Do not strip the aluminum cable shield!**

**Figure 18. RS-485 Cable strip (Aluminum Shield)**



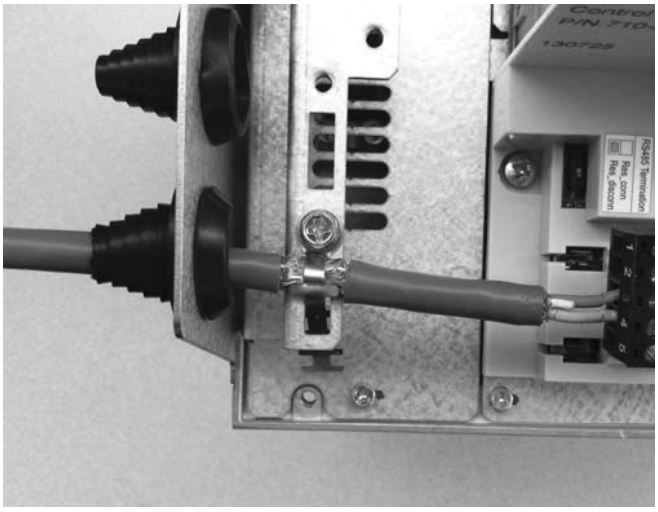

4. Then connect the cable to its appropriate terminals on the drive standard terminal block, terminals A and B (A = positive, B = negative). See illustration below.

**Figure 19. Drive terminals (BACnet)**



5. Using the cable clamp included in the delivery of the drive, ground the shield of the RS-485 cable to the frame of the AC drive.

**Figure 20. Serial ground**

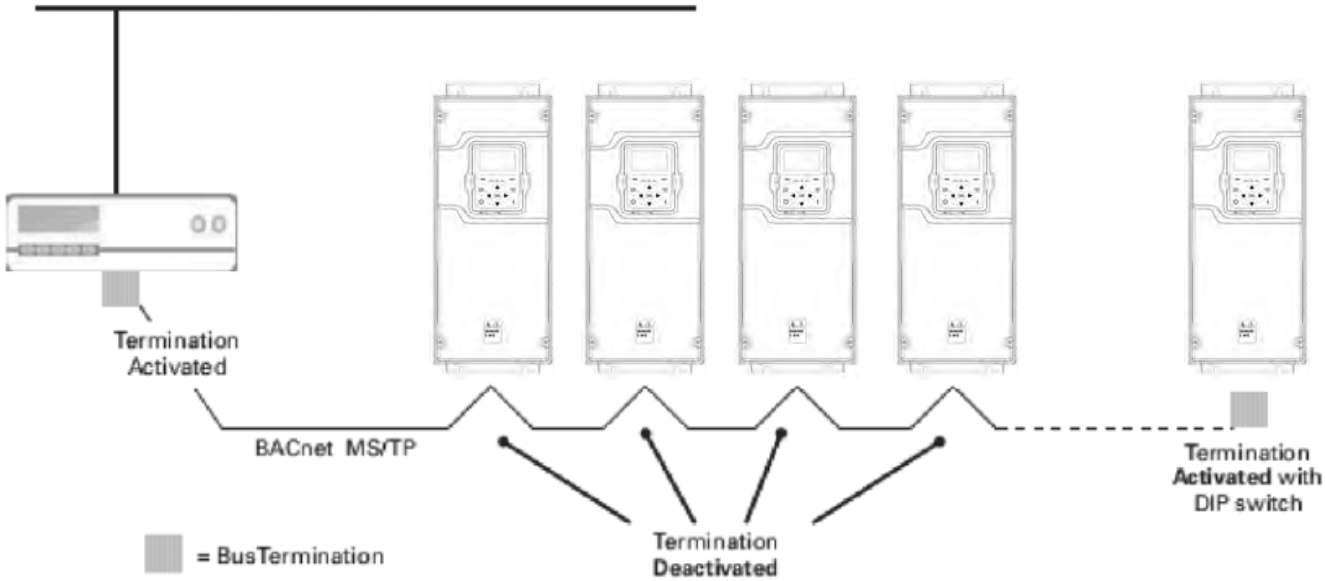


6. If the drive is the last device on the bus, the bus termination must be set. Locate the DIP switches to the right of the control keypad of the drive and turn the switch for the RS-485 bus termination resistor to position ON. Biasing is built in the termination resistor. See also step 8 below.

**Figure 21. RS-485 Bus termination setup**

**BACnet MS/TP bus termination**

**Figure 22. BACnet bus termination**




7. Remount the AC drive cover.

**Note:** When planning the cable runs, remember to keep the distance between the fieldbus cable and the motor cable at a minimum of 11.81 in (30 cm).

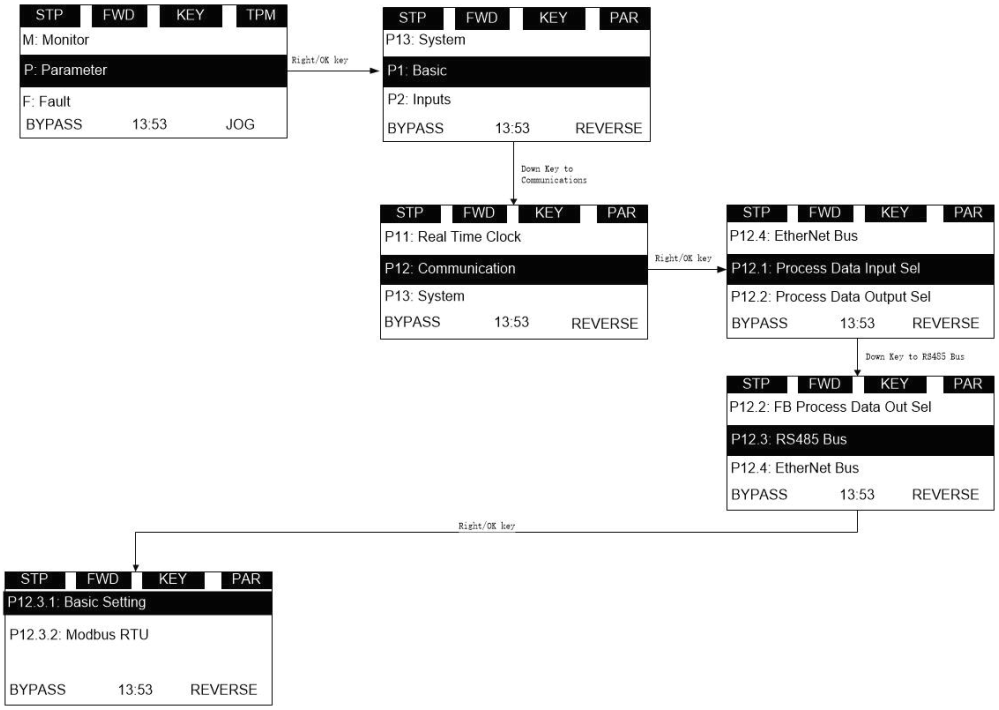
8. The bus termination must be set for the first and last device of the fieldbus line. See illustration below. See also step 6 above. We recommend that the first device on the bus terminated is the Master device.

## Commissioning

### BACnet programming

The navigation path to the fieldbus parameters may differ from application to application. The exemplary paths below apply to the drive.

**Figure 23. VS3 BACnet MSTP parameter navigation**




1. First ensure that the right fieldbus protocol is selected.

Navigate:

Main Menu ⟶ Parameter ⟶ Communication ⟶ RS485 Bus ⟶ RS-485 Comm Set ⟶ Edit ⟶ (Choose Protocol as BACnet MS/TP)

***BACnet MS/TP Parameters and monitoring values***

**Table 56. BACnet MS/TP Parameter Table**

| VS3 code | Parameter | Min. | Max. | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|
| P12.3.1.1 | RS485 Comm Set | | | | 0 | 586 | 0 = Modbus RTU<br>1 = BACnet MS/TP |
| P12.3.3.1 | BACnet Baud Rate | | | | 2 | 594 | 0 = 9600<br>1 = 19200<br>2 = 38400<br>3 = 768000<br>4 = 115200 |
| P12.3.3.2 | MAC Address | 0 | 127 | | 1 | 595 | |
| P12.3.3.3 | Instance Number | 0 | 4194302 | | varies | 596 | |
| P12.3.3.4 | Comm Timeout BACnet | | | ms | 10000 | 598 | |
| P12.3.3.5 | Protocol Status | | | | 0 | 599 | 0 = Stopped<br>1 = Operational<br>2 = Faulted |
| P12.3.3.6 | Fault Code | | | | 0 | 600 | 0 = None<br>1 = Sole Master |
| P12.3.3.7 | Modbus RTU/BACNet Fault Response | 0 | 1 | | 0 | 2516 | 0 = In Fieldbus Control<br>1 = in all Control |
| P12.3.3.8 | Max Master | 0 | 127 | | 127 | 1537 | |

## BACnet MS/TP parameters

### *Baud Rate*

Select the communication speed for the network. The default value is 38400 baud.

### *MAC address*

The parameters of every device must be set before connecting to the bus. Especially the parameters MAC Address and baud rate must be the same as in the master's configuration. The first parameter, MAC (Medium Access Control) address, must be unique on the network to which it is connected. The same MAC address may be used on a device on another network within the internetwork. Addresses 128–254 are reserved for subordinates. Addresses 1–127 are valid for both masters and subordinates. The portion of the address space that is actually used for masters in a particular installation is determined by the value of the Max_Master property of the device object. It is recommended that MAC address 0 be reserved for the MS/ TP router and MAC address 255 is used for broadcasts.

### *Instance number*

The Device Object's Instance number is used in conjunction with the MAC address to assign the devices on the network. The instance number can have up to 127 nodes on it before a different instance number is required.

### *Communication time-out*

BACnet board initiates a communication error if the board is a "sole master" in the network for a time defined with this parameter.

## BACnet overview

### BACnet technical data

*Protocol Implementation Conformance Statement (PICS)*

Controller Profile

- B—ASC

Segmentation Capability

- Not supported

Data Link Layer and Routing Options

- MS/TP Master Baud rates (9600,19200,38400, 76800, 115200)

Character Sets Supported

- UTF8

BIBBS Supported

- Data Sharing
  - ReadProperty—B
  - WriteProperty—B
- Device Management
  - Dynamic Device Binding—B
  - Dynamic Object Binding—B
  - DeviceCommunicationControl—B
  - ReinitializeDevice—B
- Alarms and Events: Not supported
- Schedules: Not supported
- Trends: Not supported
- Network Management: Not supported

**Table 57. Supported object types and properties summary**

| Property | Device object type | Analog input object type | Analog value object type | Binary value object type | Multiple state value object type |
|---|---|---|---|---|---|
| Active_Cov_Subscriptions | | | | | |
| Active_Text | | | | X | |
| Active_Vt_Sessions | | | | | |
| Alarm_Value | | | | | |
| Alarm_Values | | | | | |
| Align_Intervals | | | | | |
| Apdu_Segment_Timeout | | | | | |
| Apdu_Timeout | X | | | | |
| Application_Software_Version | X | | | | |
| Auto_Subordinate_Discovery | | | | | |
| Backup_And_Restore_State | | | | | |
| Backup_Failure_Timeout | | | | | |
| Backup_Preparation_Time | | | | | |
| Change_Of_State_Count | | | | | |
| Change_Of_State_Time | | | | | |
| Configuration_Files | | | | | |
| Cov_Increment | | | | | |
| Database_Revision | X | | | | |
| Daylight_Savings_Status | | | | | |
| Deadband | | | | | |
| Description | X | X | X | X | X |
| Device_Address_Binding | X | | | | |
| Device_Type | | | | | |
| Elapsed_Active_Time | | | | | |
| Event_Algorithm_Inhibit | | | | | |
| Event_Algorithm_Inhibit_Ref | | | | | |
| Event_Detection_Enable | | | | | |
| Event_Enable | | | | | |
| Event_Message_Texts | | | | | |
| Event_Message_Texts_Config | | | | | |
| Event_State | | X | X | X | X |
| Event_Time_Stamps | | | | | |
| Fault_Values | | | | | |
| Firmware_Revision | X | | | | |
| High_Limit | | | | | |
| Inactive_Text | | | | X | |
| Interval_Offset | | | | | |
| Last_Restart_Reason | | | | | |
| Last_Restore_Time | | | | | |
| Limit_Enable | | | | | |
| Local_Date | | | | | |
| Local_Time | | | | | |

**Table 57. Supported object types and properties summary, continued**

| Property | Device object type | Analog input object type | Analog value object type | Binary value object type | Multiple state value object type |
|---|---|---|---|---|---|
| Location | | | | | |
| Low_Limit | | | | | |
| Manual_Subordinate_Address_Binding | | | | | |
| Max_Apdu_Length_Accepted | X | | | | |
| Max_Info_Frames | X | | | | |
| Max_Master | X | | | | |
| Max_Pres_Value | | | | | |
| Max_Segments_Accepted | | | | | |
| Min_Pres_Value | | | | | |
| Minimum_Off_Time | | | | | |
| Minimum_On_Time | | | | | |
| Model_Name | X | | | | |
| Notification_Class | | | | | |
| Notify_Type | | | | | |
| Number_Of_Apdu_Retries | X | | | | |
| Number_Of_States | | | | | X |
| Object_Identifier | X | X | X | X | X |
| Object_List | X | | | | |
| Object_Name | X | X | X | X | X |
| Object_Type | X | X | X | X | X |
| Out_Of_Service | | X | X | X | X |
| Password ① | X | | | | |
| Present_Value | | X | X | X | X |
| Priority_array | | | X | X | |
| Profile_Name | X | | | | |
| Protocol_Object_Types_supported | X | | | | |
| Protocol_Revision | X | | | | |
| Protocol_Services_Supported | X | | | | |
| Protocol_Version | X | | | | |
| Reliability | | | | | |
| Reliability_Evaluation_Inhibit | | | | | |
| Relinquish_Default | | | X | X | |
| Resolution | | | | | |
| Restart_Notification_Recipients | | | | | |
| Restore_Completion_Time | | | | | |
| Restore_Preparation_Time | | | | | |
| Segmentation_Supported | X | | | | |

① Password is a vendor specific property added to device object with property identifier as 600. Default value of password is empty string; this is a writable property with max length of 20, it always returns ***** on read. Same password will be used for Reinitialize Device Service and Device communication Control service.

**Table 57. Supported object types and properties summary, continued**

| Property | Device object type | Analog input object type | Analog value object type | Binary value object type | Multiple state value object type |
|---|---|---|---|---|---|
| Serial_Number | X | | | | |
| Subordinate_Address_Binding | | | | | |
| Subordinate_Proxy_Enable | | | | | |
| State_Text | | | | | X |
| Status_Flags | | X | X | X | X |
| Structured_Object_list | | | | | |
| System_Status | X | | | | |
| Time_Delay | | | | | |
| Time_Delay_Normal | | | | | |
| Time_Of_Active_Time-reset | | | | | |
| Time_Of_Device_Restart | | | | | |
| Time_Of_State_Count_Reset | | | | | |
| Time_Synchronization_Interval | | | | | |
| Time_Synchronization_Recipients | | | | | |
| Units | | X | X | | |
| Update_Interval | | | | | |
| Utc_Offset | | | | | |
| Utc_Time_Synchronization_Recipients | | | | | |
| Vendor_Identifier | X | | | | |
| Vendor_Name | X | | | | |
| Vt_Classes_Supported | | | | | |

### Object instance summary

*Binary Value Object Instance Summary*

The following table summarizes the Binary Value Objects supported.

**Table 58. Binary value object instance summary**

| Instance ID | Object name (related To drive parameter) | Description | Inactive/Active text | Preset value access |
|---|---|---|---|---|
| BV0 | Ready State | Indicates whether the drive is ready or not | Not Ready/Ready | R |
| BV1 | Run/Stop State | Indicates whether the drive is running or stopped | Stop/Run | R |
| BV2 | Fwd/Rev State | Indicates the rotation direction of motor | Fwd/Rev | R |
| BV3 | Fault State | Indicates if a fault is active | OK/Fault | R |
| BV4 | Warning State | Indicates if a warning is active | OK/Warning | R |
| BV5 | At Setpoint | Ref. Frequency reached | False/True | R |
| BV6 | At Zero Speed | Motor Running at zero speed | False/True | R |
| BV7 | Motor Ctrl source | Command to change active source for controlling motor | LocalMotorCtrl / FBMotorCtrl | C |
| BV8 | Speed Reference Source | Command to change source of motor speed reference | LocalSpeedRef / FBSpeedRef | C |
| BV9 | Run/Stop CMD | Command to start drive | Stop/Run | C |
| BV10 | Fwd/Rev CMD | Command to change rotational direction | Fwd/Rev | C |
| BV11 | Reset Fault | Command to reset active Fault from drive | 0/Reset | C |
| BV12 | Digital Input 1 | Digital Input 1 | OFF/ON | R |
| BV13 | Digital Input 2 | Digital Input 2 | OFF/ON | R |
| BV14 | Digital Input 3 | Digital Input 3 | OFF/ON | R |
| BV15 | Digital Input 4 | Digital Input 4 | OFF/ON | R |
| BV16 | Digital Input 5 | Digital Input 5 | OFF/ON | R |
| BV17 | Digital Input 6 | Digital Input 6 | OFF/ON | R |
| BV18 | Digital Input 7 | Digital Input 7 | OFF/ON | R |
| BV19 | Digital Input 8 | Digital Input 8 | OFF/ON | R |
| BV20 | Digital Output 1 | Digital Output 1 | OFF/ON | R |
| BV21 | Digital Output 2 | Relay 1 Output | OFF/ON | R |
| BV22 | Digital Output 3 | Relay 2 Output | OFF/ON | R |
| BV23 | Digital Output 4 | Relay 3 Output | OFF/ON | R |
| BV24 | Stop By Coast | Indicates if drive stop by coast | ON/OFF | C |
| BV25 | Stop By Ramp | Indicates if drive stop by Ramp | OFF/ON | C |
| BV26 | Belt Broken | Indicates If belt is broken | OFF/ON | R |
| BV27 | Drive Fan Failure | Indicates if Drive Fan failed | OFF/ON | R |
| BV28 | Force Bypass | Command to take Drive in Bypass Mode | OFF/ON | C |
| BV29 | Fire Mode | Enable Fire Mode | OFF/ON | C |
| BV30 | DIN 1 | Fieldbus Digital Input | OFF/ON | C |
| BV31 | DIN 2 | Fieldbus Digital Input | OFF/ON | C |
| BV32 | DIN 3 | Fieldbus Digital Input | OFF/ON | C |
| BV33 | DIN 4 | Fieldbus Digital Input | OFF/ON | C |

**Note:** For Present Value Access Types, R = Read-only, W = Writeable, C = Commandable.

Commandable values support priority arrays and relinquish defaults.

### Analog value object instance summary

The following table summarizes the Analog Value Objects supported.

**Table 59. Analog value object instance summary**

| Instance ID | Object name | Description | Units | Preset value access |
|---|---|---|---|---|
| AV0 | Speed Reference | Motor speed reference from network | Percent | C |
| AV1 | Current Limit | Current Limit | Amps | W |
| AV2 | Min Frequency | Minimum Frequency | Hz | W |
| AV3 | Maximum Frequency | Maximum Frequency | Hz | W |
| AV4 | Accel Time 1 | Acceleration Time | seconds | W |
| AV5 | Decel Time 1 | Deceleration Time | seconds | W |
| AV6 | AnyParam ID | Parameter ID number to be accessed | No Units | W |
| AV7 | AnyParam Value | Value of parameter defined by AV6 | No Units | W |
| AV8 | Process Data In 1 | Fieldbus Process Data In 1 | NA | C |
| AV9 | Process Data In 2 | Fieldbus Process Data In 2 | NA | C |
| AV10 | Process Data In 3 | Fieldbus Process Data In 3 | NA | C |
| AV11 | Process Data In 4 | Fieldbus Process Data In 4 | NA | C |
| AV12 | Process Data In 5 | Fieldbus Process Data In 5 | NA | C |
| AV13 | Process Data In 6 | Fieldbus Process Data In 6 | NA | C |
| AV14 | Process Data In 7 | Fieldbus Process Data In 7 | NA | C |
| AV15 | Process Data In 8 | Fieldbus Process Data In 8 | NA | C |

**Note:** For Present Value Access Types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays and relinquish defaults.

**Table 60. Analog Input object instance summary**

| Instance ID | Object name | Description | Units | Preset value access |
|---|---|---|---|---|
| AI0 | Frequency Setpoint | Frequency Setpoint | Hz | R |
| AI1 | Output Frequency | Output Frequency | Hz | R |
| AI2 | Motor Speed | Motor Speed | Rpm | R |
| AI3 | Motor Load | Motor Load | Percent | R |
| AI4 | Kilowatt Hours total | Kilowatt Hour Counter (Total) scaled by 1000 | KWh | R |
| AI5 | Motor Current | Motor Current | Amps | R |
| AI6 | DC link Voltage | DC link Voltage | Volts | R |
| AI7 | Motor Voltage | Motor Voltage | Volts | R |
| AI8 | Unit Temperature | Heatsink Temperature | °C | R |
| AI9 | Motor Torque | In % of motor nominal Torque | Percent | R |
| AI10 | Operating Days | Operating Days (resettable) | Day | R |
| AI11 | Operating Hours | Operating Hours (resettable) | Hour | R |
| AI12 | Motor Temperature | Motor Temperature | Percent | R |
| AI13 | Analog Input 1 | Analog Input 1 | Volts | R |
| AI14 | Analog Input 2 | Analog Input 2 | Volts | R |
| AI15 | Analog Output 1 | Analog Output 1 | Volts | R |
| AI16 | Analog Output 2 | Analog Output 2 | Volts | R |
| AI17 | Kilowatt Instantaneous | Kilowatt Instantaneous | KW | R |

**Table 60. Analog Input object instance summary, continued**

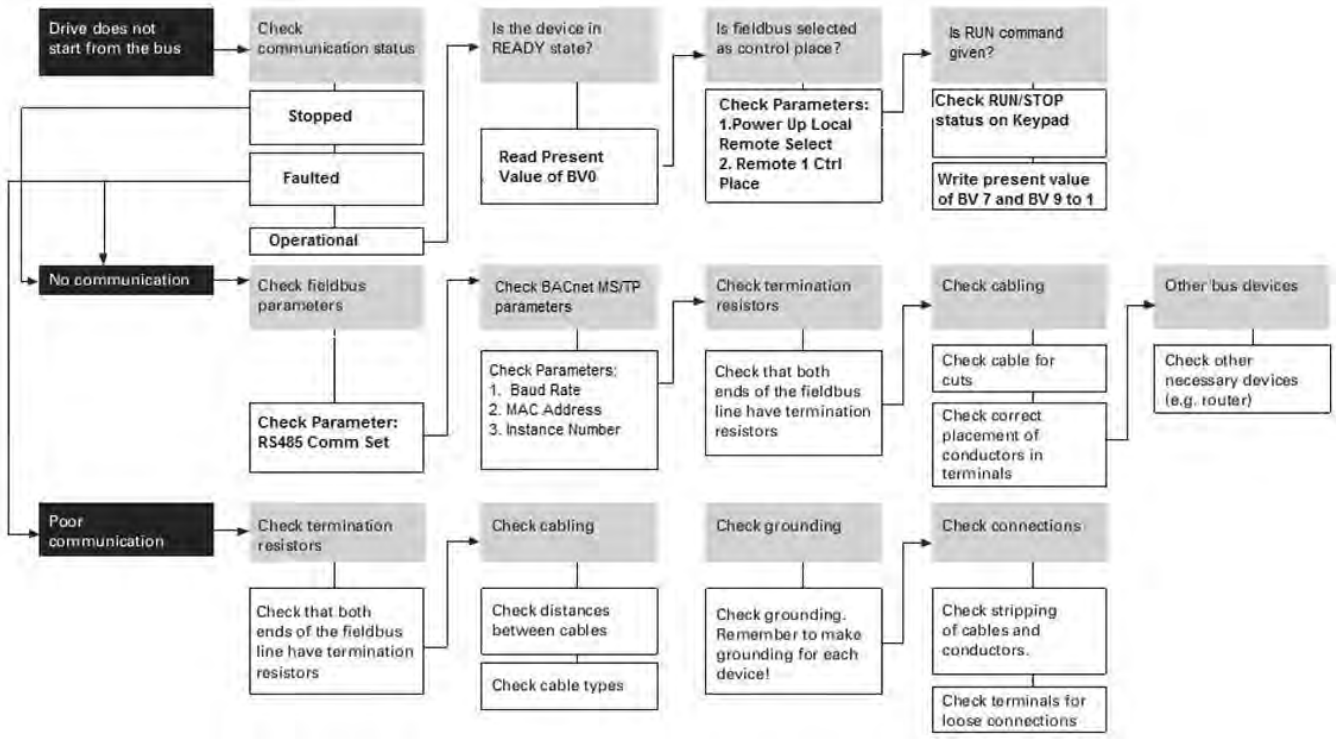
| Instance ID | Object name | Description | Units | Preset value access |
|---|---|---|---|---|
| AI18 | Process Data Out 1 | Fieldbus Process Data Out 1 | NA | R |
| AI19 | Process Data Out 2 | Fieldbus Process Data Out 2 | NA | R |
| AI20 | Process Data Out 3 | Fieldbus Process Data Out 3 | NA | R |
| AI21 | Process Data Out 4 | Fieldbus Process Data Out 4 | NA | R |
| AI22 | Process Data Out 5 | Fieldbus Process Data Out 5 | NA | R |
| AI23 | Process Data Out 6 | Fieldbus Process Data Out 6 | NA | R |
| AI24 | Process Data Out 7 | Fieldbus Process Data Out 7 | NA | R |
| AI25 | Process Data Out 8 | Fieldbus Process Data Out 8 | NA | R |

**Note:** Line length depends on different transmission speeds.

**Table 61. Multi state object instance summary**

| Instance ID | Object name | Description | State text | Preset value access |
|---|---|---|---|---|
| MV0 | Control mode | Indicates the drive control mode - local, remote or off | 0 Local(Hand) / 1 – Remote / 2 - OFF | R |
| MV1 | Active fault code | Indicates the latest active fault code of the drive | State text w.r.t the active fault code | R |

**Figure 24. Fault tracing**



# PROFIBUS-DP External Communication Cards

Variable Speed Drive Series III can be connected to the PROFIBUS® DP using an optional PROFIBUS communication card. Variable Speed Drive Series III can be controlled, monitored and programmed from the Host system. The devices are connected in a bus structure. There is a max
of 32 stations (master or subordinate) can be connected to one segment bus. The bus is terminated at beginning and end of each segment. To ensure error-free operation, both bus terminations must always be powered, if more than 32 stations are used, repeaters are required.

## PROFIBUS specifications

**Table 62. PROFIBUS technical data**

| Items | Value |
|---|---|
| Terminal | DB9 connector (Female) or 5.00 mm connector (male) |
| Data transfer method | RS-485 half-duplex |
| Cable | Twisted pair (1 pair and shield) |
| Isolation | 500 Vdc |
| Protocol | PROFIBUS-DP-V1 |
| DOIO type | ST1 Telegram |
| Baud rate | 9.6K~12M |
| Addresses | 2~125 |
| **Environment** | |
| Ambient operating temperature | –10°C to +55°C |
| Storing temperature | –40°C to +60°C |
| Humidity | <95%, no condensation allowed |
| Altitude | Max. 1000m |
| Vibration | 0.5G at 9–200 Hz |
| Safety | Fulfills EN 50178 standard |

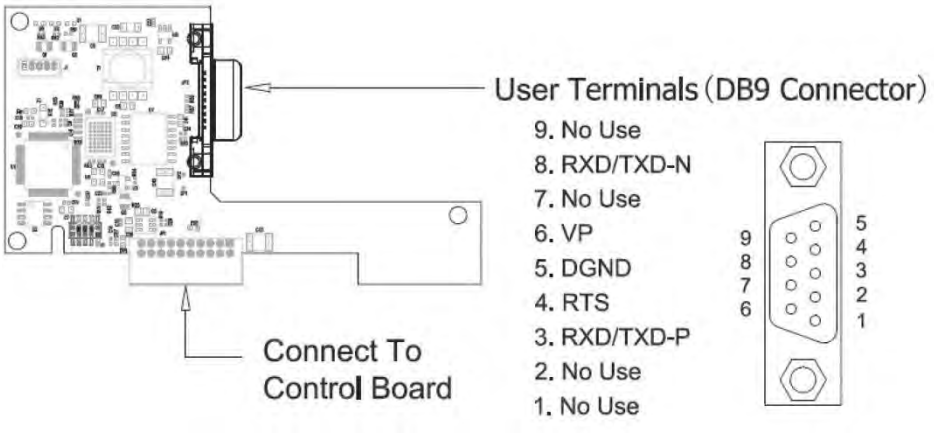
**Table 63. Line length**

| Baud rate (kbit/s) | 9.6 | 19.2 | 93.75 | 187.5 | 500 | 1500 | 3000–12000 |
|---|---|---|---|---|---|---|---|
| Length line A [m] | 1200 | 1200 | 1200 | 1000 | 400 | 200 | 100 |
| Length line B [m] | 1200 | 1200 | 1200 | 600 | 200 | — | — |

**Note:** Line length depends on different transmission speeds.

## Hardware specifications

**Figure 25. Com1 PROFIBUS card layout**




### LEDs

PROFIBUS LEDs are as stated below.

**Table 64. PROFIBUS LEDs**

| ON (GREEN, the left one) | BF (RED, the middle one) | SF (RED, the right one) | Fault condition |
|---|---|---|---|
| Blinking | Blinking | Blinking | Board Initialization |
| ON | OFF | OFF | Everything OK |
| ON | ON | OFF | No communication |
| ON | blinking | OFF | Communication, but not in data exchange |
| ON | ON | ON | No communication and system fault |
| ON | OFF | ON | Communication and system fault |

***Connector On-Board***

Use DB-9 connector, pin assignment as below.

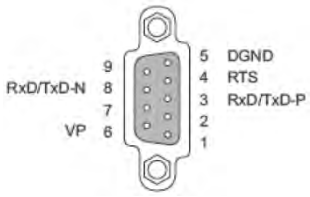


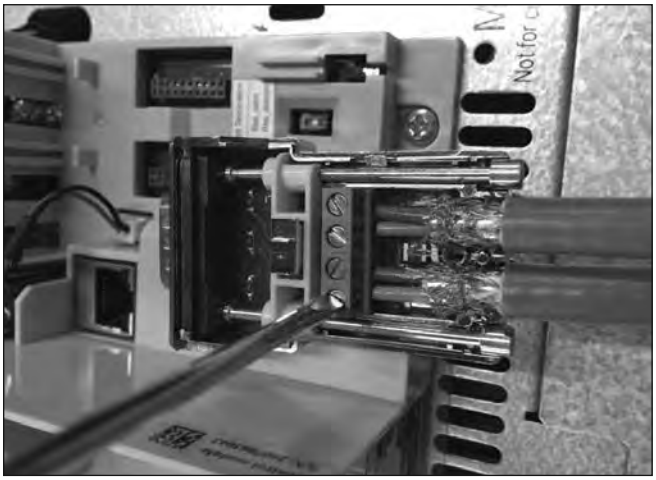

**Table 65. Connector and pin assignment**

| Pin number | Purpose |
|---|---|
| Housing | Shield, Connected to PE |
| 1 | No use (or Shield, shield or protect GND) |
| 2 | No use (or M24, Minus 24V output Voltage) |
| 3 | RXD/TXD-P, Positive of Receive or Transmit signal |
| 4 | RTS, Request To Send |
| 5 | DGND, GND of signal (Isolated GND from RS-485 side) |
| 6 | VP, +5V, (Voltage- Plus, Isolated 5V from RS-485 side) |
| 7 | No use (or P24, Plus 24V Output Voltage) |
| 8 | RXD/TXD-N, Negative of Receive or Transmit signal |
| 9 | No use (or CNTR_N, Control-N) |

Use 5.0 mm connector and pin assignment.

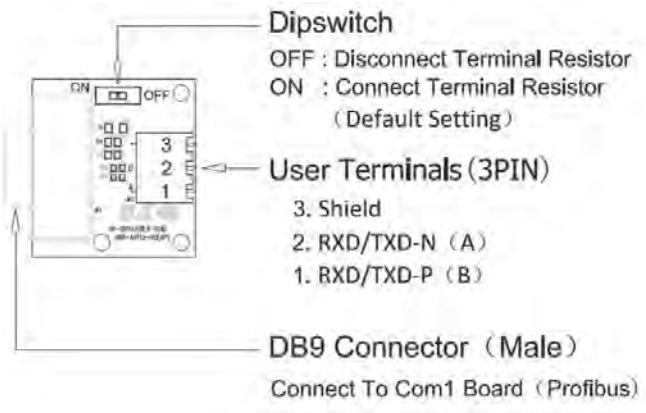
***Connector on customer side***

Customer side connector for DB9.



Customer side connector for 5.0 mm.

**Figure 26. Com1 PROFIBUS DB9 adapter**




## PROFIBUS cable

Two types of cables can be used for PROFIBUS connection.

**Table 66. PROFIBUS cable connections**

| Parameter | Line A | Line B |
|---|---|---|
| Impedance | 135–165 Ω (3–20 MHz) | 100–130 Ω (f >100 kHz) |
| Capacity | <30 pF/m | <60 pf/m |
| Resistance | <100 Ω/km | — |
| Wire gauge | >0.64 mm | >0.53 mm |
| Conductor area | >0.34 $mm^2$ | >0.22 $mm^2$ |

**Table 67. Recommended cable**

| Cable | Description | Part Number |
|---|---|---|
| Belden | PROFIBUS Data Cable | **3079A** |
| Olflex | PROFIBUS Cable | **21702xx** |
| Siemens | SINEC L2 LAN cable for PROFIBUS | **6XV1830 = 0AH0** |

## Commissioning

The PROFIBUS board is commissioned by inserting it into the Slot A or Slot B on the drive control board. Once the card is inserted to the slot, the device will recognize it and will show a warning for "Device Added." This warning will be shown for 5 seconds and will be cleared. Once the card is detected, the keypad will show the menu for this card in Optional Card Menu.

## Optional comm cards parameters

Once the card is detected, following parameters can be set on keypad for the PROFIBUS.

**Figure 27. PROFIBUS parameter menu**

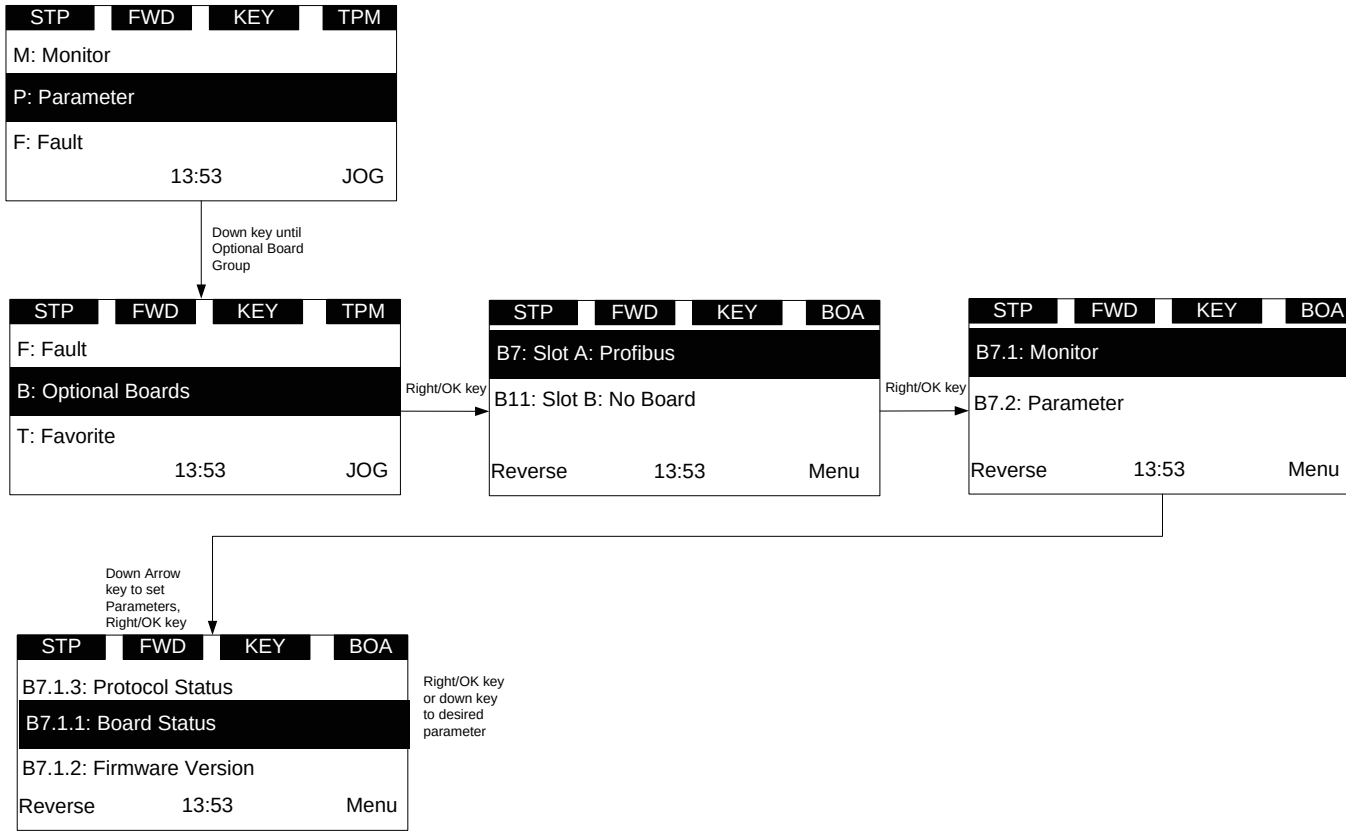


**Table 68. PROFIBUS parameters**

| VS3 code | Parameter | Min. | Max. | Unit | Default | ID (Slot A/Slot B) | Note |
|---|---|---|---|---|---|---|---|
| BX.1 | Monitor | | | | | | |
| BX.1.1 | Device Parameters | | | | | | |
| BX.1.1.1 | Board Status | | | | 0 | 883/910 | B0 = Optional Comm. Card Fault |
| | | | | | | | B1 = Board HW Fault |
| | | | | | | | B2 = Reserved |
| | | | | | | | B3 = Fieldbus Fault |
| | | | | | | | B4 = Reserved |
| BX.1.1.2 | Firmware Version | | | | | 1064/1067 | V1.06.0005 |
| BX.1.1.3 | Protocol Status | | | | 0 | 2131/2142 | B0 = Waiting for Parameterization |
| | | | | | | | B1 = Parameterization Fault |
| | | | | | | | B2 = Waiting for Configuration |
| | | | | | | | B3 = Configuration Fault |
| | | | | | | | B4 = Data Exchange |
| BX.1.1.4 | PDP-Telegram Selection | 1 | 1 | | 1 | 1244/1252 | 1=Standard Telegram 1 |
| BX.1.1.5 | Fault Counter PDP | 0 | 65535 | | | | |
| BX.1.1.6 | Fault Situations Max | | | | 8x8 | | |
| BX.1.1.7 | PDP-Profil Number | | | | 341 | | |
| BX.1.1.8 | PDP-Control Word | 0x0000 | 0xFFFF | | | | |
| BX.1.1.9 | PDP-Status Word | 0x0000 | 0xFFFF | | | | |
| BX.1.2 | Parameter Access | | | | | | |
| BX.1.2.1 | PDP-MaxBlockLength | | | | 30 | | |
| BX.1.2.2 | PDP-NoOfMultiparameter | | | | 1 | | |
| BX.1.2.3 | PDP-MaxLatency | | | | 2 | | |
| BX.1.3 | DO Identification | | | | | | |
| BX.1.3.1 | PDP-DO Manufacturer | | | | 0x019D | | |
| BX.1.3.2 | PDP-DO Device Type | | | | 0x3000 | | |
| BX.1.3.3 | PDP-DO FW-Interface | | | | | | |
| BX.1.3.5 | PDP-DO FW-DayMonth | | | | | | |
| BX.1.3.6 | PDP-DO NoOfDOs | | | | 1 | | |
| BX.1.3.7 | PDP-DO Subclass | | | | 1 | | |
| BX.2 | Parameters | | | | | | |
| BX.2.1 | Subordinate Address | 2 | 125 | | 118 | 1242/1250 | Address of the PROFIBUS Subordinate |
| BX.2.1 | Baud Rate | 1 | 10 | | 10 | 1243/1251 | Baud Rate for PROFIBUS |
| | | | | | | | 10 = Automatic |
| BX.2.2 | Operation Mode | 1 | 2 | | 1 | 1245/1253 | Operation Mode |
| | | | | | | | 0 = PROFIdrive |
| | | | | | | | 1 = Echo |
| | | | | | | | 2 = Bypass |
| BX.2.3 | Comm. Card FB Fault Response | | | | | 2519/2520 | |
| BX.2.4 | Parameter Access | 0 | 1 | | 1 | | 0=Local Control; |

**Table 68. PROFIBUS parameters, continued**

| VS3 code | Parameter | Min. | Max. | Unit | Default | ID (Slot A/Slot B) | Note |
|---|---|---|---|---|---|---|---|
| BX.2.5 | Process Data Access | 0 | 5 | | 1 | | 1=Fieldbus;<br>2=NET Control, Local Ref;<br>4=NET, Local on Fault;<br>5=NET & Local CMD; |
| BX.2.6 | Fault Situation Counter | | | | | | |
| BX.2.7 | Parameter Sets | | | | | 619 | |

**Note:** X will depend on the slot the drive is in (Slot A = 7, Slot B = 14).

The parameters of every device must be set before connecting to the bus. Especially the parameters “Subordinate Address” must be same as set in Master.

## PROFIBUS—VS3

### General

Data transfer between PROFIBUS-DP master and subordinate takes place via the input/output data field. The master writes to subordinate’s output data and the subordinate answers by sending the contents of its inputs data to master. The content of the input/output data is defined in the device profile. The device profile for drives is PROFIdrive.

The drive can be controlled by PROFIBUS-DP Master using ST1 telegram of the PROFIdrive profile using the ST1 standard telegram in Drive profile mode, or using other modules in Bypass Mode. The Modules where Process Data values are returned can be used via the Bypass Operation mode. When Fieldbus has been selected as the active control place, the drive operation is controlled from PROFIBUS-DP Master as long as PNU927 = 1 and PNU928 = 1 by default. When these bits are disabled, it only allows monitoring values via cyclic and acyclic commands.

### Operation mode

The parameter Operation Mode BX.2.4 above defines how the input/output data is handled on the option board.

#### *PROFIdrive*

Data transfer follows the document PROFIBUS Profile for variable speed drives, PROFIdrive following the Standard Telegram 1.

#### *Echo*

The OUTPUT data written by the Master is echoed back to the Master in the INPUT field.

The data is not shown in the drive, but echoing is carried out on the option board.

This mode can be used when the function of the bus connection is tested.

#### *Bypass*

The information of the Process data field is transferred to the application interface without handling.

The desired Modules define the amount of data that is transferred. Once drive is set in Bypass mode, it will give the ability to set the desired module.

### PROFIdrive interface

PROFIdrive profile 4.1 allows:

- Direct control of the drive using PROFIBUS Master
- Full access to all drive parameters

### Control word and status word

The Control Word and Status Word used when in Bypass mode using one of the 4 modules will follow the layout used in Modbus for the CW, SW, Ref Speed, ACT Speed, and FB Data points.

### Control word

The drive uses 16 bits as shown below. These bits are application specific.

**Table 69. Binary bits and corresponding outputs**

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ① | ① | ① | ① | ① | ① | FB Ref | FB Ctrl | BYS | FB DIN 4 | FB DIN 3 | FB DIN 2 | FB DIN 1 | F_RST | DIR | RUN |

① The bit is not used.

### FB general control word

The drive does not use the FB General Control Word. The main control word is used to provide commands to the drive.

### FB control word

| Bit | Description value = 0 | Value = 1 |
|---|---|---|
| 0 | Drive Output Off | Drive Output On |
| 1 | Clockwise Rotation | Counter Clockwise |
| 2 | No Reset | Fault Reset |
| 3 | FB INDATA1 Off | FB INDATA1 On |
| 4 | FB INDATA2 Off | FB INDATA2 On |
| 5 | FB INDATA3 Off | FB INDATA3 On |
| 6 | FB INDATA4 Off | FB INDATA4 On |
| 7 | Bypass Relay Disable | Bypass Relay Enable |
| 8 | FB Control Off | FB Control On |
| 9 | FB Reference Off | FB Reference On |
| 10–15 | Not in use | Not in use |

### Speed reference

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MSB | — | — | — | — | — | — | — | — | — | — | — | — | — | — | LSB |

This is the Reference 1 to the VFD. Used normally as Speed reference.

The scaling on this value is 0–100.00% of the Maximum Frequency (P1.2). The 0 to 100.00% is represented by 0 to 10,000 value indicating 0 or 0% as Minimum Frequency (P1.1) and 10,000 or %100.00 as Maximum Frequency (P1.2). This value has 2 decimal places in it.

## Process data in 1 to 8

Process Data In values 1 to 8 can be used in applications for various purposes.

**Table 70. Bypass mode process data modules**

| Module | Byte 0 | Byte 1 | Byte 2 | Byte 3 | Byte 4 | Byte 5 | Byte 6 | Byte 7 | Byte 8 | Byte 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Module 1 ① | CW | REF | FBData_In_1 | FBData_In_2 | | | | | | |
| | SW | ACT | FBData_Out_1 | FBData_Out_2 | | | | | | |
| Module 2 ① | CW | REF | FBData_In_1 | FBData_In_2 | FBData_In_3 | FBData_In_4 | | | | |
| | SW | ACT | FBData_Out_1 | FBData_Out_2 | FBData_Out_3 | FBData_Out_4 | | | | |
| Module 3 ① | CW | REF | FBData_In_1 | FBData_In_2 | FBData_In_3 | FBData_In_4 | FBData_In_5 | FBData_In_6 | | |
| | SW | ACT | FBData_Out_1 | FBData_Out_2 | FBData_Out_3 | FBData_Out_4 | FBData_Out_5 | FBData_Out_6 | | |
| Module 4 ① | CW | REF | FBData_In_1 | FBData_In_2 | FBData_In_3 | FBData_In_4 | FBData_In_5 | FBData_In_6 | FBData_In_7 | FBData_In_8 |
| | SW | ACT | FBData_Out_1 | FBData_Out_2 | FBData_Out_3 | FBData_Out_4 | FBData_Out_5 | FBData_Out_6 | FBData_Out_7 | FBData_Out_8 |

① Only available in bypass mode.

### Process data out

This register range is normally used to fast monitoring of the VFD. Process Data Out is located in range ID 2104–2111. See table below.

**Table 71. Fieldbus basic output table**

| ID | Modbus register | Group | Range/Type |
|---|---|---|---|
| 2101 | 32101, 42101 | FB Status Word | Binary coded |
| 2102 | 32102, 42102 | FB General Status Word | Binary coded |
| 2103 | 32103, 42103 | FB Actual Speed | % |
| 2104 | 32104, 42104 | FB Process Data Out 1 | |
| 2105 | 32105, 42105 | FB Process Data Out 2 | |
| 2106 | 32106, 42106 | FB Process Data Out 3 | |
| 2107 | 32107, 42107 | FB Process Data Out 4 | |
| 2108 | 32108, 42108 | FB Process Data Out 5 | |
| 2109 | 32109, 42109 | FB Process Data Out 6 | |
| 2110 | 32110, 42110 | FB Process Data Out 7 | |
| 2111 | 32111, 42111 | FB Process Data Out 8 | |

**Note:** FB Process data is defined in **Appendix B.**

### Status word

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| — | — | — | — | — | — | — | — | RUNEN | BYS | AREF | WARN | FLT | DIR | RUN | RDY |

Information about the status of the device and messages is indicated in the Status Word. The Status Word is composed of 16 bits that have the following meanings.

**Table 72. Status word bit descriptions**

| Bit | Description value = 0 | Value = 1 |
|---|---|---|
| 0 | Not Ready | Ready |
| 1 | STOP | RUN |
| 2 | Clockwise | Counterclockwise |
| 3 | — | Faulted |
| 4 | — | Warning |
| 5 | Ref. frequency not reached | Ref. frequency reached |
| 6 | Bypass not activated | Bypass activated |
| 7 | Run disable | Run Enable |
| 8 | Not in use | Not in use |
| 9–15 | Not in use | Not In use |

### Actual speed

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MSB | — | — | — | — | — | — | — | — | — | — | — | — | — | — | LSB |

This is the Actual Speed of the motor.This value comes back in the form of Hz.

## PROFIBUS overview

PROFIBUS is a vendor independent, open fieldbus standard for a wide range of applications in manufacturing, process and building automation. Vendor independence and openness are guaranteed by the PROFIBUS standard EN 50 170. With PROFIBUS, devices of different manufactures can communicate without special interfaces adjustment. PROFIBUS can be used for both high-speed time critical data transmission and extensive complex communication tasks.

**PROFIBUS-DP**—Optimized for high speed and inexpensive hookup, this PROFIBUS version is designed especially for communication between automation and control systems and distributed I/O at the device level. PROFIBUS-DP can be used to replace parallel signal transmission with 24V or 0 to 20 mA.

The PROFIBUS Family—PROFIBUS specifies the technical and functional characteristics of a serial fieldbus system with decentralized digital controllers can be networked together from the field level to the cell level. PROFIBUS distinguishes between master and subordinate devices.

**Master Devices**—Determines the data communication on the bus. A master can send messages without an external request when it holds access rights (the token). Master are also called “active stations” in the PROFIBUS protocol.

**Subordinate Devices** are peripheral devices. Typical devices include input/output devices, valves, drives and measuring transmitters. They do not have bus access rights and they can only acknowledge received messages or send messages to the master when requested to do so. Subordinates are also called ‘passive stations.”

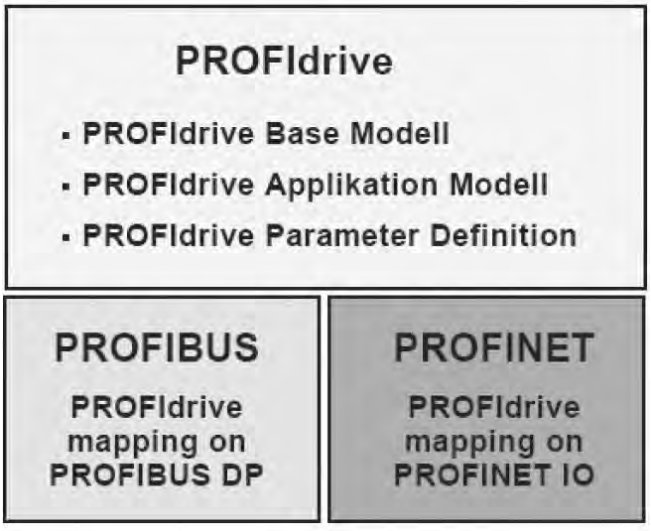
**Profiles**—The PROFIBUS-DP protocol defines how user data to be transmitted between stations over the bus. User data are not evaluated by the PROFIBUS transmission protocol. The meaning is specified in the profiles. In addition, the profiles specify how PROFIBUS-DP is to be used in the drives PROFIBUS Fieldbus board.

Leading manufacturers of drive technology have jointly defined the PROFIdrive profile. The profile specifies how the drives are to be parameterized and how the set points and actual values are to be transmitted. This enables drives from different vendors to be exchanged. The profile contains necessary specifications for speed control and positioning. It specifies the basic drive functions while leaving sufficient freedom for application-specific expansions and further developments. The profile describes the mapping of the application functions for DP.

PROFIdrive consists of a general part and a bus specific part. The following properties are defined in the general part.

- Base Model
- Parameter model
- Application Model

**Figure 28. PROFIdrive**




The PROFIdrive base model describes an automation system in terms of a number of devices and their interrelationships (application interfaces, parameter access). The base model distinguishes between following device classes.

**Communication Services**—Two communication services are defined in the PROFIdrive profile; namely, cyclic data exchange and acyclic data exchange.

### Cyclic data exchange via a cyclic data channel

Motion control system need cyclically updated data during operation for open and closed loop control purposes. This data must be sent to the drive units in the form of set points or transmitted from the drive units in the form of actual values, via the communication systems.

### Acyclic data exchange via an acyclic data channel

In addition to cyclic data exchange, there is an acyclic parameter channel for exchanging parameters between control/supervisor and drive units. Access to this data is not time critical.

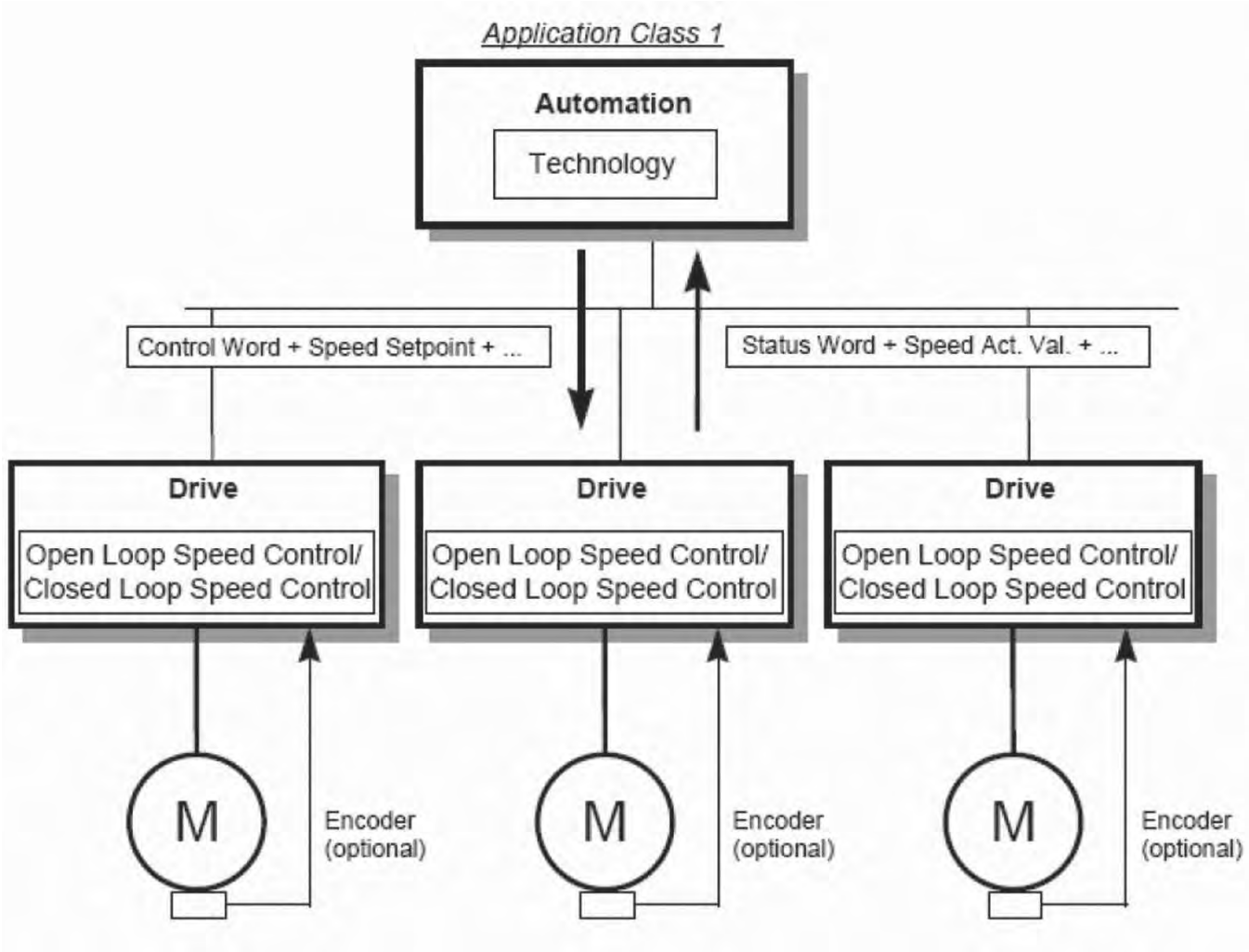
## Application classes

The integration of drives into automation solutions depend strongly upon the drive task. To cover the extensive range of drive application from the most simple frequency convertor up to highly dynamic synchronized multi axis systems with a single profile. PROFIdrive defines six application categories but the drives PROFIBUS optional card support below application class 1.

**Table 73. Application class**

| SN | Application class | Interface | Function |
|---|---|---|---|
| 1 | Standard Drive (e.g., pumps, fans, agitators) | n-set point | Cyclic I/O data interface |

**Figure 29. Application class**



***Startup test***

Set up the communication with Master and follow below steps.

1. Complete Parameterization of the device. Below parameters are important to control device on PROFIBUS.
   a. Parameterization Enable/Disable = 1 (Enabled)
   b. Local / remote selection = 1 (Remote control)
   c. Remote 1 control place = 1 (Fieldbus)
   d. Remote 1 reference = 7 (Fieldbus Ref)
   e. PNU927-Opern priority of param = 1
   f. PNU928 Ctrl priority DOIO Data = 1
   g. ProfiBus Operation Mode = 0 (ProfiDrive)
2. Select the "Standard Telegram 1" in the Configuration step in the PLC
3. Set control word value to 0x0406 to enter ProfiDrive State S2
4. Set control word value to 0x0407 to enter ProfiDrive State S3
5. Set control word value to 0x047F and Set Frequency reference t0 0x4000 to enter ProfiDrive State S4
6. Check drive is running on output frequency 100%.
7. Set control word value to 0x047E to drive stop and ProfiDrive State S2
8. Check drive is in stop mode and output frequency 0%

## Control and status words

The Control Word (PROFIBUS Parameter number (PNU) = 967) is the principal means for controlling the drive from a fieldbus system. It is sent by the fieldbus master station to the drive, the adapter module acting as a gateway.

The drive switches between its states according to the bit-coded instructions on the Control Word, and returns status information to the master in the Status Word (PROFIBUS Parameter number (PNO) = 968).

***Control word 1 (STW1)***

To improve the exchange of devices of different manufacturers in a control application, we strongly recommend using the device-specific bits only for the control of manufacturer specific functions. The device-specific bits shall not be necessary for the operation of a device in the speed control mode and in the positioning mode (default of the device-specific bits = 0).

**Table 74. PROFIdrive control word 1—STW1 message examples**

| Bit | Value | Significance | Comments |
|---|---|---|---|
| 0 | 1 | ON | "Switched on" condition; voltage at the power converter, i.e. the main contact is closed (if present). |
| | 0 | OFF (OFF 1) | Power-down (the drive returns to the "ready for switching on "condition); the drive is ramped-down along the ramp (RFG) or along the current limit or along the voltage limit of the d.c. link; if standstill is detected, the voltage is isolated; the main contact is opened (if present). During deceleration bit 1 of ZSW1 is still set.<br>An OFF command is interruptible. |
| 1 | 1 | No Coast Stop (no OFF 2) | All "Coast Stop (OFF2)" commands are withdrawn. |
| | 0 | Coast Stop (OFF 2) | Voltage is isolated.<br>The main contact is then opened (if present) and the drive goes into the "Switching On Inhibited" condition; the motor coasts down to a standstill. |
| 2 | 1 | No Quick Stop (no OFF 3) | All "Quick Stop (OFF3)" commands are withdrawn. |
| | 0 | Quick Stop (OFF 3) | Quick stop; if required, withdraw the operating enable, the drive is decelerated as fast as possible, e.g., along the current limit or at the voltage limit of the d.c. link, at n / f = 0; if the rectifier pulses are disabled, the voltage is isolated (the contact is opened) and the drive goes into the "Switching On Inhibited" condition.<br>A Quick Stop command is not interruptible. |
| 3 | 1 | Enable Operation (Start) | Enable electronics and pulses.<br>The drive then runs-up to the set point. |
| | 0 | Disable Operation (Stop) | The drive coasts down to a standstill (ramp-function generator to 0 or tracking) and goes into the "Switched on" condition (refer to control word 1, bit 0). |

**Table 74. PROFIdrive control word 1—STW1 message examples, continued**

| Bit | Value | Significance | Comments |
|---|---|---|---|
| 4 | 1 | Enable Ramp Generator | |
| | 0 | Reset Ramp Generator | Output of the RFG is set to 0. The main contact remains closed, the converter is not isolated from the line, the drive decelerates along the current limit or along the voltage limit of the d.c. link. |
| 5 | 1 | Unfreeze Ramp Generator | |
| | 0 | Freeze Ramp Generator | Freeze the actual set point entered by the ramp-function generator. If Application Class 4 is used Bit 5 is not relevant. |
| 6 | 1 | Enable Set point | The value selected at the input of the RFG is switched-in. |
| | 0 | Disable Set point | The value selected at the input of the RFG is set to 0. |
| 7 | 1 | Fault Acknowledge (0⟶1) | The group signal is acknowledged with a positive edge; the drive reaction to a fault depends on the type of fault. If the fault reaction has isolated the voltage, the drive then goes into the "Switching On Inhibited" condition. |
| | 0 | No significance | |
| 8 | 1 | Jog 1 Ona | Prerequisite. Operation is enabled, drive is in standstill and STW1 bit 4, 5, 6 = 0. The drive runs up along the ramp of RFG to jogging set point 1. |
| | 0 | Jog 1 OFFa | Drive brakes along the ramp of RFG, if "Jog 1" was previously ON, and goes into "Operation Enabled" when drive comes to a standstill. |
| 9 | 1 | Jog 2 Ona | N/A |
| | 0 | Jog 2 OFFa | N/A |
| 10 | 1 | Control By PLC | Control via interface, DO I/O Data valid (refer to 6.3.11). |
| | 0 | No Control By PLC | DO I/O Data not valid; expect Sign-Of-Life. If loosing the control priority bit the reaction is device-specific. Possible reactions.<br>1) speed control. "old" process data is kept,<br>2) positioning. DO I/O Data are set to 0. |
| 11 | 1 | Device Specific | N/A |
| | 0 | Device Specific | N/A |
| 12 | 1 | Device Specific | N/A |
| | 0 | Device Specific | N/A |
| 13 | 1 | Device Specific | N/A |
| | 0 | Device Specific | N/A |
| 14 | 1 | Device Specific | N/A |
| | 0 | Device Specific | N/A |
| 15 | 1 | Device Specific | N/A |
| | 0 | Device Specific | N/A |

Below is various defined control word (STW1) command.

**Table 75. Control word (STW1) message examples**

| SN | Control word (STW1) | Control word description (STW1) | Comment |
|---|---|---|---|
| 1 | 0x0400 | Set PLC Control | PLC Control should be set in MCU |
| 2 | 0x0000 | Clear PLC Control | PLC Control should be reset in MCU |
| 3 | 0x040F | Run Command without RFG | Motor Off as no RAMP Generator |
| 4 | 0x0407 | Clear Run Command | Motor Off as earlier |
| 5 | 0x041F | Run Command with RFG and without Set point | Motor Off as no Set point Generator |
| 6 | 0x0407 | Clear Run Command | Motor Off as earlier |
| 7 | 0x047F | Run Command with RFG and with Set point | Motor ON with RFG |
| 8 | 0x0407 | Clear Run Command | Motor Off as earlier |
| 9 | 0x047F | Run Command with RFG and with Set point | Motor ON with RFG |
| 10 | 0x045F | Set Freeze of Ramp | Motor ON with Ramp Freeze |
| 11 | 0x047F | Clear Freeze of Ramp | Motor ON with Following Ramp Timing |
| 12 | 0x047E | OFF 1 Command | Motor Off with RFG |
| 13 | 0x047F | Run Command with RFG and with Set point | Motor ON with RFG |
| 14 | 0x047D | OFF 2 Command (Coast Stop) | Motor Off with Coast |
| 15 | 0x047F | Run Command with RFG and with Set point | Motor ON with RFG |
| 16 | 0x047B | OFF 3 Command (Quick Stop) | Motor Off with 0 DECEL Time |
| 17 | 0x047F | Run Command with RFG and with Set point | Motor ON with RFG |
| 18 | 0x0477 | Disable Operation | Motor Off with Coast |
| 19 | 0x057F | Run Command with RFG and with Set point At Jog Speed | Motor ON at Jog Speed |
| 20 | 0x0477 | Disable Operation | Motor Off with Coast |
| 21 | 0x0480 | Fault Reset bit | Fault should get reset |

***Status word 1 (ZSW1)***

**Table 76. Application status word PROFIdrive**

| Bit | Value | Significance | Comments |
|---|---|---|---|
| 0 | 1 | Ready To Switch On | Power supply is switched on, electronics initialized, main contact, if available, has dropped out, pulses are inhibited. |
| | 0 | Not Ready To Switch On | |
| 1 | 1 | Ready To Operate | Refer to control word 1, bit 0. |
| | 0 | Not Ready To Operate | |
| 2 | 1 | Operation Enabled | Drive follows set point. This means, that the electronic and pulses are enabled (Refer to control word 1, bit 3), the closed loop control is active and controls the motor and the output of the set point channel is the input for the closed loop control. |
| | 0 | Operation Disabled | Either the pulses are disabled or the drive doesn't follow the output value of the set point channel. |
| 3 | 1 | Fault Present | Unacknowledged faults or currently not acknowledgeable faults (fault messages) are present (in the fault buffer). The fault reaction is fault-specific and device-specific. The acknowledging of a fault may only be successful, if the fault cause has disappeared or has been removed before. If the fault has isolated the voltage, the drive goes into the "Switching On Inhibited" condition, otherwise the drive returns to operation. The related fault numbers are in the fault buffer. |
| | 0 | No Fault | |
| 4 | 1 | Coast Stop Not Activated (No OFF 2) | |
| | 0 | Coast Stop Activated (OFF 2) | "Coast Stop (OFF 2)" command is present. |

**Table 76. Application status word PROFIdrive, continued**

| Bit | Value | Significance | Comments |
|---|---|---|---|
| 5 | 1 | Quick Stop Not Activated (No OFF 3) | |
| | 0 | Quick Stop Activated (OFF 3) | "Quick Stop (OFF 3)" command is present. |
| 6 | 1 | Switching On Inhibited | The drive goes only again in the "Switched On" condition with "No Coast Stop AND No Quick Stop" followed by "ON." This means that the "Switching On Inhibited" bit is only set back to zero if the OFF command is set after "No Coast Stop AND No Quick Stop." |
| | 0 | Switching On Not Inhibit | |
| 7 | 1 | Warning Present | Warning information present in the service/maintenance parameter; no acknowledgement. |
| | 0 | No Warning | There is no warning or the warning has disappeared again. |
| 8 | 1 | Speed Error Within Tolerance Range | Actual value is within a tolerance band; dynamic violations are permissible for t < tmax, e.g., n = nset±, f = fset±, etc., tmax may be parameterised |
| | 0 | Speed Error Out Of Tolerance Range | |
| 9 | 1 | Control Requested | The automation system is requested to assume control (refer to 6.3.11. |
| | 0 | No Control Requested | Control by the automation system is not possible, only possible at the device or by another interface. |
| 10 | 1 | f Or n Reached Or Exceeded | Actual value ≥ comparison value (set point) which may be set via the parameter number. |
| | 0 | f Or n Not Reached | |
| 11 | 1 | Device Specific | N/A |
| | 0 | Device Specific | N/A |
| 12 | 1 | Device Specific | N/A |
| | 0 | Device Specific | N/A |
| 13 | 1 | Device Specific | N/A |
| | 0 | Device Specific | N/A |
| 14 | 1 | Device Specific | N/A |
| | 0 | Device Specific | N/A |
| 15 | 1 | Device Specific | N/A |
| | 0 | Device Specific | N/A |

### *References*

References are 16-bit words containing a sign bit and a 15-bit integer. A negative reference is formed by calculating the 2's complement from the corresponding positive reference.

**Table 77. References**

| SN | N2 data type hex | N2 data type decimal | N2 data type percentage | Frequency in decimal |
|---|---|---|---|---|
| 1 | 4000 | 16384 | 100 | 50 |
| 2 | 3000 | 12288 | 74 | 37 |
| 3 | 2000 | 8192 | 50 | 25 |
| 4 | 1000 | 4096 | 24 | 12 |
| 5 | 0 | 0 | 0 | 0 |
| 6 | F000 | 61440 | –25 | 12 |
| 7 | E000 | 57344 | –50 | 25 |
| 8 | D000 | 53248 | –75 | 37 |
| 9 | C000 | 49152 | –100 | 50 |

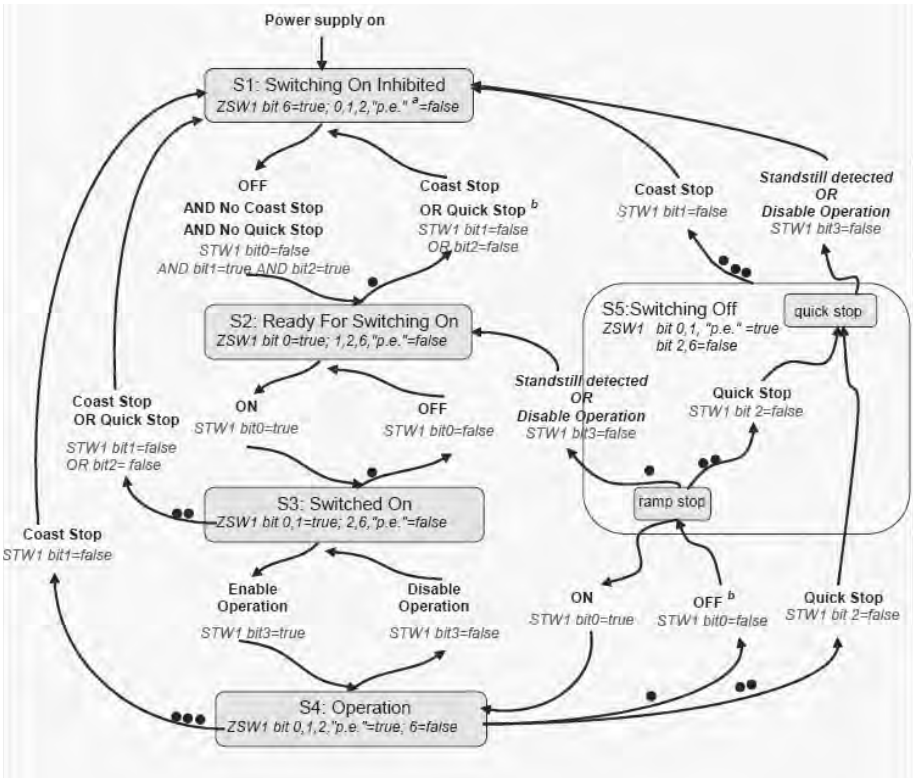
### *Actual values*

Actual values are 16-bit words containing information on the operation of the drive. The function to be monitored are selected by a drive parameter. The scaling of the integers sent to the master as Actual Values depends on the selected function.

***General state machine***

State diagrams are defined for the operating modes. In the PROFIdrive control profile, the controls bits 0 to 3 perform the basic start-up / power down functions whereas the control bits 4 to 15 perform application-oriented control.

**Figure 30. General state diagram**




**Notes:** STW1 bit x, y = These control word bits shall be set by the control.

ZSW1 bit x, y = These status word bits indicate the actual state.

***Standstill detected*** is an internal result of a stop operation.

a Abbr.: "p.e." = "Pulses enabled" optional.

b The internal condition "fault with ramp stop" also activates this transition.

*Information on the general state diagram*

- The green blocks represent states, the arrows represent transitions
- From several states, several transitions are possible
- The more points that a transition has, the higher is its priority. A transition without points has the lowest priority
- The PROFIBUS interfaces between this controller and the DO has the control priority (PNO 928)
- ZSW1 Bit 9 is set by the DO
- STW1 Bit 10 is set by the controller
- The bits defined for positioning mode are only relevant, if the drive is in the state "S4" operation
- All stop-reactions caused by faults (Fault with Ramp stop, Fault with Quick stop, Fault with Coast stop) for the general state machine to switch to state S1 (Switching on Inhibited) or S2 (Ready For switching)

## DO I/O data

The set points to the Axis and also the actual from the Axis are transferred as DO I/O data. The DO I/O data is transferred using the cyclic data exchange. The representation of data shall be in big endian format.

The following advantages are obtained due to the telegram configuring and normalization.

- Interoperability and interchangeability of PROFIdrive Controllers and Drive Objects
- Standard components may be simply commissioned
- Automation mechanisms in the controller application

### Signals

A series of signals with appropriate signal numbers is defined to configure the DO I/O Data (set points, actual values).

The following values are permissible for the signal numbers.

- 0 = not assigned
- 1-99 = standard signal numbers (profile-specific signal numbers)
- 100-65535 = signal numbers (device-specific)

The Variable Speed Drive Series III PROFIBUS optional card, the defined signal numbers are listed in the following.

**Table 78. PROFIBUS option Card**

| Signal no. | Significance | Abbreviation | Length |
|---|---|---|---|
| 1 | Control word 1 | STW1 | 16 |
| 2 | Status word 1 | ZSW1 | 16 |
| 5 | Speed set point A | NSOLL_A | 16 |
| 6 | Speed actual value A | NIST_A | 16 |

### Standard telegram 1

Standard telegrams 1 is defined for speed set point interface operations application class (AC1). The standard telegrams are selected when configuring the DO I/O Data.

The standard telegram 1 has the following structure.

- n set interface, 16 bit

**Table 79. Standard telegram 1**

| I/O Data Number | Set point | Actual value |
|---|---|---|
| 1 | STW1 | ZSW1 |
| 2 | NSOLL_A | NIST_A |

### PROFIdrive Profile

The PROFIdrive profile PNU numbers are listed in **Appendix A** of this manual.

***DPV1 acyclic communication***

Base model parameter access, whose structure is defined in the PROFIdrive profile 4.2, is always used for communicating the writing/reading parameters for PROFIdrive drives.

Under this arrangement, parameters access always consists of two elements. Under this arrangement, parameter access always consists of two elements.

Write request ("Write data set ")
Read request ("Read data set")

Write request or Request can be send via DPV1 master class 1 or master class 2.

The DP V1 command/response part is used for the standard DP V1 read/Write on the Slot 0, Index47 data block.

### Parameter requests and parameter responses

A parameter consists of three segments.

### Request header

ID for the request and number of parameters which are accessed. Multi-Axis and Modular drives, Addressing of one DO.

### Parameter address

Addressing of a parameter. If parameters are accessed, there are correspondingly many parameter addresses but can only be accessed on a single case. The parameter address appears only in the request, not in the response.

Parameter value. Per addressed parameter, there is a segment for the parameter values. Depending on the request ID, parameter values appear only either in the request or in the reply.

### Words and double words

The following telegram contents are displayed in words (a word or 2 bytes per line). Words or double words will have the most significant byte being transmitted first (big endian).

**Table 80. Words and Double Words**

| | | |
|---|---|---|
| Word | Byte 1 | Byte 2 |
| Double Word | Byte 1 | Byte 2 |
| | Byte 3 | Byte 4 |

According to the Base Model Parameter access the structure of the parameter request and parameter response as shown in **Table 82** and **Table 83**.

**Table 81. Base mode parameter request**

| Block definition | Byte n | Byte n +1 | n |
|---|---|---|---|
| Request Header | Request reference | Request ID 0 | 0 |
| | Axis-No. / DO-ID | No. of parameters = i | 2 |
| 1st Parameter address | Attribute | No. of elements | 4 |
| | Parameter number (PNU) | | |
| | Subindex | | |
| ith Parameter address | ... | | 4 + 6 × (i-1) |
| 1st Parameter value(s) (only for requst "change parameter") | Format | No. of values | 4 + 6 × i |
| | Value | | |
| | ... | | |
| ith Parameter value | ... | | |
| | | | 4 + 6 × i + ... + (Format_n x Qty_n) |

**Table 82. Base model response**

| Block definition | Byte n | Byte n +1 | n |
|---|---|---|---|
| Response header | Request Ref. mirrored | Response ID | 0 |
| | Axis-No. / DO-ID mirrored | No. of parameters = i | 2 |
| 1st Parameter Value (s) (only after request "Request") | Format | No.of values | 4 |
| | Values or error values | | |
| | ... | | |
| ith Parameter values | ... | | 4 +... + (Format_n × Qty_n) |

## Coding

Coding of the fields in parameter request/parameter response of base model parameter access.

PROFIBUS board support only single parameter and single element.

Max No. of Parameters = 1

Max No. of Elements = 1

Max No. of Values = 1

**Table 83. Field coding**

| Field | Data Type | Value | | Comment |
|---|---|---|---|---|
| Request Reference | Unsigned 8 | 0x00 | Reserved | |
| | | 0x01…0xFF | | |
| Response ID | Unsigned 8 | 0x00 | Reserved | |
| | | 0x01 | Request parameter (+) | |
| | | 0x02 | Change parameter(+) | |
| | | 0x03…0x3F | Reserved | |
| | | 0x40 | INCORRECT Request Ref | |
| | | 0x41 | INCORRECT Request ID | |
| | | 0x42 | INVALID NOS PARAM | |
| | | 0x43 | INVALID_Axis_DO_DI | |
| | | 0x44…0x7F | Manufacturer-specific | |
| | | 0x80 | Reserved | |
| | | 0x81 | Request parameter (–) | |
| | | 0x82 | Change parameter (–) | |
| | | 0x83…0xBF | Reserved | |
| | | 0xC0…0xFF | Manufacturer-specific | |
| Axis/DO-ID | Unsigned 8 | 0x00 | Device-Representative | Zero is not a DO but representative of the access to the drive unit. |
| | | 0x01…0xFE | DO-ID-Number 1–254 | |
| | | 0xFF | Reserved | |
| No. of Parameters | Unsigned 8 | 0x00 | Reserved | There may be an additional limitation through the communication system (telegram length) or optional scalability. |
| | | 0x01…0x27 | Quantity 1–39 | |
| | | 0x28…0xFF | Reserved | |
| Attribute | Unsigned 8 | 0x00 | Reserved | The four less significant bits are reserved for (future) expansion of "No. of Elements" to 12 bits. |
| | | 0x10 | Value | |
| | | 0x20 | Description | |
| | | 0x30 | Text | |
| | | 0x40…0x70 | Reserved | |
| | | 0x80…0xF0 | Manufacturer-specific | |
| No. of Elements | Unsigned 8 | 0x00 | Special Function | Limitation through compatibility with PROFIBUS process data ASE telegram length. |
| | | 0x01…0xEA | Quality 1–234 | |
| | | 0xEB…0xFF | Reserved | |
| Parameter Number | Unsigned 16 | 0x0000 | Reserved | |
| | | 0x0001 | Number 1–65535 | |
| | | 0xFFFF | | |
| Subindex | Unsigned 16 | 0x0000… | Number 0–65534 | |
| | | 0xFFFF | | |

**Table 83. Field coding, continued**

| Field | Data type | Value | | Comment |
|---|---|---|---|---|
| Format | Unsigned 8 | 0x00 | Reserved | Every subordinate shall at least support the data types Byte, Word and Double Word (mandatory). Write requests by the master preferable use the "correct" data types. As substitute, Byte, Word, or Double Word are also possible. The master shall be able to interpret all values/data types. |
| | | 0x01…0x36 | Data types | |
| | | 0x37…0x3F | Reserved | |
| | | 0x40 | Zero | |
| | | 0x41 | Byte | |
| | | 0x42 | Word | |
| | | 0x43 | Double word | |
| | | 0x44 | Error | |
| | | 0x45…0xFF | Reserved | |
| No. of Values | Unsigned 8 | 0x00…0xEA | Quantity 0–234 | Limitation because of 240 Bytes Data block size (compatible with former PROFIdrive version 3.1.2). |
| | | 0xEB…0xFF | Reserved | |
| Error Number | Unsigned 16 | 0x0000… | Error numbers | The more significant byte is reserved. |
| | | 0x00FF | | |

## Generic station description (GSD) file

Please refer GSD file "EATN0EF5.gsd"

# BACnet/IP On-Board Communication—Variable Speed Drive Series III

BACnet stands for Building Automation and Control Networks. It is the common name for the communication standard ISO 16484-5 that defines the methods and the protocol for cooperating building automation devices to communicate. Devices can be designed to operate using BACnet communication protocol as well as utilizing BACnet protocol to communicate between systems. BACnet is an internationally accepted protocol for building automation (such as lightning control, air conditioning, and heating automation) and control over a communications network. BACnet provides a method by which computer-based control equipment, from different manufacturers can work together, or "interoperate." For this to be achieved, components must be able to exchange and understand BACnet data messages. Your drive is equipped with BACnet support as standard

## BACnet/IP specifications

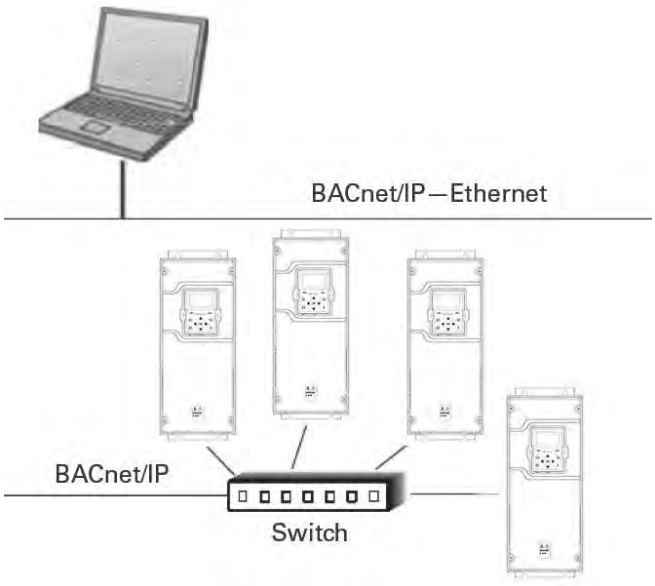
**Table 84. BACnet/IP Protocol**

| Connection | Communication |
|---|---|
| Interface | 100BaseTX, IEEE 802.3 compatible |
| Data transfer method | Ethernet half-/full-duplex |
| Data transfer speed | 10/100 MBit/s, autosensing |
| Protocol | BACnet over UDP/IP |
| Connector | Shielded RJ45 connector |
| Cable type | CAT5e STP |
| BACnet/IP | As described in ANSI/ASHRAE Standards 135-2004 |
| Default/IP | Selectable: Fixed or DHCP |

### *BACnet/IP connections*

The control board is located inside the control unit of the drive.

**Figure 31. Principle example diagram of BACnet**




## Prepare to use BACnet/IP through RJ45 port

1. Open the cover of the AC drive.

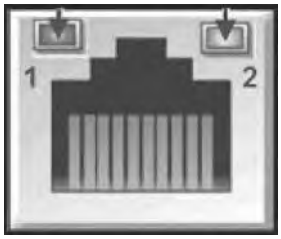
**⚠ WARNING**

**The relay outputs and other I/O-terminals may have a dangerous control voltage present even when drive is disconnected from mains.**

2. Connect Ethernet cable.
3. Remount the AC drive cover.

**Note:** When planning the cable runs, remember to keep the distance between the fieldbus cable and the motor cable at a minimum of 11.81 in (30 cm).

### RJ45 port LED indications




### RJ45 LED

1. Ethernet Link Status
2. Ethernet Link Speed

## Commissioning

### Connections and wiring

The RJ45 port supports 10/100 Mb speeds in both full and half-duplex modes. The boards must be connected to the RJ45 network with a shielded CAT-5e cable. A crossover cable (at least CAT-5e cable with STP, shielded twisted pair) may be needed if you want to connect the drive directly to the master appliance.

Use only industrial standard components in the network and avoid complex structures to minimize the length of response time and the amount of incorrect dispatches.
It is often a good practice to use a subnet that is different from other devices not related to the drive control.

**Figure 32. CAT-5e cable**

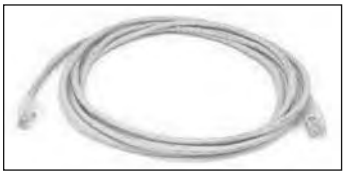
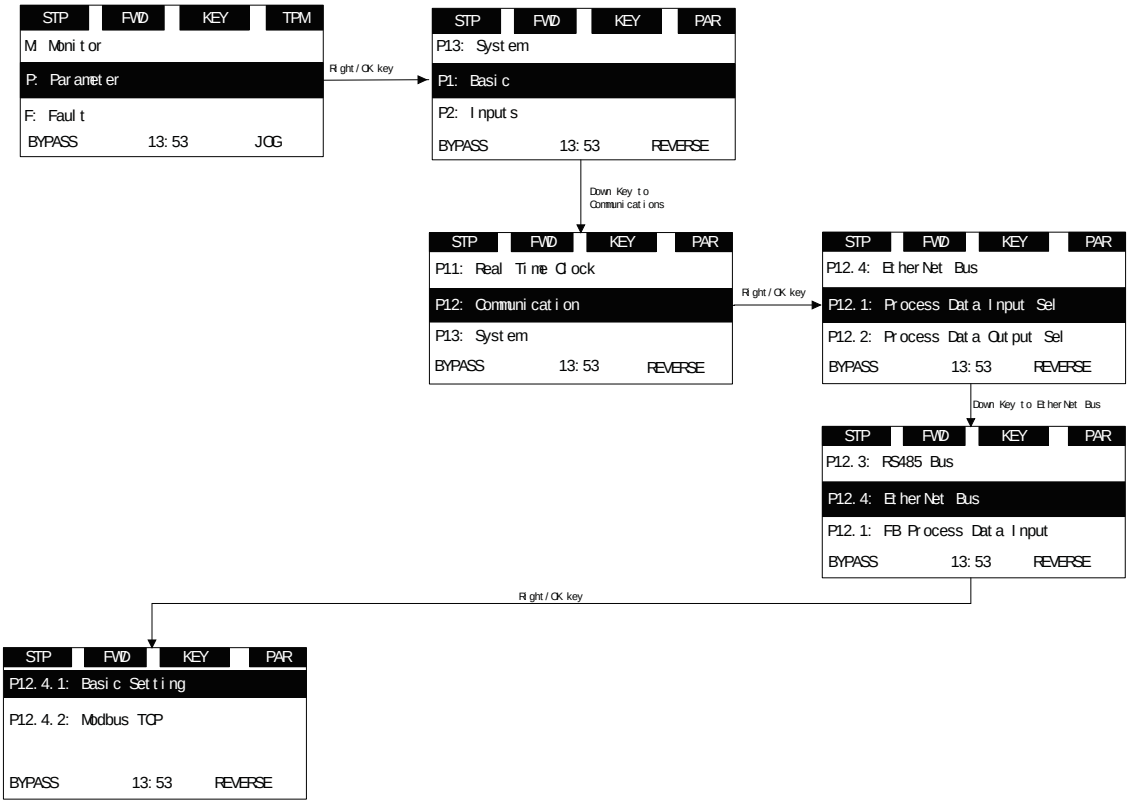


**Figure 33. VS3 keypad navigation to ethernet comm settings**




In this menu you will be able to scroll through the below settings to setup the communication protocol.

**Table 85. EtherNet/IP**

| VS3 code | Parameter | Min. | Max. | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|
| P12.4.1.1 | IP Address Mode | | | | 1 | 1500 | 0 = Static IP<br>1 = DHCP with AutoIP |
| P12.4.1.2 | Active IP Address | | | | | 1507 | |
| P12.4.1.3 | Active Subnet Mask | | | | | 1509 | |
| P12.4.1.4 | Active Default Gateway | | | | | 1511 | |
| P12.4.1.5 | MAC Address | | | | | 1513 | |
| P12.4.1.6 | Static IP Address | | | | 192.168.1.254 | 1501 | |
| P12.4.1.7 | Static Subnet Mask | | | | 255.255.255.0 | 1503 | |
| P12.4.1.8 | Static Default Gateway | | | | 192.168.1.1 | 1505 | |
| P12.4.1.9 | Enable BACnet IP | 0 | 1 | | 0 | 1725 | 0 = Disable<br>1 = Enable |

**Note:** BACnet/IP uses parameters from EtherNet/IP.

## DHCP

The BACnet/IP network communication supports DHCP for easier network configuration. Dynamic Host Configuration Protocol (DHCP) is a network protocol that is used to configure network devices so that they can communicate on an IP network. As a DHCP client, the device negotiates with the DHCP server to determine its IP address and obtain any other initial configuration details it needs for network operation.

## IP address

IP is divided into four parts. (Part = Octet) Default Static IP Address is 192.168.1.254

## Communication timeout

Defines how much time can pass from the last received message from the client device before fieldbus fault is generated. Default communication timeout is 10 seconds.

**Note:** If the network cable is broken from the RJ45 port, a fieldbus error is generated immediately.

## Static IP address

In most cases the user may want to establish a Static IP Address for the BACnet/IP based on their network configuration.

Static IP address default configurations are as defined in "EtherNet/IP network settings" table, provided in "Connections and Wiring" section.

The user can manually define the network address for the BACnet/IP as long as all units connected to the network are given the same network portion of the address. In these situations, the user will need to manually set the IP Address in the device by using the drive keypad. Be aware that overlapping IP addresses can cause conflicts between devices on the network. For more information about selecting IP addresses, contact your network administrator.

## Enable BACnet/IP

The enable BACnet/IP will enable the BACnet/IP ability and disable the BACnet MSTP protocol function.

## Manual IP address configuration

## Using the Variable Speed Drive Series III keypad

Using the Drive Keypad to set the IP Address manually in the device.

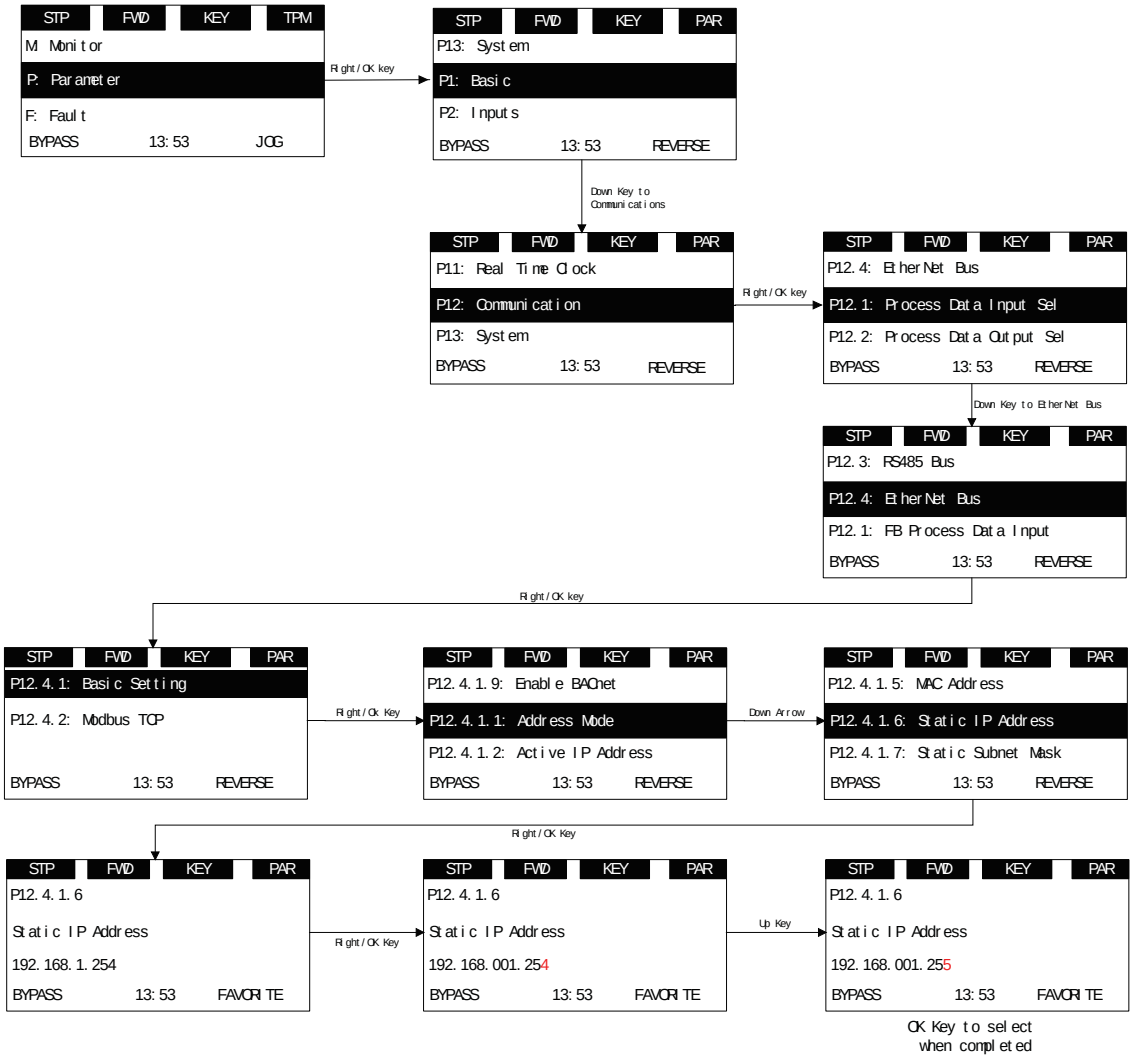
1. Select IP addressing mode as Static IP. Static IP mode configurations will be loaded.

**Note:** Change in IP address mode will require drive to power cycle to get this change effective. Also ensure device MAC address.

2. Using the drive keypad, set the IP address in the device to the desired address setting by.
   a. Setting Static IP Address
   b. Setting Static Subnet Mask
   c. Setting Static Default Gateway

**Figure 34. VS3 Static IP mode**

**Figure 35. VS3 Static IP address**




3. Make note of the changed IP Address.
4. Using drive keypad, read “Active IP Address”, “Active Subnet Mask”, “Active Default Gateway” parameters to ensure that IP address has been set to desired IP address.

**Table 86. BACnet/IP**

| VS3 code | Parameter | Min. | Max. | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|
| P12.4 | EtherNet Bus | | | | | | |
| P12.4.1 | Basic Setting | | | | | | |
| P12.4.1.1 | IP Address Mode | | | | 1 | 1500 | 0 = Static IP<br>1 = DHCP with AutoIP |
| P12.4.1.2 | Active IP Address | | | | | 1507 | |
| P12.4.1.3 | Active Subnet Mask | | | | | 1509 | |
| P12.4.1.4 | Active Default Gateway | | | | | 1511 | |
| P12.4.1.5 | MAC Address | | | | | 1513 | |
| P12.4.1.6 | Static IP Address | | | | 192.168.1.254 | 1501 | |
| P12.4.1.7 | Static Subnet Mask | | | | 255.255.255.0 | 1503 | |
| P12.4.1.8 | Static Default Gateway | | | | 192.168.1.1 | 1505 | |
| P12.4.1.9 | Enable BACnetIP | 0 | 1 | | 0 | 1725 | 0 = Disabled<br>1 = Enabled |
| P12.4.3 | BACnet IP | | | | | | |
| P12.4.3.1 | BACnet IP UDP port number | 47808 | 47823 | | 47808 | 1733 | 47808 = BAC0, 47809 = BAC1,<br>47810 = BAC2, 47811 = BAC3,<br>47812 = BAC4, 47813 = BAC5,<br>47814 = BAC6, 47815 = BAC7,<br>47816 = BAC8, 47817 = BAC9,<br>47818 = BACA, 47819 = BACB,<br>47820 = BACC, 47821 = BACD,<br>47822 = BACE, 47823 = BACF |
| P12.4.3.2 | BACnet IP Foreign Device | 0 | 1 | | 0 | 1734 | 0 = Disabled<br>1 = Enabled |
| P12.4.3.3 | BACnet IP BBMD IP | | | | 0.0.0.0 | 1735 | |
| P12.4.3.4 | BACnet IP BBMD Port | 47808 | 47823 | | 47808 | 1737 | 47808 = BAC0, 47809 = BAC1,<br>47810 = BAC2, 47811 = BAC3,<br>47812 = BAC4, 47813 = BAC5,<br>47814 = BAC6, 47815 = BAC7,<br>47816 = BAC8, 47817 = BAC9,<br>47818 = BACA, 47819 = BACB,<br>47820 = BACC, 47821 = BACD,<br>47822 = BACE, 47823 = BACF |
| P12.4.3.5 | BACnet IP Registration Interval | 0 | 65535 | Sec | 10 | 1738 | |
| P12.4.3.6 | BACnet IP Comm Timeout | 0 | 60000 | Sec | 0 | 1739 | |
| P12.4.3.7 | BACnet IP Protocol Status | | | | 0 | 1740 | 0 = Stopped,<br>1 = Operational,<br>2 = Faulted |
| P12.4.3.8 | BACnet IP Fault Behavior | 0 | 1 | | 0 | 1741 | 0 = In Fieldbus Control<br>1 = in all Control |
| P12.4.3.9 | BACnetIP Instance Number | 0 | 4194302 | | 0 | 1742 | |

## BACnet/IP parameters

**Table 87. BACnet/IP parameter descriptions**

| ID | Name | Description |
|---|---|---|
| P12.4.1.9 | Enable BACnet/IP | This parameter enables BACnet IP communications. When this parameter is enabled, other parameters in menu becomes visible, else they are hidden. |
| P12.4.3.1 | BACnet/IP UDP port number | The UDP port for the BACnet IP communication. |
| P12.4.3.2 | BACnet/IP Foreign Device | The foreign device feature is used when the device is located in a different network than the BBMD. A normal router does not send broadcast messages between different networks. The 'Foreign device' feature solves this problem by establishing a connection to the BBMD with unicast messages. All broadcast messages are forwarded to a BBMD device that takes care of receiving and transmitting broadcast messages in both directions for all foreign devices. |
| P12.4.3.3 | BACnet/IP BBMD IP | The IP address of the BACnet IP Broadcast Management Device. |
| P12.4.3.4 | BACnet/IP BBMD Port | The BBMD Port number. |
| P12.4.3.5 | BACnet/IP Registration Interval | The registration interval to keep a live connection to the BBMD. Unit is seconds. |
| P12.4.3.6 | BACnet/IP Comm Timeout | Defines the number of seconds after a timeout is indicated after a communication break or disconnected EtherNet link. Value 0 disables communication link supervision. |
| P12.4.3.7 | BACnet/IP Protocol Status | Fieldbus Protocol Status tells the status of the protocol. |
| P12.4.3.8 | BACnet/IP Fault Behavior | Defines when Fieldbus fault to be raise if fault condition is detected. |
| P12.4.3.9 | BACnet/IP Instance Number | The Device Object's Instance number is used in conjunction with the MAC address to assign the devices on the network. The instance number can have up to 127 nodes on it before a different instance number is required. |

## BACnet overview

***BACnet technical data***

Protocol Implementation Conformance Statement (PICS)

Controller Profile

- B—ASC

Segmentation Capability

- Not supported

Data Link Layer and Routing Options

- 10/100 MBit/s, Autosensing

Character Sets Supported

- UTF8

BIBBS Supported

- Data Sharing
  - ReadProperty—B
  - WriteProperty—B
- Device Management
  - Dynamic Device Binding—B
  - Dynamic Object Binding—B
  - DeviceCommunicationControl—B
  - ReinitializeDevice—B
- Alarms and Events: Not supported
- Schedules: Not supported
- Trends: Not supported
- Network Management: Not supported

**Table 88. Supported object types and properties summary**

| Property | Device object type | Analog input object type | Analog value object type | Binary value object type | Multiple state value object type |
|---|---|---|---|---|---|
| Acked_Transitions | | | | | |
| Active_Cov_Subscriptions | | | | | |
| Active_Text | | | | ■ | |
| Active_Vt_Sessions | | | | | |
| Alarm_Value | | | | | |
| Alarm_Values | | | | | |
| Align_Intervals | | | | | |
| Apdu_Segment_Timeout | | | | | |
| Apdu_Timeout | ■ | | | | |
| Application_Software_Version | ■ | | | | |
| Auto_Subordinate _Discovery | | | | | |
| Backup_And_Restore_State | | | | | |
| Backup_Failure_Timeout | | | | | |
| Backup_Preparation_Time | | | | | |
| Change_Of_State_Count | | | | | |
| Change_Of_State_Time | | | | | |
| Configuration_Files | | | | | |
| Cov_Increment | | | | | |
| Database_Revision | ■ | | | | |
| Daylight_Savings_Status | | | | | |
| Deadband | | | | | |
| Description | ■ | ■ | ■ | ■ | ■ |
| Device_Address_Binding | ■ | | | | |
| Device_Type | | | | | |
| Elapsed_Active_Time | | | | | |
| Event_Algorithm_Inhibit | | | | | |
| Event_Algorithm_Inhibit_Ref | | | | | |
| Event_Detection_Enable | | | | | |
| Event_Enable | | | | | |
| Event_Message_Texts | | | | | |
| Event_Message_Texts_Config | | | | | |
| Event_State | | ■ | ■ | ■ | ■ |
| Event_Time_Stamps | | | | | |
| Fault_Values | | | | | |
| Firmware_Revision | ■ | | | | |
| High_Limit | | | | | |
| Inactive_Text | | | | ■ | |
| Interval_Offset | | | | | |
| Last_Restart_Reason | | | | | |
| Last_Restore_Time | | | | | |
| Limit_Enable | | | | | |
| Local_Date | | | | | |
| Local_Time | | | | | |
| Location | | | | | |
| Low_Limit | | | | | |
| Manual_Subordinate _Address_Binding | | | | | |
| Max_Apdu_Length_Accepted | ■ | | | | |
| Max_Pres_Value | | | | | |
| Max_Segments_Accepted | | | | | |
| Min_Pres_Value | | | | | |

**Table 88. Supported object types and properties summary, continued**

| Property | Device object type | Analog input object type | Analog value object type | Binary value object type | Multiple state value object type |
|---|---|---|---|---|---|
| Minimum_Off_Time | | | | | |
| Minimum_On_Time | | | | | |
| Model_Name | ■ | | | | |
| Notification_Class | | | | | |
| Notify_Type | | | | | |
| Number_Of_Apdu_Retries | ■ | | | | |
| Number_Of_States | | | | | ■ |
| Object_Identifier | ■ | ■ | ■ | ■ | ■ |
| Object_List | ■ | | | | |
| Object_Name | ■ | ■ | ■ | ■ | ■ |
| Object_Type | ■ | ■ | ■ | ■ | ■ |
| Out_Of_Service | | ■ | ■ | ■ | ■ |
| Password | ■ | | | | |
| Present_Value | | ■ | ■ | ■ | ■ |
| Priority_array | | | ■ | ■ | |
| Profile_Name | ■ | | | | |
| Protocol_Object_Types_supported | ■ | | | | |
| Protocol_Revision | ■ | | | | |
| Protocol_Services_Supported | ■ | | | | |
| Protocol_Version | ■ | | | | |
| Reliability | | | | | |
| Reliability_Evaluation_Inhibit | | | | | |
| Relinquish_Default | | | ■ | ■ | |
| Resolution | | | | | |
| Restart_Notification_Recipients | | | | | |
| Restore_Completion_Time | | | | | |
| Restore_Preparation_Time | | | | | |
| Segmentation_Supported | ■ | | | | |
| Serial_Number | ■ | | | | |
| Subordinate _Address_Binding | | | | | |
| Subordinate _Proxy_Enable | | | | | |
| State_Text | | | | | ■ |
| Status_Flags | | ■ | ■ | ■ | ■ |
| Structured_Object_list | | | | | |
| System_Status | ■ | | | | |
| Time_Delay | | | | | |
| Time_Delay_Normal | | | | | |
| Time_Of_Active_Time-reset | | | | | |
| Time_Of_Device_Restart | | | | | |
| Time_Of_State_Count_Reset | | | | | |
| Time_Synchronization_Interval | | | | | |
| Time_Synchronization_Recipients | | | | | |
| Units | | ■ | ■ | | |
| Update_Interval | | | | | |
| Utc_Offset | | | | | |
| Utc_Time_Synchronization_Recipients | | | | | |
| Vendor_Identifier | ■ | | | | |
| Vendor_Name | ■ | | | | |
| Vt_Classes_Supported | | | | | |

## Object instance summary

*Binary Value Object Instance Summary*

The following table summarizes the Binary Value Objects supported.

**Table 89. Binary value object instance summary**

| Instance ID | Object name (related to drive parameter) | Description | Inactive/ active text | Preset value access |
|---|---|---|---|---|
| BV0 | Ready State | Indicates whether the drive is ready or not | Not Ready/Ready | R |
| BV1 | Run/Stop State | Indicates whether the drive is running or stopped | Stop/Run | R |
| BV2 | Fwd/Rev State | Indicates the rotation direction of motor | Fwd/Rev | R |
| BV3 | Fault State | Indicates if a fault is active | OK/Fault | R |
| BV4 | Warning State | Indicates if a warning is active | OK/Warning | R |
| BV5 | At Setpoint | Ref. Frequency reached | False/True | R |
| BV6 | At Zero Speed | Motor Running at zero speed | False/True | R |
| BV7 | Motor Ctrl source | Command to change active source for controlling motor | LocalMotorCtrl / FBMotorCtrl | C |
| BV8 | Speed Reference Source | Command to change source of motor speed reference | LocalSpeedRef / FBSpeedRef | C |
| BV9 | Run/Stop CMD | Command to start drive | Stop/Run | C |
| BV10 | Fwd/Rev CMD | Command to change rotational direction | Fwd/Rev | C |
| BV11 | Reset Fault | Command to reset active Fault from drive | 0/Reset | C |
| BV12 | Digital Input 1 | Digital Input 1 | OFF/ON | R |
| BV13 | Digital Input 2 | Digital Input 2 | OFF/ON | R |
| BV14 | Digital Input 3 | Digital Input 3 | OFF/ON | R |
| BV15 | Digital Input 4 | Digital Input 4 | OFF/ON | R |
| BV16 | Digital Input 5 | Digital Input 5 | OFF/ON | R |
| BV17 | Digital Input 6 | Digital Input 6 | OFF/ON | R |
| BV18 | Digital Input 7 | Digital Input 7 | OFF/ON | R |
| BV19 | Digital Input 8 | Digital Input 8 | OFF/ON | R |
| BV20 | Digital Output 1 | Digital Output 1 | OFF/ON | R |
| BV21 | Digital Output 2 | Relay 1 Output | OFF/ON | R |
| BV22 | Digital Output 3 | Relay 2 Output | OFF/ON | R |
| BV23 | Digital Output 4 | Relay 3 Output | OFF/ON | R |
| BV24 | Stop By Coast | Indicates if drive stop by coast | ON/OFF | C |
| BV25 | Stop By Ramp | Indicates if drive stop by Ramp | OFF/ON | C |
| BV26 | Belt Broken | Indicates If belt is broken | OFF/ON | R |
| BV27 | Drive Fan Failure | Indicates if Drive Fan failed | OFF/ON | R |
| BV28 | Force Bypass | Command to take Drive in Bypass Mode | OFF/ON | C |
| BV29 | Fire Mode | Enable Fire Mode | OFF/ON | C |
| BV30 | DIN 1 | Fieldbus Digital Input | OFF/ON | C |
| BV31 | DIN 2 | Fieldbus Digital Input | OFF/ON | C |
| BV32 | DIN 3 | Fieldbus Digital Input | OFF/ON | C |
| BV33 | DIN 4 | Fieldbus Digital Input | OFF/ON | C |

**Note:** For Present Value Access Types, R = Read-only, W = Writeable, C = Commandable.

Commandable values support priority arrays and relinquish defaults.

## Analog value object instance summary

The following table summarizes the Analog Value Objects supported.

**Table 90. Analog value object instance summary**

| Instance ID | Object name | Description | Units | Preset value access |
|---|---|---|---|---|
| AV0 | Speed Reference | Motor speed reference from network | Percent | C |
| AV1 | Current Limit | Current Limit | Amps | W |
| AV2 | Min Frequency | Minimum Frequency | Hz | W |
| AV3 | Maximum Frequency | Maximum Frequency | Hz | W |
| AV4 | Accel Time 1 | Acceleration Time | seconds | W |
| AV5 | Decel Time 1 | Deceleration Time | seconds | W |
| AV6 | AnyParam ID | Parameter ID number to be accessed | No Units | W |
| AV7 | AnyParam Value | Value of parameter defined by AV6 | No Units | W |
| AV8 | Process Data In 1 | Fieldbus Process Data In 1 | N/A | C |
| AV9 | Process Data In 2 | Fieldbus Process Data In 2 | N/A | C |
| AV10 | Process Data In 3 | Fieldbus Process Data In 3 | N/A | C |
| AV11 | Process Data In 4 | Fieldbus Process Data In 4 | N/A | C |
| AV12 | Process Data In 5 | Fieldbus Process Data In 5 | N/A | C |
| AV13 | Process Data In 6 | Fieldbus Process Data In 6 | N/A | C |
| AV14 | Process Data In 7 | Fieldbus Process Data In 7 | N/A | C |
| AV15 | Process Data In 8 | Fieldbus Process Data In 8 | N/A | C |

**Note:** For Present Value Access Types, W = Writeable, C = Commandable.

Commandable values support priority arrays and relinquish defaults.

## Analog input object instance summary

The following table summarizes the Analog Input Objects supported.

**Table 91. Analog input object instance summary**

| Instance ID | Object name | Description | Units | Preset value access |
|---|---|---|---|---|
| AI0 | Frequency Setpoint | Frequency Setpoint | Hz | R |
| AI1 | Output Frequency | Output Frequency | Hz | R |
| AI2 | Motor Speed | Motor Speed | Rpm | R |
| AI3 | Motor Load | Motor Load | Percent | R |
| AI4 | Kilowatt Hours total | Kilowatt Hour Counter (Total) scaled by 1000 | KWh | R |
| AI5 | Motor Current | Motor Current | Amps | R |
| AI6 | DC link Voltage | DC link Voltage | Volts | R |
| AI7 | Motor Voltage | Motor Voltage | Volts | R |
| AI8 | Unit Temperature | Heatsink Temperature | °C | R |
| AI9 | Motor Torque | In % of motor nominal Torque | Percent | R |
| AI10 | Operating Days | Operating Days (resettable) | Day | R |
| AI11 | Operating Hours | Operating Hours (resettable) | Hour | R |
| AI12 | Motor Temperature | Motor Temperature | Percent | R |
| AI13 | Analog Input 1 | Analog Input 1 | Volts | R |
| AI14 | Analog Input 2 | Analog Input 2 | Volts | R |
| AI15 | Analog Output 1 | Analog Output 1 | Volts | R |
| AI16 | Analog Output 2 | Analog Output 2 | Volts | R |
| AI17 | Kilowatt Instantaneous | Kilowatt Instantaneous | kW | R |
| AI18 | Process Data Out 1 | Fieldbus Process Data Out 1 | N/A | R |
| AI19 | Process Data Out 2 | Fieldbus Process Data Out 2 | N/A | R |
| AI20 | Process Data Out 3 | Fieldbus Process Data Out 3 | N/A | R |
| AI21 | Process Data Out 4 | Fieldbus Process Data Out 4 | N/A | R |
| AI22 | Process Data Out 5 | Fieldbus Process Data Out 5 | N/A | R |
| AI23 | Process Data Out 6 | Fieldbus Process Data Out 6 | N/A | R |
| AI24 | Process Data Out 7 | Fieldbus Process Data Out 7 | N/A | R |
| AI25 | Process Data Out 8 | Fieldbus Process Data Out 8 | N/A | R |

**Note:** For Present Value Access Types, R = Read-only.

Commandable values support priority arrays and relinquish defaults.

## Multi state object instance summary

The following table summarizes the Multi State Objects supported.

**Table 92. Multi state object instance summary**

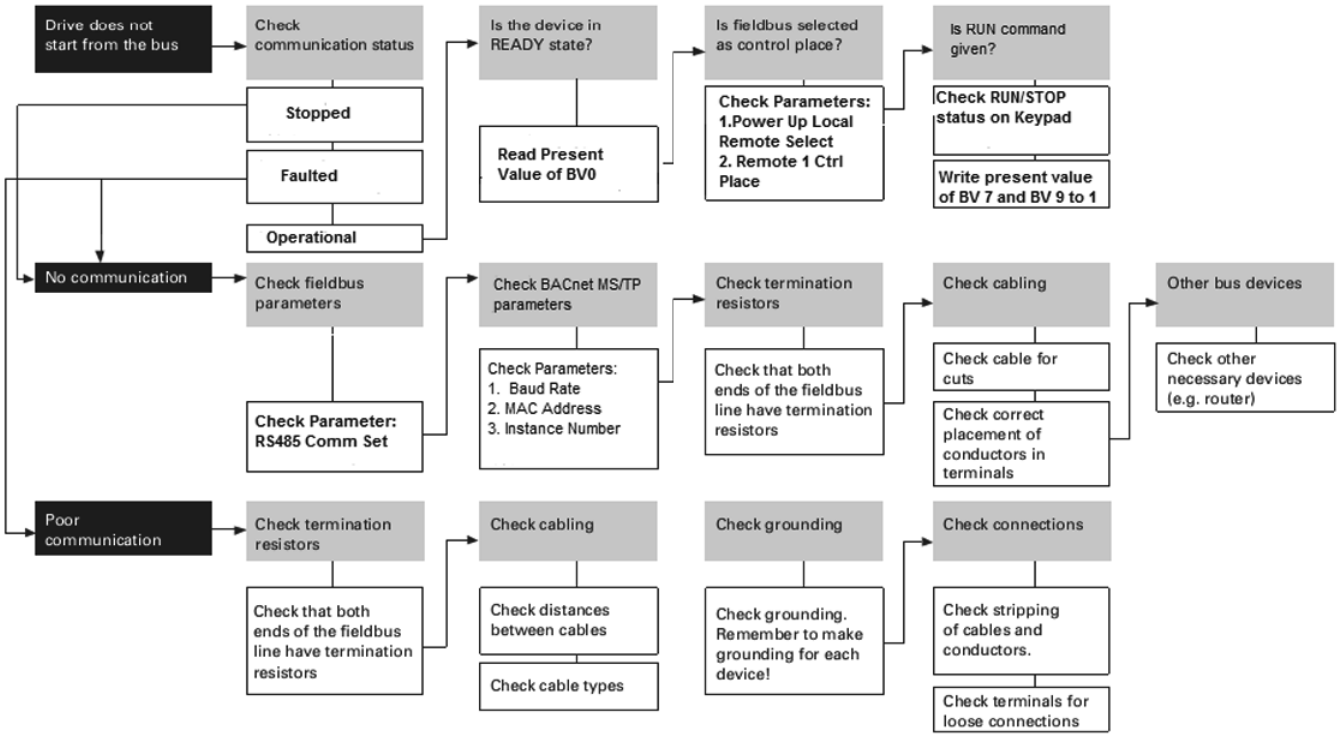
| Instance ID | Object name | Description | State text | Preset value access |
|---|---|---|---|---|
| MV0 | Control Mode | Indicates the Drive Control Mode - Local, Remote or OFF | 0 = Local(Hand) /<br>1 = Remote /<br>2 = OFF | R |
| MV1 | Active Fault Code | Indicates the Latest Active Fault Code of the Drive | State Text w.r.t the Active Fault Code | R |

**Note:** For Present Value Access Types, R = Read-only.

Commandable values support priority arrays and relinquish defaults.

## Fault tracing

**Figure 36. Fault tracing**




## Sensor/actuator bus system protocol

### SA bus general information

The SA bus communications protocol is used by Johnson Controls to connect terminal unit controllers to supervisory controllers.

The physical characteristics of the SA bus are three-wire RS-485. Logically, the SA bus is a master-subordinate protocol, the supervisory controller normally being the master. Data is partitioned into common HVAC control objects, such as Analog Input, Analog Value, Binary Value, Multi-State Value. SA bus messaging supports the reading and overriding of these points.

### Prepare for use through MS/TP

Refer to **page 28**, Steps 1–3.

**⚠ WARNING**

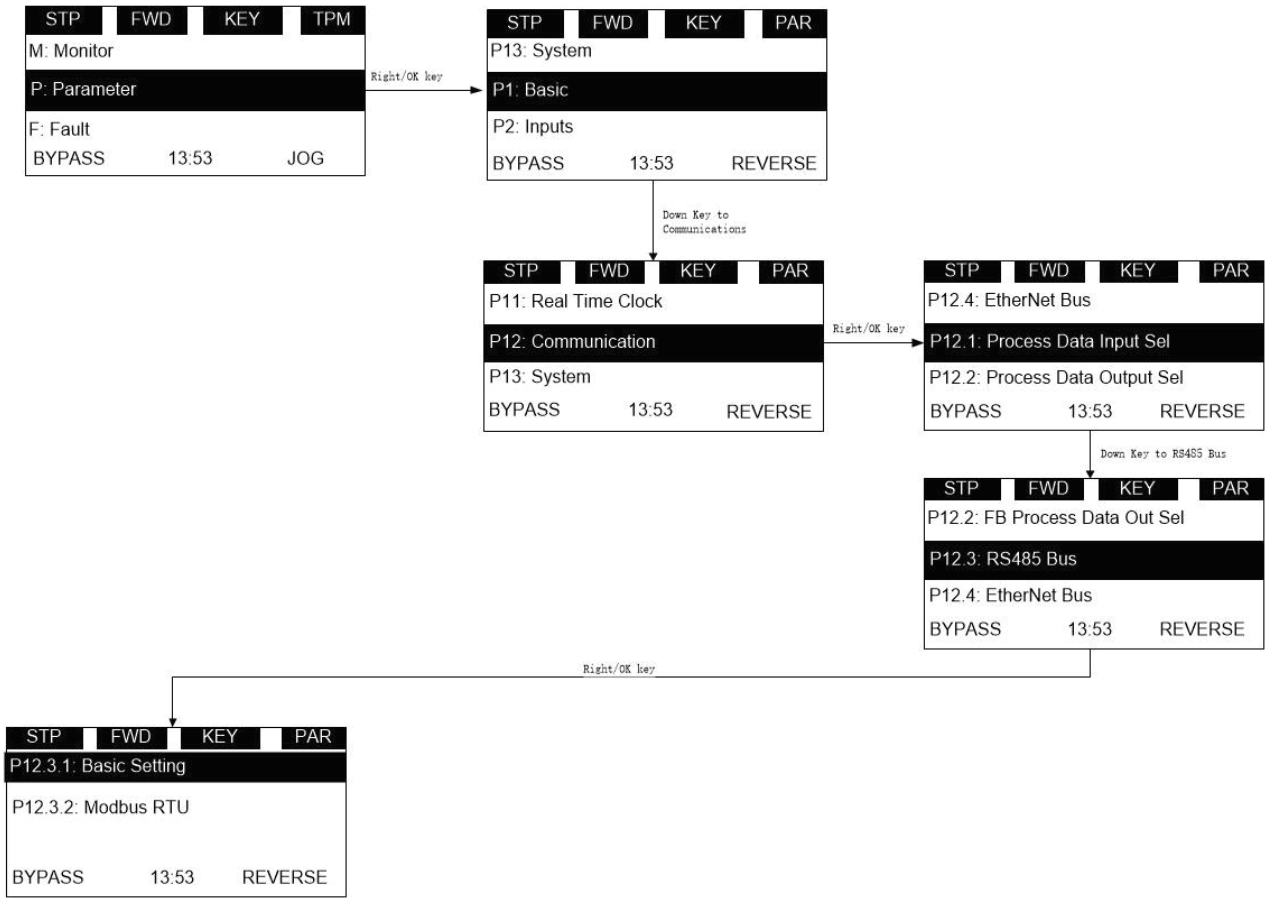
**The relay outputs and other I/O-terminals may have a dangerous control voltage present even when the VSD Series III is disconnected from mains.**

## SA bus technical data

### Table 93. SA bus protocol

| Connection | Communication |
|---|---|
| Interface | RS-485 |
| Data transfer method | RS-485 MS/TP, half-duplex |
| Data transfer cable | STP (Shielded Twisted Pair), type Belden or similar |
| Connector | 2.5 $mm^2$ |
| Electrical isolation | Functional |
| Baud rate | 38400 |
| Addresses | 204 to 254 |

### Figure 37. VS3 SA bus parameter navigation




1. First ensure that the right fieldbus protocol is selected.

Navigate:

Main Menu ⟶ Parameter ⟶ Communication ⟶ RS485 Bus ⟶ RS-485 Comm Set ⟶ Edit ⟶ (Choose Protocol as SA bus)

## Wiring diagram

**Figure 38. Wiring diagram**

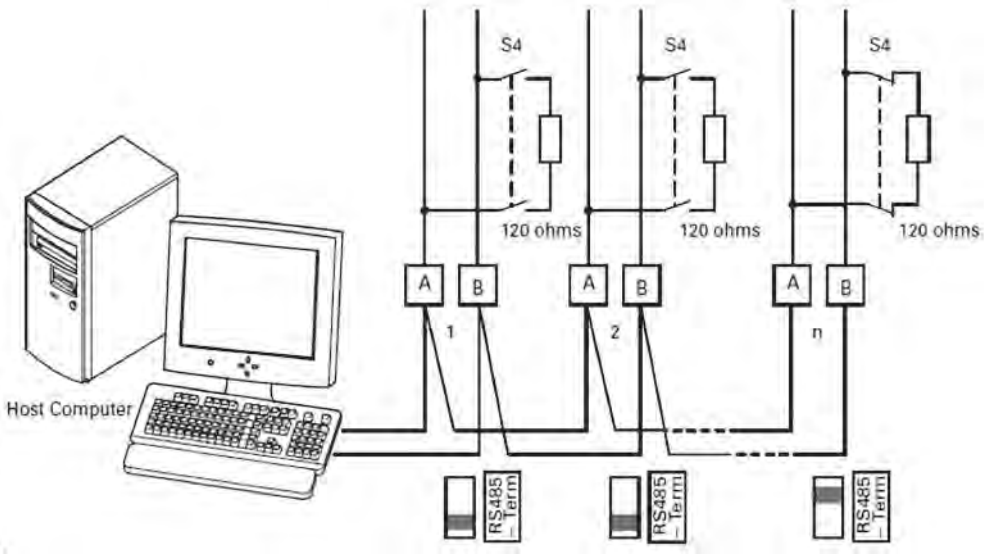



**Figure 38** shows a typical arrangement with a host computer (master) and any number maximum 31 subordinates of frequency inverters. Each frequency inverter has a unique address in the network. This addressing is executed individually for each VFD via the communication parameters.

The electrical connection between master and the subordinates connected in parallel are implemented via the serial interface A-B (A = positive, B = negative) with a shielded RS-485 twisted pair cable.

## Connections

The RS-485 communication port is connected via the A and B terminals on the drives control board.

**Figure 39. Terminal wiring**

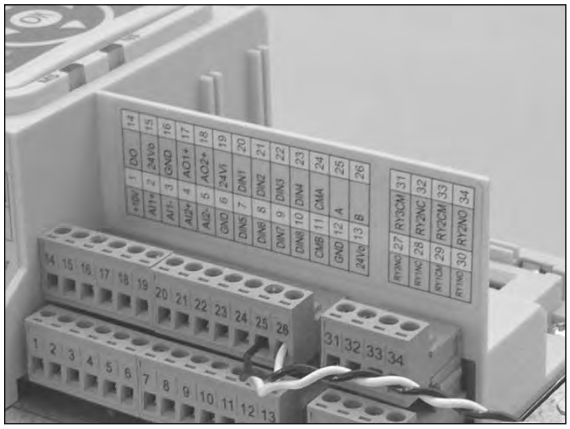
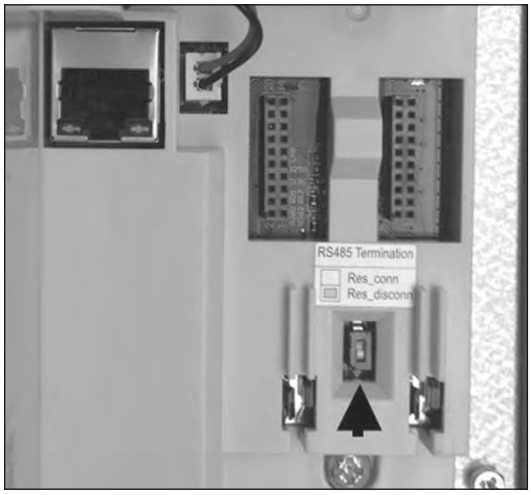


**Figure 40. Termination resistor and shielding**



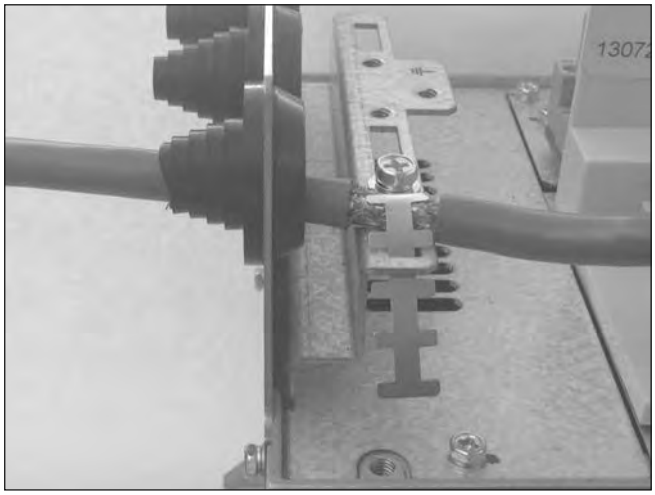



**Table 94. SA bus menu parameters**

| VS3 code | Parameter | Min. | Max. | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|
| P12.3 | RS485 Bus | | | | | | |
| P12.3.1 | Basic Setting | | | | | | |
| P12.3.1.1 | RS485 Comm Set | 0 | 2 | | 0 | 586 | 0 = Modbus RTU<br>1 = BACnet MS/TP<br>2 = SA Bus |
| P12.3.4 | SA Bus | | | | | | |
| P12.3.4.1 | SA Bus Baud Rate | 0 | 4 | | 2 | 1727 | 0 = 9600<br>1 = 19200<br>2 = 38400<br>3 = 57600<br>4 = 115200 |
| P12.3.4.2 | SA Bus Device Address | 128 | 254 | | 204 | 1726 | |
| P12.3.4.3 | SA Bus Instance Number | 0 | 4194302 | | 0 | 1728 | |
| P12.3.4.4 | SA Bus Comm Timeout | 0 | 60000 | | 10000 | 1730 | |
| P12.3.4.5 | SA Bus Protocol Status | | | | 0 | 1731 | 0 = Stopped<br>1 = Operational<br>2 = Faulted |
| P12.3.4.6 | SA Bus Fault Response | | | | 0 | 1732 | 0 = In Fieldbus Control<br>1 = In all Control |

**Table 95. SA bus parameter descriptions**

| Parameter | Parameter name | Description |
|---|---|---|
| P12.3.4.1 | SA Bus Baud Rate | Select the communication speed for the network. The default value is 38400 baud. |
| P12.3.4.2 | SA Bus Device Address | The address of the device on the network. Each device to have unique address in the network. |
| P12.3.4.3 | SA Bus Instance Number | The Device Object's Instance number is used in conjunction with the MAC address to assign the devices on the network. The instance number can have up to 127 nodes on it before a different instance number is required. |
| P12.3.4.4 | SA Bus Comm Timeout | BACnet board initiates a communication error if the board is a "sole master" in the network for a time defined with this parameter. |
| P12.3.4.5 | SA Bus Protocol Status | Fieldbus Protocol Status tells the status of the protocol. |
| P12.3.4.6 | SA Bus Fault Response | Defines when Fieldbus fault to be raise if fault condition is detected. |

**Table 96. Object instance summary**

| Object name | Object description | Object Function | NetDeviceRefAttrID | I/O | Units | States text | Set members |
|---|---|---|---|---|---|---|---|
| VSD1-C | VSD Command | Run/Stop | Drive Command | Output | | Off/On | 0=Off<br>1=On |
| VSD1-O | VSD Output | Output | Reference Command | Output | % | | |
| VSD1-BYPASS | VSD Bypass Drive | Bypass Enable | Bypass Enable | Output | | Off/On | 0=Off<br>1=On |
| VSD1-RESET | VSD Reset Drive Fault | Reset Drive Fault | Reset Drive Fault | Output | | Off/Reset | 0=Off<br>1=Reset |
| VSD1-% | VSD Speed Feedback | Speed Setpoint | Speed Setpoint | Input | % | | |
| VSD1-FAULT | VSD Fault Code | Fault Code | Fault Code | Input | | Drive Fault | Fault Code |
| VSD1-HOA | VSD Control Mode | Control Mode | Control Mode | Input | | Hand Off Auto | 0=Hand<br>1=Off<br>2=Auto |
| VSD1-HZ | VSD Output Frequency | Frequency | Output Frequency | Input | Hz | | |
| VSD1-KWH | VSD Kilowatt Hours | Kilowatt Hours | Kilowatt Hours | Input | kWh | | |
| VSD1-RPM | VSD Motor Speed | Motor Speed | Motor Speed | Input | rpm | | |
| VSD1-S | VSD Status | Status | Drive Running | Input | | Off/On | 0=Off<br>1=On |

## Attribute descriptions

### Drive Command

This attribute is an object reference to a Binary Value object that represents the Drive Command parameter of the DRIVE. The VSD will monitor any write to the Present Value attribute of this object and forward the updated value to the associated property in the DRIVE. A read of the Present Value of this object will only get what was last written and not the current state of the property in the DRIVE. The Present Value of this object is a Boolean that when written will forward a 0-Stop or 1-Run command to the DRIVE.

### Reference Command

This attribute is an object reference to an Analog Value object that represents the Reference Command parameter of the DRIVE. The VSD will monitor any write to the Present Value attribute of this object and forward the updated value to the associated parameter in the DRIVE. A read of the Present Value of this object will only get what was last written and not the current state of the parameter in the DRIVE. The Present Value of this object is a Float 32 that when written will forward 0 to 100 percent command to change the speed of the DRIVE.

### Bypass Drive

This attribute is an object reference to a Binary Value object that represents the Bypass Drive parameter of the DRIVE. The VSD will monitor any write to the Present Value attribute of this object and forward the updated value to the associated property in the DRIVE. A read of the Present Value of this object will only get what was last written and not the current state of the property in the DRIVE. The Present Value of this object is a Boolean that when written will forward a 0-False (bypass disabled) or 1-True (bypass enabled) command to the DRIVE.

### Reset Drive Fault

This attribute is an object reference to a Binary Value object that represents the Reset Drive Fault parameter of the DRIVE. The VSD will monitor any write to the Present Value attribute of this object and forward the updated value to the associated property in the DRIVE. A read of the Present Value of this object will only get what was last written and not the current state of the property in the DRIVE. The Present Value of this object is a Boolean that when written will forward a 0-N/A (do nothing) or 1-Reset command to the DRIVE. The Reset command will reset the DRIVE Fault Code parameter to "0-No Fault". The DRIVE will re-evaluate the fault condition after being sent a reset drive fault command.

### Speed Feedback

This attribute is an object reference to an Analog Input object that represents the Speed Setpoint parameter of the DRIVE. The DRIVE supplies the VSD object with the Present Value.

### Fault Code

This attribute is an object reference to a Multi-State Value object that represents the Fault Code parameter of the DRIVE. The DRIVE supplies the VSD object with the Present Value. The Present Value of this object is an enumeration with 21 states. All fault codes 21 or above will report as Drive Fault. Field Service would need to look at the DRIVE keypad for more diagnostic details.

### Control Mode

This attribute is an object reference to a Multi-State Value object that represents the Control Mode parameter of the DRIVE. The DRIVE supplies the VSD object with the Present Value. The Present Value of this object is an enumeration with 3 states of 0-Hand, 1-Off, and 2-Auto.

### Output Frequency

This attribute is an object reference to an Analog Input object that represents the Output Frequency parameter of the DRIVE. The DRIVE supplies the VSD object with Present Value.

### Kilowatt Hours

This attribute is an object reference to an Analog Input object that represents the Kilowatt Hours parameter of the DRIVE. The DRIVE supplies the VSD object with the Present Value.

### Motor Speed

This attribute is an object reference to an Analog Input object that represents the Motor Speed parameter of the DRIVE. The DRIVE supplies the VSD object with the Present Value.

### Drive Running

This attribute is an object reference to a Binary Value object that represents the Drive Running parameter of the DRIVE. The DRIVE supplies the VSD object with the Present Value. The Present Value of this object is a Boolean were 0-False means that the drive is not running and 1-True means that the drive is running.

# Appendix A—Parameter ID list

## Parameter descriptions

**Table 97. VS3 Parameter ID list**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| M1.1 | 1 | 502 | 0 | Output Frequency | INTEGER | 2 | x100 |
| M1.2 | 24 | 1 | 0 | Freq Reference | INTEGER | 2 | x100 |
| M1.3 | 2 | 503 | 0 | Motor Speed | INTEGER | 2 | x0 |
| M1.4 | 3 | 504 | 0 | Motor Current | INTEGER | 2 | x10 |
| M1.5 | 4 | 507 | 0 | Motor Torque | INTEGER | 2 | x10 |
| M1.6 | 5 | 513 | 1 | Motor Power | INTEGER | 2 | x10 |
| M1.7 | 6 | 501 | 0 | Motor Voltage | INTEGER | 2 | x10 |
| M1.8 | 7 | 501 | 1 | DC-link Voltage | INTEGER | 2 | x0 |
| M1.9 | 8 | 822 | 6 | Unit Temperature | INTEGER | 2 | x10 |
| M1.10 | 9 | 822 | 4 | Motor Temperature | INTEGER | 2 | x10 |
| M1.11 | 28 | NA | NA | Latest Fault Code | BYTE | 1 | x0 |
| M1.12 | 1686 | NA | NA | Instant Motor Power | DOUBLE | 4 | x1000 |
| M1.13 | 583 | 790 | 0 | RTC Battery Status | BYTE | 1 | x0 |
| M2.1 | 10 | 560 | 0 | Analog Input 1 | INTEGER | 2 | x100 |
| M2.2 | 11 | 560 | 1 | Analog Input 2 | INTEGER | 2 | x100 |
| M2.3 | 25 | 570 | 0 | Analog Output 1 | INTEGER | 2 | x100 |
| M2.4 | 575 | 570 | 1 | Analog Output 2 | INTEGER | 2 | x100 |
| M2.5 | 12 | 760 | 0 | DI1, DI2, DI3 | BYTE | 1 | x0 |
| M2.6 | 13 | 760 | 1 | DI4, DI5, DI6 | BYTE | 1 | x0 |
| M2.7 | 576 | 760 | 2 | DI7, DI8 | BYTE | 1 | x0 |
| M2.8 | 14 | 754 | 0 | DO1,Virtual RO1,Virtual RO2 | BYTE | 1 | x0 |
| M2.9 | 557 | 762 | 0 | RO1, RO2, RO3 | BYTE | 1 | x0 |
| M3.1 | 27 | 580 | 0 | PT100 Temperture | INTEGER | 2 | x10 |
| M4.1 | 2120 | NA | NA | Energy Savings | DOUBLE | 4 | x1000 |
| M5.1 | 2209 | NA | NA | Control Board DIDO Status | INTEGER | 2 | x0 |
| M5.2 | 2210 | NA | NA | SlotA DIDO Status | INTEGER | 2 | x0 |
| M5.3 | 2211 | NA | NA | SlotB DIDO Status | INTEGER | 2 | x0 |
| M5.4 | 29 | NA | NA | Application Status Word | INTEGER | 2 | x0 |
| M5.5 | 2414 | NA | NA | Standard Status Word | INTEGER | 2 | x0 |
| M6.1 | 16 | 2150 | 0 | PID1 Set Point | DOUBLE | 4 | x100 |
| M6.2 | 18 | 2864 | 0 | PID1 Feedback | DOUBLE | 4 | x100 |
| M6.3 | 20 | 2167 | 0 | PID1 Error Value | DOUBLE | 4 | x100 |
| M6.4 | 22 | 2124 | 0 | PID1 Output | INTEGER | 2 | x100 |
| M6.5 | 23 | 2133 | 0 | PID1 Status | BYTE | 1 | x0 |
| M6.6 | 32 | 2150 | 1 | PID2 Set Point | DOUBLE | 4 | x100 |
| M6.7 | 34 | 2864 | 1 | PID2 Feedback | DOUBLE | 4 | x100 |
| M6.8 | 36 | 2167 | 1 | PID2 Error Value | DOUBLE | 4 | x100 |
| M6.9 | 38 | 2124 | 1 | PID2 Output | INTEGER | 2 | x100 |
| M6.10 | 39 | 2133 | 1 | PID2 Status | BYTE | 1 | x0 |
| M7.1 | 558 | 763 | 0 | TC1, TC2, TC3 | BYTE | 1 | x0 |
| M7.2 | 559 | 3125 | 0 | Interval 1 | BOOLEAN | 1 | x0 |
| M7.3 | 560 | 3125 | 1 | Interval 2 | BOOLEAN | 1 | x0 |
| M7.4 | 561 | 3125 | 2 | Interval 3 | BOOLEAN | 1 | x0 |
| M7.5 | 562 | 3125 | 3 | Interval 4 | BOOLEAN | 1 | x0 |
| M7.6 | 563 | 3125 | 4 | Interval 5 | BOOLEAN | 1 | x0 |
| M7.7 | 569 | 3101 | 0 | Timer 1 | DOUBLE | 4 | x0 |
| M7.8 | 571 | 3101 | 1 | Timer 2 | DOUBLE | 4 | x0 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| M7.9 | 573 | 3101 | 2 | Timer 3 | DOUBLE | 4 | x0 |
| M8.1 | 2445 | NA | NA | Output | DOUBLE | 4 | x100 |
| M8.2 | 2447 | NA | NA | Reference | DOUBLE | 4 | x100 |
| M9.1 | 601 | 520 | 2 | Total MWh Count | DOUBLE | 4 | x10000 |
| M9.2 | 603 | 522 | 0 | Total Power Day Count | INTEGER | 2 | x0 |
| M9.3 | 606 | 821 | 1 | Total Power Hr Count | DOUBLE | 4 | x0 |
| M9.4 | 604 | 806 | 0 | Trip MWh Count | DOUBLE | 4 | x10000 |
| M9.5 | 636 | 870 | 0 | Trip Power Day Count | INTEGER | 2 | x0 |
| M9.6 | 637 | 871 | 0 | Trip Power Hr Count | DOUBLE | 4 | x0 |
| M10.1 | 30 | 329 | 0 | Multi-Monitoring | BYTE | 3 | x0 |
| P1.1 | 101 | 20 | 0 | Min Frequency | INTEGER | 2 | x100 |
| P1.2 | 102 | 20 | 1 | Max Frequency | INTEGER | 2 | x100 |
| P1.3 | 103 | 130 | 0 | Accel Time 1 | INTEGER | 2 | x10 |
| P1.4 | 104 | 134 | 0 | Decel Time 1 | INTEGER | 2 | x10 |
| P1.5 | 486 | 210 | 0 | Motor Nom Current | INTEGER | 2 | x10 |
| P1.6 | 489 | 217 | 0 | Motor Nom Speed | INTEGER | 2 | x0 |
| P1.7 | 490 | 215 | 0 | Motor PF | INTEGER | 2 | x100 |
| P1.8 | 487 | 211 | 0 | Motor Nom Voltage | INTEGER | 2 | x0 |
| P1.9 | 488 | 216 | 0 | Motor Nom Frequency | INTEGER | 2 | x100 |
| P1.10 | 2465 | NA | NA | HOA Source | BYTE | 1 | x0 |
| P1.11 | 1695 | NA | NA | Hand Control Place | BYTE | 1 | x0 |
| P1.12 | 136 | 436 | 0 | Hand Reference | BYTE | 1 | x0 |
| P1.13 | 135 | 408 | 0 | Auto 1 Control Place | BYTE | 1 | x0 |
| P1.14 | 137 | 437 | 0 | Auto 1 Reference | BYTE | 1 | x0 |
| P1.15 | 138 | 408 | 1 | Auto 2 Control Place | BYTE | 1 | x0 |
| P1.16 | 139 | 437 | 1 | Auto 2 Reference | BYTE | 1 | x0 |
| P2.1.1 | 483 | 636 | 0 | Damper Start | BYTE | 1 | x0 |
| P2.1.2 | 484 | 118 | 0 | Damper Time Out | INTEGER | 2 | x0 |
| P2.1.3 | 485 | 118 | 1 | Damper Delay | INTEGER | 2 | x0 |
| P2.1.4 | 144 | 35 | 1 | AI Ref Scale Min Value | INTEGER | 2 | x100 |
| P2.1.5 | 145 | 34 | 1 | AI Ref Scale Max Value | INTEGER | 2 | x100 |
| P2.2.1 | 143 | 425 | 0 | IO Terminal 1 Start Stop Logic | BYTE | 1 | x0 |
| P2.2.2 | 190 | 414 | 0 | IO Terminal 1 Start Signal 1 | BYTE | 1 | x0 |
| P2.2.3 | 191 | 414 | 1 | IO Terminal 1 Start Signal 2 | BYTE | 1 | x0 |
| P2.2.4 | 2206 | NA | NA | IO Terminal 2 Start Stop Logic | BYTE | 1 | x0 |
| P2.2.5 | 2207 | NA | NA | IO Terminal 2 Start Signal 1 | BYTE | 1 | x0 |
| P2.2.6 | 2208 | NA | NA | IO Terminal 2 Start Signal 2 | BYTE | 1 | x0 |
| P2.2.7 | 881 | 409 | 0 | Thermistor Input Select | BYTE | 1 | x0 |
| P2.2.8 | 198 | 421 | 2 | Reverse | BYTE | 1 | x0 |
| P2.2.9 | 192 | 446 | 0 | Ext. Fault 1 NO | BYTE | 1 | x0 |
| P2.2.10 | 193 | 447 | 0 | Ext. Fault 1 NC | BYTE | 1 | x0 |
| P2.2.11 | 2297 | NA | NA | Ext. Fault 1 Text | BYTE | 1 | x0 |
| P2.2.12 | 2293 | NA | NA | Ext. Fault 2 NO | BYTE | 1 | x0 |
| P2.2.13 | 2294 | NA | NA | Ext. Fault 2 NC | BYTE | 1 | x0 |
| P2.2.14 | 2298 | NA | NA | Ext. Fault 2 Text | BYTE | 1 | x0 |
| P2.2.15 | 2295 | NA | NA | Ext. Fault 3 NO | BYTE | 1 | x0 |
| P2.2.16 | 2296 | NA | NA | Ext. Fault 3 NC | BYTE | 1 | x0 |
| P2.2.17 | 2299 | NA | NA | Ext. Fault 3 Text | BYTE | 1 | x0 |
| P2.2.18 | 200 | 400 | 7 | Fault Reset | BYTE | 1 | x0 |
| P2.2.19 | 194 | 400 | 16 | Run Enable | BYTE | 1 | x0 |
| P2.2.20 | 205 | 432 | 0 | Preset Speed B0 | BYTE | 1 | x0 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| P2.2.21 | 206 | 432 | 1 | Preset Speed B1 | BYTE | 1 | x0 |
| P2.2.22 | 207 | 432 | 2 | Preset Speed B2 | BYTE | 1 | x0 |
| P2.2.23 | 199 | 400 | 8 | Jog Enable | BYTE | 1 | x0 |
| P2.2.24 | 195 | 435 | 0 | Accel/Decel Time Set | BYTE | 1 | x0 |
| P2.2.25 | 201 | 400 | 5 | Accel/Decel Prohibit | BYTE | 1 | x0 |
| P2.2.26 | 215 | 402 | 5 | No Access To Param | BYTE | 1 | x0 |
| P2.2.27 | 196 | 406 | 0 | Auto Control | BYTE | 1 | x0 |
| P2.2.28 | 197 | 406 | 1 | Hand Control | BYTE | 1 | x0 |
| P2.2.29 | 209 | 407 | 0 | Auto 1/2 Select | BYTE | 1 | x0 |
| P2.2.30 | 2395 | NA | NA | HOA On/Off | BYTE | 1 | x0 |
| P2.2.31 | 217 | 417 | 0 | Second Motor Para Select | BYTE | 1 | x0 |
| P2.2.32 | 2312 | NA | NA | Parameter Set1/2 Sel | BYTE | 1 | x0 |
| P2.2.33 | 208 | 415 | 0 | AI Ref Source Select | BYTE | 1 | x0 |
| P2.2.34 | 218 | NA | NA | Bypass Start | BYTE | 1 | x0 |
| P2.2.35 | 1246 | 1804 | 0 | Bypass Overload | BYTE | 1 | x0 |
| P2.2.36 | 550 | 2134 | 0 | PID1 Control Enable | BYTE | 1 | x0 |
| P2.2.37 | 553 | 2134 | 1 | PID2 Control Enable | BYTE | 1 | x0 |
| P2.2.38 | 351 | 410 | 0 | PID1 Set Point Select | BYTE | 1 | x0 |
| P2.2.39 | 352 | 410 | 1 | PID2 Set Point Select | BYTE | 1 | x0 |
| P2.2.40 | 202 | 402 | 4 | DC Brake Active | BYTE | 1 | x0 |
| P2.2.41 | 219 | 402 | 2 | Smoke Mode | BYTE | 1 | x0 |
| P2.2.42 | 220 | 402 | 3 | Fire Mode | BYTE | 1 | x0 |
| P2.2.43 | 221 | 439 | 0 | Fire Mode Ref 1/2 Select | BYTE | 1 | x0 |
| P2.2.44 | 2119 | NA | NA | Fire Mode Reverse | BYTE | 1 | x0 |
| P2.2.45 | 224 | 3104 | 0 | Start Timer 1 | BYTE | 1 | x0 |
| P2.2.46 | 225 | 3104 | 1 | Start Timer 2 | BYTE | 1 | x0 |
| P2.2.47 | 226 | 3104 | 2 | Start Timer 3 | BYTE | 1 | x0 |
| P2.3.1 | 105 | 5 | 1 | Preset Speed 1 | INTEGER | 2 | x100 |
| P2.3.2 | 106 | 5 | 2 | Preset Speed 2 | INTEGER | 2 | x100 |
| P2.3.3 | 118 | 5 | 3 | Preset Speed 3 | INTEGER | 2 | x100 |
| P2.3.4 | 119 | 5 | 4 | Preset Speed 4 | INTEGER | 2 | x100 |
| P2.3.5 | 120 | 5 | 5 | Preset Speed 5 | INTEGER | 2 | x100 |
| P2.3.6 | 121 | 5 | 6 | Preset Speed 6 | INTEGER | 2 | x100 |
| P2.3.7 | 122 | 5 | 7 | Preset Speed 7 | INTEGER | 2 | x100 |
| P2.3.8 | 117 | 1 | 9 | Jog Reference | INTEGER | 2 | x100 |
| P2.4.1 | 222 | 263 | 0 | AI1 Mode | BYTE | 1 | x0 |
| P2.4.2 | 175 | 260 | 0 | AI1 Signal Range | BYTE | 1 | x0 |
| P2.4.3 | 176 | 264 | 0 | AI1 Custom Min | INTEGER | 2 | x100 |
| P2.4.4 | 177 | 265 | 0 | AI1 Custom Max | INTEGER | 2 | x100 |
| P2.4.5 | 174 | 266 | 0 | AI1 Filter Time | INTEGER | 2 | x100 |
| P2.4.6 | 181 | 267 | 0 | AI1 Signal Invert | BOOLEAN | 1 | x0 |
| P2.4.7 | 178 | 1711 | 0 | AI1 Joystick Hyst | INTEGER | 2 | x100 |
| P2.4.8 | 179 | 1720 | 0 | AI1 Sleep Limit | INTEGER | 2 | x100 |
| P2.4.9 | 180 | 1721 | 0 | AI1 Sleep Delay | INTEGER | 2 | x100 |
| P2.4.10 | 133 | 1712 | 0 | AI1 Joystick Offset | INTEGER | 2 | x100 |
| P2.5.1 | 223 | 263 | 1 | AI2 Mode | BYTE | 1 | x0 |
| P2.5.2 | 183 | 260 | 1 | AI2 Signal Range | BYTE | 1 | x0 |
| P2.5.3 | 184 | 264 | 1 | AI2 Custom Min | INTEGER | 2 | x100 |
| P2.5.4 | 185 | 265 | 1 | AI2 Custom Max | INTEGER | 2 | x100 |
| P2.5.5 | 182 | 266 | 1 | AI2 Filter Time | INTEGER | 2 | x100 |
| P2.5.6 | 189 | 267 | 1 | AI2 Signal Invert | BOOLEAN | 1 | x0 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| P2.5.7 | 186 | 1711 | 1 | AI2 Joystick Hyst | INTEGER | 2 | x100 |
| P2.5.8 | 187 | 1720 | 1 | AI2 Sleep Limit | INTEGER | 2 | x100 |
| P2.5.9 | 188 | 1721 | 1 | AI2 Sleep Delay | INTEGER | 2 | x100 |
| P2.5.10 | 134 | 1712 | 1 | AI2 Joystick Offset | INTEGER | 2 | x100 |
| P3.1.1 | 151 | 461 | 0 | DO1 Function | BYTE | 1 | x0 |
| P3.1.2 | 152 | 451 | 0 | RO1 Function | BYTE | 1 | x0 |
| P3.1.3 | 2112 | NA | NA | RO1 On Delay | INTEGER | 2 | x10 |
| P3.1.4 | 2113 | NA | NA | RO1 Off Delay | INTEGER | 2 | x10 |
| P3.1.5 | 153 | 451 | 1 | RO2 Function | BYTE | 1 | x0 |
| P3.1.6 | 2114 | NA | NA | RO2 On Delay | INTEGER | 2 | x10 |
| P3.1.7 | 2115 | NA | NA | RO2 Off Delay | INTEGER | 2 | x10 |
| P3.1.8 | 538 | 451 | 2 | RO3 Function | BYTE | 1 | x0 |
| P3.1.9 | 2116 | NA | NA | RO3 On Delay | INTEGER | 2 | x10 |
| P3.1.10 | 2117 | NA | NA | RO3 Off Delay | INTEGER | 2 | x10 |
| P3.1.11 | 2118 | NA | NA | RO3 Reverse | BYTE | 1 | x0 |
| P3.1.12 | 2463 | NA | NA | Virtual RO1 Function | BYTE | 1 | x0 |
| P3.1.13 | 2464 | NA | NA | Virtual RO2 Function | BYTE | 1 | x0 |
| P3.2.1 | 154 | 1201 | 0 | Freq Limit 1 Supv | BYTE | 1 | x0 |
| P3.2.2 | 155 | 1101 | 0 | Freq Limit 1 Supv Val | INTEGER | 2 | x100 |
| P3.2.3 | 2200 | NA | NA | Freq Limit 1 Supv Hyst | INTEGER | 2 | x100 |
| P3.2.4 | 157 | 1201 | 1 | Freq Limit 2 Supv | BYTE | 1 | x0 |
| P3.2.5 | 158 | 1101 | 1 | Freq Limit 2 Supv Val | INTEGER | 2 | x100 |
| P3.2.6 | 2201 | NA | NA | Freq Limit 2 Supv Hyst | INTEGER | 2 | x100 |
| P3.2.7 | 159 | 1202 | 0 | Torque Limit Supv | BYTE | 1 | x0 |
| P3.2.8 | 160 | 1102 | 0 | Torque Limit Supv Val | INTEGER | 2 | x10 |
| P3.2.9 | 2202 | NA | NA | Torque Limit Supv Hyst | INTEGER | 2 | x10 |
| P3.2.10 | 161 | 1200 | 0 | Ref Limit Supv | BYTE | 1 | x0 |
| P3.2.11 | 162 | 1100 | 0 | Ref Limit Supv Val | INTEGER | 2 | x100 |
| P3.2.12 | 2203 | NA | NA | Ref Limit Supv Hyst | INTEGER | 2 | x100 |
| P3.2.13 | 165 | 1222 | 1 | Temp Limit Supv | BYTE | 1 | x0 |
| P3.2.14 | 166 | 822 | 0 | Temp Limit Supv Val | INTEGER | 2 | x10 |
| P3.2.15 | 2204 | NA | NA | Temp Limit Supv Hyst | INTEGER | 2 | x10 |
| P3.2.16 | 167 | 1203 | 0 | Power Limit Supv | BYTE | 1 | x0 |
| P3.2.17 | 168 | 1103 | 0 | Power Limit Supv Val | INTEGER | 2 | x10 |
| P3.2.18 | 2205 | NA | NA | Power Limit Supv Hyst | INTEGER | 2 | x10 |
| P3.2.19 | 170 | 1504 | 0 | AI Supv Select | BYTE | 1 | x0 |
| P3.2.20 | 171 | 1204 | 0 | AI Limit Supv | BYTE | 1 | x0 |
| P3.2.21 | 172 | 1404 | 0 | AI Limit Supv Val | INTEGER | 2 | x100 |
| P3.2.22 | 2198 | NA | NA | AI Supv Hyst | INTEGER | 2 | x100 |
| P3.2.23 | 2189 | NA | NA | Motor Current 1 Supv | BYTE | 1 | x0 |
| P3.2.24 | 2190 | NA | NA | Motor Current 1 Supv Value | INTEGER | 2 | x10 |
| P3.2.25 | 2196 | NA | NA | Motor Current 1 Supv Hyst | BYTE | 1 | x10 |
| P3.2.26 | 2191 | NA | NA | Motor Current 2 Supv | BYTE | 1 | x0 |
| P3.2.27 | 2192 | NA | NA | Motor Current 2 Supv Value | INTEGER | 2 | x10 |
| P3.2.28 | 2197 | NA | NA | Motor Current 2 Supv Hyst | BYTE | 1 | x10 |
| P3.2.29 | 2193 | NA | NA | Second AI Supv Select | BYTE | 1 | x0 |
| P3.2.30 | 2194 | NA | NA | Second AI Limit Supv | BYTE | 1 | x0 |
| P3.2.31 | 2195 | NA | NA | Second AI Limit Supv Val | INTEGER | 2 | x100 |
| P3.2.32 | 2199 | NA | NA | Second AI Supv Hyst | INTEGER | 2 | x100 |
| P3.2.33 | 1346 | 2860 | 0 | PID1 Superv Enable | BOOLEAN | 1 | x0 |
| P3.2.34 | 1347 | 2861 | 0 | PID1 Superv Upper Limit | DOUBLE | 4 | x100 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| P3.2.35 | 1349 | 2862 | 0 | PID1 Superv Lower Limit | DOUBLE | 4 | x100 |
| P3.2.36 | 1351 | 2863 | 0 | PID1 Superv Delay | INTEGER | 2 | x0 |
| P3.2.37 | 1408 | 2860 | 1 | PID2 Superv Enable | BOOLEAN | 1 | x0 |
| P3.2.38 | 1409 | 2861 | 1 | PID2 Superv Upper Limit | DOUBLE | 4 | x100 |
| P3.2.39 | 1411 | 2862 | 1 | PID2 Superv Lower Limit | DOUBLE | 4 | x100 |
| P3.2.40 | 1413 | 2863 | 1 | PID2 Superv Delay | INTEGER | 2 | x0 |
| P3.3.1 | 227 | 276 | 0 | AO1 Mode | BYTE | 1 | x0 |
| P3.3.2 | 146 | 460 | 0 | AO1 Function | BYTE | 1 | x0 |
| P3.3.3 | 149 | 279 | 0 | AO1 Minimum | BYTE | 1 | x0 |
| P3.3.4 | 147 | 277 | 0 | AO1 Filter Time | INTEGER | 2 | x100 |
| P3.3.5 | 150 | 274 | 0 | AO1 Scale | INTEGER | 2 | x0 |
| P3.3.6 | 148 | 278 | 0 | AO1 Inversion | BOOLEAN | 1 | x0 |
| P3.3.7 | 173 | 275 | 0 | AO1 Offset | INTEGER | 2 | x100 |
| P3.4.1 | 228 | 276 | 1 | AO2 Mode | BYTE | 1 | x0 |
| P3.4.2 | 229 | 460 | 1 | AO2 Function | BYTE | 1 | x0 |
| P3.4.3 | 232 | 279 | 1 | AO2 Minimum | BYTE | 1 | x0 |
| P3.4.4 | 230 | 277 | 1 | AO2 Filter Time | INTEGER | 2 | x100 |
| P3.4.5 | 233 | 274 | 1 | AO2 Scale | INTEGER | 2 | x0 |
| P3.4.6 | 231 | 278 | 1 | AO2 Inversion | BOOLEAN | 1 | x0 |
| P3.4.7 | 234 | 275 | 1 | AO2 Offset | INTEGER | 2 | x100 |
| P3.5.1 | 751 | 2002 | 0 | Logic Function Select | BYTE | 1 | x0 |
| P3.5.2 | 752 | 2000 | 0 | Logic Operation Input A | BYTE | 1 | x0 |
| P3.5.3 | 753 | 2001 | 0 | Logic Operation Input B | BYTE | 1 | x0 |
| P4.1.1 | 141 | 1 | 8 | Keypad Reference | INTEGER | 2 | x100 |
| P4.1.2 | 116 | 621 | 1 | Keypad Direction | BOOLEAN | 1 | x0 |
| P4.1.3 | 114 | 622 | 1 | Keypad Stop | BOOLEAN | 1 | x0 |
| P4.1.4 | 1724 | NA | NA | Hand Key Enable | BYTE | 1 | x0 |
| P4.1.5 | 1679 | 622 | 3 | Reverse Enable | BYTE | 1 | x0 |
| P4.1.6 | 2515 | NA | NA | Change Phase Sequence Motor | BYTE | 1 | x0 |
| P4.1.7 | 1685 | NA | NA | Power Up HOA Select | BYTE | 1 | x0 |
| P4.1.8 | 2462 | NA | NA | Bumpless Enable | BYTE | 1 | x0 |
| P4.1.9 | 2423 | NA | NA | Run Delay Time | INTEGER | 2 | x0 |
| P4.1.10 | 252 | 620 | 0 | Start Mode | BYTE | 1 | x0 |
| P4.1.11 | 253 | 620 | 1 | Stop Mode | BYTE | 1 | x0 |
| P4.1.12 | 247 | 117 | 0 | Ramp 1 Shape | INTEGER | 2 | x10 |
| P4.1.13 | 248 | 117 | 1 | Ramp 2 Shape | INTEGER | 2 | x10 |
| P4.1.14 | 249 | 130 | 1 | Accel Time 2 | INTEGER | 2 | x10 |
| P4.1.15 | 250 | 134 | 1 | Decel Time 2 | INTEGER | 2 | x10 |
| P4.1.16 | 267 | 639 | 0 | Power Loss Function | BYTE | 1 | x0 |
| P4.1.17 | 268 | 151 | 0 | Power Loss Time | INTEGER | 2 | x10 |
| P4.1.18 | 2444 | NA | NA | 2nd Stage Ramp Frequency | INTEGER | 2 | x100 |
| P4.2.1 | 254 | 2227 | 0 | DC-Brake Current | INTEGER | 2 | x10 |
| P4.2.2 | 263 | 2222 | 0 | Start DC-Brake Time | INTEGER | 2 | x100 |
| P4.2.3 | 262 | 2223 | 0 | Stop DC-Brake Frequency | INTEGER | 2 | x100 |
| P4.2.4 | 255 | 2222 | 1 | Stop DC-Brake Time | INTEGER | 2 | x100 |
| P4.2.5 | 251 | 2204 | 0 | Brake Chopper Define | BYTE | 1 | x0 |
| P4.2.6 | 266 | 2214 | 0 | Flux Brake | BOOLEAN | 1 | x0 |
| P4.2.7 | 265 | 2217 | 0 | Flux Brake Current | INTEGER | 2 | x10 |
| P4.3.1 | 264 | 43 | 0 | Skip Range Ramp Factor | INTEGER | 2 | x10 |
| P4.3.2 | 256 | 41 | 0 | Skip F1 Low Limit | INTEGER | 2 | x100 |
| P4.3.3 | 257 | 42 | 0 | Skip F1 High Limit | INTEGER | 2 | x100 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| P4.3.4 | 258 | 41 | 1 | Skip F2 Low Limit | INTEGER | 2 | x100 |
| P4.3.5 | 259 | 42 | 1 | Skip F2 High Limit | INTEGER | 2 | x100 |
| P4.3.6 | 260 | 41 | 2 | Skip F3 Low Limit | INTEGER | 2 | x100 |
| P4.3.7 | 261 | 42 | 2 | Skip F3 High Limit | INTEGER | 2 | x100 |
| P4.4.1 | 2122 | NA | NA | Currency | BYTE | 1 | x0 |
| P4.4.2 | 2123 | NA | NA | Energy Cost | INTEGER | 2 | x100 |
| P4.4.3 | 2124 | NA | NA | Data Type | BYTE | 1 | x0 |
| P4.4.4 | 2125 | NA | NA | Energy Savings Reset | BYTE | 1 | x0 |
| P5.1.1 | 287 | 255 | 0 | Motor Control Mode | BYTE | 1 | x0 |
| P5.1.2 | 107 | 281 | 0 | Current Limit | INTEGER | 2 | x10 |
| P5.1.3 | 109 | 60 | 0 | V/Hz Optimization | BOOLEAN | 1 | x0 |
| P5.1.4 | 108 | 61 | 0 | V/Hz Ratio | BYTE | 1 | x0 |
| P5.1.5 | 289 | 23 | 0 | Field Weakening Point | INTEGER | 2 | x100 |
| P5.1.6 | 290 | 24 | 0 | Voltage at FWP | INTEGER | 2 | x100 |
| P5.1.7 | 291 | 23 | 1 | V/Hz Mid Frequency | INTEGER | 2 | x100 |
| P5.1.8 | 292 | 24 | 1 | V/Hz Mid Voltage | INTEGER | 2 | x100 |
| P5.1.9 | 293 | 27 | 0 | Zero Frequency Voltage | INTEGER | 2 | x100 |
| P5.1.10 | 2522 | NA | NA | Switching Frequency | INTEGER | 2 | x10 |
| P5.1.11 | 1665 | 341 | 0 | Sine Filter Enable | BYTE | 1 | x0 |
| P5.1.12 | 294 | 626 | 3 | OverVoltage Control | BYTE | 1 | x0 |
| P5.1.13 | 298 | 2901 | 0 | Load Drooping | INTEGER | 2 | x100 |
| P5.1.14 | 1630 | 2902 | 0 | Droop Control Filter Time Constant | INTEGER | 2 | x0 |
| P5.2.1 | 577 | 210 | 1 | Motor Nom Current 2 | INTEGER | 2 | x10 |
| P5.2.2 | 578 | 217 | 1 | Motor Nom Speed 2 | INTEGER | 2 | x0 |
| P5.2.3 | 579 | 215 | 1 | Motor PF 2 | INTEGER | 2 | x100 |
| P5.2.4 | 580 | 211 | 1 | Motor Nom Volt 2 | INTEGER | 2 | x0 |
| P5.2.5 | 581 | 216 | 1 | Motor Nom Freq 2 | INTEGER | 2 | x100 |
| P6.1.1 | 308 | 840 | 9040 | Output Phase Fault | BYTE | 1 | x0 |
| P6.1.2 | 309 | 840 | 9008 | Ground Fault | BYTE | 1 | x0 |
| P6.1.3 | 2158 | NA | NA | Ground Fault Limit | BYTE | 1 | x0 |
| P6.1.4 | 310 | 840 | 17168 | Motor Thermal Protection | BYTE | 1 | x0 |
| P6.1.5 | 311 | 1012 | 0 | Motor Thermal F0 Current | INTEGER | 2 | x10 |
| P6.1.6 | 312 | 1011 | 0 | Motor Thermal Time | BYTE | 1 | x0 |
| P6.1.7 | 313 | 840 | 28963 | Stall Protection | BYTE | 1 | x0 |
| P6.1.8 | 314 | 1010 | 0 | Stall Current Limit | INTEGER | 2 | x10 |
| P6.1.9 | 315 | 1010 | 1 | Stall Time Limit | INTEGER | 2 | x10 |
| P6.1.10 | 316 | 1010 | 2 | Stall Frequency Limit | INTEGER | 2 | x100 |
| P6.1.11 | 317 | 840 | 28979 | Underload Protection | BYTE | 1 | x0 |
| P6.1.12 | 318 | 1013 | 0 | Underload Fnom Torque | INTEGER | 2 | x10 |
| P6.1.13 | 319 | 1013 | 1 | Underload F0 Torque | INTEGER | 2 | x10 |
| P6.1.14 | 320 | 1011 | 1 | Underload Time Limit | INTEGER | 2 | x100 |
| P6.1.15 | 333 | 840 | 28978 | Thermistor Fault Response | BYTE | 1 | x0 |
| P6.1.16 | 337 | 840 | 29536 | PT100 Fault Response | BYTE | 1 | x0 |
| P6.1.17 | 2159 | NA | NA | Preheat Mode | BYTE | 1 | x0 |
| P6.1.18 | 2160 | NA | NA | Preheat Control Source | BYTE | 1 | x0 |
| P6.1.19 | 2161 | NA | NA | Preheat Enter Temp | INTEGER | 2 | x10 |
| P6.1.20 | 2162 | NA | NA | Preheat Quit Temp | INTEGER | 2 | x10 |
| P6.1.21 | 2163 | NA | NA | Preheat Output Volt | BYTE | 1 | x0 |
| P6.2.1 | 750 | 861 | 0 | Line Start Lockout | BYTE | 1 | x0 |
| P6.2.2 | 2483 | NA | NA | Fault Reset Start | BYTE | 1 | x0 |
| P6.2.3 | 306 | 840 | 29520 | 4mA Input Fault | BYTE | 1 | x0 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| P6.2.4 | 331 | 1 | 7 | 4mA Fault Frequency | INTEGER | 2 | x100 |
| P6.2.5 | 307 | 840 | 36864 | External Fault | BYTE | 1 | x0 |
| P6.2.6 | 332 | 840 | 12592 | Input Phase Fault | BYTE | 1 | x0 |
| P6.2.7 | 330 | 840 | 12576 | Uvolt Fault Response | BYTE | 1 | x0 |
| P6.2.8 | 1564 | 840 | 16912 | Unit Under Temp Prot | BYTE | 1 | x0 |
| P6.2.9 | 955 | 840 | 35344 | RTC Fault | BYTE | 1 | x0 |
| P6.2.10 | 1256 | 840 | 35345 | Replace Battery Fault Response | BYTE | 1 | x0 |
| P6.2.11 | 1257 | 840 | 28688 | Replace Fan Fault Response | BYTE | 1 | x0 |
| P6.2.12 | 2126 | NA | NA | Cold Weather Mode | BYTE | 1 | x0 |
| P6.2.13 | 2127 | NA | NA | Cold Weather Volt. Level | BYTE | 1 | x10 |
| P6.2.14 | 2128 | NA | NA | Cold Weather Time Out | BYTE | 1 | x0 |
| P6.2.15 | 2129 | NA | NA | Cold Weather Password | INTEGER | 2 | x0 |
| P6.2.16 | 2130 | NA | NA | Under Temp Fault Override | BYTE | 1 | x0 |
| P6.2.17 | 2427 | NA | NA | STO Fault Response | BYTE | 1 | x0 |
| P6.3.1 | 334 | 840 | 29953 | Fieldbus Fault Response | BYTE | 1 | x0 |
| P6.3.2 | 335 | 840 | 35088 | OPTCard Fault Response | BYTE | 1 | x0 |
| P6.3.3 | 1678 | 840 | 30070 | IP Address Confliction Resp | BYTE | 1 | x0 |
| P6.3.4 | 2157 | NA | NA | Keypad Comm Fault Response | BYTE | 1 | x0 |
| P6.4.1 | 321 | 846 | 0 | AR Wait Time | INTEGER | 2 | x100 |
| P6.4.2 | 322 | 846 | 1 | AR Trail Time | INTEGER | 2 | x100 |
| P6.4.3 | 323 | 847 | 0 | AR Start Function | BYTE | 1 | x0 |
| P6.4.4 | 324 | 845 | 12832 | Undervoltage Attempts | BYTE | 1 | x0 |
| P6.4.5 | 325 | 845 | 12816 | OverVoltage Attempts | BYTE | 1 | x0 |
| P6.4.6 | 326 | 845 | 8736 | OverCurrent Attempts | BYTE | 1 | x0 |
| P6.4.7 | 327 | 845 | 29520 | 4mA Fault Attempts | BYTE | 1 | x0 |
| P6.4.8 | 329 | 845 | 28978 | Motor Temp Fault Attempts | BYTE | 1 | x0 |
| P6.4.9 | 328 | 845 | 36864 | External Fault Attempts | BYTE | 1 | x0 |
| P6.4.10 | 336 | 845 | 28979 | Underload Attempts | BYTE | 1 | x0 |
| P7.1.1 | 1294 | 2100 | 0 | PID1 Control Gain | INTEGER | 2 | x100 |
| P7.1.2 | 1295 | 2101 | 0 | PID1 Control ITime | INTEGER | 2 | x100 |
| P7.1.3 | 1296 | 2102 | 0 | PID1 Control DTime | INTEGER | 2 | x100 |
| P7.1.4 | 1297 | 2870 | 0 | PID1 Process Unit | BYTE | 1 | x0 |
| P7.1.5 | 1298 | 2871 | 0 | PID1 Process Unit Min | DOUBLE | 4 | x100 |
| P7.1.6 | 1300 | 2872 | 0 | PID1 Process Unit Max | DOUBLE | 4 | x100 |
| P7.1.7 | 1302 | 2873 | 0 | PID1 Process Unit Decimal | BYTE | 1 | x0 |
| P7.1.8 | 1303 | 2850 | 0 | PID1 Error Inversion | BOOLEAN | 1 | x0 |
| P7.1.9 | 1304 | 2851 | 0 | PID1 Dead Band | DOUBLE | 4 | x100 |
| P7.1.10 | 1306 | 2852 | 0 | PID1 Dead Band Delay | INTEGER | 2 | x100 |
| P7.1.11 | 1311 | 2151 | 0 | PID1 Ramp Time | INTEGER | 2 | x100 |
| P7.2.1 | 2542 | NA | NA | FB PID1 Set Point 1 | DOUBLE | 4 | x100 |
| P7.2.2 | 2544 | NA | NA | FB PID1 Set Point 2 | DOUBLE | 4 | x100 |
| P7.2.3 | 2550 | NA | NA | FB PID1 Feedback 1 | INTEGER | 2 | x100 |
| P7.2.4 | 2551 | NA | NA | FB PID1 Feedback 2 | INTEGER | 2 | x100 |
| P7.2.5 | 2554 | NA | NA | FB PID1 Feedforward 1 | INTEGER | 2 | x100 |
| P7.2.6 | 2555 | NA | NA | FB PID1 Feedforward 2 | INTEGER | 2 | x100 |
| P7.3.1.1 | 1307 | 2170 | 0 | PID1 Keypad Set Point 1 | DOUBLE | 4 | x100 |
| P7.3.1.2 | 1309 | 2179 | 0 | PID1 Keypad Set Point 2 | DOUBLE | 4 | x100 |
| P7.3.1.3 | 2466 | NA | NA | PID1 Wake Up Action | BYTE | 1 | x0 |
| P7.3.2.1 | 1312 | 2110 | 0 | PID1 Set Point 1 Source | BYTE | 1 | x0 |
| P7.3.2.2 | 1313 | 2168 | 0 | PID1 Set Point 1 Min | INTEGER | 2 | x100 |
| P7.3.2.3 | 1314 | 2169 | 0 | PID1 Set Point 1 Max | INTEGER | 2 | x100 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| P7.3.2.4 | 1315 | 2136 | 0 | PID1 Set Point 1 Sleep Enable | BOOLEAN | 1 | x0 |
| P7.3.2.5 | 2396 | NA | NA | PID1 Set Point 1 Sleep Unit Sel | BYTE | 1 | x0 |
| P7.3.2.6 | 2450 | 2137 | 0 | PID1 Set Point 1 Sleep Level | DOUBLE | 4 | x100 |
| P7.3.2.7 | 1317 | 2138 | 0 | PID1 Set Point 1 Sleep Delay | INTEGER | 2 | x0 |
| P7.3.2.8 | 1318 | 2139 | 0 | PID1 Set Point 1 Wake Up Level | DOUBLE | 4 | x100 |
| P7.3.2.9 | 1320 | 2154 | 0 | PID1 Set Point 1 Boost | BYTE | 1 | x10 |
| P7.3.2.10 | 1352 | 2830 | 0 | PID1 Set Point 1 Comp Enable | BOOLEAN | 1 | x0 |
| P7.3.2.11 | 1353 | 2831 | 0 | PID1 Set Point 1 Comp Max | INTEGER | 2 | x100 |
| P7.3.3.1 | 1321 | 2116 | 0 | PID1 Set Point 2 Source | BYTE | 1 | x0 |
| P7.3.3.2 | 1322 | 2177 | 0 | PID1 Set Point 2 Min | INTEGER | 2 | x100 |
| P7.3.3.3 | 1323 | 2178 | 0 | PID1 Set Point 2 Max | INTEGER | 2 | x100 |
| P7.3.3.4 | 1324 | 2140 | 0 | PID1 Set Point 2 Sleep Enable | BOOLEAN | 1 | x0 |
| P7.3.3.5 | 2397 | NA | NA | PID1 Set Point 2 Sleep Unit Sel | BYTE | 1 | x0 |
| P7.3.3.6 | 2452 | 2141 | 0 | PID1 Set Point 2 Sleep Level | DOUBLE | 4 | x100 |
| P7.3.3.7 | 1326 | 2142 | 0 | PID1 Set Point 2 Sleep Delay | INTEGER | 2 | x0 |
| P7.3.3.8 | 1327 | 2143 | 0 | PID1 Set Point 2 Wake Up Level | DOUBLE | 4 | x100 |
| P7.3.3.9 | 1329 | 2157 | 0 | PID1 Set Point 2 Boost | BYTE | 1 | x10 |
| P7.3.3.10 | 1354 | 2835 | 0 | PID1 Set Point 2 Comp Enable | BOOLEAN | 1 | x0 |
| P7.3.3.11 | 1355 | 2836 | 0 | PID1 Set Point 2 Comp Max | INTEGER | 2 | x100 |
| P7.4.1.1 | 1330 | 2171 | 0 | PID1 Feedback Function | BYTE | 1 | x0 |
| P7.4.1.2 | 1331 | 2153 | 0 | PID1 Feedback Gain | INTEGER | 2 | x10 |
| P7.4.2.1 | 1332 | 2112 | 0 | PID1 Feedback 1 Source | BYTE | 1 | x0 |
| P7.4.2.2 | 1333 | 2172 | 0 | PID1 Feedback 1 Min | INTEGER | 2 | x100 |
| P7.4.2.3 | 1334 | 2173 | 0 | PID1 Feedback 1 Max | INTEGER | 2 | x100 |
| P7.4.3.1 | 1335 | 2117 | 0 | PID1 Feedback 2 Source | BYTE | 1 | x0 |
| P7.4.3.2 | 1336 | 2181 | 0 | PID1 Feedback 2 Min | INTEGER | 2 | x100 |
| P7.4.3.3 | 1337 | 2182 | 0 | PID1 Feedback 2 Max | INTEGER | 2 | x100 |
| P7.5.1.1 | 1338 | 2800 | 0 | PID1 Feedforward Func | BYTE | 1 | x0 |
| P7.5.1.2 | 1339 | 2801 | 0 | PID1 Feedforward Gain | INTEGER | 2 | x10 |
| P7.5.2.1 | 1340 | 2810 | 0 | PID1 Feedforward 1 Source | BYTE | 1 | x0 |
| P7.5.2.2 | 1341 | 2811 | 0 | PID1 Feedforward 1 Min | INTEGER | 2 | x100 |
| P7.5.2.3 | 1342 | 2812 | 0 | PID1 Feedforward 1 Max | INTEGER | 2 | x100 |
| P7.5.3.1 | 1343 | 2815 | 0 | PID1 Feedforward 2 Source | BYTE | 1 | x0 |
| P7.5.3.2 | 1344 | 2816 | 0 | PID1 Feedforward 2 Min | INTEGER | 2 | x100 |
| P7.5.3.3 | 1345 | 2817 | 0 | PID1 Feedforward 2 Max | INTEGER | 2 | x100 |
| P8.1.1 | 1356 | 2100 | 1 | PID2 Control Gain | INTEGER | 2 | x100 |
| P8.1.2 | 1357 | 2101 | 1 | PID2 Control I Time | INTEGER | 2 | x100 |
| P8.1.3 | 1358 | 2102 | 1 | PID2 Control D Time | INTEGER | 2 | x100 |
| P8.1.4 | 1359 | 2870 | 1 | PID2 Process Unit | BYTE | 1 | x0 |
| P8.1.5 | 1360 | 2871 | 1 | PID2 Process Unit Min | DOUBLE | 4 | x100 |
| P8.1.6 | 1362 | 2872 | 1 | PID2 Process Unit Max | DOUBLE | 4 | x100 |
| P8.1.7 | 1364 | 2873 | 1 | PID2 Process Unit Decimal | BYTE | 1 | x0 |
| P8.1.8 | 1365 | 2850 | 1 | PID2 Error Inversion | BOOLEAN | 1 | x0 |
| P8.1.9 | 1366 | 2851 | 1 | PID2 Dead Band | DOUBLE | 4 | x100 |
| P8.1.10 | 1368 | 2852 | 1 | PID2 Dead Band Delay | INTEGER | 2 | x100 |
| P8.1.11 | 1373 | 2151 | 1 | PID2 Ramp Time | INTEGER | 2 | x100 |
| P8.2.1 | 2467 | NA | NA | PID2 Wake Up Action | BYTE | 1 | x0 |
| P8.2.2 | 2546 | NA | NA | FB PID2 Set Point 1 | DOUBLE | 4 | x100 |
| P8.2.3 | 2548 | NA | NA | FB PID2 Set Point 2 | DOUBLE | 4 | x100 |
| P8.2.4 | 2552 | NA | NA | FB PID2 Feedback 1 | INTEGER | 2 | x100 |
| P8.2.5 | 2553 | NA | NA | FB PID2 Feedback 2 | INTEGER | 2 | x100 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| P8.2.6 | 2556 | NA | NA | FB PID2 Feedforward 1 | INTEGER | 2 | x100 |
| P8.2.7 | 2557 | NA | NA | FB PID2 Feedforward 2 | INTEGER | 2 | x100 |
| P8.3.1.1 | 1369 | 2170 | 1 | PID2 Keypad Set Point 1 | DOUBLE | 4 | x100 |
| P8.3.1.2 | 1371 | 2179 | 1 | PID2 Keypad Set Point 2 | DOUBLE | 4 | x100 |
| P8.3.1.3 | 2467 | NA | NA | PID2 Wake Up Action | BYTE | 1 | x0 |
| P8.3.2.1 | 1374 | 2110 | 1 | PID2 Set Point 1 Source | BYTE | 1 | x0 |
| P8.3.2.2 | 1375 | 2168 | 1 | PID2 Set Point 1 Min | INTEGER | 2 | x100 |
| P8.3.2.3 | 1376 | 2169 | 1 | PID2 Set Point 1 Max | INTEGER | 2 | x100 |
| P8.3.2.4 | 1377 | 2136 | 1 | PID2 Set Point 1 Sleep Enable | BOOLEAN | 1 | x0 |
| P8.3.2.5 | 2398 | NA | NA | PID2 Set Point 1 Sleep Unit Sel | BYTE | 1 | x0 |
| P8.3.2.6 | 2454 | 2137 | 1 | PID2 Set Point 1 Sleep Level | DOUBLE | 4 | x100 |
| P8.3.2.7 | 1379 | 2138 | 1 | PID2 Set Point 1 Sleep Delay | INTEGER | 2 | x0 |
| P8.3.2.8 | 1380 | 2139 | 1 | PID2 Set Point 1 WakeUp Level | DOUBLE | 4 | x100 |
| P8.3.2.9 | 1382 | 2154 | 1 | PID2 Set Point 1 Boost | BYTE | 1 | x10 |
| P8.3.2.10 | 1414 | 2830 | 1 | PID2 Set Point1 Comp Enable | BOOLEAN | 1 | x0 |
| P8.3.2.11 | 1415 | 2831 | 1 | PID2 Set Point1 Comp Max | INTEGER | 2 | x100 |
| P8.3.2.12 | 2546 | NA | NA | FB PID2 Set Point 1 | DOUBLE | 4 | x100 |
| P8.3.3.1 | 1383 | 2116 | 1 | PID2 Set Point 2 Source | BYTE | 1 | x0 |
| P8.3.3.2 | 1384 | 2177 | 1 | PID2 Set Point 2 Min | INTEGER | 2 | x100 |
| P8.3.3.3 | 1385 | 2178 | 1 | PID2 Set Point 2 Max | INTEGER | 2 | x100 |
| P8.3.3.4 | 1386 | 2140 | 1 | PID2 Set Point 2 Sleep Enable | BOOLEAN | 1 | x0 |
| P8.3.3.5 | 2399 | NA | NA | PID2 Set Point 2 Sleep Unit Sel | BYTE | 1 | x0 |
| P8.3.3.6 | 2456 | 2141 | 1 | PID2 Set Point 2 Sleep Level | DOUBLE | 4 | x100 |
| P8.3.3.7 | 1388 | 2142 | 1 | PID2 Set Point 2 Sleep Delay | INTEGER | 2 | x0 |
| P8.3.3.8 | 1389 | 2143 | 1 | PID2 Set Point 2 WakeUp Level | DOUBLE | 4 | x100 |
| P8.3.3.9 | 1391 | 2157 | 1 | PID2 Set Point 2 Boost | BYTE | 1 | x10 |
| P8.3.3.10 | 1416 | 2835 | 1 | PID2 Set Point 2 Comp Enable | BOOLEAN | 1 | x0 |
| P8.3.3.11 | 1417 | 2836 | 1 | PID2 Set Point 2 Comp Max | INTEGER | 2 | x100 |
| P8.3.3.12 | 2548 | NA | NA | FB PID2 Set Point 2 | DOUBLE | 4 | x100 |
| P8.4.1.1 | 1392 | 2171 | 1 | PID2 Feedback Func | BYTE | 1 | x0 |
| P8.4.1.2 | 1393 | 2153 | 1 | PID2 Feedback Gain | INTEGER | 2 | x10 |
| P8.4.2.1 | 1394 | 2112 | 1 | PID2 Feedback 1 Source | BYTE | 1 | x0 |
| P8.4.2.2 | 1395 | 2172 | 1 | PID2 Feedback 1 Min | INTEGER | 2 | x100 |
| P8.4.2.3 | 1396 | 2173 | 1 | PID2 Feedback 1 Max | INTEGER | 2 | x100 |
| P8.4.2.4 | 2552 | NA | NA | FB PID2 Feedback 1 | INTEGER | 2 | x100 |
| P8.4.3.1 | 1397 | 2117 | 1 | PID2 Feedback 2 Source | BYTE | 1 | x0 |
| P8.4.3.2 | 1398 | 2181 | 1 | PID2 Feedback 2 Min | INTEGER | 2 | x100 |
| P8.4.3.3 | 1399 | 2182 | 1 | PID2 Feedback 2 Max | INTEGER | 2 | x100 |
| P8.4.3.4 | 2553 | NA | NA | FB PID2 Feedback 2 | INTEGER | 2 | x100 |
| P8.5.1.1 | 1400 | 2800 | 1 | PID2 Feedforward Func | BYTE | 1 | x0 |
| P8.5.1.2 | 1401 | 2801 | 1 | PID2 Feedforward Gain | INTEGER | 2 | x10 |
| P8.5.2.1 | 1402 | 2810 | 1 | PID2 Feedforward 1 Source | BYTE | 1 | x0 |
| P8.5.2.2 | 1403 | 2811 | 1 | PID2 Feedforward 1 Min | INTEGER | 2 | x100 |
| P8.5.2.3 | 1404 | 2812 | 1 | PID2 Feedforward 1 Max | INTEGER | 2 | x100 |
| P8.5.2.4 | 2556 | NA | NA | FB PID2 Feedforward 1 | INTEGER | 2 | x100 |
| P8.5.3.1 | 1405 | 2815 | 1 | PID2 Feedforward 2 Source | BYTE | 1 | x0 |
| P8.5.3.2 | 1406 | 2816 | 1 | PID2 Feedforward 2 Min | INTEGER | 2 | x100 |
| P8.5.3.3 | 1407 | 2817 | 1 | PID2 Feedforward 2 Max | INTEGER | 2 | x100 |
| P8.5.3.4 | 2557 | NA | NA | FB PID2 Feedforward 2 | INTEGER | 2 | x100 |
| P9.1 | 535 | 640 | 0 | Fire Mode Function | BOOLEAN | 1 | x0 |
| P9.2 | 536 | 438 | 0 | Fire Mode Ref Select Function | BYTE | 1 | x0 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| P9.3 | 537 | 28 | 2 | Fire Mode Min Frequency | INTEGER | 2 | x100 |
| P9.4 | 565 | 1 | 5 | Fire Mode Freq Ref 1 | INTEGER | 2 | x10 |
| P9.5 | 564 | 1 | 6 | Fire Mode Freq Ref 2 | INTEGER | 2 | x10 |
| P9.6 | 2443 | NA | NA | Fire Mode Test Enable | BOOLEAN | 1 | x0 |
| P9.7 | 554 | 1 | 11 | Smoke Purge Frequency | INTEGER | 2 | x10 |
| P10.1.1 | 1418 | 1801 | 0 | Bypass Enable | BOOLEAN | 1 | x0 |
| P10.1.2 | 544 | 1802 | 0 | Bypass Start Delay | INTEGER | 2 | x0 |
| P10.1.3 | 542 | 1800 | 1 | Auto Bypass | BOOLEAN | 1 | x0 |
| P10.1.4 | 543 | 1802 | 1 | Auto Bypass Delay | INTEGER | 2 | x0 |
| P10.1.5 | 547 | 1803 | 0 | OverCurrent Bypass Enable | BOOLEAN | 1 | x0 |
| P10.1.6 | 546 | 1803 | 1 | IGBT Fault Bypas Enable | BOOLEAN | 1 | x0 |
| P10.1.7 | 548 | 1803 | 2 | 4mA Fault Bypass Enable | BOOLEAN | 1 | x0 |
| P10.1.8 | 545 | 1803 | 3 | UnderVoltage Bypass Enable | BOOLEAN | 1 | x0 |
| P10.1.9 | 549 | 1803 | 4 | OverVoltage Bypass Enable | BOOLEAN | 1 | x0 |
| P10.1.10 | 1698 | NA | NA | Motor OverTemp Bypass Enable | BYTE | 1 | x0 |
| P10.1.11 | 1699 | NA | NA | UnderLoad Bypass Enable | BYTE | 1 | x0 |
| P10.1.12 | 1700 | NA | NA | External Bypass Enable | BYTE | 1 | x0 |
| P10.1.13 | 1701 | NA | NA | Charge Switch Fault Bypass Enable | BYTE | 1 | x0 |
| P10.1.14 | 1702 | NA | NA | Saturation Trip Fault Bypass Enable | BYTE | 1 | x0 |
| P10.1.15 | 1703 | NA | NA | Under Temp Fault Bypass Enable | BYTE | 1 | x0 |
| P10.1.16 | 1704 | NA | NA | EEPROM Fault Bypass Enable | BYTE | 1 | x0 |
| P10.1.17 | 1705 | NA | NA | FRAM Fault Bypass Enable | BYTE | 1 | x0 |
| P10.1.18 | 1706 | NA | NA | Watchdog Fault Bypass Enable | BYTE | 1 | x0 |
| P10.1.19 | 1707 | NA | NA | Fan Cooling Fault Bypass Enable | BYTE | 1 | x0 |
| P10.1.20 | 1708 | NA | NA | Keypad Com Fault Bypass Enable | BYTE | 1 | x0 |
| P10.1.21 | 1709 | NA | NA | Option Card Fault Bypass Enable | BYTE | 1 | x0 |
| P10.1.22 | 1710 | NA | NA | RTC Clock Fault Bypass Enable | BYTE | 1 | x0 |
| P10.1.23 | 1711 | NA | NA | Ctrl Board OverTemp Fault Bypass Enable | BYTE | 1 | x0 |
| P10.1.24 | 1712 | NA | NA | Speed Search Start Fault Bypass Enable | BYTE | 1 | x0 |
| P10.1.25 | 1713 | NA | NA | Fieldbus Fault Bypass Enable | BYTE | 1 | x0 |
| P10.2.1 | 2476 | NA | NA | Redundant Drive Enable | BYTE | 1 | x0 |
| P10.2.2 | 2278 | NA | NA | Drive ID | BYTE | 1 | x0 |
| P10.2.3 | 2477 | NA | NA | Redundant Run Time Enable | BYTE | 1 | x0 |
| P10.2.4 | 2478 | NA | NA | Redundant Run Time Reset | BYTE | 1 | x0 |
| P10.2.5 | 2479 | NA | NA | Redundant RunTime Limit | DOUBLE | 4 | x10 |
| P11.1.1 | 2487 | NA | NA | Interval 1 Setting | BYTE | 1 | x0 |
| P11.1.2 | 491 | NA | NA | Interval 1 On Time | BYTE | 3 | x0 |
| P11.1.3 | 493 | NA | NA | Interval 1 Off Time | BYTE | 3 | x0 |
| P11.1.4 | 517 | 3122 | 0 | Interval 1 From Day | BYTE | 1 | x0 |
| P11.1.5 | 518 | 3123 | 0 | Interval 1 To Day | BYTE | 1 | x0 |
| P11.1.6 | 519 | 3124 | 0 | Interval 1 Channel | BYTE | 1 | x0 |
| P11.2.1 | 2488 | NA | NA | Interval 2 Setting | BYTE | 1 | x0 |
| P11.2.2 | 495 | NA | NA | Interval 2 On Time | BYTE | 3 | x0 |
| P11.2.3 | 497 | NA | NA | Interval 2 Off Time | BYTE | 3 | x0 |
| P11.2.4 | 520 | 3122 | 1 | Interval 2 From Day | BYTE | 1 | x0 |
| P11.2.5 | 521 | 3123 | 1 | Interval 2 To Day | BYTE | 1 | x0 |
| P11.2.6 | 522 | 3124 | 1 | Interval 2 Channel | BYTE | 1 | x0 |
| P11.3.1 | 2489 | NA | NA | Interval 3 Setting | BYTE | 1 | x0 |
| P11.3.2 | 499 | NA | NA | Interval 3 On Time | BYTE | 3 | x0 |
| P11.3.3 | 501 | NA | NA | Interval 3 Off Time | BYTE | 3 | x0 |
| P11.3.4 | 523 | 3122 | 2 | Interval 3 From Day | BYTE | 1 | x0 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| P11.3.5 | 524 | 3123 | 2 | Interval 3 To Day | BYTE | 1 | x0 |
| P11.3.6 | 525 | 3124 | 2 | Interval 3 Channel | BYTE | 1 | x0 |
| P11.4.1 | 2490 | NA | NA | Interval 4 Setting | BYTE | 1 | x0 |
| P11.4.2 | 503 | NA | NA | Interval 4 On Time | BYTE | 3 | x0 |
| P11.4.3 | 505 | NA | NA | Interval 4 Off Time | BYTE | 3 | x0 |
| P11.4.4 | 526 | 3122 | 3 | Interval 4 From Day | BYTE | 1 | x0 |
| P11.4.5 | 527 | 3123 | 3 | Interval 4 To Day | BYTE | 1 | x0 |
| P11.4.6 | 528 | 3124 | 3 | Interval 4 Channel | BYTE | 1 | x0 |
| P11.5.1 | 2491 | NA | NA | Interval 5 Setting | BYTE | 1 | x0 |
| P11.5.2 | 507 | NA | NA | Interval 5 On Time | BYTE | 3 | x0 |
| P11.5.3 | 509 | NA | NA | Interval 5 Off Time | BYTE | 3 | x0 |
| P11.5.4 | 529 | 3122 | 4 | Interval 5 From Day | BYTE | 1 | x0 |
| P11.5.5 | 530 | 3123 | 4 | Interval 5 To Day | BYTE | 1 | x0 |
| P11.5.6 | 531 | 3124 | 4 | Interval 5 Channel | BYTE | 1 | x0 |
| P11.6.1 | 511 | 3100 | 0 | Timer 1 Duration | DOUBLE | 4 | x0 |
| P11.6.2 | 532 | 3102 | 0 | Timer 1 Channel | BYTE | 1 | x0 |
| P11.6.3 | 513 | 3100 | 1 | Timer 2 Duration | DOUBLE | 4 | x0 |
| P11.6.4 | 533 | 3102 | 1 | Timer 2 Channel | BYTE | 1 | x0 |
| P11.6.5 | 515 | 3100 | 2 | Timer 3 Duration | DOUBLE | 4 | x0 |
| P11.6.6 | 534 | 3102 | 2 | Timer 3 Channel | BYTE | 1 | x0 |
| P12.1.1 | 2533 | NA | NA | FB Process Data Input 1 Sel | INTEGER | 2 | x0 |
| P12.1.2 | 2534 | NA | NA | FB Process Data Input 2 Sel | INTEGER | 2 | x0 |
| P12.1.3 | 2535 | NA | NA | FB Process Data Input 3 Sel | INTEGER | 2 | x0 |
| P12.1.4 | 2536 | NA | NA | FB Process Data Input 4 Sel | INTEGER | 2 | x0 |
| P12.1.5 | 2537 | NA | NA | FB Process Data Input 5 Sel | INTEGER | 2 | x0 |
| P12.1.6 | 2538 | NA | NA | FB Process Data Input 6 Sel | INTEGER | 2 | x0 |
| P12.1.7 | 2539 | NA | NA | FB Process Data Input 7 Sel | INTEGER | 2 | x0 |
| P12.1.8 | 2540 | NA | NA | FB Process Data Input 8 Sel | INTEGER | 2 | x0 |
| P12.2.1 | 1556 | 442 | 0 | FB Process Data Output 1 Sel | INTEGER | 2 | x0 |
| P12.2.2 | 1557 | 442 | 1 | FB Process Data Output 2 Sel | INTEGER | 2 | x0 |
| P12.2.3 | 1558 | 442 | 2 | FB Process Data Output 3 Sel | INTEGER | 2 | x0 |
| P12.2.4 | 1559 | 442 | 3 | FB Process Data Output 4 Sel | INTEGER | 2 | x0 |
| P12.2.5 | 1560 | 442 | 4 | FB Process Data Output 5 Sel | INTEGER | 2 | x0 |
| P12.2.6 | 1561 | 442 | 5 | FB Process Data Output 6 Sel | INTEGER | 2 | x0 |
| P12.2.7 | 1562 | 442 | 6 | FB Process Data Output 7 Sel | INTEGER | 2 | x0 |
| P12.2.8 | 1563 | 442 | 7 | FB Process Data Output 8 Sel | INTEGER | 2 | x0 |
| P12.2.9 | 2415 | NA | NA | Standard Status Word Bit0 Function Select | BYTE | 1 | x0 |
| P12.2.10 | 2416 | NA | NA | Standard Status Word Bit1 Function Select | BYTE | 1 | x0 |
| P12.2.11 | 2417 | NA | NA | Standard Status Word Bit2 Function Select | BYTE | 1 | x0 |
| P12.2.12 | 2418 | NA | NA | Standard Status Word Bit3 Function Select | BYTE | 1 | x0 |
| P12.2.13 | 2419 | NA | NA | Standard Status Word Bit4 Function Select | BYTE | 1 | x0 |
| P12.2.14 | 2420 | NA | NA | Standard Status Word Bit5 Function Select | BYTE | 1 | x0 |
| P12.2.15 | 2421 | NA | NA | Standard Status Word Bit6 Function Select | BYTE | 1 | x0 |
| P12.2.16 | 2422 | NA | NA | Standard Status Word Bit7 Function Select | BYTE | 1 | x0 |
| P12.3.1.1 | 586 | 3220 | 0 | RS485 Comm Set | BYTE | 1 | x0 |
| P12.3.2.1 | 587 | 3221 | 0 | Subordinate Address | BYTE | 1 | x0 |
| P12.3.2.2 | 584 | 3222 | 0 | Baud Rate | BYTE | 1 | x0 |
| P12.3.2.3 | 585 | 3224 | 0 | Parity Type | BYTE | 1 | x0 |
| P12.3.2.4 | 588 | 3225 | 0 | Modbus RTU Protocol Status | BYTE | 1 | x0 |
| P12.3.2.5 | 593 | 3290 | 0 | Comm Timeout Modbus RTU | INTEGER | 2 | x0 |
| P12.3.2.6 | 2516 | NA | NA | Modbus RTU Fault Response | BYTE | 1 | x0 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| P12.3.3.1 | 594 | NA | NA | MSTP Baud Rate | BYTE | 1 | x0 |
| P12.3.3.2 | 595 | NA | NA | MSTP Device Address | BYTE | 1 | x0 |
| P12.3.3.3 | 596 | NA | NA | MSTP Instance Number | DOUBLE | 4 | x0 |
| P12.3.3.4 | 598 | NA | NA | MSTP Comm Timeout | INTEGER | 2 | x0 |
| P12.3.3.5 | 599 | NA | NA | MSTP Protocol Status | BYTE | 1 | x0 |
| P12.3.3.6 | 600 | NA | NA | MSTP Fault Code | BYTE | 1 | x0 |
| P12.3.3.7 | 2526 | NA | NA | MSTP Fault Response | BYTE | 1 | x0 |
| P12.3.3.8 | 1537 | NA | NA | MSTP Max Master | BYTE | 1 | x0 |
| P12.4.1.1 | 1500 | 3249 | 0 | IP Address Mode | BOOLEAN | 1 | x0 |
| P12.4.1.2 | 1507 | NA | NA | Active IP Address | BYTE | 4 | x0 |
| P12.4.1.3 | 1509 | NA | NA | Active Subnet Mask | BYTE | 4 | x0 |
| P12.4.1.4 | 1511 | NA | NA | Active Default Gateway | BYTE | 4 | x0 |
| P12.4.1.5 | 1513 | NA | NA | MAC Address | BYTE | 6 | x0 |
| P12.4.1.6 | 1501 | NA | NA | Static IP Address | BYTE | 4 | x0 |
| P12.4.1.7 | 1503 | NA | NA | Static Subnet Mask | BYTE | 4 | x0 |
| P12.4.1.8 | 1505 | NA | NA | Static Default Gateway | BYTE | 4 | x0 |
| P12.4.1.9 | 1725 | NA | NA | Enable BACnetIP | BYTE | 1 | X0 |
| P12.4.2.1 | 609 | NA | NA | Connection Limit | BYTE | 1 | x0 |
| P12.4.2.2 | 610 | NA | NA | Modbus TCP Unit ID | BYTE | 1 | x0 |
| P12.4.2.3 | 611 | NA | NA | Comm Timeout Modbus TCP | INTEGER | 2 | x0 |
| P12.4.2.4 | 612 | 3235 | 0 | Modbus TCP Protocol Status | BYTE | 1 | x0 |
| P12.4.2.5 | 2517 | NA | NA | Modbus TCP Fault Response | BYTE | 1 | x0 |
| P12.4.3.1 | 1733 | NA | NA | BACnet IP UDP port number | INTEGER | 2 | x0 |
| P12.4.3.2 | 1734 | NA | NA | BACnet IP Foreign Device | BYTE | 1 | x0 |
| P12.4.3.3 | 1735 | NA | NA | BACnet IP BBMD IP | BYTE | 4 | x0 |
| P12.4.3.4 | 1737 | NA | NA | BACnet IP BBMD Port | INTEGER | 2 | x0 |
| P12.4.3.5 | 1738 | NA | NA | BACnet IP Registration Interval | INTEGER | 2 | x0 |
| P12.4.3.6 | 1739 | NA | NA | BACnet IP Comm Timeout | INTEGER | 2 | x0 |
| P12.4.3.7 | 1740 | NA | NA | BACnet IP Protocol Status | BYTE | 1 | x0 |
| P12.4.3.8 | 1741 | NA | NA | BACnet IP Fault Behavior | BYTE | 1 | x0 |
| P12.4.3.9 | 1742 | NA | NA | BACnetIP Instance Number | DOUBLE | 4 | x0 |
| P13.1.1 | 340 | 323 | 0 | Language | BYTE | 1 | x0 |
| P13.1.2 | 142 | 256 | 0 | Application | BYTE | 1 | x0 |
| P13.1.3 | 619 | 970 | 0 | Parameter Sets | BYTE | 1 | x0 |
| P13.1.4 | 620 | 302 | 0 | Up To Keypad | BOOLEAN | 1 | x0 |
| P13.1.5 | 621 | 302 | 1 | Down From Keypad | BYTE | 1 | x0 |
| P13.1.6 | 623 | 305 | 0 | Parameter Comparison | BYTE | 1 | x0 |
| P13.1.7 | 624 | 320 | 0 | Password | INTEGER | 2 | x0 |
| P13.1.8 | 625 | 625 | 0 | Parameter Lock | BOOLEAN | 1 | x0 |
| P13.1.9 | 627 | 328 | 0 | Multimonitor Set | BOOLEAN | 1 | x0 |
| P13.1.10 | 628 | 326 | 0 | Default Page | BYTE | 1 | x0 |
| P13.1.11 | 629 | 330 | 0 | Timeout Time | INTEGER | 2 | x0 |
| P13.1.12 | 630 | 324 | 0 | Contrast Adjust | BYTE | 1 | x0 |
| P13.1.13 | 631 | 330 | 1 | Backlight Time | INTEGER | 2 | x0 |
| P13.1.14 | 632 | 627 | 0 | Fan Control | BYTE | 1 | x0 |
| P13.1.15 | 633 | 362 | 0 | Keypad ACK Timeout | INTEGER | 2 | x0 |
| P13.1.16 | 634 | 3291 | 0 | Keypad Retry Number | BYTE | 1 | x0 |
| P13.1.17 | 626 | NA | NA | Startup Wizard | BOOLEAN | 1 | x0 |
| P13.1.18 | 2412 | NA | NA | Jog Softkey Hidden | BYTE | 1 | x0 |
| P13.1.19 | 2413 | NA | NA | Reverse Softkey Hidden | BYTE | 1 | x0 |
| P13.1.20 | 2424 | NA | NA | Output Display Unit | BYTE | 1 | x0 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| P13.1.21 | 2460 | NA | NA | Output Display Unit Min | DOUBLE | 4 | x100 |
| P13.1.22 | 2425 | NA | NA | Output Display Unit Max | DOUBLE | 4 | x100 |
| P13.2.1 | 640 | 207 | 2 | Keypad Software Version | INTEGER | 4 | x0 |
| P13.2.2 | 642 | 206 | 0 | Motor Control Software Version | INTEGER | 4 | x0 |
| P13.2.3 | 644 | 207 | 1 | Application Software Version | INTEGER | 4 | x0 |
| P13.2.4 | 1714 | NA | NA | Software Bundle Version | | 20 | x0 |
| P13.3.1 | 646 | 2206 | 0 | Brake Chopper | BOOLEAN | 1 | x0 |
| P13.3.2 | 647 | 2200 | 0 | Brake Resistor Status | BOOLEAN | 1 | x0 |
| P13.3.3 | 648 | NA | NA | Serial Number | DOUBLE | 4 | x0 |
| P13.4.1 | 566 | 3000 | 0 | Real Time Clock | BYTE | 6 | x0 |
| P13.4.2 | 582 | 3001 | 0 | Daylight Saving | BYTE | 1 | x0 |
| P13.4.3 | 601 | 520 | 2 | Total MWh Count | DOUBLE | 4 | x10000 |
| P13.4.4 | 603 | 522 | 0 | Total Power Day Count | INTEGER | 2 | x0 |
| P13.4.5 | 606 | 821 | 1 | Total Power Hr Count | DOUBLE | 4 | x0 |
| P13.4.6 | 604 | 806 | 0 | Trip MWh Count | DOUBLE | 4 | x10000 |
| P13.4.7 | 635 | 322 | 3 | Clear Trip MWh Count | BOOLEAN | 1 | x0 |
| P13.4.8 | 636 | 870 | 0 | Trip Power Day Count | INTEGER | 2 | x0 |
| P13.4.9 | 637 | 871 | 0 | Trip Power Hr Count | DOUBLE | 4 | x0 |
| P13.4.10 | 639 | 322 | 4 | Clear Trip Power Count | BOOLEAN | 1 | x0 |
| B2.1.1 | 883 | 710 | 1 | Board Status | BYTE | 1 | x0 |
| B2.1.2 | 1064 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B2.1.3 | 889 | 760 | 3 | DI1, DI2, DI3 | BYTE | 1 | x0 |
| B2.1.4 | 888 | 761 | 3 | DO1, DO2, DO3 | BYTE | 1 | x0 |
| B2.1.5 | 891 | 593 | 100 | Thermistor Resistor | DOUBLE | 4 | x0 |
| B2.1.6 | 887 | 753 | 100 | Thermistor State | BYTE | 1 | x0 |
| B2.2.1 | 241 | 461 | 100 | DO1 Function | BYTE | 1 | x0 |
| B2.2.2 | 242 | 461 | 101 | DO2 Function | BYTE | 1 | x0 |
| B2.2.3 | 243 | 461 | 102 | DO3 Function | BYTE | 1 | x0 |
| B2.2.4 | 890 | 343 | 100 | Thermistor Config | BOOLEAN | 1 | x0 |
| B3.1.1 | 883 | 710 | 1 | Board Status | BYTE | 1 | x0 |
| B3.1.2 | 1064 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B3.1.3 | 894 | 560 | 100 | AI1 Value | INTEGER | 2 | x1000 |
| B3.1.4 | 897 | 570 | 100 | AO1 Value | INTEGER | 2 | x1000 |
| B3.1.5 | 899 | 570 | 101 | AO2 Value | INTEGER | 2 | x1000 |
| B3.2.1 | 893 | 263 | 100 | AI1 Mode | BYTE | 1 | x0 |
| B3.2.2 | 124 | 260 | 100 | AI1 Signal Range | BYTE | 1 | x0 |
| B3.2.3 | 125 | 264 | 100 | AI1 Custom Min | INTEGER | 2 | x100 |
| B3.2.4 | 126 | 265 | 100 | AI1 Custom Max | INTEGER | 2 | x100 |
| B3.2.5 | 123 | 266 | 100 | AI1 Filter Time | INTEGER | 2 | x100 |
| B3.2.6 | 127 | 267 | 100 | AI1 Signal Invert | BOOLEAN | 1 | x0 |
| B3.2.7 | 896 | 276 | 100 | AO1 Mode | BYTE | 1 | x0 |
| B3.2.8 | 235 | 460 | 100 | AO1 Function | BYTE | 1 | x0 |
| B3.2.9 | 238 | 279 | 100 | AO1 Minimum | BYTE | 1 | x0 |
| B3.2.10 | 236 | 277 | 100 | AO1 Filter Time | INTEGER | 2 | x100 |
| B3.2.11 | 239 | 274 | 100 | AO1 Scale | INTEGER | 2 | x0 |
| B3.2.12 | 237 | 278 | 100 | AO1 Inversion | BOOLEAN | 1 | x0 |
| B3.2.13 | 240 | 275 | 100 | AO1 Offset | INTEGER | 2 | x100 |
| B3.2.14 | 898 | 276 | 101 | AO2 Mode | BYTE | 1 | x0 |
| B3.2.15 | 269 | 460 | 101 | AO2 Function | BYTE | 1 | x0 |
| B3.2.16 | 270 | 279 | 101 | AO2 Minimum | BYTE | 1 | x0 |
| B3.2.17 | 271 | 277 | 101 | AO2 Filter Time | INTEGER | 2 | x100 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| B3.2.18 | 272 | 274 | 101 | AO2 Scale | INTEGER | 2 | x0 |
| B3.2.19 | 273 | 278 | 101 | AO2 Inversion | BOOLEAN | 1 | x0 |
| B3.2.20 | 274 | 275 | 101 | AO2 Offset | INTEGER | 2 | x100 |
| B4.1.1 | 883 | 710 | 1 | Board Status | BYTE | 1 | x0 |
| B4.1.2 | 1064 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B4.1.3 | 900 | 455 | 100 | RO1, RO2, RO3 | BYTE | 1 | x0 |
| B4.2.1 | 540 | 451 | 100 | RO1 Function | BYTE | 1 | x0 |
| B4.2.2 | 541 | 451 | 101 | RO2 Function | BYTE | 1 | x0 |
| B4.2.3 | 551 | 451 | 102 | RO3 Function | BYTE | 1 | x0 |
| B5.1.1 | 883 | 710 | 1 | Board Status | BYTE | 1 | x0 |
| B5.1.2 | 1064 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B5.1.3 | 905 | 756 | 100 | PT100 State | INTEGER | 6 | x0 |
| B5.1.4 | 902 | NA | NA | PT100 Values | INTEGER | 6 | x10 |
| B5.2.1 | 901 | 342 | 100 | PT100-3,2,1 | BYTE | 1 | x0 |
| B5.2.2 | 338 | 581 | 100 | PT100 Warning Limit | INTEGER | 2 | x10 |
| B5.2.3 | 339 | 582 | 100 | PT100 Fault Limit | INTEGER | 2 | x10 |
| B6.1.1 | 883 | 710 | 1 | Board Status | BYTE | 1 | x0 |
| B6.1.2 | 1064 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B6.1.3 | 908 | 760 | 3 | AC1, AC2, AC3 | BYTE | 1 | x0 |
| B6.1.4 | 1696 | 760 | 7 | AC4, AC5, AC6 | BYTE | 1 | x0 |
| B7.1.1.1 | 883 | 710 | 1 | Board Status | BYTE | 1 | x0 |
| B7.1.1.2 | 1064 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B7.1.1.3 | 2131 | NA | NA | Protocol Status | BYTE | 1 | x0 |
| B7.1.1.4 | NA | NA | NA | PDP-Telegram Selection | INTEGER | 2 | x0 |
| B7.1.1.5 | NA | NA | NA | Fault Counter PDP | INTEGER | 2 | x0 |
| B7.1.1.6 | NA | NA | NA | Fault Situations Max | INTEGER | 4 | x0 |
| B7.1.1.7 | NA | NA | NA | PDP-Profil Number | INTEGER | 2 | x0 |
| B7.1.1.8 | NA | NA | NA | PDP-Control Word | INTEGER | 2 | x0 |
| B7.1.1.9 | NA | NA | NA | PDP-Status Word | INTEGER | 2 | x0 |
| B7.1.2.1 | 2621 | NA | NA | PDP-MaxBlockLength | BYTE | 1 | x0 |
| B7.1.2.2 | 2622 | NA | NA | PDP-NoOfMultiparameter | BYTE | 1 | x0 |
| B7.1.2.3 | 2623 | NA | NA | PDP-MaxLatency | BYTE | 1 | x0 |
| B7.1.3.1 | 2624 | NA | NA | PDP-DO Manufacturer | INTEGER | 2 | x0 |
| B7.1.3.2 | 1451 | NA | NA | PDP-DO Device Type | INTEGER | 2 | x0 |
| B7.1.3.3 | NA | NA | NA | PDP-DO FW-Interface | INTEGER | 2 | x0 |
| B7.1.3.4 | NA | NA | NA | PDP-DO FW-Year | INTEGER | 2 | x0 |
| B7.1.3.5 | NA | NA | NA | PDP-DO FW-DayMonth | INTEGER | 2 | x0 |
| B7.1.3.6 | 2628 | NA | NA | PDP-DO NoOfDOs | BYTE | 1 | x0 |
| B7.1.3.7 | 2629 | NA | NA | PDP-DO Subclass | BYTE | 1 | x0 |
| B7.2.1 | 1242 | 3201 | 100 | Subordinate Address | BYTE | 1 | x0 |
| B7.2.2 | 1243 | 3202 | 100 | Baud Rate | BYTE | 1 | x0 |
| B7.2.3 | 1245 | 3200 | 100 | Operate Mode | BYTE | 1 | x0 |
| B7.2.4 | NA | NA | NA | Parameter Access | INTEGER | 2 | x0 |
| B7.2.5 | NA | NA | NA | Process Data Access | INTEGER | 2 | x0 |
| B7.2.6 | NA | NA | NA | Fault Situation Counter | INTEGER | 2 | x0 |
| B7.2.7 | 619 | 970 | 0 | Parameter Sets | BYTE | 1 | x0 |
| B8.1.1 | 883 | 710 | 1 | Board Status | BYTE | 1 | x0 |
| B8.1.2 | 1064 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B8.1.3 | 2132 | NA | NA | Protocol Status | BYTE | 1 | x0 |
| B8.2.1 | 2133 | NA | NA | Node ID | BYTE | 1 | x0 |
| B8.2.2 | 2134 | NA | NA | Baud Rate | BYTE | 1 | x0 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| B8.2.3 | 2135 | NA | NA | Operate Mode | BYTE | 1 | x0 |
| B8.2.4 | 2519 | NA | NA | Comm Card FB Fault Response | BYTE | 1 | x0 |
| B9.1.1 | 883 | 710 | 1 | Board Status | BYTE | 1 | x0 |
| B9.1.2 | 1064 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B9.1.3 | 2136 | NA | NA | Protocol Status | BYTE | 1 | x0 |
| B9.2.1 | 2137 | NA | NA | MAC ID | BYTE | 1 | x0 |
| B9.2.2 | 2138 | NA | NA | Baud Rate | BYTE | 1 | x0 |
| B9.2.3 | 2187 | NA | NA | IO Poll Type | BYTE | 1 | x0 |
| B9.2.4 | 2212 | NA | NA | Dnet Comm Timeout | INTEGER | 2 | x0 |
| B9.2.5 | 2519 | NA | NA | Comm Card FB Fault Response | BYTE | 1 | x0 |
| B11.1.1 | 910 | 710 | 2 | Board Status | BYTE | 1 | x0 |
| B11.1.2 | 1067 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B11.1.3 | 915 | 550 | 200 | DI1, DI2, DI3 | BYTE | 1 | x0 |
| B11.1.4 | 914 | 761 | 2 | DO1, DO2, DO3 | BYTE | 1 | x0 |
| B11.1.5 | 917 | 593 | 200 | Thermistor Resistor | DOUBLE | 4 | x0 |
| B11.1.6 | 913 | 753 | 200 | Thermistor State | BYTE | 1 | x0 |
| B11.2.1 | 244 | 461 | 200 | DO1 Function | BYTE | 1 | x0 |
| B11.2.2 | 245 | 461 | 201 | DO2 Function | BYTE | 1 | x0 |
| B11.2.3 | 246 | 461 | 202 | DO3 Function | BYTE | 1 | x0 |
| B11.2.4 | 916 | 343 | 200 | Thermistor Config | BYTE | 1 | x0 |
| B12.1.1 | 910 | 710 | 2 | Board Status | BYTE | 1 | x0 |
| B12.1.2 | 1067 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B12.1.3 | 920 | 560 | 200 | AI1 Value | INTEGER | 2 | x1000 |
| B12.1.4 | 923 | 570 | 200 | AO1 Value | INTEGER | 2 | x1000 |
| B12.1.5 | 925 | 570 | 201 | AO2 Value | INTEGER | 2 | x1000 |
| B12.2.1 | 919 | NA | NA | AI1 Mode | BYTE | 1 | x0 |
| B12.2.2 | 129 | 260 | 200 | AI1 Signal Range | BYTE | 1 | x0 |
| B12.2.3 | 130 | 264 | 200 | AI1 Custom Min | INTEGER | 2 | x100 |
| B12.2.4 | 131 | 265 | 200 | AI1 Custom Max | INTEGER | 2 | x100 |
| B12.2.5 | 128 | 266 | 200 | AI1 Filter Time | INTEGER | 2 | x100 |
| B12.2.6 | 132 | 267 | 200 | AI1 Signal Invert | BOOLEAN | 1 | x0 |
| B12.2.7 | 922 | 276 | 200 | AO1 Mode | BYTE | 1 | x0 |
| B12.2.8 | 275 | 460 | 200 | AO1 Function | BYTE | 1 | x0 |
| B12.2.9 | 276 | 279 | 200 | AO1 Minimum | BYTE | 1 | x0 |
| B12.2.10 | 277 | 277 | 200 | AO1 Filter Time | INTEGER | 2 | x100 |
| B12.2.11 | 278 | 274 | 200 | AO1 Scale | INTEGER | 2 | x0 |
| B12.2.12 | 279 | 278 | 200 | AO1 Inversion | BOOLEAN | 1 | x0 |
| B12.2.13 | 280 | 275 | 200 | AO1 Offset | INTEGER | 2 | x100 |
| B12.2.14 | 924 | 276 | 201 | AO2 Mode | BYTE | 1 | x0 |
| B12.2.15 | 281 | 460 | 201 | AO2 Function | BYTE | 1 | x0 |
| B12.2.16 | 282 | 279 | 201 | AO2 Minimum | BYTE | 1 | x0 |
| B12.2.17 | 283 | 277 | 201 | AO2 Filter Time | INTEGER | 2 | x100 |
| B12.2.18 | 284 | 274 | 201 | AO2 Scale | INTEGER | 2 | x0 |
| B12.2.19 | 285 | 278 | 201 | AO2 Inversion | BOOLEAN | 1 | x0 |
| B12.2.20 | 286 | 275 | 201 | AO2 Offset | INTEGER | 2 | x100 |
| B13.1.1 | 910 | 710 | 2 | Board Status | BYTE | 1 | x0 |
| B13.1.2 | 1067 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B13.1.3 | 926 | 762 | 2 | RO1, RO2, RO3 | BYTE | 1 | x0 |
| B13.2.1 | 552 | 451 | 200 | RO1 Function | BYTE | 1 | x0 |
| B13.2.2 | 555 | 451 | 201 | RO2 Function | BYTE | 1 | x0 |
| B13.2.3 | 556 | 451 | 202 | RO3 Function | BYTE | 1 | x0 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| B14.1.1 | 910 | 710 | 2 | Board Status | BYTE | 1 | x0 |
| B14.1.2 | 1067 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B14.1.3 | 931 | 757 | 2 | PT100 State | INTEGER | 6 | x0 |
| B14.1.4 | 928 | NA | NA | PT100 Values | INTEGER | 6 | x10 |
| B14.2.1 | 927 | 342 | 200 | PT100-3,2,1 | BYTE | 1 | x0 |
| B14.2.2 | 937 | 581 | 200 | PT100 Warning Limit | INTEGER | 2 | x10 |
| B14.2.3 | 938 | 582 | 200 | PT100 Fault Limit | INTEGER | 2 | x10 |
| B15.1.1 | 910 | 710 | 2 | Board Status | BYTE | 1 | x0 |
| B15.1.2 | 1067 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B15.1.3 | 934 | 760 | 4 | AC1, AC2, AC3 | BYTE | 1 | x0 |
| B15.1.4 | 1697 | 760 | 8 | AC4, AC5, AC6 | BYTE | 1 | x0 |
| B16.1.1.1 | 910 | 710 | 2 | Board Status | BYTE | 1 | x0 |
| B16.1.1.2 | 1067 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B16.1.1.3 | 2142 | NA | NA | Protocol Status | BYTE | 1 | x0 |
| B16.1.1.4 | NA | NA | NA | PDP-Telegram Selection | INTEGER | 2 | x0 |
| B16.1.1.5 | NA | NA | NA | Fault Counter PDP | INTEGER | 2 | x0 |
| B16.1.1.6 | NA | NA | NA | Fault Situations Max | INTEGER | 4 | x0 |
| B16.1.1.7 | NA | NA | NA | PDP-Profil Number | INTEGER | 2 | x0 |
| B16.1.1.8 | NA | NA | NA | PDP-Control Word | INTEGER | 2 | x0 |
| B16.1.1.9 | NA | NA | NA | PDP-Status Word | INTEGER | 2 | x0 |
| B16.1.2.1 | 2621 | NA | NA | PDP-MaxBlockLength | BYTE | 1 | x0 |
| B16.1.2.2 | 2622 | NA | NA | PDP-NoOfMultiparameter | BYTE | 1 | x0 |
| B16.1.2.3 | 2623 | NA | NA | PDP-MaxLatency | BYTE | 1 | x0 |
| B16.1.3.1 | 2624 | NA | NA | PDP-DO Manufacturer | INTEGER | 2 | x0 |
| B16.1.3.2 | 1451 | NA | NA | PDP-DO Device Type | INTEGER | 2 | x0 |
| B16.1.3.3 | 2625 | NA | NA | PDP-DO FW-Interface | INTEGER | 2 | x0 |
| B16.1.3.4 | NA | NA | NA | PDP-DO FW-Year | INTEGER | 2 | x0 |
| B16.1.3.5 | NA | NA | NA | PDP-DO FW-DayMonth | INTEGER | 2 | x0 |
| B16.1.3.6 | 2628 | NA | NA | PDP-DO NoOfDOs | BYTE | 1 | x0 |
| B16.1.3.7 | 2629 | NA | NA | PDP-DO Subclass | BYTE | 1 | x0 |
| B16.2.1 | 1250 | 3201 | 200 | Subordinate Address | BYTE | 1 | x0 |
| B16.2.2 | 1251 | 3202 | 200 | Baud Rate | BYTE | 1 | x0 |
| B16.2.3 | 1253 | 3200 | 200 | Operate Mode | BYTE | 1 | x0 |
| B16.2.4 | NA | NA | NA | Parameter Access | INTEGER | 2 | x0 |
| B16.2.5 | NA | NA | NA | Process Data Access | INTEGER | 2 | x0 |
| B16.2.6 | NA | NA | NA | Fault Situation Counter | INTEGER | 2 | x0 |
| B16.2.7 | 619 | 970 | 0 | Parameter Sets | BYTE | 1 | x0 |
| B17.1.1 | 910 | 710 | 2 | Board Status | BYTE | 1 | x0 |
| B17.1.2 | 1067 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B17.1.3 | 2143 | NA | NA | Protocol Status | BYTE | 1 | x0 |
| B17.2.1 | 2144 | NA | NA | Node ID | BYTE | 1 | x0 |
| B17.2.2 | 2145 | NA | NA | Baud Rate | BYTE | 1 | x0 |
| B17.2.3 | 2146 | NA | NA | Operate Mode | BYTE | 1 | x0 |
| B17.2.4 | 2520 | NA | NA | Comm Card FB Fault Response | BYTE | 1 | x0 |
| B18.1.1 | 910 | 710 | 2 | Board Status | BYTE | 1 | x0 |
| B18.1.2 | 1067 | NA | NA | Firmware Version | INTEGER | 4 | x0 |
| B18.1.3 | 2147 | NA | NA | Protocol Status | BYTE | 1 | x0 |
| B18.2.1 | 2148 | NA | NA | MAC ID | BYTE | 1 | x0 |
| B18.2.2 | 2149 | NA | NA | Baud Rate | BYTE | 1 | x0 |
| B18.2.3 | 2188 | NA | NA | IO Poll Type | BYTE | 1 | x0 |
| B18.2.4 | 2212 | NA | NA | Dnet Comm Timeout | INTEGER | 2 | x0 |

**Table 97. VS3 Parameter ID list, continued**

| Menu Item No. | Modbus Register | PROFIBUS PNU | PROFIBUS PNU SubIndex | Parameter Description | Data Type | Length (in Bytes) | Display Format |
|---|---|---|---|---|---|---|---|
| B18.2.5 | 2520 | NA | NA | Comm Card FB Fault Response | BYTE | 1 | x0 |
| O1 | 1 | 502 | 0 | Output Frequency | INTEGER | 2 | x100 |
| O2 | 24 | 1 | 0 | Freq Reference | INTEGER | 2 | x100 |
| O3 | 2 | 503 | 0 | Motor Speed | INTEGER | 2 | x0 |
| O4 | 3 | 504 | 0 | Motor Current | INTEGER | 2 | x10 |
| O5 | 4 | 507 | 0 | Motor Torque | INTEGER | 2 | x10 |
| O6 | 5 | 513 | 1 | Motor Power | INTEGER | 2 | x10 |
| O7 | 6 | 501 | 0 | Motor Voltage | INTEGER | 2 | x10 |
| O8 | 7 | 501 | 1 | DC-link Voltage | INTEGER | 2 | x0 |
| O9 | 8 | 822 | 6 | Unit Temperature | INTEGER | 2 | x10 |
| O10 | 9 | 822 | 4 | Motor Temperature | INTEGER | 2 | x10 |
| R11 | 141 | 1 | 8 | Keypad Reference | INTEGER | 2 | x100 |
| R12 | 1307 | 2170 | 0 | PID1 Keypad Set Point 1 | DOUBLE | 4 | x100 |
| R13 | 1309 | 2179 | 0 | PID1 Keypad Set Point 2 | DOUBLE | 4 | x100 |
| | 142 | 256 | 0 | Application | BYTE | 1 | x0 |
| | 340 | 323 | 0 | Language | BYTE | 1 | x0 |
| | 566 | 3000 | 0 | Real Time Clock | BYTE | 6 | x0 |
| | 582 | 3001 | 0 | Daylight Saving | BYTE | 1 | x0 |
| | 101 | 20 | 0 | Min Frequency | INTEGER | 2 | x100 |
| | 102 | 20 | 1 | Max Frequency | INTEGER | 2 | x100 |
| | 486 | 210 | 0 | Motor Nom Current | INTEGER | 2 | x10 |
| | 107 | 281 | 0 | Current Limit | INTEGER | 2 | x10 |
| | 489 | 217 | 0 | Motor Nom Speed | INTEGER | 2 | x0 |
| | 490 | 215 | 0 | Motor PF | INTEGER | 2 | x100 |
| | 487 | 211 | 0 | Motor Nom Voltage | INTEGER | 2 | x0 |
| | 488 | 216 | 0 | Motor Nom Frequency | INTEGER | 2 | x100 |
| | 103 | 130 | 0 | Accel Time 1 | INTEGER | 2 | x10 |
| | 104 | 134 | 0 | Decel Time 1 | INTEGER | 2 | x10 |
| | 1695 | NA | NA | Hand Control Place | BYTE | 1 | x0 |
| | 136 | 436 | 0 | Hand Reference | BYTE | 1 | x0 |
| | 135 | 408 | 0 | Auto 1 Control Place | BYTE | 1 | x0 |
| | 137 | 437 | 0 | Auto 1 Reference | BYTE | 1 | x0 |
| | 1297 | 2870 | 0 | PID1 Process Unit | BYTE | 1 | x0 |
| | 1298 | 2871 | 0 | PID1 Process Unit Min | DOUBLE | 4 | x100 |
| | 1300 | 2872 | 0 | PID1 Process Unit Max | DOUBLE | 4 | x100 |
| | 1312 | 2110 | 0 | PID1 Set Point 1 Source | BYTE | 1 | x0 |
| | 1307 | 2170 | 0 | PID1 Keypad Set Point 1 | DOUBLE | 4 | x100 |
| | 1332 | 2112 | 0 | PID1 Feedback 1 Source | BYTE | 1 | x0 |
| | 1333 | 2172 | 0 | PID1 Feedback 1 Min | INTEGER | 2 | x100 |
| | 1334 | 2173 | 0 | PID1 Feedback 1 Max | INTEGER | 2 | x100 |
| | 1297 | 2870 | 0 | PID1 Process Unit | BYTE | 1 | x0 |
| | 1298 | 2871 | 0 | PID1 Process Unit Min | DOUBLE | 4 | x100 |
| | 1300 | 2872 | 0 | PID1 Process Unit Max | DOUBLE | 4 | x100 |
| | 1312 | 2110 | 0 | PID1 Set Point 1 Source | BYTE | 1 | x0 |
| | 1307 | 2170 | 0 | PID1 Keypad Set Point 1 | DOUBLE | 4 | x100 |
| | 1332 | 2112 | 0 | PID1 Feedback 1 Source | BYTE | 1 | x0 |
| | 1333 | 2172 | 0 | PID1 Feedback 1 Min | INTEGER | 2 | x100 |
| | 1334 | 2173 | 0 | PID1 Feedback 1 Max | INTEGER | 2 | x100 |

# Appendix B—Process Data Values

## Process data OUT (subordinate→master)

The fieldbus master can read the frequency converter's actual values using process data variables. All software applications use process data as follows:

**Table 98. Process data OUT (subordinate → master)**

| Data | Value | Unit | Scale | Default, Min., Max. |
|---|---|---|---|---|
| Process data out 1 | Output frequency | Hz | 0.01 Hz | |
| Process data out 2 | Motor speed | rpm | 1 rpm | |
| Process data out 3 | Motor current | A | 0.1 A | |
| Process data out 4 | Motor torque | % | 0.10% | |
| Process data out 5 | Motor power | % | 0.10% | |
| Process data out 6 | Motor voltage | V | 0.1 V | |
| Process data out 7 | DC link voltage | V | 1 V | |
| Process data out 8 | Latest fault code | | | |

**Note:** The communication parameter group in any application has a selector parameter for every process data. The monitoring values and drive parameters can be selected using the ID number. Default selections are shown in the table above. Reference **Appendix A** for Modbus IDs that can be set via the keypad FB Process Data Out group.

## Process data IN (master → subordinate)

Control word, Reference and Process Data are used with All-in-One applications as follows:

**Table 99. Process data IN (master → subordinate) for all applications**

| Data | Value | Unit | Scale | Default |
|---|---|---|---|---|
| Process Data in 1 | FB Torque Reference | % | 0.01 | 0 |
| Process Data in 2 | FB Setpoint 1 | varies | varies | 0 |
| Process Data in 3 | FB Feedback 1 | varies | varies | 0 |
| Process Data in 4 | Accel Time 1 | s | 0.1 | varies |
| Process Data in 5 | Decel Tiime 1 | s | 0.1 | varies |
| Process Data in 6 | Current Limit | A | 0.1 | varies |
| Process Data in 7 | Not Assigned | — | — | — |
| Process Data in 8 | Not Assigned | — | — | — |

**Note:** The communication parameter group in any application has a selector parameter for every process data. The monitoring values and drive parameters can be selected using the ID number. Default selections are shown in the table above. Reference **Appendix A** for Modbus IDs that can be set via the keypad FB Process Data Out group.

# Appendix B—Process Data Values

When configuring the Process Data parameters for the drive, there are many parameters which can monitored over the fieldbus and selected using the communications settings group menu items.

| Menu Item | Parameter | Parameter Number | Default Monitored Parameter |
|---|---|---|---|
| P20.1.1 | FB Data Out 1 Sel | 1 | Output Frequency |
| P20.1.2 | FB Data Out 2 Sel | 2 | Motor Speed |
| P20.1.3 | FB Data Out 3 Sel | 3 | Motor Current |
| P20.1.4 | FB Data Out 4 Sel | 4 | Motor Torque |
| P20.1.5 | FB Data Out 5 Sel | 5 | Motor Power |
| P20.1.6 | FB Data Out 6 Sel | 6 | Motor Voltage |
| P20.1.7 | FB Data Out 7 Sel | 7 | DC-link Voltage |
| P20.1.8 | FB Data Out 8 Sel | 8 | Unit Temperature |

However, since these Menu Items are read write items, these monitored parameters can be modified to any parameter in the drive by simply changing the value for the menu item. For example, if in **FB Data Out 8** one wanted to monitor the state of the Digital Inputs D1 to D3 they would change **Process Data Out 8** from an 8 to a 12. For a complete list of parameters please refer to Communication Application Guide which can be found on the drives web site.

Typically the parameters which are monitored over fieldbus are the same types of parameters monitored on the Monitoring menu of the drive, a list of those parameters and IDs are provided below.

| Parameter ID | Description | Parameter ID | Description |
|---|---|---|---|
| 1 | Output Frequency | 16 | PID1 Set Point |
| 2 | Motor Speed | 18 | PID1 Feedback |
| 3 | Motor Current | 20 | PID1 Error Value |
| 4 | Motor Torque | 22 | PID1 Output |
| 5 | Motor Power | 23 | PID1 Status |
| 6 | Motor Voltage | 24 | Freq Reference |
| 7 | DC-link Voltage | 25 | Analog Output 1 |
| 8 | Unit Temperature | 26 | Running Motors |
| 9 | Motor Temperature | 27 | PT100 Temperature |
| 10 | Analog Input 1 | 28 | Last Active Fault |
| 11 | Analog Input 2 | 30 | Multi-Monitoring |
| 12 | DI1, DI2, DI3 | 32 | PID2 Set Point |
| 13 | DI4, DI5, DI6 | 34 | PID2 Feedback |
| 14 | DO1 | 36 | PID2 Error Value |
| 15 | Torque Reference | 38 | PID2 Output |
| | | 39 | PID2 Status |

# Appendix C—Fault codes

## Fault codes

**Table 100. Fault code list**

| Fault Code | Fault Name | Fault type | Default | Realization | CIP Fault code | PROFIdrive fault code |
|---|---|---|---|---|---|---|
| 1 | Over current | Fault | | DSP | 0x2310h | 8976 |
| 2 | Over voltage | Fault | | DSP | 0x3210h | 12816 |
| 3 | Earth vault | Configurable | Fault | DSP | 0x2330h | 9008 |
| 5 | Charging switch | Fault | | DSP | 0xA000h | 12849 |
| 6 | Emergency stop | Fault | | MCU | 0xA001h | 21121 |
| 7 | Saturation trip | Fault | | DSP | 0xA002h | 29040 |
| 9 | UnderVoltage | Configurable | Fault | DSP/MCU | 0x3220h | 12576 |
| 10 | Input Phase Spv | Configurable | Fault | DSP | 0xA004h | 8528 |
| 11 | Output Phase Spv | Configurable | Fault | DSP | 0xA005h | 9040 |
| 12 | BrakeChopperSpv | Fault | | DSP | 0x7110h | 28944 |
| 13 | Drive underTemp | Configurable | Warning | DSP | 0x4320h | 16928 |
| 14 | Drive overTemp | Fault | | DSP | 0x4310h | 16912 |
| 15 | Motor stalled | Configurable | No Action | DSP | 0x7121h | 28963 |
| 16 | Motor overTemp | Configurable | No Action | DSP | 0x4210h | 17168 |
| 17 | Motor underLoad | Configurable | No Action | DSP | 29d | 28979 |
| 18 | IP address conflict | Configurable | Warning | MCU | 0xA006h | 30070 |
| 19 | Power board EEPROM fault | Fault | | MCU | 0xA007h | 21795 |
| 20 | FRAM fault | Fault | | MCU | 0xA008h | 21777 |
| 21 | Serial flash fault | warning | | MCU | 0xA009h | 21796 |
| 25 | MCU WatchDog fault | Fault | | MCU | 0x6010h | 24848 |
| 26 | Start-up prevent | Fault | | MCU | 0xA00Ah | 35585 |
| 29 | Thermistor fault | Configurable | Fault | MCU | 0x7300h | 28978 |
| 32 | Fan cooling | Fault | | DSP | 0xA00Bh | 28689 |
| 36 | Compatibility fault | Fault | | MCU | 0x5200h | 24849 |
| 37 | Device change | Warning | | MCU | 0xA00Ch | 35360 |
| 38 | Device added | Warning | | MCU | 0xA00Dh | 35361 |
| 39 | Device removed | Fault | | MCU | 0xA00Eh | 35362 |
| 40 | Device Unknown | Fault | | MCU | 0xA00Fh | 35363 |
| 41 | IGBT temperature | Fault | | DSP | 66d | 16913 |
| 50 | AIN<4mA(4to20mA) | Configurable | No Action | MCU | 0xA011h | 29520 |
| 51 | External fault | Configurable | Fault | MCU | 0x9000h | 36864 |
| 52 | Keypad communication fault | Configurable | Fault | MCU | 0xA012h | 21264 |
| 54 | OPT card fault | Configurable | Fault | MCU | 0xA013h | 35073 |
| 55 | Real time clock fault | Configurable | Warning | MCU | 0xA015h | 35344 |
| 56 | PT100 fault | Configurable | Fault | MCU | 0xA016h | 29536 |
| 57 | Motor ID fault | Fault | | DSP | 0xA017h | 29072 |
| 59 | Possible power wiring error detected | Fault | | DSP | 0x5400h | 37121 |
| 58 | Current measure fault | Fault | | DSP | 0x2100h | 9217 |
| 60 | Control board overtemp | Fault | | DSP | 0x4300h | 16914 |
| 61 | Internal-ctrl supply | Fault | | MCU | 0x5112h | 20737 |
| 62 | Too many speed search restarts | Fault | | DSP | 0xA018h | 33809 |
| 63 | Current unbalance | Fault | | DSP | 26d | 9056 |
| 64 | Replace battery | Configurable | Warning | MCU | 0xA019h | 35345 |
| 65 | Replace fan | Configurable | Warning | MCU | 0xA01Ah | 28688 |
| 66 | Safety torque off | Fault | | DSP | 0xA01Bh | 21665 |

**Table 100. Fault code list, continued**

| Fault Code | Fault Name | Fault type | Default | Realization | CIP Fault code | PROFIdrive fault code |
|---|---|---|---|---|---|---|
| 67 | Current limit control | Warning | | DSP | 0x2200h | 8977 |
| 68 | Over voltage control | Warning | | DSP | 0x3310h | 12817 |
| 69 | System Fault - Thermistor SPI | Fault | | MCU | 0xA01Ch | 21009 |
| 70 | System Fault - DSP Parameter | Fault | | MCU | 0xA01Dh | 22018 |
| 71 | System Fault - Intercom | Fault | | MCU | 0xA01Eh | 22019 |
| 72 | Power board EEPROM fault | Fault | | MCU | 0xA01Fh | 22305 |
| 73 | Internal FRAM | Fault | | MCU | 0xA020h | 22033 |
| 74 | FRAM data error | Fault | | MCU | 0xA021h | 21809 |
| 75 | Internal power board EEPROM fault | Fault | | MCU | 0xA022h | 22035 |
| 76 | EEPROM Data error | Fault | | MCU | 0xA023h | 21808 |
| 77 | Internal serial flash | Fault | | MCU | 0xA024h | 22051 |
| 82 | Bypass overload | Fault | | MCU | 0xA025h | 28980 |
| 83 | FieldBus fault | Configurable | Fault | MCU | 0xA026h | 30064 |
| 84 | FieldBus fault | Configurable | Fault | MCU | 0xA027h | 30065 |
| 85 | FieldBus fault | Configurable | Fault | MCU | 0xA028h | 30066 |
| 86 | FieldBus fault | Configurable | Fault | MCU | 0x8100h | 30067 |
| 87 | FieldBus fault | Configurable | Fault | MCU | 0xA029h | 30068 |
| 88 | FieldBus fault | Configurable | Fault | MCU | 0xA02Ah | 30069 |
| 89 | Under voltage | Fault | | DSP | 0xA02Bh | 30070 |
| 90 | Drive UnderTemp | Warning/Fault | | DSP | 0x3221h | 30071 |
| 91 | Option card fault | Fault | | MCU | 0xA02Ch | 30072 |
| 92 | External fault 2 | Configurable | Fault | MCU | 0xA02Dh | NA |
| 93 | External fault 3 | Configurable | Fault | MCU | 0xA02Eh | NA |
| 94 | Pump lost | Warning | | MCU | 0xA02Fh | 58881 |
| 95 | Need alternation | Warning | | MCU | 0xA030 | 58882 |
| 96 | Parameter error | Warning | | MCU | 0x6320 | 33072 |
| 97 | Prime loss | Configurable | No Action | MCU | 0xA031 | 35587 |
| 98 | PID1 feedback AI loss | Configurable | No Action | MCU | 0xA032 | 33283 |
| 99 | PID2 feedback AI loss | Configurable | No Action | MCU | 0xA033 | 33284 |
| 100 | FieldBus SMDT Fault | Configurable | Fault | MCU | 0xA034 | 30002 |
| 101 | SMDT card fault | Configurable | | MCU | 0xA035 | 35120 |
| 102 | External Fault from SWD | Configurable | Fault | MCU | 0xA036 | 36871 |
| 103 | Drive OverTemp Warning | Warning | | DSP | 0xA037 | 16912 |
| 104 | Compatibility Fault | Warning | | MCU | 0xA038 | 22529 |
| 105 | Compatibility Fault | Warning | | MCU | 0xA039 | 22532 |
| 106 | Compatibility Fault | Warning | | MCU | 0xA03A | 22785 |
| 107 | Compatibility Fault | Warning | | MCU | 0xA03B | 22786 |
| 108 | Compatibility Fault | Warning | | MCU | 0xA03C | 22784 |
| 109 | Compatibility Fault | Warning | | MCU | 0xA03D | 22787 |
| 110 | Compatibility Fault | Warning | | MCU | 0xA03E | 22788 |
| 111 | Compatibility Fault | Warning | | MCU | 0xA03F | 22792 |
| 112 | Compatibility Fault | Warning | | MCU | 0xA040 | 22806 |
| 113 | Compatibility Fault | Warning | | MCU | 0xA041 | 22789 |
| 114 | Compatibility Fault | Warning | | MCU | 0xA042 | 22791 |

**Note:** Configurable—Faults that are specified as "Configurable" have "Fault configuration parameter" associated with them. This configuration parameter can be configured as using keypad (menu Protections) or using vendor specific object.

# Appendix D—Variable Speed Drive Series III Recommended Secure Hardening Guidelines

## Introduction

This section "secure configuration" or "hardening" guidelines provide information to the users to securely deploy and maintain this product to adequately minimize the cybersecurity risks to their system. Johnson Controls is committed to minimizing the Cybersecurity risk in its products and deploys cybersecurity best practices and latest cybersecurity technologies in its products and solutions; making them more secure, reliable and competitive for our customers. Johnson Controls also offers Cybersecurity Best Practices whitepapers to its customers that can be referenced at www.Johnson Controls.com/cybersecurity

**Table 101. Variable Speed Drive Series III—secure configuration guidelines**

| Category | Description |
|---|---|
| Asset identification and inventory | Keeping track of all the devices in the system is a pre-requisite for effective management of Cybersecurity of a system. Ensure you maintain an inventory of all the components in your system in a manner in which you uniquely identify each component. To facilitate this, Variable Speed Drive Series III supports the following identifying information - manufacturer, type, serial number, f/w version number, and location.<br>Customers/users can read following information from product label<br>• Model Number<br>• Serial Number<br>• Device Name<br>Information specific to communication protocols is available form parameter menu as below<br>• IP Address Mode<br>• Active IP Address<br>• MAC Address See application manual for these parameter locations. |
| Restrict physical access | Industrial Control Protocols don't offer cryptographic protections at protocol level leaving them exposed to Cybersecurity risk. Physical security is an important layer of defense in such cases. Variable Speed Drive Series III is designed with the consideration that it would be deployed and operated in a physically secure location.<br>• Johnson Controls suggests that physical access to cabinets and/or enclosures containing Variable Speed Drive Series III and the associated system should be restricted, monitored and logged at all times.<br>• Physical access to the communication lines should be restricted to prevent any attempts of wiretapping, sabotage. It's a best practice to use metal conduits for the communication lines running between one cabinet to another cabinet.<br>• Attacker with unauthorized physical access to the device could cause serious disruption of the device functionality. A combination of physical access controls to the location should be used, such as locks, card readers, and/or guards etc.<br>• Variable Speed Drive Series III supports the following physical access ports,<br>◦ RJ45 connector for removable keypad as well as Modbus RTU communications<br>◦ RJ45 for EtherNet IP/Modbus TCP communications<br>◦ Terminal block for Modbus RTU and other Digital IOs<br>Johnson Controls suggests access to above physical ports need to be restricted. |

**Table 101. Variable Speed Drive Series III—secure configuration guidelines, continued**

| Category | Description |
|---|---|
| Restrict logical access to Variable Speed Drive Series III | It is extremely important to securely configure the logical access mechanisms provided in Variable Speed Drive Series III VFD to safeguard the device from unauthorized access. Variable Speed Drive Series III VFD provides various types of administrative, operational, configuration privilege levels. Johnson Controls recommends that the available access control mechanisms be used properly to ensure that access to the system is restricted to legitimate users only. And, such users are restricted to only the privilege levels necessary to complete their job roles/functions.<br>Johnson Controls recommends below best practices to be followed to ensure adequate cybersecurity of the setup/system<br>• Default credentials are changed upon first login. Variable Speed Drive Series III VFD should not be commissioned for production with Default credentials, it's a serious Cybersecurity flaw as the default credentials are published in the manuals. Restrict administrative privileges - Threat actors are increasingly focused on gaining control of legitimate credentials, especially those associated with highly privileged accounts. Limit privileges to only those needed for a user's duties. Make sure that the password used in the device is only available to authorized users like Configuring Engineers and not shared among all operational users.<br>• Perform periodic account maintenance to make sure that password is changed whenever there is personnel change.<br>• Change passwords and other system access credentials as appropriate<br>• Variable Speed Drive Series III VFD is provided with data/access protection mechanism on keypad, follow below steps to utilize it<br>Variable Speed Drive Series III VFD provides four levels of data protection for users to ensure the security:<br>1. Lock parameters on keypad. User can lock the parameters through DI or disable change, in which way all the parameters cannot be edited.<br>2. Lock parameters while motor running. Motor control parameters can only be modified when motor is in stop mode. In which way to enhance the motor security. The parameters are listed in the application manual.<br>3. Through Power Xpert inControl tool, facility to hide parameters on keypad is available. User can hide the parameters he/she thinks are significant for himself/herself. Such as IP address and so on.<br>4. Password on keypad.<br>◦ 0000 means no password, which is the default.<br>◦ Password range is 0001 ~ 9999.<br>◦ With password, user can monitor parameters value but need enter password if he/she wants to edit parameters.<br>◦ User needs to re-enter the password if there is no key operation in 1 min after enter the password.<br>◦ User needs to enter the old password if he/she wants to change to a new one. |
| Restrict network access | Variable Speed Drive Series III VFD provides network access to facilitate communication with other devices in the systems and configuration. But this capability could open up a big security hole if it's not configured securely.<br>Johnson Controls recommends segmentation of networks into logical enclaves and restrict the communication to host-to-host paths. This helps protect sensitive information and critical services and limits damage from network perimeter breaches. At a minimum, a utility Industrial Control Systems network should be segmented into a three-tiered architecture (as recommended by NIST SP800-82[R3]) for better security control.<br>Deploy adequate network protection devices like Firewalls, Intrusion Detection / Protection devices.<br>Below are the protocols and their port details available on Variable Speed Drive Series III VFD. Use below information for configuring the firewalls.<br>Variable Speed Drive Series III VFD provides below communication protocols –<br>• EtherNet IP protocols on RJ45 connector – enabled by default on port 44818 and 2222<br>• Modbus TCP protocol on RJ45 connector – enabled by default on port 502<br>• Modbus RTU on RS485 physical layer – enabled by default<br>• BACnet MS/TP on RS485 physical layer – disabled by default, when this is enabled, Modbus RTU is disabled.<br>All the protocols have dedicated menu structure, and details are described in User's Manual for how to activate or configure them.<br>• Johnson Controls has published detailed information about various Network level protection strategies in Johnson Controls Cybersecurity Considerations for Electrical Distribution Systems [R1]. |

**Table 101. Variable Speed Drive Series III—secure configuration guidelines, continued**

| Category | Description |
|---|---|
| Logging and event management | **Best practices**<br>• Variable Speed Drive Series III VFD provides parameters change log and fault log functions for user, to help diagnose the drive<br>1. Parameters change log:<br>• Variable Speed Drive Series III VFD will log the parameter information in FRAM when the parameter changes. The max number of 66 items can be logged. New log will rewrite the old one. User cannot clear this fault information.<br>2. Fault log:<br>• Variable Speed Drive Series III VFD will log the drive information in FRAM when fault occurs. The max number of 10 items can be logged. New log will rewrite the old one. User can clear the history fault by pressing OK key more than 5 Sec.<br>• Variable Speed Drive Series III VFD will log the fault information in FRAM when fault occurs. The max number of 50 items can be logged. New log will rewrite the old one. User cannot clear this fault information. |
| Secure maintenance | **Best practices**<br>**Apply Firmware updates and patches regularly**<br>Due to rapidly increasing Cyber Threats in Industrial Control Systems, Johnson Controls implements a comprehensive patch and update process for its products. Users are encouraged to maintain a consistent process to promptly monitor for fresh firmware updates and apply the update whenever required.<br>• The latest firmware can be acquired from the www.johnsoncontrols.com website. There will be separate link for Variable Speed Drive Series III VFD FR0 to FR6.<br>• Users can also sign up on our website to get emails when new material is released to the site if desired.<br>• Using the PC Tool or verifying on the keypad the current version of firmware can be verified.<br>• For additional information or technical support on Johnson Controls's Variable frequency drive products contact local sales representative.<br>Johnson Controls also has a robust vulnerability response process. In the event of any security vulnerability getting discovered in its products, Johnson Controls patches the vulnerability and releases information bulletin through its cybersecurity website - http://www.johnsoncontrols.com/cybersecurity and patches through www.johnsoncontrols.com. |

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