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I473 GB 06 16

GB VARIABLE SPEED DRIVES

Instruction manual

VLB3

WARNING!
- Carefully read the manual before the installation or use.
- This equipment is to be installed by qualified personnel, complying to current standards, to avoid damages or safety hazards.
- Before any maintenance operation on the device, remove all the voltages from measuring and supply inputs and short-circuit the CT input terminals.
- The manufacturer cannot be held responsible for electrical safety in case of improper use of the equipment.
- Products illustrated herein are subject to alteration and changes without prior notice. Technical data and descriptions in the documentation are accurate, to the best of our knowledge, but no liabilities for errors, omissions or contingencies arising there from are accepted.
- A circuit breaker must be included in the electrical installation of the building. It must be installed close by the equipment and within easy reach of the operator. It must be marked as the disconnecting device of the equipment: IEC /EN 61010-1 § 6.11.2.
- Clean the device with a soft dry cloth; do not use abrasives, liquid detergents or solvents.

ATTENTION !
- Lire attentivement le manuel avant toute utilisation et installation.
- Ces appareils doivent être installés par un personnel qualifié, conformément aux normes en vigueur en matière d'installations, afin d'éviter de causer des dommages à des personnes ou choses.
- Avant toute intervention sur l'instrument, mettre les entrées de mesure et d'alimentation hors tension et court-circuiter les transformateurs de courant.
- Le constructeur n'assume aucune responsabilité quant à la sécurité électrique en cas d'utilisation impropre du dispositif.
- Les produits décrits dans ce document sont susceptibles d'évoluer ou de subir des modifications à n'importe quel moment. Les descriptions et caractéristiques techniques du catalogue ne peuvent donc avoir aucune valeur contractuelle.
- Un interrupteur ou disjoncteur doit être inclus dans l'installation électrique du bâtiment. Celui-ci doit se trouver tout près de l'appareil et l'opérateur doit pouvoir y accéder facilement. Il doit être marqué comme le dispositif d'interruption de l'appareil : IEC/ EN 61010-1 § 6.11.2.
- Nettoyer l'appareil avec un chiffon doux, ne pas utiliser de produits abrasifs, détergents liquides ou solvants.

ACHTUNG!
- Dieses Handbuch vor Gebrauch und Installation aufmerksam lesen.
- Zur Vermeidung von Personen- und Sachschäden dürfen diese Geräte nur von qualifiziertem Fachpersonal und unter Befolgung der einschlägigen Vorschriften installiert werden.
- Vor jedem Eingriff am Instrument die Spannungszufuhr zu den Messeingängen trennen und die Stromwandler kurzschließen.
- Bei zweckwidrigem Gebrauch der Vorrichtung übernimmt der Hersteller keine Haftung für die elektrische Sicherheit.
- Die in dieser Broschüre beschriebenen Produkte können jederzeit weiterentwickelt und geändert werden. Die im Katalog enthaltenen Beschreibungen und Daten sind daher unverbindlich und ohne Gewähr.
- In die elektrische Anlage des Gebäudes ist ein Ausschalter oder Trennschalter einzubauen. Dieser muss sich in unmittelbarer Nähe des Geräts befinden und vom Bediener leicht zugänglich sein. Er muss als Trennvorrichtung für das Gerät gekennzeichnet sein: IEC/ EN 61010-1 § 6.11.2.
- Das Gerät mit einem weichen Tuch reinigen, keine Scheuermittel, Flüssigreiniger oder Lösungsmittel verwenden.

ADVERTENCIA
- Leer atentamente el manual antes de instalar y utilizar el regulador.
- Este dispositivo debe ser instalado por personal cualificado conforme a la normativa de instalación vigente a fin de evitar daños personales o materiales.
- Antes de realizar cualquier operación en el dispositivo, desconectar la corriente de las entradas de alimentación y medida, y cortocircuitar los transformadores de corriente.
- El fabricante no se responsabilizará de la seguridad eléctrica en caso de que el dispositivo no se utilice de forma adecuada.
- Los productos descritos en este documento se pueden actualizar o modificar en cualquier momento. Por consiguiente, las descripciones y los datos técnicos aquí contenidos no tienen valor contractual.
- La instalación eléctrica del edificio debe disponer de un interruptor o disyuntor. Éste debe encontrarse cerca del dispositivo, en un lugar al que el usuario pueda acceder con facilidad. Además, debe llevar el mismo marcado que el interruptor del dispositivo (IEC/ EN 61010-1 § 6.11.2).
- Limpiar el dispositivo con un trapo suave; no utilizar productos abrasivos, detergentes líquidos ni disolventes.

UPOZORNĚNÍ
- Návod se pozorně pročtěte, než začnete regulátor instalovat a používat.
- Tato zařízení smí instalovat kvalifikovaní pracovníci v souladu s platnými předpisy a normami pro předcházení úrazů osob či poškození věcí.
- Před jakýmkoli zásahem do přístroje odpojte měřicí a napájecí vstupy od napětí a zkratujte transformátory proudu.
- Výrobce nenese odpovědnost za elektrickou bezpečnost v případě nevhodného používání regulátoru.
- Výrobky popsané v tomto dokumentu mohou kdykoli projít úpravami či dalším vývojem. Popisy a údaje uvedené v katalogu nemají proto žádnou smluvní hodnotu.
- Spínač či odpojovač je nutno zabudovat do elektrického rozvodu v budově. Musejí být nainstalované v těsné blízkosti přístroje a snadno dostupné pracovníku obsluhy. Je nutno ho označit jako vypínací zařízení přístroje: IEC/ EN 61010-1 § 6.11.2.
- Přístroj čistěte měkkou utěrkou, nepoužívejte abrazivní produkty, tekutá čistidla či rozpouštědla.

AVERTIZARE!
- Citiţi cu atenţie manualul înainte de instalare sau utilizare.
- Acest echipament va fi instalat de personal calificat, în conformitate cu standardele actuale, pentru a evita deteriorări sau pericolele.
- Înainte de efectuarea oricărei operaţiuni de întreţinere asupra dispozitivului, îndepărtaţi toate tensiunile de la intrările de măsurare şi de alimentare şi scurtcircuitaţi bornele de intrare CT.
- Producătorul nu poate fi considerat responsabil pentru siguranţa electrică în caz de utilizare incorectă a echipamentului.
- Produsele ilustrate în prezentul sunt supuse modificărilor şi schimbărilor fără notificare anterioară. Datele tehnice şi descrierile din documentaţie sunt precise, în măsura cunoştinţelor noastre, dar nu se acceptă nicio răspundere pentru erorile, omiterile sau evenimentele nepreväzute care apar ca urmare a acestora.
- Trebuie inclus un disjunctor în instalaţia electrică a clădirii. Acesta trebuie instalat aproape de echipament şi într-o zonă uşor accesibilă operatorului. Acesta trebuie marcat ca fiind dispozitivul de deconectare al echipamentului: IEC/EN 61010-1 § 6.11.2.
- Curăţaţi instrumentul cu un material textil moale şi uscat; nu utilizaţi substanţe abrazive, detergenţi lichizi sau solvenţi.

ATTENZIONE!
- Leggere attentamente il manuale prima dell'utilizzo e l'installazione.
- Questi apparecchi devono essere installati da personale qualificato, nel rispetto delle vigenti normative impiantistiche, allo scopo di evitare danni a persone o cose.
- Prima di qualsiasi intervento sullo strumento, togliere tensione dagli ingressi di misura e di alimentazione e cortocircuitare i trasformatori di corrente.
- Il costruttore non si assume responsabilità in merito alla sicurezza elettrica in caso di utilizzo improprio del dispositivo.
- I prodotti descritti in questo documento sono suscettibili in qualsiasi momento di evoluzioni o di modifiche. Le descrizioni ed i dati a catalogo non possono pertanto avere alcun valore contrattuale.
- Un interruttore o disgiuntore va compreso nell'impianto elettrico dell'edificio. Esso deve trovarsi in stretta vicinanza dell'apparecchio ed essere facilmente raggiungibile da parte dell'operatore. Deve essere marchiato come il dispositivo di interruzione dell'apparecchio: IEC/ EN 61010-1 § 6.11.2.
- Pulire l'apparecchio con panno morbido, non usare prodotti abrasivi, detergenti liquidi o solventi.

UWAGA!
- Przed użyciem i instalacją urządzenia należy uważnie przeczytać niniejszą instrukcję.
- W celu uniknięcia obrażeń osób lub uszkodzenia mienia tego typu urządzenia muszą być instalowane przez wykwalifikowany personel, zgodnie z obowiązującymi przepisami.
- Przed rozpoczęciem jakichkolwiek prac na urządzeniu należy odłączyć napięcie od wejść pomiarowych i zasilania oraz zewrzeć zaciski przekładnika prądowego.
- Producent nie przyjmuje na siebie odpowiedzialności za bezpieczeństwo elektryczne w przypadku niewłaściwego użytkowania urządzenia.
- Produkty opisane w niniejszym dokumencie mogą być w każdej chwili udoskonalone lub zmodyfikowane. Opisy oraz dane katalogowe nie mogą mieć w związku z tym żadnej wartości umownej.
- W instalacji elektrycznej budynku należy uwzględnić przełącznik lub wyłącznik automatyczny. Powinien on znajdować się w bliskim sąsiedztwie urządzenia i być łatwo osiągalny przez operatora. Musi być oznaczony jako urządzenie służące do wyłączania urządzenia: IEC/ EN 61010-1 § 6.11.2.
- Urządzenie należy czyścić miękką szmatką, nie stosować środków ściernych, płynnych detergentow lub rozpuszczalnikow.

警告！
- 安装或使用前，请仔细阅读本手册。
- 本设备只能由合格人员根据现行标准进行安装，以避免造成损坏或安全危害。
- 对设备进行任何维护操作前，请移除测量输入端和电源输入端的所有电压，并短接 CT 输入端。
- 制造商不负责因设备使用不当导致的电气安全问题。
- 此处说明的产品可能会有变更，恕不提前通知。我们竭力确保本文档中技术数据和说明的准确性，但对于错误、遗漏或由此产生的意外事件概不负责。
- 建筑电气系统中必须装有断路器。断路器必须安装在靠近设备且方便操作员触及的地方。必须将断路器标记为设备的断开装置：IEC/EN 61010-1 § 6.11.2.
- 请使用柔软的干布清洁设备；切勿使用研磨剂、洗涤液或溶剂。

ПРЕДУПРЕЖДЕНИЕ!
- Прежде чем приступать к монтажу или эксплуатации устройства, внимательно ознакомьтесь с одержанием настоящего руководства.
- Во избежание травм или материального ущерба монтаж должен существляться только квалифицированным персоналом в соответствии с действующими нормативами.
- Перед проведением любых работ по техническому обслуживанию устройства необходимо обесточить все измерительные и питающие входные контакты, а также замкнуть накоротко входные контакты трансформатора тока (TT).
- Производитель не несет ответственность за обеспечение электробезопасности в случае ненадлежащего использования устройства.
- Изделия, описанные в настоящем документе, в любой момент могут подвергнуться изменениям или усовершенствованиям. Поэтому каталожные данные и описания не могут рассматриваться как действительные с точки зрения контрактов
- Электрическая сеть здания должна быть оснащена автоматическим выключателем, который должен быть расположен вблизи оборудования в пределах доступа оператора. Автоматический выключатель должен быть промаркирован как отключающее устройство оборудования: IEC /EN 61010-1 § 6.11.2.
- Очистку устройства производить с помощью мягкой сухой ткани, без применения абразивных материалов, жидких моющих средств или растворителей.

DİKKAT!
- Montaj ve kullanımdan önce bu el kitabını dikkatlice okuyunuz.
- Bu aparatlar kişilere veya nesnelere zarar verme ihtimaline karşı yürürlükte olan sistem kurma normlarına göre kalifiye personel tarafından monte edilmelidirler
- Aparata (cihaz) herhangi bir müdahalede bulunmadan önce ölçüm girişlerindeki gerilimi kesip akım transformatörlerinede kısa devre yaptırınız.
- Üretici aparatın hatalı kullanımından kaynaklanan elektriksel güvenliğe ait sorumluluk kabul etmez.
- Bu doküманda tarif edilen ürünler her an evrimlere veya değişimlere açıktır. Bu sebeple katalogdaki tarif ve değerler herhangi bir bağlayıcı değeri haiz değildir.
- Binanın elektrik sisteminde bir anahtar veya şalter bulunmalıdır. Bu anahtar veya şalter operatörün kolaylıkla ulaşabileceği yakın bir yerde olmalıdır. Aparatı (cihaz) devreden çıkartma görevi yapan bu anahtar veya şalterin markası: IEC/ EN 61010-1 § 6.11.2.
- Aparatı (cihaz) sıvı deterjan veya solvent kullanarak yumuşak bir bez ile siliniz aşındırıcı temizlik ürünleri kullanmayınız.

CONTENTS

1 SAFETY INFORMATION

1.1 INTENDED USE OF VSD

The VLB3 VSDs are used for controlling low-voltage motors in industrial and commercial applications within the range of the VSD's technical specifications.

1.2 EXAMPLES OF UNINTENDED USE

– Commissioning of a VLB3 VSD in the event of visible damage or if its display shows any sign of damage.
– Commissioning of a VLB3 VSD that is not fully mounted.
– Illegal technical modifications or software modifications on a VLB3 VSD.
– Using accessories not approved for the VLB3 VSD.
– Operating a VLB3 VSD without necessary protecting covers or outside the technical specifications.
– Operating a VLB3 VSD in explosive atmosphere.

i This list shows a few examples of unintended use, it is not complete and not limited to the examples stated.

1.3 QUALIFIED PERSONNEL

Only qualified personnel according to relevant international and national standards may work on or with the VSD. The necessary skills of qualified persons are defined as follows:
– They have read and understand this operation manual.
– They are familiar with installing, mounting, commissioning, and operating the VLB3 VSD.
– They have the corresponding qualifications for their work.
– They know safe work procedures and lockout/ tagout procedures to create a safe work area.
– They know and can apply all regulations for the prevention of accidents, directives, and laws applicable at the place of use.

1.4 SIGNAL WORDS AND SYMBOLS

The following symbol and signal words are used in this manual to indicate dangers and important information:

⚠ The safety alert symbol is part of a safety message and is used to alert to potential hazards.

⚠ DANGER!
DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING!
WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION!
CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

ⓘ NOTICE!
NOTICE indicates a situation which could lead to property damage.

i This symbol indicates an important note or helpful advice to ensure trouble-free operation.

➔ This symbol indicates a page reference or reference to another VLB3 manual.

1.4.1 ELEMENTS OF A SAFETY MESSAGE

⚠ WARNING! ← Safety alert symbol with signal word in color bar
Dangerous electrical voltage ← Type and source of danger
Death or severe injuries. ← Consequences of non-compliance
► All works on the VSD must only be carried out in the deenergised state. ← Prevention measure(s)
► …

1.5 WARNING LABELS ON VSD

Fig. 1: VLB3 warning labels

Observe the following warning labels on the front side of the VSD:

WARNING LABEL	DESCRIPTION
	**Dangerous electrical voltage** Before working on the VSD, check whether all power connections are dead! After mains OFF, power connections X100 and X105 carry a dangerous electrical voltage for the time specified on the VSD! After switching off the mains voltage wait at least 180s before starting to work on the device.
	**High leakage current** Carry out fixed installation and PE connection in compliance with standard EN 61800–5–1 !
	**Hot surface** Use personal protective equipment or wait until VSD has cooled down!
WARNING LABEL	DESCRIPTION
	**Electrostatic sensitive devices** Before working on the VSD, the staff must ensure to be free of electrostatic charge!

1.6 BASIC SAFETY MEASURES

⚠ WARNING!
Workplace hazards
Possible death or severe personal injury.
– Observe all specifications of the corresponding documentation supplied. This is the precondition for safe and trouble-free commissioning and operation of the VSD and for obtaining the product features specified.
– Observe the specific safety instructions in this operation manual.
– Equip the VSD/drive system with additional monitoring and protection devices if required by national safety regulations.
– Commissioning of the VSD and the related drive system (i.e. starting of the operation as directed) is prohibited until it is proven that the machine complies with the regulations of the EC Directive 2006/42/EC (Machinery Directive); the standard EN 60204 must be observed.

⚠ WARNING!
Dangerous electrical voltage
An electrical shock can cause death or severe personal injury.
– Apply lockout/tagout procedures whenever possible.
– Connect/disconnect all pluggable VSD connections only in deenergised condition!
– Only remove the VSD from the installation in completely deenergised state.

ⓘ NOTICE!
Incorrect VSD installation
Disregarding the following instructions may lead to VSD damage and damage to material assets:
– The VSD must be installed and cooled according to the instructions given in the “VLB3 Mounting and switch-on instructions“. The ambient air must not exceed pollution degree 2 according to EN 61800-5-1.
– Ensure proper handling and avoid excessive mechanical stress. Do not bend any VSD components and do not change any insulation distances during transport or handling.

ⓘ NOTICE!
Incomplete or faulty VSD parameterization
Disregarding the following advices may lead to VSD damage and damage to material assets:
– Always check if the procedural notes and circuit details described in this document can be adapted to the particular application.

1.7 ELECTROMAGNETIC INFLUENCES

The VLB3 VSDs can be installed in drive systems of category C2 according to EN 61800-3. These devices can cause radio interferences in residential areas. In this case, special measures can be necessary.

ⓘ NOTICE!
Possible electromagnetic interference of drive and control system
Sporadic malfunctions can cause unsafe operation conditions.
– Commissioning of the VSD and the related drive system (i.e. starting of the operation as directed) is only allowed when there is compliance with the EMC Directive (2004/108/EC).
– The VSD must be installed in a housing (e.g. control cabinet) to meet the limit values for radio interferences valid at the site of installation.

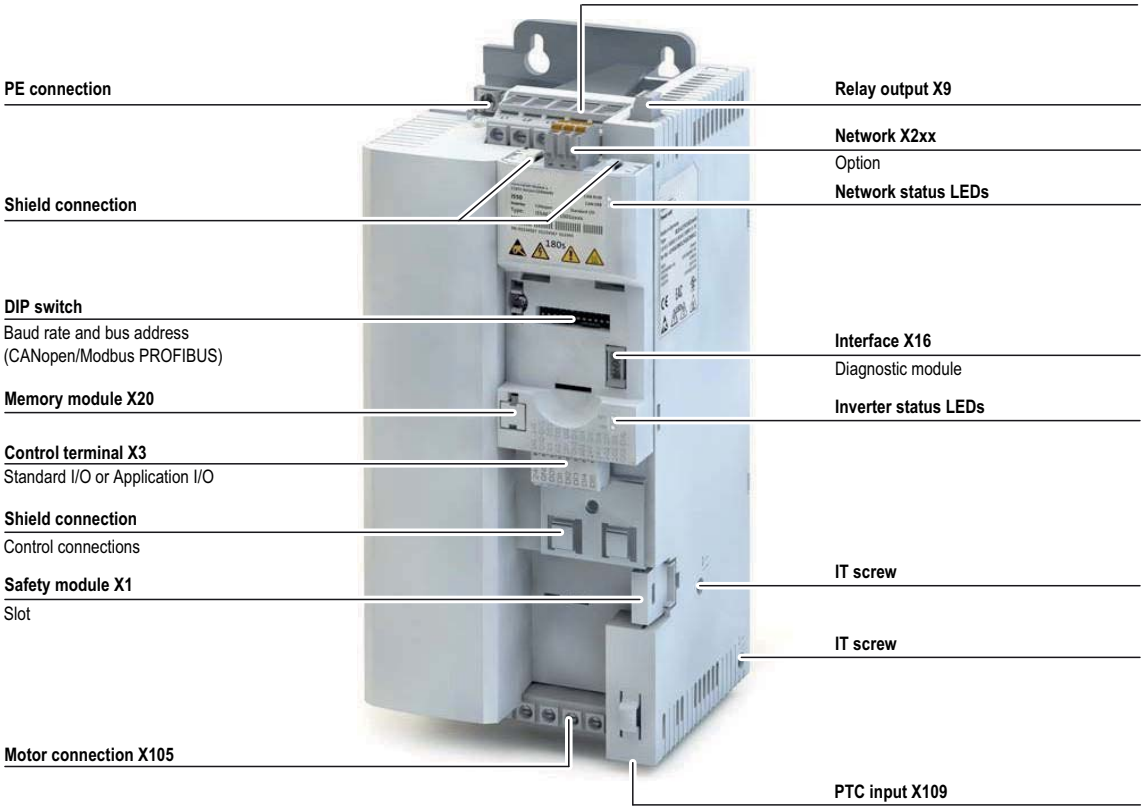
1.8 RESIDUAL HAZARDS

Consider the following residual hazards in the risk assessment of the application.

⚠ WARNING!
Unexpected drive motion
Possible personal injury or property damage.
If there is a short circuit of two power transistors in the VSD, a residual movement of up to 180°/number of pole pairs can occur at the connected motor! (For 4-pole motor: residual movement max. 180°/2 = 90°).

⚠ WARNING!
Dangerous residual voltage – long discharge time!
An electrical shock can cause death or severe personal injury.
– After the VSD or the drive system has been disconnected from the supply voltage, all live components and power terminals must not be touched immediately because capacitors in the VSD can still be charged.
– Observe the waiting time on the VSD label.

⚠ WARNING!
High leakage current
VLB3 VSDs may cause a DC current in the PE conductor.
Possible personal injury due to inappropriate or insufficient protective measures.
– If a residual current device (RCD) is used for protection against direct or indirect contact for an VSD with three-phase supply, only a residual current device (RCD) of type B is permissible on the supply side of the VSD.
– If the VSD has a single-phase supply, a residual current device (RCD) of type A is also permissible.
– Apart from using a residual current device (RCD), other protective measures can be taken as well, e.g. electrical isolation by double or reinforced insulation or isolation from the supply system by means of a transformer.

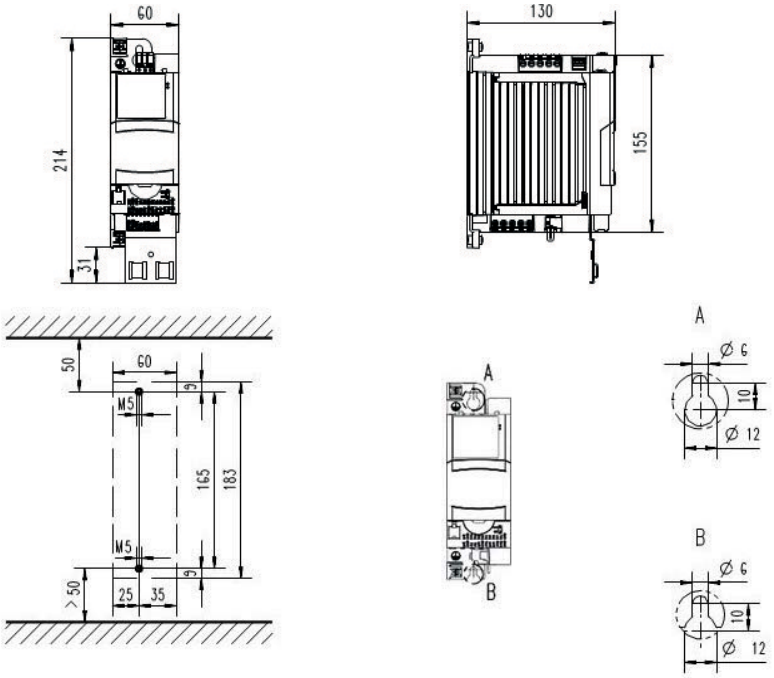


CONNECTION TO THE IT SYSTEM
Internal components have earth potential if the IT screws are not removed.
Consequence: the monitoring functions of the IT system respond.
Before connection to an IT system be abso-lutely sure to remove the IT screws.

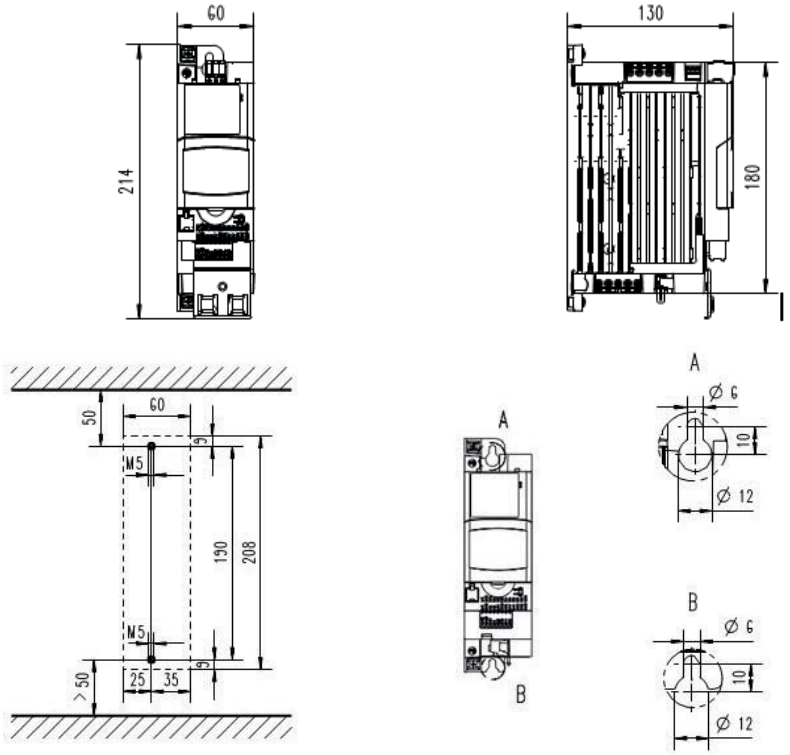
3 MOUNTING

3.1 MECHANICAL INSTALLATION

3.1.1 DIMENSION 0,37KW

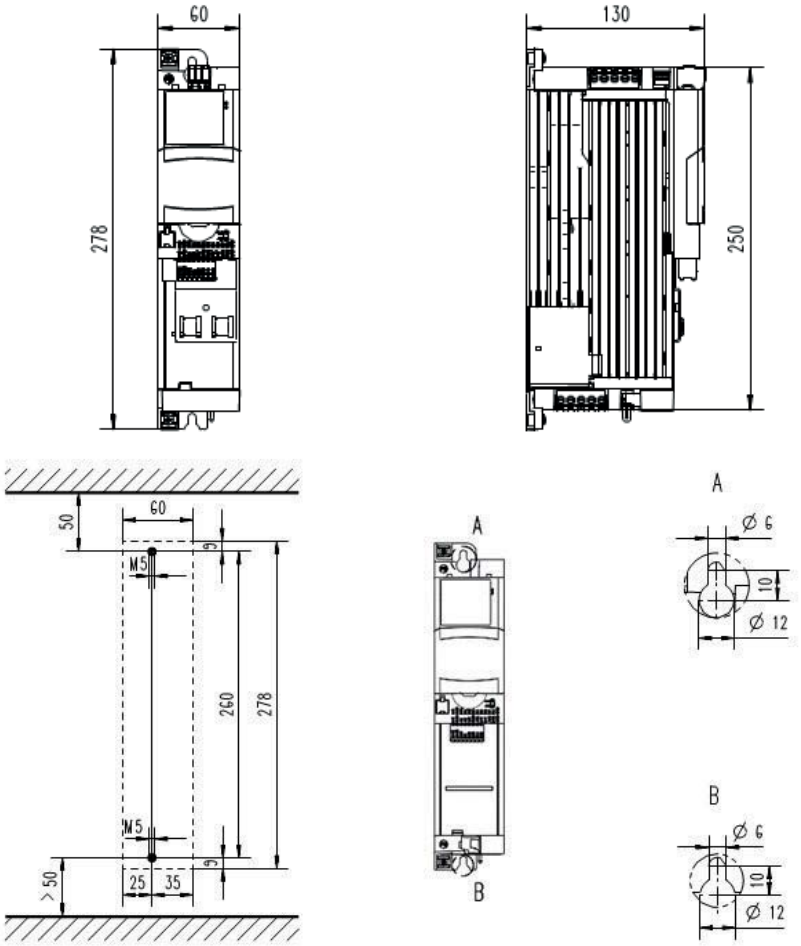


3.1.2 DIMENSION 0,75KW

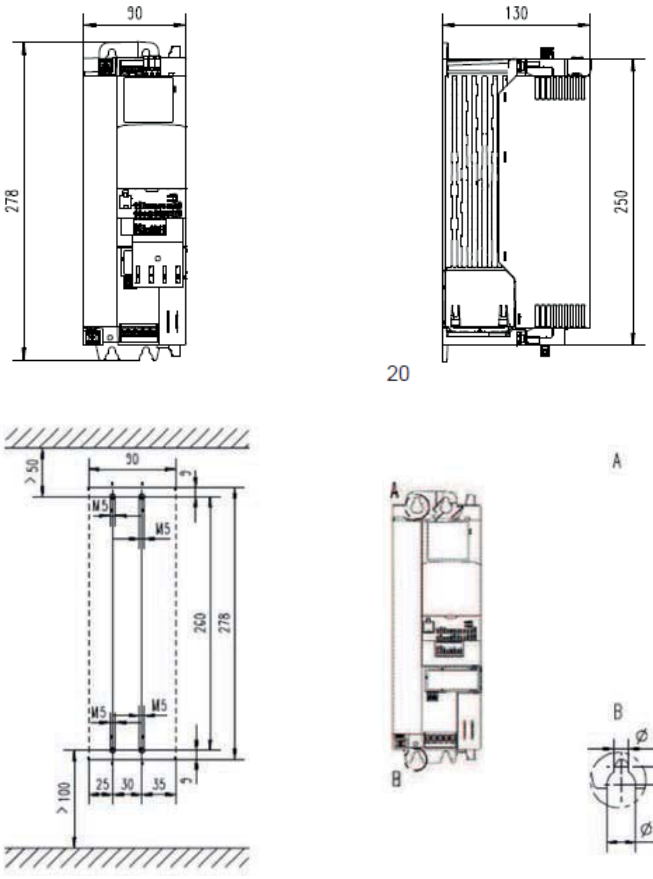


All dimensions in mm

3.1.3 DIMENSION 1,5KW..2,2KW

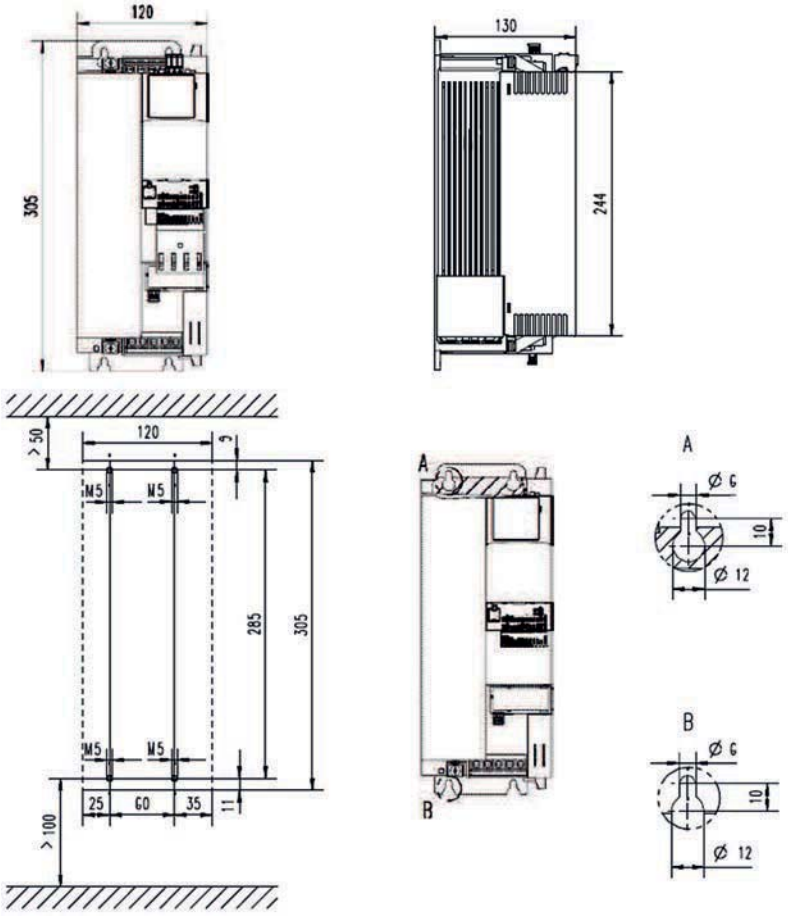


3.1.4 DIMENSIONS 4KW..5,5KW

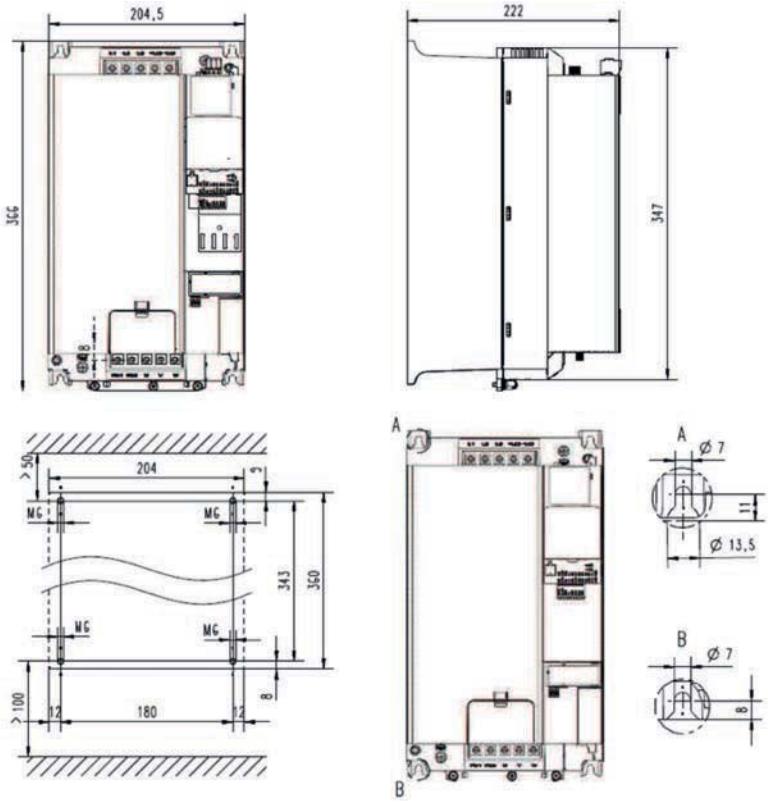


All dimensions in mm

3.1.5 DIMENSIONS 7,5KW ... 11KW

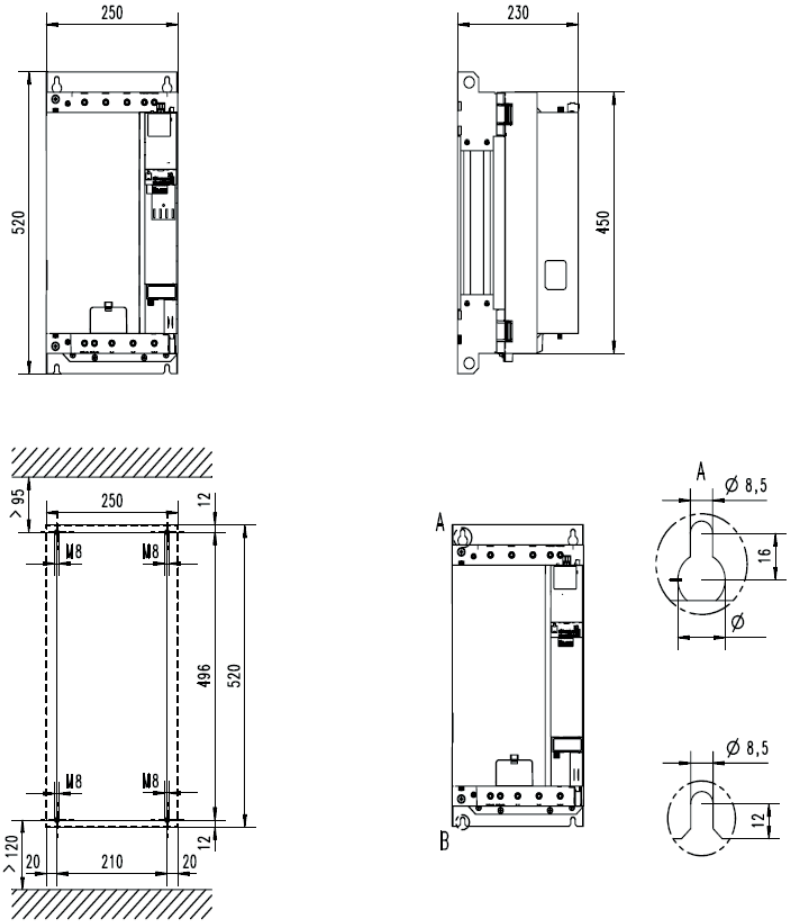


3.1.6 DIMENSIONS 15KW ... 22KW



All dimensions in mm

3.1.7 DIMENSIONS 30KW



All dimensions in mm

3.2 ELECTRICAL INSTALLATION

3.2.1 CONNECTION TO THE 400 V SYSTEM

3.2.1.1 WIRING DIAGRAM

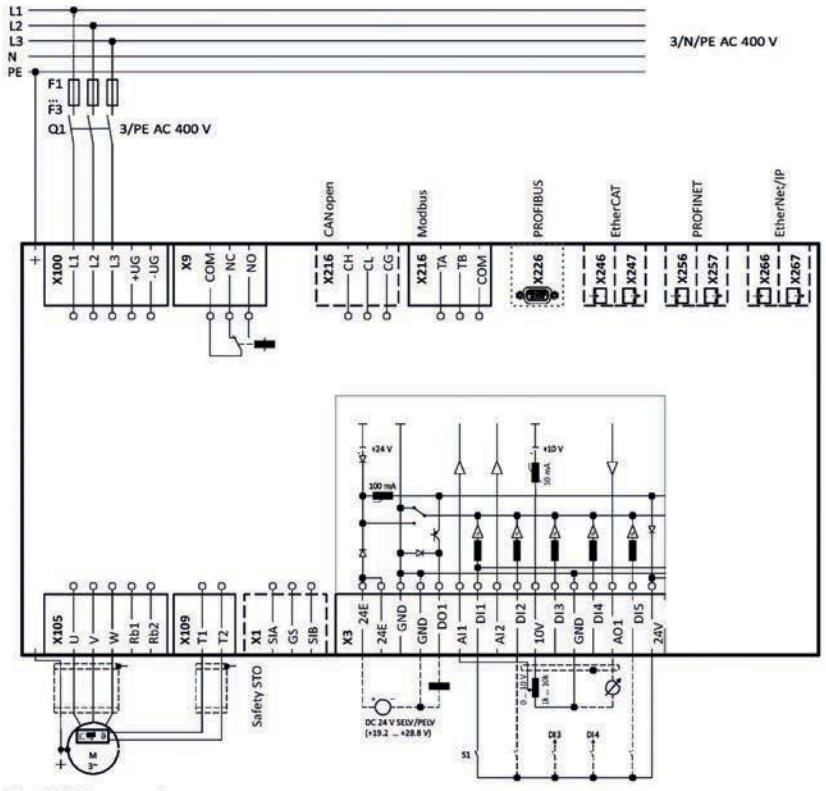


Fig. 1: Wiring example

S1 Start enable

--- Dashed line = options

3.2.1.2 FUSES AND CABLE CROSS-SECTIONS

Operation without mains choke
Cable installation in compliance with EN 60204-1
Laying system B2

Rated power	kW	0.37	0.75	1.5	2.2
Rated mains current					
with mains choke	A	4.8	8.8	13.9	16.9
Fuse					
Characteristcs		gG/gL or gRL			
Max. rated current	A	10	16	25	25
Cable cross-section	mm^2	1.5	2.5	6	6
Circuit breaker					
Characheristics		B			
Max. rated current	A	10	16	25	25
Cable cross-section	mm^2	1.5	2.5	6	6

Rated power	kW	4	5.5	7.5	11	15	18.5
Rated mains current							
with mains choke	A	9	12.4	15.7	22.3	28.8	36
Fuse							
Characteristcs		gG/gL or gRL					
Max. rated current	A	25	25	32	32	63	63
Cable cross-section	mm^2	6	6	10	10	25	25
Circuit breaker							

Operation with mains choke
Cable installation in compliance with EN 60204-1
Laying system B2

Rated power	kW	0.37	0.75	1.5	2.2
Rated mains current					
with mains choke	A	5.7	10	16.7	22.5
Fuse					
Characteristcs		gG/gL or gRL			
Max. rated current	A	10	16	25	25
Cable cross-section	mm^2	1.5	2.5	6	6
Circuit breaker					
Characheristics		B			
Max. rated current	A	10	16	25	25
Cable cross-section	mm^2	1.5	2.5	6	6

Rated power	kW	4	5.5	7.5	11	15	18.5
Rated mains current							
with mains choke	A	12.5	17.2	20	28.4	38.7	48.4
Fuse							
Characteristcs		gG/gL or gRL					
Max. rated current	A	25	25	32	32	63	63
Cable cross-section	mm^2	6	6	10	10	25	25
Circuit breaker							
Characteristcs		B					
Max. rated current	A	25	25	32	32	63	63
Cable cross-section	mm^2	6	6	10	10	25	25
Characteristcs		B					
Max. rated current	A	25	25	32	32	63	63
Cable cross-section	mm^2	6	6	10	10	25	25

Rated power	kW	22	30
Rated mains current			
with mains choke	A	42.3	54.9
Fuse			
Characteristcs		gG/gL or gRL	
Max. rated current	A	63	80
Cable cross-section	mm^2	25	25
Circuit breaker			
Characheristics		B	
Max. rated current	A	63	80
Cable cross-section	mm^2	25	50

3.2.1.3 TERMINAL DATA
Main connection

Rated power	kW	0.37	0.75	1.5	2.2
Connection		x100			
Connection type		Screw terminal			
Min. cable cross-section	mm^2	1			
Max. cable cross-section	mm^2	2.5		6	
Stripping length	mm	8			
Tightening torque	Nm	0.5		0.7	
Required screwdriver		0.5x3.0		0.6x3.5	

Rated power	kW	4	7.5	11	15	18.5
Connection		x100				
Connection type		Screw terminal				
Min. cable cross-section	mm^2	1.5				
Max. cable cross-section	mm^2	6		16		35
Stripping length	mm	9		11		18
Tightening torque	Nm	0.5		1.2		3.8
Required screwdriver		0.6x3.5		0.8x4.0		0.8x5.5

Rated power	kW	22/30
Connection		x100
Connection type		Screw terminal
Min. cable cross-section	mm^2	1.5
Max. cable cross-section	mm^2	35
Stripping length	mm	18
Tightening torque	Nm	3.8
Required screwdriver		0.8x5.5

Rated power	kW	0.37	0.75	1.5	2.2
Connection		x105			
Connection type		Screw terminal			
Min. cable cross-section	mm^2	1			
Max. cable cross-section	mm^2	2.5			
Stripping length	mm	8			
Tightening torque	Nm	0.5			
Required screwdriver		0.5x3.0			

Rated power	kW	4	5.5	7.5	11	15	18.5
Connection		x105					
Connection type		Screw terminal					
Min. cable cross-section	mm^2	1.5					
Max. cable cross-section	mm^2	6		16		35	
Stripping length	mm	9		11		18	
Tightening torque	Nm	0.5		1.2		3.8	
Required screwdriver		0.6x3.5		0.8x4.0		0.8x5.5	

Rated power	kW	22	30
Connection		x105	
Connection type		Screw terminal	
Min. cable cross-section	mm^2	1.5	
Max. cable cross-section	mm^2	35	
Stripping length	mm	18	
Tightening torque	Nm	3.8	
Required screwdriver		0.8x5.5	

PE conductor connection

Rated power	kW	0.37	0.75	1.5	2.2
Connection		PE			
Connection type		PE screw			
Min. cable cross-section	mm^2	1			
Max. cable cross-section	mm^2	6			
Stripping length	mm	10			
Tightening torque	Nm	1.2			
Required screwdriver		0.8x5.5			

Rated power	kW	4	5.5	7.5	11	15	18.5
Connection		PE					
Connection type		PE screw					
Min. cable cross-section	mm^2	1.5					
Max. cable cross-section	mm^2	6		16		25	
Stripping length	mm	10		11		16	
Tightening torque	Nm	1.2		3.4		4	
Required screwdriver		0.8x5.5			PZ2		

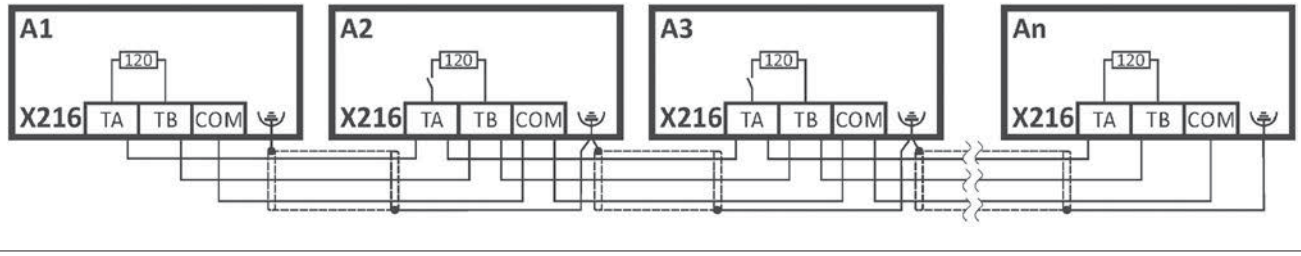
Rated power	kW	22	30
Connection		PE	
Connection type		PE screw	
Min. cable cross-section	mm^2	1.5	10
Max. cable cross-section	mm^2	25	50
Stripping length	mm	16	19
Tightening torque	Nm	4	
Required screwdriver		PZ2	Allen key 4.0

Control connections

Rated power	kW	Relay output	PTC input	Control terminals
Connection		X9	X109	X3
Connection type		Screw terminal	Screw terminal	Spring terminal
Min. cable cross-section	mm^2	0.5	0.5	0.5
Max. cable cross-section	mm^2	1-5	1.5	1.5
Stripping length	mm	6	6	9
Tightening torque	Nm	0.2	0.2	—
Required screwdriver		0.4x2.5	0.4x2.5	0.4x2.5

3.2.2 MODBUS CONNECTION

3.2.2.1 Wiring diagram



Wiring example: Modbus network

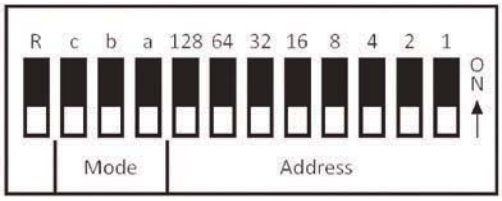
3.2.2.2 Terminal Data

Rated power		Modbus
Connection		x216
Connection type		Spring terminal
Min. cable cross-section	mm^2	0.5
Max. cable cross-section	mm^2	1.5
Stripping length	mm	10
Tightening torque	Nm	—
Required screwdriver		0.4x2.5

3.2.2.3 Basic network settings

i The network must be terminated with a 120Ω resistor at the physically first and last mode.
Set the “R” switch to ON at these nodes.

Use the DIP switch to set node address and baud rate and to ativitate the integrated bus terminating resistor.



Bus termination		Baud rate	Parity	Modbus node address							
R	**c**	**b**	**a**	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
OFF	**n.c.**	**OFF**	**OFF**	**OFF**	**OFF**	**OFF**	**OFF**	**OFF**	**OFF**	**OFF**	**OFF**
Inactive		Automatic detection	Automatic detection	Value from parameter							
ON		ON	ON	Node address - example:							
Active		Value from parameter	Value from parameter	OFF	OFF	OFF	ON	OFF	ON	ON	ON
				Node address = 16 + 4 + 2 + 1 = 23 Node address > 247: value from parameter							

Printed in bold = Standard setting

3.2.3 CONNECTION OF THE SAFETY MODULE

3.2.3.1 Important notes

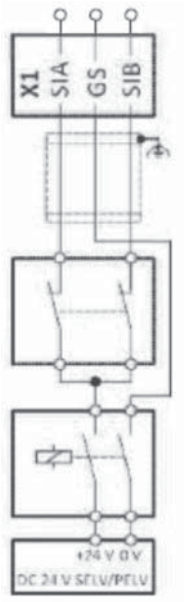
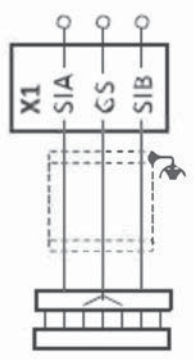
⚠
Improper installation of the safety engineering system can cause an uncontrolled starting action of the drives.
Possible consequences: Death or severe injuries
– Safety engineering systems may only be installed and commissioned by qualified and skilled personnel.
– All control components (switches, relays, PLC, ...) and the control cabinet must comply with the requirements of the EN ISO 13849-1 and the EN ISO 13849-2.
– Switches, relays with a least IP54 enclosure.
– Control cabinet with at least IP54 enclosure.
– It is essential to use insulated wire end ferrules for wiring
– All safety relevant cables outside the control cabinet must be protected, e.g. by means of a cable duct.
– Ensure that no short circuits can occur according to the specifications of the EN ISO 13849-2.
– All further requirements and measures can be obtained from the EN ISO 13849-1 and the EN ISO 13849-2.
– If an external force acts upon the drive axes, additional brakes are required. Please observe that hanging loads are subject to the force of gravity!
– The user has to ensure that the inverter will only be used in its intended application within the specified environmental conditions. This is the only way to comply with the declared safety-related characteristics.

⚠ DANGER!
With the “Safe torque off” (STO) function, no “emergency stop” in terms - EN 60204-1 can be executed without additional measures. There is no isolation between the motor and inverter, no service switch or maintenance switch!
Possible consequence: death or severe injuries.
– “Emergency stop” requires electrical isolation, e.g. by a central mains contactor.

⚠
Automatic restart if the request of the safety function is deactivated.
Possible consequence: death or severe injuries.
– You must provide external measures according to EN ISO 13849-1 which ensure that the drive only restarts after a confirmation.

ⓘ NOTICE!
Overvoltage
Destruction of the safety component.
– The maximum voltage (maximum rated) at the safety inputs is 32VDC. The user must make provisions to avoid that this voltage is exceeded.

3.2.3.2 Connection plan

Passive sensors	Active sensors
	
S1 safety switching device S2 passive sensor	S1 active sensor - example lightgrid

3.2.3.3 Terminal Data

Terminal description		Safety STO
Connection		x1
Connection type		Screw terminal
Min. cable cross-section	mm^2	0.5
Max. cable cross-section	mm^2	1.5
Stripping length	mm	6
Tightening torque	Nm	0.2
Required screwdriver		0.4x2.5

X1	Specification	Unit	min.	typ.	max.
SIA, SIB	LOW signal	V	-3	0	+5
	HIGH signal	V	+15	+24	+30
	Running time	ms		3	
	Input current SIA	mA		10	14
	Input current SIB	mA		7	12
	Input peak current	mA		100	
	Tolerated test pulse	ms			1
	Switch-off time	ms		50	
	Permissible distance of the test pulses	ms	10		
GS	Reference potential for SIA and SIB				

4 COMMISSIONING

⚠ DANGER!
Hazards during parameter change
A parameter change gets immediately active. This can result in a unexpected reaction of the motor shaft.
– Do Parameter change, if possible, only if the VSD is inhibited.

⚠ WARNING!
Hazards during VSD installation and commissioning
Possible death or severe personal injury.
– Only authorized and qualified persons are allowed to install and commission the VSD.
– Keep the manual at hand.
– Proper lockout/ tagout procedures must be applied to prevent inadvertently starting of motor or making alive of equipment.
– The motor shall be uncoupled from load and free to rotate before performing tests. Verify that the equipment is ready to be operated and that all safety circuits have been checked and are operational.

4.1 SETUP TOOLS
Three set-up methods with special tools and software are available for commissioning the VLB3.

4.1.1 OVERVIEW

	**Keypad VLBX C01** – Change parameter – Diagnosis – Local control If it's only a matter of setting a few key parameters such as acceleration and deceleration time, this can be done quickly on the keypad.
	**USB adapter VLBX C02** – Change parameter (advanced) – Out of the box commissioning (parameter change without main power) – Diagnosis – Parameter management If functions such as the motor potentiometer or sequence control for a positioning application need to be set, it's best to use VLB3SW01 software.
	**WLAN VLBX C03** – Change parameter (advanced) – Diagnosis – Parameter management Use VLB3SW01 software and laptop wireless connection.

4.1.2 KEYPAD
The keypad with display is snapped on the front side of the VSD.
– Keypad (Type code: VLBX C01)

Operating elements

		Navigation in menu Adjust parameter values
		Enter (sub-)menu/parameter Confirm parameter
		Exit (sub-)menu/parameter
		Keystop VSD
		Enable VSD

DISPLAY

Pos.	Description	
1	Status and unit	
2	Speed / Parameter value / Fault code	
3	LOC	• Local start button on keypad is active (stop button is always active)
	REM	• Local start button is inactive (start is initiated remotely)
	MAN	• Up/Down arrows are active and control speed
	AUTO	• Up/Down arrows are inactive (speed control is external)
	Set ↲	• When blinking indicates that a setting or value has changed and needs to be entered

Every parameter has a hexadecimal index number. Parameters which are visible on the keypad have also a parameter number. In the VLB3SW01 software the parameter number and the hexadecimal index are visible. Every parameter can have subindex.

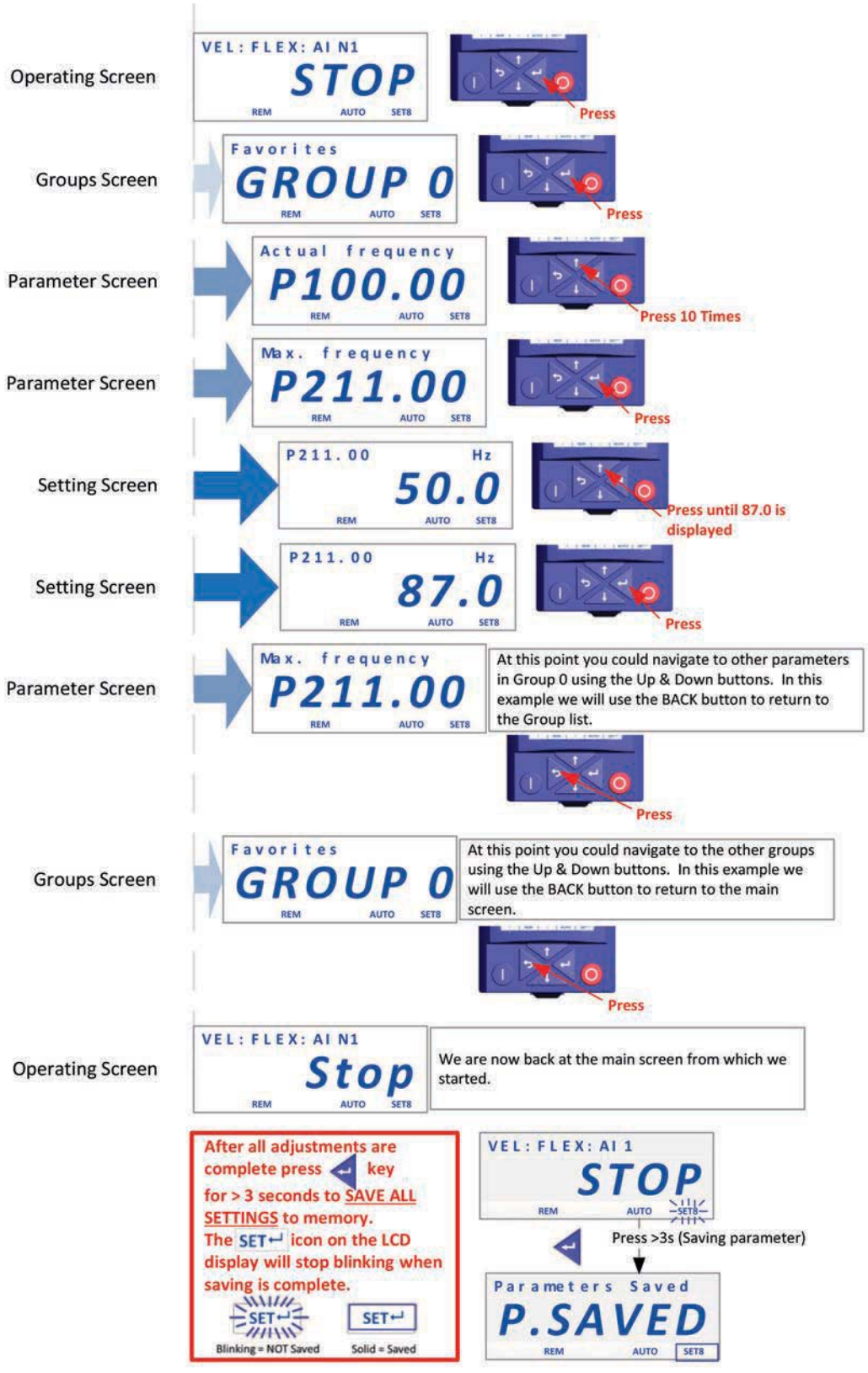
Example	Parameter number	Index
Base Frequency	P303.02	0x2B01:002
Control select	P200.00	0x2824:000

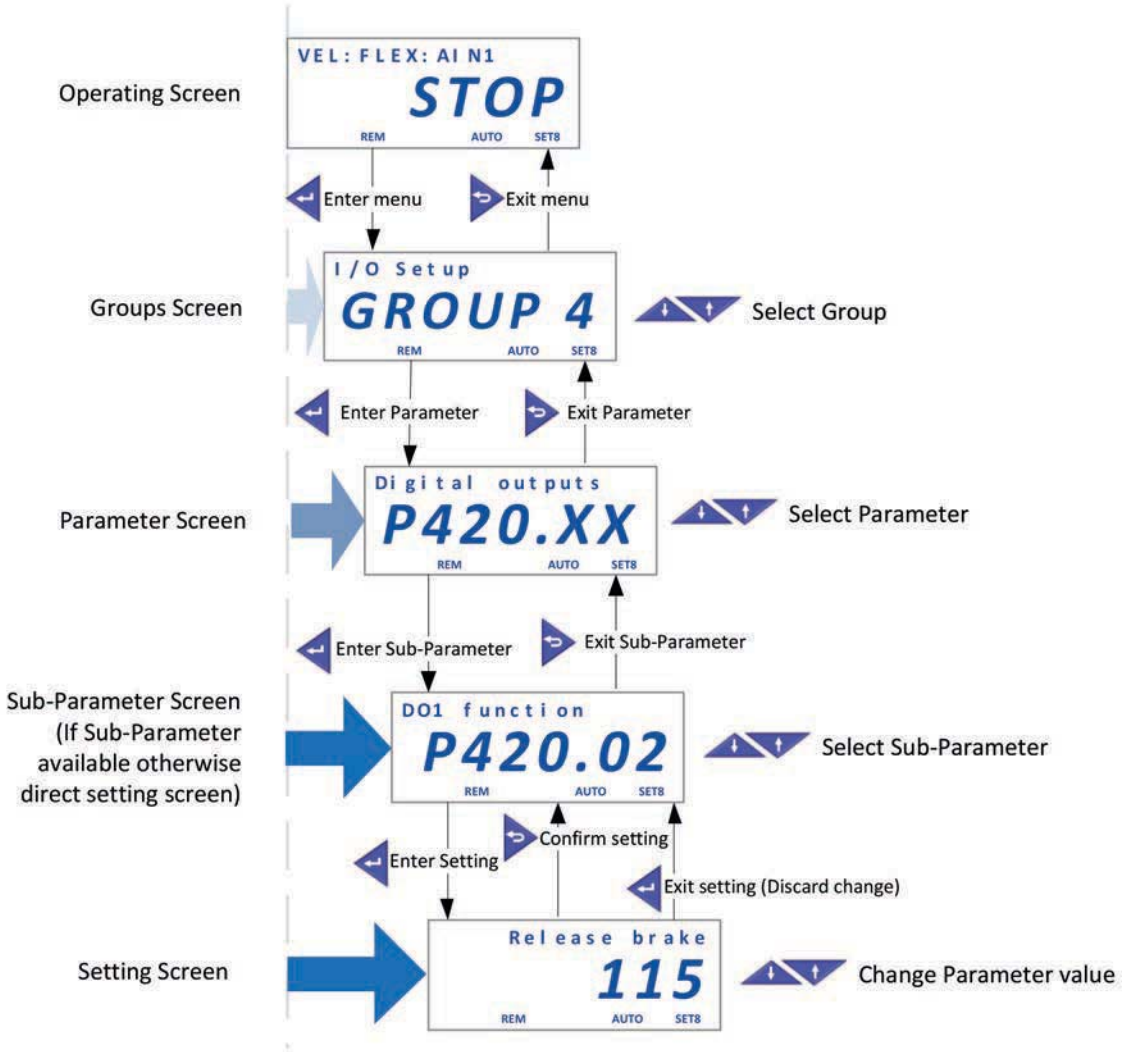
The parameters are organized into groups 0…7:

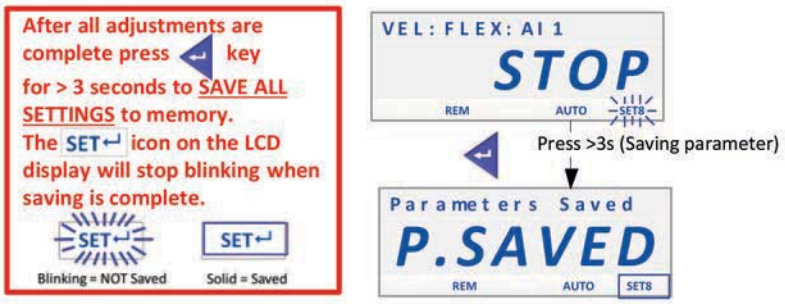
Group	Name	Group	Name
0	Favorites	5	Fieldbus Setup
1	Diagnostics	6	Process Controller
2	Basic Setup	7	Auxiliary Functions
3	Motor Control		
4	I/O Setup		

i Group 0 - Favorites contains links to the most commonly used parameters for initial commissioning and monitoring of the VSD for general applications.

NAVIGATION IN GROUP 0 - FAVORITES




Operating Screen
VEL: FLEX: AI N1
STOP
REM AUTO SET8
Enter menu
Exit menu
Groups Screen
I/O Setup
GROUP 4
REM AUTO SET8
Select Group
Enter Parameter
Exit Parameter
Parameter Screen
Digital outputs
P420.XX
REM AUTO SET8
Select Parameter
Enter Sub-Parameter
Exit Sub-Parameter
Sub-Parameter Screen
(If Sub-Parameter
available otherwise
direct setting screen)
DO1 function
P420.02
REM AUTO SET8
Select Sub-Parameter
Confirm setting
Enter Setting
Exit setting (Discard change)
Setting Screen
Release brake
115
REM AUTO SET8
Change Parameter value


After all adjustments are complete press key for > 3 seconds to SAVE ALL SETTINGS to memory.
The SET icon on the LCD display will stop blinking when saving is complete.
SET
Blinking = NOT Saved
SET
Solid = Saved
VEL: FLEX: AI 1
STOP
REM AUTO SET8
Press >3s (Saving parameter)
Parameters Saved
P.SAVED
REM AUTO SET8

4.1.3 USB ADAPTER

Required materials
- USB adapter (Type code: VLBX C02)
- VLB3SW01 software (version from 1.8.0.0)
- PC or laptop with free USB port

i The VLB3SW01 software is available for free - see download area on the LOVATO Electric web (www.lovatoelectric.com)

Procedure
1. Download and install the VLB3SW01 software.
2. Connect USB adapter to VSD.
3. Connect USB adapter to laptop with USB cable.

i No external voltage or mains voltage is required to program the VSD.

4. Run VLB3SW01 software.
5. Select “USB Diagnosis via adapter” for communication. Then click on “Insert” button.
6. Program VSD:

Setting	Guided setting windows
Diagnosis	Actual status of VSD / IO / Errors / Controller
Parameter list	Access to all parameters
Trend	Record data trends from VSD values

➔ For more information see documentation of the VLB3SW01 software.

7. Click on the following icon to save the parameters to the VSDs nonvolatile memory:

4.2 COMMISSIONING PROCEDURE

Use the following table as a reminder that guides you through the commissioning procedure.

Step	Action	Information
1	**Initial checks** – Check delivery for completeness. – Check the nameplate information to ensure that you have the correct type of VSD for your motor/application. – Check for delivery damages. Don’t continue if your VSD seems to be damaged!	
2	**Module assembly** – Assembly your Safety Unit (Option)	➔ VLB3 mounting and switch-on instructions
3	**Mechanical installation** – Install the VSD according to the instruction.	
4	**Electrical installation** – If you install the VSD to an IT network, remove the IT-screws. – Install the control wiring. – Install motor and supply wiring in accordance to the EMC requirements.	
5	**Functional test (if needed)** Perform a uncoupled functional test for basic test	
6	**General parameter setup** The VLB3 has linked the most common parameters to the favorites menu. With these parameters most common basic application can be solved.	➔ 4.4 General parameter setup (favorites) page 34
7	**Parameter setup (auxiliary functions)** The VLB3 contains additional functions which can be used for more complex applications.	➔ 5 Function & parameter description, page 39.
8	**Testrun & tuning** – Run the motor and check the performance of your application. – Adjust the corresponding parameter to tune your application.	➔ 5 Function & parameter description, page 39.
9	**Diagnose & troubleshooting** Status LED and error messages are available for troubleshooting.	➔ 8 Troubleshooting, page 122

4.4 GENERAL PARAMETER SETUP (FAVORITES)

The VLB3 has linked the most common parameters to the favorites menu. With this parameters most common basic applica-tion can be solved.

This chapter leads you through the favorites menu and gives you basic hints.
For detailed information about the parameters and additional functions, see chapter “5 Function & parameter description” on page 39

4.4.1 DIAGNOSTIC

P no.	Type	Name	Default setting	Unit
P100:0	Diagnostics	Actual frequency	Actual value	Hz
P103.0	Diagnostics	Actual motor current	Actual value	%
P106:0	Diagnostics	Motor voltage	Actual value	VAC
P150:0	Diagnostics	Error code	Actual value	–

Further diagnostic parameters are available in Group 1 – Diagnostics.

4.4.2 BASIC SETUP

1. Select the default control location (terminal – flexible or keypad).
2. Select the default speed setpoint.
3. Select the required start and stop method for your application.
4. Check if correct mains voltage is set for your network.
5. Set the motor frequency range (see illustration below).
6. Set the motor acceleration/ deceleration time (see illustration below).

P no.	Type	Name	Default setting	Unit
P200:0	Basic Setup	Control source	0: Flexible	–
P201:1	Basic Setup	Frequency setpnt.source	2: Analog input 1	–
P203:1	Basic Setup	Start method	0: Normal	–
P203:3	Basic Setup	Stop method	1: Standard Ramp	–
P208:1	Basic Setup	AC input voltage	230/400/480 Typecode dependent	VAC
P210:0	Basic Setup	Minimum frequency	0.0	Hz
P211:0	Basic Setup	Maximum frequency	50.0 / 60.0 Typecode dependent	Hz
P220:0	Basic Setup	Acceleration time 1	5.0	sec
P221:0	Basic Setup	Deceleration time 1	5.0	sec

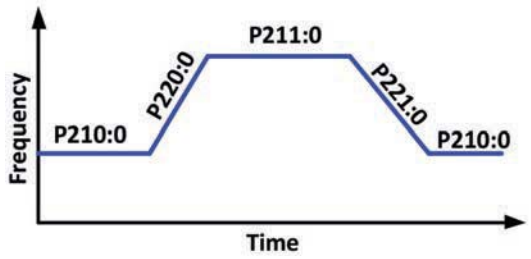
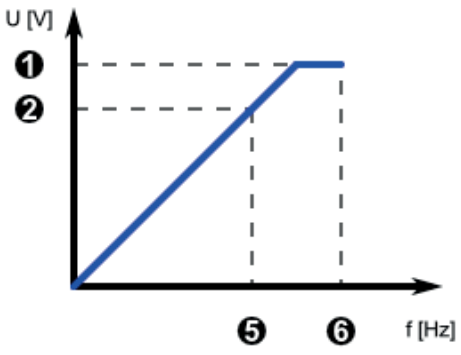


Fig. 2: Motor settings

4.4.3 MOTOR CONTROL MODES

Most applications like fans, pumps, and conveyors are possible in V/f (Voltage/frequency) mode. If the application requires more dynamic and speed assurance then the SLVC (Sensor less Vector Control) mode can be used.



1:	P208:1	AC input voltage
2:	P303:1	Base Voltage
5:	P303:2	Base Frequency
6:	P211:0	Maximum frequency

Fig. 3: V/F mode

For V/f mode set the following parameters:

Example: 400V/50Hz Motor
Base Voltage = 400V
Base Frequency = 50 Hz

P no.	Type	Name	Default setting	Unit
P300:0	Motor Control	Motor control mode	6: VFC open loop	–
P302:0	Motor Control	V/f shape	0: Linear	–
P303:1	Motor Control	Base Voltage	230/400/480 Typecode dependent	VAC
P303:2	Motor Control	Base Frequency	50.0 / 60.0 Typecode dependent	Hz

➔ For SLVC mode refer to chapter “5.5.1 Motor control mode”, page 61.

MOTOR ROTATION RESTRICTION
Set this parameter if your ap-plication requires that the mo-tor is running only in one direction:

P no.	Type	Name	Default setting	Unit
P304:0	Motor Control	Rotational restriction	1: Forwards/Reverse	–

Tuning parameters

For most applications the de-fault tuning parameters can be used:

P no.	Type	Name	Default setting	Unit
P305:0	Motor control	Switching frequency	21: 8kHz var/opt/4kHz min.	kHz
P308:1	Motor control	Load at 60 sec	150	%
P316:1	Motor control	V/f boost: static	0.4%...2.5% Typecode dependent	%
P324:0	Motor control	Max current	200.0	%

➔ If the performance is insufficient during operation, see chapter “Motor Control setup” for tuning the parameters above.

Control selection
The VLB3 can be controlled from various locations and in different ways.

P no.	Type	Name	Default setting	Unit
P200:0	Basic Setup	Control source	0: Flexible	–

Basic functionalities:
- VSD enable
  Enables the VSD. Signal must have the state TRUE (by Input or setting) to be able to start the motor.
- Run/Stop
  Enables the running of the motor. Can be used as single signal or in combination with the signals Start Forward / Start Reverse. Signal must have the state TRUE (by Input or setting) to be able to start the motor.
- Start Forward / Start Reverse
  Used to start the motor (Positive edge triggered). Stop is down with the Run/Stop signal.
- Run Forward / Run Reverse
  Used to run and stop the motor (Maintained signals)
- Rotation invertion
  Inverts the speed setpoint
- Fault Reset
  For a successful reset of a fault it is necessary to correct the condition that caused the fault first. Afterwards there are different possibilities to reset the fault:
- Quick Stop (QSP) works as “pause” / “zero-speed” function. (The QSP ramp time can be set in P225:0)

i In Flexible Control mode (P200:0) either VSD enable (P400:1) or Run/Stop (P400:2) must be assigned to I/O to ensure that the drive can always be stopped!
(Exception: VSD is controlled from network, Network enable (P400:37) is HIGH)

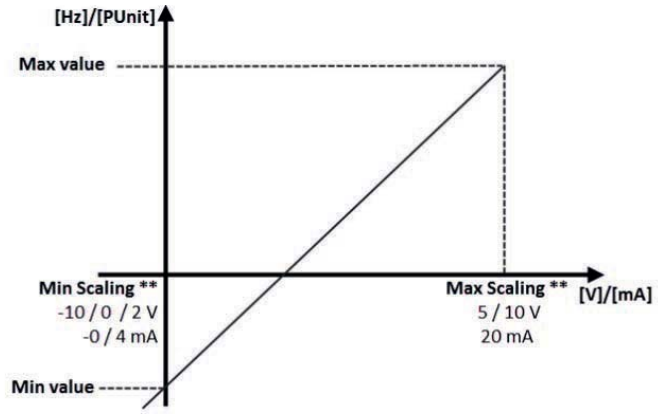
➔ See chapter “5.2.3 Control examples” on page 44 for control application examples.
See chapter “5.6.1 Function list (Run/Stop/Start/Jog/Reverse)” on page 74 for detailed information.

P no.	Type	Name	Default setting	Unit
P400:1	I/O Setup	VSD enable	1: TRUE	–
P400:2	I/O Setup	Run/Stop	11: Digital input 1	–
P400:3	I/O Setup	Quick Stop [QSP]	0: Not connected	–
P400:4	I/O Setup	Reset fault	12: Digital input 2	–
P400:5	I/O Setup	DC brake	0: Not connected	–
P400:6	I/O Setup	Start forward (CW)	0: Not connected	–
P400:7	I/O Setup	Start reverse (CCW)	0: Not connected	–
P400:8	I/O Setup	Run forward (CW)	0: Not connected	–
P400:9	I/O Setup	Run reverse (CCW)	0: Not connected	–
P400:13	I/O Setup	Invert rotation	13: Digital input 3	–
P no.	Type	Name	Default setting	Unit
P400:18	I/O Setup	Preset selection bit0	14: Digital input 4	–
P400:19	I/O Setup	Preset selection bit1	15: Digital input 5	–
P400:20	I/O Setup	Preset selection bit2	0: Not connected	–

OUTPUT SELECTION
The digital output and relay can be used as feedback signal for your control system.

P no.	Type	Name	Default setting	Unit
P420:1	I/O Setup	Relay function	51: Ready to run	–
P420:2	I/O Setup	DO1 function	115: Holding brake	–

ANALOG INPUT 1 FOR SPEED SETPOINT



** Availability of scaling depending on type of control unit.

Fig. 4: Speed setpoint

If you have defined the AI1 as your speed setpoint define the correct input scaling.

P no.	Type	Name	Default setting	Unit
P430:1	I/O Setup	AI1 configuration	0: 0...10VDC	–
P430:2	I/O Setup	AI1 frequency @ min	0.0	Hz
P430:3	I/O Setup	AI1 frequency @ max	50.0/60.0 *Typecode dependent	Hz

ANALOG OUTPUT 1
Analog output can be used as a feedback for your control system. Select the correct scaling and range (See Fig. 14 for Scaling):

P no.	Type	Name	Default setting	Unit
P440:1	I/O Setup	AO1 configuration	1: 0...10VDC	–
P440:2	I/O Setup	AO1 function	1: Output freq.	–
P440:3	I/O Setup	AO1 function @ min	0	–
P440:4	I/O Setup	AO1 function @ max	1000	–

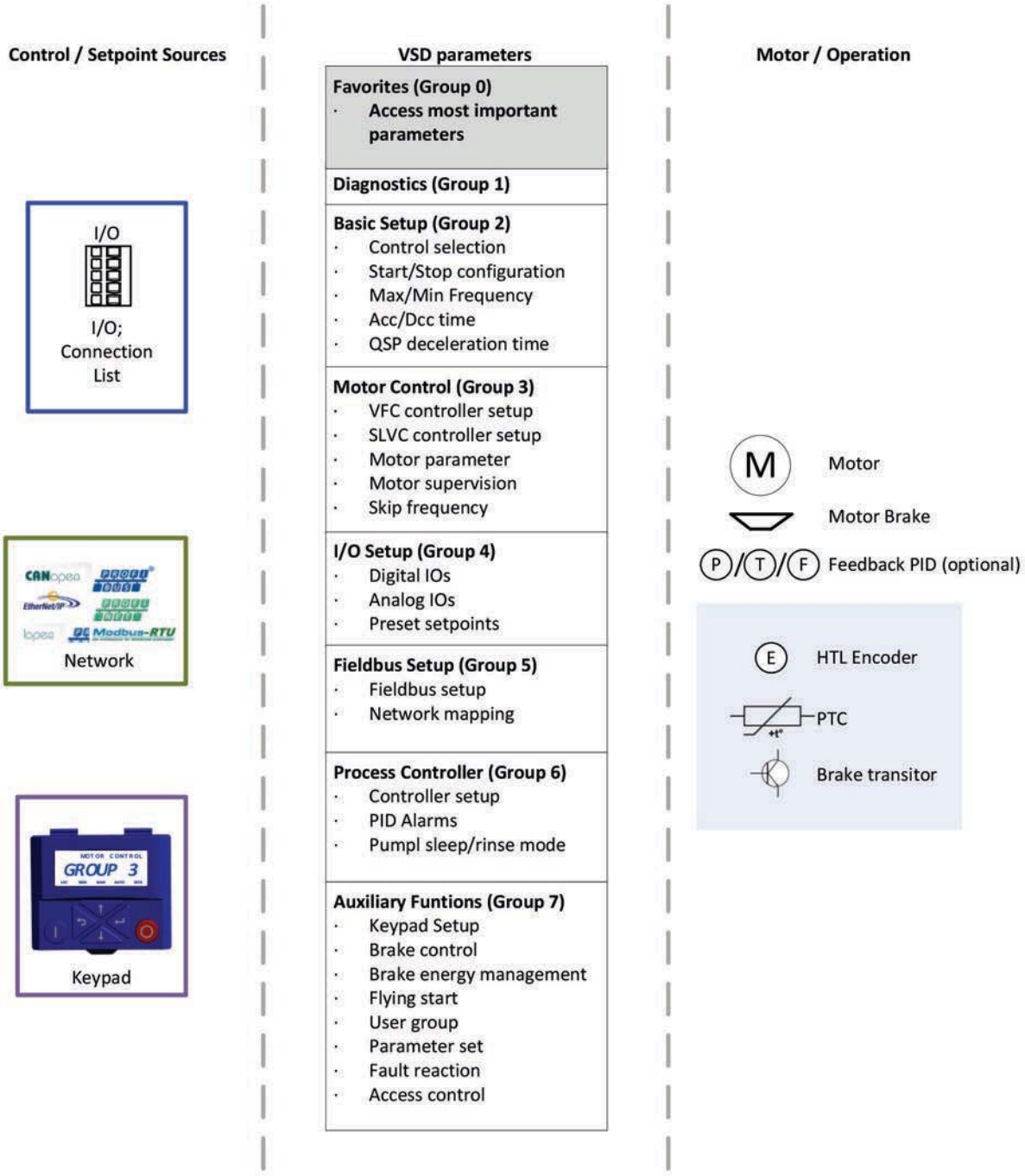
PRESET FREQUENCY
Define your basic preset fre-quency if required:

P no.	Type	Name	Default setting	Unit
P450:1	I/O Setup	Preset 01	20.0	Hz
P450:2	I/O Setup	Preset 02	40.0	Hz
P450:3	I/O Setup	Preset 03	50.0/60.0 *Typecode dependent	Hz
P450:4	I/O Setup	Preset 04	0.0	Hz

5 FUNCTION & PARAMETER DESCRIPTION

5.1 PARAMETER / FUNCTION OVERVIEW

The VLB3 series is a multipurpose VSD with a various amount of functionalities. For fast and easy commissioning the parameters are grouped. The group 0 “Favorites” contains a link to the most common used parameters. The following graphic shows an overview over the functionalities and where they can be programmed. For detailed information see the corresponding chapter.



Every parameter has a hexadecimal index number. Parameters which are visible on the keypad have also a parameter number. In the VLB3SW01 software the parameter number and the hexadecimal index are visible. Every parameter can have subindex.

Example	Parameter number	Index
Base Frequency	P303.02	0x2B01:002
Control select	P200.00	0x2824:000

Parameter number — Index — Subindex

P510:1	0x23A1:1	IP address (*)		1550	R/V
--... [192.168.124.16] ...--		EtherNet/IP adress settings			

i

Parameter witch are not visible on the keypad are marked in the manual as P (without number).

Parameters or selections with marking (*) are not available on all control unit types.
Example:

P510:1	0x23A1:1	IP address (*)		1550	R/V
--... [192.168.124.16] ...--		EtherNet/IP adress settings			

5.2 CONTROL CONCEPT

5.2.1 SETPOINT STRUCTURE / OPERATION MODE

The VLB3 can be used for various applications. The graphic below gives an overview for the operation modes and the setpoint structure.

Modes of Operation

In general the VSD has 2 modes of operation:

– Velocity mode (PID optionally)
– Velocity mode by CiA402

Setpoint source

First of all the setpoint depends on the selected operation mode (P301:0). Every mode has a default setpoint source (P201:1, P201:2, P201:3). This default setpoint source applies if no other source is selected. In the connection list (P400:15 to 400:21). On the list below the priority of the different source signals can be seen.

➔ See chapter “5.4.2 Default setpoint“, on page 55
See chapter “5.6.2 Setpoint selection“, on page 78

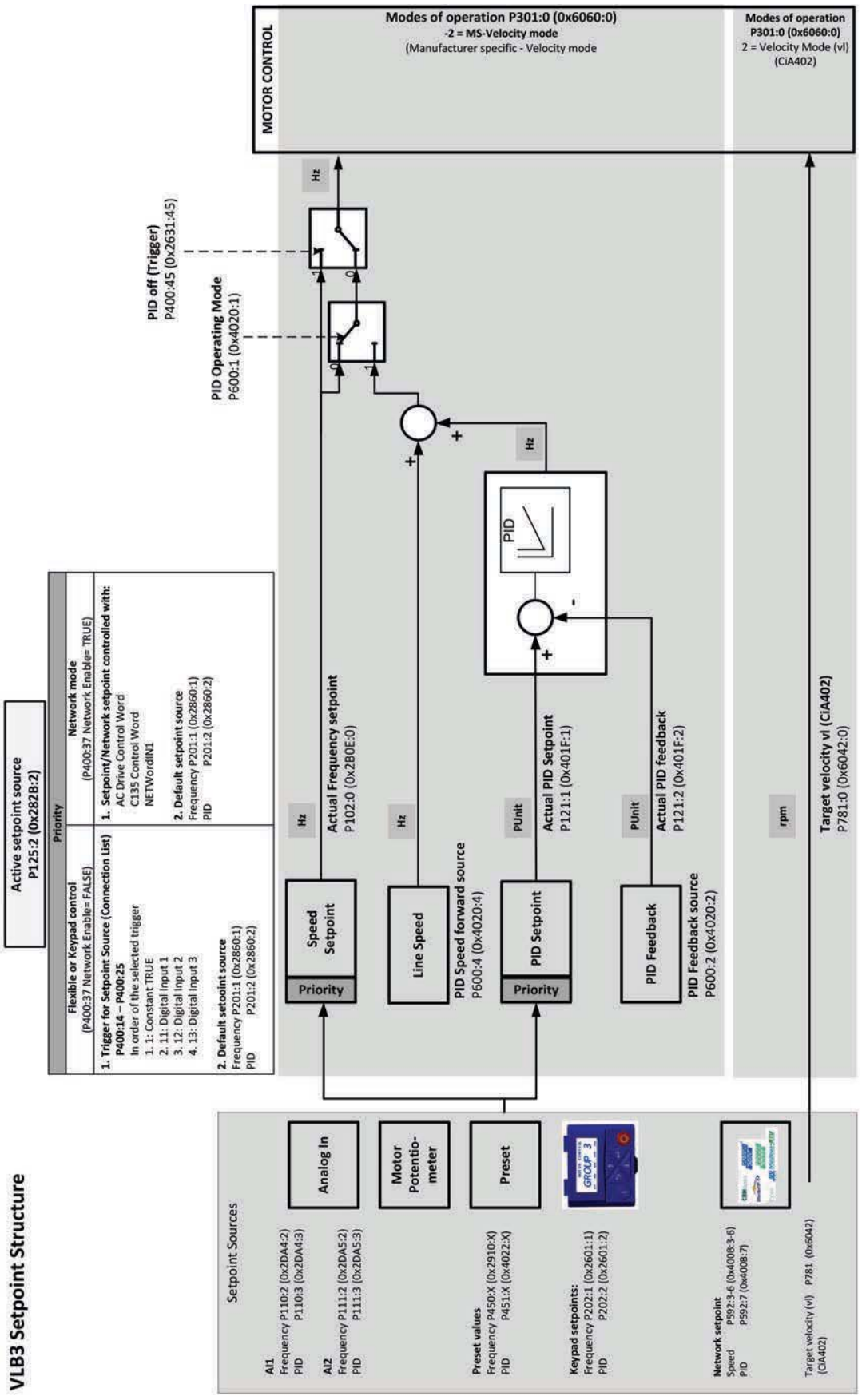
i The actual control setpoint source can be seen in P125:2

Setpoint Priority

The priority of the setpoint is according the following list:

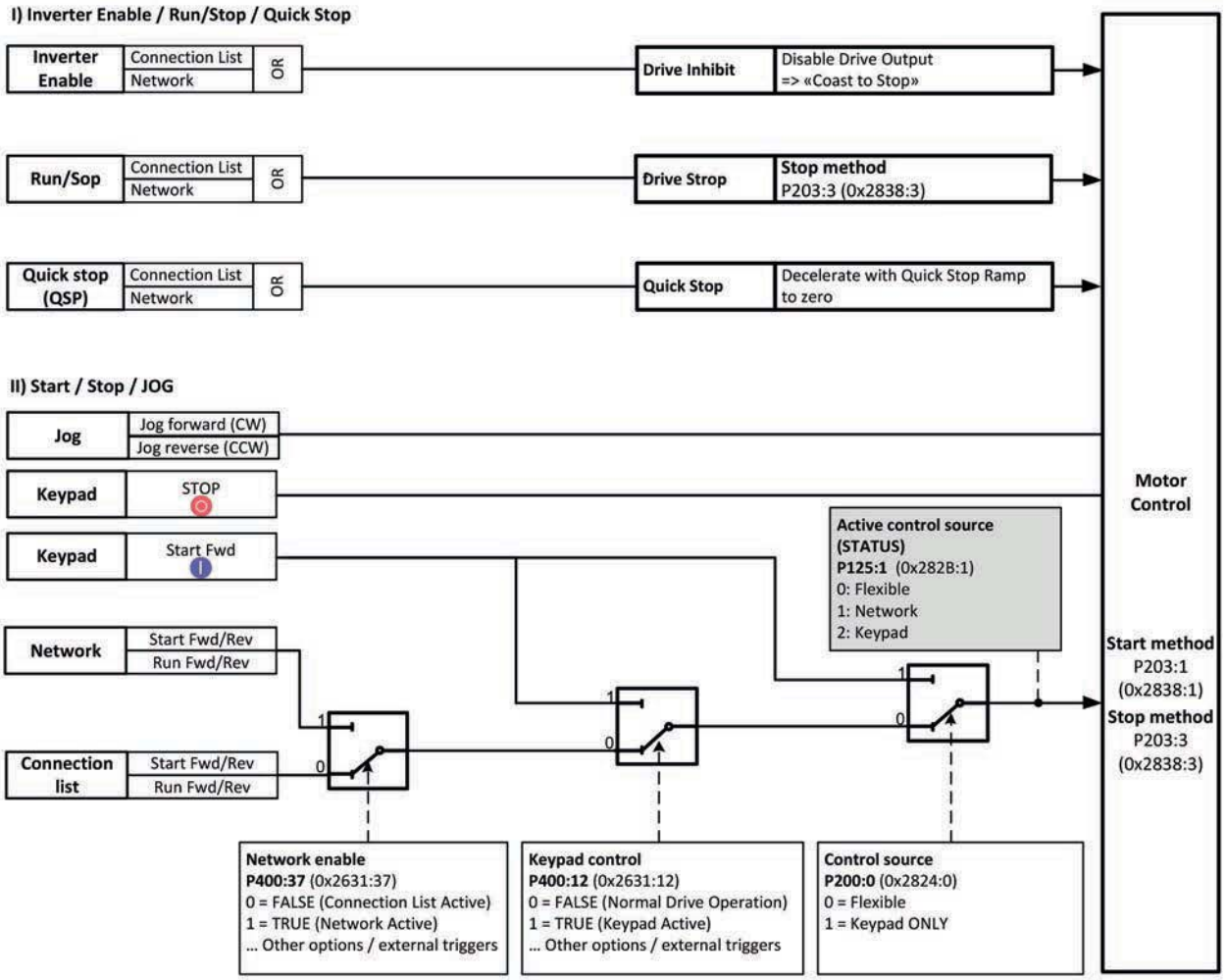
Flexible or Keypad control (P400:37 Network Enable= False)	**Network mode** (P400:37 Network Enable= TRUE)
1. **Trigger for Setpoint Source (Connection List)** **P400:14 – P400:25** In order of the selected trigger 1. 1: Constant TRUE 2. 11: Digital Input 1 3. 12: Digital Input 2 4. 13: Digital Input 3 2. **Default setpoint source** **Frequency P201:1 (0x2860:1)** **PID P201:2 (0x2860:2)**	1. **Setpoint/Network setpoint controlled with:** Drive Control Word C135 Control Word NETWordIN1 2. **Default setpoint source** **Frequency P201:1 (0x2860:1)** **PID P201:2 (0x2860:2)**

i In Network mode (P400:37 = TRUE) the triggers P400:14 – P400:25 are not active.
To select the network as setpoint source in network mode (P400:37 = TRUE) use the “Default setpoint source” (P201:1-2) or the corresponding control bits (Drive Control Word, C135 Control Word, NETWordIN1).


VLB3 Setpoint Structure
Active setpoint source
P125:2 (0x282B:2)
Priority
Flexible or Keypad control
(P400:37 Network Enable= FALSE)
Network mode
(P400:37 Network Enable= TRUE)
1. Trigger for Setpoint Source (Connection List)
P400:14 – P400:25
In order of the selected trigger
1. 1: Constant TRUE
2. 11: Digital Input 1
3. 12: Digital Input 2
4. 13: Digital Input 3
2. Default setooint source
Frequency P201:1 (0x2860:1)
PID P201:2 (0x2860:2)
1. Setpoint/Network setpoint controlled with:
AC Drive Control Word
C135 Control Word
NETWordIN1
2. Default setpoint source
Frequency P201:1 (0x2860:1)
PID P201:2 (0x2860:2)
Setpoint Sources
AI1
Frequency P110:2 (0x2DA4:2)
PID P110:3 (0x2DA4:3)
AI2
Frequency P111:2 (0x2DA5:2)
PID P111:3 (0x2DA5:3)
Analog In
Motor Potentio-meter
Preset
Preset values
Frequency P450:X (0x2910:X)
PID P451:X (0x4022:X)
Keypad setpoints:
Frequency P202:1 (0x2601:1)
PID P202:2 (0x2601:2)
Network setpoint
Speed P592:3-6 (0x4008:3-6)
PID P592:7 (0x4008:7)
Target velocity (vl) P781 (0x6042)
(CiA402)
Speed Setpoint
Priority
Line Speed
PID Setpoint
Priority
PID Feedback
PID Speed forward source
P600:4 (0x4020:4)
PID Feedback source
P600:2 (0x4020:2)
Hz
PUnit
rpm
Actual Frequency setpoint
P102:0 (0x2B0E:0)
Actual PID Setpoint
P121:1 (0x401F:1)
Actual PID feedback
P121:2 (0x401F:2)
Target velocity vl (CiA402)
P781:0 (0x6042:0)
PID
PID off (Trigger)
P400:45 (0x2631:45)
PID Operating Mode
P600:1 (0x4020:1)
MOTOR CONTROL
Modes of operation P301:0 (0x6060:0)
-2 = MS-Velocity mode
(Manufacturer specific - Velocity mode
Modes of operation
P301:0 (0x6060:0)
2 = Velocity Mode (vl)
(CiA402)

5.2.2 CONTROL SOURCE

The VLB3 can be controlled from various locations like digital IO's, keypad or network. The following graphic gives an overview of the parameters and their influence.



i The actual control source can be seen in P125:1

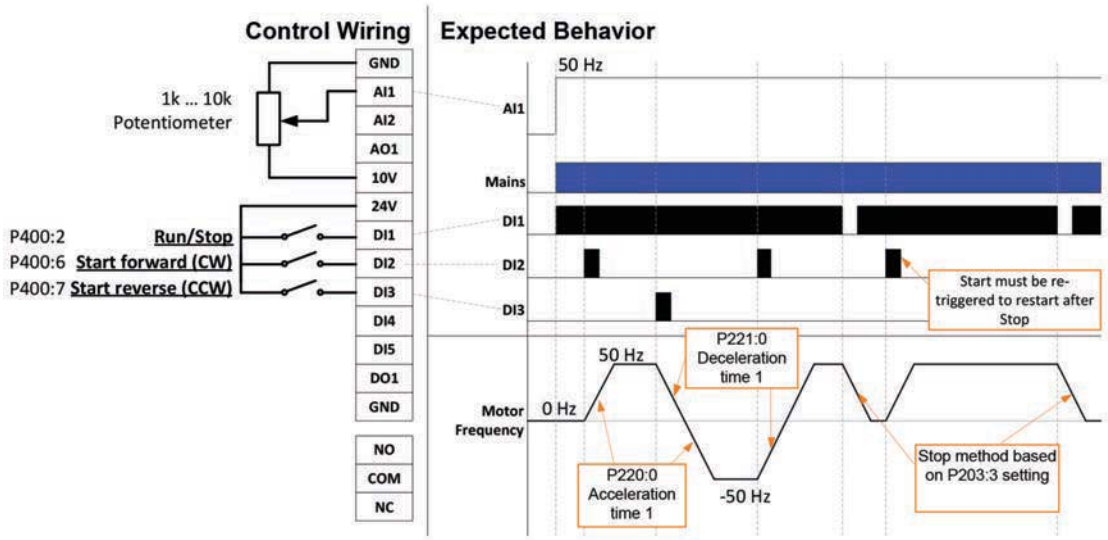
5.2.3 CONTROL EXAMPLES

The VSD can be configured with different Run/Start/Stop signals. The following 3 examples show the most commonly used signals with the corresponding parameters and a signal flow chart which explains in detail the behavior of the VSD.

Run/Stop (One Signal)

- Using one signal **Run/Stop** to start and stop the VSD. **Run/Stop** Level High will start the VSD, Level Low will stop the VSD according to the selected stop method (P203:3)
- **Invert Rotation** Level High will change the motor direction

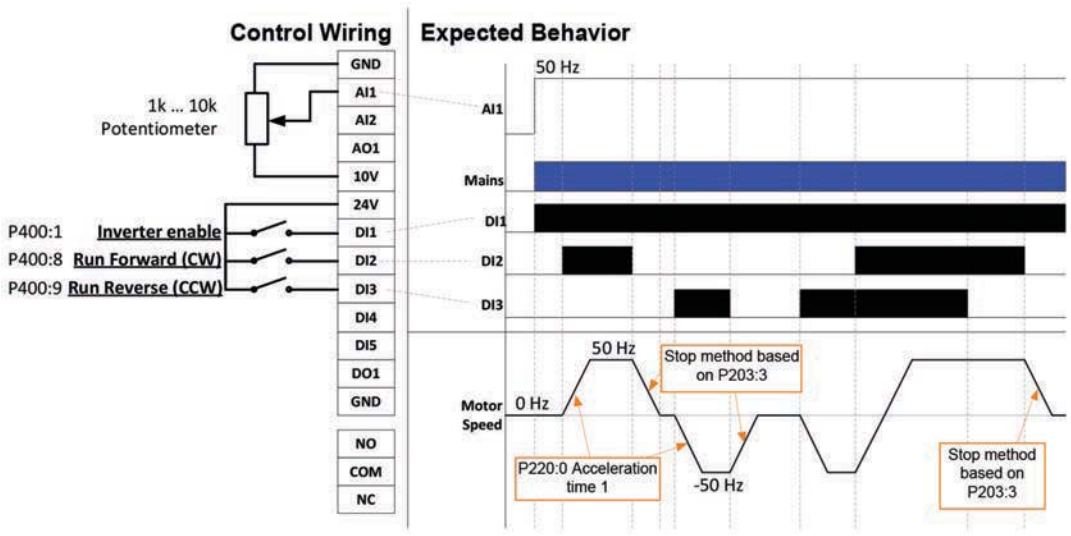
Parameter	Parameter Name	Default Setting
P400:1	Inverter enable	1: Constant TRUE
P400:2	Run/Stop	11: Digital input 1
P400:3	Quick stop	0: Not connected
P400:6	Start forward (CW)	0: Not connected
P400:7	Start reverse (CCW)	0: Not connected
P400:8	Run forward (CW)	0: Not connected
P400:9	Run reverse (CCW)	0: Not connected
P400:13	Invert rotation	13: Digital input 3



Start forward/reverse (Rising Edge triggered Signals)

- Start using flag triggered signals **Start forward (CW)** and **Start reverse (CCW)**
- **Run/Stop** Level LOW will stop the VSD according to the selected stop method (P203:3)

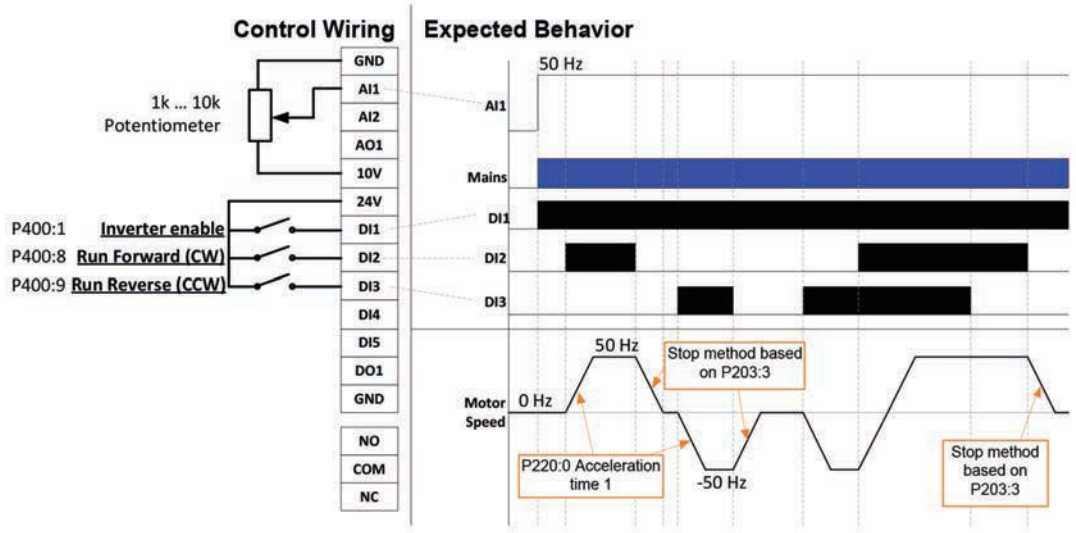
Parameter	Parameter Name	Setting for this example
P400:1	Inverter enable	1: Constant TRUE
P400:2	Run/Stop	11: Digital input 1
P400:3	Quick stop	0: Not connected
P400:6	Start forward (CW)	12: Digital input 2
P400:7	Start reverse (CCW)	13: Digital input 3
P400:8	Run forward (CW)	0: Not connected
P400:9	Run reverse (CCW)	0: Not connected
P400:13	Invert rotation	0: Not connected



Run Forward/Reverse (Steady Signals)

– Start using steady signals **Run Forward (CW)** and **Run Reverse (CCW)**. If no Run command is active the motor will stop according the selected stop method (P203:3)
– **Inverter enable** Level Low will stop the VSD with a coast stop.

Parameter	Parameter Name	Setting for this example
P400:1	Inverter enable	11: Digital input 1
P400:2	Run/Stop	1: Constant TRUE
P400:3	Quick stop	0: Not connected
P400:6	Start forward (CW)	0: Not connected
P400:7	Start reverse (CCW)	0: Not connected
P400:8	Run forward (CW)	12: Digital input 2
P400:9	Run reverse (CCW)	13: Digital input 3
P400:13	Invert rotation	0: Not connected

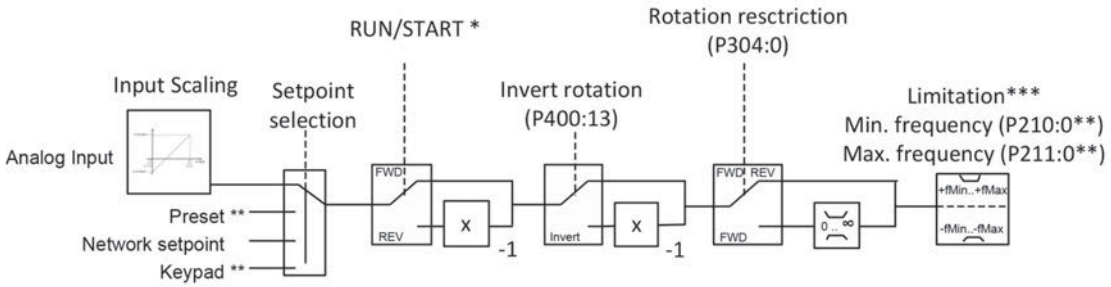


5.2.4 ROTATION DIRECTION

The rotation of the motor depends on different parameters.

– **Commands Forward/Reverse**
  The reverse commands invert the setpoint (multiplied by factor -1).
  Exception: If the input is bidirectional (-10V ... +10V), the direction Forward/Reverse of the Start and Run are ignored.
– **Invert rotation**
  The function “Invert rotation” inverts the speed setpoint (multiplied by factor -1).
– **Rotation restriction**
  The rotation can be restricted to forward. Negative set points will be ignored.

The following graphic shows an overview of the rotation direction:



Note:
* If the input is bidirectional (-10V...10V), the direction FWD/REV of the Start and Run are ignored.
** Only positive value can be entered.
*** Direction changes only if speedsetpoint is higher than fmin!

5.3 GROUP 1 – DIAGNOSTICS

General:
Bit coded status words are displayed on the keypad as described in the following picture:

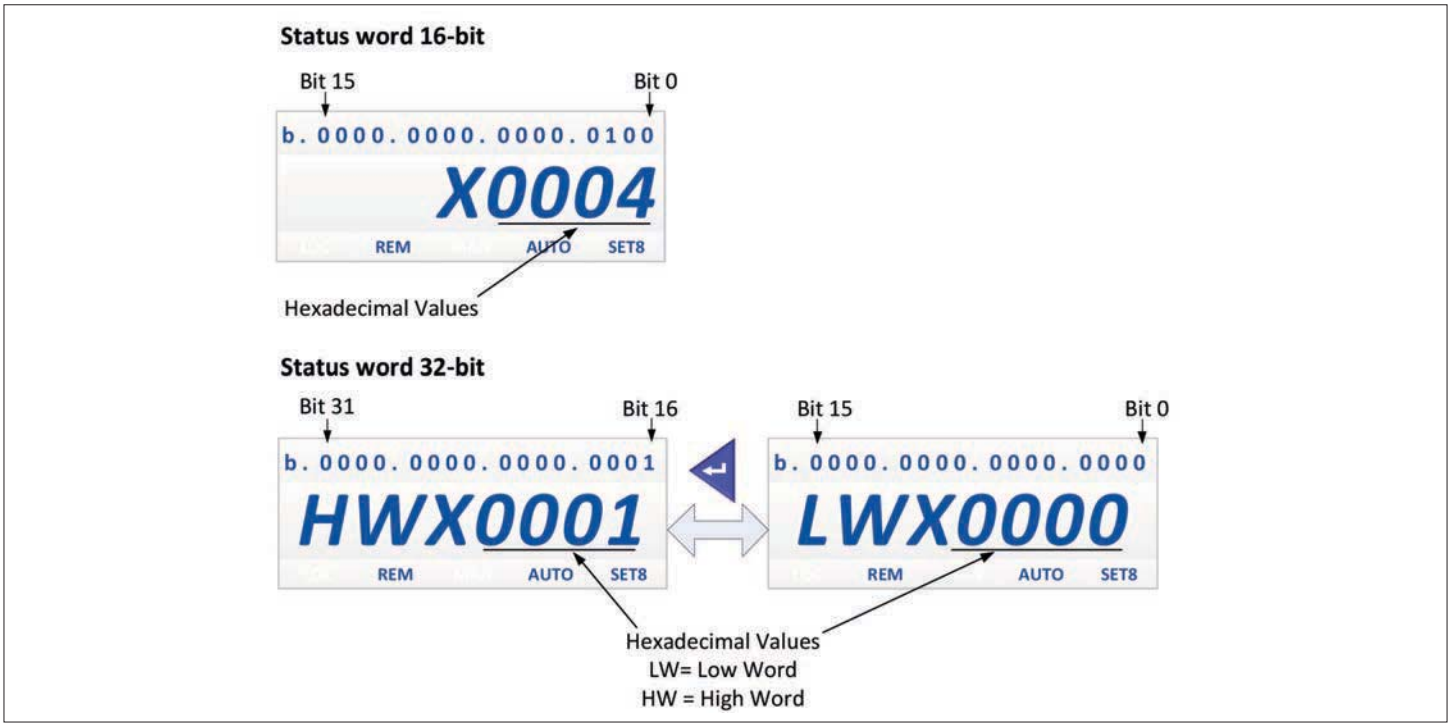


Fig. 5: Display of bit coded status word on keypad

5.3.1 GENERAL DIAGNOSTIC DATA

P100:0	0x2DDD:0	Actual frequency			
-- ... [Actual value] ... -- Hz		Actual motor frequency			
P101:0	0x400D:0	Scaled actual value			
-- ... [Actual value] ... -- Units		Actual motor speed in user units. Actual frequency x Scaling factor (P702:0)			
P102:0	0x2B0E:0	Frequency setpoint			
-- ... [Actual value] ... -- Hz		Actual frequency setpoint			
P103:0	0x6078:0	Actual motor current			
-- ... [Actual value] ... -- %		Actual motor current in % of P323:0			
P104:0	0x2D88:0	Actual motor current			
-- ... [Actual value] ... -- A		Actual motor current			
P105:0	0x2D87:0	DC-bus voltage			
-- ... [Actual value] ... -- V		Actual DC-Link voltage			
P106:0	0x2D89:0	Actual motor voltage			
-- ... [Actual value] ... -- VAC		Actual motor voltage			
P107:0	0x6077:0	Actual torque			
-- ... [Actual value] ... -- %		Actual motor torque (100% = Max. torque)			

5.3.2 OUTPUT POWER

P108:1	0x2DA2:1	Effective power			
-- ... [Actual value] ... -- kW		Actual motor effective power			
P108:2	0x2DA2:2	Apparent power			
-- ... [Actual value] ... -- kVA		Actual motor apparent power			

5.3.3 OUTPUT ENERGY

P109:1	0x2DA3:1	Motor			
-- ... [Actual value] ... -- kWh		Estimated energy at the VSD output when the motor is being driven			
P109:2	0x2DA3:2	Generator			
-- ... [Actual value] ... -- kWh		Estimated energy at the VSD output when the motor is regenerating			

5.3.4 ANALOG INPUT 1 DIAGNOSIS

P110:1	0x2DA4:1	Percent value			
-- ... [Actual value] ... -- %		Actual value of AI1 in % of the selected input range			
P110:2	0x2DA4:2	Frequency value			
-- ... [Actual value] ... -- Hz		Actual value of AI1 as frequency setpoint			
P110:3	0x2DA4:3	Process controller value			
-- ... [Actual value] ... -- P	Unit	Actual value of AI1 as PID input			
P110:4	0x2DA4:4	Torque value			
-- ... [Actual value] ... -- %		Actual value of AI1 as torque setpoint			
P110:16	0x2DA4:16	Status analog input 1			
-- ... [Actual value] ... --		Bit coded status of AI1			

5.3.5 ANALOG INPUT 2 DIAGNOSIS

P111:1	0x2DA5:1	Percent value			
-- ... [Actual value] ... -- %		Actual value of AI2 in % of the selected input range			
P111:2	0x2DA5:2	Frequency value			
-- ... [Actual value] ... -- Hz		Actual value of AI2 as frequency setpoint			
P111:3	0x2DA5:3	Process controller value			
-- ... [Actual value] ... -- P	Unit	Actual value of AI2 as PID input			
P111:4	0x2DA5:4	Torque value			
-- ... [Actual value] ... -- %		Actual value of AI2 as torque setpoint			
P111:16	0x2DA5:16	Status analog input 2			
-- ... [Actual value] ... --		Bit coded status of AI2			

5.3.6 ANALOG OUTPUT 1 VALUE

P112:1	0x2DAA:1	Voltage			
-- ... [Actual value] ... -- V		Actual output voltage of A01			
P112:2	0x2DAA:2	Current			
-- ... [Actual value] ... -- mA		Actual output current of A01			

5.3.7 ANALOG OUTPUT 2 VALUE

P113:1	0x2DAB:1	Voltage (*)			
-- ... [Actual value] ... -- V		Actual output voltage of A02			
P113:2	0x2DAB:2	Current (*)			
-- ... [Actual value] ... -- mA		Actual output current of A02			

5.3.8 HEATSINK TEMPERATURE

P117:1	0x2D84:1	Heatsink temperature			
-- ... [Actual value] ... -- °C		Actual heatsink temperature			

5.3.9 I/O STATUS

P118:0	0x60FD:0	Digital inputs status			
Bit # description: 16: Level at digital input 1 17: Level at digital input 2 18: Level at digital input 3 19: Level at digital input 4 20: Level at digital input 5 21: Level at digital input 6 22: Level at digital input 7 25: Low active - NPN		Status of digital input (Bit coded) Display toggles between LWX/HWX LWX Bit 0-15 HWX Bit 16 - 31			
P119:0	0x2DAC:0	Keypad status			
Bit # description: 0: Start Key 1: Stop Key 2: Up Key 3: Down Key 4: Enter Key 5: Escape Key		Keypad status (Bit coded)			
P120:0	0x2DAD:0	Digital outputs status			
Bit # description: 0: Relay 1: Digital output 1 2: Digital output 2 10: Charge Relay		Status of digital outputs and relay (Bit coded)			

5.3.10 PROCESS CONTROLLER DIAGNOSIS

P121:1	0x401F:1	PID setpoint			
-- ... [Actual value] ... -- PUnit		Actual PID setpoint			
P121:2	0x401F:2	PID feedback			
-- ... [Actual value] ... -- PUnit		Actual PID feedback			
P121:3	0x401F:3	Status (PID)			
Bit # description: 0: Process controller off 1: PID output set to 0 2: PID I-component set to 0 3: PID influence shown 4: Setpoint = actual value 5: Sleepmode active		PID status (Bit coded)			

5.3.11 MOTOR PROTECTION I2XT

P123:0	0x2D4F:0	Motor utilisation (i^2*t)			
-- ... [Actual value] ... -- %		Actual thermal load of the motor (I2xt)			

5.3.12 CONTROL / SETPOINT SOURCE

P125:1	0x282B:1	Active control source			
-- ... [Actual value] ... --		Actual active control source			
P125:2	0x282B:2	Active setpoint source			
-- ... [Actual value] ... --		Actual active setpoint source			
P125:3	0x282B:3	LCD icon states			
-- ... [Actual value] ... --		Actual status of LCD (Bit coded)			
P125:4	0x282B:4	Active drive mode			
-- ... [Actual value] ... --		Actual drive mode			
P125:5	0x282B:5	Actual control register			
-- ... [Actual value] ... --		Network Mode: Last active control register. Parameter Index is shown as hex code: Format: 0xiiiiss00 (iiii = Index hexadezimal, ss = Subindex hexadezimal) Example: 0x400C0100 --> 0x400C:01			
P125:6	0x282B:6	Actual setpoint register			
-- ... [Actual value] ... --		Network Mode: Last active setpoint register. Parameter Index is shown as hex code: Format: 0xiiiiss00 (iiii = Index hexadezimal, ss = Subindex hexadezimal) Example: 0x400B0300 --> 0x400B:03			

5.3.13 VSD STATUS

P126:1	0x282A:1	Cause of disable			
Bit # description: 0: Flexible I/O: Inhibit 1: Network inhibit 2: Axis inhibit 6: DC bus voltage 7: Drive not ready 9: Motor parameter ident 10: Auto brake 12: CiA 402 disabled 13: CIA402 Quick stop inhibit 14: STO inhibit 15: CiA402 mode disabled		Cause of controller stop (Bit coded)			
P126:2	0x282A:2	Cause of quick stop			
Bit # description: 0: Flexible I/O: configuration 1: Network 2: Axis command		Cause of quick stop (Bit coded)			
P126:3	0x282A:3	Cause of stop			
Bit # description: 0: Flexible I/O: Run/Stop 1: Flexible I/O: Run CW 2: Flexible I/O: Run CCW 3: Flexible I/O: Jog CW 4: Flexible I/O: Jog CCW 5: Network 6: Keypad 7: Control mode transition 15: Waiting for start		Cause of stop (Bit coded)			
P126:5	0x282A:5	CiA402 state machine			
0: Initial 2: Not Ready to Switch On 3: Switch On Disabled 4: Ready to Switch On 5: Switched on 6: Operation enable 7: Disable Operation 8: Shut Down 9: Quick stop active 10: Fault reaction active 11: Fault		Actual state of VSD			

5.3.14 DEVICE UTILIZATION (IXT)

P135:4	0x2D40:4	Device utilisation (i*t)			
-- ... [Actual value] ... -- %		Actual VSD utilization			
P135:5	0x2D40:5	Device utilisation (i*t): Error response			
2: Trouble 3: Error Configuration of ixt error response					

5.3.15 ERROR CODE

P150:0	0x603F:0	Error code			
-- ... [Actual value] ... --		Actual pending error code.			
		See chapter "Troubleshooting" for code explanation			

5.3.16 TIMER / COUNTER

On the keypad timers are displayed in the following format:
Days (d), Hours (h), Minutes (m), Seconds (s) (Example: 05d15h13m12s)

P151:1	0x2D81:1	Operating time			
-- ... [Actual value] ... -- s		Total operating time of VSD (VSD released)			
P151:2	0x2D81:2	Power-on time			
-- ... [Actual value] ... -- s		Total time that VSD was powered on			
P151:3	0x2D81:3	Control unit operating time			
-- ... [Actual value] ... -- ns		Total time that control unit was powered on. It includes the time where the control section is powered by USB adapter.			
P151:4	0x2D81:4	Main Switching Cycles			
-- ... [Actual value] ... --		Total number of power cycles			
P151:5	0x2D81:5	Relay switching cycles			
-- ... [Actual value] ... --		Total number of relay switchings			
P151:6	0x2D81:6	Short-circuit counter			
-- ... [Actual value] ... --		Total number of short circuit detections			
P151:7	0x2D81:7	Earth fault counter			
-- ... [Actual value] ... --		Total number of earth faults			
P151:8	0x2D81:8	Clamp counter			
-- ... [Actual value] ... --		Total number of active clamping			
P151:9	0x2D81:9	Fan operating time			
-- ... [Actual value] ... -- s		Total time of running fan.			

5.3.17 HISTORY BUFFER

P155:0	0x2006:0	Error history buffer			
-- ... [Actual value] ... --		See chapter "Troubleshooting"			

5.3.18 DEVICE DATA

P190:1	0x2000:1	Product code			
-- ... [Actual value] ... --		Product code of VSD (If control unit and power unit were ordered separately it will indicate XXXXXXXXXXXXXXXXXX)			
P190:2	0x2000:2	Serial number			
-- ... [Actual value] ... --		Serial number of VSD Example: 0000000000000000XYZXYZ			
P190:4	0x2000:4	Ctrl unit firmware version			
-- ... [Actual value] ... --		Example: 01.00.01.00			
P190:5	0x2000:5	Control unit - firmware type			
-- ... [Actual value] ... --		Example: IOFW51AC10			
P190:6	0x2000:6	Ctrl unit bootloader version			
-- ... [Actual value] ... --		Example: 00.00.00.13			
P190:7	0x2000:7	Control unit- bootloader type			
-- ... [Actual value] ... --		Example: IOBL51AOnn			
P190:8	0x2000:8	Object directory version			
-- ... [Actual value] ... --		Example: 108478			
P190:10	0x2000:10	Power unit- firmware version			
-- ... [Actual value] ... --		Example: 00196			
P190:11	0x2000:11	Power unit - firmware type			
-- ... [Actual value] ... --		Example: IDFW5AA			
P190:12	0x2000:12	Power Unit bootloader vers.			
-- ... [Actual value] ... --					
P190:13	0x2000:13	Power unit - bootloader type			
-- ... [Actual value] ... --					

5.3.19 DEVICE NAME

P191:0	0x2001:0	Device name			
-- ... [My Device] ... --		Configurable name of VSD			

5.3.20 DEVICE MODULE

P192:4	0x2002:4	Control unit - type code			
-- ... [Actual value] ... --		Type code of control unit			
P192:5	0x2002:5	Power unit - product code			
-- ... [Actual value] ... --		Type code of power unit			
P192:6	0x2002:6	Control unit - serial number			
-- ... [Actual value] ... --					
P192:7	0x2002:7	Power unit - serial number			
-- ... [Actual value] ... --					

5.3.21 ADDITIONAL STATUS

P197:0	0x2040:0	Access protection status			
Bit # description: 0: Full write access protected 1: Write access only for favorites		Actual status of access protection 0 = No protection 1 = Only read access to all parameters 2 = Only read & write access on favorites group			
P198:0	0x2827:0	Loaded parameter status			
0: User settings 1: Reset 60 Hz Settings 2: Reset 50 Hz Settings 3: OEM Settings		Actual loaded parameter settings			

5.4 GROUP 2 – BASIC SETUP

5.4.1 DEFAULT CONTROL SOURCE

See chapter “5.2.1 Setpoint structure / operation mode”, page 41
See chapter “5.2.2 Control source”, page 43

P200:0	0x2824:0	Control source			
0: Flexible 1: Keypad		Defines the default Control Source for Start, Stop and Rotation direction. The VSD can be controlled from several sources such as terminals (Digital Inputs), Fieldbus or Keypad. 0: Flexible Control Start / Stop and rotation direction configured in P400.xx 1: Keypad Local or remote mounted keypad provides the start / stop commands to the VSD. Other sources for starting the VSD are ignored in this mode. NOTE: Digital Input “VSD Enable” (P400:1), "Run/Stop" (P400:2) and Keypad Stop are always active!			

5.4.2 DEFAULT SETPOINT

The default setpoint selects the setpoint sources that will become active when no other setpoint is selected by any other means. The default setpoint values can come from external sources (Analog Inputs, Network, etc.) and internal sources (Presets).

See chapter 5.2.1 Setpoint structure / operation mode, page 41

P201:1	0x2860:1	Frequency control: Default setpoint source			
1: Keypad frequency setpoint 2: Analog input 1 3: Analog input 2 5: Network frequency setpoint 11: Preset frequency val. 1 12: Preset frequency val. 2 13: Preset frequency val. 3 14: Preset frequency val. 4 15: Preset frequency val. 5 16: Preset frequency val. 6 17: Preset frequency val. 7 18: Preset frequency val. 8 19: Preset frequency val. 9 20: Preset frequency val. 10 21: Preset frequency val. 11 22: Preset frequency val. 12 23: Preset frequency val. 13 24: Preset frequency val. 14 25: Preset frequency val. 15 50: Motor potentiometer (MOP)		Default Frequency setpoint 1: Keypad frequency setpoint Setpoint by Up and Down buttons on the optional local or remote keypad 2: Analog input 1 Selects analog input 1 as default setpoint. 3: Analog input 2 Selects analog input 2 as default setpoint. 5: Network frequency setpoint Selects the network as default setpoint Frequency: 11..25: Preset val. 1..15 Selects the preset values defined in P450:1 - P450:15 as default setpoint PID: 11..18: Preset setpoint 1..18 Selects the preset values defined in P451:1 - P451:8 as default setpoint Torque: 11..18: Preset setpoint 1..18 Selects the preset values defined in P452:1 - P452:8 as default setpoint 31-38: Preset segment Select sequencer segment setting as default setpoint 50: Motor potentiometer (MOP) Default setpoint defined by MOP (Motorized potentiometer function). Two digital inputs (increase/decrease) control the setpoint			
P201:2	0x2860:2	PID control : Default setpoint source			
1: Keypad PID setpoint (Reference see P201:1)		Default PID setpoint			

5.4.3 KEYPAD SETPOINTS

P202:1	0x2601:1	Frequency setpoint			
0.0 ... [20.0] ... 599.0 Hz		Actual Keypad setpoint, defined by Up and Down buttons			
P202:2	0x2601:2	Process controller setpoint			
-300.00 ... [0.00] ... 300.00 PUnit		Actual Keypad PID setpoint, defined by Up and Down buttons			

5.4.4 START AND STOP CONFIGURATION

The motor can be started and stopped with different methods:

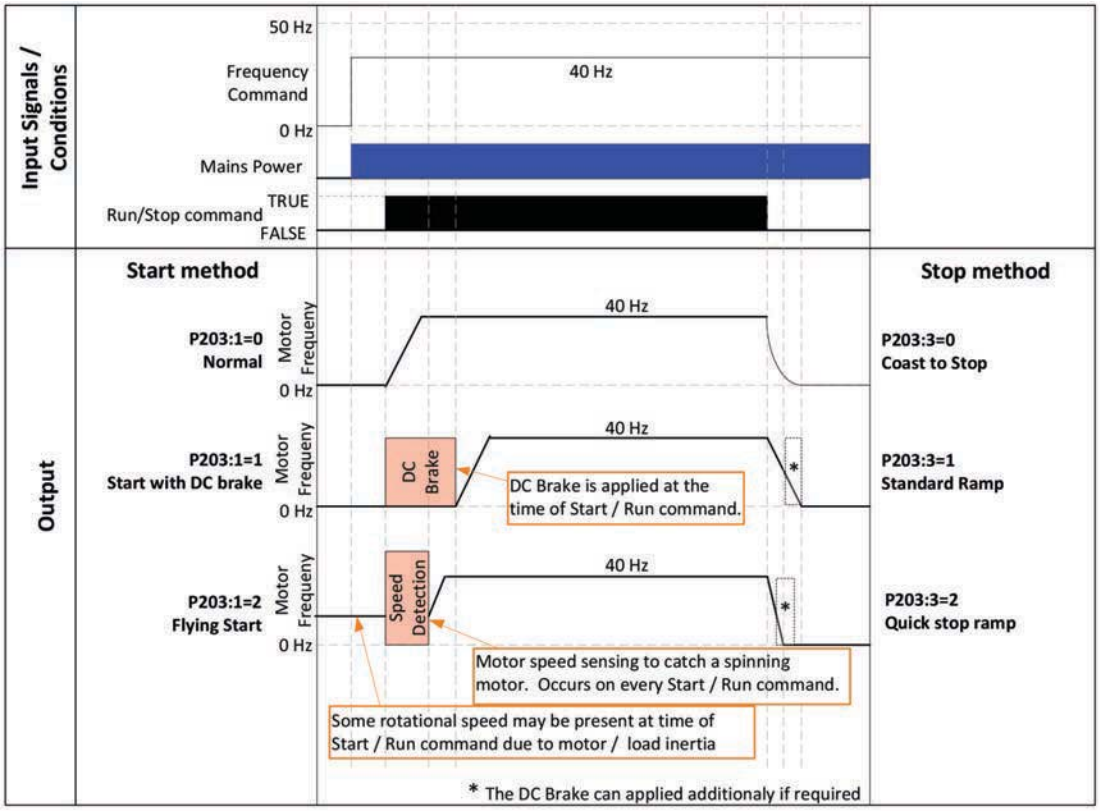


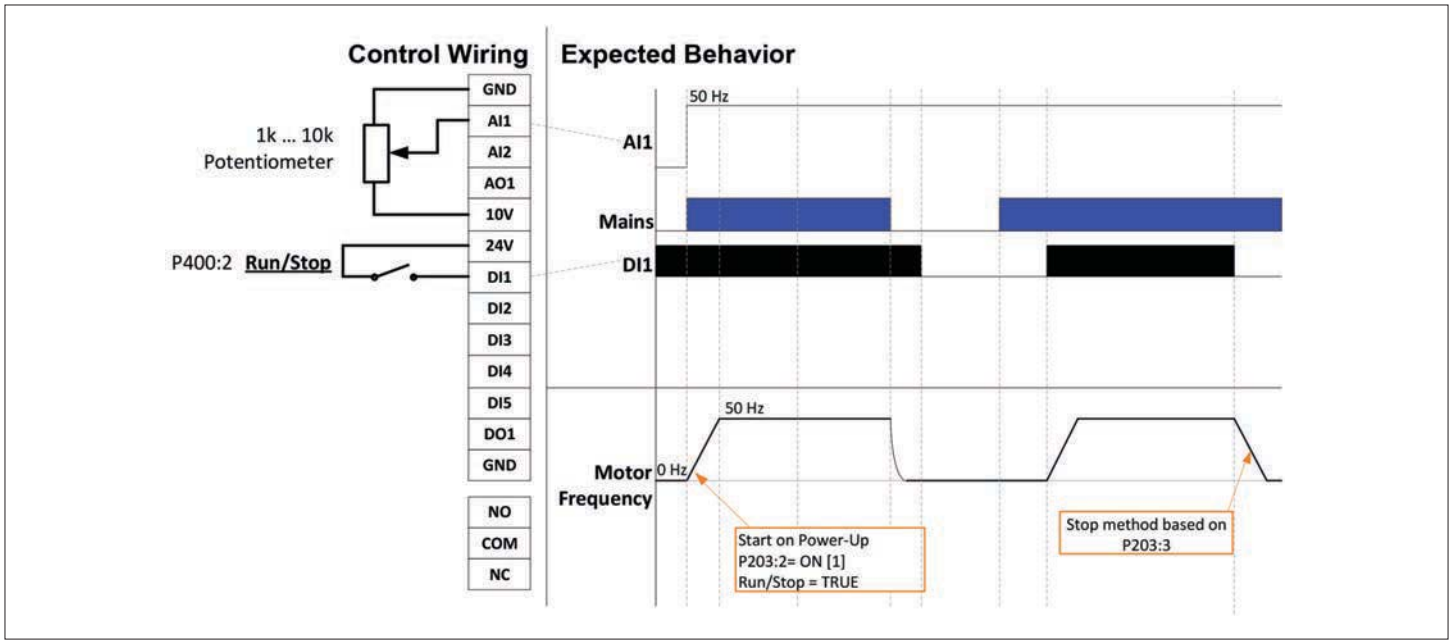
Fig. 6: Start and Stop configuration

See chapter “5.9.3DC brake setup”, page 93 for DC brake setup

P203:1	0x2838:1	Start method			
0: Normal 1: Start with DC brake 2: Flying Start		Defines starting method of the motor 0: Normal: VSD accelerates the motor in the selected direction when the start is initiated 1: Start with DC brake: VSD apply the DC Brake when the start is initiated, before beginning rotation of the motor. When the DC Brake delay time has elapsed the acceleration of the motor will begin. To activate DC Brake also P704:1 and P704:2 need to be set. 2: Flying Start: VSD can start on a rotating motor. During start the VSD detects the actual frequency and catches the motor. This feature provides smoother starting for high inertia loads like fans, flywheels, etc...			
P203:3	0x2838:3	Stop method			
0: Coast to Stop 1: Standard Ramp 2: Quick stop ramp		Defines the Stopping method of the motor 0: Coast VSD will shut off the output of the motor and the motor will coast to stop based on the inertia of the machine. 1: Standard Ramp VSD will ramp down the motor according to the selected deceleration time 2: Quick stop ramp VSD will ramp down the motor according to the quick stop ramp.			

5.4.5 START ON POWER UP

The “Start on Power” function allows to start the VSD automatically upon application of mains power if a valid start signal is present.



P203:2	0x2838:2	Start on Power up			
0: Off 1: On		Configuration of “Start on Power” function 0: Off Already present start/run signal upon application of mains power are ignored. The VSD needs a new start/run signal to start. 1: On The VSD starts automatically when mains power is applied and a valid start/run command is present.			

5.4.6 VOLTAGE CONFIGURATION

P208:1	0x2540:1	Rated mains voltage			
0: 230 Veff 1: 400 Veff 2: 480 Veff		Configuration of the actual applied mains voltage (VAC). Note: Default value is type code dependent			
P208:2	0x2540:2	Warninglevel under voltage			
0 ... [Type Code dependent] ... 800 V		Warning threshold for undervoltage If the DC-bus voltage falls below the threshold value the VSD reports a warning. Reset of the warning is done with a hysteresis of 10V.			
P208:3	0x2540:3	Error level under voltage			
-- ... [Actual value] ... -- V		Error threshold for undervoltage If the DC-bus voltage falls below the threshold value the VSD changes to Error state.			
P208:4	0x2540:4	Clear level under voltage			
-- ... [Actual value] ... -- V		Error reset threshold for undervoltage			
P208:5	0x2540:5	Warning level over voltage			
0 ... [Type Code dependent] ... 800 V		Warning threshold for overvoltage If the DC-bus voltage exceeds the threshold value the VSD reports a warning. Reset of the warning is done with a hysteresis of 10V.			
P208:6	0x2540:6	Error level over voltage			
-- ... [Actual value] ... -- V		Error threshold for overvoltage If the DC-bus voltage exceeds the threshold value the VSD changes to Error state.			
P208:7	0x2540:7	Clear level over voltage			
-- ... [Actual value] ... -- V		Error reset threshold for overvoltage			

5.4.7 MIN/MAX FREQUENCY

Minimum Frequency and Maximum Frequency define the overall operating frequency range (Hz) of the VSD. All references setpoints (analog input frequency setpoints, preset frequency setpoints, network frequency setpoints, etc…) are limited this settings.

P210:0	0x2915:0	Minimum frequency			
0.0 ... [0.0] ... 599.0 Hz		Minimum motor frequency			
P211:0	0x2916:0	Maximum frequency			
0.0 ... [Type Code dependent] ... 599.0 Hz		Maximum motor frequency			

5.4.8 ACCELERATION / DECELERATION

Two sets of Acceleration/Deceleration ramps are available. Two ways of switching between ACC/DEC 1 and ACC/DEC 2 are available:

– External Trigger (i.e. Digital Input)
– Ramp time switch level to trigger from ACC/DEC1 to ACC/DEC2 based on Frequency

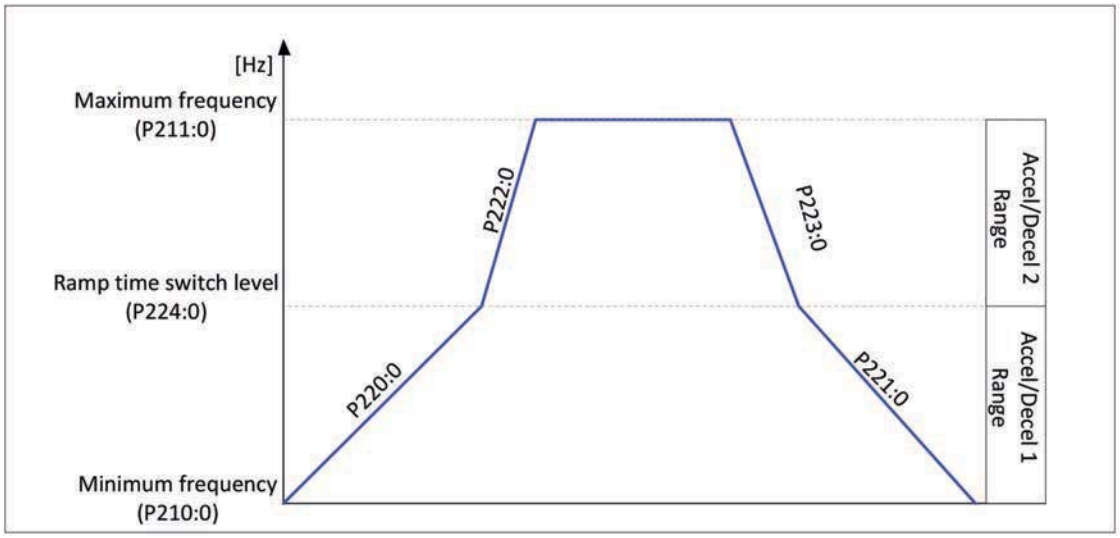


Fig. 7: Speed setpoint

P400:39	0x2631:39	Ramp 2 selection			
0:Not connected (Reference see P400:1)		Trigger for ACC/DEC2 selection: TRUE: Selects ACC2/DEC2 as ramp times			
P220:0	0x2917:0	Acceleration time 1			
0.0 ... [5.0] ... 3600.0 s		Acceleration time 1 for the output frequency to increase from 0.0 Hz to Maximum frequency (P211:0)			
P221:0	0x2918:0	Deceleration time 1			
0.0 ... [5.0] ... 3600.0 s		Deceleration time 1 for the output frequency to decrease from P211:0 Maximum Frequency to 0.0 Hz			
P222:0	0x2919:0	Acceleration time 2			
0.0 ... [5.0] ... 3600.0 s		Acceleration time 2 for the output frequency to increase from 0.0 Hz to Maximum frequency (P211:0) Note: MOP use ACC/DEC2			
P223:0	0x291A:0	Deceleration time 2			
0.0 ... [5.0] ... 3600.0 s		Acceleration time 2 for the output frequency to decrease from Maximum Frequency (P211:0) to 0.0 Hz Note: MOP use ACC/DEC2			
P224:0	0x291B:0	Ramp time switch level			
0.0 ... [0.0] ... 599.0 Hz		Switch point between ACC/DEC1 and ACC/DEC2: Act frequency < Ramp time switch level (P224:0) --> Use Accel/Decel time #1 Act frequency > Ramp time switch level(P224:0) --> Use Accel/Decel time #2 0: Function Disabled Note: Selection of ACC/DEC by P400:39, PID ACC/DEC sequencer ACC/DEC, Quickstops have higher priority			
P226:1	0x291E:1	Smooth factor			
0.0 ... [0.0] ... 100.0 %		Smothing factor for S-Shape characteristic ramping. Note: Smothing factor will extend ramp time: 50% --> 1,5 x configured ramp time 100% --> 2 x configured ramp time			

5.4.9 QUICKSTOP RAMP TIME (QSP)

The VSD has an additional stopping method called “Quick Stop” (QSP) It works as a zero-speed or Pause function where the ramp time can be setup separately.

P225:0	0x291C:0	Quick stop decel. time			
0.0 ... [1.0] ... 3600.0 s		Quick stop ramp time for the output frequency to decrease from Maximum frequency (P211:0) to 0.0 Hz Note: In Cia402 Velocity mode (P301:0 = [2] Velocity mode (vl)) the quick stop deceleration time is defined by P790:0.			

5.5 GROUP 3 – MOTOR CONTROL

5.5.1 MOTOR CONTROL MODE

The VSD can control the motor in different modes:

AC induction motors:

Motor control mode (P300:0)	Modes of operation (P301:0)	V/f characteristic shape (P302:0)		
VFC open loop [6]	MS-Velocity mode [-2	Linear [0] Quadratic [1] Eco [3]		
Sensorless vector control [4] SLVC	MS-Velocity mode [-2]			
Servo control ASM [2] (With encoder)	MS-Velocity mode [-2]			

VFC open loop (Linear / quadratic)
Typical for AC induction motors. Suitable for many general applications like conveyors, pumps, fans, etc. No motor feedback is needed.

➔ See the following chapters:
"5.5.2 V/f: Curve setting", page 64
"5.5.3 V/f: Slip compensation", page 65
"5.5.4 V/f: Frequency boost", page 65

VFC Eco
Energy Saving Control for Asynchronous Motor (reduction of copper losses).

1. Set the motor control mode:
   P300:0 to "VFC open Loop [6]"
2. Set the V/f characteristic shape:
   P302:0 to "Eco [3]"
3. Advanced Motor setup:
   Set motor parameter (5.5.12 Motor parameter, page 70)
4. Set VFC-ECO Minimum Voltage:
   P330:1 Set VFC-ECO Minimum Voltage

➔ See "5.5.2 V/f: Curve setting" on page 64

SENSORLESS VECTOR CONTROL (SLVC)
For higher performance on torque response and speed regulation the SLVC can be used. To use this mode the motor parameter and the motor identification mode is required. No motor feedback is needed.

1. Set the motor control mode:
   P300:0 to "Sensorless vector control [4]"
2. Advanced Motor setup:
   Set motor parameter (5.5.12 Motor parameter, page 70)

ⓘ NOTICE!
For the usage of SLVC the following restrictions apply:
- ► Only for asynchronous motors
- ► Only permissible for one single motor
- ► Not Permissible for hoists
- ► The connected motor may be maximum two power classes lower than the motor assigned to the VSD

SERVO CONTROL (ASM)
Vector controlled servo control (with encoder) for asynchronous motors. Generally, the servo control offers the same ad-vantages as the sensorless vector control (SLVC) with increased speed regulation performance.
1. Set the motor control mode:
   P300:0 to "Servo control ASM [2]"
2. Advanced Motor setup:
   Set motor parameter (5.5.12 Motor parameter, page 70)
3. Encoder setup (5.5.16 HTL Encoder setup, page 72).

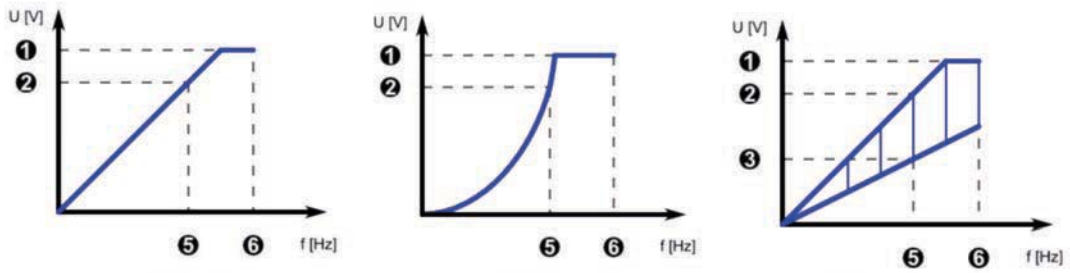
FUNCTIONS:

	Index	Display code	VFC open loop [6]	SLVC [4]	Servo control ASM [2]*
5.5.8 Switching frequency	0x2939:0	P305:0	X	X	X
5.5.2 V/f: Curve setting	0x2B00:0 0x2B01:X	P302:0 P303:X	X		
5.5.3 V/f: Slip compensation	0x2B09:X	P315:X	X		
5.5.4 V/f: Frequency boost	0x2B12:X	P316:X	X		
5.5.11 Skip frequency	0x291F:X	P317:X	(X)	X	X
5.5.5 V/f: Oscillation damping	0x2B0A:X	P318:X	(X)		
5.5.6 V/f: Override point of field weakening	0x2B0C:X	P319:X	(X)		
5.5.12 Motor parameter	0x2C01:X 0x6075:0	P320:X P323:0	(X)	X	X
5.5.13 Speed limitation	0x6080:0	P322:0	(X)	X	X
5.5.14 Current limitation	0x6073:0	P324:0	(X)	X	X
0 Torque limitation	0x6076:0 0x6072:0	P325:0 P326:0		X	X

(X) Optional

P300:0	0x2C00:0	Motor control mode
2: Servo Control ASM (*) 4: Sensorless vector control 6: VFC open loop		Selection of the motor control mode
P301:0	0x6060:0	Modes of operation
-2: MS-Velocity mode 0: Mode no change/assigned 2: Velocity mode (vl)		Selection of the operation mode of the VSD -2: MS-Velocity mode (Manufacturer specific velocity mode) Speed controlled motor with optional PID (Normal operating mode) 0: Mode no change/assigned No operation mode selected. VSD disabled. 2: Velocity mode (vl): CiA402 velocity mode. Control word 0x6040 is following CiA402 standard

5.5.2 V/f: CURVE SETTING



1: P208:1 Rated mains voltage
2: P303:1 Base Voltage
3: P330:1 VFC-ECO: Minimum Voltage
5: P303:2 Base Frequency
6: P211:0 Maximum Frequency

P302:0	0x2B00:0	V/f characteristic shape			
0: Linear 1: Quadratic 3: Eco		Configuration of V/f shape 0: Linear The curve has a constant V/f ratio which provides constant torque in the motor. V/f curves are used in many general applications. 1: Quadratic The curve V/f is a quadratic function. This is used for fan or pump applications. 3: Eco Energy Saving Control for Asynchronous Motor			
P303:1	0x2B01:1	Base Voltage			
0 ... [Type Code dependent] ... 5000 V		V/f Base Voltage To be set to motor nominal voltage			
P303:2	0x2B01:2	Base Frequency			
0 ... [Type Code dependent] ... 599 Hz		V/f Base Frequency To be set to motor nominal frequency			
P330:1	0x2B0D:1	Minimum voltage			
20 ... [20] ... 100 %		Minimum voltage (Only used for Eco Mode) The efficiency range of VFC Eco is limited by the standard U/f curve and the VFC Eco curve. (See graphic above) This parameter describes the operating point in relation to a chosen percentage value of Base voltage (P303:1) at Base frequency (P303:2). See graphic above.			

5.5.3 V/f: SLIP COMPENSATION

In a standard AC induction motor, the shaft speed decreases as load increases, and increases as load decreases. Slip compensation is used to counteract changes in motor speed (slip) caused by changes in load.

1. SETUP THE FOLLOWING MOTOR PARAMETER.
(Out of this parameters the VSD automatically calculates the nominal slip)
P320:4 Motor parameter: Rated speed
P320:5 Motor parameter: Rated frequency

2. SETUP THE SLIP INFLUENCE GAIN
100% means that full motor rated slip is applied with full torque. If the slip compensation is not accurate (Example: Motor data not accurate) the slip compensation can be adjusted with this value.

P315:1	0x2B09:1	Gain			
-200.00 ... [100.00] ... 200.00 %		Configuration of the slip compensation influence. 100% means that full motor rated slip is applied with full torque.			
P315:2	0x2B09:2	Filter time			
1 ... [5] ... 6000 ms		Configuration of the slip compensation filter time. The default is optimized for best slip speed loss recovery time performance of typical motors. If oscillation or instability occurs at full load (or near full load) then increasing the Slip Compensation Filter Time is recommended.			

5.5.4 V/f: FREQUENCY BOOST

The voltage boost (Fixed or during Acceleration) can increase the starting torque for application with high inertia load, high friction loads.

P316:1	0x2B12:1	Fixed boost			
0.0 ... [Type Code dependent] ... 20.0 %		The Fixed voltage boost increases the output voltage with the configured % of Base Voltage (P303:1)			
P316:2	0x2B12:2	Boost at acceleration			
0.0 ... [0.0] ... 20.0 %		The Acceleration voltage boost increases the output voltage during acceleration in with the configured [%] of Base Voltage (P303:1)			

5.5.5 V/f: OSCILLATION DAMPING

The oscillation damping function is used to reduce speed oscillations which can occur in unloaded or lightly loaded operation.

➔ See VLB3SW01 software for setup and more information

5.5.6 V/f: OVERRIDE POINT OF FIELD WEAKENING

➔ See VLB3SW01 software for setup and more information

5.5.7 ROTATION RESTRICTION

The rotation of the motor can be restricted to forward only.

➔ See chapter “5.2.4 Rotation direction”, page 47

P304:0	0x283A:0	Rotation restriction			
0: Forward only 1: Forward and reverse		The VSD can be limited to Forward (FWD) rotation only. This affects the final output setpoint for velocity and PID setpoint Note: This command only prevents negative velocity setpoints. Therefore it is still pos-sible that the motor runs reverse (Example: Wrong wiring).			

5.5.8 SWITCHING FREQUENCY

The VSD output is DC voltage that is sine-coded pulse width modulated (PWM) to approximate variable frequency AC voltage. The frequency of the PWM pulses is adjustable. This adjustment is called the PWM switching frequency.

General:
– Higher switching frequencies will result in less audible noise but will cause the VSD to generate more heat and operate less efficiently.
– Lower switching frequencies will result in more audible noise but will cause decreased earth leakage current, increased VSD efficiency and increased ambient operating temperature range.

P305:0	0x2939:0	Switching frequency			
1: 4kHz var. / optimized 2: 8kHz var. / optimized 3: 16kHz var. / optimized 5: 2kHz fix / optimized 6: 4kHz fix / optimized 7: 8kHz fix / optimized 8: 16kHz fix / optimized 11: 4kHz var. / min. Pv 12: 8kHz var. / min. Pv 13: 16kHz var. / min. Pv 15: 2kHz fix / min. Pv 16: 4kHz fix / min. Pv 17: 8kHz fix / min. Pv 18: 16kHz fix / min. Pv 21: 8kHz var./ opt./4kHz min. 22: 16kHz var./opt./4kHz min. 23: 16kHz var./opt./8kHz min 31: 8kHz var./ Pv/4kHz min. 32: 16kHz var./ Pv/4kHz min. 33: 16kHz var./ Pv/8kHz min.		Definition of the Switching Frequency 1, 2, 3: Optimized for best VSD performance (symmetrical modulation) Variable switching frequency: VSD reduces the switching frequency if output current or VSD temperature are too high. Minimal Switching Frequency is limited to 2 kHz. 5, 6, 7, 8: Optimized for best VSD performance (symmetrical modulation) Switching frequency is fixed. 11, 12, 13: Optimized for best VSD efficiency (asymmetrical modulation). Variable switching frequency: VSD reduces the switching frequency if output current or VSD temperature are too high. Minimal Switching Frequency is limited to 2 kHz. 15, 16, 17, 18: Optimized for best VSD efficiency (asymmetrical modulation). Switching frequency is fixed. 21, 22, 23: Optimized for best VSD performance (symmetrical modulation) Variable switching frequency: VSD reduces the switching frequency if output current or VSD temperature are too high. Minimal Switching Frequency is limited to 4 kHz or 8 kHz. 31, 32, 33: Optimized for best VSD efficiency (asymmetrical modulation). Variable switching frequency: VSD reduces the switching frequency if output current or VSD temperature are too high. Minimal Switching Frequency is limited to 4 kHz or 8 kHz.			

5.5.9 MOTOR THERMAL OVERLOAD (i2xt)

The function monitors the thermal power dissipation from the measured motor currents on the basis of a mathematical model. This can be used for motor overload protection. It is only usable for functional protection, i.e. to guarantee the service life time of the motor. It is not suitable as safety relevant protection against energy induced hazards.

⚠ DANGER!
FIRE HAZARD FROM MOTOR OVERLOAD
Additional means must be provided to prevent fire hazards arising from motor overload.
► Independent temperature monitoring of the motor with shut down.

⚠ DANGER!
UNCONTROLLED MOTOR BEHAVIOR
If the motor overload occurs the VSD stops modulating and no torque is available on the motor. On motors under load without holding brake this can lead to uncontrolled motor movements.
► Use the VSD only under the specified load conditions.

P308:1	0x2D4B:1	Maximum utilisation [60 s] .			
30 ... [150] ... 200 %		Configuration of the I2xt trip time. If the motor is running with nominal current (P323) for longer than the configured trip time, the VSD will trip according the configured reaction.			
P308:2	0x2D4B:2	Speed compensation .			
0: On 1: Off		Slow speed compensation (<40 Hz) 0: On The over load trip time on motor is reduced to compensate the decreased cooling of self-cooled AC induction motors when running at slow speed. 1: Off Function disabled, no reduction. Notes: - For compliance with UL the user must enable this function or use an appropriate PTC to protect the motor. - Function to protect motors at speed lower than 40 Hz			
P308:3	0x2D4B:3	Error response			
3:Fault (Reference see P310:1)		Configuration of the i2xt over load fault reaction. If the trip level is reached to motor will react as defined. Notes: - For compliance with UL the user must enable this function or use an appropriate PTC to protect the motor.			

5.5.10 MOTOR TEMPERATURE SENSOR

For detecting and monitoring of the motor temperature, a PTC thermistor (DIN 44081 Single, DIN 44082 Triplet) or a thermal contact (NC contact) can be connected to the terminals T1 and T2.
Stop!

NOTICE!
The VSD can only evaluate one PTC thermistor!
Do not connect several PTC thermistors in series or parallel.
- ► If several motors are operated on one VSD, use thermal contacts (NC contacts) connected in series.
- ► To achieve full motor protection, an additional temperature monitoring with separate evaluation must be installed.

i It is recommended to always use this function if the motor is equipped with a PTC thermistors or thermo contact.

P309:2	0x2D49:2	Reaction			
3:Fault (Reference see P310:1)		Motor temperature sensor fault reaction. 0: No response No reaction on the VSD. 1: Warning Warning will be displayed. VSD will continue operation normally. 2: Trouble VSD will go to Trouble state and ramp down the motor with the Quick Stop Ramp time. 3: Fault VSD will go to Fault state and stop the motor with a coast stop.			

5.5.11 SKIP FREQUENCY

Three skip frequencies are available to lock out critical frequencies that cause mechanical resonance.

Example:
Skip frequency 20 Hz
Skip bandwidth 10 Hz
Frequency area 15 Hz .. 25 Hz is skipped

i Skip frequencies are absolute.
Disable function: Skip bandwidth = 0
Skip frequencies cannot be set to include 0Hz (i.e. if 2Hz was set as a skip frequency and a bandwidth of 4Hz or greater was selected, the skip range is ignored).

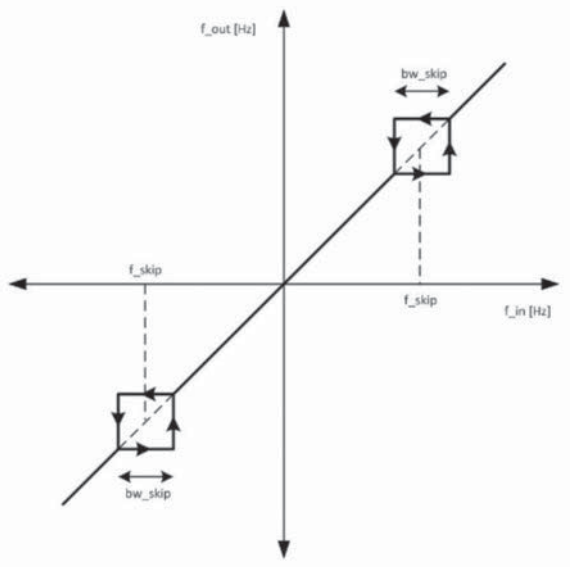


Fig. 8: Skip frequency

P317:1	0x291F:1	Skip frequency 1			
0.0 ... [0.0] ... 599.0 Hz		Skip frequency 1			
P317:2	0x291F:2	Skip bandwidth 1			
0.0 ... [0.0] ... 10.0 Hz		Skip bandwidth 1			
P317:3	0x291F:3	Skip frequency 2			
0.0 ... [0.0] ... 599.0 Hz		Skip frequency 2			
P317:4	0x291F:4	Skip bandwidth 2			
0.0 ... [0.0] ... 10.0 Hz		Skip bandwidth 2			
P317:5	0x291F:5	Skip frequency 3			
0.0 ... [0.0] ... 599.0 Hz		Skip frequency 3			
P317:6	0x291F:6	Skip bandwidth 3			
0.0 ... [0.0] ... 10.0 Hz		Skip bandwidth 3			

5.5.12 MOTOR PARAMETER

i For the mode “Sensorless vector control”, “Servo Control ASM”, and “VFC Eco mode” the parameter setup and calibration is necessary.
For “VFC open loop” linear/quadratic it is not necessary but can increase the control behavior.

THIRD PARTY MOTOR OR KEYPAD
Set the motor parameter described below and execute the “identification” (P327:4) or “estimation” (P327:4)

P320:4	0x2C01:4	Rated speed			
50 ... [1450] ... 50000 rpm		Rated motor nominal speed (motor nameplate)			
P320:5	0x2C01:5	Rated frequency			
1.0 ... [50.0] ... 1000.0 Hz		Rated motor nominal frequency (motor nameplate)			
P320:6	0x2C01:6	Rated power			
-- ... [Type Code dependent] ... -- kW		Rated motor nominal power (motor nameplate)			
P320:7	0x2C01:7	Rated voltage			
-- ... [Type Code dependent] ... -- V		Rated motor nominal voltage (motor nameplate)			
P320:8	0x2C01:8	Rated cosine phi			
0.00 ... [0.80] ... 1.00		Rated motor nominal cos phi (motor nameplate)			
P323:0	0x6075:0	Motor rated current			
0.001 ... [Type Code dependent] ... 500.000 A		Rated motor nominal cos phi (motor nameplate)			
P335:1	0x2910:1	Motor			
0.00 ... [Type Code dependent] ... 20000000.00 kg cm²		Moment of inertia of motor (Set it based on Motor)			
P335:2	0x2910:2	Load			
0.00 ... [Type Code dependent] ... 20000000.00 kg cm²		Moment of inertia of load (Set it based on Application)			
P	0x2910:3	Coupling			
0: Stiff 1: Elastic 2: With backlash		Coupling of motor and load (Set it based on Application)			
P327:4	0x2822:4	Motor identification			
0 ... [0] ... 1		Motor identification (Energized) 1: Enables the motor identification (Energized). After setting the parameter a valid Run/Start command starts the identification. For that cycle DI1 (Run / Stop Command). This initiates the energized identification. The identification may take several seconds/minutes and measures the motor characteristic and calculates motor control parameters (Speed/Current control loop) based on the identified parameters. During the identification the blue status LED is ON. The blue LED flashing and the red LED OFF indicate that the identification was successfully finished. The red LED ON indicates that the identification failed.			
P327:5	0x2822:5	Motor estimation			
0 ... [0] ... 1		Motor estimation (Non-Energized) 1: Enables the motor estimation. The estimation takes less than 1s and calculates the equivalent circuit data and the motor control parameters (Speed/Current control loop) based on the motor rated values. The blue LED flashing and the red LED OFF indicate that the calibration was successfully finished. The red LED ON indicates that the calibration failed.			

5.5.13 SPEED LIMITATION

The overall maximal speed can be limited.

i The speed limitation is active after the ramp generator!

P322:0	0x6080:0	Max motor speed			
0 ... [6075] ... 480000 rpm		Overall Maximum motor speed			

5.5.14 CURRENT LIMITATION

The maximum current can be limited. If the current limit is reached the output frequency is reduced in motor operation and increased in generator operation. When the over current condition passes, the VSD will return to normal operation and reaccelerate to the set point.
If the limitation cannot correct the condition and the VSD remains in current limit for too long, it will trip with I2T motor error.

P324:0	0x6073:0	Max current			
0.0 ... [200.0] ... 3000.0 %		Maximum motor current in % of P323:0			

5.5.15 TORQUE LIMITATION

The maximum torque can be limited.

i Note: the limitation is not active in V/f mode!

P325:0	0x6076:0	Motor rated torque			
0.001 ... [Type Code dependent] ... 1000.000 Nm		Motor rated torque in [Nm]			
P326:0	0x6072:0	Maximum Torque in [%]			
0.0 ... [250.0] ... 3000.0 %		Maximum motor torque in % of P325:0			
P329:1	0x2D67:1	Torque monitor:response			
0: No reaction 1: Warning 2: Trouble 3: Fault		Torque limitation fault reaction Note: Status bit "MotorTorqueMax" is set independently of the selected response.			
P329:2	0x2D67:2	Torque monit:Shutter delay			
0.000 ... [0.000] ... 10.000 s		Torque limitation fault delay			

5.5.16 HTL ENCODER SETUP

A HTL encoder can be connected to the DI3 and DI4 of the VSD. The encoder can be used for:
– As a motor encoder for speed control
– As a process encoder as a setpoint (e.g. true web speed for winding application) or as an actual value for e.g. PID Controller

Setup:
1. Select the encoder in P410:2
2. Set the encoder increment/revolution P341:1
3. Select the function of the encoder:
   P600:2 Feedback PID / P201:2 PID setpoint / P201:1 Frequency setpoint
   Note: If SC or SLPSM mode is selected the encoder is automatically assigned as feedback.
   The actual encoder feedback is displayed in 0x2C42:6

P341:1	0x2C42:1	Increments/ revolution			
1 ... [128] ... 16384		Set the number of increments per revolution of the connected encoder (See data sheet of the encoder)			
P410:2	0x2630:2	Mode selection			
0: Digital input 1: Encoder (AB) (*)		Mode selection for digital input functionalities (DI4 / DI3)			
P	0x2C42:6	Actual velocity			
-- ... [Actual value] ... -- rpm		Actual velocity feedback of encoder			

5.5.17 OVERSPEED MONITORING

The VSD contains Motor Overspeed detection. If the specified threshold is exceeded, the VSD will react as defined.

i The overspeed monitoring is only active if the motor is in motoring mode.

P350:1	0x2D44:1	Threshold			
50 ... [8000] ... 50000 rpm		Overspeed threshold			
P350:2	0x2D44:2	Reaction			
3:Fault (Reference see P310:1)		Overspeed fault reaction			

5.5.18 OVERCURRENT MONITORING

The VSD monitors the output current and compares it to a threshold value. If the specified threshold is exceeded, the VSD will react as defined.

i This parameter can also be set and overwritten by using the non-energized calibration process. The user should adjust this default value for proper protection.

P353:1	0x2D46:1	Threshold			
0.0 ... [Type Code dependent] ... 1000.0 A		Overcurrent threshold			
P353:2	0x2D46:2	Reaction			
3:Fault (Reference see P310:1)		Overcurrent fault reaction			

5.6 GROUP 4 – I/O SETUP

5.6.1 FUNCTION LIST (RUN/STOP/START/JOG/REVERSE)

Parameters P400:1…P400:49 contain the main functions of the VSD. The function can be assigned to a trigger. If the trigger is activated the function is executed. The digital trigger values can come from external sources (Digital Inputs, Network, etc.) and internal sources (VSD status, faults, etc.) It is possible to assign more than one function to a single trigger.

Basic functionalities:

- VSD enable
  Enables the VSD. Signal must have the state TRUE (by Input or setting) to be able to start the motor.
- Run/Stop
  Enables the running of the motor. Can be used as single signal or in combination with the signals Start Forward / Start Reverse. Signal must have the state TRUE (by Input or setting) to be able to start the motor.
- Start Forward / Start Reverse
  Used to start the motor (Positive edge triggered). Stop is down with the Run/Stop signal.
- Run Forward / Run Reverse
  Used to run and stop the motor (Maintained signals)
- Rotation invertion
  Inverts the speed setpoint
- JOG Forward / JOG Reverse
  JOG the motor with a fixed speed. Jog has higher priority than Run/Stop, Start or Run commands.
- Fault Reset
  For a successful reset of a fault it is necessary to correct the condition that caused the fault first. Afterwards there are different possibilities to reset the fault:

Function to reset fault:	Parameter	Transition
Reset fault	P400:4	FALSE > TRUE (Rising edge)
VSD enable	P400:1	TRUE > FALSE (Falling Edge)
Run/Stop	P400:2	TRUE > FALSE (Falling Edge)
Keypad STOP	-	FALSE > TRUE (Rising edge)

➔ See chapter “5.2.2 Control source”, page 43
See chapter “5.2.3 Control examples”, page 44

i In Flexible Control mode (P200:0) either VSD enable (P400:1) or Run/Stop (P400:2) must be assigned to I/O to ensure that the drive can always be stopped!
(Exception: VSD is controlled from network, Network enable (P400:37) is HIGH)

ⓘ NOTICE!
The JOG functions have priority over Stop commands. If the VSD is currently JOGGING, pressing the STOP key on the keypad or triggering STOP command will NOT stop the motor!

P400:1	0x2631:1	VSD enable			
0: Not connected 1: Constant TRUE 11: Digital input 1 12: Digital input 2 13: Digital input 3 14: Digital input 4 15: Digital input 5 16: Digital input 6 (*) 17: Digital input 7 (*) 50: Running 51: Ready to run 53: Stop active 54: Quick stop active 58: Device warning 59: Device fault active 60: Heatsink temp. warning 69: Rotation inverted 70: Frequency thld exceeded 71: Actual speed = 0 78: Current thld exceeded 79: Maximum torque 80: Follower signal loss 81: Error analog input 1 82: Error analog input 2 83: Loss of load 104: Local control active 105: Remote control active 106: Manual setpoint active 107: Automatic setpoint active		State: TRUE enables the VSD. FALSE inhibits the VSD and the motor will cost stop. Note: Signal must have the state TRUE (by Input or setting) to be able to start the motor			
P400:2	0x2631:2	Run/Stop			
11:Digital input 1 (Reference see P400:1)		VSD Run/Stop signal State: TRUE will make the VSD ready to run FALSE will stop the motor according to the defined stop method Note: Set 01 TRUE to disable the function Signal must have the state TRUE (by Input or setting) to be able to start the motor			

P400:3	0x2631:3	Quick stop			
0:Not connected (Reference see P400:1)		The quick stop function works as pause or zero speed function. If the quick stop is applied the motor will ramp down with the defined QSP ramp. Note: 0: FALSE disables this functionality			
P400:4	0x2631:4	Reset fault			
12:Digital input 2 (Reference see P400:1)		Trigger for fault reset FALSE->TRUE transition the faults will be reset.			
P400:6	0x2631:6	Start forward (CW)			
0:Not connected (Reference see P400:1)		Start forward signal (Edge triggered) State: Transition FALSE-->TRUE will start the motor forward Note: – Use P400:2 “Run/Stop” signal to stop the motor –Set the signal to 0: FALSE to disable the function – If a bipolar input (-10V..+10V) is used the direction is controlled by the reference signal			
P400:7	0x2631:7	Start reverse (CCW)			
0:Not connected (Reference see P400:1)		Start reverse signal (Edge triggered) State: Transition FALSE-->TRUE will start the motor forward Note: – Use P400:2 “Run/Stop” signal to stop the motor – Set the signal to 0: FALSE to disable the function – If a bipolar input (-10V..+10V) is used the direction is controlled by the reference signal			
P400:8	0x2631:8	Run forward (CW)			
0:Not connected (Reference see P400:1)		Run forward signal (Maintained signal) State: TRUE will start the motor forward The last activated signal of run forward and run reverse defines the direction! FALSE of Run Forward and Run Reverse will stop the motor according to the defined stop method Note: – Set the signal to 0: FALSE to disable the function – If a bipolar input (-10V..+10V) is used the direction is controlled by the reference signal			
P400:9	0x2631:9	Run reverse (CCW)			
0:Not connected (Reference see P400:1)		Run reverse signal (Maintained signal) State: TRUE will start the motor reverse The last activated Signal of Run Forward and Run Reverse defines the direction! FALSE of Run Forward and Run Reverse will stop the motor according to the defined stop method Note: – Set the signal to 0: FALSE to disable the function – If a bipolar input (-10V..+10V) is used the direction is controlled by the reference signal			
P400:10	0x2631:10	Jog forward (CW)			
0:Not connected (Reference see P400:1)		JOG Forward with preset frequency 5 State: TRUE will start the motor forward with preset frequency 5 FALSE will stop the motor If JOG forward and JOG reverse are applied at the same time the motor will stop and the JOG has to be retriggered! WARNING: The JOG functions have priority over Stop commands. If the VSD is currently JOGGING, pressing the STOP key on the keypad or triggering STOP command will NOT stop the motor!			
P400:11	0x2631:11	Jog reverse (CCW)			
0:Not connected (Reference see P400:1)		JOG Forward with preset frequency 6 State: TRUE will start the motor reverse with preset frequency 6 FALSE will stop the motor If JOG forward and JOG reverse are applied at the same time the motor will stop and the JOG has to be retriggered! WARNING: The JOG functions have priority over Stop commands. If the VSD is currently JOGGING, pressing the STOP key on the keypad or triggering STOP command will NOT stop the motor!			
P400:12	0x2631:12	Keypad control			
0:Not connected (Reference see P400:1)		Keypad Selection for Start/Stop command State: TRUE: Start and Stop commands coming from the keypad FALSE: Start and Stop commands are defined by the connection list			
P400:13	0x2631:13	Invert rotation			
13:Digital input 3 (Reference see P400:1)		Rotation inversion signal State: TRUE: target reference setpoint is inverted (i.e. times -1) FALSE: the target reference setpoint in not inverted			

5.6.2 SETPOINT SELECTION

Setpoint Priority
The priority of the setpoint is according the following list:

Terminal/Flexible or Keypad control (P400:37 = False)	Network mode (P400:37 = TRUE)
1. Trigger for Setpoint Source (Connection List) P400:14 – P400:25 In order of the selected trigger 1. 1: TRUE 2. 11: Digital Input 1 (DI1) 3. 12: Digital Input 2 (DI2) 4. 13: Digital Input 3 (DI3) 2. Default Setpoint Speed P201:1 (0x2860:1) PID P201:2 (0x2860:2)	1. Setpoint/Network setpoint controlled with: AC Drive Control Word C135 Control Word NETWordIN1 2. Default Setpoint Speed P201:1 (0x2860:1) PID P201:2 (0x2860:2)

i In Network mode (P400:37 = TRUE) the triggers P400:14 – P400:25 are not active.
To select the network as setpoint source in network mode (P400:37 = TRUE) use the "Default setpoint source" (P201:1-2) or the corresponding control bits (AC Drive Control Word, C135 Control Word, NETWordIN1).

i The actual control setpoint source can be seen in P125:2

➔ See chapter "5.4.2 Default setpoint", page 54
See chapter "5.2.1 Setpoint structure / operation mode", page 41

P400:14	0x2631:14	AI1 setpoint selection			
0:Not connected (Reference see P400:1)		Selects Analog input 1 as setpoint source			
P400:15	0x2631:15	AI2 setpoint selection			
0:Not connected (Reference see P400:1)		Selects Analog input 2 as setpoint source			
P400:16	0x2631:16	Keypad setpoint selection			
0:Not connected (Reference see P400:1)		Selects Keypad as setpoint source			
P400:17	0x2631:17	Setpoint = Network			
0: Not connected 116: Netw.Ref active (Other Reference see P400:1)		Selects Network as setpoint source (SW 02.01) in terminal mode. Note: In Network mode (P400:37 = TRUE) the triggers P400:14 – P400:25 are not active. To select the network as setpoint source in network mode (P400:37 = TRUE) use the "Default setpoint source" (P201:1-2) or the corresponding control bits (AC Drive Control Word, C135 Control Word, NET-WordIN1). 116: TRUE if AC Drive Control Word (0x400B:1) bit 6 is active			
P400:18	0x2631:18	Preset selection bit 0			
14:Digital input 4 (Reference see P400:1)		Preset frequency setpoint selection bit 0 Combination Example: bit0 and bit2 result in preset frequency 5			
P400:19	0x2631:19	Preset selection bit 1			
15:Digital input 5 (Reference see P400:1)		Preset frequency setpoint selection bit 1			
P400:20	0x2631:20	Preset selection bit 2			
0:Not connected (Reference see P400:1)		Preset frequency setpoint selection bit 2			
P400:21	0x2631:21	Preset selection bit 3			
0:Not connected (Reference see P400:1)		Preset frequency setpoint selection bit 3			

5.6.3 MOTOR POTENTIOMETER

With the motor potentiometer mode (MOP) the setpoint is controlled with the two triggers Increase and Decrease (Example: 2 digital inputs).

- The MOP is enabled by trigger P400:25 or can be set as default setpoint source.
- Motor potentiometer up TRUE: Setpoint will increase with acceleration time 2.
- Motor potentiometer down TRUE: Setpoint will decrease with deceleration time 2.
- MOP is increasing/decreasing the setpoint according acceleration/deceleration time 2. The motor is following the setpoint with acceleration/deceleration time 1 also in MOP-mode.
- If both triggers are TRUE or FALSE at the same time the setpoint will remain constant.
- The start value of the MOP is defined with P413:0.

P400:23	0x2631:23	Motor potentiometer up			
0:Not connected (Reference see P400:1)		State TRUE will increase the speed setpoint in MOP-Mode.			
P400:24	0x2631:24	Motor potentiometer down			
0:Not connected (Reference see P400:1)		State TRUE will decrease the speed setpoint in MOP-Mode.			
P400:25	0x2631:25	Motor potentiometer select			
0:Not connected (Reference see P400:1)		Trigger to enable the MOP-Mode. After enabling the speed is controlled by digital inputs MOP up / MOP down.			
P413:0	0x4003:0	Motor pot. start mode			
0: Last value 1: Init Value 2: Minimum Value		Defines the start setpoint value when MOP is enabled. 0: Last value MOP starts with the last MOP set value. 1: Init Value MOP starts with the value in P414:1 or P414:2 2: Minimum Value MOP starts with minimum frequency (P210:0) or minimum PID value (P605:1)			
P414:1	0x4004:1	Speed			
0.0 ... [0.0] ... 599.0 Hz		Frequency start value for MOP-Mode Note: Only active if P413:0 is set to 1			
P414:2	0x4004:2	Process controller (PID)			
-300.00 ... [0.00] ... 300.00 PUnit		Process controller start value for MOP-Mode Note: Only active if P413:0 is set to 1			

5.6.4 USER DEFINED FAULTS

Two user defined fault can be configured. (Example: To stop motor in case of process fault) If a user defined fault occurs the VSD goes into fault state. After clearing the fault the resetting of the VSD is required.

P400:43	0x2631:43	User-defined fault 1			
0:Not connected (Reference see P400:1)		Configuration of user defined fault 1			
P400:44	0x2631:44	User-defined fault 2			
0:Not connected (Reference see P400:1)		Configuration of user defined fault 2			

5.6.5 DIGITAL INPUT CONFIGURATION

The digital input are used for control operations. The following configurations are available for the digital input signals:
- Assertion Level (Only VLB3)
  The VLB3 digital inputs can be used with PNP or NPN signals. The setting applies for all digital inputs!
- Signal inversion
  Every digital Input can be inverted individually
- Connection list / Function
  In general a digital input is assigned to a specific function like Start Reverse or Quick stop. With that it is possible to have more than one function on the same digital input.

➔ See chapter 5.6.1 Function list (Run/Stop/Start/Jog/Reverse), page 74 for the configurable functions.

P410:1	0x2630:1	Assertion level			
0: LOW active 1: HIGH active		Input signal assertion for PNP/NPN selection 0: Low For NPN input signals 1: High For PNP input signals			
P410:2	0x2630:2	Mode selection			
0: Digital input 1: Encoder (AB) (*)		Mode selection for digital input functionalities (DI4 / DI3): 0: DI4 / DI3 = digital inputs 1: Encoder (AB)			
P411:1	0x2632:1	Digital input 1			
0: Not inverted 1: Inverted		Inversion of Digital Input			
P411:2	0x2632:2	Digital input 2			
0: Not inverted 1: Inverted		Inversion of Digital Input			
P411:3	0x2632:3	Digital input 3			
0: Not inverted 1: Inverted		Inversion of Digital Input			
P411:4	0x2632:4	Digital input 4			
0: Not inverted 1: Inverted		Inversion of Digital Input			
P411:5	0x2632:5	Digital input 5			
0: Not inverted 1: Inverted		Inversion of Digital Input			
P411:6	0x2632:6	Digital input 6 (*)			
0: Not inverted 1: Inverted		Inversion of Digital Input			
P411:7	0x2632:7	Digital input 7 (*)			
0: Not inverted 1: Inverted		Inversion of Digital Input			

5.6.6 FREQUENCY THRESHOLD SETUP

A frequency threshold can be used to trigger a function, a digital output or the relay. The trigger is referenced to actual VSD output frequency. This trigger is TRUE when the actual output frequency is above a programmable frequency threshold.

P412:0	0x4005:0	Frequency threshold			
0.0 ... [0.0] ... 599.0 Hz		Frequency threshold			

5.6.7 DIGITAL OUTPUT CONFIGURATION

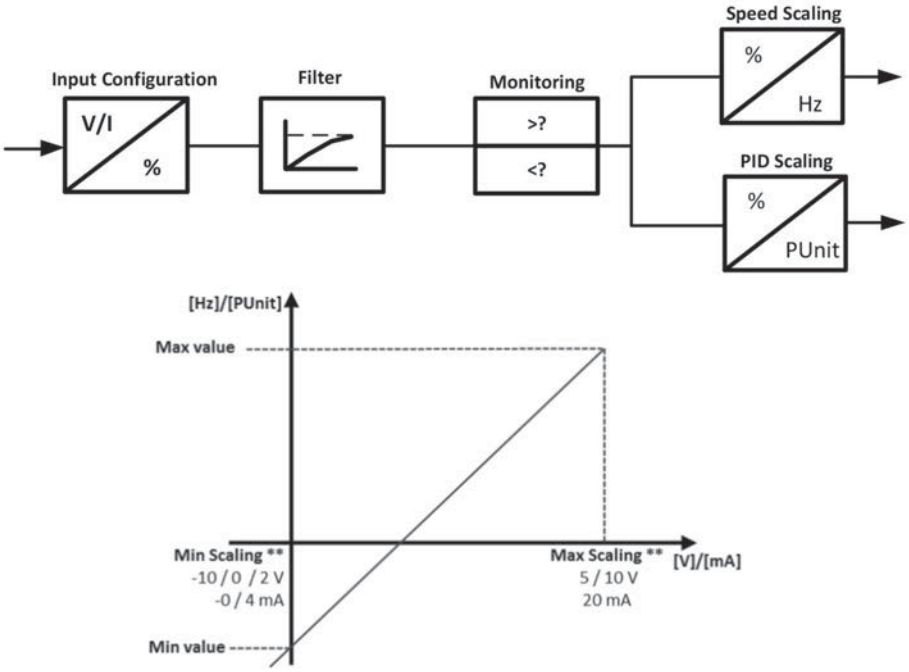
The digital outputs (Relay, DO) can be configured:
- Functionality can be selected
- Inversion of Output (Only Relay and DO)

P420:1	0x2634:1	Relay			
0: Not connected 1: Constant TRUE 11: Digital input 1 12: Digital input 2 13: Digital input 3 14: Digital input 4 15: Digital input 5 16: Digital input 6 (*) 17: Digital input 7 (*) 34: NETWordIN2 - bit 0 35: NETWordIN2 - bit 1 36: NETWordIN2 - bit 2 37: NETWordIN2 - bit 3 38: NETWordIN2 - bit 4 39: NETWordIN2 - bit 5 40: NETWordIN2 - bit 6 41: NETWordIN2 - bit 7 42: NETWordIN2 - bit 8 43: NETWordIN2 - bit 9		0: Not Connected / always false 1: TRUE always 11-17: TRUE when corresponding digital input is asserted 34-49: TRUE when selected bit of the NETWordIn is high. 50: TRUE when the VSD is running. FALSE when VSD is disabled, DC-Brake active, quick stopped and speed <0,2Hz, faulted or stopped. 51: TRUE when VSD not in Failure, Safety OK and DC link charged (SW 02.01) 52: TRUE when the VSD is enabled. 53: TRUE when VSD is enabled, output=0V, not running and not faulted 54: TRUE when quick stop is selected and active. 55: TRUE when Safe Torque OFF is active 56: TRUE when the VSD has a fault condition. 57: TRUE when the VSD has a fault condition that is locked and cannot be reset. 58: TRUE when a warning is present. 59: TRUE when a trouble condition is present. 60: TRUE when the heat sink temperature exceeds the warning level 65: TRUE when a PTC fault is detected. 66: TRUE when a flying start or a restart is active 67: TRUE when the DC brake is on.			

44: NETWordIN2 - bit 10 45: NETWordIN2 - bit 11 46: NETWordIN2 - bit 12 47: NETWordIN2 - bit 13 48: NETWordIN2 - bit 14 49: NETWordIN2 - bit 15 50: Running 51: Ready for operation 52: VSD enable 53: Stop active 54: Quick stop active 55: Safe Torque Off 56: Fault 57: Fault interlocking 58: Device warning 59: Device fault active 60: Heatsink temp. warn. active 65: PTC fault 66: Flying restart 67: DC brake active 69: Inverse rotation 70: Frequency thld exceeded 71: Actual speed = 0 72: Setpoint speed reached 73: PID feedback = setpoint 74: Sleep mode on 75: Minimum alarm 76: Maximum alarm 77: Minimum/Maximum alarm 78: At current limit 79: At torque limit 80: Follower signal loss 81: Error analog input 1 82: Error analog input 2 83: Loss of load 104: Local control active 105: Remote control active 106: Manual setpoint active 107: Automatic setpoint active 108: Parameter set 1 active 109: Parameter set 2 active 110: Parameter set 3 active 111: Parameter set 4 active 112: Parmeter set load OK 113: Parameter set load fail 114: Network control 115: Holding brake release		69: TRUE when output frequency is negative 70: TRUE when the output frequency is > the frequency threshold (P412:0) 71: TRUE when the output frequency is zero +/- 0.01Hz 72: TRUE when the VSD reaches the commanded setpoint and setpoint <> 0 Hz 73: TRUE when the PID feedback is equal to the programmed setpoint +/- 2% 74: TRUE when in Sleep mode 75: TRUE when a minimum alarm is triggered (reference to P608:1) 76: TRUE when a maximum alarm is triggered (reference to P608:2) 77: TRUE when no minimum/maximum alarm is active. (reference to P608:1 & P608:2) 78: TRUE when the actual motor current has exceeded the level in P324:0. 79: TRUE when the actual torque has exceeded the level in P326:0, 0x60E0:0 or 0x60E1:0. 80: TRUE when AI1 / AI2 are configured for 4…20 mA, the setpoint source is ac-tive and the signal falls below 2 mA. 81: TRUE when loss of the analog input 1 has been detected. P430:8-10 82: TRUE when loss of the analog input 2 has been detected. P431:8-10 83: TRUE when no load is detected 104: TRUE when local (LOC) mode is active (local keypad START control) 105: TRUE when remote (REM) mode is active (all control sources EXCEPT key-pad control) 106: TRUE when manual (MAN) mode is active (Keypad setpoint control) 107: TRUE when automatic (AUTO) mode is active (All setpoint sources other than Keypad) 108: TRUE when parameter set #1 is loaded and active. 109: TRUE when parameter set #1 is loaded and active. 110: TRUE when parameter set #1 is loaded and active. 111: TRUE when parameter set #1 is loaded and active. 112: TRUE after any parameter set 1…4 change-over has completed without error. 113: TRUE when any parameter set load fails. 114: TRUE when on AC Drive control word (P592:1) Bit 5 = TRUE (specifically for AC Drive profile) 115: TRUE when brake release signal is TRUE (either by auto trigger or manual trigger).			
P420:2	0x2634:2	Digital output 1			
115:Holding brake release (Reference see P420:1)		Function of Digital Output 1 (Reference list see P420:1)			
56:Fault (Reference see P420:1)		Function of Digital Output 2 (Reference list see P420:1) Note: Only with Application IO			
0: Not inverted 1: Inverted		Inversion of Relay Output			
0: Not inverted 1: Inverted		Inversion of Digital Output 1			
0: Not inverted 1: Inverted		Inversion of Digital Output 2 Note: Only with Application IO			

5.6.8 ANALOG INPUT SETTINGS

The VSD is equipped with two analog inputs. These can be configured as reference or feedback singal.
The following settings are available:
– Input configuration
– Input filter time / Input Dead time
– Input monitoring function
– Input scaling



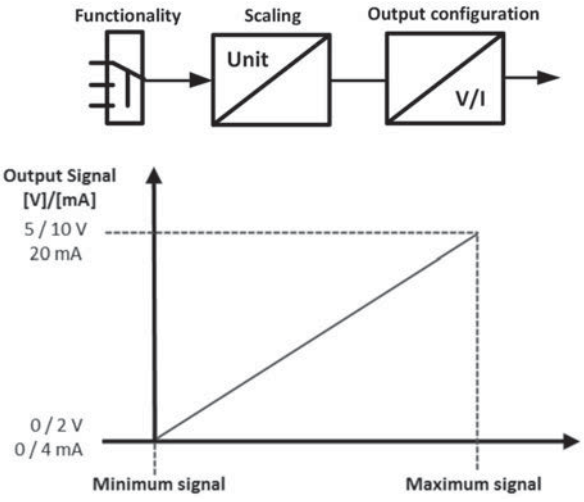
** Availability of scaling depending on type of control unit.

P430:1	0x2636:1	AI 1 configuration			
0: 0...10VDC 1: 0...5VDC 2: 2...10VDC 3: -10...+10VDC (*) 4: 4...20mA 5: 0...20mA		Configuration of Analog input signal 1 Note: On only current and unipolar voltage input available.			
P430:2	0x2636:2	Analog input 1: Min value [Hz]			
-1000.0 ... [0.0] ... 1000.0 Hz		Frequency scaling of the analog input Represents the minimum of the analog input value			
P430:3	0x2636:3	Analog input 1: Max value [Hz]			
-1000.0 ... [50.0] ... 1000.0 Hz		Frequency scaling of the analog input Represents the maximum of the analog input value			
P430:4	0x2636:4	Analog input 1: Min value [Punit/%]			
-300.00 ... [0.00] ... 300.00 PUnit/%		PID/Torque scaling of the analog input Represents the minimum of the analog input value			
P430:5	0x2636:5	Analog input 1: Max value [Punit/%]			
-300.00 ... [100.00] ... 300.00 PUnit/%		PID/Torque scaling of the analog input Represents the maximum of the analog input value			
P430:6	0x2636:6	Analog input 1: Filter time			
0 ... [10] ... 10000 ms		Analog input filter time constant			
P430:7	0x2636:7	Analog input 1: Deadband			
0.0 ... [0.0] ... 100.0 %		Configuration of the deadband such that any input value below this percentage will be treated as 0Hz. (In % of Max Input Value) Example: Deadband 10% of 50Hz: -10V … 10V Deadband -5Hz … 5 Hz 0 … 10V Deadband 0Hz … 5 Hz			
P430:8	0x2636:8	Analog input 1: Monitoring level			
-100.0 ... [0.0] ... 100.0 %		Monitoring condition of the analog input			
P430:9	0x2636:9	Analog input 1: Monitoring action			
0: Below level 1 1: Above level 1		Monitoring condition of the analog input			
P430:10	0x2636:10	Analog input 1: Error response			
3:Fault (Reference see P310:1)		Fault reaction of the analog input monitoring.			
P431:1	0x2637:1	AI2 configuration			
0: 0...10VDC 1: 0...5VDC 2: 2...10VDC 3: -10...+10VDC (*)VLB34: 4...20mA (*) 5: 0...20mA (*)		Configuration of analog input signal 2 Note: On only unipolar voltage input available.			

P431:2	0x2637:2	Analog input 2: Min value [Hz]			
-1000.0 ... [0.0] ... 1000.0 Hz		Frequency scaling of the analog input Represents the minimum of the analog input value			
P431:3	0x2637:3	Analog input 2: Max value [Hz]			
-1000.0 ... [50.0] ... 1000.0 Hz		Frequency scaling of the analog input Represents the maximum of the analog input value			
P431:4	0x2637:4	Analog input 2: Min value [Punit/%]			
-300.00 ... [0.00] ... 300.00 PUnit/%		PID/Torque scaling of the analog input Represents the minimum of the analog input value			
P431:5	0x2637:5	Analog input 2: Max value [Punit/%]			
-300.00 ... [100.00] ... 300.00 PUnit/%		PID/Torque scaling of the analog input Represents the maximum of the analog input value			
P431:6	0x2637:6	Analog input 2: Filter time			
0 ... [10] ... 10000 ms		Analog input filter time constant			
P431:7	0x2637:7	Analog input 2: Deadband			
0.0 ... [0.0] ... 100.0 %		Configuration of the deadband such that any input value below this percentage will be treated as 0Hz. (In % of Max Input Value) Example: Deadband 10% of 50Hz: -10V … 10V Deadband -5Hz … 5 Hz 0 … 10V Deadband 0Hz … 5 Hz			
P431:8	0x2637:8	Analog input 2: Monitoring level			
-100.0 ... [0.0] ... 100.0 %		Monitoring condition of the analog input			
P431:9	0x2637:9	Analog input 2: Monitoring action			
0: Below level 1 1: Above level 1		Monitoring condition of the analog input			
P431:10	0x2637:10	Analog input 2: Error response			
3:Fault (Reference see P310:1)		Fault reaction of the analog input monitoring.			

5.6.9 ANALOG OUTPUT SETTINGS

The analog output can be used to send a feedback signal to the control system (I. e. Motor current, Actual Frequency, …). Different functions and output configurations are available.



P440:1	0x2639:1	AO1 configuration			
0: Disabled 1: 0...10VDC 2: 0...5VDC 3: 2...10VDC 4: 4...20mA 5: 0...20mA		Configuration of Analog output signal 1			
P440:2	0x2639:2	Function			
0: Not connected 1: Output frequency 2: Frequency setpoint 3: Analog input 1 4: Analog input 2 5: Motor current 6: Actual power 20: NETWordIN3 21: NETWordIN4		Analog output function1 Scaling factors: 1: [0.1 Hz] 2: [0.1 Hz] 3: [0.1 %] 4: [0.1 %] 5: [0.1 A] 6: [0.001 kW] 20: [0.1 %] 21: [0.1 %]			
P440:3	0x2639:3	Minimum signal			
-- ... [0] ... --		Minimum scaling of the analog output 1 Setting x Scaling factor = Minimum analog output value: Example: Setting 10, 'Actual output frequency' Minimum analog output value = 10 x 0.1 Hz = 1Hz			
P440:4	0x2639:4	Maximum signal			
-- ... [1000] ... --		Maximum scaling of the analog Output 1 Setting x Scaling factor = Maximum analog output value: Example: Setting 500, 'Actual output frequency' Maximum analog output value = 500 x 0.1 Hz = 50Hz			

5.6.10 PRESET SETPOINTS (FREQUENCY, PID)

The VSD has 15 preset frequency setpoints, 8 preset PID setpoints. They can be selected in two ways:
– As default setpoint (Frequency: P201:1, PID: P201:2)
– Triggered by digital inputs (P400:18 – 400:21)
The Preset setpoint selection is done by a binary combination of bits triggering the Preset Setpoint Selection Functions. Combination Example: bit0 and bit2 result in Preset 6

See chapter 5.2.1 Setpoint structure / operation mode, page 41

P450:1	0x2911:1	Preset 1			
0.0 ... [20.0] ... 599.0 Hz		Preset frequency setpoint 1			
P450:2	0x2911:2	Preset 2			
0.0 ... [40.0] ... 599.0 Hz		Preset frequency setpoint 2			
P450:3	0x2911:3	Preset 3			
0.0 ... [Type code dependent] ... 599.0 Hz		Preset frequency setpoint 3			
P450:4	0x2911:4	Preset 4			
0.0 ... [0.0] ... 599.0 Hz		Preset frequency setpoint 4			
P450:5	0x2911:5	Preset 5			
0.0 ... [0.0] ... 599.0 Hz		Preset frequency setpoint 5 Note: Also used for Jog FWD			
P450:6 0x2911:6		Preset 6			
0.0 ... [0.0] ... 599.0 Hz		Preset frequency setpoint 6 Note: Also used for Jog REV			
P450:7	0x2911:7	Preset 7			
0.0 ... [0.0] ... 599.0 Hz		Preset frequency setpoint 7			
P450:8	0x2911:8	Preset 8			
0.0 ... [0.0] ... 599.0 Hz		Preset frequency setpoint 8			
P450:9	0x2911:9	Preset 9			
0.0 ... [0.0] ... 599.0 Hz		Preset frequency setpoint 9			
P450:10	0x2911:10	Preset 10			
0.0 ... [0.0] ... 599.0 Hz		Preset frequency setpoint 10			
P450:11	0x2911:11	Preset 11			
0.0 ... [0.0] ... 599.0 Hz		Preset frequency setpoint 11			
P450:12	0x2911:12	Preset 12			
0.0 ... [0.0] ... 599.0 Hz		Preset frequency setpoint 12			
P450:13	0x2911:13	Preset 13			
0.0 ... [0.0] ... 599.0 Hz		Preset frequency setpoint 13			
P450:14	0x2911:14	Preset 14			
0.0 ... [0.0] ... 599.0 Hz		Preset frequency setpoint 14			
P450:15	0x2911:15	Preset 15			
0.0 ... [0.0] ... 599.0 Hz		Preset frequency setpoint 15			
P451:1-8	0x4022:1-8	Process controller preset 1-8			
-300.00 ... [0.00] ... 300.00 PUnit		Preset PID setpoint 1-8			

5.7 GROUP 5 – FIELDBUS

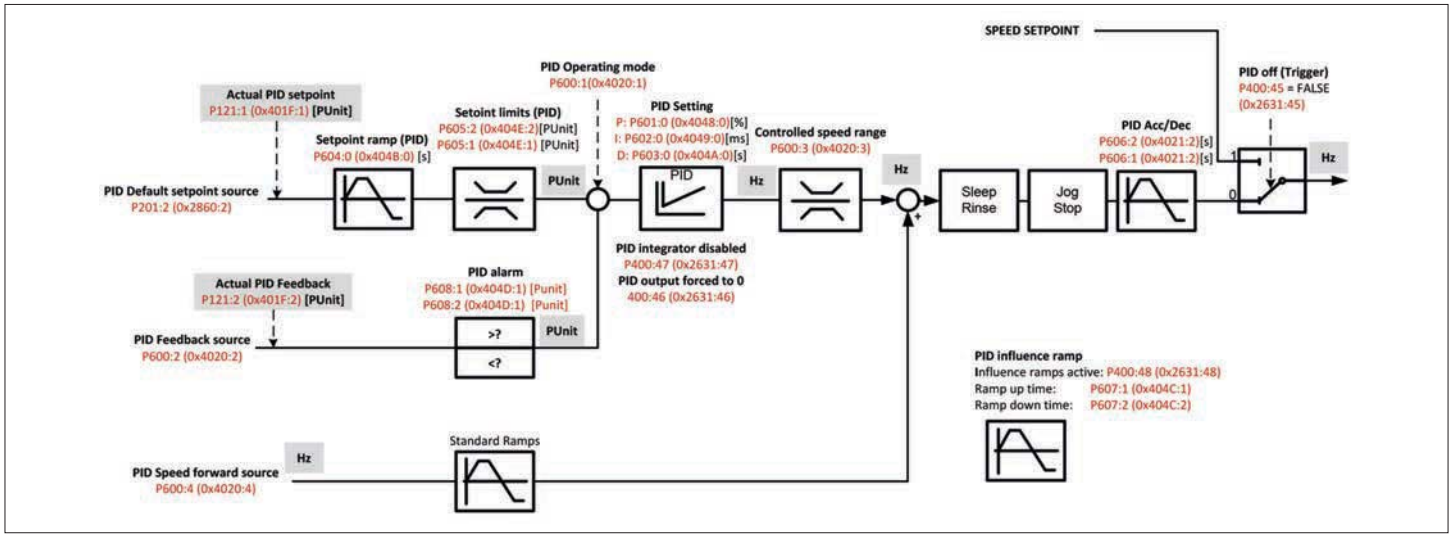
See chapter 6 Fieldbus on page 100

5.8 GROUP 6 – PID SETUP

To regulate the motor speed related to a process value the VSD has a PID controller integrated. This is a closed loop control.

Example:
Using an feedback signal (i.e. pressure transducer) the VSD can regulate the speed.

Setup procedure:
1. Select the correct PID Operating mode (P600:1)
2. Select the PID feedback source (P600:2) and setup the analog input accordingly
3. Select the PID default setpoint source (P201:2)
4. Set the PID speed range (P600:3) to a proper value
5. Test and tune your PID control
   (Start with default settings first)
6. Set additional functions (if needed)
   Setpoint ramp time, PID ramp time, Min/Max Alarm, line speed, influence function.



5.8.1 PID SETUP

P600:1	0x4020:1	Operating mode
0: Disabled 1: Normal operation 2: Reverse operation 3: Normal bi-drectional 4: Reverse bi-directional		PID Operating mode 0: Disabled: PID is disabled 1: Normal operation Direct acting system. Motor needs to increase the speed to increase the feedback signal. Example: Booster pump regulated by Pressure. (Increase of Motor speed results in an increase of the pressure) Motor can turn only in one direction 2: Reverse operation Motor needs to increase the speed to decrease the feedback signal. Example: Cooling water pump regulated by temperature. (Increase of the cooling pump speed results in a decrease of the temperature.) Motor can run only in one direction 3: Normal bi-directional Normal acting mode. Motor can run in both directions. 4: Reverse bi-directional Reverse acting mode. Motor can run in both directions.
P600:2	0x4020:2	Feedback source
1: Analog input 1 2: Analog input 2 3: DC Bus voltage 4: Motor Current 5: Network		Selection of the PID feedback source Note: The PID set point and PID Feedback can be different signals!
P600:3	0x4020:3	Controlled speed range
0 ... [100] ... 100 %		Defines the % of the VSD output frequency that PID will regulate to. Example: P211:0 Max frequency = 50 Hz P600:3 PID Controlled sped range = 80 % --> Max calculated PID setpoint 40 Hz

P600:4	0x4020:4	Speed feedforward source			
0: No Speed Added 1: Keypad frequency setpoint 2: Analog input 1 3: Analog input 2 4: Preset frequency setpoint 1 5: Preset frequency setpoint 2 6: Preset frequency setpoint 3 7: Preset frequency setpoint 4 8: Network		Selection of Speed feedforward source PID speed output = Speed feedforward source + PID controlled speed (Used for Trim control, Dancer control). The line speed (feed-forward) value is added to the calculated PID output frequency value (see PID block diagram above).			
P601:0	0x4048:0	P component gain			
0.0 ... [5.0] ... 1000.0 %		PID controller P gain % of max Frequency that results from a 1% PID Error Example: PID Error = 20 PUnits P601:0 P component gain = 2% P211:0 Maximum frequency = 50Hz --> PID Output = PID Error * P Gain * (Maximum frequency / 100) --> PID Output = 10 Hz			
P602:0	0x4049:0	I component reset time			
20 ... [400] ... 6000 ms		PID controller adjustment time Tn - Value "6000 ms" deactivates the I component. - With P400:47 the I Part can be disabled			
P603:0	0x404A:0	D component gain			
0.0 ... [0.0] ... 20.0 s		PID controller D gain % of max Frequency that results from of 1%/s change of the PID Error			
P604:0	0x404B:0	Setpoint ramp (PID)			
0.0 ... [20.0] ... 100.0 s		PID Setpoint ramp up/down time (Time from Analog Min to Analog Max)			

5.8.2 PID TRIGGERS

P400:45	0x2631:45	Process controller off			
0:Not connected (Reference see P400:1)		Switch off PID controller by external trigger State: TRUE: VSD switched to velocity mode. FALSE: PID control is determined by P600:1 PID Operating mode			
P400:46	0x2631:46	PID output forced to 0			
0:Not connected (Reference see P400:1)		Switch off PID controller output to zero State: TRUE: The output of the PID controller is forced to 0. FALSE: No action			
P400:47	0x2631:47	PID integrator disabled			
0:Not connected (Reference see P400:1)		Disable PID Integrator by external Trigger			

5.8.3 PID SETPOINT LIMITS

P605:1	0x404E:1	Minimum setpoint			
-300.00 ... [-300.00] ... 300.00 PUnit		Minimum limitation of the PID setpoint			
P605:2	0x404E:2	Maximum setpoint			
-300.00 ... [300.00] ... 300.00 PUnit		Maximum limitation of the PID setpoint			

5.8.4 PID ACCELERATION / DECELERATION

P606:1	0x4021:1	Acceleration time			
0.0 ... [1.0] ... 3600.0 s		PID output Acceleration time (Time from 0 to Maximum frequency)			
P606:2	0x4021:2	Deceleration time			
0.0 ... [1.0] ... 3600.0 s		PID output Deceleration time (Time from Maximum frequency)			

5.8.5 PID INFLUENCE

The Influence of the PID can be ramped up / down with a external Trigger.
Example usage: winding application.

P400:48	0x2631:48	PID influence ramps active			
1:Constant TRUE (Reference see P400:1)		Activates PID influence ramp by external Trigger States: TRUE: Influence ramp time have no effect on PID Transition states: FALSE --> TRUE: Ramping up PID according P607:1 TRUE --> FALSE: Ramping down PID according P607:2			
P607:1	0x404C:1	Ramp up time			
0.0 ... [5.0] ... 999.9 s		Ramp up time during switch ON of influencing (P400:48 PID influence ramps active) (Time from 0 to Maximum frequency)			
P607:2	0x404C:2	Ramp Down Time			
0.0 ... [5.0] ... 999.9 s		Ramp down time during switch OFF of influencing (P400:48 PID influence ramps active) (Time from Maximum frequency to 0)			

5.8.6 PID ALARMS

P608:1	0x404D:1	MIN alarm threshold			
-300.00 ... [0.00] ... 300.00 PUnit		Minimum alarm of PID feedback signal If PID feedback signal is lower than Min alarm level the signal is activated. Signal can be used to switch Digital Output / Relays / Network Output (Selection 75-77)			
P608:2	0x404D:2	MAX alarm threshold			
-300.00 ... [100.00] ... 300.00 PUnit		Maximum alarm of PID feedback signal If PID feedback signal is high than Min alarm level the signal is activated. Signal can be used to switch Digital Output / Relays / Network Output (Selection 75-77)			

5.8.7 PID SLEEP/RINSE FUNCTION

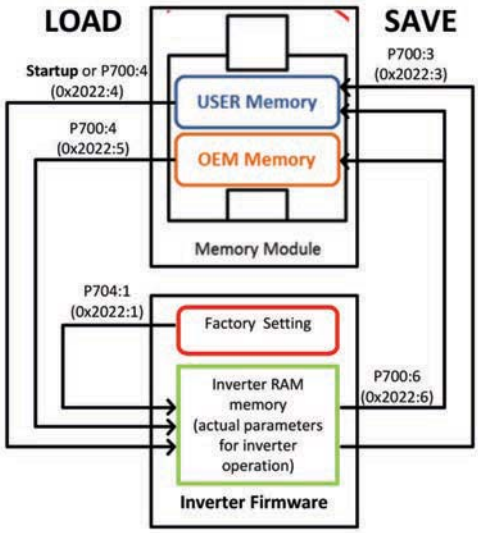
The PID has an integrated sleep & rinse function.
- Sleep function: Stop PID if there is no demand from the process
- Rinse function: Start the VSD periodically during sleep mode to prevent accumulation of deposits in the piping or the pump system.

➔ See VLB3SW01 software for setup and more information.

5.9 GROUP 7 – AUXILIARY FUNCTIONS

5.9.1 DEVICE FUNCTIONS (FACTORY RESET, LOAD/STORE PARAMETER)

To regulate the motor speed related to a process value the VSD has a PID controller integrated. This is a closed loop control.



P700:1	0x2022:1	Load factory setting			
0: Off / ready 1: On / start 2: In process 3: Action cancelled 4: No access 5: No access / disabled		All parameters are reset to the factory setting optimized for 50Hz or 60Hz line frequency. Line frequency is selected by type key of device. 1: On / start Start the reset to factory function 0, 2, 3, 4, 5: Status of the reset to factory function Note: possible when the VSD is inhibited.			
P700:3	0x2022:3	Save data into EPM			
0: Off / ready (Reference see P700:1)		Saves RAM values to the USER section of the EPM.			
P700:4	0x2022:4	Load data from EPM			
0: Off / ready (Reference see P700:1)		Reload USER parameters from EPM to the RAM.			
P700:5	0x2022:5	Load OEM data from EPM			
0: Off / ready (Reference see P700:1)		Reload OEM parameters from EPM to the RAM.			
P700:6	0x2022:6	Save OEM data to EPM			
0: Off / ready (Reference see P700:1)		Saves RAM values to the OEM section of the EPM.			

5.9.2 KEYPAD SETUP

P701:0	0x2862:0	Keypad setpoints			
1 ... [1] ... 100		Defines the setpoint increment by pressing UP/DOWN buttons on the keypad. (Scaling: Frequency = 0.1, PID = 0,01)			
P702:0	0x4002:0	Speed display scaling			
0.00 ... [0.00] ... 650.00		User unit can be shown on the keypad during running of hte motor. (Example: Calculated speed after gearbox) The scaling factor P702:0 defines the user unit: User unit = "Actual frequency" x P702:0 The scaled user unit is also shown in P101:0 (0x400D:0) Note: 0: Function disabled In PID mode the user unit has to be selected setting P703:0 to the scaled user unit (Set P703:0 = 0x400D0000)			
P703:0	0x2864:0	Keypad display			
0x0 ... [0x0] ... 0xFFFFFF00		The parameter which is show on the keypad during running of the motor can be configured. Format: 0xiiiiss00 (iiii = Index heximal, ss=subindex) Note: 0: Function disabled Only parameters from group 1 can be selected.			
P705:0	0x2863:0	Keypad language selection			
0: No Language 1: English 2: German Selects the language of the Keypad					

5.9.3 DC BRAKE SETUP

DC Braking creates a braking torque by injecting DC current into the motor. This is useful to aid in decelerating a load that would otherwise take a long time due to inertia. It is also useful to lock the motor rotor either before starting or upon stopping.

The DC-Brake can be used as follow:

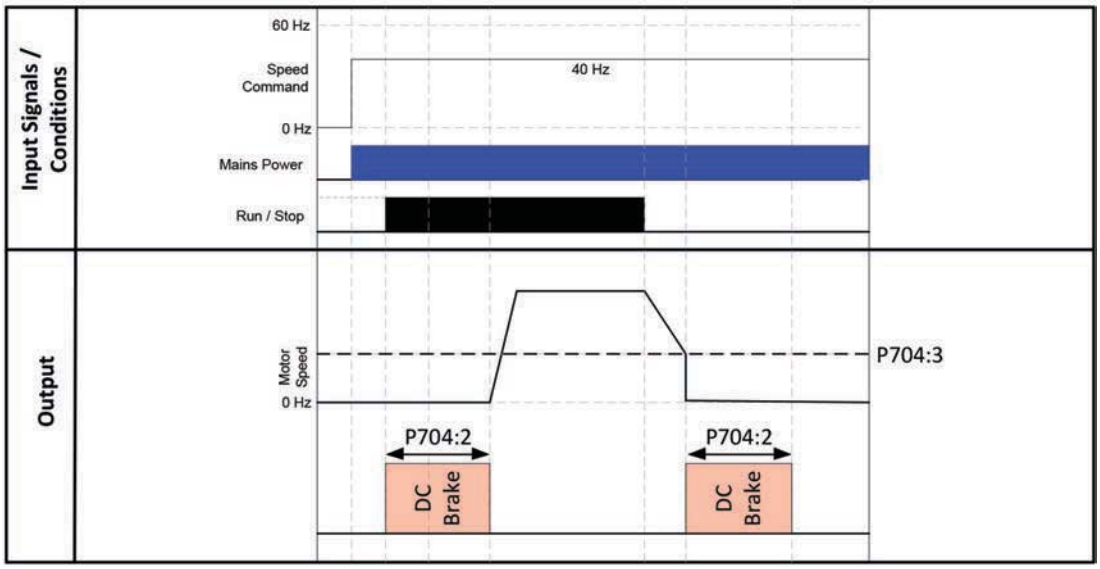
1. Starting of the motor
DC-Brake can be selected as starting method in P203:1. At the starting of the motor the DC-Brake with the value of P704:1 is applied for the time defined in P704:2. After that the speed is ramped up.

2. Stopping of the motor
If during stopping the motor frequency goes below the level P704:3 the VSD stops the speed deceleration and applies the DC Brake with the value of P704:1 is applied for the time defined in P704:2.

3. Manually triggered (I.e. Digital IO)
The Trigger P400:5 activates the DC brake manually.

Note: The DC brake is ON as long as the function is triggered!

NOTICE!
Motor failure or damage
During DC-Brake the motor heats up.
► DC Braking should only be used in applications where the load is stopped infrequently and should only be applied for the minimum time required possible.



P400:5	0x2631:5	DC brake			
0:Not connected (Reference see P400:1)		Manual DC Brake activation signal Level: TRUE: DC brake will be active. FALSE: DC brake will be deactivated.			
P704:1	0x2B84:1	Current			
0.0 ... [0.0] ... 200.0 %	DC	Brake current as of % of motor rated current			
P704:2	0x2B84:2	Auto hold time			
0.0 ... [0.0] ... 999.9 s		DC Brake time			
P704:3	0x2B84:3	Auto enable threshold			
0.0 ... [0.0] ... 599.0 Hz		Frequency Threshold to apply the DC Brake during deceleration of motor.			

5.9.4 REGENERATIVE ENERGY MANAGEMENT

0: Brake resistor

If the threshold voltage is exceeded the braking resistor is energized.

1: Deceleration override

The motor will stop decelerating momentarily if the threshold voltage threshold is exceeded. (Maximum 4 s).

2: Resistor and deceleration override

Combination of brake resistor and deceleration override.

3: Compound and deceleration override

Combination of compound brake and deceleration override.

The compound is an alternative where the VSD will superimpose a temporary increase to the speed setpoint to force the drive to cycle between decelerating and accelerating to maintain control of the DC Bus. Compound braking will cause the regenerative energy to be bled off of the motor in the form of heat. This results in the motor temperature rising and must be used with care to not shorten the life of the motor.

4: Resistor/compound/override

Combination of brake resistor compound brake and deceleration override.

NOTICE!

Brake resistor failure

A wrong dimensioned brake resistor can lead to a component failure.

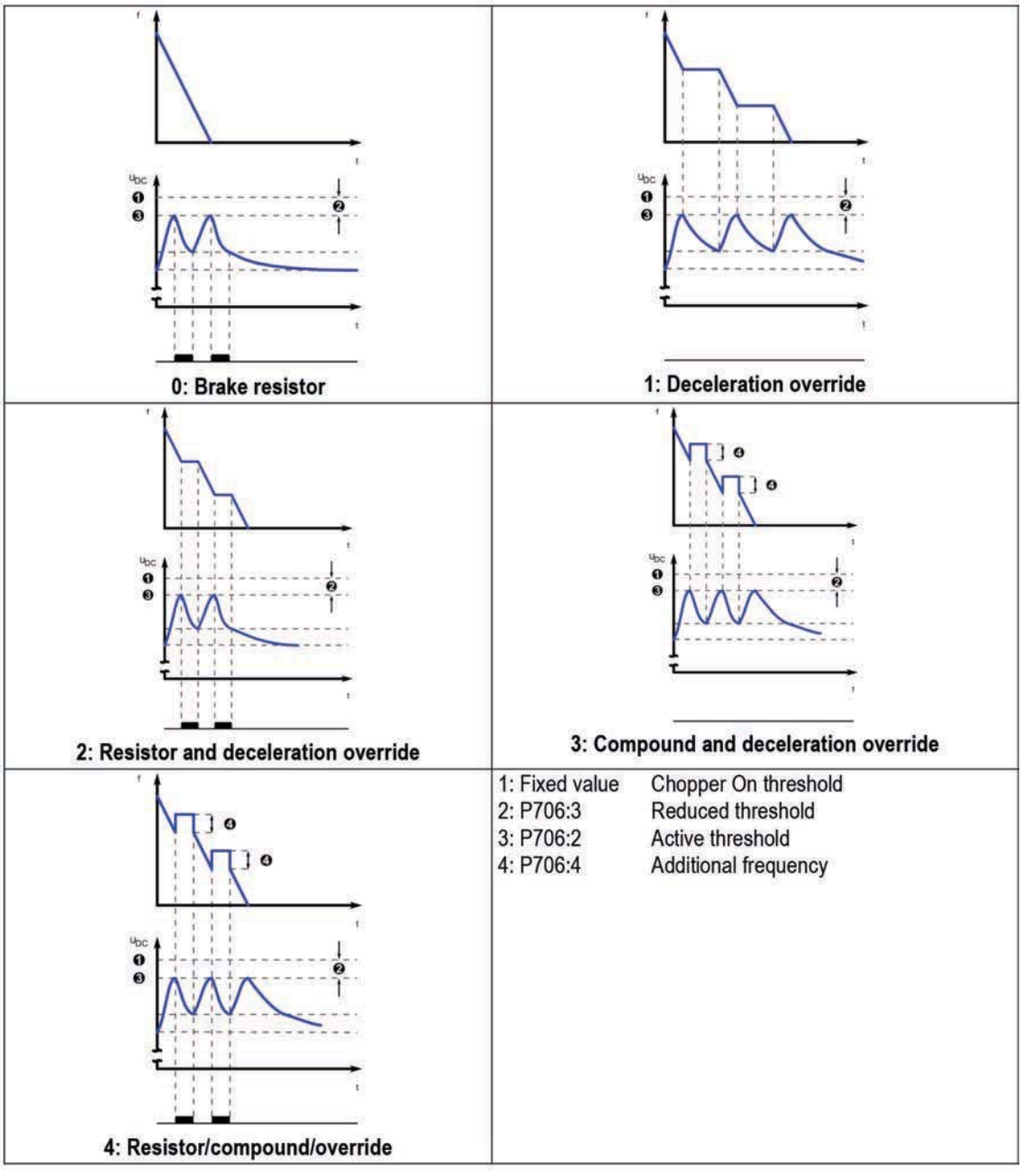
- ► Use the brake resistor specified for the VSD.
- ► Avoid thermal overload of the brake resistor
- ► Set the correct parameter for the braking resistor

NOTICE!

Thermal overload of the motor

During compound braking the motor overload monitoring (I2xt)is not adapted. If the braking too frequently, there is a risk of the motor being thermally overloaded.

- ► Avoid long braking times using the compound braking.
- ► The Compound Braking function must not be used with vertical conveyors (hoists) or with active loads!



P706:1	0x2541:1	Operating mode			
0: Brake resistor (*) 1: Deceleration override 2: Resistor and decel. override (*) 3: Comp. and decel.override 4: Resistor/comp/override (*)		Selection of braking mode			
P706:2	0x2541:2	Active threshold			
-- ... [Actual value] ... -- V		DC link voltage threshold at which the braking is activated. The threshold depends on the selected "Rated mains voltage" and parameter "Reduced threshold" (P706:3)			
P706:3	0x2541:3	Reduced threshold			
0 ... [0] ... 100 V		The activation of the braking method is reduced by this parameter			
P706:4	0x2541:4	Additional frequency			
0.0 ... [0.0] ... 10.0 Hz		Additional Frequency for deceleration compound braking mode			
P706:5	0x2541:5	Deceleration override time			
0.0 ... [2.0] ... 60.0 s		Maximum time in deceleration override braking mode. If the DC-Voltage doesn't fall below in the defined time the VSD goes to fault state			
P706:6	0x2541:6	Brake resistor response			
0: Off: VSD disable / Error 1: On: Disable/Off: Error 2: Off: Disable / On: Error 3: On: Disable / Error		Defines the behavior of the braking chopper in case of state Inhibit and Error (Used for VSDs connected over DC-Link)			
P707:2	0x2550:2	Resistance value			
0.0 ... [Type Code dependent] ... 500.0 Ohm		Setup brake resistor Set the nominal resistance of the brake resistor			
P707:3	0x2550:3	Rated power			
0 ... [Type Code dependent] ... 800000 W		Setup brake resistor Set the rated power of the brake resistor			
P707:4	0x2550:4	Maximum thermal load			
0.0 ... [Type Code dependent] ... 100000.0 kWs		Setup brake resistor Set the maximal thermal load of the brake resistor			
P707:7	0x2550:7	Thermal load			
-- ... [Actual value] ... -- %		Actual thermal load of the braking resistor			
P707:8	0x2550:8	Warning level			
50.0 ... [90.0] ... 150.0 %		If the actual thermal load of the braking resistor exceeds the defined level, the reaction in P707:10 is executed			
P707:9	0x2550:9	Error threshold			
50.0 ... [100.0] ... 150.0 %		If the actual thermal load of the braking resistor exceeds the defined level, the reaction in P707:11 is executed			
P707:10	0x2550:10	Response to warning			
1:Warning (Reference see P310:1)		Configuration of the brake resistor warning reaction			
P707:11	0x2550:11	Response to error			
3:Fault (Reference see P310:1)		Configuration of the brake resistor error reaction			

5.9.5 LOSS OF LOAD DETECTION

A loss of load can be detected and function can be triggered (Example: Relay).

➔ See VLB3SW01 software for setup and more information.

5.9.6 MOTOR BRAKE CONTROL

The VLB3 has an integrated function to control a mechanical brake.

➔ See VLB3SW01 software for setup and more information.

5.9.7 ACCESS PROTECTION

The write access to the parameter set can be fully or partially protected. Read access can't be prohibited. For that PIN1 and PIN2 are available.

Enable access protection:
By setting a PIN (1-9999) the access protection is automatically set as follow:

Power ON Login with PIN1	→ →	Favorites only Full write access
Power ON Login with PIN2	→ →	No write access Full write access
Power ON Login with PIN1 Login with PIN2	→ → →	No write access Favorites only Full write access

Login (Keypad)
The PIN is automatically requested if you enter the menu.

Logout (Keypad)
Go out of the menu is logging you out automatically.

Disable access protection:
1. Login
2. Set the corresponding PIN parameter back to 0 disables the access protection

P730:0	0x203D:0	Access protection PIN1			
-1 ... [0] ... 9999		Configure PIN1 for access protection Setting PIN to 1-9999 enables the access protection Setting PIN to 0 disables the access protection			
P731:0	0x203E:0	Access protection PIN2			
-1 ... [0] ... 9999		Configure PIN2 for access protection Setting PIN to 1-9999 enables the access protection Setting PIN to 0 disables the access protection			

ⓘ NOTICE!
The Behavior from the keypad and PC tool are the same. If the PIN1/PIN2 is lost the only way to unlock the device is to reset the device back to factory settings with the SW-tool.

5.9.8 FAVORITES SETUP

The favorites menu can be freely configured.

➔ See VLB3SW01 software for setup and more information.

5.9.9 MULTIPLE PARAMETER SET SETUP

The VSD can switch between 4 sets of 32 parameters. The 32 parameters can be freely configured.

➔ See VLB3SW01 software for setup and more information.

ENABLE NETWORK
In order to control the drive from the network the 0x2631:37 (P400:37) Network enable needs to be set (Either setting “TRUE” or mapping to a digital input to trigger signal). Once it is asserted the drive enters the network control mode.

i It is important to note that in network control mode the following functions still are active:
- VSD Enable 0x2361:1 (P400:1)
- Run/Stop 0x2361:1 (P400:2)
- Quick Stop 0x2361:3 (P400:3)
- Reset fault 0x2361:4 (P400:4)
- DC Brake 0x2361:5 (P400:5)
- Jog forward (CW) 0x2361:10 (P400:10)
- Jog reverse (CCW) 0x2361:11 (P400:11)

All other function triggers 0x2361:6-25 (P400:6-25) are not active while the drive is in the network control mode.
To select the network as setpoint source in network mode use the “Default setpoint source” (P201:1-2) or the corresponding control bits (AC Drive Control Word, C135 Control Word, NETWordIN1).

P400:37	0x2631:37	Network enable			
0: Not connected 114: Netw.Ctrl activ (Other Reference see P400:1)		Enables the network for control 114: TRUE if AC Drive Control Control Word (0x400B:1) bit 5 is active State: TRUE: Network is enabled FALSE: Network is disabled Note: If Network is enabled (Network enable 0x2361:37, P400:37 is HIGH) it is not mandatory that VSD enable (0x2361:1, P410:1) or Run/Stop (0x2361:2, P410:2) are assigned to a digital input (DI1-7). They can be set to [1] Constant TRUE to Enable and Run the VSD without using digital inputs (DI1-7).			

Several command words, status and setpoint are available to control the drive from remote:
- CIA402 (Predefined mapping) Used for EtherCAT/CAN
- Drive profile (Predefined mapping) Used for EtherNet/IP
- LOVATO Electric (Predefined mapping)
- Netword IN/Out (Configurable mapping)

➔ See chapter 7 Drive Profile on page 108 for details.

6.1 CANOPEN QUICK START

The Can communicates with the drive over the COB-IDs. This COB-IDs access the RPDO and TPDO Registers which are mapped to the parameter registers.

➔ Detailed information about dip-switch settings for Node address, baud rate, and network termination are described in the VLB3 installation manual.

1. Register the eds file into your CANOpen master’s configuration software
2. Set an individual Node address:
   : Parameter setting P510:1 (0x2301:1)
   VLB3: Dip-Switches or Parameter setting P510:1 (0x2301:1)
3. Set the baud rate
   : Parameter setting P510:2 (0x2301:2)
   VLB3: Dip-Switches or Parameter setting P510:2 (0x2301:2)
4. Setup network termination and both network ends (Resistor)
   : Install external 120 Ohm ¼ W Resistor
   VLB3: Dip-Switches setting
5. CANOpen Slave / Mini-Master
   The CANOpen enter a Preopreational state upon but-up. The CANOpen master send a NMT message to wake the drive up and the CANOpen goes to Operational state. The VLB3 can be configured as CANOpen Slave or Mini-Master. A "mini-master" will boot in an "operational" state and after the delay time programmed in 0x2301:4 (P510.4) will send out the NMT message to set all slaves on the network to the "operational" state.
6. Watchdog
   Per Default the watchdog is enabled with P540:5 (0x1400:5) setting 100ms. (Setting 0 disables the watchdog)
   For a safe operation it is highly recommended to have the watchdog enabled!
7. Save the parameters (Set P700:3, 0x2022:3=1) and power cycle the drive completely that the configuration takes effect.
8. For network control the following setup needs to be done:
   (This can also be done with SDO messages)
   – For network control the P400:37 (0x2631:37) “Network enable” need to be set.
   – Set P201:1 (0x2860:1) “Default frequency setpoint” to the network
9. Change the mapping as followed:
   Controller to the drive:

COB ID	Register	Accessed Parameter
0x200+nodeID	RPDO1, Entry 1	0x4008:1 NetWordIN1
0x200+nodeID	RPDO1, Entry 2	0x400B:3 Network Speed Setpoint [0.1 Hz]

Drive to the Controller

COB ID	Register	Accessed Parameter
0x180+nodeID	TPDO1, Entry 1	0x400A:1 NetWordOut1
0x180+nodeID	TPDO1, Entry 2	0x400C:3 Network Speed Actual [0.1 Hz]

i The mapping can be easily done with a guided screen in VLB3SW01 software (Version ≥ V1.9)
If the mapping is down over the master PLC the procedure under point 10-11 needs to be followed.

10. RPDO1 Mapping (Used to command the drive)
RPDO1 must first have it's COB ID set and have the PDO unlocked so that it's mapping can be changed.
To do so you must set bit 31 in 0x1400:1. This will unlock the PDO for editing (makes the PDO invalid).

RPDO1 Default COB ID: 0x200+the node ID (hex)

Example:
Node ID is 10 (0xA) mapping of RPDO1 should be changed

1. Unlock the mapping:
COB ID = 0x200+A. Setting Bit 31
Set 0x1400:1 to 0x8000020A
2. Set the number of mapped subindexes for RPDO1 = 0. This allows the default data mapping of the PDO to be changed.
Set 0x1600:0 = 0
3. Set the data mapping for the first two bytes of RPDO1 to NetWordIN1:
Set 0x1600:1 = 0x40080110.
4. Set the mapping of byte 3 and of RPDO1 to Network Speed Setpoint [0.1 Hz]
Set 0x1600:2 =0x400B0310.
The second word of RPDO1 will now be the drive's speed command in 0.1 Hz (i.e. 412=41.2Hz, absolute value)
5. Set the number of mapped subindexes for RPDO1 = 2
Set 0x1600:0 = 2
6. Set the timeout for RPDO1 monitoring value in milliseconds
Set 0x1400:5 = msec, Fault reaction set in 0x2857:1
7. Lock mapping
Bit31 of 0x1400:1 must be set back to 0. Write the COB ID back to 0x1400:1
COB ID = 0x200+A (If required the COB ID can be set here individually)
Set 0x1400:1 to 0x20A
11. TPDO1 Mapping (used to get status from the drive)
TPDO1 must first have it's COB ID set and have the PDO unlocked so that it's mapping may be changed.
To do so you must set bit 31 in 0x1800:1. This will unlock the PDO for editing (makes the PDO invalid).

TPDO1 Default COB ID: 0x180+the node ID (hex)
(Note: Bit 30=Remote Frame OFF should be always set → 0x40000180)

Example:
Node ID is 10 (0xA) mapping of TPDO1 should be changed
1. Unlock the mapping:
COB ID = 0x40000180+A. Setting Bit 31
Writing 0xC000018A to 0x1800:1
2. Set the number of mapped subindexes for RPDO1 = 0. This allows the default data mapping of the PDO to be changed
Set 0x1A00:0 = 0
3. Set the data mapping for the first two bytes of TPDO1 to NetWordOut1:
Set 0x1A00:1 = 0x400A0110
4. Set the mapping of byte 3 of TPDO1 to Network Speed Actual [0.1 Hz]
Set 0x1A00:2 =0x400C0310
5. Set the number of mapped subindexes for TPDO1 = 2
Set 0x1A00:0 = 2
6. By default TPDO will transmit on event (0x1800:2 = 255). The event timer is default 20msec (0x1800:5 = 20) TPDO1 will be transmitted every 20msec.
7. Lock mapping
Bit31 of 0x1800:1 must be set back to 0. Write the COB ID back to 0x1800:1
COB ID = 0x40000180+A (If required the COB ID can be set here individually)
Set 0x1800:1 to 0x4000018A
12. Controlling the VSD:
– With the default IO-setting DI1 need to be asserted (Run/Stop).
– Set Bit 4 of NetWordIN1 to start the drive

Default setting of NetWordIN1 / NetWordOUT1 (SW 02.01)

Control word (NetWordIN1)	
Bits	Function
0	Not connected
1	Not connected
2	Quick Stop
3	Not connected
4	Run forward (CW)
5	Preset bit0 selection
6	Preset bit1 selection
7	Reset Fault
8	Not connected
9	DC brake
10	Not connected
11	Not connected
12	Invert rotation
13	Not connected
14	Not connected
15	Not connected

Status word (NetWordOUT1)	
Bits	Function
0	Ready for operation
1	Not connected
2	VSD enable
3	Fault
4	Not connected
5	Quick stop active
6	Running
7	Device warning
8	Not connected
9	Not connected
10	Setpoint speed reached
11	At current limit
12	Actual speed = 0
13	Invert rotation
14	Holding brake release
15	Safe Torque Off

6.2 MODBUS QUICK START

1. General Information about Modbus.
   The Can communicates with the drive over the Modbus-Register Numbers. This Number access the parameter registers.
   The supports the following function codes:
   – 3 (Read Holding Registers)
   – 6 (Preset Single Register)
   – 16 (10hex - Preset Multiple Registers)
   – 23 - (17hex - Read/Write 4X registers)

i All data in the drives is only accessible via Modbus as 4X holding registers.
In Modbus the function code used defines what the leading character in the Modbus address (so the leading 4 is not transmitted in the message).
It is important to note that the manufacturer complies with base 1 addressing of Modbus. So there is a 1 offset in the address transmitted to the address requested (i.e. 0000 would be register 40001, 0001 would be 40002, 0002 would be 40003, etc.).

i By default important Parameters are already mapped to Modbus Registers.

Modbus Control Parameters

Modbus Register No	Index	Description
42101	0x400B:1	Drive Command Word (AC Drive Control Word)
42102	0x400B:5	Network Frequency Setpoint ABS[0.01Hz]
42103	0x4008:2	NetWordIN2 (trigger for Digital / Relay Output)
42104	0x4008:3	NetWordIN3 (Analog output source)
42105	0x2DA7:0	Network PID Setpoint
42106	0x6071:0	Target Torque
42107	0x4008:1	NetWordIN1 (triggers for functions in PAR0400)
42108	0x4008:4	NetWordIN4(Analog output source)
42109 - 42121		Reserved

Modbus Drive Status Parameters (Read Only)

Modbus Register No	Index	Description
42001	0x400C:1	Drive Status Word (See bit details below)
42002	0x400C:6	Actual Frequency ABS [0.01Hz]
42003	0x603F:0	Error Code
42004	0x400C:0	Drive State
42005	0x2D89:0	Motor Voltage
42006	0x2D88:0	Motor Current
42007	0x6078:0	Motor Load
42008	0x2DA2:2	Effective power output [HIGH WORD]
42009		Effective power output [LOW WORD]
42010	0x2D84:1	Heatsink Temperature (Actual Value)
42011	0x2D87:0	DC Bus Voltage
42012	0x60FD:0 (Upper 16 bits only! – bits 16..31)	Digital Inputs
42013	0x6077:0	Torque Actual Value
42014 - 42021		Reserved

➔ Detailed information about dip-switch settings for Node address, baud rate, data format and network termination are described in the VLB3 installation manual.

2. Set an individual Node address
   Default Adress 1
   Parameter setting (P510:1, 0x2321:1)
   VLB3: Dip-Switches or Parameter setting (P510:1, 0x2321:1)
3. Set the baud rate:
   Default: Auto Detect. First 5 – 10 messages will be lost!
   Parameter setting (P510:2, 0x2321:2)
   VLB3: Dip-Switch b=0 AutoDetect
   Dip-Switch b=1 Parameter setting (P510:2, 0x2321:2)
4. Set the data Format:
   Default: Auto Detect. First 5 – 10 messages will be lost!
   Parameter setting (P510.3, 0x2321:3)
   VLB3: Dip-Switch a=0 AutoDetect
   Dip-Switch a=1 Parameter setting (P510.3, 0x2321:3)
5. Setup network termination and both network ends (Resistor)
   Install external 120 Ohm ¼ W Resistor
   VLB3: Dip-Switches setting
6. Save the parameter with P700:3 (0x2022:3) and power cycle the drive completely that the configuration takes effect.
7. For network control the following setup needs to be done:
   – For network control the P400:37 (0x2631:37) “Network enable” need to be set.
   – Set P201:1 (0x2860:1) “Default frequency setpoint” to the network

i Per default the watchdog timeout response for the communication is set to fault (P515.1, 0x2858:1).

8. With the default IO-setting DI1 need to be asserted (Run/Stop).
9. Controlling the VSD:
   Set the following bits on register 42101 (Drive control word) with function code 0x06 or 0x10 to start:
   0x61 (Bit0 - Run Forward, Bit5 - Network Control, Bit6-Network Setpoint)
10. Set speed setpoint:
    Set register 42102 (Network Frequency Setpoint ABS[0.01Hz]) with the setpoint with function code 0x06
    Example: 1234 = 12.34 Hz

6.3 PROFIBUS QUICK START

➔ Detailed information about network setup and dip-switch settings for Node address are described in the VLB3 installation manual.

1. Set an individual node address:
   VLB3: Dip-Switches or Parameter setting P510:1 (0x2341.1)
   The active node address will be displayed in P511:1 (0x2342.1)
2. Save the parameters (P700:3, 0x2022:3) and power cycle the drive completely that the configuration takes effect.
3. Configuration of the host:
   Read the device description file (GSD) into the Profibus master.

i The user data length is defined during the initialization phase of the master. The VLB3 support the configuration of a maximum of 16 process data words (max 32 bytes) in each direction.

4. Process data configuration
   The process data configuration must be configured in the Profibus master configuration tool.
   The default configuration in the VLB3 GSD-file is:

PLC to Drive:
Control word (NetWordIN1) P590:1 (0x4008:1)
Network frequency setpoint 0.01Hz P592:5 (0x400B:5)
16Bit selectable OUT-Data

Drive to PLC:
Status word (NetWordOUT1) P591:1 (0x400A:1)
Actual Speed [0.01 Hz] P593:6 (0x400C:6)
Actual motor current [0.1A] P104 (0x2D88)

Steckplatz	DP-Kunnung	Bestellnummer / Bezeichnung	E-Adresse	A-Adresse
1	132	L-Controlword 0x4008:01		254...265
2	131	Net freq. 0.01Hz 0x400B:05		266...267
3	129	16Bit selecteble OUT-Data		268...269
4	68	L-Statusworld 0x400A:01	264...265	
5	67	Act. freq. 0.01Hz 0x400C:06	266...267	
6	67	Motor current A 0x2D88:00	268...269	

i The configuration of the process data is automatically sent to the drive. Also the Bit-configuration of NetWordIN1 and NetWordOUT1.

The default setting for the control word (NetWordIN1) and status word (NetWordOUT1) are as follow (SW 02.01):

Control word (NetWordIN1)	
Bits	Function
0	Not connected
1	Not connected
2	Quick Stop
3	Not connected
4	Run forward (CW)
5	Preset bit0 selection
6	Preset bit1 selection
7	Reset Fault
8	Not connected
9	DC brake
10	Not connected
11	Not connected
12	Invert rotation
13	Not connected
14	Not connected
15	Not connected

Status word (NetWordOUT1)	
Bits	Function
0	Ready for operation
1	Not connected
2	VSD enable
3	Fault
4	Not connected
5	Quick stop active
6	Running
7	Device warning
8	Not connected
9	Not connected
10	Setpoint speed reached
11	At current limit
12	Actual speed = 0
13	Invert rotation
14	Holding brake release
15	Safe Torque Off

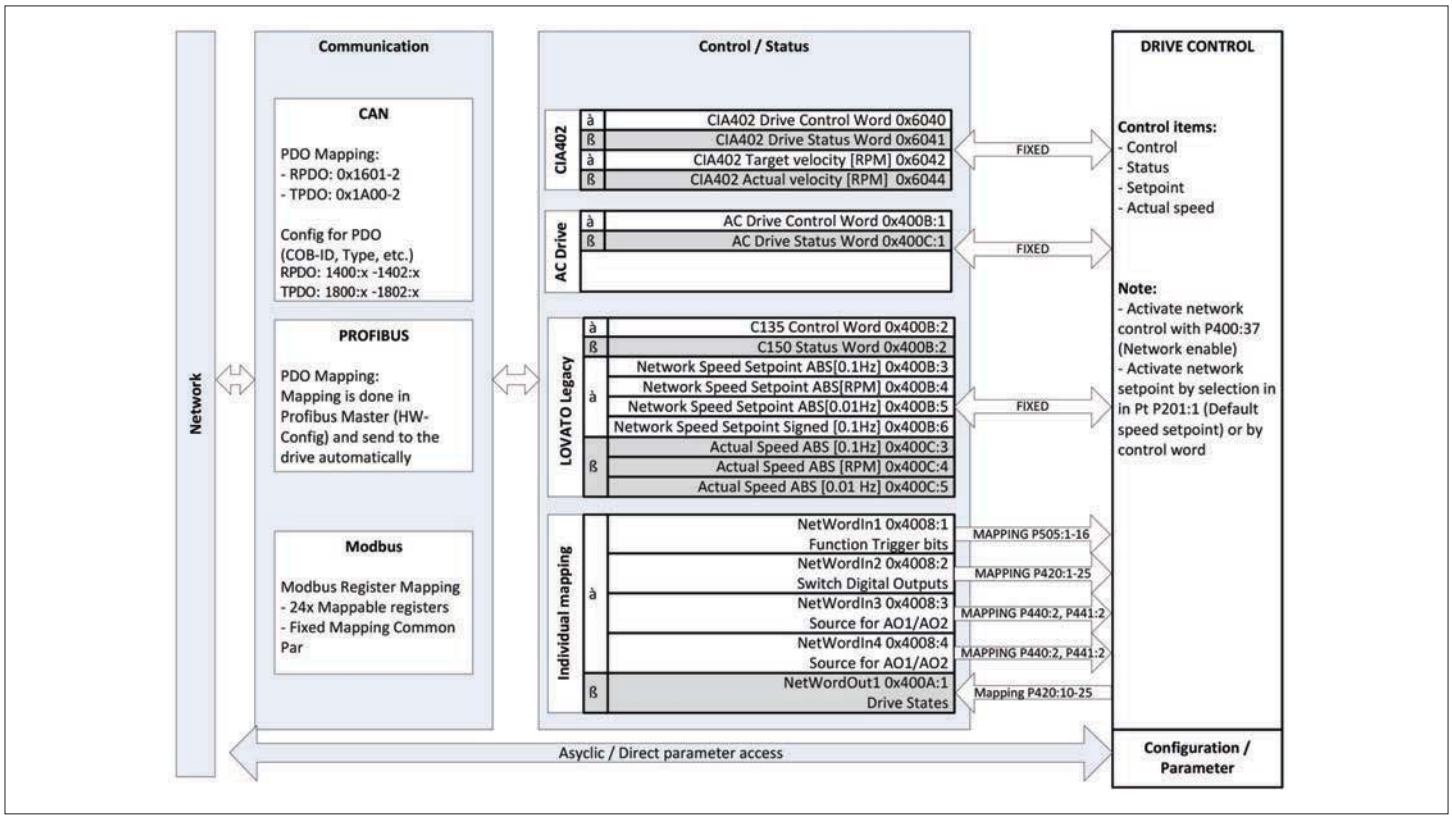
5. For network control the following setup needs to be done:
   – For network control the P400:37 (0x2631:37) “Network enable” need to be set
   – Set P201:1 (0x2860:1) “Default frequency setpoint” to the network
6. Controlling the VSD:
   – With the default IO-setting DI1 need to be asserted (Run/Stop)
   – Set “Network frequency setpoint 0.01Hz”, (Example 1234 = 12.34 Hz)
   – Set Bit 4 of “Control word (NetWordIN1)” to start the drive

i Per default the watchdog timeout response for the communication is set to fault (P515:1, 0x2859:1).

7 DRIVE PROFILE (FIELDBUS)

Several command words, status and setpoint are available to control the drive from remote:

- CIA402 (Predefined mapping) Used for EtherCAT/CAN
- Drive profile (Predefined mapping) Used for EtherNet/IP
- LOVATO Electric (Predefined mapping)
- Netword IN/Out (Individual mapping)



7.1 CiA402

This chapter describes the CIA402 Format.

i This Format is normally used for EtherCAT and CAN.

i With default settings the State machine is active. For full compatibility with CIA402 state machine the CiA402 mode needs to be selected in 0x6060. (Selection: [2] “Velocity mode CIA402”)
For detailed description about CiA402 state machine refer to CiA402 documents.

7.1.1 CONTROL WORD

0x6040 CIA402 Drive Control Word

Bit	Function	Note
0	Switch on	0 = Switch VSD OFF 1 = Switch VSD ON
1	Enable voltage	0 = Disable Voltage 1 = Enable Voltage
2	Activate quick stop	0 = Quick stop active 1 = Quick stop not active
3	Enable operation	0 = Controller inhibit 1 = No controller inhibit
4	Operation mode specific	
5	Operation mode specific	
6	Operation mode specific	
7	Fault reset	Transition from 0 to 1 resets fault
8	n/a	
9	Operation mode specific	
10	Reserved	
11	Reserved	
12	Reserved	
13	Reserved	
14	Holding brake release	1 = Releases holding brake
15	Reserved	

7.1.2 Status word

0x6041:0 P780:0 CIA402 Drive Status Word

Bit	Function	Note
0	Ready to switch on	
1	Switched on	
2	Operation enabled	
3	Fault active	
4	Voltage enabled	
5	Quick stop	0 = Quick stop active 1 = Quick stop not active
6	Switch on disabled	
7	Warning active	
8	Deactivate RPDOs	
9	Remote	Network control mode active
10	Target reached	Target speed reached
11	Internal limit active	Internal limit of speed setpoint active
12	Reserved	
13	Reserved	
14	Brake released	
15	STO not active	

7.1.3 SPEED SETPOINT / ACTUAL SPEED

P781:0	0x6042:0	Target velocity vl			
-- ... [0] ... -- rpm		CiA402 network speed setpoint			
P783:0	0x6044:0	Velocity actual value vl			
-- ... [Actual value] ... -- rpm		CiA402 actual speed			

7.2 LOVATO ELECTRIC FORMAT

This chapter describes the LOVATO Electric Format.

7.2.1 CONTROL WORD C135

0x400B:2 P592:2 C135 control word

Bit	Function	Comments
0	Setpoint Selection bit 0	Bits 0,1 decoding: 0 = Flexible (Default setpoint is active) 1 = Preset Setpoint #1 2 = Preset Setpoint #2 3 = Preset Setpoint #3
1	Setpoint Selection bit 1	
2	Rotation (0-CW/1-CCW)	
3	Activate quick stop	0 = Not Active 1 = Active
4	Reserved	
5	Reserved	
6	Reserved	
7	Reserved	
8	Reserved	
9	Disable (1-active/0-inactiv)	0 = Controller released 1 = Controller Inhibited
10	Network user fault	
11	Fault reset (0→1)	0->1 edge causes TRIP reset
12	Reserved	
13	Reserved	
14	DC Brake Active	0 = Not Active 1 = Active
15	Reserved	

7.2.2 STATUS WORD

0x400C:2 P593:2 C150 status word

Bit	Function	Comments
0	Active Parameter Set	0 = Parameter Set 1 or 3 active 1 = Parameter Set 2 or 4 active
1	Power stage inhibited	0 = enabled 1 = inhibited
2	Current/torque limit reached	Current limit reached Torque limit reached (in Torque mode)
3	Frequency setpoint reached	
4	Ramp generator	Input = Output
5	Below Frequency threshold	Below Frequency threshold Qmin Index 0x4005 (f < 0x4005) Qmin
6	Actual frequency = 0	
7	Inhibit (1-activ/0-inactiv)	0 = Drive Enabled 1 = Drive Inhibited
8	Encode status bit 0	0000 = Initializing 0001 = Mains Voltage Off 0010 = Switch n Inhibited 0011 = Operation Inhibited 0100 = Flying Restart 0101 = DC Brake Active 0110 = Operation Enabled 0111 = Message Active 1000 = FAULT
9	Encode status bit 1	
10	Encode status bit 2	
11	Encode status bit 3	
12	Over-temperature warning	
13	DC Bus overvoltage	
14	Rotation (0-CW/1-CCW)	
15	Ready for Operation	

0x400C:5 P593:5 Drive status

Bit	Function	Comments
0	Fault Locked	
1	Fault	
2	Start Pending	
3	Identification Not Done	
4	Inhibit	
5	Stop	
6	Switching On Sequence	
7	Identification in Progress	
8	Running	
9	Acceleration	
10	Deceleration	
11	Deceleration Override	
12	DC Brake	
13	Flying Start	
14	Current Limit	
16	Sleep Mode	

7.2.3 SPEED SETPOINT / ACTUAL SPEED

Several speed command formats are also available:

P592:3	0x400B:3	Network frequency setpoint			
0.0 ... [0.0] ... 599.0 Hz		Network frequency setpoint Scaling: 0.1 Hz unsigned (direction information comes via control word)			
P592:4	0x400B:4	Network setpoint speed			
0 ... [0] ... 50000 rpm		Network speed setpoint Scaling: RPM unsigned (direction information comes via control word)			
P592:5	0x400B:5	Network setp. frequency			
0.00 ... [0.00] ... 599.00 Hz		Network frequency setpoint Scaling: 0.01 Hz unsigned (direction information comes via control word)			
P592:6	0x400B:6	Network speed setpoint			
-599.0 ... [0.0] ... 599.0 Hz		Network frequency setpoint Scaling: 0.1 Hz signed			

Several actual speed formats are also available:

P593:3	0x400C:3	Actual frequency Hz			
-- ... [Actual value] ... -- Hz		Actual frequency Scaling 0.1Hz, unsigned			
P593:4	0x400C:4	Actual motor speed RPM			
-- ... [Actual value] ... -- rpm		Actual speed Scaling RPM, unsigned			
P593:6	0x400C:6	Actual frequency			
-- ... [Actual value] ... -- Hz		Actual frequency Scaling 0.01Hz, unsigned			

7.3 VSD PROFILE

This chapter describes the Drive Format.

i This Format is normally used for EtherNet/IP.

7.3.1 CONTROL WORD

0x400B:1 P592:1 Drive control word

i Some of the bits will be ignored if bit5 NetCtrl bit is not set, see table below for details.

Bit	Function	Comments
0	Run forward (CW)	Run Forward - see transition table below for exact logic NOTE: Bit processed only when NetCtrl = 1
1	Run reverse (CCW)	Run Reverse - see transition table below for exact logic NOTE: Bit processed only when NetCtrl = 1
2	Fault Reset (0 -> 1)	Reset existing fault. Only on transition from 0->1
3	Reserved	
4	Reserved	
5	Control from Network (NetCtrl)	If bit5 NetCtrl is 1 and Network Enable 0x2631:37 = 114 (Network ControlEnableRequest.Bit): All bits of this control word are processed. If bit5 NetCRI is 0 or Network Enable 0x2631:37 is not asserted: Control bits 0, 1, 12, 13, 14, 15 are NOT processed; their states are ignored and the drive is in local control with functions triggered by settings in 0x2631 (P400)
6	Network setpoint source	If NetRef = 1 Network Setpoint becomes active drive setpoint. Network Setpoint could be speed, frequency, PID setpoint or Torque setpoint If NetRef = 0 Selected default setpoint 0x2860:1-2 (0x201:1-2) is active. Note: Bit 6 can also be used to set network as setpoint source in terminal mode. See 0x2631:17 (P400:17)
7	Reserved	
8	Reserved	
9	Reserved	
10	Reserved	
11	Reserved	
12	Inhibit	NOTE: Bit processed only when NetCtrl = 1
13	Activate quick stop	NOTE: Bit processed only when NetCtrl = 1
14	PID off (1 – off)	NOTE: Bit processed only when NetCtrl = 1
15	DC Brake	NOTE: Bit processed only when NetCtrl = 1

7.3.2 STATUS WORD

0x400C:1 P593:1 Drive status word

Bit	Function	Comments
0	Fault/Trip	0 = No Fault 1 = Faulted
1	Warning active	
2	Running forward (CW)	0 = Not running Forward 1 = Running Forward
3	Running reverse (CCW)	0 = Not running Forward 1 = Running Forward
4	Ready	0 = NOT Ready 1 = Ready
5	Control from Network	0 = Local Control 1 = Network Control
6	Reference from Network	0 = Local Reference 1 = Network Reference
7	At Reference	0 = Setpoint not reached 1 = Setpoint reached
8	Profile State bit0	
9	Profile State bit1	
10	Profile State bit2	
11	Profile State bit3	
12	PID active	0 = PID NOT Active 1 = PID Active
13	Torque mode active	0 = NOT in Torque Mode 1 = Torque Mode Active
14	Current Limit reached	0 = NOT in Current Limit 1 = in Current Limit
15	DC Brake Active	0 = DC brake NOT active 1 = DC brake active

Drive Status: CIA402 state machine to Ethernet/IP Drive State conversion table:

CiA402 Plus State	Drive Profile Drive State
INIT (0, 1)	0 - Vendor Specific
NOT_READY_TO_SWITCH_ON (2)	1 = Startup
SWITCH_ON_DISABLED (3)	2 = Not_Ready
READY_TO_SWITCH_ON (4)	
SWITCHED_ON (5)	3 = Ready
OPERATION_ENABLED (6)	4 = Enabled
DISABLE_OPERATION (7)	
SHUT_DOWN (8)	
QUICK_STOP (9)	5 = Stopping
FAULT_REACTION_ACTIVE (10)	6 = Fault_Stop
FAULT (11)	7 = Faulted

7.3.3 SPEED SETPOINT / ACTUAL SPEED

Several speed command formats are also available:

P592:3	0x400B:3	Network frequency setpoint			
0.0 ... [0.0] ... 599.0 Hz		Network frequency setpoint Scaling: 0.1 Hz unsigned (direction information comes via control word)			
P592:4	0x400B:4	Network setpoint speed			
0 ... [0] ... 50000 rpm		Network speed setpoint Scaling: RPM unsigned (direction information comes via control word)			
P592:5	0x400B:5	Network setp. frequency			
0.00 ... [0.00] ... 599.00 Hz		Network frequency setpoint Scaling: 0.01 Hz unsigned (direction information comes via control word)			
P592:6	0x400B:6	Network speed setpoint			
-599.0 ... [0.0] ... 599.0 Hz		Network frequency setpoint Scaling: 0.1 Hz signed			

Several actual speed formats are also available:

P593:3	0x400C:3	Actual frequency Hz			
-- ... [Actual value] ... -- Hz		Actual frequency Scaling 0.1Hz, unsigned			
P593:4	0x400C:4	Actual motor speed RPM			
-- ... [Actual value] ... -- rpm		Actual speed Scaling RPM, unsigned			
P593:6	0x400C:6	Actual frequency			
-- ... [Actual value] ... -- Hz		Actual frequency Scaling 0.01Hz, unsigned			

7.4 NETWORD CONFIGURATION

Instead of using the predefined command and status word there are general NETWords can be configured.

i Depending on the fieldbus the mapping can be done in the Slave (VSD) or in the Master (PLC).
Note: If the mapping is done in the Master (Example: PROFIBUS) the mapping in the Slave is overwritten!

Master → VSD (NETWordIn)
– NETWordIn1: Function trigger bit
  Value: 0x4008:1 (P590:1)
  Configuration: 0x400E:1 (P505:1-16)

– NETWordIn2: Switch digital outputs/relay
  Value: 0x4008:2 (P590:2)
  Configuration: 0x2643:1-3 (P420:1-3)

– NETWordIn3: Source for AO1/AO2
  Value: 0x4008:3 (P590:3)
  Configuration AO1: 0x2639:2 (P440:2)
  Configuration AO1: 0x263A:2 (P441:2)

– NETWordIn4: Source for AO1/AO2
  Value: 0x4008:4 (P590:4)
  Configuration AO1: 0x2639:2 (P440:2)
  Configuration AO1: 0x263A:2 (P441:2)

VSD → Master (NETWordOut)
– NETWordOut1: Drive Status bits
  Value: 0x400A:1 (P591:1)
  Configuration: 0x2635:10-25 (P420:10-25)

– NETWordOut2: Switched by Sequencer
  Value: 0x400A:2 (P591:2)
  Configuration: Sequencer parameter

7.4.1 NETWORDIN CONFIGURATION

Actual value:

P590:1	0x4008:1	NETWordIN1			
--		Actual value of mappable network in word 1 bit collector (Trigger Function) --> Trigger mapping 0x400E1-16 (P505:1-16)			
P590:2	0x4008:2	NETWordIN2			
--		Actual value of mappable network in word 2 bit collector (Trigger for digital Outputs) --> Trigger mapping 0x2634:1-3 (P420:1-3)			
P590:3	0x4008:3	NETWordIN3			
0.0 ... [0.0] ... 100.0 %		Actual value of mappable network in word 3 (Source for Analog Output 1 and 2) --> Mapping 0x2639:2 (P440:2), 0x263A:2 (P441:2)			
P590:4	0x4008:4	NETWordIN4			
0.0 ... [0.0] ... 100.0 %		Actual value of mappable network in word 3 (Source for Analog Output 1 and 2) --> Mapping 0x2639:2 (P440:2), 0x263A:2 (P441:2)			

Configuration:

P505:1	0x400E:1	NETWordIN1.00			
0: Not connected 1: VSD disabled 2: Stop 3: Quick stop 4: Reset fault 5: DC brake 8: Run forward (CW) 9: Run reverse (CCW) 13: Invert rotation 14: AI1 setpoint selection 15: AI2 setpoint selection 17: Network setpoint selection 18: Preset bit0 selection 19: Preset bit1 selection 20: Preset bit2 selection 21: Preset bit3 selection 39: Ramp 2 selection 40: Load parameter set 41: Parameter set 1 selection 42: Parameter set 2 selection 43: User-Netw. fault 1 44: User-Netw. fault 2 45: Process controller off 46: Set PID output to 0 47: PID integrator disabled 48: PID influence ramps active		Function of Network Input Word Bit 0			
P505:2	0x400E:2	NETWordIN1.01			
0:Not connected (Reference see P505:0)		Function of Network Input Word Bit 1			
P505:3	0x400E:3	NETWordIN1.02			
3:Quick stop (Reference see P505:0)		Function of Network Input Word Bit 2			
P505:4	0x400E:4	NETWordIN1.03			
0:Not connected (Reference see P505:0)		Function of Network Input Word Bit 3 (SW 02.01: New Default)			
P505:5	0x400E:5	NETWordIN1.04			
8:Run forward (CW) (Reference see P505:0)		Function of Network Input Word Bit 4 (SW 02.01: New Default)			
P505:6	0x400E:6	NETWordIN1.05			
18:Preset bit0 selection (Reference see P505:0)		Function of Network Input Word Bit 5 (SW 02.01: New Default)			
P505:7	0x400E:7	NETWordIN1.06			
19:Preset bit1 selection (Reference see P505:0)		Function of Network Input Word Bit 6 (SW 02.01: New Default)			
P505:8	0x400E:8	NETWordIN1.07			
4:Reset fault (Reference see P505:0)		Function of Network Input Word Bit 7			
P505:9	0x400E:9	NETWordIN1.08			
0:Not connected (Reference see P505:0)		Function of Network Input Word Bit 8 (SW 02.01: New Default)			
P505:10	0x400E:10	NETWordIN1.09			
5:DC brake (Reference see P505:0)		Function of Network Input Word Bit 9 (SW 02.01: New Default)			
P505:11	0x400E:11	NETWordIN1.10			
0:Not connected (Reference see P505:0)		Function of Network Input Word Bit 10			
P505:12	0x400E:12	NETWordIN1.11			
0:Not connected (Reference see P505:0)		Function of Network Input Word Bit 11			
P505:13	0x400E:13	NETWordIN1.12			
13:Invert rotation (Reference see P505:0)		Function of Network Input Word Bit 12 (SW 02.01: New Default)			
P505:14	0x400E:14	NETWordIN1.13			
0:Not connected (Reference see P505:0)		Function of Network Input Word Bit 13			
P505:15	0x400E:15	NETWordIN1.14			
0:Not connected (Reference see P505:0)		Function of Network Input Word Bit 14			
P505:16	0x400E:16	NETWordIN1.15			
0:Not connected (Reference see P505:0)		Function of Network Input Word Bit 15			

7.4.2 NETWORDOUT CONFIGURATION

Actual value:

P591:1	0x400A:1	NetWordOUT1			
Bit # description: 0: Mapping bit 0 1: Mapping bit 1 …		Actual value of mappable network out word 1 bit collector (Status bits) --> Trigger mapping 0x2634:1-3 (P420:1-3)			
P591:2	0x400A:2	NetWordOUT2			
Bit # description: 0: Mapping bit 0 1: Mapping bit 1 …		No mapping			

Configuration:

P420:10	0x2634:10	NETWordOUT1 - bit 0			
51:Ready for operation (Reference see P420:1)		Function of Network Bit 0			
P420:11	0x2634:11	NETWordOUT1 - bit 1			
0:Not connected (Reference see P420:1)		Function of Network Bit 1 (SW 02.01: New Default)			
P420:12	0x2634:12	NETWordOUT1 - bit 2			
52:VSD enable (Reference see P420:1)		Function of Network Bit 2 (SW 02.01: New Default)			
P420:13	0x2634:13	NETWordOUT1 - bit 3			
56:Fault (Reference see P420:1)		Function of Network Bit 3			
P420:14	0x2634:14	NETWordOUT1 - bit 4			
0:Not connected (Reference see P420:1)		Function of Network Bit 4 (SW 02.01: New Default)			
P420:15	0x2634:15	NETWordOUT1 - bit 5			
54:Quick stop active (Reference see P420:1)		Function of Network Bit 5			
P420:16	0x2634:16	NETWordOUT1 - bit 6			
50:Running (Reference see P420:1)		Function of Network Bit 6 (SW 02.01: New Default)			
P420:17	0x2634:17	NETWordOUT1 - bit 7			
58:Device warning (Reference see P420:1)		Function of Network Bit 7			
P420:18	0x2634:18	NETWordOUT1 - bit 8			
0:Not connected (Reference see P420:1)		Function of Network Bit 8 (SW 02.01: New Default)			
P420:19	0x2634:19	NETWordOUT1 - bit 9			
0:Not connected (Reference see P420:1)		Function of Network Bit 9 (SW 02.01: New Default)			
P420:20	0x2634:20	NETWordOUT1 - bit 10			
72:Setpoint speed reached (Reference see P420:1)		Function of Network Bit 10			
P420:21	0x2634:21	NETWordOUT1 - bit 11			
78:At current limit (Reference see P420:1)		Function of Network Bit 11 (SW 02.01: New Default)			
P420:22	0x2634:22	NETWordOUT1 - bit 12			
71:Actual speed = 0 (Reference see P420:1)		Function of Network Bit 12 (SW 02.01: New Default)			
P420:23	0x2634:23	NETWordOUT1 - bit 13			
69:Inverse rotation (Reference see P420:1)		Function of Network Bit 13 (SW 02.01: New Default)			
P420:24	0x2634:24	NETWordOUT1 - bit 14			
115:Holding brake release (Reference see P420:1)		Function of Network Bit 14 (SW 02.01: New Default)			
P420:25	0x2634:25	NETWordOUT1 - bit 15			
55:Safe Torque Off (Reference see P420:1)		Function of Network Bit 15 (SW 02.01: New Default)			

8 TROUBLESHOOTING

8.1 LED STATUS DISPLAY

The VSD has two LEDs (RDY = READY, ERR = ERROR) on the front cover to identify the status of the VSD:

RDY (Blue)	ERR (Red)	State
–	–	No supply voltage
1 Hz	–	STO active
		STO active, warning active
2 Hz	–	VSD inhibited
		VSD inhibited, DC Voltage not
		VSD inhibited, Warning active
		VSD inhibited, Fault active
3s ON / 1s OFF	–	PID Sleep Mode active
	–	VSD released, drive running OR Quick Stop active
		VSD released, drive running, Warning active
		VSD released, Trouble reaction active

8.2 CAN LED STATUS DISPLAY

The LED CAN-RUN and CAN-ERR in combination indicate when the VSD is not yet active on the CAN-Bus:

CAN-RUN (Green)	CAN-ERR (Red)	State
–		VSD not active on CAN-Bus / Bus OFF
		Automatic baud rate detection

In general the LED CAN-RUN indicates CANopen state:

CAN-RUN (Green)	CANopen state
	Pre-Operational
	Operational
	Stopped

In general the LED CAN-ERR indicates error states:

CAN-ERR (Red)	CANopen error
	Warning Limit reached
	Node Guard Event
	Sync Message Error (Can only occur in state “Operational”)

8.3 MODBUS LED STATUS DISPLAY

The Modbus module has two LEDs (RDY = READY, ERR = ERROR) on the front cover to identify the status:

RDY (Green)	ERR (Red)	State
–	ANY	No reception / transmission
		Frame reception or transmission
ANY	–	No error
		Communication Fault
		Internal fault
		Automatic baud rate detection

8.4 PROFIBUS LED STATUS DISPLAY

The profibus module has two LEDs (NS = Status, NE = ERROR) on the front cover to identify the status:

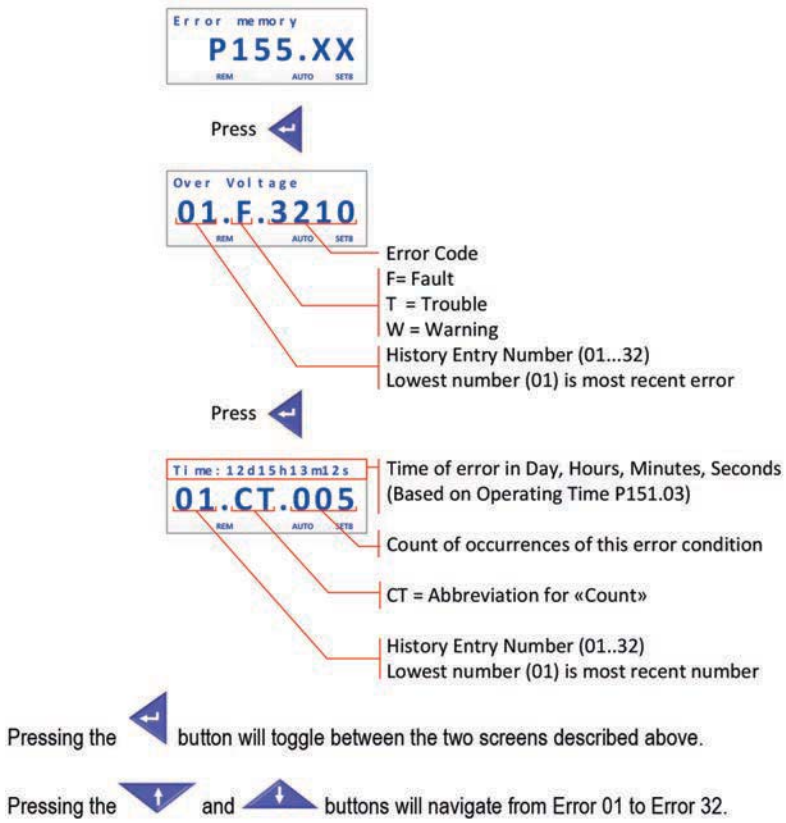
NS (Green)	NE (Red)	State
–	–	Fieldbus deactivated, not initialized, power off or Firmware download
		Connected to master PLC in RUN state, current state is “data exchange”
		Not connected, PLC STOP or no data exchange
		Incorrect setting of station address, operation with default values
		Watchdog expired
–		Unrecoverable fault
ANY		PROFIBUS parameterization error
		PROFIBUS configuration error

8.5 ERROR HISTORY

8.5.1 ERROR HISTORY KEYPAD

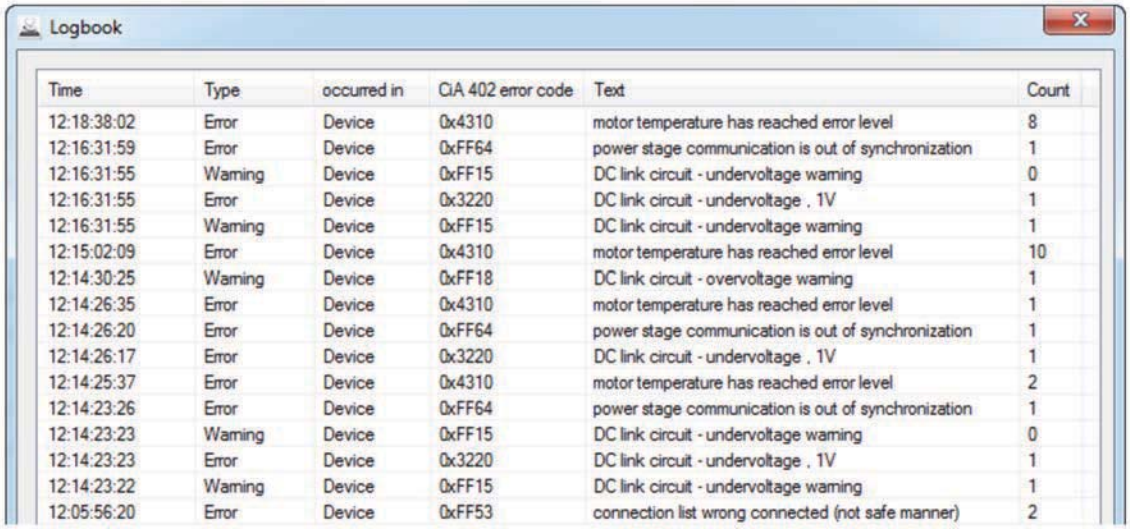
Any time the VSD experiences an Error condition during operation it is captured in the VSD non-volatile memory. For historical Error tracking purposes the Errors can be viewed in P155.00. This parameter contains the actual Error codes, the time (in running hours) that the Error occurred and the count of Errors (in case of multiple instances of the same Error condition). The Error History will retain the 32 most recent Errors.

The data in the Error History is described below:



8.5.2 ERROR HISTORY VLB3SW01 SOFTWARE

	Opens the error logbook
	Reset the drive error



Time	Type	occurred in	CiA 402 error code	Text	Count
12:18:38:02	Error	Device	0x4310	motor temperature has reached error level	8
12:16:31:59	Error	Device	0xFF64	power stage communication is out of synchronization	1
12:16:31:55	Warning	Device	0xFF15	DC link circuit - undervoltage warning	0
12:16:31:55	Error	Device	0x3220	DC link circuit - undervoltage , 1V	1
12:16:31:55	Warning	Device	0xFF15	DC link circuit - undervoltage warning	1
12:15:02:09	Error	Device	0x4310	motor temperature has reached error level	10
12:14:30:25	Warning	Device	0xFF18	DC link circuit - overvoltage warning	1
12:14:26:35	Error	Device	0x4310	motor temperature has reached error level	1
12:14:26:20	Error	Device	0xFF64	power stage communication is out of synchronization	1
12:14:26:17	Error	Device	0x3220	DC link circuit - undervoltage , 1V	1
12:14:25:37	Error	Device	0x4310	motor temperature has reached error level	2
12:14:23:26	Error	Device	0xFF64	power stage communication is out of synchronization	1
12:14:23:23	Warning	Device	0xFF15	DC link circuit - undervoltage warning	0
12:14:23:23	Error	Device	0x3220	DC link circuit - undervoltage , 1V	1
12:14:23:22	Warning	Device	0xFF15	DC link circuit - undervoltage warning	1
12:05:56:20	Error	Device	0xFF53	connection list wrong connected (not safe manner)	2

Time	Time of the fault occurrence based on “Operation time (Control unit)” P150.03. If more than one fault of the same type is counted (Count >1) the first fault occurrence time is shown! [dd:hh:mm:ss]
Type	Error type (Warning, Error, Trouble)
Occurred in	Occurrence of the event
CiA 402 Error code	Error Code
Text	Error text
Count	Number of sequential fault occurrences

Error (Hex)	Error (Dec)	Fault Type	Tool text	Description
0x2250	8784	Error	PU over current	Short circuit (device internal). Will be triggered by the following events: – Brake chopper over current – Power stage over current – Charge relay not closed
0x2320	8992	Error	Earth leak fault	Short circuit/earth leakage (device internal)
0x2340	9024	Error	Motor shorted	Short circuit (motor-side)
0x2350	9040	Configurable	i2t motor	Load level fault (I2t, thermal state). (P308:1-3)
0x2382	9090	Configurable	ixt Fault	Ixt fault. (P135:5)
0x2383	9091	Warning	ixt Warning	Ixt warning
0x2387	9095	Error	Clamp timeout	Clamp responded too often
0x3120	12576	Error	Mains Phase fail	Main single phase fault
0x3210	12816	Error	DC Bus OV	DC link circuit overvoltage
0x3211	12817	Warning	Warn.DC Bus OV	DC link circuit overvoltage warning
0x3220	12832	Trouble	DC Bus UV	DC link circuit undervoltage
0x3221	12833	Warning	Warn.DC Bus UV	DC link circuit undervoltage warning
0x3222	12834	Warning	DC Bus on-UV	DC link voltage to low for power up
0x4210	16912	Error	PU Overtemp.	Power module overtemperature fault
0x4281	17025	Warning	Heats. fan error	Heat sink fan fault. Check heat sink fan
0x4285	17029	Warning	Warn.PU Overtemp	Power module overtemperature warning
0x4310	17168	Configurable	Overtemp. motor	Motor temperature has reached error level. (P309:2)
0x5112	20754	Warning	24V supply low	24V supply level critical
0x5380	21376	Error	Incomp. OEM HW	Control Unit HW OEM Type is not compatible with Power Unit HW OEM Type
0x6010	24592	Warning	Watchdog timeout	Watchdog time-out
0x618A	24970	Warning	Int. fan error	Internal fan fault
0x6280	25216	Error	P400 config err	Connection list wrong connected. Start forward/reverse an Run forward/reverse can't be used together. In Flexible control mode VSD enable or Run/Stop must be assigned to a I/O. (Exception: VSD is controlled from network, Network enable (P400:37) is HIGH)
0x6281	25217	Error	User fault 1	User fault 1 (Defined in P400:43)
0x6282	25218	Error	User fault 2	User fault 2 (Defined in P400:44)
0x6290	25232	Warning	Invert rotation	Reverse direction protection warning. (P304:0)
0x6291	25233	Error	Trouble overflow	Maximal allowed troubles exceeded. (P760:2-5)
0x62A0	25248	Error	AC User fault	AC control user fault
0x62A1	25249	Error	Netw.UserFault 1	Network user fault 1
0x62A2	25250	Error	Netw.UserFault 2	Network user fault 2
0x62B1	25265	Error	NetwordIN1 error	NetwordIN1 duplicate bit connection fault
0x7080	28800	Error	Assertionlevel	Last setting of Assertion level is different to stored pa-rameter. Check setting of P410:1, save parameters and reboot VSD.
0x7081	28801	Configurable	AI1 monitoring	Analog input 1 fault (P430:8-10)
0x7082	28802	Configurable	AI2 monitoring	Analog input 2 fault (P431:8-10)
0x70A1	28833	Warning	AO1 monitoring	Analog output 1 fault
0x70A2	28834	Warning	AO2 monitoring	Analog output 2 fault
0x7121	28961	Error	Pole posi error	Pole position identification fault
0x7180	29056	Configurable	Mot max current	Motor over current. (P353:1-2)
0x7385	29573	Warning	F.fdb spd limit	Feedback system: speed limit
0x7580	30080	Configurable	Diag TX error	Diagnosis transmit message ring buffer error (0x218B:0)
0x7581	30081	Configurable	Diag RX error	Diagnosis receive message ring buffer error (0x218B:0)
0x7680	30336	Warning	EPM full	There are to many parameters on the EPM. Fault reaction: The device will copy the current backup to the user block and won't overwrite the RAM data. Troubleshooting: Tigger the command P700:3. The device will erase the user block and create a new one with current RAM data.
0x7681	30337	Error	EPM not present	The EPM ist not present. Fault reaction: Factory setting will load. The user is not able to reset this fault. Troubleshooting: Switch off the device, plug in an EPM and power up again.
0x7682	30338	Error	EPM invalid data	The user parameter setting is invalid. Both blocks (User and backup block) are invalid. Fault reaction: The user parameter setting has lost. The default values will be loaded automatically. Troubleshooting: Safe again user parameters with P700:3. The default values will stored to the EPM. The old user parameter set will lost.
0x7684	30340	Warning	Save incomplete	The store command has been interrupted through a unexpected power down. The user data are not completely stored. Fault reaction: At power up, the data will load from backup and copied to user block (The backup is on a older contition). Troubleshooting: Check the parameter setting and store them again.

Error (Hex)	Error (Dec)	Fault Type	Tool text	Description
0x7686	30342	Error	Net.config.error	Fieldbus module configuration mismatch fault
0x7689	30345	Warning	OEM data invalid	One or more parameters are invalid or the OEM block is blank. Fault reaction: The user parameter set will load automatically. Troubleshooting: Save OEM parameter (P700:6). In this case, the user parameter set will be lost.
0x768A	30346	Error	Wrong EPM	EPM: EPM Type not match
0x7690	30352	Error	OEM CU not match	The FW version does not match to the current used EPM data. Fault reaction: The data will load to RAM. Troubleshooting: Factory setting need to be loaded (P700:1)
0x7691	30353	Error	PU Data not matc	The FW type does not match to the current used EPM data. Fault reaction: The data will load to RAM. Troubleshooting: Factory setting need to be loaded (P700:1)
0x7692	30354	Error	User CU not matc	New FW type detected. The FW type is compatible to the currrent used EPM. Fault reaction: The data will load to RAM. Troubleshooting: Accept new FW type (P700:27) (Changes in parameter setting). Alternative: Load factory settings (P700:1).
0x7693	30355	Error	EPM PU size inco	The PU type does not match to the current used EPM data. Fault reaction: The data will load to RAM. Troubleshooting: Factory setting need to be loaded (P700:1)
0x7694	30356	Error	EPM new PU size	New PU type detected. The PU type is compatible to the currrent used EPM. Fault reaction: The data will load to RAM. Troubleshooting: Accept new PU type (P700:27) (Changes in parameter setting). Alternative: Load factory settings (P700:1).
0x7695	30357	Warning	InvalidChgovrCfg	One or more parameter are not usable for the parameter changeover. Fault reaction: Parameter changeover is disabled. Troubleshooting: Check fault status in P756:1 and correct the wrong in-dex indicated in P756:2.
0x7697	30359	Error	Param. lost	EPM data: Lost modified parameters because of 24V power-cycling
0x8112	33042	Configurable	TO expl. msg	Fieldbus - Timeout explicit message (P515:6)
0x8114	33044	Configurable	TO overall comm	Fieldbus - Overall communication timeout (P515:7)
0x8182	33154	Configurable	CAN bus off	CAN bus off. (0x2857:10)
0x8183	33155	Configurable	CAN bus warning	CAN warning. (0x2857:11)
0x8184	33156	Configurable	CAN heartb. C1	CAN heartbeat time-out consumer 1. (0x2857:5)
0x8185	33157	Configurable	CAN heartb. C2	CAN heartbeat time-out consumer 2. (0x2857:6)
0x8186	33158	Configurable	CAN heartb. C3	CAN heartbeat time-out consumer 3. (0x2857:7)
0x8187	33159	Configurable	CAN heartb. C4	CAN heartbeat time-out consumer 4. (0x2857:8)
0x8190	33168	Configurable	Watchdog timeout	Fieldbus watchdog expired. (P515:1)
0x8191	33169	Configurable	Cycl data error	Fieldbus disruption of cyclic data exchange. (P515:2)
0x8192	33170	Configurable	Net. Init. error	Fieldbus communication stack initialization error (P515:4)
0x8193	33171	Configurable	Inv. cyclic data	Fieldbus invalid cyclic process data. (P515:5)
0x81A0	33184	Warning	Modbus TX error	Modbus transmit message ring buffer error
0x81A1	33185	Configurable	Timeout Modbus	Modbus network time-out. (P515:1-2)
0x81A2	33186	Warning	Modbus request	Modbus wrong request from master
0x8286	33414	Configurable	PDO map error	Fieldbus PDO mapping error. (P515:3)
0x8291	33425	Configurable	Timeout RPDO1	CAN time-out Rx PDO 1 (0x2857:1)
0x8292	33426	Configurable	Timeout RPDO2	CAN time-out Rx PDO 2 (0x2857:2)
0x8293	33427	Configurable	Timeout RPDO3	CAN time-out Rx PDO 3 (0x2857:3)
0x8311	33553	Configurable	F.TrqExc	Max torque exceeded (P329:1)
0x9080	36992	Error	Keypad removed	Keypad removed fault
0xFF02	65282	Configurable	Brk Resistor OL	Brake resistor overload fault. (P707:9, P707:11)
0xFF05	65285	Error	STO error	Safety supervision fault
0xFF06	65286	Configurable	Motor overspeed	Motor over speed. (P350:1-2)
0xFF09	65289	Configurable	Mot.PhaseFailure	Motor phase failure (P310:1-3)
0xFF0A	65290	Configurable	Phase U failure	Motor phase failure phase U. (P310:1-3)
0xFF0B	65291	Configurable	Phase V failure	Motor phase failure phase V. (P310:1-3)
0xFF0C	65292	Configurable	Phase W failure	Motor phase failure phase W. (P310:1-3)
0xFF19	65305	Error	Motor ID fault	Motor parameter identification fault
0xFF36	65334	Configurable	BrkResistor OL	Brake resistor overload warning. (P707:8, P707:10)
0xFF37	65335	Error	Auto start disab	Automatic start was inhibited. Run/Start signal was pre-sent during Power-On and start was inhibited because of setting in P203:2. Remove Run/Start signal and reset fault
0xFF56	65366	Warning	Warn. Max. Freq	Max output frequency reached

For other faults reboot the VSD. If the problem can't be resolved contact the supplier.

9 MAINTENANCE

The VLB3 VSD does not require any maintenance if the prescribed operating conditions are observed.

9.1 ROUTINE INSPECTIONS

NOTICE!
It is a good practice to check the VSD during a routine inspection of the drive system:
- ► Remove dust from VSD housing if necessary.
- ► Check that ventilation slots are not covered or obstructed.
- ► Check the condition and tightness of the electric connections.
- ► The integrity of all earth / ground connections should be periodically checked.

DANGER!
Dangerous electrical voltage
Possible death or severe injuries due to electrical shock.
- ► All inspection works on the VSD must only be carried out in the deenergised state.
- ► After switching off the mains voltage, the capacitors in the VSD can still be charged. Observe the waiting time on the VSD label before commencing work.

9.2 PRODUCT SUPPORT

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Fax: +39 0354282295
Email: service@LOVATOElectric.com

10 DECOMMISSIONING

10.1 SAFETY INSTRUCTIONS

WARNING!
Dangerous electrical voltage
An electrical shock can cause death or severe personal injury.
- ► Apply lockout/tagout procedures for decommissioning.
- ► Connect/disconnect all pluggable VSD connections only in deenergised condition!
- ► Only remove the VSD from the installation in completely deenergised state.

10.2 REMOVAL AND DISPOSAL

Recycle metal and plastic materials of the VSD. Ensure professional disposal of assembled PCBs.

Observe all applicable national regulations for the disposal of waste electronic equipment.