Honeywell

3G SmartVFD

Installation and User Guide



TABLE OF CONTENTS

1 Introduction 1

1.1 Purpose of the Manual 1
1.2 Additional Resources 1
1.3 Document and Software Version 2
1.4 Product Overview 2
1.5 Approvals and Certifications 9
1.6 Disposal 9

2 Safety 11

2.1 Safety Symbols 11
2.2 Qualified Personnel 11
2.3 Safety Precautions 12

3 Mechanical Installation 15

3.1 Unpacking 15
3.2 Installation Environments 15
3.3 Mounting 16

4 Electrical Installation 19

4.1 Safety Instructions 19
4.2 EMC-compliant Installation 20
4.3 Grounding 20
4.4 Wiring Schematic 21
4.5 Access 23
4.6 Motor Connection 24

4.7 AC Line Input Connection 27
4.8 Control Wiring 28
4.9 Installation Check List 33

5 Commissioning 35

5.1 Safety Instructions 35
5.2 Applying Power 36
5.3 Local Control Panel Operation 36
5.4 Basic Programming 41
5.5 Checking Motor Rotation 46
5.6 Local Control Test 46
5.7 System Start-up 47

6 Application Set-up Examples 49

7 Diagnostics and Troubleshooting 57

7.1 Maintenance and Service 57
7.2 Status Messages 57
7.3 Warning and Alarm Types 60
7.4 List of Warnings and Alarms 61
7.5 Troubleshooting 74

8 Specifications 78

8.1 Electrical Data 78
8.2 Line Power Supply 90
8.3 Motor Output and Motor Data 90
8.4 Ambient Conditions 91
4.5 Access 91
8.5 Cable Specifications 92
8.6 Control Input/Output and Control Data 92
8.7 Connection Tightening Torques 95
8.8 Fuses and Circuit Breakers 96
8.9 Power Ratings, Weight and Dimensions 101

9 Appendix 104
9.1 Symbols, Abbreviations and Conventions 104
9.2 Parameter Menu Structure 105

CHAPTER

1 INTRODUCTION

1 Introduction

1.1 Purpose of the Manual

This instruction manual provides information for safe installation and commissioning of the adjustable frequency drive.

This instruction manual is intended for use by qualified personnel.

Read and follow the instruction manual to use the adjustable frequency drive safely and professionally, and pay particular attention to the safety instructions and general warnings. Keep this instruction manual available with the adjustable frequency drive at all times.

1.2 Additional Resources

Other resources are available to understand advanced adjustable frequency drive functions and programming.

- The 3G SmartVFD Programming Guide provides greater detail on working with parameters and many application examples.
- The 3G SmartVFD Design Guide provides detailed information about capabilities and functionality to design motor control systems.
- Instructions for operation with optional equipment.

Supplementary publications and manuals are available from Honeywell.
See buildings.honeywell.com

1.3 Product Overview

1.3.1 Intended Use

The adjustable frequency drive is an electronic motor controller intended for:

• The regulation of motor speed in response to system feedback or to remote commands from external controllers. A power drive system consists of the adjustable frequency drive, the motor and equipment driven by the motor.

• System and motor status surveillance. The adjustable frequency drive can also be used for motor protection.

Depending on configuration, the adjustable frequency drive can be used in standalone applications or form part of a larger appliance or installation.

The adjustable frequency drive is allowed for use in residential, industrial and commercial environments in accordance with local laws and standards.



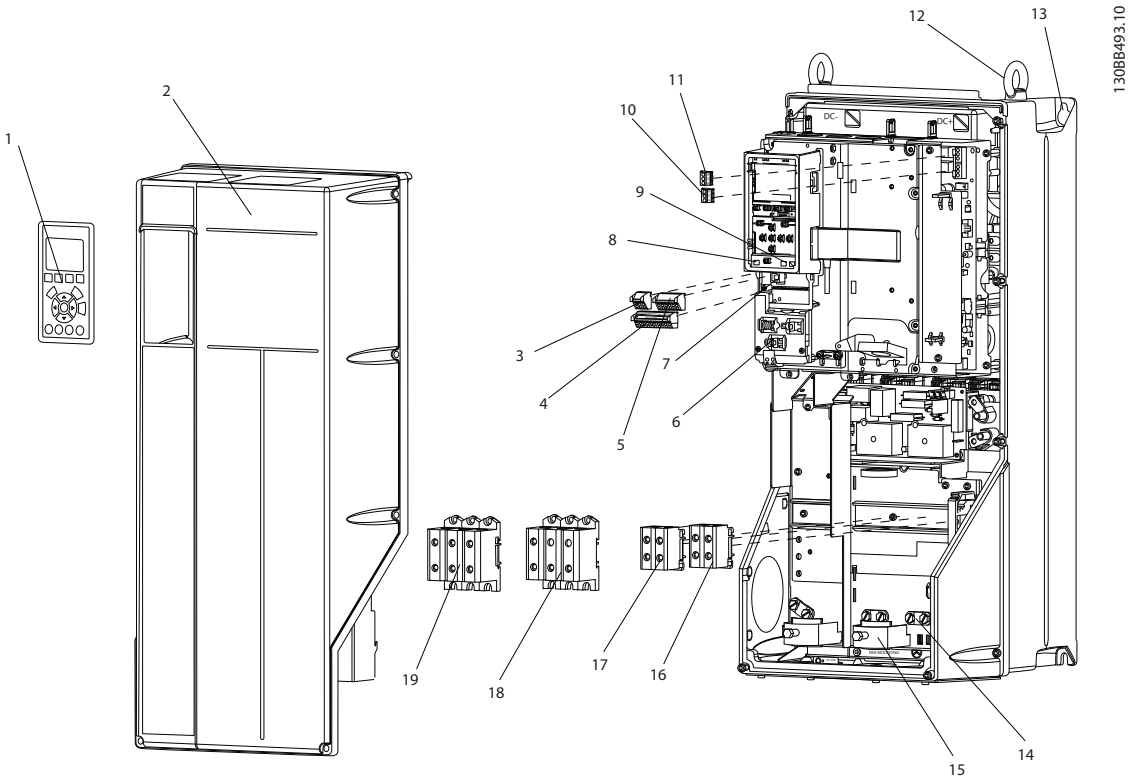
Caution: In a residential environment, this product can cause radio interference, in which case supplementary mitigation measures can be required.

Foreseeable misuse

Do not use the adjustable frequency drive in applications which are non-compliant with specified operating conditions and environments. Ensure compliance with the conditions specified in Chapter 8.

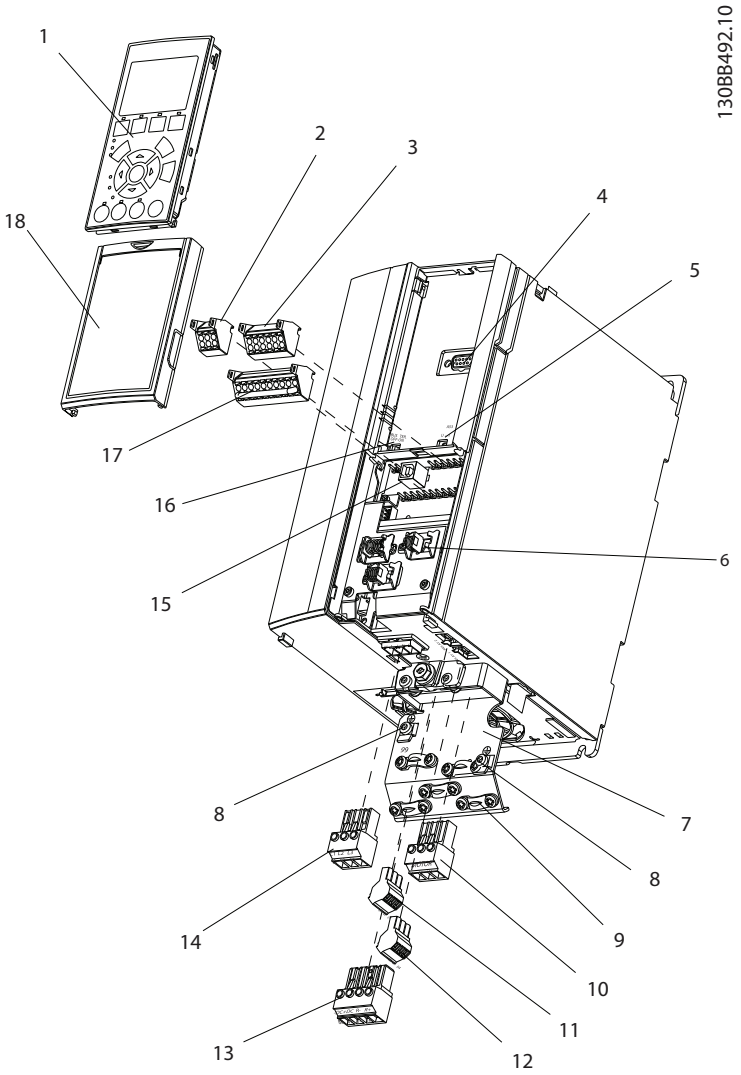
1.3.2 Exploded Views

Figure 1.1. Exploded View Enclosure Types B and C.



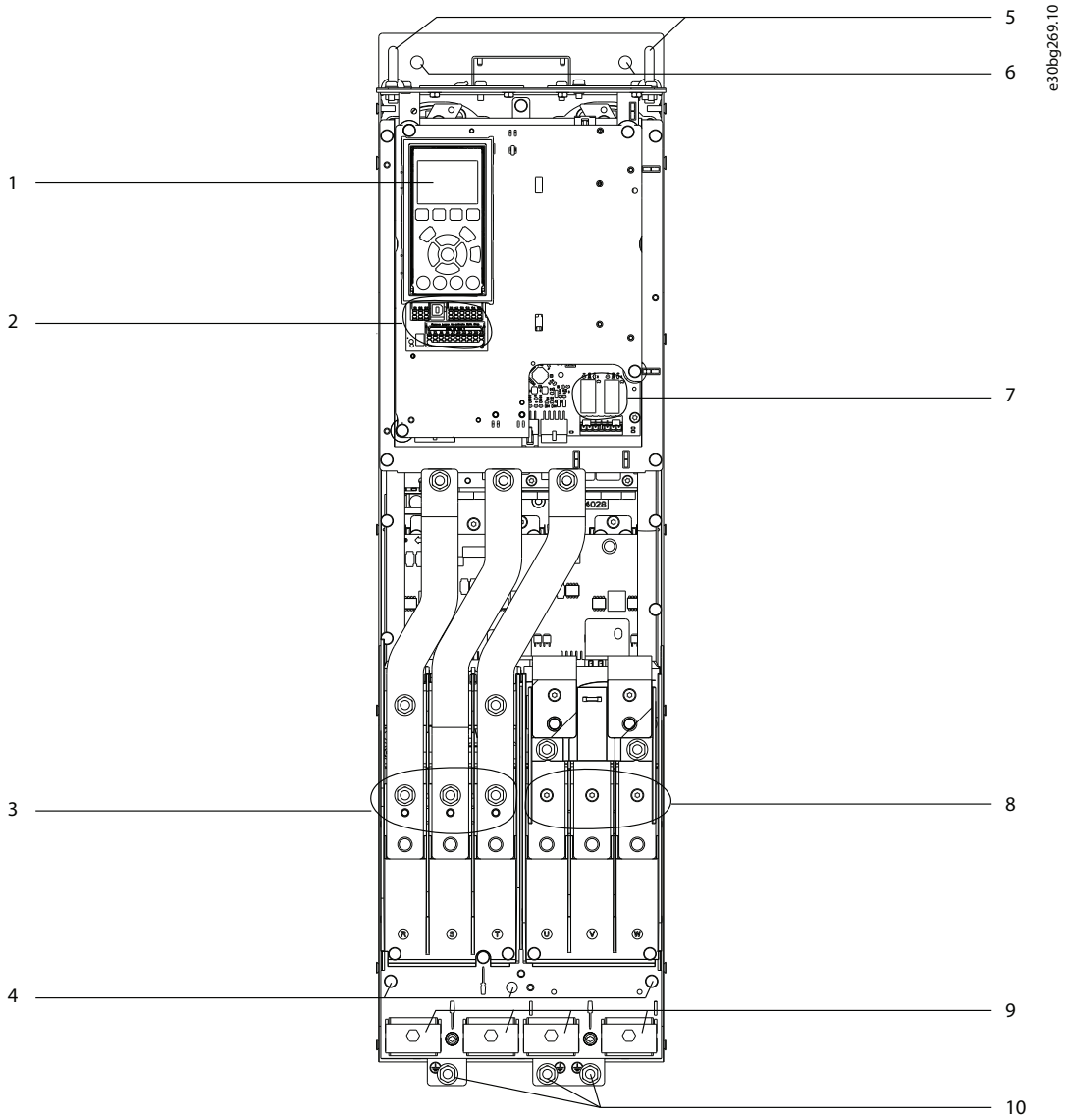
1	Local control panel (LCP)	11	Relay 2 (04, 05, 06)
2	Cover	12	Lifting ring
3	RS-485 serial bus connector	13	Mounting slot
4	Digital I/O and 24 V power supply	14	Grounding clamp (PE)
5	Analog I/O connector	15	Cable shield connector
6	Cable shield connector	16	Brake terminal (-81, +82)
7	USB connector	17	Load sharing terminal (DC bus) (-88, +89)
8	Serial bus terminal switch	18	Motor output terminals 96 (U), 97 (V), 98 (W)
9	Analog switches (A53), (A54)	19	Line power input terminals 91 (L1), 92 (L2), 93 (L3)
10	Relay 1 (01, 02, 03)		

Figure 1.2. Exploded View Enclosure Type A.



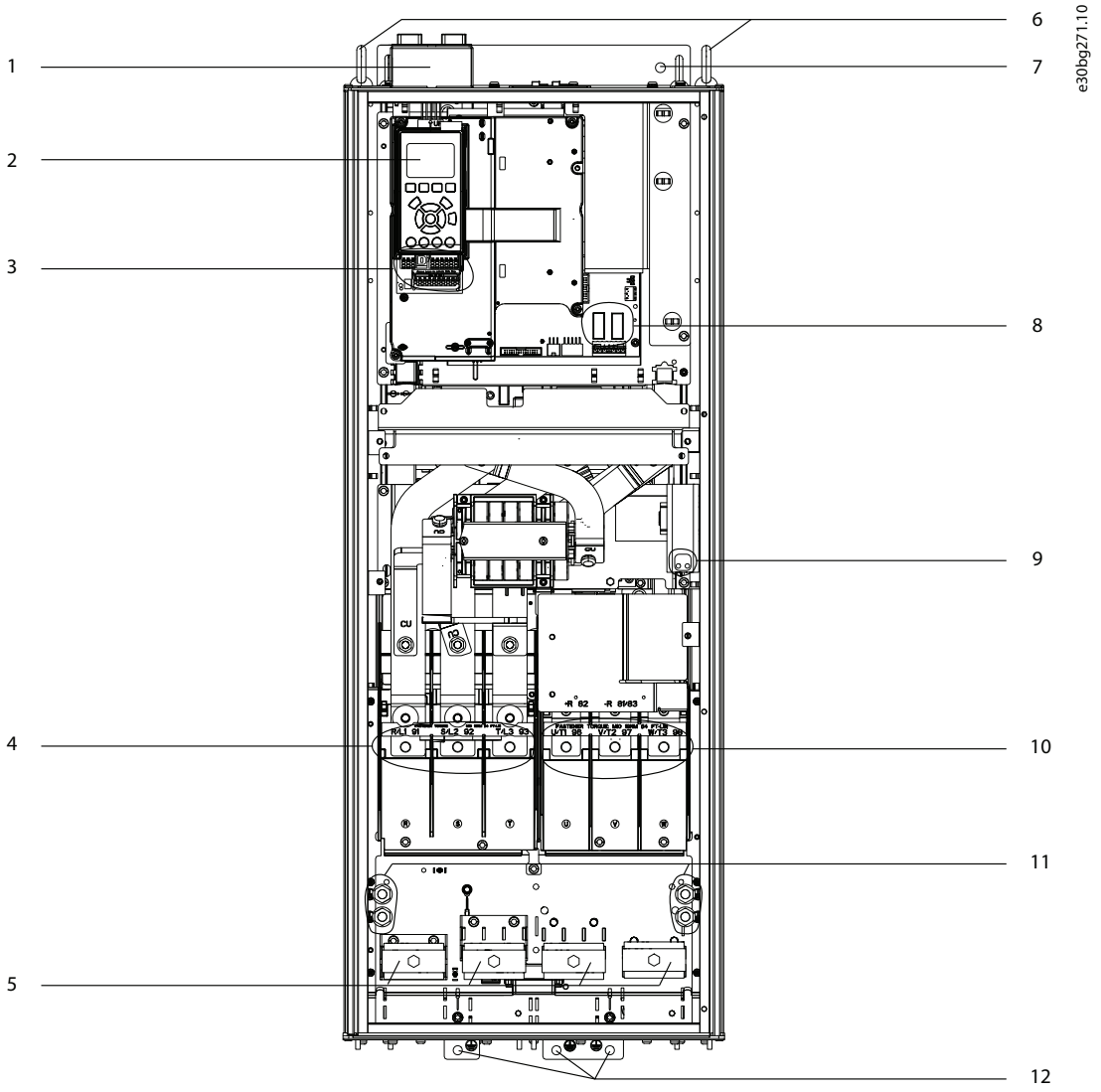
1	Local control panel (LCP)	10	Motor output terminals 96 (U), 97 (V), 98 (W)
2	RS-485 serial bus connector (+68, -69)	11	Relay 2 (01, 02, 03)
3	Analog I/O connector	12	Relay 1 (04, 05, 06)
4	LCP input plug	13	Brake (-81, +82) and load sharing (-88, +89) terminals
5	Analog switches (A53), (A54)	14	Line power input terminals 91 (L1), 92 (L2), 93 (L3)
6	Cable shield connector	15	USB connector
7	Decoupling plate	16	Serial bus terminal switch
8	Grounding clamp (PE)	17	Digital I/O and 24 V power supply
9	Shielded cable grounding clamp and strain relief	18	Cover

Figure 1.3. Interior View of D1 Drive.



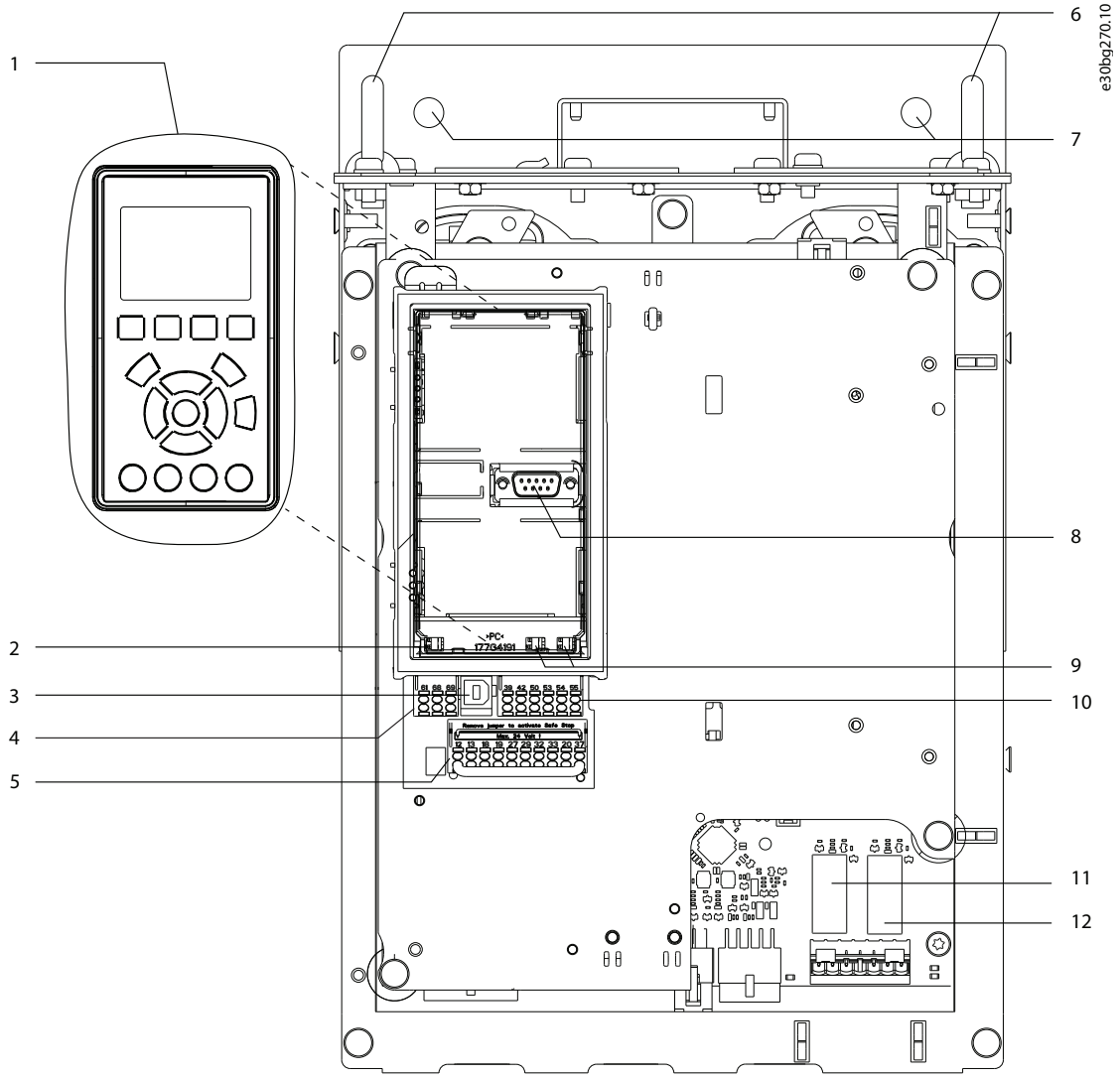
1	LCP (local control panel)	6	Mounting holes
2	Control terminals	7	Relays 1 and 2
3	Mains input terminals 91 (L1), 92 (L2), 93 (L3)	8	Motor output terminals 96 (U), 97 (V), 98 (W)
4	Ground terminals for IP21/54 (Type 1/12)	9	Cable clamps
5	Lifting ring	10	Ground terminals for IP20 (Chassis)

Figure 1.4. Interior View of D2 Drive.



1	Fieldbus top entry kit (optional)	7	Mounting hole
2	LCP (local control panel)	8	Relays 1 and 2
3	Control terminals	9	Terminal block for anti-condensation heater (optional)
4	Mains input terminals 91 (L1), 92 (L2), 93 (L3)	10	Motor output terminals 96 (U), 97 (V), 98 (W)
5	Cable clamps	11	Ground terminals for IP21/54 (Type 1/12)
6	Lifting ring	12	Ground terminals for IP20 (Chassis)

Figure 1.5. View of Control Shelf Frame D Drives.



1	Local control panel (LCP)	7	Mounting holes
2	RS485 termination switch	8	LCP connector
3	USB connector	9	Analog switches (A53, A54)
4	RS485 fieldbus connector	10	Analog I/O connector
5	Digital I/O and 24 V supply	11	Relay 1 (01, 02, 03) on power card
6	Lifting rings	12	Relay 2 (04, 05, 06) on power card

1.3.3 Block Diagram of the Adjustable Frequency Drive

Figure 1.6 is a block diagram of the internal components of the adjustable frequency drive. See Table 1.1 for their functions.

Figure 1.6. Adjustable Frequency Drive Block Diagram.

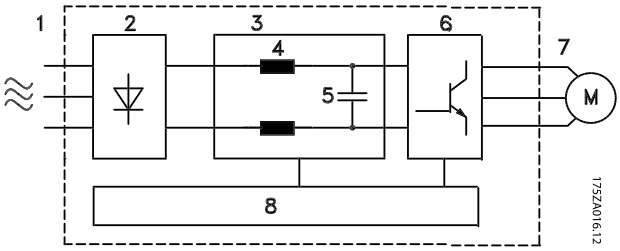


Table 1.1. Legend to Figure 1.6.

Area	Title	Functions
1	Line power input	• 3-phase AC line power supply to the adjustable frequency drive
2	Rectifier	• The rectifier bridge converts the AC input to DC current to supply inverter power
3	DC bus	• Intermediate DC bus circuit handles the DC current
4	DC reactors	• Filter the intermediate DC circuit voltage • Prove line transient protection • Reduce RMS current • Raise the power factor reflected back to the line • Reduce harmonics on the AC input
5	Capacitor bank	• Stores the DC power • Provides ride-through protection for short power losses
6	Inverter	• Converts the DC into a controlled PWM AC waveform for a controlled variable output to the motor
7	Output to motor	• Regulated 3-phase output power to the motor
8	Control circuitry	• Input power, internal processing, output, and motor current are monitored to provide efficient operation and control • User interface and external commands are monitored and performed • Status output and control can be provided

1.3.4 Enclosure Types and Power Ratings

For enclosure types and power ratings of the adjustable frequency drives, refer to Chapter 8.9 Power Ratings, Weight and Dimensions.

1.4 Approvals and Certifications

Table 1.2. Approvals and Certifications.



Drives of voltage 525–690 V are UL certified for only 525–600 V.

The adjustable frequency drive complies with UL508C thermal memory retention requirements. For more information, refer to the section Motor Thermal Protection in the Design Guide.

1.5 Disposal



Do not dispose of equipment containing electrical components together with domestic waste.

Collect it separately in accordance with local and currently valid legislation.

CHAPTER

2 SAFETY

2 Safety

2.1 Safety Symbols

The following symbols are used in this document:



Warning: Indicates a potentially hazardous situation which could result in death or serious injury.



Caution: Indicates a potentially hazardous situation which could result in minor or moderate injury. It may also be used to alert against unsafe practices.

Note: *Indicates important information, including situations that may result in damage to equipment or property.*

2.2 Qualified Personnel

Correct and reliable transport, storage, installation, operation and maintenance are required for the trouble free and safe operation of the adjustable frequency drive. Only qualified personnel is allowed to install or operate this equipment.

Qualified personnel is defined as trained staff, who are authorized to install, commission, and maintain equipment, systems and circuits in accordance with pertinent laws and regulations. Additionally, the personnel must be familiar with the instructions and safety measures described in this document.

2.3 Safety Precautions

HIGH VOLTAGE!

Adjustable frequency drives contain high voltage when connected to AC line power input, DC power supply, or load sharing. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.

- **Installation, start-up, and maintenance must be performed by qualified personnel only.**

UNINTENDED START!

When the adjustable frequency drive is connected to AC line power, the motor may start at any time, causing risk of death, serious injury, equipment, or property damage. The motor can start by means of an external switch, a serial bus command, an input reference signal from the LCP, or after a cleared fault condition.

- **Disconnect the adjustable frequency drive from line power whenever personal safety considerations make it necessary to avoid unintended motor start.**
- **Press [Off] on the LCP before programming parameters.**
- **The adjustable frequency drive, motor, and any driven equipment must be in operational readiness when the adjustable frequency drive is connected to AC line power.**

DISCHARGE TIME!

The adjustable frequency drive contains DC link capacitors that can remain charged even when the adjustable frequency drive is not powered. Failure to wait the specified time after power has been removed before performing service or repair work could result in death or serious injury.

Step 1. Stop motor.

Step 2. Disconnect AC line power, permanent magnet type motors, and remote DC link power supplies, including battery backups, UPS, and DC link connections to other adjustable frequency drives.

Step 3. Wait for the capacitors to discharge fully before performing any service or repair work. The duration of waiting time is specified in Table 2.1.

Table 2.1. Discharge Time.

Voltage	Minimum waiting time (minutes)			
	4	7	15	20
200–240	1.5–5 hp [1.1–3.7 kW]		7.5–60 hp [5.5–45 kW]	75-125 hp [55-90 kW]
380–480	1.5–10 hp [1.1–7.5 kW]		15–125 hp [11–90 kW]	150-250 hp [110-160 kW]
525–600	1.5–10 hp [1.1–7.5 kW]		15–125 hp [11–90 kW]	
525–690				150-200 hp [110-132 kW]
High voltage may be present even when the warning LED indicator lights are off.				

LEAKAGE CURRENT HAZARD!
Leakage currents exceed 3.5 mA. Failure to ground the adjustable frequency drive properly can result in death or serious injury.

- **Ensure correct grounding of the equipment by a certified electrical installer.**

LEAKAGE CURRENT HAZARD!
Contact with rotating shafts and electrical equipment can result in death or serious injury.

- **Ensure that only trained and qualified personnel perform installation, start-up, and maintenance.**
- **Ensure that electrical work conforms to national and local electrical codes.**
- **Follow the procedures in this manual.**

UNINTENDED MOTOR ROTATION WINDMILLING!
Unintended rotation of permanent magnet motors can result in serious injury or equipment damage.

- **Ensure that permanent magnet motors are blocked to prevent unintended rotation.**

INTERNAL FAILURE HAZARD!
An internal failure in the adjustable frequency drive can result in serious injury when the adjustable frequency drive is not properly closed.

- **Before applying power, ensure all safety covers are in place and securely fastened.**

CHAPTER

3 MECHANICAL INSTALLATION

3 Mechanical Installation

3.1 Unpacking

3.1.1 Items Supplied

Items supplied may vary according to product configuration.

- Make sure the items supplied and the information on the nameplate correspond to the order confirmation.
- Check the packaging and the adjustable frequency drive visually for damage caused by inappropriate handling during shipment. File any claim for damage with the carrier. Retain damaged parts for clarification.

Note: *Do not remove the nameplate from the adjustable frequency drive (loss of warranty).*

3.1.2 Storage

Ensure that requirements for storage are fulfilled. Refer to Chapter 8 Ambient Conditions for further details.

Periodic forming (capacitor charging) is not necessary during storage unless storage exceeds 12 months. For drives stored more than 12 months but less than four years apply full voltage for three hours before running motor.

3.2 Installation Environments

Note: *In environments with airborne liquids, particles, or corrosive gases, ensure that the IP/Type rating of the equipment matches the installation environment. Failure to meet requirements for ambient conditions can reduce lifetime of the adjustable frequency drive. Ensure that requirements for air humidity, temperature and altitude are met.*

Vibration and Shock

The adjustable frequency drive complies with requirements for units mounted on the walls and floors of production premises, as well as in panels bolted to walls or floors. For detailed ambient conditions specifications, refer to chapter 8.4 Ambient Conditions.

3.3 Mounting

Note: *Improper mounting can result in overheating and reduced performance.*

Cooling

Ensure that top and bottom clearance for air cooling is provided. See Figure 3.1 for clearance requirements.

Figure 3.1. Top and Bottom Cooling Clearance.

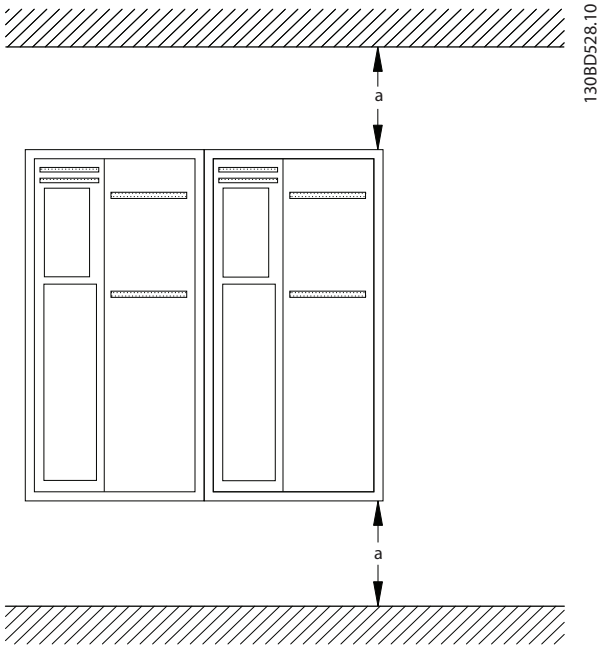


Table 3.1. Minimum Airflow Clearance Requirements.

Enclosure	A2-A5	B1-B2	C1	C2	D1, D2
a (ins [mm])	3.94 [100]	7.87 [200]	7.87 [200]	8.86 [225]	8.86 [225]

Lifting

- To determine a safe lifting method, check the weight of the unit, see Chapter 8.9 Power Ratings, Weight and Dimensions.
- Ensure that the lifting device is suitable for the task.
- If necessary, plan for a hoist, crane, or forklift with the appropriate rating to move the unit.
- For lifting, use hoist rings on the unit, when provided.

Mounting

Step 1. Ensure that the strength of the mounting location supports the unit weight. The adjustable frequency drive allows side-by-side installation.

Step 2. Place the unit as near to the motor as possible. Keep the motor cables as short as possible.

Step 3. Mount the unit vertically to a solid flat surface or to the optional backplate to provide cooling airflow.

Step 4. Use the slotted mounting holes on the unit for wall mounting, when provided.

Note: *All B, and C enclosures allow side-by-side installation. Exception: NEMA 1 Frame A drives, there has to be a clearance between the enclosures:*

- For enclosures A2 and A3 the minimum clearance is 2 ins [50 mm].

CHAPTER

4 ELECTRICAL INSTALLATION

4 Electrical Installation

4.1 Safety Instructions

See Chapter 2 Safety for general safety instructions.

INDUCED VOLTAGE

Induced voltage from output motor cables that run together can charge equipment capacitors even with the equipment turned off and locked out. Failure to run output motor cables separately or use shielded cables or metal conduits could result in death or serious injury.

- **Run output motor cables separately, or**
- **Use shielded cables or metal conduits.**

SHOCK HAZARD

The adjustable frequency drive can cause a DC current in the PE conductor. Failure to follow the recommendation below means the RCD may not provide the intended protection.

- **When a residual current-operated protective device (RCD) is used for protection against electrical shock, only an RCD of Type B is permitted on the supply side.**

Note: *The adjustable frequency drive is supplied with Class 20 motor overload protection.*

Overcurrent Protection

- Additional protective equipment such as short-circuit protection or motor thermal protection between adjustable frequency drive and motor is required for applications with multiple motors.
- Input fusing is required to provide short circuit and overcurrent protection. If not factory-supplied, fuses must be provided by the installer. See maximum fuse ratings in 8.8 Fuses and Circuit Breakers.

Wire Type and Ratings

- All wiring must comply with local and national regulations regarding cross-section and ambient temperature requirements.
- Power connection wire recommendation: minimum 167°F [75°C] rated copper wire.

See Chapter 8.1 Electrical Data and Chapter 8.5 Cable Specifications for recommended wire sizes and types.

4.2 EMC-compliant Installation

To obtain an EMC-compliant installation, follow the instructions provided in Chapter 4.3 Grounding, Chapter 4.4 Wiring Schematic, Chapter 4.6 Motor Connection, and Chapter 4.8 Control Wiring.

4.3 Grounding

LEAKAGE CURRENT HAZARD
Leakage currents exceed 3.5 mA. Failure to ground the adjustable frequency drive properly could result in death or serious injury.

- **Ensure correct grounding of the equipment by a certified electrical installer.**

For electrical safety

- Ground the adjustable frequency drive in accordance with applicable standards and directives.
- Use a dedicated ground wire for input power, motor power and control wiring.
- Do not ground one adjustable frequency drive to another in a “daisy chain” fashion.
- Keep the ground wire connections as short as possible.
- Follow the motor manufacturer wiring requirements.
- Minimum cable cross-section: AWG 7 [10 mm^2] (or two rated ground wires terminated separately).

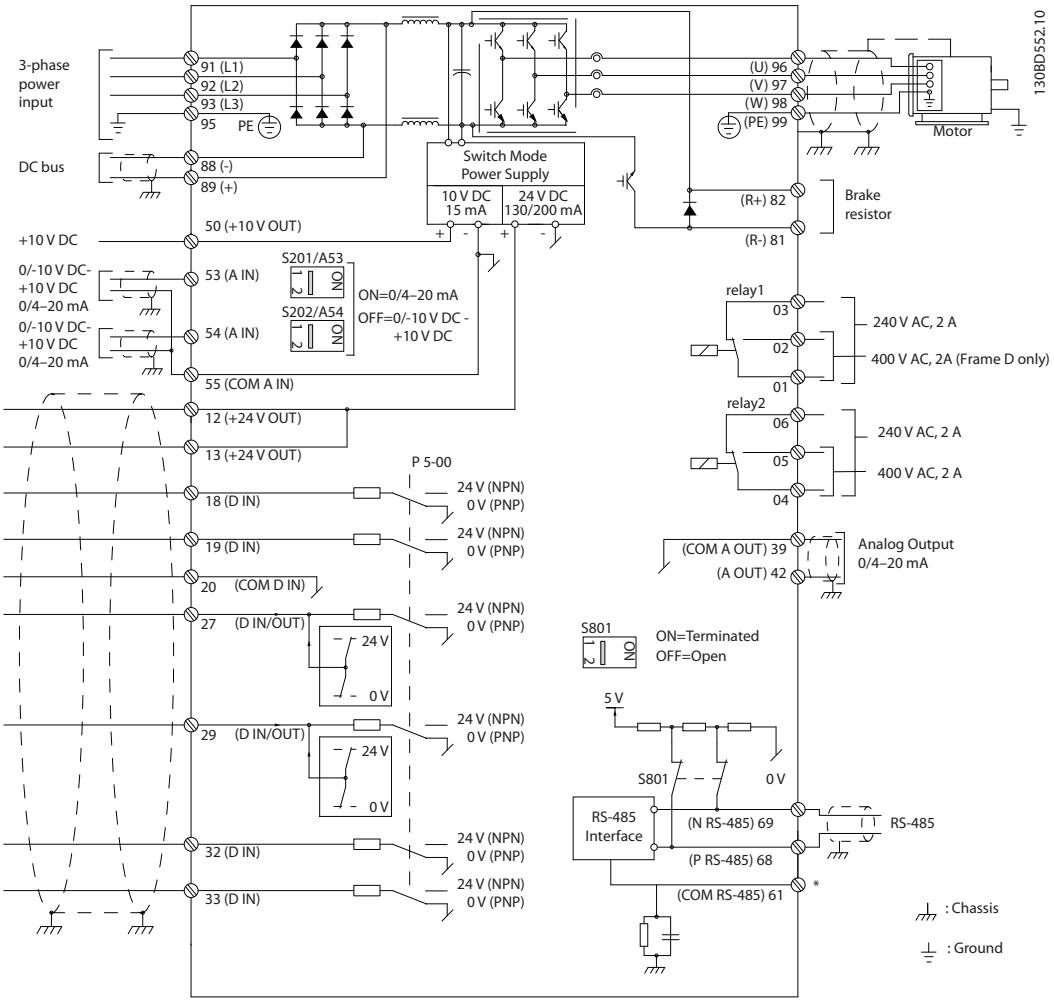
For EMC-compliant installation

- Establish electrical contact between cable shield and adjustable frequency drive enclosure by using metal cable connectors or by using the clamps provided on the equipment (see Chapter 4.6 Motor Connection).
- Use high-strand wire to reduce electrical interference.
- Do not use pigtails.

Note: *POTENTIAL EQUALIZATION*
Risk of electrical interference, when the ground potential between the adjustable frequency drive and the system is different. Install equalizing cables between the system components. Recommended cable cross-section: AWG 6 [16 mm^2].

4.4 Wiring Schematic

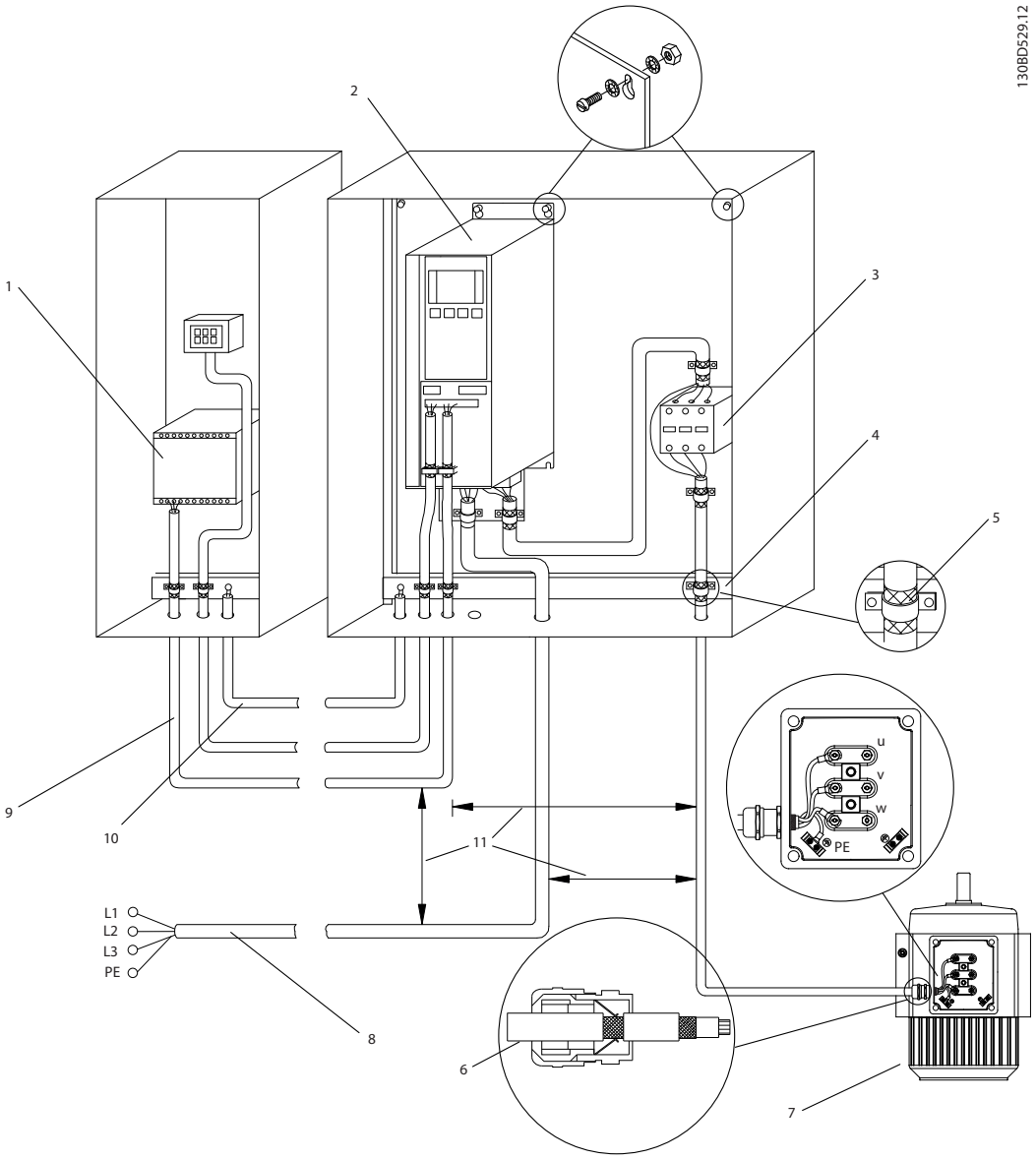
Figure 4.1. Basic Wiring Schematic.



A=Analog, D=Digital

*Do not connect cable shield.

Figure 4.2. EMC-compliant Electrical Connection.



1	PLC	6	Cable connector
2	Adjustable frequency drive	7	Motor, 3-phase and PE
3	Output contactor	8	Line power, 3-phase and reinforced PE
4	Grounding rail (PE)	9	Control wiring
5	Cable insulation (stripped)	10	Equalizing min. 0.025 in^2 [16 mm^2]

Note: *EMC INTERFERENCE*
Run cables for input power, motor wiring and control wiring in three separate metallic conduits. Failure to isolate power, motor and control cables can result in unintended behavior or reduced performance. Minimum 7.9 in [200 mm] clearance between power, motor and control cables is required.

4.5 Access

Remove cover with a screwdriver (See Figure 4.3) or by loosening attaching screws (See Figure 4.4).

Figure 4.3. Access to Wiring for NEMA 1 (IP21) Enclosures.

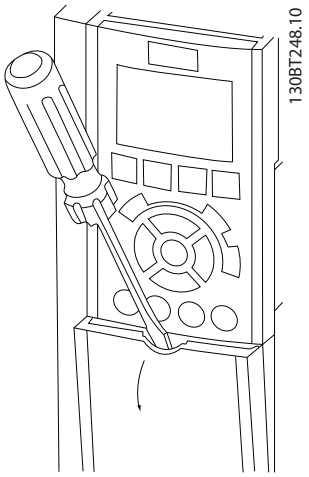
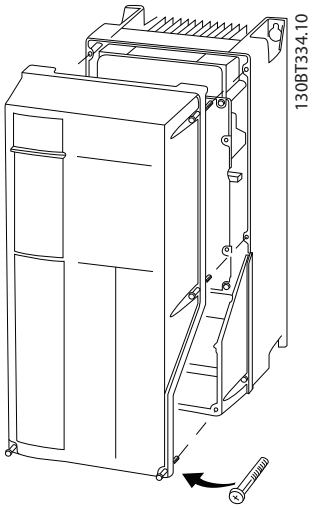


Figure 4.4. Access to Wiring for NEMA 12 (IP54/55) Enclosures.



See Table 4.1 before tightening the covers.

Table 4.1. Tightening Torques for Covers [Nm].

Enclosure	IP55
A5	2
B1/B2	2.2
C1/C2	2.2
No screws to tighten for A2/A3.	

4.6 Motor Connection

INDUCED VOLTAGE!
Induced voltage from output motor cables that run together can charge equipment capacitors even with the equipment turned off and locked out. Failure to run output motor cables separately or use shielded cables or metal conduits could result in death or serious injury.

- **Comply with local and national electrical codes for cable sizes. For maximum wire sizes, see Chapter 8.1 Electrical Data.**
- **Follow the motor manufacturer wiring requirements.**
- **Motor wiring knockouts or access panels are provided at the base of IP21 (NEMA1/12) and higher units.**
- **Do not wire a starting or pole-changing device (e.g., Dahlander motor or slip ring induction motor) between the adjustable frequency drive and the motor.**

Procedure

Step 1. Strip a section of the outer cable insulation.

Step 2. Position the stripped wire under the cable clamp to establish mechanical fixation and electrical contact between cable shield and ground.

Step 3. Connect ground wire to the nearest grounding terminal in accordance with grounding instructions provided in Chapter 4.3 Grounding, see Figure 4.5.

Step 4. Connect the 3-phase motor wiring to terminals 96 (U), 97 (V), and 98 (W), see Figure 4.5.

Step 5. Tighten terminals in accordance with the information provided in 8.7 Connection Tightening Torques.

Figure 4.5. Motor Connection.

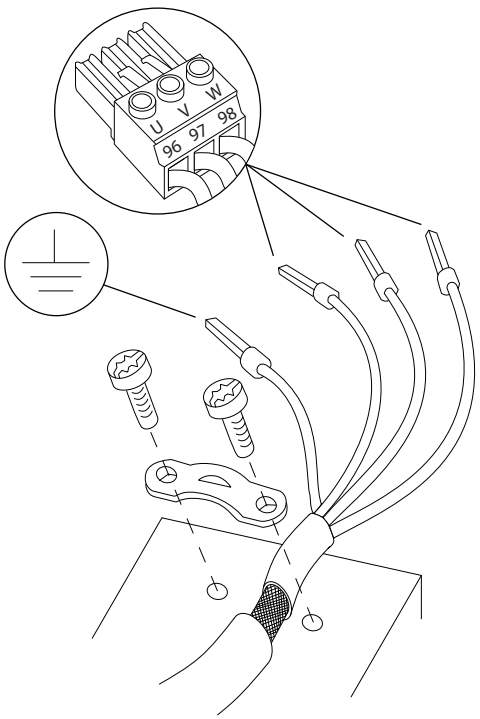


Figure 4.6, Figure 4.7, Figure 4.8, Figure 4.9, and Figure 4.10 and represent line power input, motor, and grounding for basic adjustable frequency drives. Actual configurations vary with unit types and optional equipment.

Figure 4.6. Motor Connection for Enclosure Type A2 and A3.

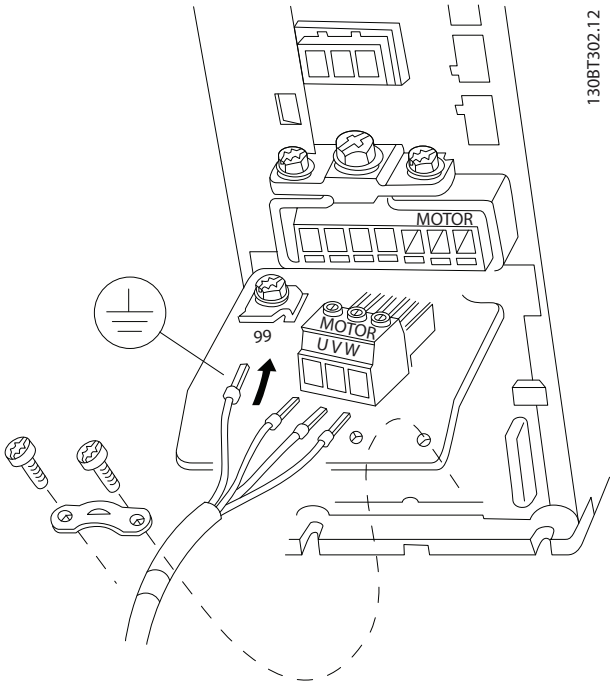


Figure 4.7. Motor Connection for Enclosure Type A5 (IP55/NEMA Type 12).

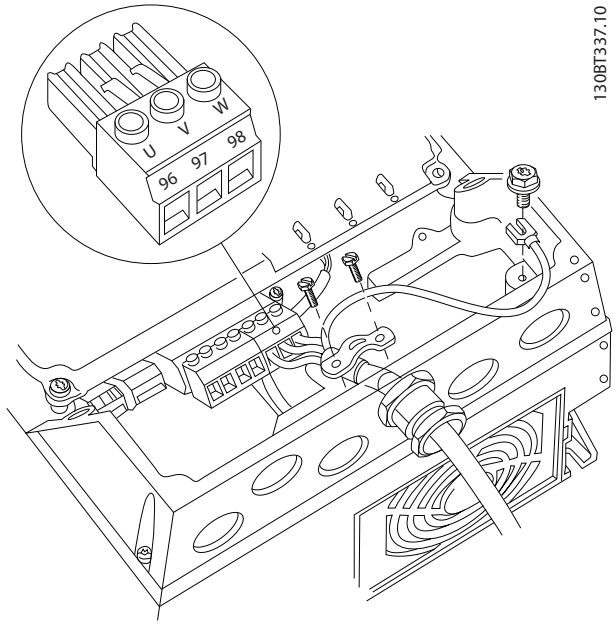


Figure 4.8. Motor Terminals (D1 shown).

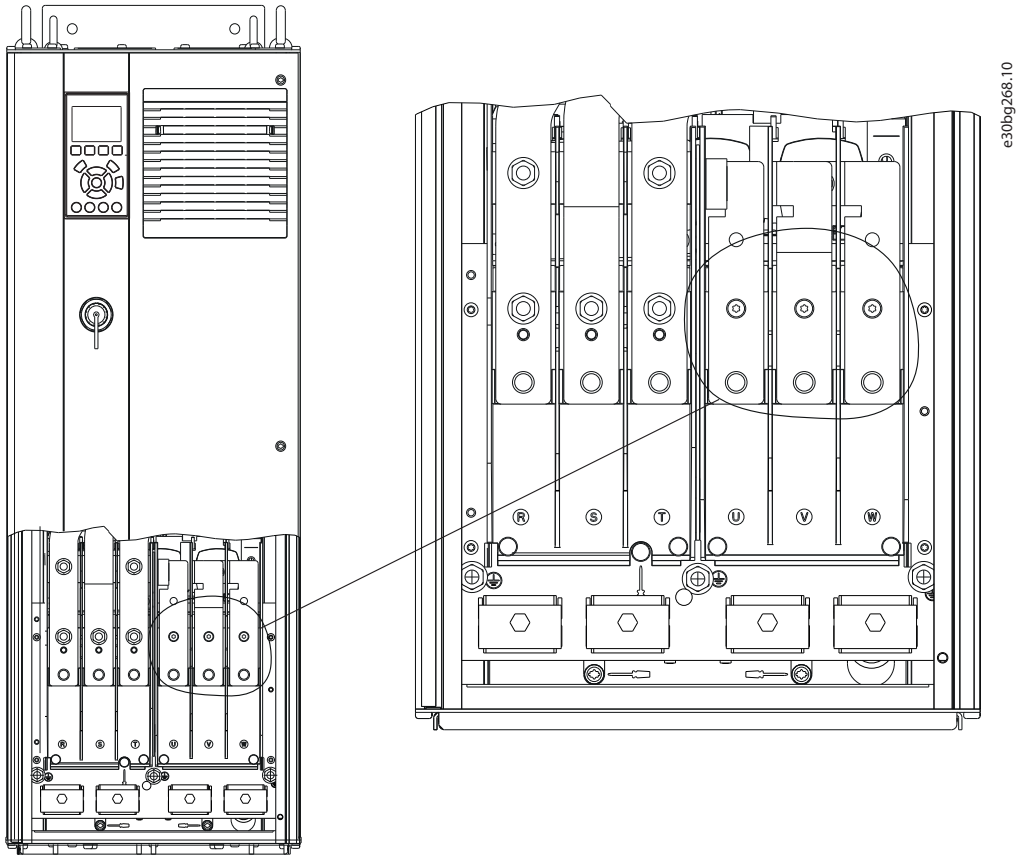


Figure 4.9. Motor, Line Power and Ground Wiring for Enclosure Types B and C Using Shielded Cable.

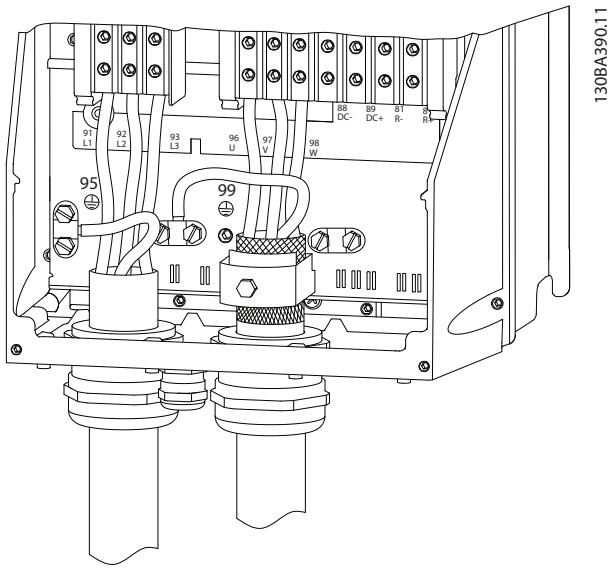
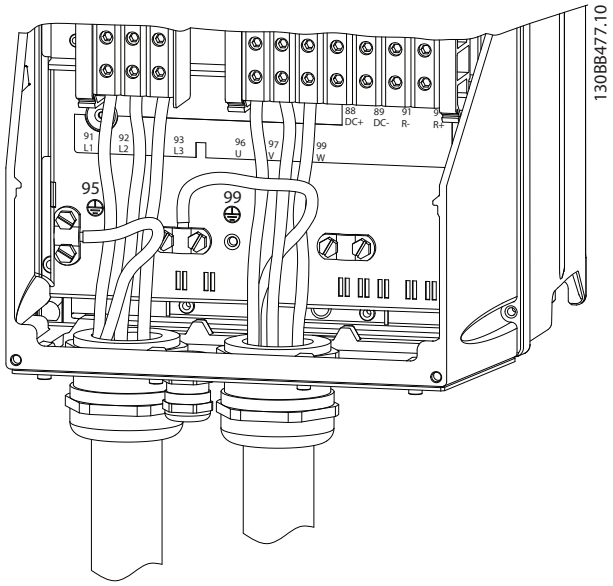


Figure 4.10. Motor, Line Power and Ground Wiring for Enclosure Types B and C Using Conduit.



4.7 AC Line Input Connection

- Size wiring based upon the input current of the adjustable frequency drive. For maximum wire sizes, see Chapter 8.1 Electrical Data.
- Comply with local and national electrical codes for cable sizes.

Procedure

Step 1. Connect 3-phase AC input power wiring to terminals L1, L2, and L3 (R, S and T on Frame D) (see Figure 4.11 and Figure 4.12).

Step 2. Depending on the configuration of the equipment, input power will be connected to the line power input terminals or the input disconnect.

Step 3. Ground the cable in accordance with grounding instructions provided in Chapter 4.3 Grounding.

Step 4. When supplied from an isolated line power source (IT line power or floating delta) or TT/TN-S line power with a grounded leg (grounded delta), ensure that 14-50 RFI Filter is set to OFF to avoid damage to the intermediate circuit and to reduce ground capacity currents in accordance with IEC 61800-3.

Figure 4.11. Connecting to AC Line Power (Frames A, B and C).

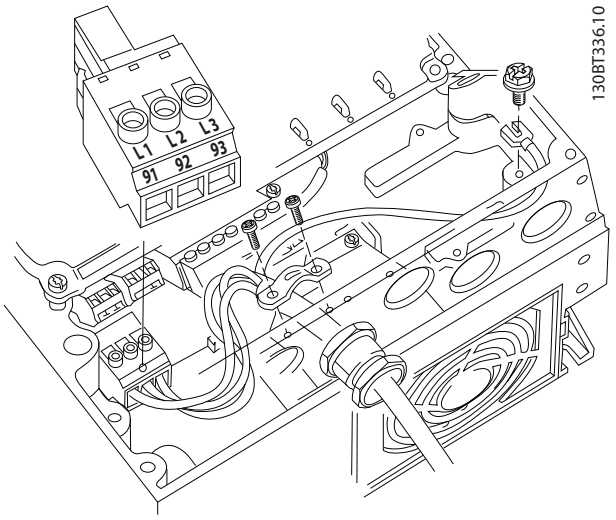
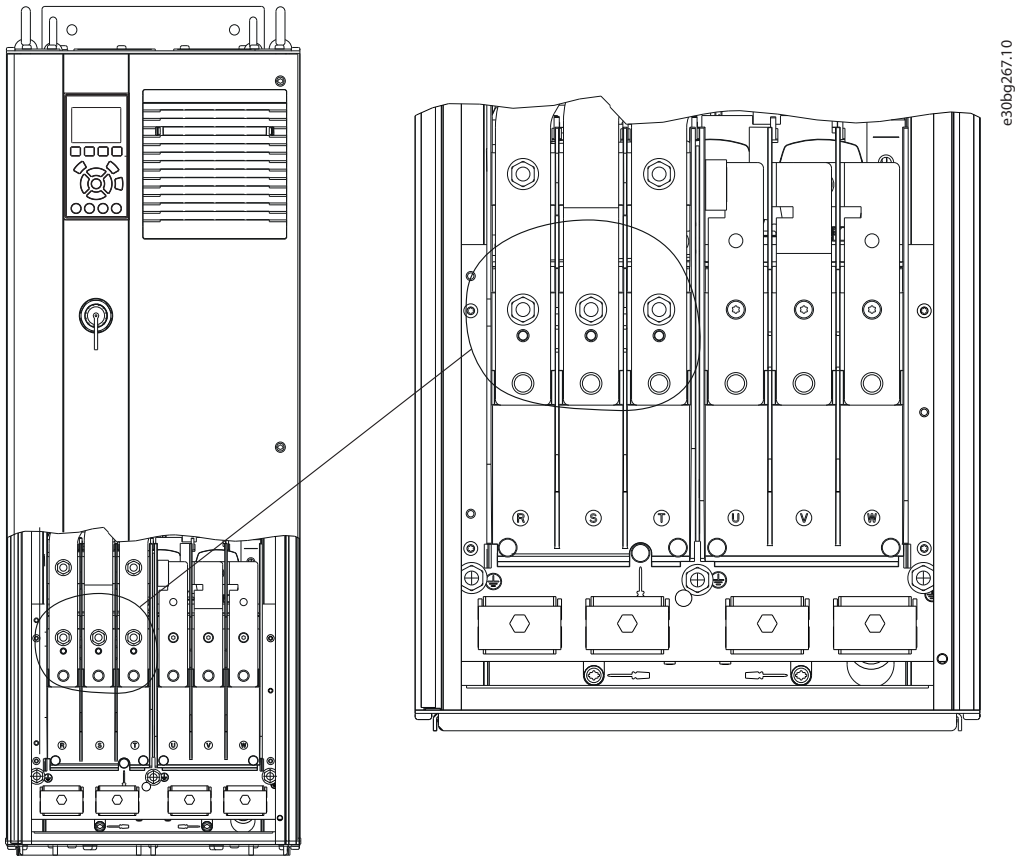


Figure 4.12. AC Mains Terminals (D1 shown).



4.8 Control Wiring

- Isolate control wiring from high power components in the adjustable frequency drive.
- When the adjustable frequency drive is connected to a thermistor, ensure that the thermistor control wiring is shielded and reinforced/double insulated. A 24 V DC supply voltage is recommended.

4.8.1 Control Terminal Types

Figure 4.13 and Figure 4.14 show the removable adjustable frequency drive connectors. Terminal functions and default settings are summarized in Table 4.2.

Figure 4.13. Control Terminal Locations.

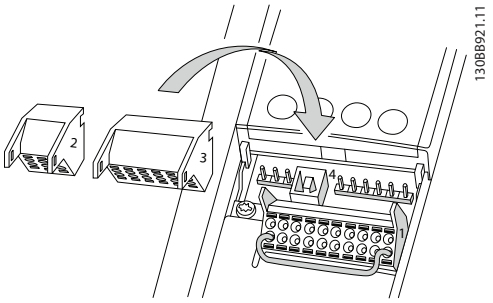
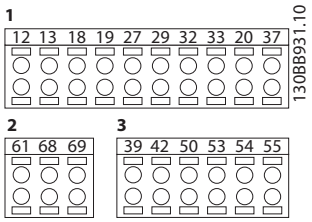


Figure 4.14. Terminal Numbers.



- **Connector 1** provides four programmable digital inputs terminals, two additional digital terminals programmable as either input or output, a 24 V DC terminal supply voltage, and a common for optional customer supplied 24 V DC voltage.
- **Connector 2** terminals (+) 68 and (-) 69 are for an RS-485 serial communication connection.
- **Connector 3** provides two analog inputs, one analog output, 10 V DC supply voltage, and commons for the inputs and output.
- **Connector 4** is a USB port available for use with the MCT 10 Set-up Software.

Table 4.2. Terminal Description.

Terminal	Parameter	Default Setting	Description
Digital Inputs/Outputs			
12, 13	—	+24 V DC	24 V DC supply voltage for digital inputs and external transducers. Maximum output current 200 mA for all 24 V loads.
18	5-10	[8] Start	Digital inputs.
19	5-11	[0] No operation	
32	5-14	[0] No operation	
33	5-15	[0] No operation	
27	5-12	[2] Coast inverse	For digital input or output. Default setting is input.
29	5-13	[14] JOG	
20	—		Common for digital inputs and 0 V potential for 24 V supply.
Analog Inputs/Outputs			
39	—		Common for analog output.
42	6-50	Speed 0 - High Limit	Programmable analog output. 0–20 mA or 4–20 mA at a maximum of 500 Ω
50	—	+10 V DC	10 V DC analog supply voltage for potentiometer or thermistor. 15 mA maximum
53	6-1	Reference	Analog input. For voltage or current. Switches A53 and A54 select mA or V.
54	6-2	Feedback	
55	—		Common for analog input.
Serial Communication			
61	—		Integrated RC filter for cable shield. ONLY for connecting the shield in the event of EMC problems.
68 (+)	8-3		RS-485 Interface. A control card switch is provided for termination resistance.
69 (-)	8-3		
Relays			
01, 02, 03	5-40 [0]	[9] Alarm	Form C relay output. For AC or DC voltage and resistive or inductive loads.
04, 05, 06	5-40 [1]	[5] Running	

Additional terminals:

- Two form C relay outputs. Location of the outputs depends on adjustable frequency drive configuration.
- Terminals located on built-in optional equipment. See the manual provided with the equipment option.

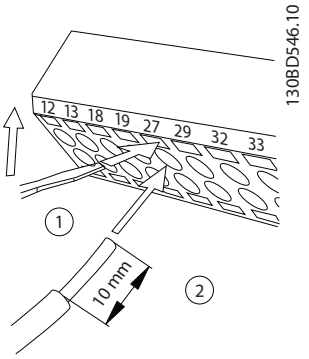
4.8.2 Wiring to Control Terminals

Control terminal connectors can be unplugged from the adjustable frequency drive for ease of installation, as shown in Figure 4.13.

Note: *Keep control wires as short as possible and separate from high power cables to minimize interference.*

Step 1. Open the contact by inserting a small screwdriver into the slot above the contact and push the screwdriver slightly upwards.

Figure 4.15. Connecting Control Wires.



Step 2. Insert the bared control wire into the contact.

Step 3. Remove the screwdriver to fasten the control wire into the contact.

Step 4. Ensure the contact is firmly established and not loose. Loose control wiring can be the source of equipment faults or less than optimal operation.

See Chapter 8.5 Cable Specifications for control terminal wiring sizes and 6 Application Set-up Examples for typical control wiring connections.

4.8.3 Enabling Motor Operation (Terminal 27)

A jumper wire may be required between terminal 12 (or 13) and terminal 27 for the adjustable frequency drive to operate if the drive is configured for External Interlock.

- Digital input terminal 27 is designed to receive an 24 V DC external interlock command. In many applications, the user wires an external interlock device to terminal 27.
- When the status line at the bottom of the LCP reads AUTO REMOTE COAST or EXTERNAL INTERLOCK [A60], this indicates that the unit is ready to operate but is missing an input signal on terminal 27.
- When factory installed optional equipment is wired to terminal 27, do not remove that wiring.

4.8.4 Voltage/Current Input Selection (Switches)

The analog input terminals 53 and 54 allow setting of input signal to voltage (0–10 V) or current (0/4–20 mA).

Default parameter settings:

- Terminal 53: speed reference signal in open-loop (see 16-61 Terminal 53 Switch Setting).
- Terminal 54: feedback signal in closed-loop (see 16-63 Terminal 54 Switch Setting).

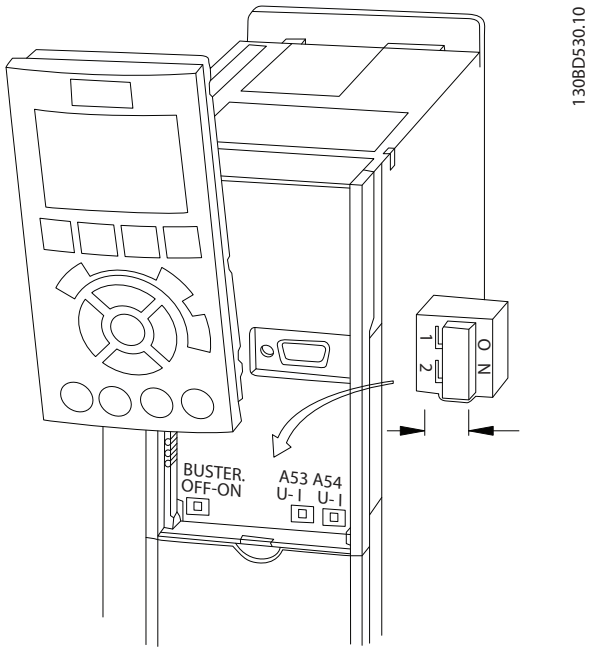
Note: *Disconnect power to the adjustable frequency drive before changing switch positions.*

Step 1. Remove the local control panel (see Figure 4.16.)

Step 2. Remove any optional equipment covering the switches.

Step 3. Set switches A53 and A54 to select the signal type. U selects voltage, I selects current.

Figure 4.16. Location of Terminals 53 and 54 Switches.



4.8.5 RS-485 Serial Communication

Up to 32 nodes can be connected as a bus, or via drop cables from a common trunk line to one network segment. Repeaters can divide network segments. Each repeater functions as a node within the segment in which it is installed. Each node connected within a given network must have a unique node address across all segments.

- Connect RS-485 serial communication wiring to terminals (+) 68 and (-) 69.

- Terminate each segment at both ends, using either the termination switch (bus term on/off, see Figure 4.16) on the adjustable frequency drives, or a biased termination resistor network.
- Connect a large surface of the shield to ground, for example with a cable clamp or a conductive cable connector.
- Apply potential-equalizing cables to maintain the same ground potential throughout the network.
- Use the same type of cable throughout the entire network to prevent impedance mismatch.

Table 4.3. Cable Information.

Cable	Shielded twisted pair (STP)
Impedance	120 Ω
Max. cable length (ft [m])	4,000 ft [1,200 m] (including drop lines) 1,650 ft [500 m] station-to-station

4.9 Installation Check List

Before completing installation of the unit, inspect the entire installation as detailed in Table 4.4. Check and mark the items when completed.

Table 4.4. Installation Check List.

Inspect for	Parameter	✓
Auxiliary equipment	• Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers that may reside on the input power side of the adjustable frequency drive or output side to the motor. Ensure that they are ready for full-speed operation. • Check function and installation of any sensors used for feedback to the adjustable frequency drive. • Remove any power factor correction caps on motor(s). • Adjust any power factor correction caps on the line power side and ensure that they are dampened.	
Cable routing	• Ensure that motor wiring and control wiring are separated or shielded or in three separate metallic conduits for high-frequency interference isolation.	
Control wiring	• Check for broken or damaged wires and loose connections. • Check that control wiring is isolated from power and motor wiring for noise immunity. • Check the voltage source of the signals, if necessary. • The use of shielded cable or twisted pair is recommended. Ensure that the shield is terminated correctly.	
Cooling clearance	• Measure that top and bottom clearance is adequate to ensure proper air flow for cooling, see chapter 3.3 Mounting.	
Ambient conditions	• Check that requirements for ambient conditions are met.	
Fusing and circuit breakers	• Check for proper fusing or circuit breakers. • Check that all fuses are inserted firmly and are in operational condition and that all circuit breakers are in the open position.	
Grounding	• Check for sufficient ground connections that are tight and free of oxidation. • Grounding to conduit or mounting the back panel to a metal surface is not a suitable grounding.	

Inspect for	Parameter	✓
Input and output power wiring	• Check for loose connections. • Check that motor and line power are in separate conduits or separated shielded cables.	
Panel interior	• Make sure that the unit interior is free of dirt, metal chips, moisture, and corrosion. • Check that the unit is mounted on an unpainted, metal surface.	
Switches	• Ensure that all switch and disconnect settings are in the proper positions.	
Vibration	• Check that the unit is mounted solidly or that shock mounts are used, as necessary. • Check for an unusual amount of vibration.	

POTENTIAL HAZARD IN THE EVENT OF INTERNAL FAILURE
Risk of personal injury when the adjustable frequency drive is not properly closed.

- **Before applying power, ensure all safety covers are in place and securely fastened.**

CHAPTER

5 COMMISSIONING

5 Commissioning

5.1 Safety Instructions

See Chapter 2 Safety for general safety instructions.

HIGH VOLTAGE
Adjustable frequency drives contain high voltage when connected to AC line input power. Failure to perform installation, start-up, and maintenance by qualified personnel could result in death or serious injury.

- **Installation, start-up, and maintenance must be performed by qualified personnel only.**

Before applying power:

Step 1. Close cover properly.

Step 2. Check that all cable connectors are firmly tightened.

Step 3. Ensure that input power to the unit is OFF and locked out. Do not rely on the adjustable frequency drive disconnect switches for input power isolation.

Step 4. Verify that there is no voltage on input terminals L1 (91), L2 (92), and L3 (93), phase-to-phase and phase-to-ground.

Step 5. Verify that there is no voltage on output terminals 96 (U), 97 (V), and 98 (W), phase-tophase and phase-to-ground.

Step 6. Confirm continuity of the motor by measuring ohm values on U-V (96-97), V-W (97-98), and W-U (98-96).

Step 7. Check for proper grounding of the adjustable frequency drive as well as the motor.

Step 8. Inspect the adjustable frequency drive for loose connections on terminals.

Step 9. Confirm that the supply voltage matches voltage of adjustable frequency drive and motor.

5.2 Applying Power

UNINTENDED START
When the adjustable frequency drive is connected to AC line power, the motor may start at any time, causing risk of death, serious injury, equipment, or property damage. The motor can start by means of an external switch, a serial bus command, an input reference signal from the LCP, or after a cleared fault condition.



- **Disconnect the adjustable frequency drive from line power whenever personal safety considerations make it necessary to avoid unintended motor start.**
- **Press [Off] on the LCP before programming parameters.**
- **The adjustable frequency drive, motor, and any driven equipment must be in operational readiness when the adjustable frequency drive is connected to AC line power.**

Apply power to the adjustable frequency drive using the following steps:

Step 1. Confirm that the input voltage is balanced within 3%. If not, correct input voltage imbalance before proceeding. Repeat this procedure after the voltage correction.

Step 2. Ensure that optional equipment wiring, if present, matches the installation application.

Step 3. Ensure that all operator devices are in the OFF position. Panel doors must be closed or cover mounted.

Step 4. Apply power to the unit. DO NOT start the adjustable frequency drive now.

Note: *When the status line at the bottom of the LCP reads AUTO REMOTE COASTING or EXTERNAL INTERLOCK [A60] is displayed, this message indicates that the unit is ready to operate but is missing an input signal on, for example, terminal 27. See Chapter 4.8.3 Enabling Motor Operation (Terminal 27) for details.*

5.3 Local Control Panel Operation

5.3.1 Local Control Panel

The local control panel (LCP) is the combined display and keypad on the front of the unit.

The LCP has several user functions:

- Start, stop, and control speed when in local control
- Display operational data, status, warnings and cautions
- Programming adjustable frequency drive functions
- Manually reset the adjustable frequency drive after a fault when auto-reset is inactive

5.3.2 LCP Layout

The LCP is divided into four functional groups (see Figure 5.1).

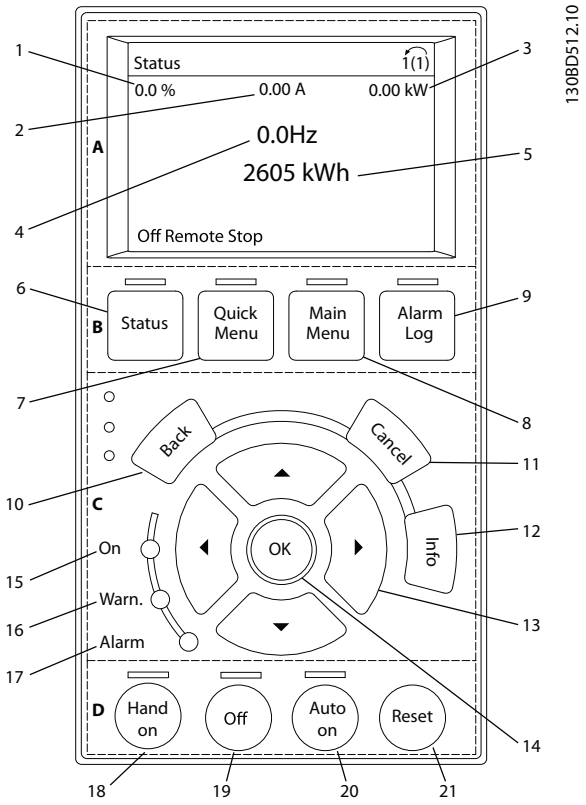
A. Display area

B. Display menu keys

C. Navigation keys and LEDs

D. Operation keys and reset

Figure 5.1. Local Control Panel (LCP).



A. Display Area

The display area is activated when the adjustable frequency drive receives power from AC line voltage, a DC bus terminal, or an external 24 V DC supply.

The information displayed on the LCP can be customized for user application. Select options in the Quick Menu Q3-13 Display Settings.

Table 5.1. Legend to Figure 5.1, Display Area.

Callout	Display	Parameter number	Default setting
1	1.1	0–20	Reference %
2	1.2	0–21	Motor current
3	1.3	0–22	Power [kW]

Callout	Display	Parameter number	Default setting
4	2	0–23	Frequency
5	3	0–24	kWh counter

B. Display Menu Keys

Menu keys are used for menu access for parameter set-up, toggling through status display modes during normal operation, and viewing fault log data.

Table 5.2. Legend to Figure 5.1, Display Menu Keys.

Callout	Key	Function
6	Status	Shows operational information.
7	Quick Menu	Allows access to programming parameters for initial set-up instructions and many detailed application instructions.
8	Main Menu	Allows access to all programming parameters.
9	Alarm Log	Displays a list of current warnings, the last ten alarms, and the maintenance log.

C. Navigation Keys and Indicator Lights (LEDs)

Navigation keys are used for programming functions and moving the display cursor. The navigation keys also provide speed control in local (hand) operation. There are also three adjustable frequency drive status indicator lights in this area.

Table 5.3. Legend to Figure 5.1, Navigation Keys.

Callout	Key	Function
10	Back	Reverts to the previous step or list in the menu structure.
11	Cancel	Cancels the last change or command as long as the display mode has not changed.
12	Info	Press for a definition of the function being displayed.
13	Navigation keys	Press to move between items in the menu.
14	OK	Press to access parameter groups or to enable a choice.

Table 5.4. Legend to Figure 5.1, Indicator Lights (LEDs).

Callout	Key	Light	Function
15	ON	Green	The ON light activates when the adjustable frequency drive receives power from AC line voltage, a DC bus terminal, or an external 24 V supply.
16	WARN	Yellow	When warning conditions are met, the yellow WARN light comes on and text appears in the display area identifying the problem.
17	ALARM	Red	A fault condition causes the red alarm light to flash and an alarm text is displayed.

D. Operation Keys and Reset

Operation keys are located at the bottom of the LCP.

Table 5.5. Legend to Figure 5.1, Operation Keys and Reset.

Callout	Key	Function
18	Hand On	Starts the adjustable frequency drive in local control. • An external stop signal by control input or serial communication overrides the local hand on
19	Off	Stops the motor but does not remove power to the adjustable frequency drive.
20	Auto On	Puts the system in remote operational mode. • Responds to an external start command by control terminals or serial communication
21	Reset	Resets the adjustable frequency drive manually after a fault has been cleared.

Note: *The display contrast can be adjusted by pressing [Status] and* [▲]/[▼] *keys.*

5.3.3 Parameter Settings

Establishing the correct programming for applications often requires setting functions in several related parameters.

Programming data are stored internally in the adjustable frequency drive.

- For backup, upload data into the LCP memory
- To download data to another adjustable frequency drive, connect the LCP to that unit and download the stored settings
- Restoring factory default settings does not change data stored in the LCP memory

5.3.4 Uploading/Downloading Data to/from the LCP

Step 1. Press [Off] to stop the motor before uploading or downloading data.

Step 2. Go to [Main Menu] 0-50 LCP Copy and press [OK].

Step 3. Select [1] All to LCP to upload data to LCP or select [2] All from LCP to download data from the LCP.

Step 4. Press [OK]. A progress bar shows the uploading or downloading process.

Step 5. Press [Hand On] or [Auto On] to return to normal operation.

5.3.5 Changing Parameter Settings

Parameter settings can be accessed and changed from the [Quick Menu] or from the [Main Menu]. The [Quick Menu] only gives access to a limited number of parameters.

Step 1. Press [Quick Menu] or [Main Menu] on the LCP.

Step 2. Press [▲]/[▼] to browse through the parameter groups, press [OK] to select a parameter group.

Step 3. Press [▲]/[▼] to browse through the parameters, press [OK] to select a parameter.

Step 4. Press [▲]/[▼] to change the value of a parameter setting.

Step 5. Press [▲]/[▼] to shift digit when a decimal parameter is in the editing state.

Step 6. Press [OK] to accept the change. 7. Press either [Back] twice to enter Status, or press [Main Menu] once to enter Main Menu.

View changes

Quick Menu Q5 - Changes Made lists all parameters changed from default settings.

- The list shows only parameters which have been changed in the current edit setup.
- Parameters which have been reset to default values are not listed.
- The message Empty indicates that no parameters have been changed.

5.3.6 Restoring Default Settings

Note: *Risk of losing programming, motor data, localization, and monitoring records by restoration of default settings. To provide a backup, upload data to the LCP before initialization.*

Restoring the default parameter settings is done by initialization of the adjustable frequency drive. Initialization is carried out through 14-22 Operation Mode (recommended) or manually.

- Initialization using 14-22 Operation Mode does not reset adjustable frequency drive settings such as operating hours, serial communication selections, personal menu settings, fault log, alarm log, and other monitoring functions.
- Manual initialization erases all motor, programming, localization, and monitoring data and restores factory default settings.

Recommended initialization procedure, via 14-22 Operation Mode

Step 1. Press [Main Menu] twice to access parameters.

Step 2. Scroll to 14-22 Operation Mode and press [OK].

Step 3. Scroll to Initialization and press [OK].

Step 4. Remove power to the unit and wait for the display to turn off.

Step 5. Apply power to the unit.

Default parameter settings are restored during start-up. This may take slightly longer than normal.

Step 6. Alarm 80 is displayed.

Step 7. Press [Reset] to return to operation mode.

Manual initialization procedure

Step 1. Remove power to the unit and wait for the display to turn off.

Step 2. Press and hold [Status], [Main Menu], and [OK] at the same time while applying power to the unit (approximately 5 s or until audible click and fan starts).

Factory default parameter settings are restored during start-up. This may take slightly longer than normal. Manual initialization does not reset the following adjustable frequency drive information:

- 15-00 Operating hours
- 15-03 Power Up's
- 15-04 Over Temp's
- 15-05 Over Volt's

5.4 Basic Programming

5.4.1 Commissioning with SmartStart

The SmartStart wizard enables fast configuration of basic motor and application parameters.

- At first power-up or after initialization of the adjustable frequency drive, SmartStart starts automatically.
- Follow on-screen instructions to complete commissioning of the adjustable frequency drive. Always reactivate SmartStart by selecting Quick Menu Q4 - SmartStart.
- For commissioning without use of the SmartStart wizard, refer to Chapter 5.4.2 Commissioning via [Main Menu] or the Programming Guide.

Note: *Motor data are required for the SmartStart set-up. The required data are normally available on the motor nameplate.*

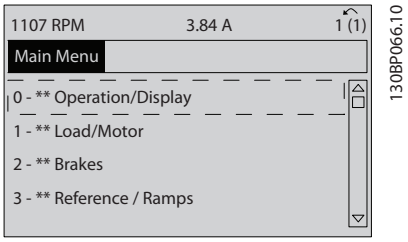
5.4.2 Commissioning via [Main Menu]

Recommended parameter settings are intended for startup and checkout purposes. Application settings may vary. Enter data with power ON, but before operating the adjustable frequency drive.

Step 1. Press [Main Menu] on the LCP.

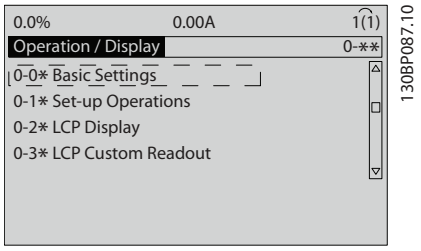
Step 2. Press the navigation keys to scroll to parameter group 0-** Operation/Display and press [OK].

Figure 5.2. Main Menu.



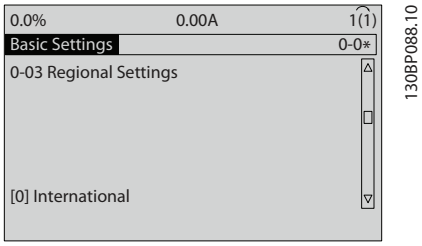
Step 3. Press navigation keys to scroll to parameter group 0-0* Basic Settings and press [OK].

Figure 5.3. Operation/Display.



Step 4. Press navigation keys to scroll to 0-03 Regional Settings and press [OK].

Figure 5.4. Basic Settings.



Step 5. Press navigation keys to select [0] International or [1] North America as appropriate and press [OK]. (This changes the default settings for a number of basic parameters).

Step 6. Press [Main Menu] on the LCP.

Step 7. Press the navigation keys to scroll to 0-01 Language.

Step 8. Select language and press [OK].

Step 9. If a jumper wire is in place between control terminals 12 and 27, set 5-12 Terminal 27 Digital Input to External Interlock. Otherwise, leave 5-12 Terminal 27 Digital Input at factory default No Operation.

Step 10. 3-02 Minimum Reference

Step 11. 3-03 Maximum Reference

Step 12. 3-41 Ramp 1 Ramp Up Time

Step 13. 3-42 Ramp 1 Ramp Down Time

Step 14. 3-13 Reference Site. Linked to Hand/Auto Local Remote.

5.4.3 Asynchronous Motor Set-up

Enter the motor data in parameter 1-20 Motor Power [kW] or 1-21 Motor Power [HP] to 1-25 Motor Nominal Speed. The information can be found on the motor nameplate.

Step 1. 1-20 Motor Power [kW] or 1-21 Motor Power [HP]

Step 2. 1-22 Motor Voltage

Step 3. 1-23 Motor Frequency

Step 4. 1-24 Motor Current

Step 5. 1-25 Motor Nominal Speed

5.4.4 Permanent Magnet Motor Set-up

Note: *Only use permanent magnet (PM) motor with fans and pumps.*

Initial Programming Steps

Step 1. Activate PM motor operation 1-10 Motor Construction, select (1) PM, non-salient SPM.

Step 2. Set 0-02 Motor Speed Unit to [0] RPM.

Programming motor data

After selecting PM motor in 1-10 Motor Construction, the PM motor-related parameters in parameter groups 1-2* Motor Data, 1-3* Addl. Motor Data and 1-4* are active.

The necessary data can be found on the motor nameplate and in the motor data sheet.

Program the following parameters in the listed order

Step 1. 1-24 Motor Current

Step 2. 1-26 Motor Cont. Rated Torque

Step 3. 1-25 Motor Nominal Speed

Step 4. 1-39 Motor Poles

Step 5. 1-30 Stator Resistance (Rs)
Enter line to common stator winding resistance (Rs). If only line-line data

are available, divide the line-line value by 2 to achieve the line to common (starpoint) value.
It is also possible to measure the value with an ohmmeter, which takes the resistance of the cable into account. Divide the measured value by 2 and enter the result.

Step 6. 1-37 d-axis Inductance (Ld)
Enter line to common direct axis inductance of the PM motor. If only line-line data are available, divide the line-line value by 2 to achieve the line-common (starpoint) value.
It is also possible to measure the value with an inductance meter, which takes the inductance of the cable into account. Divide the measured value by 2 and enter the result.

Step 7. 1-40 Back EMF at 1000 RPM
Enter line-to-line back EMF of PM Motor at 1000 RPM mechanical speed (RMS value). Back EMF is the voltage generated by a PM motor when no drive is connected and the shaft is turned externally. Back EMF is normally specified for nominal motor speed or for 1,000 RPM measured between two lines. If the value is not available for a motor speed of 1000 RPM, calculate the correct value as follows: If back EMF is, e.g., 320 V at 1800 RPM, it can be calculated at 1000 RPM as follows: Back EMF = (Voltage /RPM)*1000 = (320/1800)*1000 = 178. This is the value that must be programmed for 1-40 Back EMF at 1000 RPM.

Test motor operation

Step 1. Start the motor at low speed (100 to 200 RPM). If the motor does not turn, check installation, general programming and motor data.

Step 2. Check if start function in 1-70 PM Start Mode fits the application requirements.

Rotor detection

This function is the recommended choice for applications where the motor starts from standstill, e.g., pumps or conveyors. On some motors, an acoustic sound is heard when the impulse is sent out. This does not harm the motor.

Parking

This function is the recommended choice for applications where the motor is rotating at slow speed, e.g., windmilling in fan applications. 2-06 Parking Current and 2-07 Parking Time can be adjusted. Increase the factory setting of these parameters for applications with high inertia.

Start the motor at nominal speed. If the application does not run well, check the VVC+ PM settings. Recommendations for different applications can be seen in Table 5.6.

Table 5.6. Recommendations for Different Applications.

Callout	Key
Low inertia applications I_{Load}/I_{Motor} <5	1-17 Voltage filter time const. to be increased by factor 5 to 10 1-14 Damping Gain should be reduced 1-66 Min. Current at Low Speed should be reduced (<100%)
Low inertia applications 50>I_{Load}/I_{Motor} >5	Keep calculated values
High inertia applications I_{Load}/I_{Motor} > 50	1-14 Damping Gain, 1-15 Low Speed Filter Time Const. and 1-16 High Speed Filter Time Const. should be increased
High load at low speed <30% (rated speed)	1-17 Voltage filter time const. should be increased 1-66 Min. Current at Low Speed should be increased (>100% for a prolonged time can overheat the motor)

If the motor starts oscillating at a certain speed, increase 1-14 Damping Gain. Increase the value in small steps. Depending on the motor, a good value for this parameter can be 10% or 100% higher than the default value. Starting torque can be adjusted in 1-66 Min. Current at Low Speed. 100% provides nominal torque as starting torque.

5.4.5 Automatic Energy Optimization (AEO)

Note: *AEO is not relevant for permanent magnet motors.*

Automatic Energy Optimization (AEO) is a procedure that minimizes voltage to the motor, reducing energy consumption, heat, and noise.

To activate AEO, set parameter 1-03 Torque Characteristics to [2] Auto Energy Optim. CT or [3] Auto Energy Optim. VT.

5.4.6 Automatic Motor Adaptation (AMA)

Note: *AMA is not relevant for permanent magnet motors.*

Automatic motor adaptation (AMA) is a procedure that optimizes compatibility between the adjustable frequency drive and the motor.

- The adjustable frequency drive builds a mathematical model of the motor for regulating output motor current. The procedure also tests the input phase balance of electrical power. It compares the motor characteristics with the data entered in parameters 1-20 to 1-25.
- The motor shaft does not turn and no harm is done to the motor while running the AMA.
- Some motors may be unable to run the complete version of the test. In that case, select [2] Enable reduced AMA.
- If an output filter is connected to the motor, select Enable reduced AMA.

- If warnings or alarms occur, see Chapter **7.4 List of Warnings and Alarms**.
- Run this procedure on a cold motor for best results.

To run AMA

Step 1. Press [Main Menu] to access parameters.

Step 2. Scroll to parameter group 1-** Load and Motor and press [OK].

Step 3. Scroll to parameter group 1-2* Motor Data and press [OK].

Step 4. Scroll to 1-29 Automatic Motor Adaptation (AMA) and press [OK].

Step 5. Select [1] Enable complete AMA and press [OK].

Step 6. Follow the on-screen instructions.

Step 7. The test runs automatically and indicate when it is complete.

5.5 Checking Motor Rotation

Note: *Risk of damage to pumps/compressors caused by motor running in wrong direction. Before running the adjustable frequency drive, check the motor rotation. The motor runs briefly at 5 Hz or the minimum frequency set in 4-12 Motor Speed Low Limit [Hz].*

Step 1. Press [Main Menu].

Step 2. Scroll to 1-28 Motor Rotation Check and press [OK].

Step 3. Scroll to [1] Enable.

The following text appears: Note! Motor may run in wrong direction.

Step 4. Press [OK].

Step 5. Follow the on-screen instructions.

Note: *To change the direction of rotation, remove power to the adjustable frequency drive and wait for power to discharge. Reverse the connection of any two of the three motor wires on the motor or adjustable frequency drive side of the connection.*

5.6 Local Control Test

Step 1. Press [Hand On] to provide a local start command to the adjustable frequency drive.

Step 2. Accelerate the adjustable frequency drive by pressing [▲] to full speed. Moving the cursor left of the decimal point provides quicker input changes.

Step 3. Note any acceleration problems.

Step 4. Press [Off]. Note any deceleration problems.

In the event of acceleration or deceleration problems, see Chapter 7.5 Troubleshooting. See Chapter **7.4 List of Warnings and Alarms** for resetting the adjustable frequency drive after a trip.

5.7 System Start-up

The procedure in this section requires user-wiring and application programming to be completed. The following procedure is recommended after application set-up is completed.

Step 1. Press [Auto On].

Step 2. Apply an external run command.

Step 3. Adjust the speed reference throughout the speed range.

Step 4. Remove the external run command.

Step 5. Check sound and vibration level of the motor to ensure that the system is working as intended.

If warnings or alarms occur, see or Chapter 7.4 List of Warnings and Alarms.

CHAPTER

6 APPLICATION SET-UP EXAMPLES

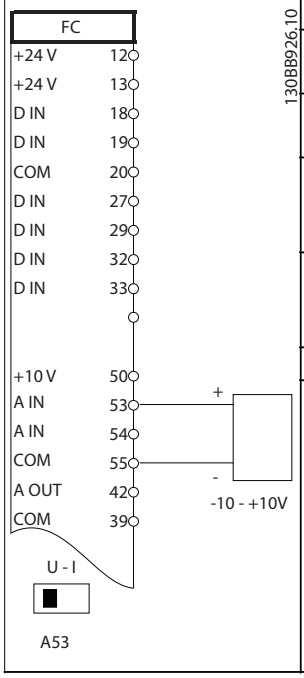
6 Application Set-up Examples

The examples in this section are intended as a quick reference for common applications.

- Parameter settings are the regional default values unless otherwise indicated (selected in 0-03 Regional Settings).
- Parameters associated with the terminals and their settings are shown next to the drawings.
- Where switch settings for analog terminals A53 or A54 are required, these are also shown.

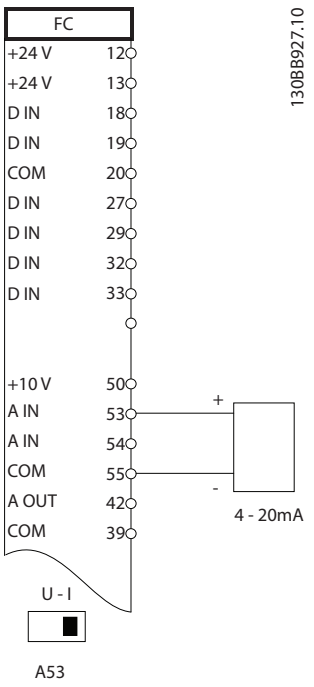
6.1 Speed

Table 6.1. Analog Speed Reference (Voltage).



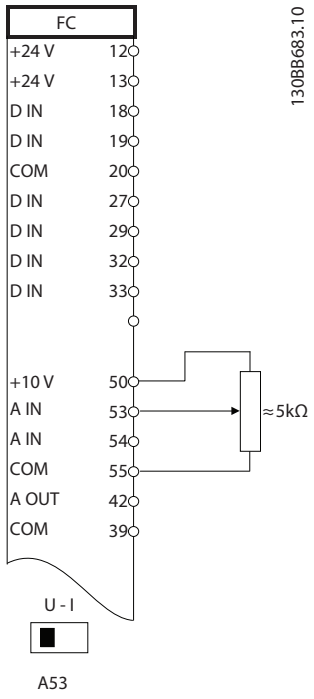
Parameters	
Function	**Setting**
6-10 Terminal 53 Low Voltage	0.07 V*
6-11 Terminal 53 High Voltage	10 V*
6-14 Terminal 53 Low Ref./Feedb. Value	0 RPM
6-15 Terminal 53 High Ref./Feedb. Value	1500 RPM
* = Default Value	
Notes/comments:	

Table 6.2. Analog Speed Reference (Current).



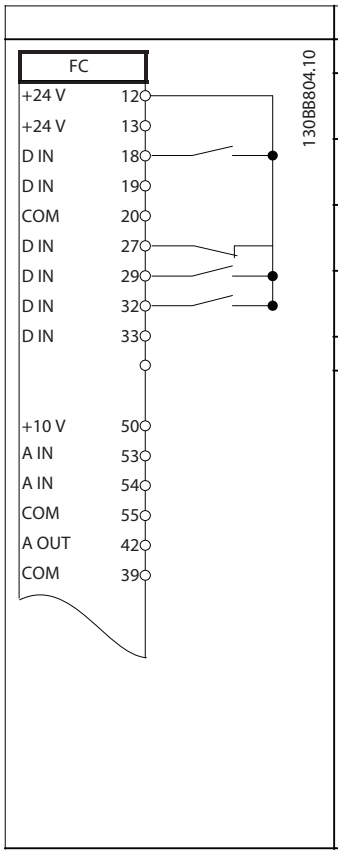
Parameters	
Function	**Setting**
6-12 Terminal 53 Low Current	4 mA*
6-13 Terminal 53 High Current	20 mA*
6-14 Terminal 53 Low Ref./ Feedb. Value	0 RPM
6-15 Terminal 53 High Ref./ Feedb. Value	1500 RPM
* = Default Value	
Notes/comments:	

Table 6.3. Speed Reference (using a Manual Potentiometer).



Parameters	
Function	**Setting**
6-10 Terminal 53 Low Voltage	0.07 V*
6-11 Terminal 53 High Voltage	10 V*
6-14 Terminal 53 Low Ref./ Feedb. Value	0 RPM
6-15 Terminal 53 High Ref./ Feedb. Value	1500 RPM
* = Default Value	
Notes/comments:	

Table 6.4. Speed Up/Down.



Parameters	
Function	**Setting**
5-10 Terminal 18 Digital Input	[8] Start*
5-12 Terminal 27 Digital Input	[19] Freeze Reference
5-13 Terminal 29 Digital Input	[21] Speed Up
5-14 Terminal 32 Digital Input	[22] Speed down
* = Default Value	

Figure 6.1. Speed Up/Down.

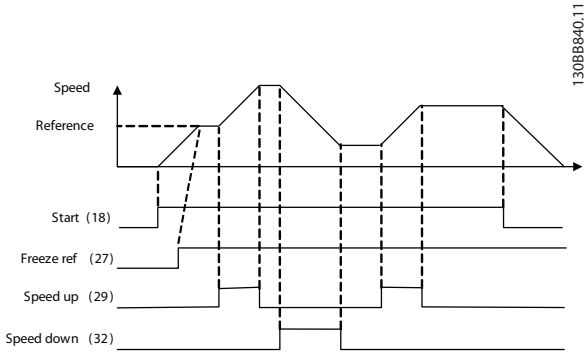


Table 6.5. Start/Stop Command.

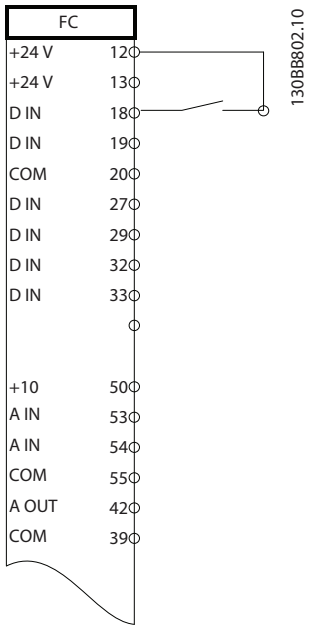
	Parameters	
	**Function**	**Setting**
	5-10 Terminal 18 Digital Input	[8] Start*
	5-12 Terminal 27 Digital Input	[0] No operation*
	* = Default Value	
	Notes/comments: If *5-12 Terminal 27 Digital Input* is set to *[0] No operation*, a jumper wire to terminal 27 is not needed.	

Figure 6.2. Start/Stop Command.

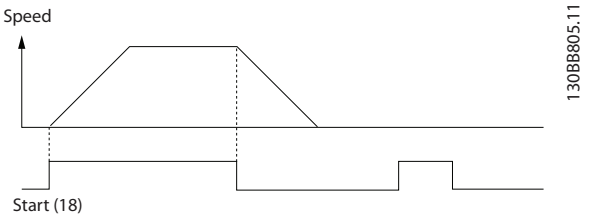
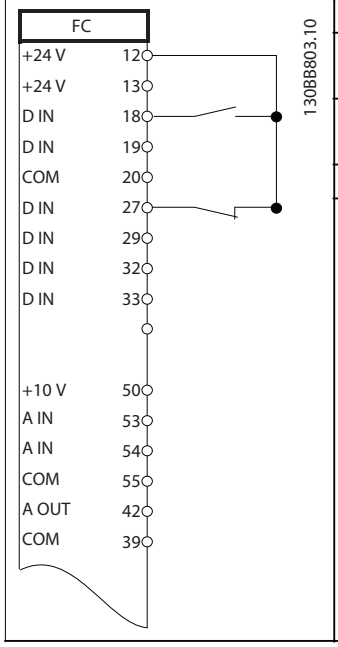


Table 6.6. Pulse Start/Stop.



Parameters	
Function	**Setting**
5-10 Terminal 18 Digital Input	[9] Latched Start
5-12 Terminal 27 Digital Input	[6] Stop Inverse
* = Default Value	
Notes/comments:	

Figure 6.3. Latched Start/Stop Inverse.

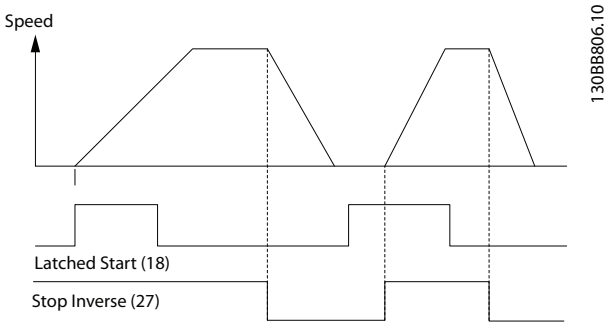
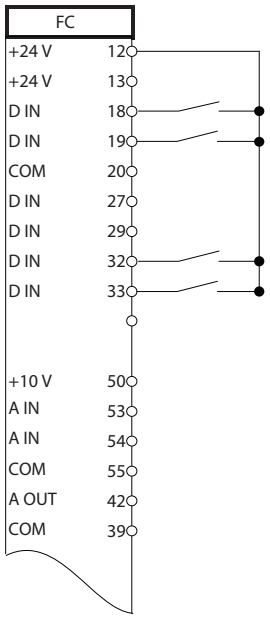


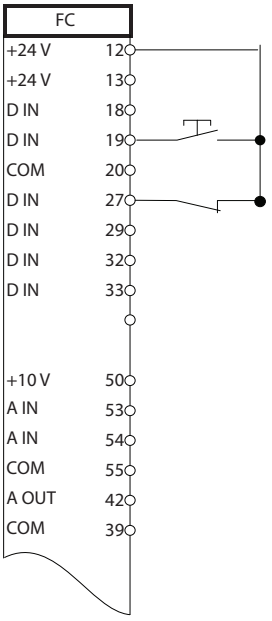
Table 6.7. Start/Stop with Reversing and Four Preset Speeds.



Parameters	
Function	**Setting**
5-10 Terminal 18 Digital Input	[8] Start*
5-11 Terminal 19 Digital Input	[10] Start reversing*
5-12 Terminal 27 Digital Input	[0] No operation*
5-14 Terminal 32 Digital Input	[16] Preset ref bit 0*
5-15 Terminal 33 Digital Input	[17] Preset ref bit 1*
3-10 Preset Reference	
Preset ref. 1	50%
Preset ref. 2	75%
Preset ref. 3	100%
* = Default Value	

6.1.3 External Alarm Reset

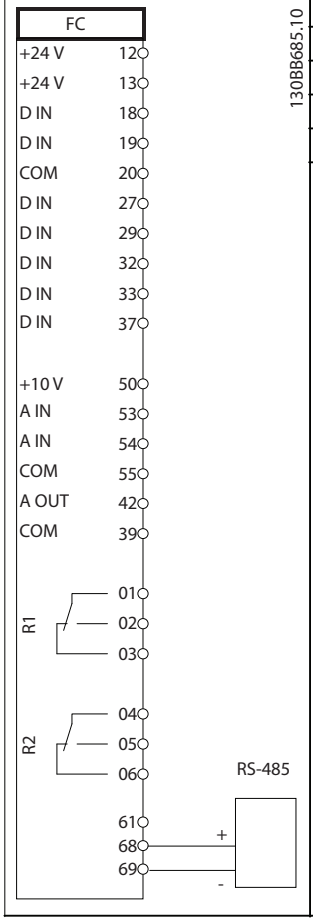
Table 6.8. External Alarm Reset.



Parameters	
Function	**Setting**
5-11 Terminal 19 Digital Input	[1] Reset
* = Default Value	

6.1.4 RS-485

Table 6.9. RS-485 Network Connection.



Parameters	
Function	**Setting**
8-30 Protocol	FC*
8-31 Address	1*
8-32 Baud Rate	9600*
* = Default Value	

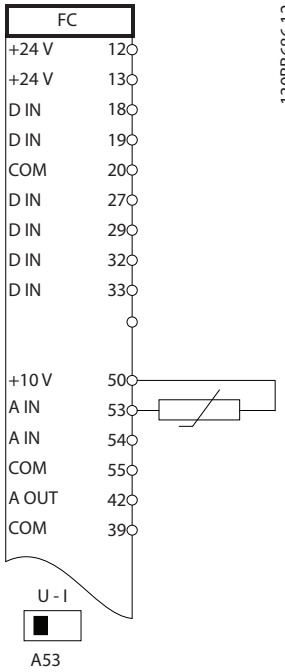
Notes/comments:
Select protocol, address and baud rate in the above-mentioned parameters.
D IN 37 is an option.

6.1.5 Motor Thermistor

THERMISTOR INSULATION
Risk of equipment damage exists.

- **Use only thermistors with reinforced or double insulation to meet PELV insulation requirements.**

Table 6.10. RS-485 Network Connection.



Parameters	
Function	**Setting**
1-90 Motor Thermal Protection	[2] Thermistor trip
1-93 Thermistor Source	[1] Analog input 53
* = Default Value	
Notes/comments: If only a warning is desired, *1-90 Motor Thermal Protection* should be set to *[1] Thermistor warning*.	

CHAPTER

7 DIAGNOSTICS AND TROUBLESHOOTING

7 Diagnostics and Troubleshooting

This chapter includes maintenance and service guidelines, status messages, warnings and alarms and basic troubleshooting.

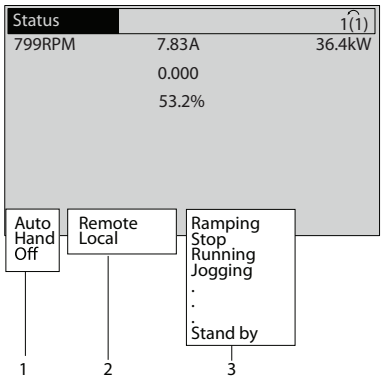
7.1 Maintenance and Service

Under normal operating conditions and load profiles, the adjustable frequency drive is maintenance-free throughout its designed lifetime. To prevent breakdown, danger, and damage, examine the adjustable frequency drive at regular intervals depending on the operating conditions. Replace worn or damaged parts with original spare parts or standard parts. For service and support, refer to buildings.honeywell.com.

7.2 Status Messages

When the adjustable frequency drive is in status mode, status messages are generated automatically and appear in the bottom line of the display (see Figure 7.1).

Figure 7.1. Status Display.



1	Operation mode (see Table 7.1)
2	Reference site (see Table 7.2)
3	Operation status (see Table 7.3)

Table 7.1 to Table 7.3 describe the displayed status messages.

Table 7.1. Operation Mode.

Off	The adjustable frequency drive does not react to any control signal until [Auto On] or [Hand On] is pressed.
Auto On	The adjustable frequency drive is controlled from the control terminals and/or the serial communication.
Hand On	The adjustable frequency drive is controlled by the navigation keys on the LCP. Stop commands, reset, reversing, DC brake, and other signals applied to the control terminals override local control.

Table 7.2. Reference Site.

Remote	The speed reference is given from external signals, serial communication, or internal preset references.
Local	The adjustable frequency drive uses [Hand On] control or reference values from the LCP.

Table 7.3. Operation Status.

AC Brake	AC Brake was selected in 2-10 Brake Function. The AC brake overmagnetizes the motor to achieve a controlled slow-down.
AMA finish OK	Automatic motor adaptation (AMA) was carried out successfully.
AMA ready	AMA is ready to start. Press [Hand On] to start.
AMA running	AMA process is in progress.
Braking	The brake chopper is in operation. Generative energy is absorbed by the brake resistor.
Braking max.	The brake chopper is in operation. The power limit for the brake resistor defined in 2-12 Brake Power Limit (kW) has been reached.
Coast	• Coast inverse was selected as a function for a digital input (parameter group 5-1* Digital Inputs). The corresponding terminal is not connected. • Coast activated by serial communication
Ctrl. Ramp-down	Control Ramp-down was selected in 14-10 Mains Failure. • The AC line voltage is below the value set in 14-11 Mains Voltage at Mains Fault at line power fault • The adjustable frequency drive ramps down the motor using a controlled ramp-down.
Current High	The adjustable frequency drive output current is above the limit set in 4-51 Warning Current High.
Current Low	The adjustable frequency drive output current is below the limit set in 4-52 Warning Speed Low.
DC Hold	DC Hold is selected in 1-80 Function at Stop and a stop command is active. The motor is held by a DC current set in 2-00 DC Hold/Preheat Current.
DC Stop	The motor is held with a DC current (2-01 DC Brake Current) for a specified time (2-02 DC Braking Time). • DC Brake is activated in 2-03 DC Brake Cut In Speed [RPM] and a stop command is active. • DC Brake (inverse) is selected as a function for a digital input (parameter group 5-1* Digital Inputs). The corresponding terminal is not active. • The DC Brake is activated via serial communication.
Feedback high	The sum of all active feedbacks is above the feedback limit set in 4-57 Warning Feedback High.
Feedback low	The sum of all active feedbacks is below the feedback limit set in 4-56 Warning Feedback Low.

Freeze output	The remote reference is active, which holds the present speed. • Freeze output was selected as a function for a digital input (parameter group 5-1* Digital Inputs). The corresponding terminal is active. Speed control is only possible via the terminal functions Speed Up and Slow. • Hold ramp is activated via serial communication.
Freeze output request	A freeze output command was given but the motor remains stopped until a run permissive signal is received.
Freeze ref.	Freeze Reference was selected as a function for a digital input (parameter group 5-1* Digital Inputs). The corresponding terminal is active. The adjustable frequency drive saves the actual reference. Changing the reference is now only possible via terminal functions Speed Up and Slow.
Jog request	A jog command was given but the motor remains stopped until a run permissive signal is received via a digital input.
Jogging	The motor is running as programmed in 3-19 Jog Speed [RPM]. • Jog was selected as function for a digital input (parameter group 5-1* Digital Inputs). The corresponding terminal (e.g., Terminal 29) is active. • The Jog function is activated via the serial communication. • The Jog function was selected as a reaction for a monitoring function (e.g., No signal). The monitoring function is active.
Motor check	In 1-80 Function at Stop, Motor Check was selected. A stop command is active. To ensure that a motor is connected to the adjustable frequency drive, a permanent test current is applied to the motor.
Over Voltage Control (OVC)	Overvoltage control was activated in 2-17 Overvoltage Control, [2] Enabled. The connected motor supplies the adjustable frequency drive with generative energy. The overvoltage control adjusts the V/Hz ratio to run the motor in controlled mode and to prevent the adjustable frequency drive from tripping.
PowerUnit Off	(Only adjustable frequency drives with an external 24 V power supply installed). Line power supply to the adjustable frequency drive was removed, and the control card is supplied by the external 24 V.
Protection md	Protection mode is active. The unit has detected a critical status (overcurrent or overvoltage). • To avoid tripping, switching frequency is reduced to 4 kHz. • If possible, protection mode ends after approximately 10 s. • Protection mode can be restricted in 14-26 Trip Delay at Inverter Fault.
QStop	The motor is decelerating using 3-81 Quick Stop Ramp Time. • Quick stop inverse was selected as a function for a digital input (parameter group 5-1* Digital Inputs). The corresponding terminal is not active. • The quick stop function was activated via serial communication.
Ramping	The motor is accelerating/decelerating using the active Ramp-Up/Down. The reference, a limit value, or a standstill is not yet reached.
Ref. high	The sum of all active references is above the reference limit set in 4-55 Warning Reference High.
Ref. low	The sum of all active references is below the reference limit set in 4-54 Warning Reference Low.
Run on ref.	A start command was given but the motor remains stopped until a run permissive signal is received via digital input.
Running	The motor is driven by the adjustable frequency drive.
Sleep Mode	The energy-saving function is enabled. The motor has stopped but restarts automatically when required.
Speed high	Motor speed is above the value set in 4-53 Warning Speed High.

Speed low	Motor speed is below the value set in 4-52 Warning Speed Low.
Standby	In Auto On mode, the adjustable frequency drive starts the motor with a start signal from a digital input or serial communication.
Start delay	In 1-71 Start Delay, a delay starting time was set. A start command is activated and the motor starts after the start delay time expires.
Start fwd/rev	Start forward and start reverse were selected as functions for two different digital inputs (parameter group 5-1* Digital Inputs). The motor starts in forward or reverse depending on which corresponding terminal is activated.
Stop	The adjustable frequency drive has received a stop command from the LCP, digital input or serial communication.
Trip	An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, the adjustable frequency drive can be reset manually by pressing [Reset] or remotely by control terminals or serial communication.
Trip lock	An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, power must be cycled to the adjustable frequency drive. The adjustable frequency drive can then be reset manually by pressing [Reset] or remotely by control terminals or serial communication.

Note: *In auto/remote mode, the adjustable frequency drive requires external commands to execute functions.*

7.3 Warning and Alarm Types

Warnings

A warning is issued when an alarm condition is impending or when an abnormal operating condition is present and may result in the adjustable frequency drive issuing an alarm. A warning clears by itself when the abnormal condition is removed.

Alarms

Trip

An alarm is issued when the adjustable frequency drive is tripped, which means that the adjustable frequency drive suspends operation to prevent adjustable frequency drive or system damage. The motor coasts to a stop. The adjustable frequency drive logic continues to operate and monitor the adjustable frequency drive status. After the fault condition is remedied, the adjustable frequency drive can be reset. It is then ready to start operation again.

Resetting the adjustable frequency drive after trip/trip lock

A trip can be reset in any of four ways:

- Press [Reset] on the LCP
- Digital reset input command
- Serial communication reset input command
- Auto reset

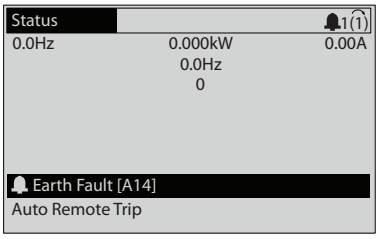
Trip lock

Input power is cycled. The motor coasts to a stop. The adjustable frequency drive continues to monitor the adjustable frequency drive status. Remove input power to the adjustable frequency drive, correct the cause of the fault, and reset the adjustable frequency drive.

Warning and Alarm Displays

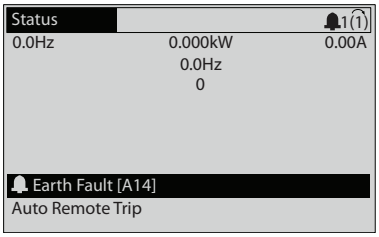
- A warning is displayed in the LCP along with the warning number.
- An alarm flashes along with the alarm number.

Figure 7.2. Alarm Display Example.



In addition to the text and alarm code in the LCP, there are three status indicator lights.

Figure 7.3. Status Indicator Lights. .



	Warning LED	Alarm LED
Warning	On	Off
Alarm	Off	On (Flashing)
Trip Lock	On	On (Flashing)

7.4 List of Warnings and Alarms

The warning/alarm information below defines each warning/alarm condition, provides the probable cause for the condition, and details a remedy or troubleshooting procedure.

WARNING 1, 10 Volts low

The control card voltage is below 10 V from terminal 50. Remove some of the load from terminal 50, as the 10 V supply is overloaded. Max. 15 mA or minimum 590 Ω.

A short circuit in a connected potentiometer or improper wiring of the potentiometer can cause this condition.

Troubleshooting

- Remove the wiring from terminal 50. If the warning clears, the problem is with the wiring. If the warning does not clear, replace the control card.

WARNING/ALARM 2, Live zero error

This warning or alarm only appears if programmed in 6-01 Live Zero Timeout Function. The signal on one of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or faulty device sending the signal can cause this condition.

Troubleshooting

- Check connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common. MCB 101 terminals 11 and 12 for signals, terminal 10 common. MCB 109 terminals 1, 3, 5 for signals, terminals 2, 4, 6 common.
- Check that the adjustable frequency drive programming and switch settings match the analog signal type.
- Perform input terminal signal test.

WARNING/ALARM 4, Mains phase loss

A phase is missing on the supply side, or the line voltage imbalance is too high. This message also appears for a fault in the input rectifier on the adjustable frequency drive. Options are programmed at 14-12 Function at Mains Imbalance.

Troubleshooting

- Check the supply voltage and supply currents to the adjustable frequency drive.

WARNING 5, DC link voltage high

The intermediate circuit voltage (DC) is higher than the high-voltage warning limit. The limit is dependent on the adjustable frequency drive voltage rating. The unit is still active.

WARNING 6, DC link voltage low

The intermediate circuit voltage (DC) is lower than the low-voltage warning limit. The limit is dependent on the adjustable frequency drive voltage rating. The unit is still active.

WARNING/ALARM 7, DC overvoltage

If the intermediate circuit voltage exceeds the limit, the adjustable frequency drive trips after a time.

Troubleshooting

- Connect a brake resistor
- Extend the ramp time
- Change the ramp type
- Activate the functions in 2-10 Brake Function

- Increase 14-26 Trip Delay at Inverter Fault
- If the alarm/warning occurs during a power sag, use kinetic backup (14-10 Line Failure)

WARNING/ALARM 8, DC undervoltage

If the DC link voltage drops below the undervoltage limit, the adjustable frequency drive checks if a 24 V DC backup supply is connected. If no 24 V DC backup supply is connected, the adjustable frequency drive trips after a fixed time delay. The time delay varies with unit size.

Troubleshooting

- Make sure that the supply voltage matches the adjustable frequency drive voltage.
- Perform input voltage test.
- Perform soft charge circuit test.

WARNING/ALARM 9, Inverter overload

The adjustable frequency drive is about to cut out because of an overload (current too high for too long). The counter for electronic, thermal inverter protection issues a warning at 98% and trips at 100%, while giving an alarm. The adjustable frequency drive cannot be reset until the counter is below 90%.

The fault is that the adjustable frequency drive has run with more than 100% overload for too long.

Troubleshooting

- Compare the output current shown on the LCP with the adjustable frequency drive rated current.
- Compare the output current shown on the LCP with measured motor current.
- Display the thermal drive load on the LCP and monitor the value. When running above the adjustable frequency drive continuous current rating, the counter increases. When running below the adjustable frequency drive continuous current rating, the counter decreases.

WARNING/ALARM 10, Motor overload temperature

According to the electronic thermal protection (ETR), the motor is too hot. Select whether the adjustable frequency drive issues a warning or an alarm when the counter reaches 100% in 1-90 Motor Thermal Protection. The fault occurs when the motor runs with more than 100% overload for too long.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded
- Check that the motor current set in 1-24 Motor Current is correct.

- Ensure that Motor data in parameters 1-20 to 1-25 are set correctly.
- If an external fan is in use, check in 1-91 Motor External Fan that it is selected.
- Running AMA in 1-29 Automatic Motor Adaptation (AMA) tunes the adjustable frequency drive to the motor more accurately and reduces thermal loading.

WARNING/ALARM 11, Motor thermistor over-temp

Check whether the thermistor is disconnected. Select whether the adjustable frequency drive issues a warning or an alarm in 1-90 Motor Thermal Protection.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- When using terminal 53 or 54, check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply). Also check that the terminal switch for 53 or 54 is set for voltage. Check 1-93 Thermistor Source selects terminal 53 or 54.
- When using digital inputs 18 or 19, check that the thermistor is connected correctly between either terminal 18 or 19 (digital input PNP only) and terminal 50. Check 1-93 Thermistor Source selects terminal 18 or 19.

WARNING/ALARM 12, Torque limit

The torque has exceeded the value in 4-16 Torque Limit Motor Mode or the value in 4-17 Torque Limit Generator Mode. 14-25 Trip Delay at Torque Limit can change this warning from a warning-only condition to a warning followed by an alarm.

Troubleshooting

- If the motor torque limit is exceeded during ramp-up, extend the ramp-up time.
- If the generator torque limit is exceeded during ramp-down, extend the ramp-down time.
- If torque limit occurs while running, possibly increase the torque limit. Make sure that the system can operate safely at a higher torque.
- Check the application for excessive current draw on the motor.

WARNING/ALARM 13, Overcurrent

The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts about 1.5 s, then the adjustable frequency drive trips and issues an alarm. Shock loading or quick acceleration with high inertia loads can cause this fault. If the acceleration during ramp up is quick, the fault can also appear after kinetic backup.

If extended mechanical brake control is selected, trip can be reset externally.

Troubleshooting

- Remove power and check if the motor shaft can be turned.
- Make sure that the motor size matches the adjustable frequency drive.
- Check parameters 1-20 to 1-25 for correct motor data.

ALARM 14, Ground fault

There is current from the output phases to ground, either in the cable between the adjustable frequency drive and the motor or in the motor itself.

Troubleshooting

- Remove power to the adjustable frequency drive and repair the ground fault.
- Check for ground faults in the motor by measuring the resistance to ground of the motor leads and the motor with a megohmmeter.

ALARM 15, Hardware mismatch

A fitted option is not operational with the present control board hardware or software.

Record the value of the following parameters and contact Honeywell:

- 15-40 FC Type
- 15-41 Power Section
- 15-42 Voltage
- 15-43 Software Version
- 15-45 Actual Typecode String
- 15-49 SW ID Control Card
- 15-50 SW ID Power Card
- 15-60 Option Mounted
- 15-61 Option SW Version (for each option slot)

ALARM 16, Short-circuit

There is short-circuiting in the motor or motor wiring.

Troubleshooting

- Remove power to the adjustable frequency drive and repair the short circuit.

WARNING/ALARM 17, Control word timeout

There is no communication to the adjustable frequency drive.

The warning is only active when 8-04 Control Word Timeout Function is NOT set to [0] Off.

If 8-04 Control Word Timeout Function is set to [5] Stop and Trip, a warning appears and the adjustable frequency drive ramps down until it stops then displays an alarm.

Troubleshooting

- Check connections on the serial communication cable.
- Increase 8-03 Control Word Timeout Time.
- Check the operation of the communication equipment.
- Verify a proper installation based on EMC requirements.

ALARM 18, Start failed

The speed has not been able to exceed 1-77 Compressor Start Max Speed [RPM] during start within the allowed time (set in 1-79 Compressor Start Max Time to Trip). This may be caused by a blocked motor.

WARNING 23, Internal fan fault

The fan warning function is an extra protective function that checks if the fan is running/mounted. The fan warning can be disabled in 14-53 Fan Monitor ([0] Disabled).

For the D frame filters, the regulated voltage to the fans is monitored.

Troubleshooting

- Check for proper fan operation.
- Cycle power to the adjustable frequency drive and check that the fan operates briefly at startup.
- Check the sensors on the heatsink and control card.

WARNING 24, External fan fault

The fan warning function is an extra protective function that checks if the fan is running/mounted. The fan warning can be disabled in 14-53 Fan Monitor ([0] Disabled).

Troubleshooting

- Check for proper fan operation.
- Cycle power to the adjustable frequency drive and check that the fan operates briefly at startup.
- Check the sensors on the heatsink and control card.

WARNING 25, Brake resistor short-circuit

The brake resistor is monitored during operation. If a short circuit occurs, the brake function is disabled and the warning appears. The adjustable frequency drive is still operational but without the brake function.

Troubleshooting

- Remove power to the adjustable frequency drive and replace the brake resistor (see 2-15 Brake Check).

WARNING/ALARM 26, Brake resistor power limit

The power transmitted to the brake resistor is calculated as a mean value over the last 120 s of run time. The calculation is based on the intermediate circuit voltage and the brake resistance value set in 2-16 AC brake Max. Current. The warning is active when the dissipated braking energy is higher than 90% of the brake resistance power. If [2] Trip is selected in 2-13 Brake Power Monitoring, the adjustable frequency drive trips when the dissipated braking energy reaches 100%.

WARNING/ALARM 27, Brake chopper fault

The brake transistor is monitored during operation and if a short circuit occurs, the brake function is disabled and a warning is issued. The adjustable frequency drive is still operational but, since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.

Troubleshooting

- Remove power to the adjustable frequency drive and remove the brake resistor.

WARNING/ALARM 28, Brake check failed

The brake resistor is not connected or not working. Check 2-15 Brake Check.

ALARM 29, Heatsink temp

The maximum temperature of the heatsink has been exceeded. The temperature fault does not reset until the temperature falls below a defined heatsink temperature. The trip and reset points are different based on the adjustable frequency drive power size.

Troubleshooting

Check for the following conditions.

- Ambient temperature too high.
- Motor cable too long.
- Incorrect airflow clearance above and below the adjustable frequency drive.
- Blocked airflow around the adjustable frequency drive.
- Damaged heatsink fan.
- Dirty heatsink.

ALARM 30, Motor phase U missing

Motor phase U between the adjustable frequency drive and the motor is missing.

Remove power from the adjustable frequency drive and check motor phase U.

ALARM 31, Motor phase V missing

Motor phase V between the adjustable frequency drive and the motor is missing.

Remove power from the adjustable frequency drive and check motor phase V.

ALARM 32, Motor phase W missing

Motor phase W between the adjustable frequency drive and the motor is missing.

Remove power from the adjustable frequency drive and check motor phase W.

ALARM 33, Inrush fault

Too many power-ups have occurred within a short time period. Let the unit cool to operating temperature.

WARNING/ALARM 34, Fieldbus communication fault

The serial communication bus on the communication option card is not working.

WARNING/ALARM 36, Mains failure

This warning/alarm is only active if the supply voltage to the adjustable frequency drive is lost and 14-10 Mains Failure is not set to [0] No Function. Check the fuses to the adjustable frequency drive and line power supply to the unit.

ALARM 38, Internal fault

When an internal fault occurs, a code number defined in Table 7.4 is displayed.

Troubleshooting

- Cycle power
- Check that the option is properly installed
- Check for loose or missing wiring

It may be necessary to contact your Honeywell supplier or service department. Note the code number for further troubleshooting directions.

Table 7.4. Internal Fault Codes

0	Serial port cannot be initialized. Contact your Honeywell supplier or Honeywell Service Department
256-258	Power EEPROM data is defective or too old. Replace power card.
512-519	Internal fault. Contact your Honeywell supplier or Honeywell Service Department.
783	Parameter value outside of min/max limits.
1024-1284	Internal fault. Contact your Honeywell supplier or the Honeywell Service Department.
1299	Option SW in slot A is too old.
1300	Option SW in slot B is too old.
1315	Option SW in slot A is not supported (not allowed).
1316	Option SW in slot B is not supported (not allowed).
1379-2819	Internal fault. Contact your Honeywell supplier or Honeywell Service Department.
2561	Replace control card.
2820	LCP stack overflow.
2821	Serial port overflow.
2822	USB port overflow.

3072-5122	Parameter value is outside its limits.
5123	Option in slot A: Hardware incompatible with control board hardware
5124	Option in slot B: Hardware incompatible with control board hardware
5376-6231	Internal fault. Contact your Honeywell supplier or Honeywell Service Department

ALARM 39, Heatsink sensor

No feedback from the heatsink temperature sensor. The signal from the IGBT thermal sensor is not available on the power card. The problem could be on the power card, on the gate drive card, or the ribbon cable between the power card and gate drive card.

WARNING 40, Overload of digital output terminal 27

Check the load connected to terminal 27 or remove short-circuit connection. Check 5-00 Digital I/O Mode and 5-01 Terminal 27 Mode.

WARNING 41, Overload of digital output terminal 29

Check the load connected to terminal 29 or remove short-circuit connection. Check 5-00 Digital I/O Mode and 5-02 Terminal 29 Mode.

WARNING 42, Overload of digital output on X30/6 or overload of digital output on X30/7

For X30/6, check the load connected to X30/6 or remove the short-circuit connection. Check 5-32 Term X30/6 Digi Out (MCB 101).

For X30/7, check the load connected to X30/7 or remove the short-circuit connection. Check 5-33 Term X30/7 Digi Out (MCB 101).

ALARM 45, Ground fault 2

Ground fault.

Troubleshooting

- Check for proper grounding and loose connections.
- Check for proper wire size.
- Check motor cables for short-circuits or leakage currents.

ALARM 46, Power card supply

The supply on the power card is out of range. There are three power supplies generated by the switch mode power supply (SMPS) on the power card: 24 V, 5 V, ±18 V. When powered with 24 V DC with the MCB 107 option, only the 24 V and 5 V supplies are monitored. When powered with three-phase AC line voltage, all three supplies are monitored.

Troubleshooting

- Check for a defective power card.
- Check for a defective control card.
- Check for a defective option card.

- If a 24 V DC power supply is used, verify proper supply power.

WARNING 47, 24 V supply low

The 24 V DC is measured on the control card. This alarm arises when the detected voltage of terminal 12 is lower than 18 V.

Troubleshooting

• Check for a defective control card.

WARNING 48, 1.8 V supply low

The 1.8 V DC supply used on the control card is outside of allowable limits. The power supply is measured on the control card. Check for a defective control card. If an option card is present, check for an overvoltage condition.

WARNING 49, Speed limit

When the speed is not within the specified range in 4-11 Motor Speed Low Limit [RPM] and 4-13 Motor Speed High Limit [RPM], the adjustable frequency drive shows a warning. When the speed is below the specified limit in 1-86 Trip Speed Low [RPM] (except when starting or stopping), the adjustable frequency drive trips.

ALARM 50, AMA calibration failed

Contact Honeywell supplier or Honeywell service department.

ALARM 51, AMA check Unom and Inom

The settings for motor voltage, motor current and motor power are wrong. Check the settings in parameters 1-20 to 1-25.

ALARM 52, AMA low Inom

The motor current is too low. Check the settings.

ALARM 53, AMA motor too big

The motor is too big for the AMA to operate.

ALARM 54, AMA motor too small

The motor is too small for the AMA to operate.

ALARM 55, AMA parameter out of range

The parameter values of the motor are outside of the acceptable range. AMA cannot run.

ALARM 56, AMA interrupted by user

The user has interrupted the AMA.

ALARM 57, AMA internal fault

Try to restart AMA again. Repeated restarts can overheat the motor.

ALARM 58, AMA Internal fault

Contact the Honeywell supplier.

WARNING 59, Current limit

The current is higher than the value in 4-18 Current Limit. Ensure that motor data in parameters 1–20 to 1–25 are set correctly. Possibly increase the current limit. Be sure that the system can operate safely at a higher limit.

WARNING 60, External interlock

A digital input signal is indicating a fault condition external to the adjustable frequency drive. An external interlock has commanded the adjustable frequency drive to trip. Clear the external fault condition. To resume normal operation, apply 24 V DC to the terminal programmed for external interlock. Reset the adjustable frequency drive.

WARNING 62, Output frequency at maximum limit

The output frequency has reached the value set in 4-19 Max Output Frequency. Check the application to determine the cause. Possibly increase the output frequency limit. Be sure the system can operate safely at a higher output frequency. The warning clears when the output drops below the maximum limit.

WARNING/ALARM 65, Control card overtemperature

The cut-out temperature of the control card is 176 °F [80 °C].

Troubleshooting

- Check that the ambient operating temperature is within limits.
- Check for clogged filters.
- Check fan operation.
- Check the control card.

WARNING 66, Heatsink temperature low

The adjustable frequency drive is too cold to operate. This warning is based on the temperature sensor in the IGBT module.

Increase the ambient temperature of the unit. Also, a trickle amount of current can be supplied to the adjustable frequency drive whenever the motor is stopped by setting 2-00 DC Hold/Preheat Current at 5% and 1-80 Function at Stop.

ALARM 67, Option module configuration has changed

One or more options have either been added or removed since the last power-down. Check that the configuration change is intentional and reset the unit.

ALARM 69, Power card temperature

The temperature sensor on the power card is either too hot or too cold.

Troubleshooting

- Check that the ambient operating temperature is within limits.
- Check for clogged filters.
- Check fan operation.
- Check the power card.

ALARM 70, Illegal FC configuration

The control card and power card are incompatible. To check compatibility, contact the Honeywell supplier with the type code of the unit from the nameplate and the part numbers of the cards.

ALARM 80, Drive initialized to default value

Parameter settings are initialized to default settings after a manual reset. To clear the alarm, reset the unit.

ALARM 92, No-Flow

A no-flow condition has been detected in the system. 22-23 No-Flow Function is set for alarm. Troubleshoot the system and reset the adjustable frequency drive after the fault has been cleared.

ALARM 93, Dry pump

A no-flow condition in the system with the adjustable frequency drive operating at high speed may indicate a dry pump. 22-26 Dry Pump Function is set for alarm. Troubleshoot the system and reset the adjustable frequency drive after the fault has been cleared.

ALARM 94, End of curve

Feedback is lower than the setpoint. This may indicate leakage in the system. 22-50 End of Curve Function is set for alarm. Troubleshoot the system and reset the adjustable frequency drive after the fault has been cleared.

ALARM 95, Broken belt

Torque is below the torque level set for no load, indicating a broken belt. 22-60 Broken Belt Function is set for alarm. Troubleshoot the system and reset the adjustable frequency drive after the fault has been cleared.

ALARM 96, Start delayed

Motor start has been delayed due to short-cycle protection. 22-76 Interval between Starts is enabled. Troubleshoot the system and reset the adjustable frequency drive after the fault has been cleared.

WARNING 97, Stop delayed

Stopping the motor has been delayed due to short cycle protection. 22-76 Interval between Starts is enabled. Troubleshoot the system and reset the adjustable frequency drive after the fault has been cleared.

WARNING 98, Clock fault

Time is not set or the RTC clock has failed. Reset the clock in 0-70 Date and Time.

WARNING 200, Fire mode

This warning indicates the adjustable frequency drive is operating in Fire mode. The warning clears when fire mode is removed. See the fire mode data in the alarm log.

WARNING 201, Fire Mode was Active

This indicates the adjustable frequency drive had entered fire mode. Cycle power to the unit to remove the warning. See the fire mode data in the alarm log.

WARNING 202, Fire mode limits exceeded

While operating in fire mode one or more alarm conditions have been ignored which would normally trip the unit. Operating in this condition voids unit warranty. Cycle power to the unit to remove the warning. See the fire mode data in the alarm log.

WARNING 203, Missing motor

With an adjustable frequency drive operating multi-motors, an underload condition was detected. This could indicate a missing motor. Inspect the system for proper operation.

WARNING 204, Locked rotor

With an adjustable frequency drive operating multi-motors, an overload condition was detected. This could indicate a locked rotor. Inspect the motor for proper operation.

WARNING 250, New spare part

A component in the adjustable frequency drive has been replaced. Reset the adjustable frequency drive for normal operation.

WARNING 251, New type code

The power card or other components have been replaced and the type code changed. Reset to remove the warning and resume normal operation.

7.5 Troubleshooting

Table 7.5. Troubleshooting.

Symptom	Possible cause	Test	Solution
Display dark/ No function	Missing input power	See Table 4.4	Check the input power source.
	Missing or open fuses or circuit breaker tripped	See open fuses and tripped circuit breaker in this table for possible causes.	Follow the recommendations provided.
	No power to the LCP	Check the LCP cable for proper connection or damage.	Replace the faulty LCP or connection cable.
	Shortcut on control voltage (terminal 12 or 50) or at control terminals	Check the 24 V control voltage supply for terminals 12/13 to 20-39 or 10 V supply for terminals 50 to 55.	Wire the terminals properly.
	Incompatible LCP		Use only LCP 101 or LCP 102.
	Wrong contrast setting		Press [Status] + [▲]/[▼] to adjust the contrast.
	Display (LCP) is defective	Test using a different LCP.	Replace the faulty LCP or connection cable.
	Internal voltage supply fault or SMPS is defective		Contact supplier.
Intermittent display	Overloaded power supply (SMPS) due to improper control wiring or a fault within the adjustable frequency drive	To rule out a problem in the control wiring, disconnect all control wiring by removing the terminal blocks.	If the display stays lit, then the problem is in the control wiring. Check the wiring for short circuits or incorrect connections. If the display continues to cut out, follow the procedure for display dark.

Symptom	Possible cause	Test	Solution
Motor not running	Service switch open or missing motor connection	Check if the motor is connected and the connection is not interrupted (by a service switch or other device).	Connect the motor and check the service switch.
	No line power with 24 V DC option card	If the display is functioning but no output, check that line power is applied to the adjustable frequency drive.	Apply line power to run the unit.
	LCP Stop	Check if [Off] has been pressed.	Press [Auto On] or [Hand On] (depending on operation mode) to run the motor.
	Missing start signal (Standby)	Check 5-10 Terminal 18 Digital Input for correct setting for terminal 18 (use default setting).	Apply a valid start signal to start the motor.
	Motor coast signal active (Coasting)	Check 5-12 Coast inv. for correct setting for terminal 27 (use default setting).	Apply 24 V on terminal 27 or program this terminal to No operation.
	Wrong reference signal source	Check reference signal: Local, remote or bus reference? Preset reference active? Terminal connection correct? Scaling of terminals correct? Reference signal available?	Program correct settings. Check 3-13 Reference Site. Set preset reference active in parameter group 3-1* References. Check for correct wiring. Check scaling of terminals. Check reference signal.
	AIC not running	Check the following for current: • 2-70 AIC L1 Current • 2-71 AIC L2 Current • 2-72 AIC L3 Current	Troubleshoot the AIC (Active In-Converter)
Motor running in wrong direction	Motor rotation limit	Check that 4-10 Motor Speed Direction is programmed correctly.	Program correct settings.
	Active reversing signal	Check if a reversing command is programmed for the terminal in parameter group 5-1* Digital inputs.	Deactivate reversing signal.
	Wrong motor phase connection		See chapter 5.5 Checking Motor Rotation.

Symptom	Possible cause	Test	Solution
Motor is not reaching maximum speed	Frequency limits set wrong	Check output limits in 4-13 Motor Speed High Limit [RPM], 4-14 Motor Speed High Limit [Hz] and 4-19 Max Output Frequency.	Program correct settings.
	Reference input signal not scaled correctly	Check reference input signal scaling in 6-0* Analog I/O Mode and parameter group 3-1* References. Reference limits in parameter group 3-0* Reference Limits.	Check settings in parameter group 1-6* Load Depen.Setting. For closed-loop operation, check settings in parameter group 20-0* Feedback.
Motor runs rough	Possible overmagnetization	Check for incorrect motor settings in all motor parameters.	Check motor settings in parameter groups 1-2* Motor Data, 1-3* Addl. Motor Data, and 1-5* Load Indep. Setting.
Motor will not brake	Possible incorrect settings in the brake parameters. Possible too short ramp-down times	Check brake parameters. Check ramp time settings.	Check parameter group 2-0* DC Brake and 3-0* Reference Limits.
Open power fuses or circuit breaker trip	Phase-to-phase short	Motor or panel has a short phase-to-phase. Check motor and panel phase for shorts.	Eliminate any short circuits detected.
	Motor overload	Motor is overloaded for the application.	Perform start-up test and verify motor current is within specifications. If motor current is exceeding nameplate full load current, motor may run only with reduced load. Review the specifications for the application.
	Loose connections	Perform pre-start-up check for loose connections	Tighten loose connections.
Line power current imbalance greater than 3%	Problem with line power (See Alarm 4 Mains phase loss description)	Rotate input power leads into the adjustable frequency drive one position: A to B, B to C, C to A.	If imbalanced leg follows the wire, it is a power problem. Check line power supply.
	Problem with the adjustable frequency drive	Rotate input power leads into the adjustable frequency drive one position: A to B, B to C, C to A.	If imbalance leg stays on same input terminal, it is a problem with the unit. Contact the supplier.

Symptom	Possible cause	Test	Solution
Motor current imbalance greater than 3%	Problem with motor or motor wiring	Rotate output motor leads one position: U to V, V to W, W to U.	If imbalanced leg follows the wire, the problem is in the motor or motor wiring. Check motor and motor wiring.
	Problem with the adjustable frequency drives	Rotate output motor leads one position: U to V, V to W, W to U.	If imbalance leg stays on same output terminal, it is a problem with the unit. Contact the supplier.
Adjustable frequency drive acceleration problems	Motor data are entered incorrectly	If warnings or alarms occur, see chapter 7.4 List of Warnings and Alarms Check that motor data are entered correctly	Increase the ramp-up time in 3-41 Ramp 1 Ramp Up Time. Increase current limit in 4-18 Current Limit. Increase torque limit in 4-16 Torque Limit Motor Mode.
Adjustable frequency drive deceleration problems	Motor data are entered incorrectly	If warnings or alarms occur, see chapter 7.4 List of Warnings and Alarms Check that motor data are entered correctly	Increase the ramp-down time in 3-42 Ramp 1 Ramp Down Time. Enable overvoltage control in 2-17 Over-voltage Control.
Acoustic noise or vibration (e.g., a fan blade is making noise or vibrations at certain frequencies)	Resonances, e.g., in the motor/fan system	Bypass critical frequencies by using parameters in parameter group 4-6* Speed Bypass.	Check if noise and/or vibration have been reduced to an acceptable limit.
		Turn off overmodulation in 14-03 Overmodulation.	
		Change switching pattern and frequency in parameter group 14-0* Inverter Switching.	
		Increase Resonance Dampening in 1-64 Resonance Dampening.	

CHAPTER

8 SPECIFICATIONS

8 Specifications

8.1 Electrical Data

Table 8.1. Line Power Supply 3x200–240 V AC.

Type Designation, HVFD3D…	3A0015	2A0020	3A0030	3A0050
Typical Shaft Output [HP] at 208 V	1.5	2.0	2.9	4.9
Typical Shaft Output [kW]	1.1	1.5	2.2	3.7
Enclosure Size				
IP21/NEMA 1	A2	A2	A2	A3
IP55/NEMA 12	A5	A5	A5	A5
Output Current				
Continuous (3x200–240 V) [A]	6.6	7.5	10.6	16.7
Intermittent (3x200–240 V) [A]	7.3	8.3	11.7	18.4
Continuous kVA (208 V AC) [kVA]	2.38	2.70	3.82	6.00
Max. Input Current				
Continuous (3x200–240 V) [A]	5.9	6.8	9.5	15.0
Intermittent (3x200–240 V) [A]	6.5	7.5	10.5	16.5
Additional Specifications				
Estimated power loss at rated max. load [W][2)]	63	82	116	185
IP21 max. cable cross-section (line power, motor, brake and load sharing) [AWG/(mm^2)]	12 (4)			
IP55 max. cable cross-section (line power, motor, brake and load sharing) [AWG/(mm^2)]	12 (4)			
Efficiency[1)]	0.96	0.96	0.96	0.96

1) Efficiency measured at nominal current. For energy efficiency class see Chapter 8.4 Ambient Conditions.

2) Applies for dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included.

8.1.1 Line Power Supply 3x200–240 V AC

Table 8.2. Line Power Supply 3x200–240 V AC - Normal overload 110% for 1 minute, 7.5 to 20 HP.

Type Designation, HVFD3D...	3A0075	3A0100	3A0150	3A0200
Typical Shaft Output [HP] at 208 V	7.5	10	15	20
Typical Shaft Output [kW]	5.5	7.5	11	15
Enclosure Size				
IP21/NEMA 1	B1	B1	B1	B2
IP55/NEMA 12	B1	B1	B1	B2
Output Current				
Continuous (3x200–240 V) [A]	24.2	30.8	46.2	59.4
Intermittent (3x200–240 V) [A]	26.6	33.9	50.8	65.3
Continuous kVA (208 V AC) [kVA]	8.7	11.1	16.6	21.4
Max. Input Current				
Continuous (3x200–240 V) [A]	22.0	28.0	42.0	54.0
Intermittent (3x200–240 V) [A]	24.2	30.8	46.2	59.4
Additional Specifications				
Estimated power loss at rated max. load [W][2]	269	310	447	602
IP21, IP55 max. cable cross-section (line power, motor) [AWG/(mm^2)]	7 (10)			2 (35)
IP21, IP55 max. cable cross-section (brake, load sharing) [AWG/(mm^2)]	7 (10)			2 (35)

1) Efficiency measured at nominal current. For energy efficiency class see Chapter 8.4 Ambient Conditions.

2) Applies for dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included.

Table 8.3. Line Power Supply 3x200–240 V AC - Normal overload 110% for 1 minute, 25 to 60 HP.

Type Designation, HVFD3D…	3A0250	3A0300	3A0400	3A0500	3A0600
Typical Shaft Output [HP] at 208 V	25	30	40	50	60
Typical Shaft Output [kW]	18.5	22	30	37	45
Enclosure Size					
IP21/NEMA 1	C1	C1	C1	C2	C2
IP55/NEMA 12	C1	C1	C1	C2	C2
Output Current					
Continuous (3x200–240 V) [A]	74.8	88.0	115	143	170
Intermittent (3x200–240 V) [A]	82.3	96.8	127	157	187
Continuous kVA (208 V AC) [kVA]	26.9	31.7	41.4	51.5	61.2
Max. Input Current					
Continuous (3x200–240 V) [A]	68.0	80.0	104.0	130.0	154.0
Intermittent (3x200–240 V) [A]	74.8	88.0	114.0	143.0	169.0
Additional Specifications					
Estimated power loss at rated max. load [W][2]	737	845	1140	1353	1636
IP21, IP55 max. cable cross-section (line power, motor) [AWG/(mm^2)]	1/0 (50)			4/0 (95)	
IP21, IP55 max. cable cross-section (brake, load sharing) [AWG/(mm^2)]	1/0 (50)			4/0 (95)	
Efficiency[1]	0.96	0.97	0.97	0.97	0.97

1) Efficiency measured at nominal current. For energy efficiency class see Chapter 8.4 Ambient Conditions.

2) Applies for dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included.

Table 8.4. Line Power Supply 3x200–240 V AC - Normal overload 110% for 1 minute, 75 to 125 HP.

Type Designation, HVFD3D...	3A0750	3A1000	3A1250
Typical shaft output at 230 V [hp]	75	100	120
Typical shaft output at 230 V [kW]	55	75	90
Enclosure Size			
IP21/NEMA 1	D1	D1	D2
IP54/NEMA 12	D1	D1	D2
Output Current			
Continuous (3x230 V) [A]	190	240	302
Intermittent (3x230 V) [A]	209	264	332
Continuous kVA (230 V AC) [kVA]	76	96	120
Max. Input Current			
Continuous (3x230 V) [A]	183	231	291
Additional Specifications			
Estimated power loss at 230 V [W][1, 2]	1505	2398	2623
Max. cable cross-section (line power, motor, brake and load sharing) [AWG/(mm^2)]	2x3/0 (2x95)	2x3/0 (2x95)	2x3/0 (2x95)
Efficiency[2]	0.97	0.97	0.97

1) Typical power loss is at normal conditions and expected to be within ±15% (tolerance relates to variety in voltage and cable conditions). These values are based on a typical motor efficiency (IE/IE3 border line). Lower efficiency motors add to the power loss in the drive. Applies to dimensioning of drive cooling. If the switching frequency is higher than the default setting, the power losses can increase. LCP and typical control card power consumptions are included. Options and customer load can add up to 30 W to the losses, though usually a fully loaded control card and options for slots A and B each add only 4 W.

2) Measured using 5 m (16.4 ft) shielded motor cables at rated load and rated frequency. Efficiency measured at nominal current. For energy efficiency class, see chapter Chapter 8.4 Ambient Conditions.

8.1.2 Line Power Supply 3x380–480 V AC

Table 8.5. Line Power Supply 3x380–480 V AC - Normal overload 110% for 1 minute, 1.5 to 10 HP.

Type Designation, HVFD3D...	3C0015	3C0020	3C0030	3C0050	3C0075	3C0100
Typical Shaft Output [HP] at 460 V	1.5	2.0	2.9	5.0	7.5	10
Typical Shaft Output [kW]	1.1	1.5	2.2	4.0	5.5	7.5
Enclosure Size						
IP21/NEMA 1	A2	A2	A2	A2	A3	A3
IP55/NEMA 12	A5	A5	A5	A5	A5	A5
Output Current						
Continuous (3x380–440 V) [A]	3	4.1	5.6	10	13	16
Intermittent (3x380–440 V) [A]	3.3	4.5	6.2	11	14.3	17.6
Continuous (3x441–480 V) [A]	2.7	3.4	4.8	8.2	11	14.5
Intermittent (3x441–480 V) [A]	3.0	3.7	5.3	9.0	12.1	15.4
Continuous kVA (400 V AC) [kVA]	2.1	2.8	3.9	6.9	9.0	11.0
Continuous kVA (460 V AC) [kVA]	2.4	2.7	3.8	6.5	8.8	11.6
Max. Input Current						
Continuous (3x380–440 V) [A]	2.7	3.7	5.0	9.0	11.7	14.4
Intermittent (3x380–440 V) [A]	3.0	4.1	5.5	9.9	12.9	15.8
Continuous (3x441–480 V) [A]	2.7	3.1	4.3	7.4	9.9	13.0
Intermittent (3x441–480 V) [A]	3.0	3.4	4.7	8.1	10.9	14.3
Additional Specifications						
Estimated power loss at rated max. load [W][2]	58	62	88	124	187	255
IP21 max. cable cross-section (line power, motor, brake and load sharing) [AWG/(mm^2)]	12 (4)					
IP55 max. cable cross-section (line power, motor, brake and load sharing) [AWG/(mm^2)]	12 (4)					
Efficiency[1]	0.96	0.97	0.97	0.97	0.97	0.97

1) Efficiency measured at nominal current. For energy efficiency class see Chapter 8.4 Ambient Conditions.

2) Applies for dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included.

Table 8.6. Line Power Supply 3x380–480 V AC - Normal overload 110% for 1 minute, 15 to 40 HP.

Type Designation, HVFD3D3...	3C0150	3C0200	3C0250	3C0300	3C0400
Typical Shaft Output [HP] at 460 V	15	20	25	30	40
Typical Shaft Output [kW]	11	15	18.5	22	30
Enclosure Size					
IP21/NEMA 1	B1	B1	B1	B2	B2
IP55/NEMA 12	B1	B1	B1	B2	B2
Output Current					
Continuous (3x380–439 V) [A]	24	32	37.5	44	61
Intermittent (3x380–439 V) [A]	26.4	35.2	41.3	48.4	67.1
Continuous (3x440–480 V) [A]	21	27	34	40	52
Intermittent (3x440–480 V) [A]	23.1	29.7	37.4	44	61.6
Continuous kVA (400 V AC) [kVA]	16.6	22.2	26	30.5	42.3
Continuous kVA (460 V AC) [kVA]	16.7	21.5	27.1	31.9	41.4
Max. Input Current					
Continuous (3x380–439 V) [A]	22	29	34	40	55
Intermittent (3x380–439 V) [A]	24.2	31.9	37.4	44	60.5
Continuous (3x440–480 V) [A]	19	25	31	36	47
Intermittent (3x440–480 V) [A]	20.9	27.5	34.1	39.6	51.7
Additional Specifications					
Estimated power loss at rated max. load [W][2]	278	392	465	525	698
IP21, IP55 max. cable cross-section (line power, motor) [AWG/(mm^2)]	7 (10)			2 (35)	
IP21, IP55 max. cable cross-section (brake, load sharing) [AWG/(mm^2)]	7 (10)			2 (35)	
Efficiency[1]	0.98	0.98	0.98	0.98	0.98

1) Efficiency measured at nominal current. For energy efficiency class see Chapter 8.4 Ambient Conditions.

2) Applies for dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included.

Table 8.7. Line Power Supply 3x380–480 V AC - Normal overload 110% for 1 minute, 50 to 125 HP.

Type Designation, HVFD3D3...	3C0500	3C0600	3C0750	3C1000	3C1250
Typical Shaft Output [HP] at 460 V	50	60	75	100	125
Typical Shaft Output [kW]	37	45	55	75	90
Output Current					
IP21/NEMA 1	C1	C1	C1	C2	C2
IP55/NEMA 12	C1	C1	C1	C2	C2
Output Current					
Continuous (3x380–439 V) [A]	73	90	106	147	177
Intermittent (3x380–439 V) [A]	80.3	99	117	162	195
Continuous (3x440–480 V) [A]	65	80	105	130	160
Intermittent (3x440–480 V) [A]	71.5	88	116	143	176
Continuous kVA (400 V AC) [kVA]	50.6	62.4	73.4	102	123
Continuous kVA (460 V AC) [kVA]	51.8	63.7	83.7	104	128
Max. Input Current					
Continuous (3x380–439 V) [A]	66	82	96	133	161
Intermittent (3x380–439 V) [A]	72.6	90.2	106	146	177
Continuous (3x440–480 V) [A]	59	73	95	118	145
Intermittent (3x440–480 V) [A]	64.9	80.3	105	130	160
Additional Specifications					
Estimated power loss at rated max. load [W][2]	739	843	1083	1384	1474
IP21, IP55 max. cable cross-section (line power, motor) [AWG/(mm^2)]	1/0 (50)			4/0 (95)	
IP21, IP55 max. cable cross-section (brake, load sharing) [AWG/(mm^2)]	1/0 (50)			4/0 (95)	
Efficiency[1]	0.98	0.98	0.98	0.98	0.99

1) Efficiency measured at nominal current. For energy efficiency class see Chapter 8.4 Ambient Conditions.

2) Applies for dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included.

Table 8.8. Line Power Supply 3x380–480 V AC - Normal overload 110% for 1 minute, 150 to 250 HP.

Type Designation, HVFD3D...	3C1500	3C2000	3C2500
Typical shaft output at 460 V [hp]	150	200	250
Typical shaft output at 400 V [kW]	110	132	160
Typical shaft output at 480 V [kW]	132	160	200
Enclosure Size			
IP21/NEMA 1	D1	D1	D1
IP54/NEMA 12	D1	D1	D1
Output Current			
Continuous (3x400 V) [A]	212	260	315
Intermittent (3x400 V) [A]	233	286	347
Continuous (3x460/480 V) [A]	190	240	302
Intermittent (3x460/480 V) [kVA]	209	264	332
Continuous kVA (400 V AC) [kVA]	147	180	218
Continuous kVA (460 V AC) [kVA]	151	191	241
Continuous kVA (480 V AC) [kVA]	165	208	262
Maximum Input Current			
Continuous (3x400 V) [A]	204	251	304
Continuous (3x460/480 V) [A]	183	231	291
Maximum Number and Size of cables Per Phase			
Estimated power loss at 400 V [W][1, 2]	2555	2949	3764
Estimated power loss at 460 V [W][1, 2]	2257	2719	3628
Max. cable cross-section (line power, motor, brake and load sharing) [AWG/(mm^2)]	2x3/0 (2x95)	2x3/0 (2x95)	2x3/0 (2x95)
Efficiency[1]	0.98	0.98	0.98

1) Typical power loss is at normal conditions and expected to be within ±15% (tolerance relates to variety in voltage and cable conditions). These values are based on a typical motor efficiency (IE/IE3 border line). Lower efficiency motors add to the power loss in the drive. Applies to dimensioning of drive cooling. If the switching frequency is higher than the default setting, the power losses can increase. LCP and typical control card power consumptions are included. Options and customer load can add up to 30 W to the losses, though usually a fully loaded control card and options for slots A and B each add only 4 W.

2) Measured using 5 m (16.4 ft) shielded motor cables at rated load and rated frequency. Efficiency measured at nominal current. For energy efficiency class, see Chapter 8.4 Ambient Conditions.

8.1.3 Line Power Supply 3x525–600 V AC

Table 8.9. Line Power Supply 3x525–600 V AC - Normal overload 110% for 1 minute, 3 to 10 HP.

Type Designation, HVFD3D...	3D0030	3D0050	3D0075	3D0100
Typical Shaft Output [HP]	3	5	7.5	10
Typical Shaft Output [kW]	2.2	4.0	5.5	7.5
IP21/NEMA 1	A3	A3	A3	A3
IP55/NEMA 12	A5	A5	A5	A5
Output Current				
Continuous (3x525–550 V) [A]	4.1	6.4	9.5	11.5
Intermittent (3x525–550 V) [A]	4.5	7.0	10.5	12.7
Continuous (3x525–600 V) [A]	3.9	6.1	9.0	11.0
Intermittent (3x525–600 V) [A]	4.3	6.7	9.9	12.1
Continuous kVA (525 V AC) [kVA]	3.9	6.1	9.0	11.0
Continuous kVA (575 V AC) [kVA]	3.9	6.1	9.0	11.0
Max. Input Current				
Continuous (3x525–600 V) [A]	4.1	5.8	8.6	10.4
Intermittent (3x525–600 V) [A]	4.5	6.4	9.5	11.5
Additional Specifications				
Estimated power loss at rated max. load [W][2]	92	145	195	261
IP21 max. cable cross-section (line power, motor, brake and load sharing) [AWG/(mm^2)]	4 (12)			
IP55 max. cable cross-section (line power, motor, brake and load sharing) [AWG/(mm^2)]	4 (12)			
Efficiency[1]	0.97	0.97	0.97	0.97

1) Efficiency measured at nominal current. For energy efficiency class see Chapter 8.4 Ambient Conditions.

2) Applies for dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included.

Table 8.10. Line Power Supply 3x525–600 V AC - Normal overload 110% for 1 minute, 15 to 40 HP.

Type Designation, HVFD3D...	3D0150	3D0200	3D0250	3D0300	3D0400
Typical Shaft Output [HP]	15	20	25	30	40
Typical Shaft Output [kW]	11	15	18.5	22	30
IP21/NEMA 1	B1	B1	B1	B2	B2
IP55/NEMA 12	B1	B1	B1	B2	B2
Output Current					
Continuous (3 x 525–550 V) [A]	19	23	28	36	43
Intermittent (3 x 525–550 V) [A]	21	25	31	40	47
Continuous (3x525–600 V) [A]	18	22	27	34	41
Intermittent (3x525–600 V) [A]	20	24	30	37	45
Continuous kVA (525 V AC) [kVA]	18.1	21.9	26.7	34.3	41
Continuous kVA (575 V AC) [kVA]	17.9	21.9	26.9	33.9	40.8
Max. Input Current					
Continuous (3x525–600 V) [A]	17.2	20.9	25.4	32.7	39
Intermittent (3x525–600 V) [A]	19	23	28	36	43
Additional Specifications					
Estimated power loss at rated max. load [W]4)	300	400	475	525	700
IP21, IP55 max. cable cross- section (line power, brake and load sharing) [AWG/(mm^2)]	7 (10)			2 (35)	
IP21, IP55 max. cable cross-section (motor) [AWG/(mm^2)]	7 (10)			2 (35)	
Efficiency[3]	0.98	0.98	0.98	0.98	0.98

1) Efficiency measured at nominal current. For energy efficiency class see Chapter 8.4 Ambient Conditions.

2) Applies for dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included.

Table 8.11. Line Power Supply 3x525–600 V AC - Normal overload 110% for 1 minute, 50 to 125 HP.

Type Designation, HVFD3D...	3D0500	3D0600	3D0750	3D1000	3D1250
Typical Shaft Output [HP]	50	60	75	100	125
Typical Shaft Output [kW]	37	45	55	75	90
IP21/NEMA 1	C1	C1	C1	C2	C2
IP55/NEMA 12	C1	C1	C1	C2	C2
Output Current					
Continuous (3 x 525–550 V) [A]	54	65	87	105	137
Intermittent (3 x 525–550 V) [A]	59	72	96	116	151
Continuous (3x525–600 V) [A]	52	62	83	100	131
Intermittent (3x525–600 V) [A]	57	68	91	110	144
Continuous kVA (525 V AC) [kVA]	51.4	61.9	82.9	100	130.5
Continuous kVA (575 V AC) [kVA]	51.8	61.7	82.7	99.6	130.5
Max. Input Current					
Continuous (3x525–600 V) [A]	49	59	78.9	95.3	124.3
Intermittent (3x525–600 V) [A]	54	65	87	105	137
Additional Specifications					
Estimated power loss at rated max. load [W][4]	750	850	1100	1400	1500
IP21, IP55 max. cable cross- section (line power, brake and load sharing) [AWG/(mm^2)]	1/0 (50)			4/0 (95)	
IP21, IP55 max. cable cross-section (motor) [AWG/(mm^2)]	1/0 (50)			4/0 (95)	
Efficiency[3]	0.98	0.98	0.98	0.98	0.98

1) Efficiency measured at nominal current. For energy efficiency class see Chapter 8.4 Ambient Conditions.

2) Applies for dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included.

8.1.4 Line Power Supply 3 x 525–690 V AC

Table 8.12. Line Power Supply 3x525–690 V AC - Normal overload 110% for 1 minute, 150 to 200 HP.

Type Designation, HVFD3D...	3D1500	3D2000
Typical shaft output at 575 V [hp]	150	200
Typical shaft output at 525 V [kW]	110	132
Typical shaft output at 690 V [kW]	132	160
Enclosure Size		
IP21/NEMA 1	D1	D1
IP54/NEMA 12	D1	D1
Output Current		
Continuous (3x525 V) [A]	162	201
Intermittent (3x525 V) [A]	178	221
Continuous (3x575/690 V) [A]	155	192
Intermittent (3x575/690 V) [A]	171	211
Continuous kVA (525 V AC) [kVA]	147	183
Continuous kVA (575 V AC) [kVA]	154	191
Continuous kVA (690 V AC) [kVA]	185	230
Maximum Input Current		
Continuous (3x525 V) [A]	156	193
Continuous (3x575/690 V) [A]	149	185
Additional Specifications		
Estimated power loss at 575 V [W][1, 2]	2101	2649
Estimated power loss at 690 V [W][1, 2]	2167	2740
Mains, motor, brake, and load share [AVG/(mm^2)]	2x3/0 (2x95)	2x3/0 (2x95)
Efficiency[2]	0.98	0.98

1) Typical power loss is at normal conditions and expected to be within ±15% (tolerance relates to variety in voltage and cable conditions). These values are based on a typical motor efficiency (IE/IE3 border line). Lower efficiency motors add to the power loss in the drive. Applies to dimensioning of drive cooling. If the switching frequency is higher than the default setting, the power losses can increase. LCP and typical control card power consumptions are included.Options and customer load can add up to 30 W to the losses, though usually a fully loaded control card and options for slots A and B each add only 4 W.

2) Measured using 5 m (16.4 ft) shielded motor cables at rated load and rated frequency. Efficiency measured at nominal current. For energy efficiency class, see Chapter 8.4 Ambient Conditions.

8.2 Line Power Supply

Table 8.13. Line power supply.

Supply Terminals	L1, L2, L3
Supply Voltage Nominal 208/230 V AC	200 to 240 V AC ± 10%
Supply Voltage Nominal 460 V AC	380 to 280 V AC ± 10%
Supply Voltage Nominal 600 V AC	525 to 600 V AC ± 10% (Frame A, B, C) 525 to 690 V AC ± 10% (Frame D)
AC line voltage low/line drop-out: During low AC line voltage or a line drop-out, the adjustable frequency drive continues until the intermediate circuit voltage drops below the minimum stop level, which corresponds typically to 15% below the adjustable frequency drive's lowest rated supply voltage. Power-up and full torque cannot be expected at AC line voltage lower than 10% below the adjustable frequency drive's lowest rated supply voltage.	
Supply Frequency	50/60 Hz ± 5%
Max. temporary imbalance between line phases	3% of rated supply voltage
True Power Factor (λ)	≥ 0.9 nominal at rated load
Displacement power factor (cos ϕ)	near unity (> 0.98)
Switching on input supply L1, L2, L3	Frame A, B, C: up to 10 HP maximum 2 times/ min, greater than 10 HP maximum 1 time/min Frame D: maximum 1 time/2 min
Environment according to EN60664-1	Overvoltage category III/pollution degree 2
The unit is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical Amperes, 240/500/600/690 V maximum.	

8.3 Motor Output and Motor Data

Table 8.14. Motor Output.

Motor Output Terminals	U, V, W
Output voltage	0-100% of supply voltage
Output frequency	0-590 Hz
Switching on output	Unlimited
Ramp times	1-3600 s

Table 8.15. Torque Characteristics Frame A, B, C.

Starting Torque	maximum 135% up to 0.5 s[1]
Starting Torque (Variable torque)	maximum 110% for 60 s[1]
Overload Torque (Variable torque)	maximum 110% for 60 s[1]
Starting torque (Constant torque)	maximum 110% for 60 s[1]
Overload Torque (Constant torque)	maximum 110% for 60 s[1]
Torque rise time in VCC[2] (independent of fsw)	10 ms
1) Percentage relates to the nominal torque. *2) The torque response time depends on application and load but as a general rule, the torque step from 0 to reference is 4–5 x torque rise time.*	

Table 8.16. Torque Characteristics Frame D.

Starting torque (Constant torque)	maximum 150% for 60 s[1, 2]
Overload Torque (Constant torque)	maximum 150% for 60 s[1, 2]
1) Percentage relates to the nominal current of the drive. *2) Once every 10 minutes.*	

8.4 Ambient Conditions

Table 8.17. Environment.

Enclosure Ratings	NEMA1/IP21 (All Frame Sizes) NEMA12/IP55 (Frame A, B, C) NEMA12/IP54 (Frame D)
Vibration Test	1.0 g
Max. relative Humidity	5%-93% (IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43) H2S test	class Kd
Ambient temperature	Max 122°F [50°C] (24-hour average maximum 113°F [45°C])
Derating for high ambient temperature, see special conditions in the Design Guide	
Minimum ambient temperature during full-scale operation	32°F [0°C]
Minimum ambient temperature at reduced performance	14°F [-10°C]
Temperature during storage/transport	-13°-+149/158°F [-25-+65/70°C]
Maximum altitude above sea level without derating	3,300 ft [1000 m]
Derating for high altitude, see special conditions in the Design Guide	
EMC Standards, Emission	EN 61800-3
EMC standards, Immunity	EN 61800-3

8.5 Cable Specifications

Table 8.18. Cable lengths and cross-sections for control cables.

Maximum motor cable length, shielded/armored	500 ft [150 m]
Maximum motor cable length, unshielded/unarmored	1,000 ft [300 m]
Maximum cross-section to motor, mains, load sharing, and brake	See Chapter 8.1 Electrical Data
Maximum cross-section to control terminals, flexible/ rigid wire without cable end sleeves	16 AWG [1.5 mm^2]
Maximum cross-section to control terminals, flexible wire with cable end sleeves	18 AWG [1 mm^2]

Maximum cross-section to control terminals, flexible wire with cable end sleeves with collar	20 AWG [0.5 mm^2]
Minimum cross-section to control terminals	24 AWG [0.25 mm^2]

8.6 Control Input/Output and Control Data

Table 8.19. Digital Inputs.

Programmable digital inputs	4 (6)1)
Terminal number	18, 19, 271), 291), 32, 33
Logic	PNP or NPN
Voltage level	0-24 V DC
Voltage level, logic '0' PNP	<5 V DC
Voltage level, logic '1' PNP	>10 V DC
Voltage level, logic '0' NPN	>19 V DC
Voltage level, logic '1' NPN	<14 V DC
Maximum voltage on input	28 V DC
Input resistance, Ri	Approx. 4 kΩ
All digital inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. *1) Terminals 27 and 29 can also be programmed as output.*	

Table 8.20. Analog Inputs.

Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Frame A, B, C: Switch S201 and switch S202 Frame D: Switch A53 and A54
Voltage mode	Switch = OFF (U)
Voltage level	-10 to +10 V (scalable)
Input resistance, Ri	Approximately 10 kΩ
Max. voltage	±20 V
Current mode	Switch = ON (i)
Current level	0/4 to 20 mA (scalable)
Input resistance, Ri	Approximately 200 Ω
Max. current	30 mA
Resolution for analog inputs	10 bit (+ sign)
Accuracy of analog inputs	Max. error 0.5% of full scale
Bandwidth	20 Hz/100 Hz
The analog inputs are galvanically isolated from the supply voltage (PELV) and other high voltage terminals.	

Table 8.21. Pulse Inputs.

Programmable pulse	2
Terminal number pulse	29, 33
Max. Frequency at terminal 29, 33	110 kHz (push-pull driven)
Max. Frequency at terminal 29, 33	5 kHz (open collector)
Max. Frequency at terminal 29, 33	4 Hz
Voltage level	See digital inputs
Maximum voltage on input	28 V DC
Input resistance, Ri	Approx. 4 kΩ
Pulse input accuracy (0.1-1 kHz)	Max. error: 0.1% of full scale
The pulse inputs are galvanically isolated from the supply voltage (PELV) and other high voltage terminals.	

Table 8.22. Analog Output.

Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4-20 mA
Max. load GND - analog output	500 Ω
Accuracy on analog output	Frame A, B, C: Max. error: 0.5% of full scale Frame D: Maximum error: 0.8% of full scale
Resolution on analog output	8 bit
The analog output is galvanically isolated from the supply voltage (PELV) and other high voltage terminals.	

Figure 8.1. PELV Isolation.

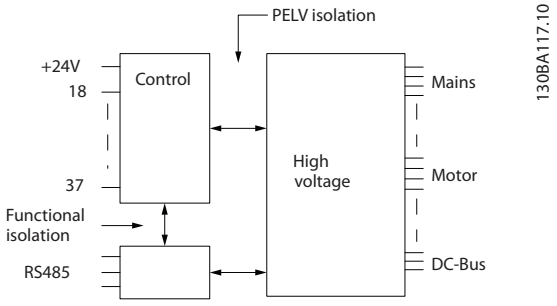


Table 8.23. Digital Outputs.

Programmable digital/pulse outputs	2
Terminal number	27, 291)
Voltage level at digital/frequency output	0-24 V
Max. output current (sink or source)	40 mA
Max. load at frequency output	1 kΩ
Max. capacitive load at frequency output	10 nF

Minimum output frequency at frequency output	0 Hz
Maximum output frequency at frequency output	32 kHz
Accuracy of frequency output	Max. error: 0.1% of full scale
Resolution of frequency outputs	12 bit
All digital outputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. *1) Terminals 27 and 29 can also be programmed as input.*	

Table 8.24. Relay outputs.

Programmable relay outputs	2
Environment according to EN 60664-1	Overvoltage category III/pollution degree 2
Relay 01 (Frame A, B, C)	
Terminal number	1-2 (NO), 1-3 (NC)
Maximum terminal load1), 1-2 (NO) and 1-3 (NC)	240 V AC, 2A, Resistive 240 V AC, 0.2A, Inductive @ cosϕ 0.4 60 V DC, 1 A, Resistive 24 V DC, 0.1A, Inductive
Maximum terminal load1), 1-2 (NO) and 1-3 (NC)	24 V DC, 10 mA 24 V AC, 2 mA
Relay 01 (Frame D)	
Terminal number	1-2 (NO), 1-3 (NC)
Maximum terminal load1), 1-2 (NO)	400 V AC, 2A, Resistive2), 3) 240 V AC, 0.2A, Inductive @ cosϕ 0.4 80 V DC, 1 A, Resistive 24 V DC, 0.1A, Inductive
Maximum terminal load1), 1-3 (NC)	240 V AC, 2A, Resistive 240 V AC, 0.2A, Inductive @ cosϕ 0.4 60 V DC, 1 A, Resistive 24 V DC, 0.1A, Inductive
Minimum terminal load1), 1-2 (NO) and 1-3 (NC)	24 V DC, 10 mA 24 V AC, 2 mA
Relay 02 (All Frame Sizes)	
Terminal number	4-5 (NO), 4-6 (NC)
Maximum terminal load1), 4-5 (NO)	400 V AC, 2A, Resistive2), 3) 240 V AC, 0.2A, Inductive @ cosϕ 0.4 80 V DC, 1 A, Resistive 24 V DC, 0.1A, Inductive
Maximum terminal load1), 4-6 (NC)	240 V AC, 2A, Resistive 240 V AC, 0.2A, Inductive @ cosϕ 0.4 60 V DC, 1 A, Resistive 24 V DC, 0.1A, Inductive
Minimum terminal load1), 4-5 (NO) and 4-6 (NC)	24 V DC, 10 mA 24 V AC, 2 mA
The relay contacts are galvanically isolated from the rest of the circuit by reinforced isolation (PELV). *1) IEC 60947 part 4 and 5.* *2) Overvoltage Category II.* *3) UL applications 300 V AC 2 A.*	

Control Card, RS-485 serial communication	
Terminal number	68 (P,TX+, RX+), 69 (N,TX-, RX-)
Terminal number 61	Common for terminals 68 and 69
The RS-485 serial communication circuit is functionally separated from other central circuits and galvanically isolated from the supply voltage (PELV).	
Control Card, 24 V DC output	
Terminal number	12, 13
Output voltage	24 V +1, -3 V
Max. load	200 mA
The 24 V DC supply is galvanically isolated from the supply voltage (PELV), but has the same potential as the analog and digital inputs and outputs.	
Control Card, 10 V DC output	
Terminal number	50
Output voltage	10.5 V ±0.5 V
Max. load	15 mA
The 10 V DC supply is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.	
Control card, USB serial communication	
USB standard	1.1 (full speed)
USB plug	USB type B device plug
Connection to PC is carried out via a standard host/device USB cable. The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. The USB ground connection is not galvanically isolated from protection ground. Use only an isolated laptop as PC connection to the USB connector on the adjustable frequency drive.	
Control Characteristics	
Resolution of output frequency at 0-590 Hz	± 0.003 Hz
Repeat accuracy of Precise start/stop (terminals 18, 19)	≤± 0.1 ms
System response time (terminals 18, 19, 27, 29, 32, 33)	≤ 2 ms
Speed control range (open-loop)	1:100 of synchronous speed
Speed accuracy (open-loop)	30-4000 rpm: error ± 8 rpm
All control characteristics are based on a 4-pole asynchronous motor	

8.7 Connection Tightening Torques

Apply the correct torque when tightening fasteners in the locations that are listed in Table 8.25 and Table 8.26. Too low or too high torque when fastening an electrical connection results in a bad electrical connection. To ensure correct torque, use a torque wrench.

Table 8.25. Tightening of Terminals, Enclosure Types A, B and C.

Enclosure	Power [HP]			Torque [in-lb (Nm)]					
	208/ 230 V AC	460 V AC	600 V AC	Line power	Motor	DC Connection	Brake	Ground	Relay
A2	1.5 to 3	1.5 to 5		5 (0.6)	5 (0.6)	5 (0.6)	16 (1.8)	26.5 (3)	5 (0.6)
A3	5	7.5 to 10	3 to 10	5 (0.6)	5 (0.6)	5 (0.6)	16 (1.8)	26.5 (3)	5 (0.6)
A5	1.5 to 5	1.5 to 10	3 to 10	5 (0.6)	5 (0.6)	5 (0.6)	16 (1.8)	26.5 (3)	5 (0.6)
B1	7.5 to 15	15 to 25	15 to 25	16 (1.8)	16 (1.8)	13.2 (1.5)	13.2 (1.5)	26.5 (3)	5 (0.6)
B2	20	30 to 40	30 to 40	40 (4.5)	40 (4.5)	32.5 (3.7)	32.5 (3.7)	26.5 (3)	5 (0.6)
C1	25 to 40	50 to 75	50 to 75	88.5 (10)	88.5 (10)	88.5 (10)	88.5 (10)	26.5 (3)	5 (0.6)
C2	50 to 60	100 to 125	100 to 125	124/212 (14/24)[1]	124/212 (14/24)[1]	124 (14)	124 (14)	26.5 (3)	5 (0.6)

1) For different cable dimensions x/y, where x ≤ 4/0 AWG [95 mm^2] and y ≥ 4/0 AWG [95 mm^2].

Table 8.26. Tightening of Fasteners, Enclosure Type D.

Location	Bolt size	Torque [in-lb (Nm)]
Mains terminals	M10/M12	168 (19)/335 (37)
Motor terminals	M10/M12	168 (19)/335 (37)
Ground terminals	M8/M10	84 (9.6)/169 (19.1)
Brake terminals	M8	84 (9.6)
Load sharing terminals	M10/M12	168 (19)/335 (37)
Regeneration terminals	M8	84 (9.6)
Relay terminals	-	0.5 (4)
Door/panel cover	M5	20 (2.3)
Gland plate	M5	20 (2.3)
Heat sink access panel	M5	35 (3.9)
Serial communication cover	M5	20 (2.3)

8.8 Fuses and Circuit Breakers

Use recommended fuses and/or circuit breakers on the supply side as protection in case of component breakdown inside the adjustable frequency drive (first fault).

Note: *Use of fuses on the supply side is mandatory for IEC 60364 (CE) and NEC 2009 (UL) compliant installations.*

Recommendations

- Fuses of the type gG.
- Circuit breakers of Moeller types. For other circuit breaker types, ensure that the energy into the adjustable frequency drive is equal to or lower than the energy provided by Moeller types.

Use of recommended fuses and circuit breakers ensures possible damage to the adjustable frequency drive is limited to damages inside the unit. For further information, see Application Note Fuses and Circuit Breakers, MN90T.

The fuses below are suitable for use on a circuit capable of delivering 100,000 Arms (symmetrical), depending on the adjustable frequency drive voltage rating. With the proper fusing the adjustable frequency drive Short Circuit Current Rating (SCCR) is 100,000 A_{rms}.

8.8.1 CE Compliance

Table 8.27. 200–240 V, Enclosure Types A, B and C.

Enclosure Type	Power (hp [kW])	Recommended Fuse Size	Recommended Max. Fuse Size	Recommended Circuit breaker (Moeller)	Max. Trip Level [A]
A2	1.5–3 [1.1–2.2]	gG-10 (1.5–2 [1.1–1.5]) gG-16 (3 [2.2])	gG-25	PKZM0-25	25
A3	4–5 [3.0–3.7]	gG-16 (4 [3]) gG-20 (5 [3.7])	gG-32	PKZM0-25	25
A5	1.5-5 [1.1-3.7]	gG-10 (0.34–2 [0.25–1.5]) gG-16 (3–4 [2.2–3]) gG-20 (5 [3.7])	gG-32	PKZM0-25	25
B1	7.5–15 [5.5–11]	gG-25 (7.5 [5.5]) gG-32 (10–15 [7.5–11])	gG-80	PKZM4-63	63
B2	20 [15]	gG-50	gG-100	NZMB1-A100	100
C1	25–40 [18–30]	gG-63 (25 [18.5]) gG-80 (30 [22]) gG-100 (40 [30])	gG-160 (25–30 [18.5–22]) aR-160 (40 [30])	NZMB2-A200	160
C2	50–60 [37–45]	aR-160 (50 [37]) aR-200 (60 [45])	aR-200 (50 [37]) aR-250 (60 [45])	NZMB2-A250	250

Table 8.28. 380–480 V, Enclosure Types A, B and C.

Enclosure Type	Power (hp [kW])	Recommended Fuse Size	Recommended Max. Fuse Size	Recommended Circuit breaker (Moeller)	Max. Trip Level [A]
A2	1.5–5 [1.1–4.0]	gG-10 (1.5–4 [1.1–3]) gG-16 (5 [4])	gG-25	PKZM0-25	25
A3	7.5–10 [5.5–7.5]	gG-16	gG-32	PKZM0-25	25
A5	1.5–10 [1.1–7.5]	gG-10 (1.5–4 [1.1–3]) gG-16 (5–10 [4–7.5])	gG-32	PKZM0-25	25
B1	15–25 [11–18.5]	gG-40	gG-80	PKZM4-63	63
B2	30–40 [22–30]	gG-50 (30 [22]) gG-63 (40 [30])	gG-100	NZMB1-A100	100
C1	50–75 [37–55]	gG-80 (50 [37]) gG-100 (60 [45]) gG-160 (75 [55])	gG-160	NZMB2-A200	160
C2	100–125 [75–90]	aR-200 (100 [75]) aR-250 (125 [90])	aR-250	NZMB2-A250	250

Table 8.29. 525–600 V, Enclosure Types A, B and C.

Enclosure Type	Power (hp [kW])	Recommended Fuse Size	Recommended Max. Fuse Size	Recommended Circuit breaker (Moeller)	Max. Trip Level [A]
A3	3 to 10 [5.5–7.5]	gG-10 (7.5 [5.5]) gG-16 (10 [7.5])	gG-32	PKZM0-25	25
A5	1.5–10 [1.1–7.5]	gG-10 (1.5–7.5 [1.1–5.5]) gG-16 (10 [7.5])	gG-32	PKZM0-25	25
B1	15–25 [11–18]	gG-25 (15 [11]) gG-32 (20 [15]) gG-40 (25 [18.5])	gG-80	PKZM4-63	63
B2	30–40 [22–30]	gG-50 (30 [22]) gG-63 (40 [30])	gG-100	NZMB1-A100	100
C1	50–75 [37–55]	gG-63 (50 [37]) gG-100 (60 [45]) aR-160 (75 [55])	gG-160 (50–60 [37–45]) aR-250 (75 [55])	NZMB2-A200	160
C2	100–125 [75–90]	aR-200 (100–125 [75–90])	aR-250	NZMB2-A250	250

8.8.2 UL Compliance

Table 8.30. 3x200–240 V, Enclosure Types A, B and C.

Recommended Max. Fuse						
Power (hp [kW])	**Bussmann Type RK1[1]**	**Bussmann Type J**	**Bussmann Type T**	**Bussmann Type CC**	**Bussmann Type CC**	**Bussmann Type CC**
1.5 [1.1]	KTN-R-10	JKS-10	JJN-10	FNQ-R-10	KTK-R-10	LP-CC-10
2 [1.5]	KTN-R-15	JKS-15	JJN-15	FNQ-R-15	KTK-R-15	LP-CC-15
3 [2.2]	KTN-R-20	JKS-20	JJN-20	FNQ-R-20	KTK-R-20	LP-CC-20
5 [3.7]	KTN-R-30	JKS-30	JJN-30	FNQ-R-30	KTK-R-30	LP-CC-30
7.5–10 [5.5–7.5]	KTN-R-50	JKS-50	JJN-50	—	—	—
15 [11]	KTN-R-60	JKS-60	JJN-60	—	—	—
20 [15]	KTN-R-80	JKS-80	JJN-80	—	—	—
25–30 [18.5–22]	KTN-R-125	JKS-125	JJN-125	—	—	—
40 [30]	KTN-R-150	JKS-150	JJN-150	—	—	—
50 [37]	KTN-R-200	JKS-200	JJN-200	—	—	—
60 [45]	KTN-R-250	JKS-250	JJN-250	—	—	—

Table 8.31. 3x200–240 V, Enclosure Types A, B and C.

Recommended Max. Fuse								
Power (hp [kW])	**SIBA Type RK1**	**Littlefuse Type RK1**	**Ferraz-Shawmut Type CC**	**Ferraz-Shawmut Type RK1[3]**	**Bussmann Type JFHR2[2]**	**Littelfuse JFHR2**	**Ferraz-Shawmut JFHR2[4]**	**Ferraz-Shawmut J**
1.5 [1.1]	5017906-010	KLN-R-10	ATM-R-10	A2K-10-R	FWX-10	–	–	HSJ-10
2 [1.5]	5017906-016	KLN-R-15	ATM-R-15	A2K-15-R	FWX-15	–	–	HSJ-15
3 [2.2]	5017906-020	KLN-R-20	ATM-R-20	A2K-20-R	FWX-20	–	–	HSJ-20
5 [3.7]	5012406-032	KLN-R-30	ATM-R-30	A2K-30-R	FWX-30	–	–	HSJ-30
7.5–10 [5.5–7.5]	5014006-050	KLN-R-50	–	A2K-50-R	FWX-50	–	–	HSJ-50
15 [11]	5014006-063	KLN-R-60	–	A2K-60-R	FWX-60	–	–	HSJ-60
20 [15]	5014006-080	KLN-R-80	–	A2K-80-R	FWX-80	–	–	HSJ-80
25–30 [18.5–22]	2028220-125	KLN-R-125	–	A2K-125-R	FWX-125	–	–	HSJ-125
40 [30]	2028220-150	KLN-R-150	–	A2K-150-R	FWX-150	L25S-150	A25X-150	HSJ-150
50 [37]	2028220-200	KLN-R-200	–	A2K-200-R	FWX-200	L25S-200	A25X-200	HSJ-200
60 [45]	2028220-250	KLN-R-250	–	A2K-250-R	FWX-250	L25S-250	A25X-250	HSJ-250

1) KTS fuses from Bussmann may substitute KTN for 240 V adjustable frequency drives.
2) FWH fuses from Bussmann may substitute FWX for 240 V adjustable frequency drives.
3) A6KR fuses from FERRAZ SHAWMUT may substitute A2KR for 240 V adjustable frequency drives.
4) A50X fuses from FERRAZ SHAWMUT may substitute A25X for 240 V adjustable frequency drives.

Table 8.32. 3x380–480 V, Enclosure Types A, B and C.

Recommended Max. Fuse						
Power (hp [kW])	**Bussmann Type RK1[1]**	**Bussmann Type J**	**Bussmann Type T**	**Bussmann Type CC**	**Bussmann Type CC**	**Bussmann Type CC**
1.5 [1.1]	KTS-R-6	JKS-6	JJS-6	FNQ-R-6	KTK-R-6	LP-CC-6
2–3 [1.5–2.2]	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10
5 [4]	KTS-R-20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20
7.5 [5.5]	KTS-R-25	JKS-25	JJS-25	FNQ-R-25	KTK-R-25	LP-CC-25
10 [7.5]	KTS-R-30	JKS-30	JJS-30	FNQ-R-30	KTK-R-30	LP-CC-30
15–20 [11–15]	KTS-R-40	JKS-40	JJS-40	—	—	—
25 [18]	KTS-R-50	JKS-50	JJS-50	—	—	—
30 [22]	KTS-R-60	JKS-60	JJS-60	—	—	—
40 [30]	KTS-R-80	JKS-80	JJS-80	—	—	—
50 [37]	KTS-R-100	JKS-100	JJS-100	—	—	—
60 [45]	KTS-R-125	JKS-125	JJS-125	—	—	—
75 [55]	KTS-R-150	JKS-150	JJS-150	—	—	—
100 [75]	KTS-R-200	JKS-200	JJS-200	—	—	—
125 [90]	KTS-R-250	JKS-250	JJS-250	—	—	—

Table 8.33. 3x200–240 V, Enclosure Types A, B and C.

Recommended Max. Fuse								
Power (hp [kW])	**SIBA Type RK1**	**Littlefuse Type RK1**	**Ferraz-Shawmut Type CC**	**Ferraz-Shawmut Type RK1**	**Bussmann JFHR2**	**Ferraz-Shawmut J**	**Ferraz-Shawmut JFHR2[1]**	**Ferraz-Shawmut JFHR21)**
1.5 [1.1]	5017906-006	KLS-R-6	ATM-R-6	A6K-10-6	FWH-6	HSJ-6	–	–
2–3 [1.5–2.2]	5017906-010	KLS-R-10	ATM-R-10	A6K-10-R	FWH-10	HSJ-10	–	–
5 [4]	5017906-020	KLS-R-20	ATM-R-20	A6K-20-R	FWH-20	HSJ-20	–	–
7.5 [5.5]	5017906-025	KLS-R-25	ATM-R-25	A6K-25-R	FWH-25	HSJ-25	–	–
10 [7.5]	5012406-032	KLS-R-30	ATM-R-30	A6K-30-R	FWH-30	HSJ-30	–	–
15–20 [11–15]	5014006-040	KLS-R-40	–	A6K-40-R	FWH-40	HSJ-40	–	–
25 [18]	5014006-050	KLS-R-50	–	A6K-50-R	FWH-50	HSJ-50	–	–
30 [22]	5014006-063	KLS-R-60	–	A6K-60-R	FWH-60	HSJ-60	–	–
40 [30]	2028220-100	KLS-R-80	–	A6K-80-R	FWH-80	HSJ-80	–	–
50 [37]	2028220-125	KLS-R-100	–	A6K-100-R	FWH-100	HSJ-100	–	–
60 [45]	2028220-125	KLS-R-125	–	A6K-125-R	FWH-125	HSJ-125	–	–
75 [55]	2028220-160	KLS-R-150	–	A6K-150-R	FWH-150	HSJ-150	–	–
100 [75]	2028220-200	KLS-R-200	–	A6K-200-R	FWH-200	HSJ-200	A50-P-225	L50-S-225
125 [90]	2028220-250	KLS-R-250	–	A6K-250-R	FWH-250	HSJ-250	A50-P-250	L50-S-250

1) Ferraz-Shawmut A50QS fuses may substitute A50P fuses.

Table 8.34. 3x525–600 V, Enclosure Types A, B and C.

Recommended Max. Fuse										
Power (hp [kW])	Bussmann Type RK1	Bussmann Type J	Bussmann Type T	Bussmann Type CC	Bussmann Type CC	Bussmann Type CC	SIBA Type RK1	Littelfuse Type RK1	Ferraz-Shawmut Type RK1	Ferraz-Shawmut J
3 [2.2]	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10	5017906-010	KLS-R-010	A6K-10-R	HSJ-10
5 [4]	KTS-R20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20	5017906-020	KLS-R-020	A6K-20-R	HSJ-20
7.5 [5.5]	KTS-R-25	JKS-25	JJS-25	FNQ-R-25	KTK-R-25	LP-CC-25	5017906-025	KLS-R-025	A6K-25-R	HSJ-25
10 [7.5]	KTS-R-30	JKS-30	JJS-30	FNQ-R-30	KTK-R-30	LP-CC-30	5017906-030	KLS-R-030	A6K-30-R	HSJ-30
15–20 [11–15]	KTS-R-35	JKS-35	JJS-35	–	–	–	5014006-040	KLS-R-035	A6K-35-R	HSJ-35
25 [18]	KTS-R-45	JKS-45	JJS-45	–	–	–	5014006-050	KLS-R-045	A6K-45-R	HSJ-45
30 [22]	KTS-R-50	JKS-50	JJS-50	–	–	–	5014006-050	KLS-R-050	A6K-50-R	HSJ-50
40 [30]	KTS-R-60	JKS-60	JJS-60	–	–	–	5014006-063	KLS-R-060	A6K-60-R	HSJ-60
50 [37]	KTS-R-80	JKS-80	JJS-80	–	–	–	5014006-080	KLS-R-075	A6K-80-R	HSJ-80
60 [45]	KTS-R-100	JKS-100	JJS-100	–	–	–	5014006-100	KLS-R-100	A6K-100-R	HSJ-100
75 [55]	KTS-R-125	JKS-125	JJS-125	–	–	–	2028220-125	KLS-125	A6K-125-R	HSJ-125
100 [75]	KTS-R-150	JKS-150	JJS-150	–	–	–	2028220-150	KLS-150	A6K-150-R	HSJ-150
125 [90]	KTS-R-175	JKS-175	JJS-175	–	–	–	2028220-200	KLS-175	A6K-175-R	HSJ-175

8.9 Power Ratings, Weight and Dimensions

Table 8.35. Frame A, B and C Power Ratings, Weight and Dimensions.

Enclosure Type			A2	A3	A5	B1	B2	C1	C2
Rated Power (hp [kW])	**200–240 V**		**1.5–3 [1.1–2.2]**	**5 [3.7]**	**1.5–5 [1.1–3.7]**	**7.5–15 [5.5–11]**	**20 [15]**	**25–40 [18–30]**	**50–60 [37–45]**
	380–480 V		**1.5–5 [1.1–4.0]**	**7.5–10 [5.5–7.5]**	**1.5–10 [1.1–7.5]**	**15–25 [11–18.5]**	**30–40 [22–30]**	**50–75 [37–55]**	**100–125 [75–90]**
	525–600 V			**3–10 [2.2–7.5]**	**3–10 [2.2–7.5]**	**15–25 [11–18.5]**	**30–40 [22–30]**	**50–75 [37–55]**	**100–125 [75–90]**
IP NEMA			21 Type 1	21 Type 1	55 Type 12	21/ 55 Type 1/ Type 12	21/ 55 Type 1/ Type 12	21/ 55 Type 1/ Type 12	21/ 55 Type 1/ Type 12
Height (in [mm])									
Height of backplate		A	14.76 [375]	14.76 [375]	16.54 [420]	18.9 [480]	25.59 [650]	26.77 [680]	30.32 [770]
Distance between mounting holes		a	13.78 [350]	13.78 [350]	15.83 [402]	17.87 [454]	24.57 [624]	25.5 [648]	29.1 [739]
Width (in [mm])									
Width of backplate		B	3.54 [90]	5.12 [130]	9.53 [242]	9.53 [242]	9.53 [242]	12.13 [308]	14.57 [370]
Width of backplate with one C option		B	5.12 [130]	6.69 [170]	9.53 [242]	9.53 [242]	9.53 [242]	12.13 [308]	14.57 [370]

Enclosure Type		A2	A3	A5	B1	B2	C1	C2
Width of backplate with two C options	B	5.91 [150]	7.48 [190]	9.53 [242]	9.53 [242]	9.53 [242]	12.13 [308]	14.57 [370]
Distance between mounting holes	b	2.76 [70]	4.33 [110]	8.47 [215]	8.27 [210]	8.27 [210]	10.71 [272]	13.15 [334]
Depth (in [mm])								
Depth without option A/B	C	8.15 [207]	8.15 [207]	7.87 [200]	10.24 [260]	10.24 [260]	12.21 [310]	13.19 [335]
With option A/B	C	8.47 [222]	8.47 [222]	7.87 [200]	10.24 [260]	10.24 [260]	12.21 [310]	13.19 [335]
Screw holes (in [mm])								
	c	0.315 [8.0]	0.315 [8.0]	0.33 [8.25]	0.47 [12]	0.47 [12]	0.49 [12.5]	0.49 [12.5]
	d	ø0.43 [ø11]	ø0.43 [ø11]	ø0.49 [ø12]	ø0.75 [ø19]	ø0.75 [ø19]	ø0.75 [ø19]	ø0.75 [ø19]
	e	ø0.22 [ø5.5]	ø0.22 [ø5.5]	ø0.26 [ø6.5]	ø0.35 [ø9]	ø0.35 [ø9]	ø0.35 [ø9]	ø0.35 [ø9]
	f	0.35 [9]	0.26 [6.5]	0.35 [9]	0.35 [9]	0.35 9]	0.39 [9.8]	0.39 [9.8]
Max. weight (lbs [kg])		11.7 [5.3]	15.5 [7.0]	29.8/ 31.3 [13.5/ 14.2]	51 [23]	59.6 [27]	99.2 [45]	143.3 [65]
Front cover tightening torque [Nm]								
Plastic cover (NEMA 1/IP21)		Click	Click	-	Click	Click	Click	Click
Metal cover (NEMA 12/IP55)				1.5	2.2	2.2	2.2	2.2

Table 8.36. Frame D Power Rating, Weight and Dimensions.

Enclosure Type		D1	D2
Rated Power (hp [kW])	**200–240 V**	**75-100 [55-75]**	**125 [90]**
	380–480 V	**150-250 [110-160]**	
	525–690 V	**150-200 [110-132]**	
IP NEMA		**21/54 Type 1/12**	**21/54 Type 1/12**
Shipping dimensions (in [mm])	Height	23.1 [587]	23.1 [587]
	Width	39.3 [997]	46.1 [1170]
	Depth	18.1 [460]	21.1 [535]
Drive dimensions (in [mm])	Height	35.5 [901]	41.7 [1060]
	Width	12.8 [325]	16.5 [420]
	Depth	14.9 [378]	14.9 [378]
Maximum weight (lb [kg])		216 [98]	362 [164]

CHAPTER

9 APPENDIX

9 Appendix

9.1 Symbols, Abbreviations and Conventions

Table 9.1. Symbols and Abbreviations.

AC	Alternating Current
AEO	Automatic Energy Optimization
AWG	American Wire Gauge
AMA	Automatic Motor Adaptation
°C	Degrees Celsius
DC	Direct Current
EMC	Electro Magnetic Compatibility
ETR	Electronic Thermal Relay
FC	Adjustable Frequency Drive
LCP	Local Control Panel
MCT	Motion Control Tool
IP	Ingress Protection
$I_{M,N}$	Nominal Motor Current
$f_{M,N}$	Nominal Motor Frequency

$P_{M,N}$	Nominal Motor Power
$U_{M,N}$	Nominal Motor Voltage
PM Motor	Permanent Magnet Motor
PELV	Protective Extra Low Voltage
PCB	Printed Circuit Board
PWM	Pulse Width Modulated
I_{LIM}	Current Limit
I_{INV}	Rated Inverter Output Current
RPM	Revolutions Per Minute
Regen	Regenerative Terminals
n_s	Synchronous Motor Speed
T_{LIM}	Torque Limit
$I_{VLT,MAX}$	The Maximum Output Current
$I_{VLT,N}$	The Rated Output Current Supplied by the Adjustable Frequency Drive

Conventions

Numbered lists indicate procedures.

Bullet lists indicate other information and description of figures.

Italicized text indicates.

- cross reference
- link
- parameter name

9.2 Parameter Menu Structure

0- Operation/Display**

0-0* Basic Settings
- 0-01 Language
- 0-02 Motor Speed Unit
- 0-03 Regional Settings
- 0-04 Operating State at Power-up
- 0-05 Local Mode Unit

0-1* Set-up Operations
- 0-10 Active Set-up
- 0-11 Programming Set-up
- 0-12 This Set-up Linked to
- 0-13 Readout: Linked Set-ups
- 0-14 Readout: Prog. Set-ups / Channel

0-2* LCP Display
- 0-20 Display Line 1.1 Small
- 0-21 Display Line 1.2 Small
- 0-22 Display Line 1.3 Small
- 0-23 Display Line 2 Large
- 0-24 Display Line 3 Large
- 0-25 My Personal Menu

0-3* LCP Cust. Readout
- 0-30 Custom Readout Unit
- 0-31 Custom Readout Min Value
- 0-32 Custom Readout Max Value
- 0-37 Display Text 1
- 0-38 Display Text 2
- 0-39 Display Text 3

0-4* LCP Keypad
- 0-40 [Hand on] Key on LCP
- 0-41 [Off] Key on LCP
- 0-42 [Auto on] Key on LCP
- 0-43 [Reset] Key on LCP
- 0-44 [Off/Reset] Key on LCP
- 0-45 [Drive Bypass] Key on LCP

0-5* Copy/Save
- 0-50 LCP Copy
- 0-51 Set-up Copy

0-6* Password
- 0-60 Main Menu Password
- 0-61 Access to Main Menu w/o Password
- 0-65 Personal Menu Password
- 0-66 Access to Personal Menu w/o Password
- 0-67 Bus Access Password

0-7* Clock Settings
- 0-70 Date and Time
- 0-71 Date Format
- 0-72 Time Format
- 0-74 DST/Summertime
- 0-76 DST/Summertime Start
- 0-77 DST/Summertime End
- 0-79 Clock Fault
- 0-81 Working Days
- 0-82 Additional Working Days
- 0-83 Additional Non-Working Days
- 0-89 Date and Time Readout

1- Load and Motor**

1-0* General Settings
- 1-00 Configuration Mode
- 1-03 Torque Characteristics
- 1-06 Clockwise Direction

1-1* Motor Selection
- 1-10 Motor Construction

1-1* VVC+ PM
- 1-14 Damping Gain
- 1-15 Low Speed Filter Time Const.
- 1-16 High Speed Filter Time Const.
- 1-17 Voltage filter time const.

1-2* Motor Data
- 1-20 Motor Power [kW]
- 1-21 Motor Power [HP]
- 1-22 Motor Voltage
- 1-23 Motor Frequency
- 1-24 Motor Current
- 1-25 Motor Nominal Speed
- 1-26 Motor Cont. Rated Torque
- 1-28 Motor Rotation Check
- 1-29 Automatic Motor Adaptation (AMA)

1-3* Addl. Motor Data
- 1-30 Stator Resistance (Rs)
- 1-31 Rotor Resistance (Rr)

1-35 Main Reactance (Xh)
1-36 Iron Loss Resistance (Rfe)
1-37 d-axis Inductance (Ld)
1-39 Motor Poles
1-40 Back EMF at 1000 RPM
1-46 Position Detection Gain

1-5* Load-Indep. Setting
1-50 Motor Magnetization at Zero Speed
1-51 Min Speed Normal Magnetizing [RPM]
1-52 Min Speed Normal Magnetizing [Hz]
1-58 Flystart Test Pulses Current
1-59 Flystart Test Pulses Frequency

1-6* Load-Depend. Settg.
1-60 Low Speed Load Compensation
1-61 High Speed Load Compensation
1-62 Slip Compensation
1-63 Slip Compensation Time Constant
1-64 Resonance Dampening
1-65 Resonance Dampening Time Constant
1-66 Min. Current at Low Speed

1-7* Start Adjustments
1-70 PM Start Mode
1-71 Start Delay
1-72 Start Function
1-73 Flying Start
1-77 Compressor Start Max Speed [RPM]
1-78 Compressor Start Max Speed [Hz]
1-79 Compressor Start Max Time to Trip

1-8* Stop Adjustments
1-80 Function at Stop
1-81 Min Speed for Function at Stop [RPM]
1-82 Min Speed for Function at Stop [Hz]
1-86 Trip Speed Low [RPM]
1-87 Trip Speed Low [Hz]

1-9* Motor Temperature
1-90 Motor Thermal Protection
1-91 Motor External Fan
1-93 Thermistor Source

2-** Brakes

2-0* DC Brake
2-00 DC Hold/Preheat Current
2-01 DC Brake Current
2-02 DC Braking Time
2-03 DC Brake Cut-in Speed [RPM]
2-04 DC Brake Cut-in Speed [Hz]
2-06 Parking Current
2-07 Parking Time

2-1* Brake Energy Funct.
2-10 Brake Function
2-11 Brake Resistor (ohm)
2-12 Brake Power Limit (kW)
2-13 Brake Power Monitoring
2-15 Brake Check
2-16 AC Brake Max. Current
2-17 Over-voltage Control

3-** Reference / Ramps

3-0* Reference Limits
3-02 Minimum Reference
3-03 Maximum Reference
3-04 Reference Function

3-1* References
3-10 Preset Reference
3-11 Jog Speed [Hz]
3-13 Reference Site
3-14 Preset Relative Reference
3-15 Reference 1 Source
3-16 Reference 2 Source
3-17 Reference 3 Source
3-19 Jog Speed [RPM]

3-4* Ramp 1
3-41 Ramp 1 Ramp-up Time
3-42 Ramp 1 Ramp-down Time

3-5* Ramp 2
3-51 Ramp 2 Ramp-up Time

3-52 Ramp 2 Ramp-down Time

3-8* Other Ramps
3-80 Jog Ramp Time
3-81 Quick Stop Ramp Time
3-82 Starting Ramp-up Time

3-9* Digital Pot. meter
3-90 Step Size
3-91 Ramp Time
3-92 Power Restore
3-93 Maximum Limit
3-94 Minimum Limit
3-95 Ramp Delay

4-** Limits / Warnings

4-1* Motor Limits
4-10 Motor Speed Direction
4-11 Motor Speed Low Limit [RPM]
4-12 Motor Speed Low Limit [Hz]
4-13 Motor Speed High Limit [RPM]
4-14 Motor Speed High Limit [Hz]
4-16 Torque Limit Motor Mode
4-17 Torque Limit Generator Mode
4-18 Current Limit
4-19 Max Output Frequency

4-5* Adj. Warnings
4-50 Warning Current Low
4-51 Warning Current High
4-52 Warning Speed Low
4-53 Warning Speed High
4-54 Warning Reference Low
4-55 Warning Reference High
4-56 Warning Feedback Low
4-57 Warning Feedback High
4-58 Missing Motor Phase Function

4-6* Speed Bypass
4-60 Bypass Speed From [RPM]
4-61 Bypass Speed From [Hz]
4-62 Bypass Speed to [RPM]
4-63 Bypass Speed To [Hz]
4-64 Semi-Auto Bypass Set-up

5-** Digital In/Out

5-0* Digital I/O mode
5-00 Digital I/O Mode
5-01 Terminal 27 Mode
5-02 Terminal 29 Mode

5-1* Digital Inputs
5-10 Terminal 18 Digital Input
5-11 Terminal 19 Digital Input
5-12 Terminal 27 Digital Input
5-13 Terminal 29 Digital Input
5-14 Terminal 32 Digital Input
5-15 Terminal 33 Digital Input
5-16 Terminal X30/2 Digital Input
5-17 Terminal X30/3 Digital Input
5-18 Terminal X30/4 Digital Input
5-19 Terminal 37 Safe Stop

5-3* Digital Outputs
5-30 Terminal 27 Digital Output
5-31 Terminal 29 Digital Output
5-32 Term X30/6 Digi Out (MCB 101)
5-33 Term X30/7 Digi Out (MCB 101)

5-4* Relays
5-40 Function Relay
5-41 On Delay, Relay
5-42 Off Delay, Relay

5-5* Pulse Input
5-50 Term. 29 Low Frequency
5-51 Term. 29 High Frequency
5-52 Term. 29 Low Ref./Feedb. Value
5-53 Term. 29 High Ref./Feedb. Value
5-54 Pulse Filter Time Constant #29
5-55 Term. 33 Low Frequency
5-56 Term. 33 High Frequency
5-57 Term. 33 Low Ref./Feedb. Value
5-58 Term. 33 High Ref./Feedb. Value
5-59 Pulse Filter Time Constant #33

5-6* Pulse Output

5-60 Terminal 27 Pulse Output Variable
5-62 Pulse Output Max Freq #27
5-63 Terminal 29 Pulse Output Variable
5-65 Pulse Output Max Freq #29
5-66 Terminal X30/6 Pulse Output Variable
5-68 Pulse Output Max Freq #X30/6

5-8* I/O Options

5-80 AHF Cap Reconnect Delay

5-9* Bus Controlled

5-90 Digital & Relay Bus Control
5-93 Pulse Out #27 Bus Control
5-94 Pulse Out #27 Timeout Preset
5-95 Pulse Out #29 Bus Control
5-96 Pulse Out #29 Timeout Preset
5-97 Pulse Out #X30/6 Bus Control
5-98 Pulse Out #X30/6 Timeout Preset

6-** Analog In/Out

6-0* Analog I/O Mode

6-00 Live Zero Timeout Time
6-01 Live Zero Timeout Function
6-02 Fire Mode Live Zero Timeout Function

6-1* Analog Input 53

6-10 Terminal 53 Low Voltage
6-11 Terminal 53 High Voltage
6-12 Terminal 53 Low Current
6-13 Terminal 53 High Current
6-14 Terminal 53 Low Ref./Feedb. Value
6-15 Terminal 53 High Ref./Feedb. Value
6-16 Terminal 53 Filter Time Constant
6-17 Terminal 53 Live Zero

6-2* Analog Input 54

6-20 Terminal 54 Low Voltage
6-21 Terminal 54 High Voltage
6-22 Terminal 54 Low Current
6-23 Terminal 54 High Current
6-24 Terminal 54 Low Ref./Feedb. Value
6-25 Terminal 54 High Ref./Feedb. Value
6-26 Terminal 54 Filter Time Constant
6-27 Terminal 54 Live Zero

6-3* Analog Input X30/11

6-30 Terminal X30/11 Low Voltage
6-31 Terminal X30/11 High Voltage
6-34 Term. X30/11 Low Ref./Feedb. Value
6-35 Term. X30/11 High Ref./Feedb. Value
6-36 Term. X30/11 Filter Time Constant
6-37 Term. X30/11 Live Zero

6-4* Analog Input X30/12

6-40 Terminal X30/12 Low Voltage
6-41 Terminal X30/12 High Voltage
6-44 Term. X30/12 Low Ref./Feedb. Value
6-45 Term. X30/12 High Ref./Feedb. Value
6-46 Term. X30/12 Filter Time Constant
6-47 Term. X30/12 Live Zero

6-5* Analog Output 42

6-50 Terminal 42 Output
6-51 Terminal 42 Output Min Scale
6-52 Terminal 42 Output Max Scale
6-53 Terminal 42 Output Bus Control
6-54 Terminal 42 Output Timeout Preset
6-55 Analog Output Filter

6-6* Analog Output X30/8

6-60 Terminal X30/8 Output
6-61 Terminal X30/8 Min. Scale
6-62 Terminal X30/8 Max. Scale
6-63 Terminal X30/8 Output Bus Control
6-64 Terminal X30/8 Output Timeout Preset

8- Comm. and Options**

8-0* General Settings
- 8-01 Control Site
- 8-02 Control Source
- 8-03 Control Timeout Time
- 8-04 Control Timeout Function
- 8-05 End-of-Timeout Function
- 8-06 Reset Control Timeout
- 8-07 Diagnosis Trigger
- 8-08 Readout Filtering
- 8-09 Communication Charset

8-1* Control Settings
- 8-10 Control Profile
- 8-13 Configurable Status Word STW

8-3* FC Port Settings
- 8-30 Protocol
- 8-31 Address
- 8-32 Baud Rate
- 8-33 Parity / Stop Bits
- 8-34 Estimated cycle time
- 8-35 Minimum Response Delay
- 8-36 Maximum Response Delay
- 8-37 Maximum Inter-Char Delay

8-4* FC MC protocol set
- 8-40 Telegram selection
- 8-42 PCD Write Configuration
- 8-43 PCD Read Configuration

8-5* Digital/Bus
- 8-50 Coasting Select
- 8-52 DC Brake Select
- 8-53 Start Select
- 8-54 Reverse Select
- 8-55 Set-up Select
- 8-56 Preset Reference Select

8-7* BACnet
- 8-70 BACnet Device Instance
- 8-72 MS/TP Max Masters
- 8-73 MS/TP Max Info Frames
- 8-74 "I-Am" Service
- 8-75 Initialisation Password

8-8* FC Port Diagnostics
- 8-80 Bus Message Count
- 8-81 Bus Error Count
- 8-82 Slave Messages Rcvd
- 8-83 Slave Error Count
- 8-84 Slave Messages Sent
- 8-85 Slave Timeout Errors
- 8-89 Diagnostics Count

8-9* Bus Jog
- 8-90 Bus Jog 1 Speed
- 8-91 Bus Jog 2 Speed
- 8-94 Bus Feedback 1
- 8-95 Bus Feedback 2
- 8-96 Bus Feedback 3

9- Profibus**
- 9-00 Setpoint
- 9-07 Actual Value
- 9-15 PCD Write Configuration
- 9-16 PCD Read Configuration
- 9-18 Node Address
- 9-22 Telegram Selection
- 9-23 Parameters for Signals
- 9-27 Parameter Edit
- 9-28 Process Control
- 9-44 Fault Message Counter
- 9-45 Fault Code
- 9-47 Fault Number
- 9-52 Fault Situation Counter
- 9-53 Profibus Warning Word
- 9-63 Actual Baud Rate
- 9-64 Device Identification
- 9-65 Profile Number
- 9-67 Control Word 1
- 9-68 Status Word 1
- 9-71 Profibus Save Data Values
- 9-72 ProfibusDriveReset
- 9-75 DO Identification
- 9-80 Defined Parameters (1)
- 9-81 Defined Parameters (2)
- 9-82 Defined Parameters (3)
- 9-83 Defined Parameters (4)
- 9-84 Defined Parameters (5)
- 9-90 Changed Parameters (1)
- 9-91 Changed Parameters (2)
- 9-92 Changed Parameters (3)
- 9-93 Changed parameters (4)
- 9-94 Changed parameters (5)
- 9-99 Profibus Revision Counter

10- CAN Fieldbus**

10-0* Common Settings
- 10-00 CAN Protocol
- 10-01 Baud Rate Select
- 10-02 MAC ID

10-05 Readout Transmit Error Counter
10-06 Readout Receive Error Counter
10-07 Readout Bus Off Counter

10-1* DeviceNet
10-10 Process Data Type Selection
10-11 Process Data Config Write
10-12 Process Data Config Read
10-13 Warning Parameter
10-14 Net Reference
10-15 Net Control

10-2* COS Filters
10-20 COS Filter 1
10-21 COS Filter 2
10-22 COS Filter 3
10-23 COS Filter 4

10-3* Parameter Access
10-30 Array Index
10-31 Store Data Values
10-32 Devicenet Revision
10-33 Store Always
10-34 DeviceNet Product Code
10-39 Devicenet F Parameters

11- LonWorks**

11-0* LonWorks ID
11-00 Neuron ID

11-1* LON Functions
11-10 Drive Profile
11-15 LON Warning Word
11-17 XIF Revision
11-18 LonWorks Revision

11-2* LON Param. Access
11-21 Store Data Values

12- Ethernet**

12-0* IP Settings
12-00 IP Address Assignment
12-01 IP Address
12-02 Subnet Mask
12-03 Default Gateway
12-04 DHCP Server
12-05 Lease Expires
12-06 Name Servers
12-07 Domain Name
12-08 Host Name
12-09 Physical Address

12-1* Ethernet Link Parameters
12-10 Link Status
12-11 Link Duration
12-12 Auto Negotiation
12-13 Link Speed
12-14 Link Duplex

12-2* Process Data
12-20 Control Instance
12-21 Process Data Config Write
12-22 Process Data Config Read
12-27 Primary Master
12-28 Store Data Values
12-29 Store Always

12-3* EtherNet/IP
12-30 Warning Parameter
12-31 Net Reference
12-32 Net Control
12-33 CIP Revision
12-34 CIP Product Code
12-35 EDS Parameter
12-37 COS Inhibit Timer
12-38 COS Filter

12-4* Modbus TCP
12-40 Status Parameter
12-41 Slave Message Count
12-42 Slave Exception Message Count

12-8* Other Ethernet Services
12-80 FTP Server
12-81 HTTP Server
12-82 SMTP Service
12-89 Transparent Socket Channel Port

12-9* Advanced Ethernet Services
12-90 Cable Diagnostic
12-91 Auto Cross Over
12-92 IGMP Snooping
12-93 Cable Error Length

12-94 Broadcast Storm Protection
12-95 Broadcast Storm Filter
12-96 Port Config
12-98 Interface Counters
12-99 Media Counters

13-** Smart Logic

13-0* SLC Settings
13-00 SL Controller Mode
13-01 Start Event
13-02 Stop Event
13-03 Reset SLC
13-1* Comparators
13-10 Comparator Operand
13-11 Comparator Operator
13-12 Comparator Value

13-2* Timers
13-20 SL Controller Timer

13-4* Logic Rules
13-40 Logic Rule Boolean 1
13-41 Logic Rule Operator 1
13-42 Logic Rule Boolean 2
13-43 Logic Rule Operator 2
13-44 Logic Rule Boolean 3

13-5* States
13-51 SL Controller Event
13-52 SL Controller Action

14-** Special Functions

14-0* Inverter Switching
14-00 Switching Pattern
14-01 Switching Frequency
14-03 Overmodulation
14-04 PWM Random

14-1* Mains On/Off
14-10 Mains Failure
14-11 Mains Voltage at Mains Fault
14-12 Function at Mains Imbalance

14-2* Reset Functions
14-20 Reset Mode
14-21 Automatic Restart Time
14-22 Operation Mode
14-23 Typecode Setting
14-25 Trip Delay at Torque Limit
14-26 Trip Delay at Inverter Fault
14-28 Production Settings
14-29 Service Code

14-3* Current Limit Ctrl.
14-30 Current Lim Ctrl, Proportional Gain
14-31 Current Lim Ctrl, Integration Time
14-32 Current Lim Ctrl, Filter Time

14-4* Energy Optimizing
14-40 VT Level
14-41 AEO Minimum Magnetization
14-42 Minimum AEO Frequency
14-43 Motor Cos-Phi

14-5* Environment
14-50 RFI 1
14-51 DC Link Compensation
14-52 Fan Control
14-53 Fan Monitor
14-55 Output Filter
14-59 Actual Number of Inverter Units

14-6* Auto Derate
14-60 Function at Overtemperature
14-61 Function at Inverter Overload
14-62 Inv. Overload Derate Current

14-9* Fault Settings
14-90 Fault Level

15-** Drive Information

15-0* Operating Data
15-00 Operating hours
15-01 Running Hours
15-02 kWh Counter
15-03 Power-ups
15-04 Over Temps
15-05 Over Volts
15-06 Reset kWh Counter
15-07 Reset Running Hours Counter
15-08 Number of Starts

15-1* Data Log Settings
- 15-10 Logging Source
- 15-11 Logging Interval
- 15-12 Trigger Event
- 15-13 Logging Mode
- 15-14 Samples Before Trigger

15-2* Historic Log
- 15-20 Historic Log: Event
- 15-21 Historic Log: Value
- 15-22 Historic Log: Time
- 15-23 Historic Log: Date and Time

15-3* Alarm Log
- 15-30 Alarm Log: Error Code
- 15-31 Alarm Log: Value
- 15-32 Alarm Log: Time
- 15-33 Alarm Log: Date and Time

15-4* Drive Identification
- 15-40 FC Type
- 15-41 Power Section
- 15-42 Voltage
- 15-43 Software Version
- 15-44 Ordered Typecode String
- 15-45 Actual Typecode String
- 15-46 Adj Freq Dr Ordering No.
- 15-47 Power Card Ordering No.
- 15-48 LCP ID Num.
- 15-49 SW ID Control Card
- 15-50 SW ID Power Card
- 15-51 Adj Freq Dr Serial No.
- 15-53 Power Card Serial Number
- 15-55 Vendor URL
- 15-56 Vendor Name
- 15-59 CSIV Filename

15-6* Option Ident
- 15-60 Option Mounted
- 15-61 Option SW Version
- 15-62 Option Ordering No
- 15-63 Option Serial No
- 15-70 Option in Slot A
- 15-71 Slot A Option SW Version
- 15-72 Option in Slot B
- 15-73 Slot B Option SW Version
- 15-74 Option in Slot C0
- 15-75 Slot C0/E0 Option SW Version
- 15-76 Option in Slot C1
- 15-77 Slot C1/E1 Option SW Version

15-8* Operating Data II
- 15-80 Fan Running Hours
- 15-81 Preset Fan Running Hours

15-9* Parameter Info
- 15-92 Defined Parameters
- 15-93 Modified Parameters
- 15-98 Drive Identification
- 15-99 Parameter Metadata

16- Data Readouts**

16-0* General Status
- 16-00 Control Word
- 16-01 Reference [Unit]
- 16-02 Reference [%]
- 16-03 Status Word
- 16-05 Main Actual Value [%]
- 16-09 Custom Readout

16-1* Motor Status
- 16-10 Power [kW]
- 16-11 Power [hp]
- 16-12 Motor voltage
- 16-13 Frequency
- 16-14 Motor current
- 16-15 Frequency [%]
- 16-16 Torque [Nm]
- 16-17 Speed [RPM]
- 16-18 Motor Thermal
- 16-20 Motor Angle
- 16-22 Torque [%]
- 16-26 Power Filtered [kW]
- 16-27 Power Filtered [hp]

16-3* Drive Status
- 16-30 DC Link Voltage
- 16-32 Brake Energy /s
- 16-33 Brake Energy /2 min
- 16-34 Heatsink Temp.
- 16-35 Inverter Thermal
- 16-36 Inv. Nom. Current
- 16-37 Inv. Max. Current
- 16-38 SL Controller State
- 16-39 Control Card Temp.
- 16-40 Logging Buffer Full

16-41 Logging Buffer Full
16-43 Timed Actions Status
16-49 Current Fault Source

16-5* Ref. & Feedb.
16-50 External Reference
16-52 Feedback [Unit]
16-53 Digi Pot Reference
16-54 Feedback 1 [Unit]
16-55 Feedback 2 [Unit]
16-56 Feedback 3 [Unit]
16-58 PID Output [%]

16-6* Inputs & Outputs
16-60 Digital Input
16-61 Terminal 53 Switch Setting
16-62 Analog Input 53
16-63 Terminal 54 Switch Setting
16-64 Analog Input 54
16-65 Analog Output 42 [mA]
16-66 Digital Output [bin]
16-67 Pulse Input #29 [Hz]
16-68 Pulse Input #33 [Hz]
16-69 Pulse Output #27 [Hz]
16-70 Pulse Output #29 [Hz]
16-71 Relay Output [bin]
16-72 Counter A
16-73 Counter B
16-75 Analog In X30/11
16-76 Analog In X30/12
16-77 Analog Out X30/8 [mA]

16-8* Fieldbus & FC Port
16-80 Fieldbus CTW 1
16-82 Fieldbus REF 1
16-84 Comm. Option Status
16-85 FC Port CTW 1
16-86 FC Port REF 1

16-9* Diagnosis Readouts
16-90 Alarm Word
16-91 Alarm Word 2
16-92 Warning Word
16-93 Warning Word 2
16-94 Ext. Status Word
16-95 Ext. Status Word 2
16-96 Maintenance Word

18-** Info & Readouts

18-0* Maintenance Log
18-00 Maintenance Log: Item
18-01 Maintenance Log: Action
18-02 Maintenance Log: Time
18-03 Maintenance Log: Date and Time

18-1* Fire Mode Log
18-10 Fire Mode Log: Event
18-11 Fire Mode Log: Time
18-12 Fire Mode Log: Date and Time

18-3* Inputs & Outputs
18-30 Analog Input X42/1
18-31 Analog Input X42/3
18-32 Analog Input X42/5
18-33 Analog Out X42/7 [V]
18-34 Analog Out X42/9 [V]
18-35 Analog Out X42/11 [V]
18-36 Analog Input X48/2 [mA]
18-37 Temp. Input X48/4
18-38 Temp. Input X48/7
18-39 Temp. Input X48/10

18-5* Ref. & Feedb.
18-50 Sensorless Readout [unit]

20-** Drive Closed-loop

20-0* Feedback
20-00 Feedback 1 Source
20-01 Feedback 1 Conversion
20-02 Feedback 1 Source Unit
20-03 Feedback 2 Source
20-04 Feedback 2 Conversion
20-05 Feedback 2 Source Unit
20-06 Feedback 3 Source
20-07 Feedback 3 Conversion
20-08 Feedback 3 Source Unit
20-12 Reference/Feedback Unit
20-13 Minimum Reference/Feedb.
20-14 Maximum Reference/Feedb.

20-2* Feedback/Setpoint
20-20 Feedback Function
20-21 Setpoint 1
20-22 Setpoint 2

20-23 Setpoint 3

20-3* Feedb. Adv. Conv.
20-30 Refrigerant
20-31 User-defined Refrigerant A1
20-32 User-defined Refrigerant A2
20-33 User-defined Refrigerant A3
20-34 Duct 1 Area [m2]
20-35 Duct 1 Area [in2]
20-36 Duct 2 Area [m2]
20-37 Duct 2 Area [in2]
20-38 Air Density Factor [%]

20-6* Sensorless
20-60 Sensorless Unit
20-69 Sensorless Information

20-7* PID Autotuning
20-70 Closed-loop Type
20-71 PID Performance
20-72 PID Output Change
20-73 Minimum Feedback Level
20-74 Maximum Feedback Level
20-79 PID Autotuning

20-8* PID Basic Settings
20-81 PID Normal/ Inverse Control
20-82 PID Start Speed [RPM]
20-83 PID Start Speed [Hz]
20-84 On Reference Bandwidth

20-9* PID Controller
20-91 PID Anti Windup
20-93 PID Proportional Gain
20-94 PID Integral Time
20-95 PID Differentiation Time
20-96 PID Diff. Gain Limit

21- Ext. Closed-loop**

21-0* Ext. CL Autotuning
21-00 Closed-loop Type
21-01 PID Performance
21-02 PID Output Change
21-03 Minimum Feedback Level
21-04 Maximum Feedback Level
21-09 PID Autotuning

21-1* Ext. CL 1 Ref./Fb.
21-10 Ext. 1 Ref./Feedback Unit
21-11 Ext. 1 Minimum Reference
21-12 Ext. 1 Maximum Reference
21-13 Ext. 1 Reference Source
21-14 Ext. 1 Feedback Source
21-15 Ext. 1 Setpoint
21-17 Ext. 1 Reference [Unit]
21-18 Ext. 1 Feedback [Unit]
21-19 Ext. 1 Output [%]

21-2* Ext. CL 1 PID
21-20 Ext. 1 Normal/Inverse Control
21-21 Ext. 1 Proportional Gain
21-22 Ext. 1 Integral Time
21-23 Ext. 1 Differentation Time
21-24 Ext. 1 Dif. Gain Limit

21-3* Ext. CL 2 Ref./Fb.
21-30 Ext. 2 Ref./Feedback Unit
21-31 Ext. 2 Minimum Reference
21-32 Ext. 2 Maximum Reference
21-33 Ext. 2 Reference Source
21-34 Ext. 2 Feedback Source
21-35 Ext. 2 Setpoint
21-37 Ext. 2 Reference [Unit]
21-38 Ext. 2 Feedback [Unit]
21-39 Ext. 2 Output [%]

21-4* Ext. CL 2 PID
21-40 Ext. 2 Normal/Inverse Control
21-41 Ext. 2 Proportional Gain
21-42 Ext. 2 Integral Time
21-43 Ext. 2 Differentation Time
21-44 Ext. 2 Dif. Gain Limit

21-5* Ext. CL 3 Ref./Fb.
21-50 Ext. 3 Ref./Feedback Unit
21-51 Ext. 3 Minimum Reference
21-52 Ext. 3 Maximum Reference
21-53 Ext. 3 Reference Source
21-54 Ext. 3 Feedback Source
21-55 Ext. 3 Setpoint
21-57 Ext. 3 Reference [Unit]
21-58 Ext. 3 Feedback [Unit]
21-59 Ext. 3 Output [%]

21-6* Ext. CL 3 PID
- 21-60 Ext. 3 Normal/Inverse Control
- 21-61 Ext. 3 Proportional Gain
- 21-62 Ext. 3 Integral Time
- 21-63 Ext. 3 Differentation Time
- 21-64 Ext. 3 Dif. Gain Limit

22-** Application Functions

22-0* Miscellaneous
- 22-00 External Interlock Delay
- 22-01 Power Filter Time

22-2* No-Flow Detection
- 22-20 Low Power Auto Set-up
- 22-21 Low Power Detection
- 22-22 Low Speed Detection
- 22-23 No-Flow Function
- 22-24 No-Flow Delay
- 22-26 Dry Pump Function
- 22-27 Dry Pump Delay

22-3* No-Flow Power Tuning
- 22-30 No-Flow Power
- 22-31 Power Correction Factor
- 22-32 Low Speed [RPM]
- 22-33 Low Speed [Hz]
- 22-34 Low Speed Power [kW]
- 22-35 Low Speed Power [HP]
- 22-36 High Speed [RPM]
- 22-37 High Speed [Hz]
- 22-38 High Speed Power [kW]
- 22-39 High Speed Power [HP]

22-4* Sleep Mode
- 22-40 Minimum Run Time
- 22-41 Minimum Sleep Time
- 22-42 Wake-up Speed [RPM]
- 22-43 Wake-up Speed [Hz]
- 22-44 Wake-up Ref./FB Difference
- 22-45 Setpoint Boost
- 22-46 Maximum Boost Time

22-5* End of Curve
- 22-50 End of Curve Function
- 22-51 End of Curve Delay

22-6* Broken Belt Detection
- 22-60 Broken Belt Function
- 22-61 Broken Belt Torque
- 22-62 Broken Belt Delay

22-7* Short Cycle Protection
- 22-75 Short Cycle Protection
- 22-76 Interval between Starts
- 22-77 Minimum Run Time
- 22-78 Minimum Run Time Override
- 22-79 Minimum Run Time Override Value

22-8* Flow Compensation
- 22-80 Flow Compensation
- 22-81 Square-linear Curve Approximation
- 22-82 Work Point Calculation
- 22-83 Speed at No-Flow [RPM]
- 22-84 Speed at No-Flow [Hz]
- 22-85 Speed at Design Point [RPM]
- 22-86 Speed at Design Point [Hz]
- 22-87 Pressure at No-Flow Speed
- 22-88 Pressure at Rated Speed
- 22-89 Flow at Design Point
- 22-90 Flow at Rated Speed

23-** Time-based Functions

23-0* Timed Actions
- 23-00 ON Time
- 23-01 ON Action
- 23-02 OFF Time
- 23-03 OFF Action
- 23-04 Occurrence

23-0* Timed Actions Set.
- 23-08 Timed Actions Mode
- 23-09 Timed Actions Reactivation

23-1* Maintenance
- 23-10 Maintenance Item
- 23-11 Maintenance Action
- 23-12 Maintenance Time Base
- 23-13 Maintenance Time Interval
- 23-14 Maintenance Date and Time

23-1* Maintenance Reset
- 23-15 Reset Maintenance Word
- 23-16 Maintenance Text

23-5* Energy Log
- 23-50 Energy Log Resolution
- 23-51 Period Start
- 23-53 Energy Log
- 23-54 Reset Energy Log

23-6* Trending
- 23-60 Trend Variable
- 23-61 Continuous Bin Data
- 23-62 Timed Bin Data
- 23-63 Timed Period Start
- 23-64 Timed Period Stop
- 23-65 Minimum Bin Value
- 23-66 Reset Continuous Bin Data
- 23-67 Reset Timed Bin Data

23-8* Payback Counter
- 23-80 Power Reference Factor
- 23-81 Energy Cost
- 23-82 Investment
- 23-83 Energy Savings
- 23-84 Cost Savings

24-** Appl. Functions 2

24-0* Fire Mode
- 24-00 Fire Mode Function
- 24-01 Fire Mode Configuration
- 24-02 Fire Mode Unit
- 24-03 Fire Mode Min Reference
- 24-04 Fire Mode Max Reference
- 24-05 Fire Mode Preset Reference
- 24-06 Fire Mode Reference Source
- 24-07 Fire Mode Feedback Source
- 24-09 Fire Mode Alarm Handling

24-1* Drive Bypass
- 24-10 Drive Bypass Function
- 24-11 Drive Bypass Delay Time

24-9* Multi-Motor Funct.
- 24-90 Missing Motor Function
- 24-91 Missing Motor Coefficient 1
- 24-92 Missing Motor Coefficient 2
- 24-93 Missing Motor Coefficient 3
- 24-94 Missing Motor Coefficient 4
- 24-95 Locked Rotor Function
- 24-96 Locked Rotor Coefficient 1
- 24-97 Locked Rotor Coefficient 2
- 24-98 Locked Rotor Coefficient 3
- 24-99 Locked Rotor Coefficient 4

25-** Cascade Controller

25-0* System Settings
- 25-00 Cascade Controller
- 25-02 Motor Start
- 25-04 Pump Cycling
- 25-05 Fixed Lead Pump
- 25-06 Number Of Pumps

25-2* Bandwidth Settings
- 25-20 Staging Bandwidth
- 25-21 Override Bandwidth
- 25-22 Fixed Speed Bandwidth
- 25-23 SBW Staging Delay
- 25-24 SBW De-staging Delay
- 25-25 OBW Time
- 25-26 Destage At No-Flow
- 25-27 Stage Function
- 25-28 Stage Function Time
- 25-29 Destage Function
- 25-30 Destage Function Time

25-4* Staging Settings
- 25-40 Ramp-down Delay
- 25-41 Ramp-up Delay
- 25-42 Staging Threshold
- 25-43 De-staging Threshold
- 25-44 Staging Speed [RPM]
- 25-45 Staging Speed [Hz]
- 25-46 De-staging Speed [RPM]
- 25-47 De-staging Speed [Hz]

25-5* Alternation Settings
- 25-50 Lead Pump Alternation
- 25-51 Alternation Event
- 25-52 Alternation Time Interval
- 25-53 Alternation Timer Value
- 25-54 Alternation Predefined Time
- 25-55 Alternate if Load < 50%
- 25-56 Staging Mode at Alternation
- 25-58 Run Next Pump Delay
- 25-59 Run-on Line Delay

25-8* Status
- 25-80 Cascade Status
- 25-81 Pump Status
- 25-82 Lead Pump
- 25-83 Relay Status
- 25-84 Pump ON Time
- 25-85 Relay ON Time
- 25-86 Reset Relay Counters

25-9* Service
25-90 Pump Interlock
25-91 Manual Alternation

26- Analog I/O Option**

26-0* Analog I/O Mode
26-00 Terminal X42/1 Mode
26-01 Terminal X42/3 Mode
26-02 Terminal X42/5 Mode

26-1* Analog Input X42/1
26-10 Terminal X42/1 Low Voltage
26-11 Terminal X42/1 High Voltage
26-14 Term. X42/1 Low Ref./Feedb. Value
26-15 Term. X42/1 High Ref./ Feedb. Value
26-16 Term. X42/1 Filter Time Constant
26-17 Term. X42/1 Live Zero

26-2* Analog Input X42/3
26-20 Terminal X42/3 Low Voltage
26-21 Terminal X42/3 High Voltage
26-24 Term. X42/3 Low Ref./Feedb. Value
26-25 Term. X42/3 High Ref./ Feedb. Value
26-26 Term. X42/3 Filter Time Constant
26-27 Term. X42/3 Live Zero
26-3* Analog Input X42/5
26-30 Terminal X42/5 Low Voltage
26-31 Terminal X42/5 High Voltage
26-34 Term. X42/5 Low Ref./Feedb. Value
26-35 Term. X42/5 High Ref./ Feedb. Value
26-36 Term. X42/5 Filter Time Constant
26-37 Term. X42/5 Live Zero

26-4* Analog Out X42/7
26-40 Terminal X42/7 Output
26-41 Terminal X42/7 Min. Scale
26-42 Terminal X42/7 Max. Scale
26-43 Terminal X42/7 Bus Control
26-44 Terminal X42/7 Timeout Preset

26-5* Analog Out X42/9
26-50 Terminal X42/9 Output
26-51 Terminal X42/9 Min. Scale
26-52 Terminal X42/9 Max. Scale
26-53 Terminal X42/9 Bus Control
26-54 Terminal X42/9 Timeout Preset

26-6* Analog Out X42/11
26-60 Terminal X42/11 Output
26-61 Terminal X42/11 Min. Scale
26-62 Terminal X42/11 Max. Scale
26-63 Terminal X42/11 Bus Control
26-64 Terminal X42/11 Timeout Preset

30- Special Features**

30-2* Adv. Start Adjust
30-22 Locked Rotor Detection
30-23 Locked Rotor Detection Time [s]

31- Bypass Option**
31-00 Bypass Mode
31-01 Bypass Start Time Delay
31-02 Bypass Trip Time Delay
31-03 Test Mode Activation
31-10 Bypass Status Word
31-11 Bypass Running Hours
31-19 Remote Bypass Activation

35- Sensor Input Option**

35-0* Temp. Input Mode
35-00 Term. X48/4 Temp. Unit
35-01 Term. X48/4 Input Type
35-02 Term. X48/7 Temp. Unit
35-03 Term. X48/7 Input Type
35-04 Term. X48/10 Temp. Unit
35-05 Term. X48/10 Input Type
35-06 Temperature Sensor Alarm Function

35-1* Temp. Input X48/4
35-14 Term. X48/4 Filter Time Constant
35-15 Term. X48/4 Temp. Monitor
35-16 Term. X48/4 Low Temp. Limit
35-17 Term. X48/4 High Temp. Limit

35-2* Temp. Input X48/7

35-24 Term. X48/7 Filter Time Constant
35-25 Term. X48/7 Temp. Monitor
35-26 Term. X48/7 Low Temp. Limit
35-27 Term. X48/7 High Temp. Limit

35-3* Temp. Input X48/10

35-34 Term. X48/10 Filter Time Constant
35-35 Term. X48/10 Temp. Monitor
35-36 Term. X48/10 Low Temp. Limit
35-37 Term. X48/10 High Temp. Limit

35-4* Analog Input X48/2

35-42 Term. X48/2 Low Current
35-43 Term. X48/2 High Current
35-44 Term. X48/2 Low Ref./Feedb. Value
35-45 Term. X48/2 High Ref./ Feedb. Value
35-46 Term. X48/2 Filter Time Constant
35-47 Term. X48/2 Live Zero

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