

GE

AF-600 FP™ Fan & Pump Drive (230V to 60HP, 460/575V to 125HP) Operating Instructions



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Safety

⚠ WARNING

HIGH VOLTAGE!

Frequency converters contain high voltage when connected to AC mains input power. Installation, start up, and maintenance should be performed by qualified personnel only. Failure to perform installation, start up, and maintenance by qualified personnel could result in death or serious injury.

High Voltage

Frequency converters are connected to hazardous mains voltages. Extreme care should be taken to protect against shock. Only trained personnel familiar with electronic equipment should install, start, or maintain this equipment.

⚠ WARNING

UNINTENDED START!

When the drive is connected to AC mains, the motor may start at any time. The drive, motor, and any driven equipment must be in operational readiness. Failure to be in operational readiness when the drive is connected to AC mains could result in death, serious injury, equipment, or property damage.

Unintended Start

When the drive is connected to the AC mains, the motor may be started by means of an external switch, a serial bus command, an input reference signal, or a cleared fault condition. Use appropriate cautions to guard against an unintended start.

⚠ WARNING

DISCHARGE TIME!

Frequency converters contain DC link capacitors that can remain charged even when AC mains is disconnected. To avoid electrical hazards, remove AC mains from the drive before doing any service or repair and wait the amount of time specified in *Table 1.1*. Failure to wait the specified time after power has been removed prior to doing service or repair on the unit could result in death or serious injury.

Voltage (V)	Minimum Waiting Time (Minutes)	
	4	15
200 - 240	0.75 - 3.7 kW 1 - 5 hp	5.5 - 45 kW 7 1/2 - 60 hp
380 - 480	0.75 - 7.5 kW 1 - 10 hp	11 - 90 kW 15 - 125 hp
525 - 600	0.75 - 7.5 kW 1 - 10 hp	11 - 90 kW 15 - 125 hp

High voltage may be present even when the warning LEDs are off!

Discharge Time

Symbols

The following symbols are used in this manual.

⚠ WARNING

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

⚠ CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

CAUTION

Indicates a situation that may result in equipment or property-damage-only accidents.

NOTE

Indicates highlighted information that should be regarded with attention to avoid mistakes or operate equipment at less than optimal performance.

Approvals



Safety

AF-600 FP Operating Instructions



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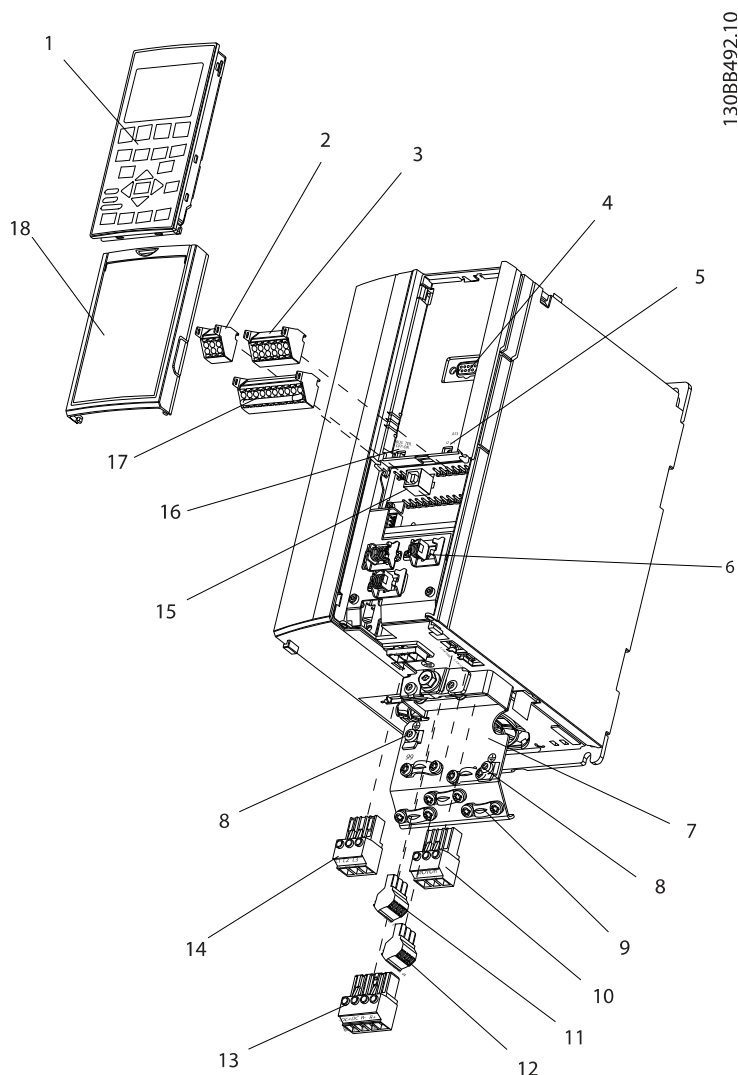


Introduction

AF-600 FP Operating Instructions

1 Introduction

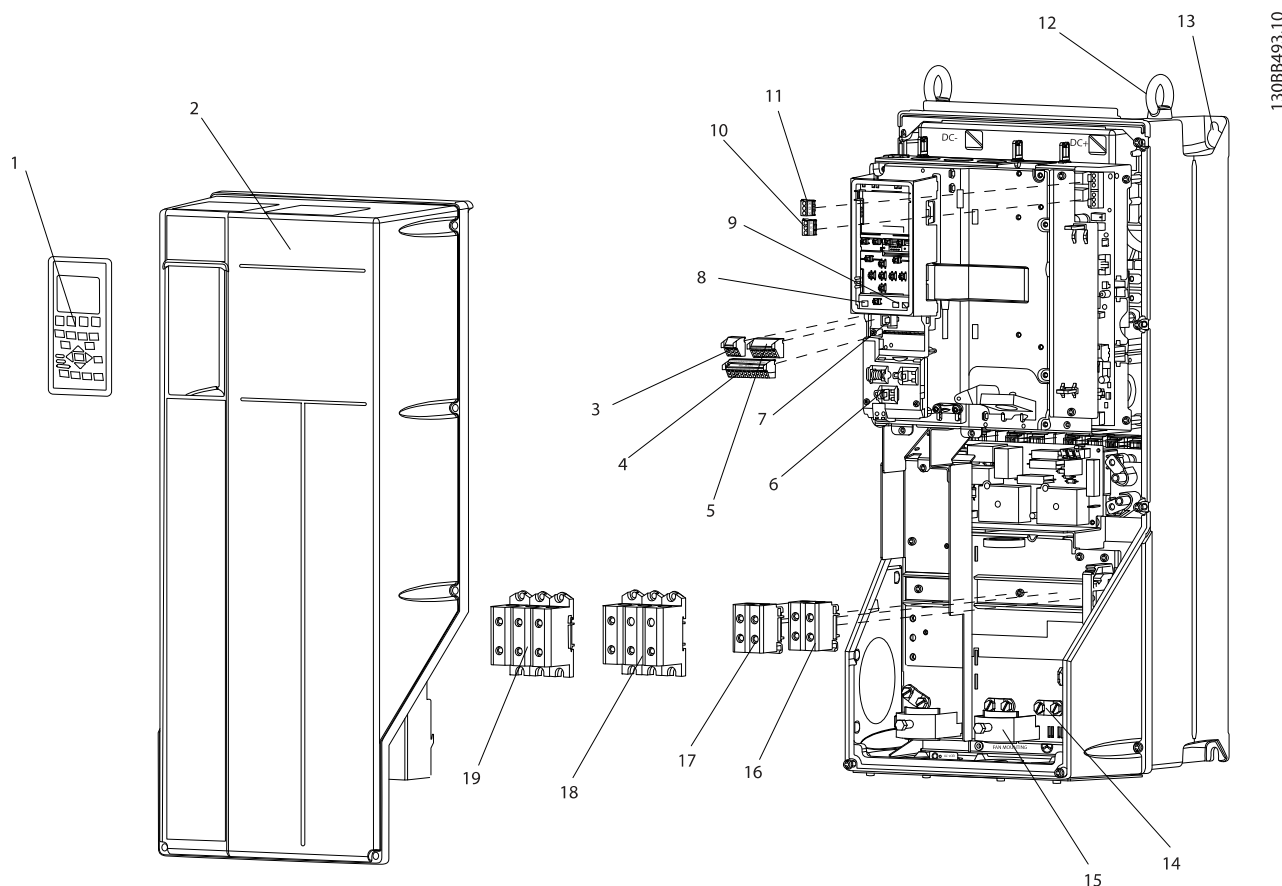
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Illustration 1.1 Exploded View Unit Size 1X

1	Keypad	10	Motor output terminals 96 (U), 97 (V), 98 (W)
2	RS-485 serial bus connector (+68, -69)	11	Relay 1 (01, 02, 03)
3	Analog I/O connector	12	Relay 2 (04, 05, 06)
4	Keypad input plug	13	Brake (-81, +82) and load sharing (-88, +89) terminals
5	Analog switches (A53), (A54)	14	Mains input terminals 91 (L1), 92 (L2), 93 (L3)
6	Cable strain relief / PE ground	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	Control cable cover plate



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Illustration 1.2 Exploded View Unit Sizes 21, 22, 31, and 32

1	Keypad	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 strain relief / PE ground
6	Cable strain relief / PE ground	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	Mains input terminals 91 (L1), 92 (L2), 93 (L3)
10	Relay 1 (01, 02, 03)		

1.1 Purpose of the Manual

This manual is intended to provide detailed information for the installation and start up of the frequency converter. Chapter 2 *Installation* provides requirements for mechanical and electrical installation, including input, motor, control and serial communications wiring, and control terminal functions. Chapter 3 *Start Up and Functional Testing* provides detailed procedures for start up, basic operational programming, and functional testing. The remaining chapters provide supplementary details. These include user interface, detailed programming, application examples, start-up troubleshooting, and specifications.

1.2 Additional Resources

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

- The Programming Guide provides greater detail in how to work with parameters and many application examples.
- The Design Guide is intended to provide detailed capabilities and functionality to design motor control systems.
- Optional equipment is available that may change some of the procedures described. Be sure to see the instructions supplied with those options for specific requirements.

1.3 Product Overview

A drive is an electronic motor controller that converts AC mains input into a variable AC waveform output. The frequency and voltage of the output are regulated to control the motor speed or torque. The drive can vary the speed of the motor in response to system feedback, such as changing temperature or pressure for controlling fan, compressor, or pump motors. The drive can also regulate the motor by responding to remote commands from external controllers.

In addition, the drive monitors the system and motor status, issues warnings or alarms for fault conditions, starts and stops the motor, optimizes energy efficiency, and offers many more control, monitoring, and efficiency functions. Operation and monitoring functions are available as status indications to an outside control system or serial communication network.

1.4 Internal Drive Controller Functions

Below is a block diagram of the frequency converter's internal components. See *Table 1.1* for their functions.

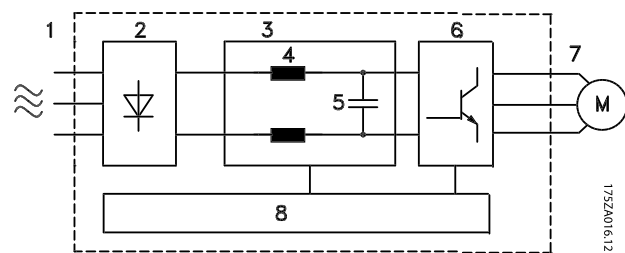


Illustration 1.3 Drive Block Diagram

Area	Title	Functions
1	Mains input	• Three-phase AC mains power supply to the drive
2	Rectifier	• The rectifier bridge converts the AC input to DC current to supply inverter power
3	DC bus	• The frequency converter's intermediate DC-bus circuit handles the DC current
4	DC reactors	• Filter the intermediate DC circuit voltage • Provide 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 three-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

Table 1.1 Drive Internal Components



1.5 Unit Sizes and Power Ratings

References to unit sizes used in this manual are defined in *Table 1.2*.

	Unit sizes										
	IP20 / Open Chassis						IP55 / Nema 12				
Volts	12	13	23	24	33	34	15	21	22	31	32
200-240	1-3 HP	5 HP	7.5-15 HP	20-25 HP	30-40 HP	50-60 HP	1-5 HP	7.5-15 HP	20 HP	25-40 HP	50-60 HP
380-480	1-5 HP	7.5-10 HP	15-25 HP	25-40 HP	50-75 HP	100-125 HP	1-10 HP	15-25 HP	25-40 HP	50-75 HP	100-125 HP
525-600	-	1-10 HP	15-25 HP	25-40 HP	50-75 HP	100-125 HP	1-10 HP	15-25 HP	25-40 HP	50-75 HP	100-125 HP

2 Installation

2

2.1 Installation Site Check List

- The drive relies on the ambient air for cooling. Observe the limitations on ambient air temperature for optimal operation
- Ensure that the installation location has sufficient support strength to mount the drive
- Keep the drive interior free from dust and dirt. Ensure that the components stay as clean as possible. In construction areas, provide a protective covering. Optional IP55 (NEMA 12) enclosures may be necessary.
- Keep the manual, drawings, and diagrams accessible for detailed installation and operation instructions. It is important that the manual is available for equipment operators.
- Locate equipment as near to the motor as possible. Keep motor cables as short as possible. Check the motor characteristics for actual tolerances. Do not exceed
 - 300m (1000ft) for unshielded motor leads
 - 150m (500ft) for shielded cable.

2.2 Drive and Motor Pre-installation Check List

- Compare the model number of unit on the nameplate to what was ordered to verify the proper equipment
- Ensure each of the following are rated for same voltage:
 - Mains (power)
 - Drive
 - Motor
- Ensure that drive output current rating is equal to or greater than motor full load current for peak motor performance
 - Motor size and drive power must match for proper overload protection
 - If drive rating is less than motor, full motor output cannot be achieved

2.3 Mechanical Installation

2.3.1 Cooling

- To provide cooling airflow, mount the unit to a solid flat surface or to the optional back plate (see 2.3.3 *Mounting*)
- Top and bottom clearance for air cooling must be provided. Generally, 100-225mm (4-10in) is required. See *Illustration 2.1* for clearance requirements
- Improper mounting can result in over heating and reduced performance
- Derating for temperatures starting between 40°C (104°F) and 50°C (122°F) and elevation 1000m (3300ft) above sea level must be considered. See the equipment Design Guide for detailed information.

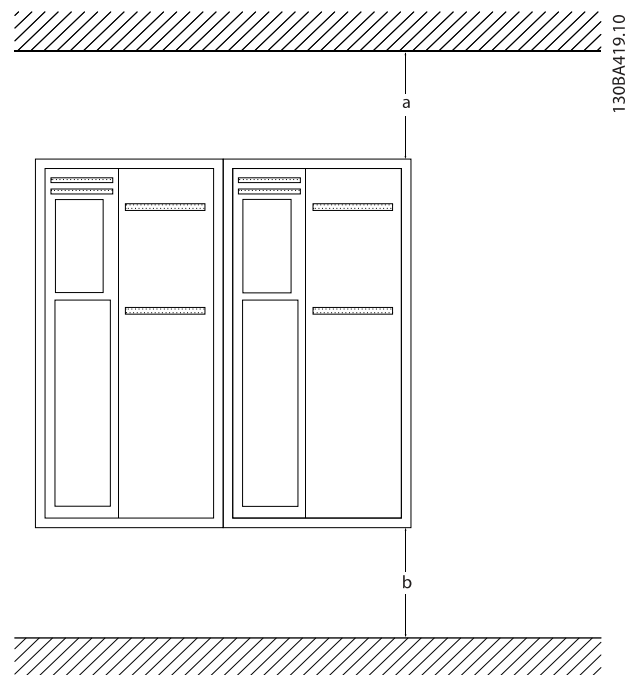


Illustration 2.1 Top and Bottom Cooling Clearance

Size	12	13	-	15	21	22
a/b (mm)	100	100	-	100	200	200
a/b (in)	4	4	-	4	8	8
Size	23	24	31	32	33	34
a/b (mm)	200	200	200	225	200	225
a/b (in)	8	8	8	9	8	9

Table 2.1 Minimum Airflow Clearance Requirements

2.3.2 Lifting

- Check the weight of the unit to determine a safe lifting method
- 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

2.3.3 Mounting

- Mount the unit vertically
- The drive allows side by side installation
- Ensure that the strength of the mounting location will support the unit weight
- Mount the unit to a solid flat surface or to the optional back plate to provide cooling airflow (see *Illustration 2.2* and *Illustration 2.3*)
- Improper mounting can result in over heating and reduced performance
- Use the slotted mounting holes on the unit for wall mounting, when provided

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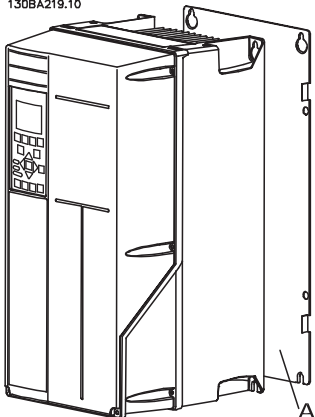
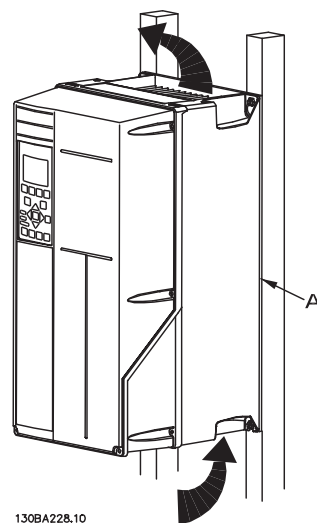


Illustration 2.2 Proper Mounting with Back Plate

Item A is a back plate properly installed for required airflow to cool the unit.



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Illustration 2.3 Proper Mounting with Railings

NOTE

Back plate is needed when mounted on railings.

2.3.4 Tightening Torques

See *10.4 Connection Tightening Torques* for proper tightening specifications.

This section contains detailed instructions for wiring the drive. The following tasks are described.

- Illustration 2.4 shows a basic electrical connection.



2.4.1 Requirements

⚠ WARNING

EQUIPMENT HAZARD!

Rotating shafts and electrical equipment can be hazardous. All electrical work must conform to national and local electrical codes. It is strongly recommended that installation, start up, and maintenance be performed only by trained and qualified personnel. Failure to follow these guidelines could result in death or serious injury.

CAUTION

WIRING ISOLATION!

Run input power, motor wiring and control wiring in three separate metallic conduits or use separated shielded cable for high frequency noise isolation. Failure to isolate power, motor and control wiring could result in less than optimum drive and associated equipment performance.

For your safety, comply with the following requirements.

- Electronic controls equipment is connected to hazardous mains voltage. Extreme care should be taken to protect against electrical hazards when applying power to the unit.
- Run motor cables from multiple frequency converters separately. Induced voltage from output motor cables run together can charge equipment capacitors even with the equipment turned off and locked out.

Overload and Equipment Protection

- An electronically activated function within the drive provides overload protection for the motor. The overload calculates the level of increase to activate timing for the trip (controller output stop) function. The higher the current draw, the quicker the trip response. The overload provides Class 20 motor protection. See *8 Warnings and Alarms* for details on the trip function.
- Because the motor wiring carries high frequency current, it is important that wiring for mains, motor power, and control are run separately. Use metallic conduit or separated shielded wire. Failure to isolate power, motor, and control wiring could result in less than optimum equipment performance. See *Illustration 2.5*.

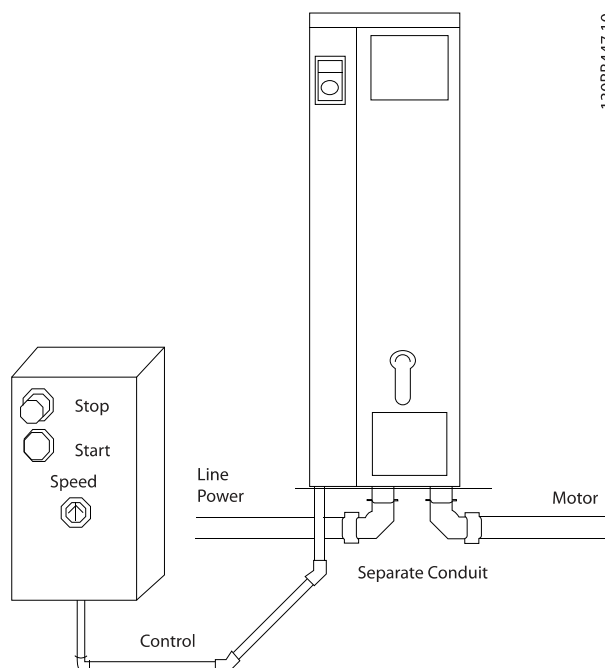


Illustration 2.5 Proper Electrical Installation Using Conduit

- All frequency converters must be provided with short-circuit and over-current protection. Input fusing is required to provide this protection, see *Illustration 2.6*. See maximum fuse ratings in *10.3 Fuse Tables*.

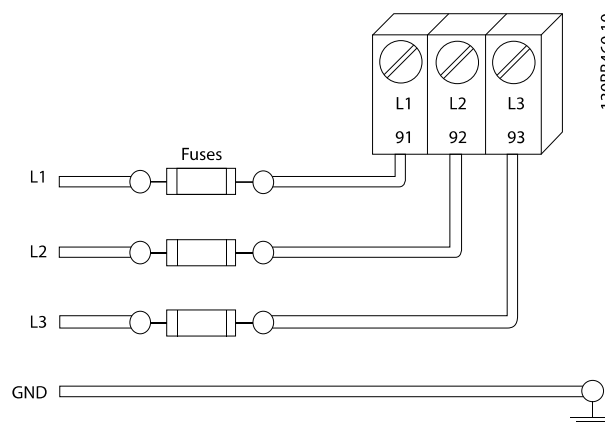


Illustration 2.6 Drive Fuses

Wire Type and Ratings

- All wiring must comply with local and national regulations regarding cross-section and ambient temperature requirements.
- GE recommends that all power connections be made with a minimum 75° C rated copper wire.
- See *10.1 Power-dependent Specifications* for recommended wire sizes.

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2.4.2 Earth (Grounding) Requirements

⚠ WARNING

GROUNDING HAZARD!

For operator safety, it is important to ground drive properly in accordance with national and local electrical codes as well as instructions contained within these instructions. Ground currents are higher than 3,5mA. Failure to ground drive properly could result in death or serious injury.

NOTE

It is the responsibility of the user or certified electrical installer to ensure correct grounding (earthing) of the equipment in accordance with national and local electrical codes and standards.

- Follow all local and national electrical codes to ground electrical equipment properly
- Proper protective grounding for equipment with ground currents higher than 3,5mA must be established, see *Leakage Current (>3,5mA)*
- A dedicated ground wire is required for input power, motor power and control wiring
- Use the clamps provided with on the equipment for proper ground connections
- Do not ground one drive to another in a "daisy chain" fashion
- Keep the ground wire connections as short as possible
- Use of high-strand wire to reduce electrical noise is recommended
- Follow motor manufacturer wiring requirements

2.4.2.1 Leakage Current (>3,5mA)

Follow national and local codes regarding protective earthing of equipment with a leakage current > 3,5mA. Drive technology implies high frequency switching at high power. This will generate a leakage current in the earth connection. A fault current in the drive at the output power terminals might contain a DC component which can charge the filter capacitors and cause a transient earth current. The earth leakage current depends on various system configurations including RFI filtering, screened motor cables, and drive power.

EN/IEC61800-5-1 (Power Drive System Product Standard) requires special care if the leakage current exceeds 3,5mA. Earth grounding must be reinforced in one of the following ways:

- Earth ground wire of at least 10mm²
- Two separate earth ground wires both complying with the dimensioning rules

See EN 60364-5-54 § 543.7 for further information.

Using RCDs

Where residual current devices (RCDs), also known as earth leakage circuit breakers (ELCBs), are used, comply with the following:

Use RCDs of type B only which are capable of detecting AC and DC currents

Use RCDs with an inrush delay to prevent faults due to transient earth currents

Dimension RCDs according to the system configuration and environmental considerations

2.4.2.2 Grounding Using Shielded Cable

Earthing (grounding) clamps are provided for motor wiring (see *Illustration 2.7*).

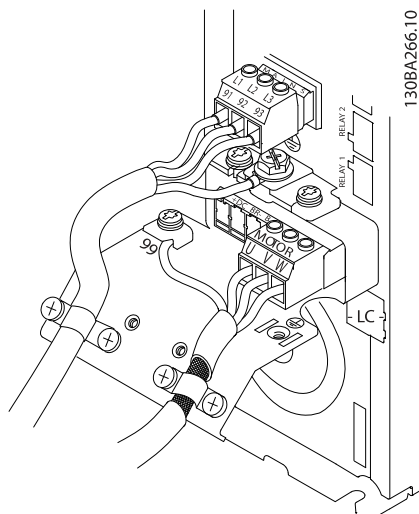


Illustration 2.7 Grounding with Shielded Cable

2.4.2.3 Grounding Using Conduit

CAUTION

GROUNDING HAZARD!

Do not use conduit connected to the drive as a replacement for proper grounding. Ground currents are higher than 3.5mA. Improper grounding can result in personal injury or electrical shorts.

Dedicated grounding clamps are provided (See *Illustration 2.8*).

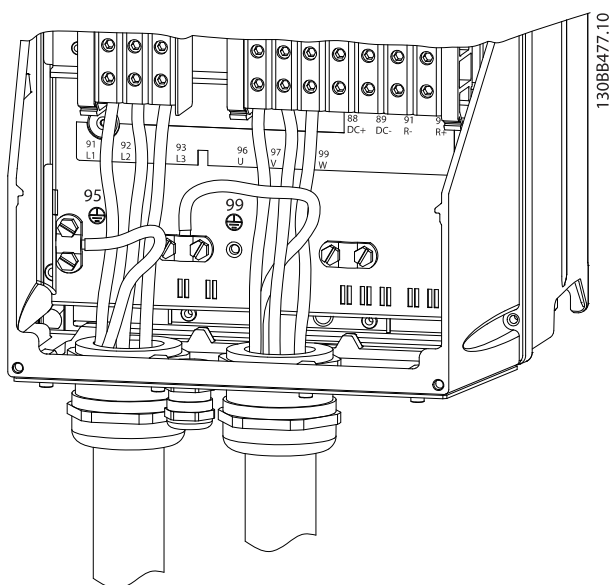


Illustration 2.8 Grounding with Conduit

1. Use a wire stripper to remove the insulation for proper grounding.
2. Secure the grounding clamp to the stripped portion of the wire with the screws provided.
3. Secure the grounding wire to the grounding clamp provided.

2.4.3 Motor Connection

WARNING

INDUCED VOLTAGE!

Run output motor cables from multiple frequency converters separately. Induced voltage from output motor cables run together can charge equipment capacitors even with the equipment turned off and locked out. Failure to run output motor cables separately could result in death or serious injury.

- For maximum wire sizes see *10.1 Power-dependent Specifications*
- Comply with local and national electrical codes for cable sizes
- Motor wiring knockouts or access panels are provided at the base of IP55 / Nema 12 units
- Do not install power factor correction capacitors between the drive and the motor
- Do not wire a starting or pole-changing device between the drive and the motor
- Connect the 3-phase motor wiring to terminals 96 (U), 97 (V), and 98 (W)
- Ground the cable in accordance with grounding instructions provided
- Torque terminals in accordance with the information provided in *10.4.1 Connection Tightening Torques*
- Follow motor manufacturer wiring requirements

The three following illustrations represent mains input, motor, and earth grounding for basic frequency converters. Actual configurations vary with unit types and optional equipment.

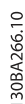


Diagram illustrating the rear panel connections for the 130BA390.11 unit. The unit is shown with its rear cover removed, revealing the internal wiring and terminal block.

Terminal block connections (left side):

- 91 L1
- 92 L2
- 93 L3
- 96 U
- 97 V
- 98 W

Terminal block connections (right side):

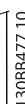
- 88 DC
- 89 DC+
- 81 R
- 87 R

Internal wiring and components:

- 95: A cable connected to the left terminal block.
- 99: A cable connected to the right terminal block, passing through a filter or connector.

The diagram shows the unit's internal structure, including the terminal block, wiring, and the rear cover.

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2.4.4 AC Mains Connection

- Size wiring based upon the input current of the drive. For maximum wire sizes see *10.1 Power-dependent Specifications*.
- Comply with local and national electrical codes for cable sizes.
- Connect 3-phase AC input power wiring to terminals L1, L2, and L3 (see *Illustration 2.12*).
- Input power will be connected to the mains input terminals.



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- Ground the cable in accordance with grounding instructions provided in 2.4.2 *Earth (Grounding) Requirements*
- All frequency converters may be used with an isolated input source as well as with ground reference power lines. When supplied from an isolated mains source (IT mains or floating delta) or TT/TN-S mains with a grounded leg (grounded delta), set *SP-50 RFI Filter* to OFF. When off, the internal RFI filter capacitors between the chassis and the intermediate circuit are isolated to avoid damage to the intermediate circuit and to reduce earth capacity currents in accordance with IEC 61800-3.



Illustration 2.14 Control Wiring Access for IP55 / Nema 12 enclosures

2.4.5 Control Wiring

- Isolate control wiring from high power components in the drive.
- If the drive is connected to a thermistor, for PELV isolation, optional thermistor control wiring must be reinforced/double insulated. A 24 VDC supply voltage is recommended.

2.4.5.1 Access

- Remove access cover plate with a screw driver. See *Illustration 2.13*.
- Or remove front cover by loosening attaching screws. See *Illustration 2.14*. Tightening torque for front cover is 2.0Nm for unit size 15 and 2.2Nm for unit sizes 2X and 3X.

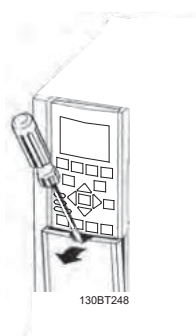
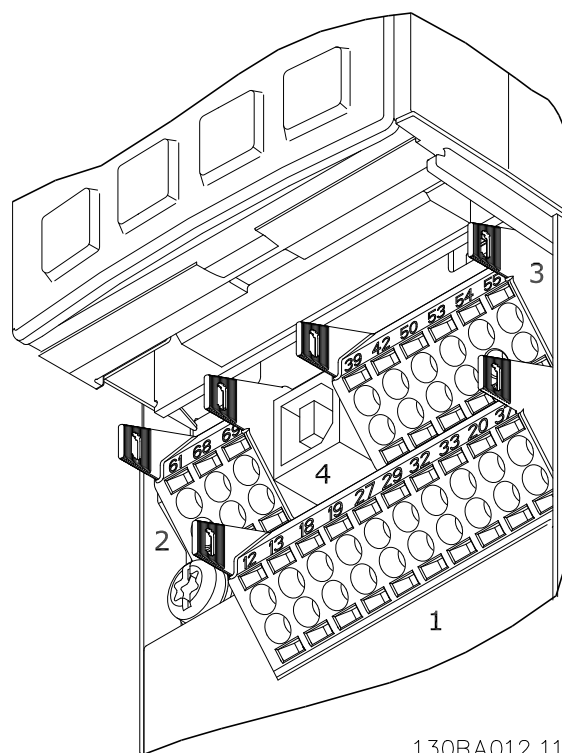


Illustration 2.13 Control Wiring Access for IP20 / Open chassis enclosures

2.4.5.2 Control Terminal Types

Illustration 2.18 shows the removable drive connectors. Terminal functions and default settings are summarized in *Table 2.2*.



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Illustration 2.15 Control Terminal Locations

- **Connector 1** provides four programmable digital inputs terminals, two additional digital terminals programmable as either input or output, a 24V DC terminal supply voltage, and a common for optional customer supplied 24V DC voltage
- **Connector 2** terminals (+)68 and (-)69 are for an RS-485 serial communications connection
- **Connector 3** provides two analog inputs, one analog output, 10V DC supply voltage, and commons for the inputs and output

Installation

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- **Connector 4** is a USB port available for use with the DCT-10
- Also provided are two Form C relay outputs that are in various locations depending upon the drive configuration and size
- Some options available for ordering with the unit may provide additional terminals. See the manual provided with the equipment option.

See 10.2 General Technical Data for terminal ratings details.

Terminal Description			
Digital Inputs/Outputs			
Terminal	Parameter	Default Setting	Description
12, 13	-	+24V DC	24V DC supply voltage. Maximum output current is 200mA total for all 24V loads. Useable for digital inputs and external transducers.
18	E-01	[8] Start	Digital inputs.
19	E-02	[0] No operation	
32	E-05	[0] No operation	
33	E-06	[0] No operation	
27	E-03	[0] No operation	Selectable for either digital input or output. Default setting is input.
29	E-04	[14] JOG	
20	-		Common for digital inputs and 0V potential for 24V supply.
Analog Inputs/Outputs			
39	-		Common for analog output
42	AN-50	Speed 0 - High Limit	Programmable analog output. The analog signal is 0-20mA or 4-20mA at a maximum of 500Ω
50	-	+10V DC	10V DC analog supply voltage. 15mA maximum commonly used for potentiometer or thermistor.
53	AN-1#	Reference	Analog input.
54	AN-2#	Feedback	Selectable for voltage or current. Switches A53 and A54 select mA or V.

Terminal Description			
Digital Inputs/Outputs			
Terminal	Parameter	Default Setting	Description
55	-		Common for analog input
Serial Communication			
61	-		Integrated RC-Filter for cable screen. ONLY for connecting the screen when experiencing EMC problems.
68 (+)	O-3#		RS-485 Interface. A control card switch is provided for termination resistance.
69 (-)	O-3#		
Relays			
01, 02, 03	E-24 [0]	[0] Alarm	Form C relay output.
04, 05, 06	E-24 [1]	[0] Running	Usable for AC or DC voltage and resistive or inductive loads.

Table 2.2 Terminal Description

2.4.5.3 Wiring to Control Terminals

Control terminal connectors can be unplugged from the drive for ease of installation, as shown in *Illustration 2.16*.

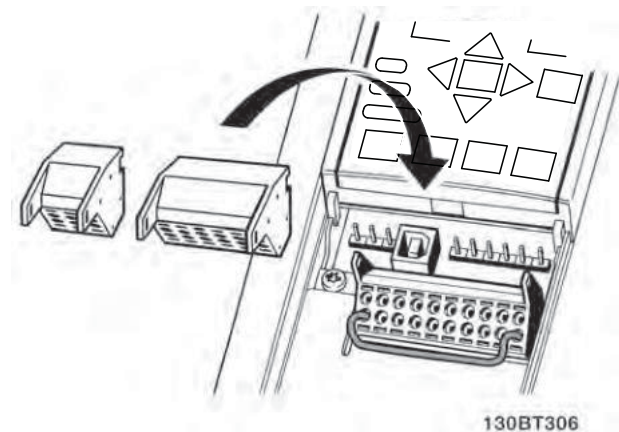


Illustration 2.16 Unplugging Control Terminals

1. Open the contact by inserting a small screwdriver into the slot above or below the contact, as shown in *Illustration 2.17*.
2. Insert the bared control wire into the contact.
3. Remove the screwdriver to fasten the control wire into the contact.
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 10.1 Power-dependent Specifications for control terminal wiring sizes.

See 6 Application Set-Up Examples for typical control wiring connections.

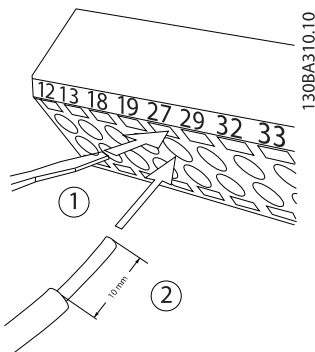
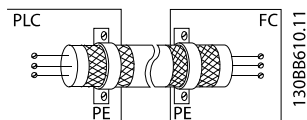


Illustration 2.17 Connecting Control Wiring

2.4.5.4 Using Screened Control Cables

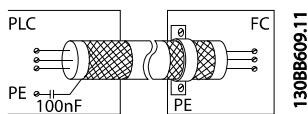
Correct screening

The preferred method in most cases is to secure control and serial communication cables with screening clamps provided at both ends to ensure best possible high frequency cable contact.



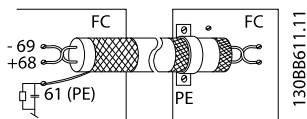
50/60Hz ground loops

With very long control cables, ground loops may occur. To eliminate ground loops, connect one end of the screen-to-ground with a 100nF capacitor (keeping leads short).



Avoid EMC noise on serial communication

To eliminate low-frequency noise between frequency converters, connect one end of the screen to terminal 61. This terminal is connected to ground via an internal RC link. Use twisted-pair cables to reduce interference between conductors.



2.4.5.5 Control Terminal Functions

Drive functions are commanded by receiving control input signals.

- Each terminal must be programmed for the function it will be supporting in the parameters associated with that terminal. See Table 2.2 for terminals and associated parameters.
- It is important to confirm that the control terminal is programmed for the correct function. See 4 User Interface for details on accessing parameters and for details on programming.
- The default terminal programming is intended to initiate drive functioning in a typical operational mode.

2.4.5.6 Terminal 53 and 54 Switches

- Analog input terminals 53 and 54 can select either voltage (0 to 10V) or current (0/4-20mA) input signals
- Remove power to the drive before changing switch positions
- Set switches A53 and A54 to select the signal type. U selects voltage, I selects current.
- The switches are accessible when the keypad has been removed (see Illustration 2.18). Note that some option cards available for the unit may cover these switches and must be removed to change switch settings. Always remove power to the unit before removing option cards.
- Terminal 53 default is for a speed reference signal in open loop set in DR-61 Terminal 53 Switch Setting
- Terminal 54 default is for a feedback signal in closed loop set in DR-63 Terminal 54 Switch Setting

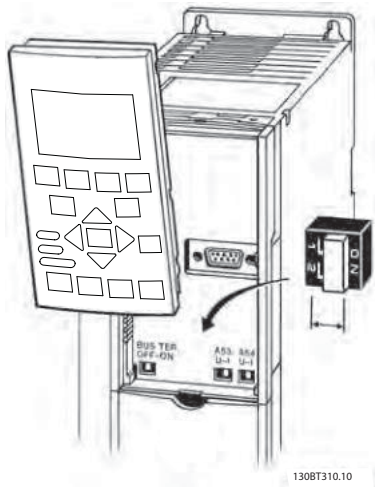


Illustration 2.18 Location of Terminals 53 and 54 Switches

2.4.6 Serial Communication

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

- Screened serial communication cable is recommended
- See 2.4.2 *Earth (Grounding) Requirements* for proper grounding

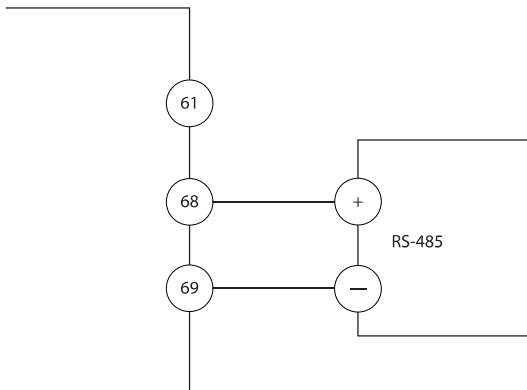


Illustration 2.19 Serial Communication Wiring Diagram

For basic serial communication set-up, select the following

1. Protocol type in *O-30 Protocol*.
 2. Drive address in *O-31 Address*.
 3. Baud rate in *O-32 Drive Port Baud Rate*.
- Four communication protocols are internal to the drive. Follow motor manufacturer wiring requirements.

Drive profile

Modbus RTU

Metasys N2®

Apogee FLN®

- Functions can be programmed remotely using the protocol software and RS-485 connection or in parameter group *O-## Options / Comms*
- Selecting a specific communication protocol changes various default parameter settings to match that protocol's specifications along with making additional protocol-specific parameters available
- Option cards which install into the drive are available to provide additional communication protocols. See the option-card documentation for installation and operation instructions



3 Start Up and Functional Testing

3.1 Pre-start

3.1.1 Safety Inspection

⚠ WARNING

HIGH VOLTAGE!

If input and output connections have been connected improperly, there is potential for high voltage on these terminals. If power leads for multiple motors are improperly run in same conduit, there is potential for leakage current to charge capacitors within the drive, even when disconnected from mains input. For initial start up, make no assumptions about power components. Follow pre-start procedures. Failure to follow pre-start procedures could result in personal injury or damage to equipment.

1. Input power to the unit must be OFF and locked out. Do not rely on the drive disconnect switches for input power isolation.
2. Verify that there is no voltage on input terminals L1 (91), L2 (92), and L3 (93), phase-to-phase and phase-to-ground,
3. Verify that there is no voltage on output terminals 96 (U), 97 (V), and 98 (W), phase-to-phase and phase-to-ground.
4. Confirm continuity of the motor by measuring ohm values on U-V (96-97), V-W (97-98), and W-U (98-96).
5. Check for proper grounding of the drive as well as the motor.
6. Inspect the drive for loose connections on terminals.
7. Record the following motor-nameplate data: power, voltage, frequency, full load current, and nominal speed. These values are needed to program motor nameplate data later.
8. Confirm that the supply voltage matches voltage of drive and motor.



3.1.2 Start Up Check List

CAUTION

Before applying power to the unit, inspect the entire installation as detailed in *Table 3.1*. Check mark those items when completed.

3

Inspect for	Description	☒
Auxiliary equipment	- Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers that may reside on input power side of drive or output side to motor. Examine their operational readiness and ensure that they are ready in all respects for operation at full speed. - Check function and installation of any sensors used for feedback to drive - Remove power factor correction caps on motor(s), if present	
Cable routing	Ensure that input power, motor wiring, and control wiring are separated or in three separate metallic conduits for high frequency noise 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	
EMC considerations	Check for proper installation regarding electromagnetic compatibility	
Environmental considerations	- See equipment label for the maximum ambient operating temperature limits - Humidity levels must be 5-95% non-condensing	
Fusing and circuit breakers	- Check for proper fusing or circuit breakers - Check that all fuses are inserted firmly and in operational condition and that all circuit breakers are in the open position	
Grounding	- The unit requires a ground wire from its chassis to the building ground - Check for good 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 ground	
Input and output power wiring	- Check for loose connections - Check that motor and mains are in separate conduit or separated screened cables	
Panel interior	Inspect that the unit interior is free of dirt, metal chips, moisture, and corrosion	
Switches	Ensure that all switch and disconnect settings are in the proper position	
Vibration	- Check that the unit is mounted solidly or that shock mounts are used, as necessary - Look for any unusual amount of vibration the unit may be subjected to	

Table 3.1 Start Up Check List



3.2 Applying Power to the Drive

⚠ WARNING

HIGH VOLTAGE!

Frequency converters contain high voltage when connected to AC mains. Installation, start-up and maintenance should be performed by qualified personnel only. Failure to perform installation, start-up and maintenance by qualified personnel could result in death or serious injury.

⚠ WARNING

UNINTENDED START!

When drive is connected to AC mains, the motor may start at any time. The drive, motor, and any driven equipment must be in operational readiness. Failure to be in operational readiness when the drive is connected to AC mains could result in death, serious injury, equipment, or property damage.

1. Confirm input voltage is balanced within 3%. If not, correct input voltage imbalance before proceeding. Repeat procedure after voltage correction.
2. Ensure optional equipment wiring, if present, matches installation application.
3. Ensure that all operator devices are in the OFF position. Panel doors closed or cover mounted.
4. Apply power to the unit. DO NOT start the drive at this time. For units with a disconnect switch, turn to the ON position to apply power to the drive.

3.3 Basic Operational Programming

Drives require basic operational programming prior to running for best performance. Basic operational programming requires entering motor-nameplate data for the motor being operated and the minimum and maximum motor speeds. Enter data in accordance with the following procedure. Parameter settings recommended are intended for start up and checkout purposes. Application settings may vary. See 4 User Interface for detailed instructions on entering data through the keypad.

Enter data with power ON, but prior to operating the drive.

1. Press [Quick Menu] on the keypad.
3. Use the navigation keys to scroll to Quick Start and press [OK].

4. Select language and press [OK]. Then enter the motor data in parameters P-02, P-03, P-06, P-07, F-04 and F-05. The information can be found on the motor nameplate. The entire quick menu is shown in 5.5.1 Quick Menu Structure

P-07 Motor Power [kW] or P-02 Motor Power [HP]

F-05 Motor Rated Voltage

F-04 Base Frequency

P-03 Motor Current

P-06 Base Speed

5. *F-07 Accel Time 1* is recommended as 60 seconds for fans or 10 seconds for pumps.
6. *F-08 Decel Time 1* is recommended as 60 seconds for fans or 10 seconds for pumps.
7. For F-10 enter Elec OL Trip 1 for Class 20 overload protection. For further information, please see 2.4.1 Requirements
8. For *F-16 Motor Speed Low Limit [Hz]* enter the application requirements. If these values are unknown at this time, the following values are recommended. These values will ensure initial drive operation. However, take any precautions necessary to prevent equipment damage. Make sure that the recommended values are safe to use for functional testing before starting the equipment.

Fan = 20Hz

Pump = 20Hz

Compressor = 30Hz

9. In *F-15 Motor Speed High Limit [Hz]* enter the motor frequency from *F-04 Base Frequency*.

This concludes the quick set-up procedure. Press [Status] to return to the operational display.

In *P-04 Auto Tune* select Reduced Auto Tune or Full Auto Tune and follow on-screen instructions. See 3.4 Auto Tune

3.4 Auto Tune

Auto tune is a test procedure that measures the electrical characteristics of the motor to optimize compatibility between the drive and the motor.

- The 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 character-

istics with the data entered in P-02, P-03, P-06, P-07, F-04 and F-05.

- It does not cause the motor to run or harm to the motor
- Some motors may be unable to run the complete version of the test. In that case, select *Reduced Auto Tune*
- If an output filter is connected to the motor, select *Reduced Auto Tune*
- If warnings or alarms occur, see *8 Warnings and Alarms*
- Run this procedure on a cold motor for best results

3.5 Check Motor Rotation

Prior to running the drive, check the motor rotation. The motor will run briefly at 5Hz or the minimum frequency set in *F-16 Motor Speed Low Limit [Hz]*.

1. Press [Main Menu] twice on the keypad.
2. Enter Parameter Data Set and scroll to P-## Motor Data and press [OK] to enter.
3. Scroll to *P-08 Motor Rotation Check*.
4. Press [OK].
5. Scroll to *Enable*.

The following text will appear: *Note! Motor may run in wrong direction*.

6. Press [OK].
7. Follow the on-screen instructions.

To change the direction of rotation, remove power to the drive and wait for power to discharge. Reverse the connection of any two of the three motor cables on the motor or drive side of the connection.

3.6 Local-control Test

CAUTION

MOTOR START!

Ensure that the motor, system, and any attached equipment is ready for start. It is the responsibility of the user to ensure safe operation under any operational condition. Failure to ensure that the motor, system, and any attached equipment is ready for start could result in personal injury or equipment damage.

NOTE

The hand key on the keypad provides a local start command to the drive. The OFF key provides the stop function.

When operating in local mode, the up and down arrows on the keypad increase and decrease the speed output of the drive. The left and right arrow keys move the display cursor in the numeric display.

1. Press [Hand].
2. Accelerate the drive by pressing [▲] to full speed. Moving the cursor left of the decimal point provides quicker input changes.
3. Note any acceleration problems.
4. Press [OFF].
5. Note any deceleration problems.

If acceleration problems were encountered

- If warnings or alarms occur, see *8 Warnings and Alarms*
- Check that motor data is entered correctly
- Increase the accel time in *F-07 Accel Time 1*
- Increase current limit in *F-43 Current Limit*
- Increase torque limit in *F-40 Torque Limiter (Driving)*

If deceleration problems were encountered

- If warnings or alarms occur, see *8 Warnings and Alarms*
- Check that motor data is entered correctly
- Increase the decel time in *F-08 Decel Time 1*

See *8.4 Warning and Alarm Definitions* for resetting the drive after a trip.

NOTE

3.1 Pre-start through *3.6 Local-control Test* in this chapter concludes the procedures for applying power to the drive, basic programming, set-up, and functional testing.



3.7 System Start Up

The procedure in this section requires user-wiring and application programming to be completed. is intended to help with this task. Other aids to application set-up are listed in *1.2 Additional Resources*. The following procedure is recommended after application set-up by the user is completed.

CAUTION

MOTOR START!

Ensure that the motor, system, and any attached equipment is ready for start. It is the responsibility of the user to ensure safe operation under any operational condition. Failure to ensure that the motor, system, and any attached equipment is ready for start could result in personal injury or equipment damage.

1. Press [Auto].
2. Ensure that external control functions are properly wired to the drive and all programming completed.
3. Apply an external run command.
4. Adjust the speed reference throughout the speed range.
5. Remove the external run command.
6. Note any problems.

If warnings or alarms occur, see *8 Warnings and Alarms*.

4 User Interface

4.1 Keypad

The keypad is the combined display and keys on the front of the unit. The keypad is the user interface to the frequency converter.

The keypad has several user functions.

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

NOTE

The display contrast can be adjusted by pressing [STATUS] and the up/ down key.

4.1.1 Keypad Layout

The keypad is divided into four functional groups (see *Illustration 4.1*).

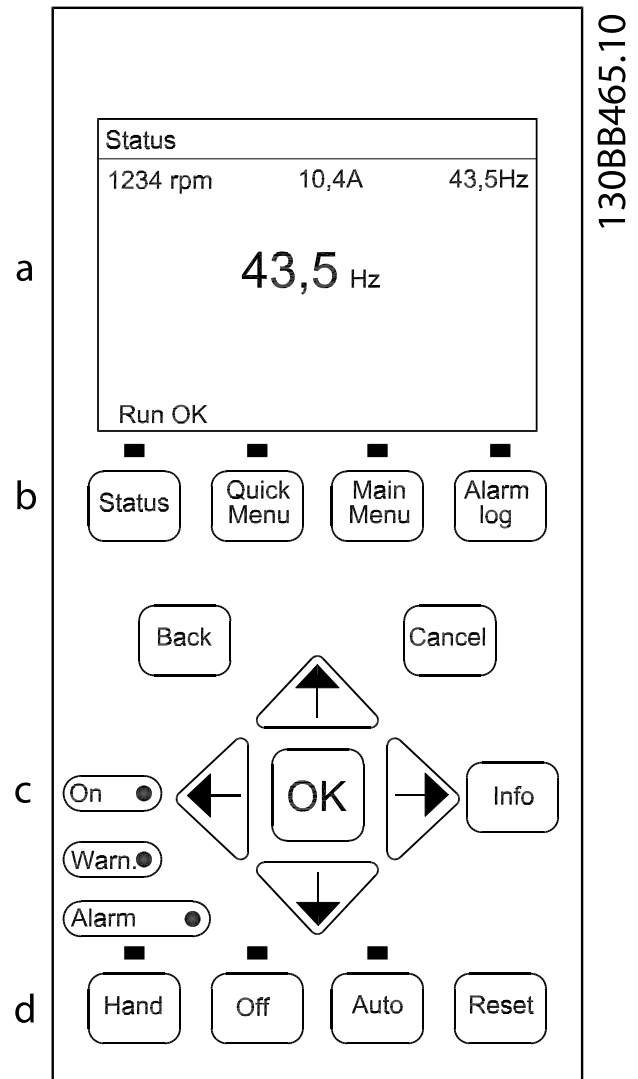


Illustration 4.1 Keypad

- Display area.
- Display menu keys for changing the display to show status options, programming, or error message history.
- Navigation keys for programming functions, moving the display cursor, and speed control in local operation. Also included are the status indicator lights.
- Operational mode keys and reset.



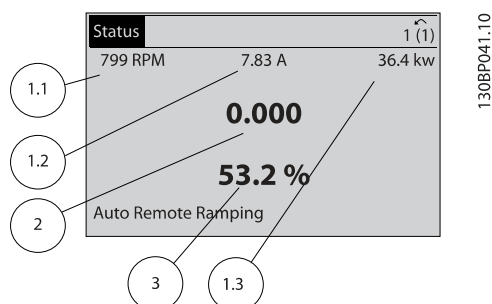
4.1.2 Setting Keypad Display Values

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

The information displayed on the keypad can be customized for user application.

- Each display readout has a parameter associated with it.
- Options are selected in the menu Keypad Set-up.
- Display 2 has an alternate larger display option.
- The frequency converter status at the bottom line of the display is generated automatically and is not selectable. See 7 *Status Messages* for definitions and details.

Display	Parameter number	Default setting
1.1	K-20	Motor RPMs
1.2	K-21	Motor current
1.3	K-22	Motor power (kW)
2	K-23	Motor frequency
3	K-24	Reference in percent



4.1.3 Display Menu Keys

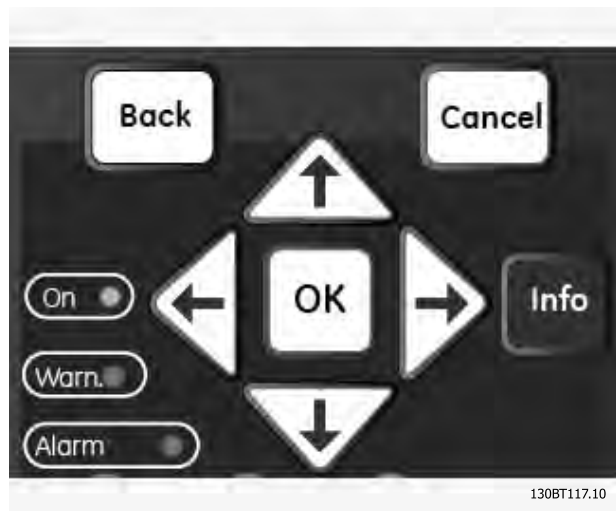
Menu keys are used for menu access for parameter set-up, toggling through status display modes during normal operation, and viewing fault log data.



Key	Function
Status	Press to show operational information. • In Auto mode, press and hold to toggle between status read-out displays • Press repeatedly to scroll through each status display • Press and hold [Status] plus [▲] or [▼] to adjust the display brightness • The symbol in the upper right corner of the display shows the direction of motor rotation and which set-up is active. This is not programmable.
Quick Menu	Allows access to programming parameters for initial set up instructions and many detailed application instructions. • Press to access <i>Quick Start</i> for sequenced instructions to program the basic frequency controller set up • Press to access <i>Fan Macros, Pump Macros, Compressor Macros, or Closed Loop</i> for sequenced instructions to program applications • Press to access Trending for realtime logging on keypad display. • Press to access Parameter Data Check for changes in parameter data set. • Follow the sequence of parameters as presented for the function set up
Main Menu	Allows access to all programming parameters. • Press twice to access top-level index • Press once to return to the last location accessed • Press and hold to enter a parameter number for direct access to that parameter
Alarm Log	Displays a list of current warnings, the last 10 alarms, and the maintenance log. • For details about the drive before it entered the alarm mode, select the alarm number using the navigation keys and press [OK].

4.1.4 Navigation Keys

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



Key	Function
Back	Reverts to the previous step or list in the menu structure.
Cancel	Cancels the last change or command as long as the display mode has not changed.
Info	Press for a definition of the function being displayed.
Navigation Keys	Use the four navigation arrows to move between items in the menu.
OK	Use to access parameter groups or to enable a choice.

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

4.1.5 Operation Keys

Operation keys are found at the bottom of the keypad.



Key	Function
Hand	Press to start the drive in local control. - Use the navigation keys to control drive speed - An external stop signal by control input or serial communication overrides the local hand
Off	Stops the motor but does not remove power to the drive.
Auto	Puts the system in remote operational mode. - Responds to an external start command by control terminals or serial communication - Speed reference is from an external source
Reset	Resets the drive manually after a fault has been cleared.

4.2 Back Up and Copying Parameter Settings

Programming data is stored internally in the drive.

- The data can be up loaded into the keypad memory as a storage back up
- Once stored in the keypad, the data can be downloaded back into the drive
- Or downloaded into other frequency converters by connecting the keypad into those units and downloading the stored settings. (This is a quick way to program multiple units with the same settings.)
- Initialisation of the drive to restore factory default settings does not change data stored in the keypad memory

⚠ WARNING

UNINTENDED START!

When drive is connected to AC mains, the motor may start at any time. The drive, motor, and any driven equipment must be in operational readiness. Failure to be in operational readiness when the drive is connected to AC mains could result in death, serious injury, equipment, or property damage.



4.2.1 Uploading Data to the keypad

1. Press [OFF] to stop the motor before uploading or downloading data.
2. Go to *K-50 Keypad Copy*.
3. Press [OK].
4. Select *All to keypad*.
5. Press [OK]. A progress bar shows the uploading process.
6. Press [Hand] or [Auto] to return to normal operation.

4.2.2 Downloading Data from the keypad

1. Press [OFF] to stop the motor before uploading or downloading data.
2. Go to *K-50 Keypad Copy*.
3. Press [OK].
4. Select *All from keypad*.
5. Press [OK]. A progress bar shows the downloading process.
6. Press [Hand] or [Auto] to return to normal operation.

4.3 Restoring Default Settings

CAUTION

Initialisation restores the unit to factory default settings. Any programming, motor data, localization, and monitoring records will be lost. Uploading data to the keypad provides a backup prior to initialisation.

Restoring the drive parameter settings back to default values is done by initialisation of the frequency converter. Initialisation can be through *H-03 Restore Factory Settings* or manually.

- Initialisation using *H-03 Restore Factory Settings* does not change drive data such as operating hours, serial communication selections, personal menu settings, fault log, alarm log, and other monitoring functions
- Using *H-03 Restore Factory Settings* is generally recommended
- Manual initialisation erases all motor, programming, localization, and monitoring data and restores factory default settings

4.3.1 Recommended Initialisation

1. Press [Main Menu] twice to access parameters.
2. Scroll to *H-03 Restore Factory Settings*.
3. Press [OK].
4. Scroll to *Initialisation*.
5. Press [OK].
6. Remove power to the unit and wait for the display to turn off.
7. Apply power to the unit.

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

8. Alarm 80 is displayed.
9. Press [Reset] to return to operation mode.

4.3.2 Manual Initialisation

1. Remove power to the unit and wait for the display to turn off.
2. Press and hold [Status], [Main Menu], and [OK] at the same time and apply power to the unit.

Factory default parameter settings are restored during start up. This may take slightly longer than normal.

Manual initialisation does not reset the following drive information

- *ID-00 Operating Hours*
- *ID-03 Power Up's*
- *ID-04 Over Temp's*
- *ID-05 Over Volt's*

5 About Drive Programming

5.1 Introduction

The drive is programmed for its application functions using parameters. Parameters are accessed by pressing either [Quick Menu] or [Main Menu] on the keypad. (See 4 *User Interface* for details on using the keypad function keys.) Parameters may also be accessed through a PC using the DCT-10 (see 5.6 *Remote Programming with*).

The quick menu is intended for initial start up and detailed instructions for common drive applications . Step-by-step instructions are provided. These instructions enable the user to walk through the parameters used for programming applications in their proper sequence. Data entered in a parameter can change the options available in the parameters following that entry. The quick menu presents easy guidelines for getting most systems up and running.

The main menu accesses all parameters and allows for advanced drive applications.

5.2 Programming Example

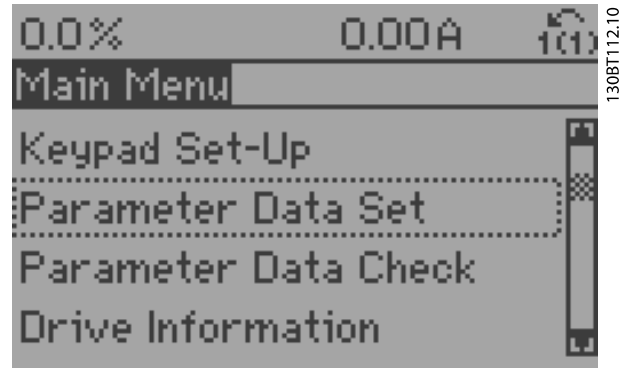
Here is an example for programming the drive for a common application in open loop using the quick menu.

- This procedure programs the drive to receive a 0-10V DC analog control signal on input terminal 53
- The drive will respond by providing 20-50Hz output to the motor proportional to the input signal (0-10V DC = 20-50Hz)

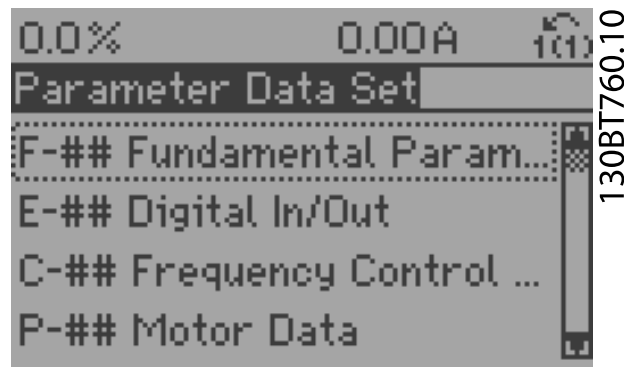
This is a common pump or fan application.

Press [Main Menu] twice and select the following parameters using the navigation keys to scroll to the titles and press [OK] after each action.

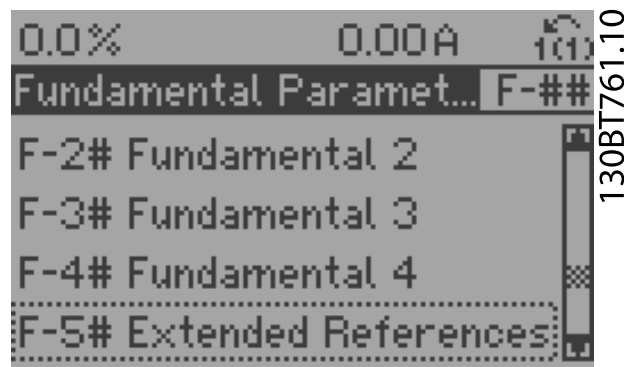
1. *Parameter Data Set*



3. *Fundamental Parameters*

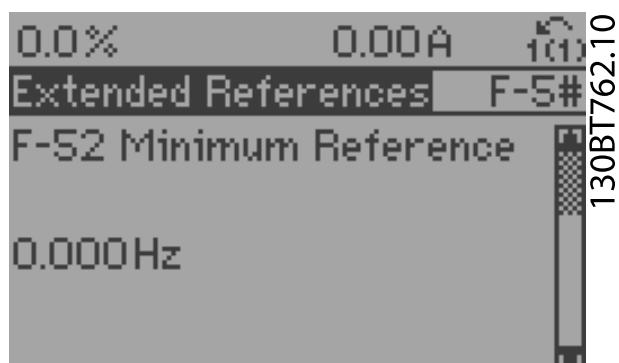


4. *Extended References*

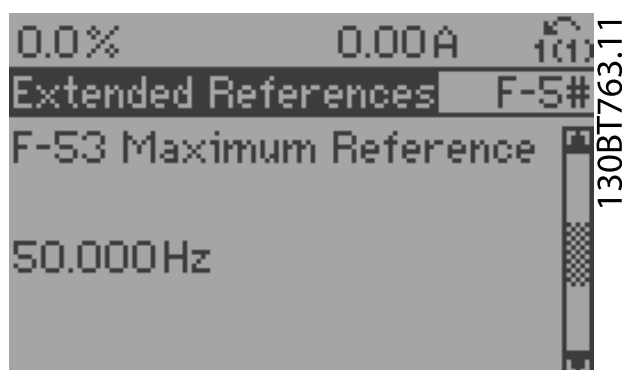




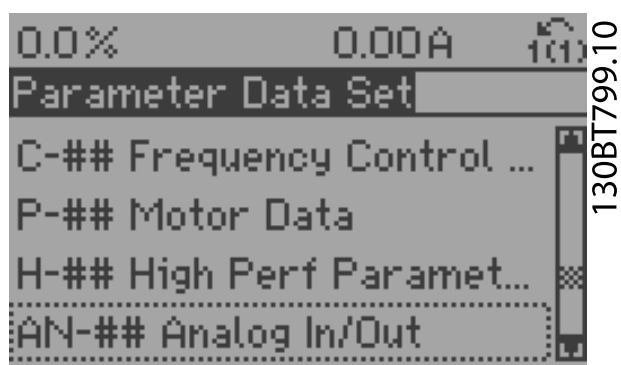
5. *F-52 Minimum Reference.* Set minimum internal drive reference to 0Hz. (This sets the minimum drive speed at 0Hz.)



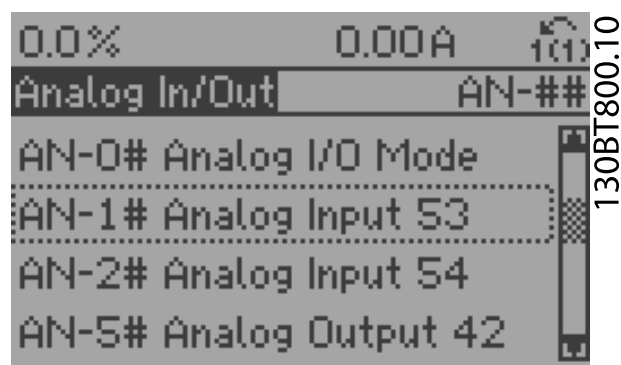
6. *F-53 Maximum Reference.* Set maximum internal drive reference to 60Hz. (This sets the maximum drive speed at 60Hz. Note that 50/60Hz is a regional variation.)



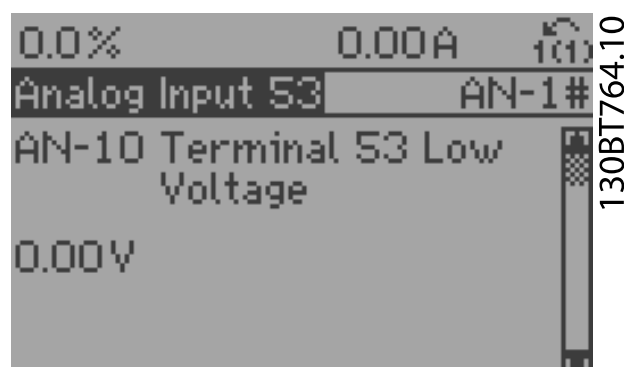
7. Press [Back] twice to return to Parameter Data Set and scroll to Analog In/Out



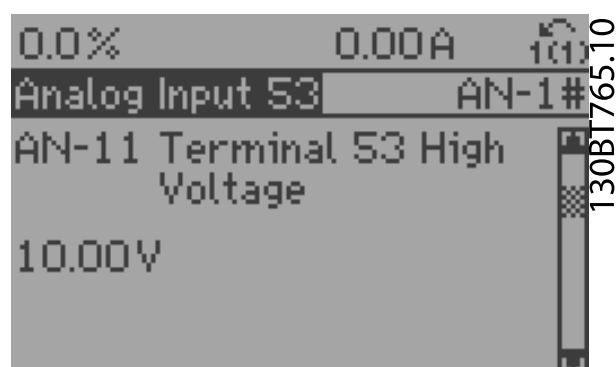
8. Analog Input 53



9. *AN-10 Terminal 53 Low Voltage.* Set minimum external voltage reference on Terminal 53 at 0V. (This sets the minimum input signal at 0V.)



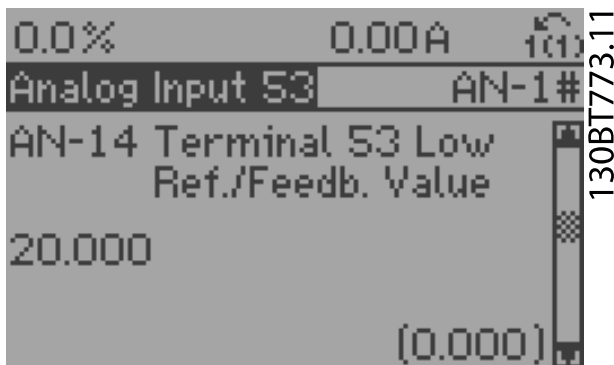
10. *AN-11 Terminal 53 High Voltage.* Set maximum external voltage reference on Terminal 53 at 10V. (This sets the maximum input signal at 10V.)



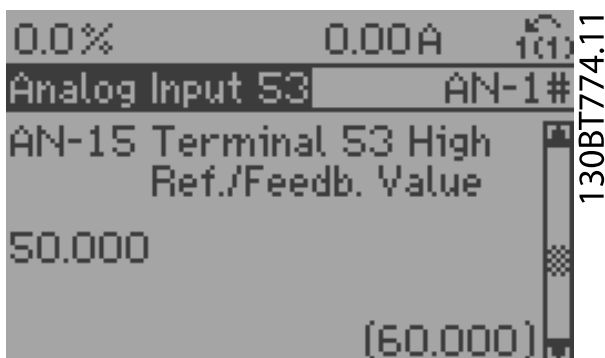
About Drive Programming

AF-600 FP Operating Instructions

11. **AN-14 Terminal 53 Low Ref./Feedb. Value.** Set minimum speed reference on Terminal 53 at 20Hz. (This tells the drive that the minimum voltage received on Terminal 53 (0V) equals 20Hz output.)



12. **AN-15 Terminal 53 High Ref./Feedb. Value.** Set maximum speed reference on Terminal 53 at 50Hz. (This tells the drive that the maximum voltage received on Terminal 53 (10V) equals 50Hz output.)



With an external device providing a 0-10V control signal connected to drive terminal 53, the system is now ready for operation. Note that the scroll bar on the right in the last illustration of the display is at the bottom, indicating the procedure is complete.

Illustration 5.1 shows the wiring connections used to enable this set up.

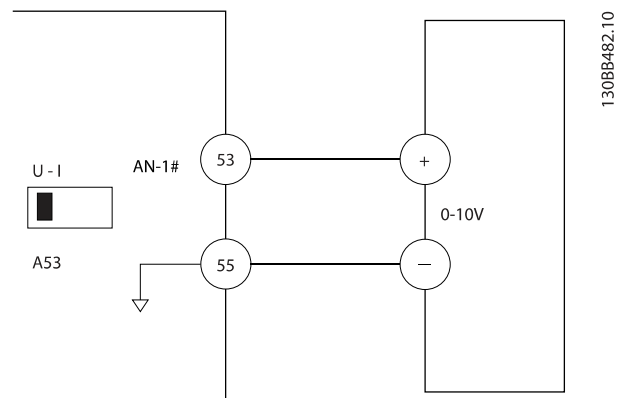


Illustration 5.1 Wiring Example for External Device Providing 0-10V Control Signal

5.3 Control Terminal Programming Examples

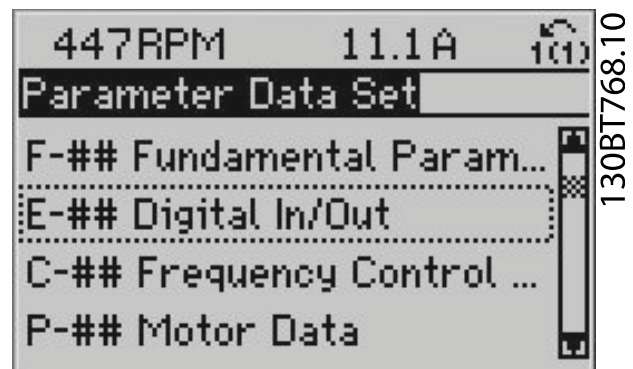
Control terminals can be programmed.

- Each terminal has specified functions it is capable of performing
- Parameters associated with the terminal enable the function
- For proper drive functioning, the control terminals must be
 - Wired properly
 - Programmed for the intended function
 - Receiving a signal

See *Table 2.2* for control terminal parameter number and default setting. (Default setting can change based on the selection in *K-03 Regional Settings*.)

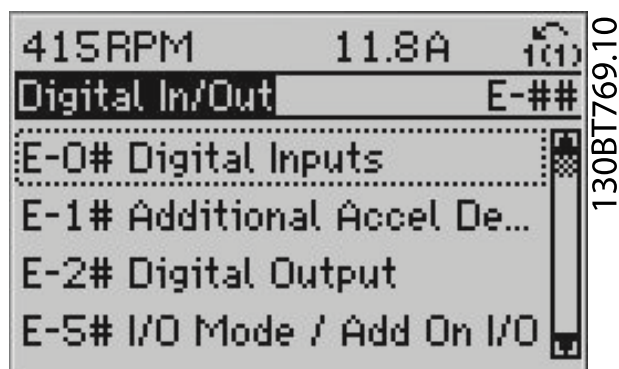
The following example shows accessing Terminal 18 to see the default setting.

- Press [Main Menu] twice, scroll to *Parameter Data Set* and press [OK].

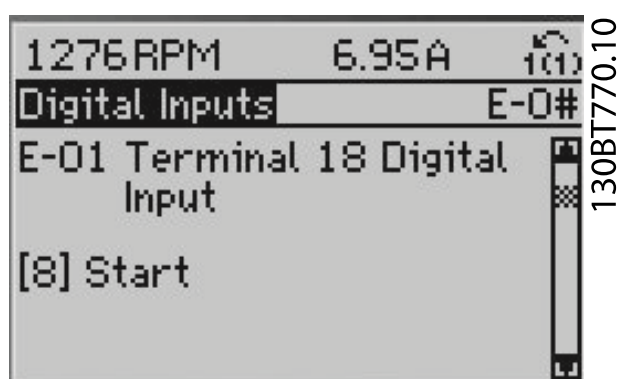




2. Scroll to parameter group E-## *Digital In/Out* and press [OK].



3. Scroll to parameter group E-0# *Digital Inputs* and press [OK]
4. Scroll to E-01 *Terminal 18 Digital Input*. Press [OK] to access function choices. The default setting *Start* is shown.



5.4 International/North American Default Parameter Settings

Setting *K-03 Regional Settings* to [0]*International* or [1]*North America* changes the default settings for some parameters. Table 5.1 lists those parameters that are effected.

Parameter	International Default Parameter Value	North American Default Parameter Value
K-03 Regional Settings	International	North America
K-71 Date Format	DD-MM-YYYY	MM/DD/YYYY
K-72 Time Format	24h	12h
P-07 Motor Power [kW]	See Note 1	See Note 1
P-02 Motor Power [HP]	See Note 2	See Note 2
F-05 Motor Rated Voltage	230V/400V/575V	208V/460V/575V

Parameter	International Default Parameter Value	North American Default Parameter Value
F-04 Base Frequency	50Hz	60Hz
F-53 Maximum Reference	50Hz	60Hz
F-54 Reference Function	Sum	External/Preset
F-17 Motor Speed High Limit [RPM] See Note 3	1500RPM	1800RPM
F-15 Motor Speed High Limit [Hz] See Note 4	50Hz	60Hz
F-03 Max Output Frequency 1	100Hz	120Hz
H-73 Warning Speed High	1500RPM	1800RPM
E-03 Terminal 27 Digital Input	Coast inverse	External interlock
E-24 Function Relay	Alarm	No alarm
AN-15 Terminal 53 High Ref./Feedb. Value	50	60
AN-50 Terminal 42 Output	Speed 0 - HighLim	Speed 4-20mA
H-04 Auto-Reset (Times)	Manual reset	Infinite auto reset
AP-85 Speed at Design Point [RPM] See Note 3	1500RPM	1800RPM
AP-86 Speed at Design Point [Hz]	50Hz	60Hz
FB-04 Fire Mode Max Reference	50Hz	60Hz

Table 5.1 International/North American Default Parameter Settings

Note 1: *P-07 Motor Power [kW]* is only visible when *K-03 Regional Settings* is set to [0] *International*.

Note 2: *P-02 Motor Power [HP]*, is only visible when *K-03 Regional Settings* is set to [1] *North America*.

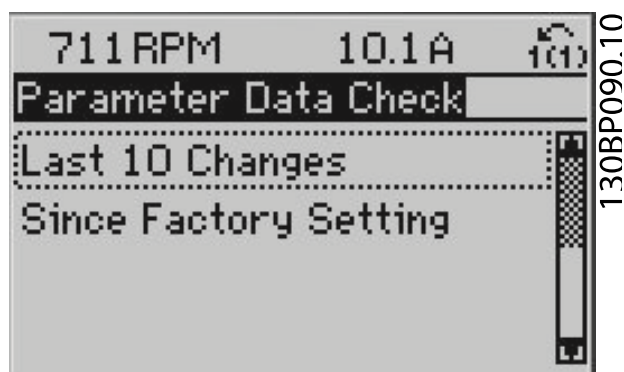
Note 3: This parameter is only visible when *K-02 Motor Speed Unit* is set to [0] *RPM*.

Note 4: This parameter is only visible when *K-02 Motor Speed Unit* is set to [1] *Hz*.

Changes made to default settings are stored and available for viewing in the quick menu along with any programming entered into parameters.

5.4.1 Parameter Data Check

1. Press [Quick Menu].
2. Scroll to *Q5 Changes Made* and press [OK].



3. Select *Q5-2 Since Factory Setting* to view all programming changes or *Q5-1 Last 10 Changes* for the most recent.

5

5.5 Parameter Menu Structure

Establishing the correct programming for applications often requires setting functions in several related parameters. These parameter settings provide the drive with system details for the drive to operate properly. System details may include such things as input and output signal types, programming terminals, minimum and maximum signal ranges, custom displays, automatic restart, and other features.

- See the keypad display to view detailed parameter programming and setting options
- Press [Info] in any menu location to view additional details for that function
- Press and hold [Main Menu] to enter a parameter number for direct access to that parameter
- Details for common application set ups are provided in *6 Application Set-Up Examples*

5.5.1 Quick Menu Structure

Quick Start	
K-01	Language
K-02	Motor Speed Unit
P-02	Motor Power [HP]
P-07	Motor Power [kW]
F-05	Motor Rated Voltage
P-03	Motor Current
F-04	Base Frequency
P-06	Base Speed
F-01	Frequency Setting 1
F-02	Operation Method
F-07	Accel Time 1
F-08	Decel Time 1
F-10	Electronic Overload
F-15	Motor Speed High Limit [Hz]
F-16	Motor Speed Low Limit [Hz]
H-08	Reverse Lock
P-04	Auto Tune



5.5.2 Main Menu Structure

K-# Keypad Set-Up	K-37 Display Text 1	K-8# Days and Date/Time Readout	F-2# Fundamental 2	E-# Digital In/Out
K-0# Keypad Basic Settings	K-38 Display Text 2	K-81 Working Days	F-24 Holding Time	E-0# Digital Inputs
K-01 Language	K-39 Display Text 3	K-82 Additional Working Days	F-26 Motor Noise (Carrier Freq)	E-00 Digital I/O Mode
K-02 Motor Speed Unit	K-4# Keypad Buttons	K-83 Additional Non-Working Days	F-27 Motor Tone Random	E-01 Terminal 18 Digital Input
K-03 Regional Settings	K-40 [Hand] Button on Keypad	K-89 Date and Time Readout	F-3# Fundamental 3	E-02 Terminal 19 Digital Input
K-04 Operating State at Power-up	K-41 [Off] Button on Keypad	F-# Fundamental Parameters	F-37 Adv. Switching Pattern	E-03 Terminal 27 Digital Input
K-05 Local Mode Unit	K-42 [Auto] Button on Keypad	F-0# Fundamental 0	F-38 Overmodulation	E-04 Terminal 29 Digital Input
K-1# Keypad Set-Up Operations	K-43 [Reset] Button on Keypad	F-01 Frequency Setting 1	F-4# Fundamental 4	E-05 Terminal 32 Digital Input
K-10 Active Set-up	K-5# Copy/Save	F-02 Operation Method	F-40 Torque Limiter (Driving)	E-06 Terminal 33 Digital Input
K-11 Edit Set-up	K-50 Keypad Copy	F-03 Max Output Frequency 1	F-41 Torque Limiter (Braking)	E-1# Additional Accel Decel Ramps
K-12 This Set-up Linked to	K-51 Set-up Copy	F-04 Base Frequency	F-43 Current Limit	E-10 Accel Time 2
K-13 Readout: Linked Set-ups	K-6# Password Protection	F-05 Motor Rated Voltage	F-5# Extended References	E-11 Decel Time 2
K-14 Readout: Edit Set-ups / Channel	K-60 Main Menu Password	F-07 Accel Time 1	F-52 Minimum Reference	E-2# Digital Outputs
K-2# Keypad Display	K-61 Access to Main Menu w/o Password	F-08 Decel Time 1	F-53 Maximum Reference	E-20 Terminal 27 Digital Output
K-20 Display Line 1.1 Small	K-65 Quick Menu Password	F-1# Fundamental 1	F-54 Reference Function	E-21 Terminal 29 Digital Output
K-21 Display Line 1.2 Small	K-66 Access to Quick Menu w/o Password	F-10 Electronic Overload	F-6# References	E-24 Function Relay
K-22 Display Line 1.3 Small	K-7# Clock Settings	F-11 Motor External Fan	F-64 Preset Relative Reference	E-26 On Delay, Relay
K-23 Display Line 2 Large	K-70 Date and Time	F-12 Motor Thermistor Input	F-9# Digital Pot.Meter	E-27 Off Delay, Relay
K-24 Display Line 3 Large	K-71 Date Format	F-15 Motor Speed High Limit [Hz]	F-90 Step Size	E-5# I/O Mode / Add On I/O
K-25 Quick Start	K-72 Time Format	F-16 Motor Speed Low Limit [Hz]	F-91 Accel/Decel Time	E-51 Terminal 27 Mode
K-3# Keypad Custom Readout	K-74 DST/Summertime	F-17 Motor Speed High Limit [RPM]	F-92 Power Restore	E-52 Terminal 29 Mode
K-30 Unit for Custom Readout	K-76 DST/Summertime Start	F-18 Motor Speed Low Limit [RPM]	F-93 Maximum Limit	E-53 Terminal X30/2 Digital Input
K-31 Min Value of Custom Readout	K-77 DST/Summertime End		F-94 Minimum Limit	E-54 Terminal X30/3 Digital Input
K-32 Max Value of Custom Readout	K-79 Clock Fault		F-95 Accel/Decel Ramp Delay	E-55 Terminal X30/4 Digital Input

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E-56 Term X30/6 Digi Out (OPCGPIO)	E-96 Pulse Out #29 Timeout Preset	P-07 Motor Power [kW]	H-5# Load Indep. Setting	AN-1# Analog Input 53
E-57 Term X30/7 Digi Out (OPCGPIO)	E-97 Pulse Out #X30/6 Bus Control	P-08 Motor Rotation Check	H-58 Flystart Test Pulses Current	AN-10 Terminal 53 Low Voltage
E-6# Pulse Input	E-98 Pulse Out #X30/6 Timeout Preset	P-09 Slip Compensation	H-59 Flystart Test Pulses Frequency	AN-11 Terminal 53 High Voltage
E-60 Term. 29 Low Frequency	C-## Frequency Control Functions	P-10 Slip Compensation Time Constant	H-6# Load Depen. Setting	AN-12 Terminal 53 Low Current
E-61 Term. 29 High Frequency	C-0# Frequency Control Functions	P-3# Adv. Motor Data	H-64 Resonance Dampening	AN-13 Terminal 53 High Current
E-62 Term. 29 Low Ref./Feedb. Value	C-01 Jump Frequency From [Hz]	P-30 Stator Resistance (Rs)	H-65 Resonance Dampening Time Constant	AN-14 Terminal 53 Low Ref./Feedb. Value
E-63 Term. 29 High Ref./Feedb. Value	C-02 Jump Speed From [RPM]	P-31 Rotor Resistance (Rr)	H-7# Adjustable Warnings	AN-15 Terminal 53 High Ref./Feedb. Value
E-64 Pulse Filter Time Constant #29	C-03 Jump Speed To [RPM]	P-35 Main Reactance (Xh)	H-70 Warning Current Low	AN-16 Terminal 53 Filter Time Constant
E-65 Term. 33 Low Frequency	C-04 Jump Frequency To [Hz]	P-36 Iron Loss Resistance (Rfe)	H-71 Warning Current High	AN-17 Terminal 53 Live Zero
E-66 Term. 33 High Frequency	C-05 Multi-step Frequency 1 - 8	H-## High Perf Parameters	H-72 Warning Speed Low	AN-2# Analog Input 54
E-67 Term. 33 Low Ref./Feedb. Value	C-2# Jog Setup	H-0# High Perf Operations	H-73 Warning Speed High	AN-20 Terminal 54 Low Voltage
E-68 Term. 33 High Ref./Feedb. Value	C-20 Jog Speed [Hz]	H-03 Restore Factory Settings	H-74 Warning Reference Low	AN-21 Terminal 54 High Voltage
E-69 Pulse Filter Time Constant #33	C-21 Jog Speed [RPM]	H-04 Auto-Reset (Times)	H-75 Warning Reference High	AN-22 Terminal 54 Low Current
E-7# Pulse Output	C-22 Jog Accel/Decel Time	H-05 Auto-Reset (Reset Interval)	H-76 Warning Feedback Low	AN-23 Terminal 54 High Current
E-70 Terminal 27 Pulse Output Variable	C-3# Frequency Setting 2 and 3	H-06 Fan Operation	H-77 Warning Feedback High	AN-24 Terminal 54 Low Ref./Feedb. Value
E-71 Pulse Output Max Freq #27	C-30 Frequency Command 2	H-08 Reverse Lock	H-78 Missing Motor Phase Function	AN-25 Terminal 54 High Ref./Feedb. Value
E-72 Terminal 29 Pulse Output Variable	C-34 Frequency Command 3	H-09 Start Mode	H-8# Stop Adjustments	AN-26 Terminal 54 Filter Time Constant
E-74 Pulse Output Max Freq #29	C-4# Semi-Auto Jump Freq Set-up	H-3# Stop Speed	H-80 Function at Stop	AN-27 Terminal 54 Live Zero
E-75 Terminal X30/6 Pulse Output Variable	C-40 Semi-Auto Jump Freq Set-up	H-36 Trip Speed Low [RPM]	H-81 Min Speed for Function at Stop [RPM]	AN-3# Analog Input X30/11
E-76 Pulse Output Max Freq #X30/6	P-## Motor Data	H-37 Trip Speed Low [Hz]	H-82 Min Speed for Function at Stop [Hz]	AN-30 Terminal X30/11 Low Voltage
E-9# Bus Controlled	P-0# Motor Data	H-4# Advanced Settings	AN-## Analog In/Out	AN-31 Terminal X30/11 High Voltage
E-90 Digital & Relay Bus Control	P-02 Motor Power [HP]	H-40 Configuration Mode	AN-0# Analog I/O Mode	AN-34 Term. X30/11 Low Ref./Feedb. Value
E-93 Pulse Out #27 Bus Control	P-03 Motor Current	H-43 Torque Characteristics	AN-00 Live Zero Timeout Time	AN-35 Term. X30/11 High Ref./Feedb. Value
E-94 Pulse Out #27 Timeout Preset	P-04 Auto Tune	H-48 Clockwise Direction	AN-01 Live Zero Timeout Function	AN-36 Term. X30/11 Filter Time Constant
E-95 Pulse Out #29 Bus Control	P-06 Base Speed		AN-02 Fire Mode Live Zero Timeout Function	AN-37 Term. X30/11 Live Zero



AN-4# Analog Input X30/12	SP-# Special Functions	SP-5# Environment	O-13 Configurable Status Word STW	O-8# Drive Port Diagnostics
AN-40 Terminal X30/12 Low Voltage	SP-1# Line On/Off	SP-50 RFI Filter	O-3# Drive Port Settings	O-80 Bus Message Count
AN-41 Terminal X30/12 High Voltage	SP-10 Line failure	SP-51 DC Link Compensation	O-30 Protocol	O-81 Bus Error Count
AN-44 Term. X30/12 Low Ref./Feedb. Value	SP-11 Line Voltage at Input Fault	SP-53 Fan Monitor	O-31 Address	O-82 Slave Messages Rcvd
AN-45 Term. X30/12 High Ref./Feedb. Value	SP-12 Function at Line Imbalance	SP-55 Output Filter	O-32 Drive Port Baud Rate	O-83 Slave Error Count
AN-46 Term. X30/12 Filter Time Constant	SP-2# Reset Functions	SP-59 Actual Number of Inverter Units	O-33 Drive Port Parity	O-89 Diagnostics Count
AN-47 Term. X30/12 Live Zero	SP-23 Typecode Setting	SP-6# Automatic Derate	O-34 Estimated cycle time	O-9# Bus Jog / Feedback
AN-5# Analog Output 42	SP-25 Trip Delay at Torque Limit	SP-60 Function at Over Temperature	O-35 Minimum Response Delay	O-90 Bus Jog 1 Speed
AN-50 Terminal 42 Output	SP-26 Trip Delay at Drive Fault	SP-61 Function at Drive Overload	O-36 Maximum Response Delay	O-91 Bus Jog 2 Speed
AN-51 Terminal 42 Output Min Scale	SP-28 Production Settings	SP-62 Drive Overload Derate Current	O-37 Maximum Inter-Char Delay	O-94 Bus Feedback 1
AN-52 Terminal 42 Output Max Scale	SP-29 Service Code	O-# Options / Comms	O-4# Drive MC protocol set	O-95 Bus Feedback 2
AN-53 Terminal 42 Output Bus Control	SP-3# Current Limit Ctrl.	O-0# General Settings	O-40 Telegram Selection	O-96 Bus Feedback 3
AN-54 Terminal 42 Output Timeout Preset	SP-30 Current Lim Ctrl, Proportional Gain	O-01 Control Site	O-42 PCD write configuration	AO-# Analog I/O Option
AN-6# Analog Output X30/8	SP-31 Current Lim Ctrl, Integration Time	O-02 Control Word Source	O-43 PCD read configuration	AO-0# Analog I/O Mode
AN-60 Terminal X30/8 Output	SP-32 Current Lim Ctrl, Filter Time	O-03 Control Word Timeout Time	O-5# Digital/Bus	AO-00 Terminal X42/1 Mode
AN-61 Terminal X30/8 Min. Scale	SP-4# Energy Savings	O-04 Control Word Timeout Function	O-50 Coasting Select	AO-01 Terminal X42/3 Mode
AN-62 Terminal X30/8 Max. Scale	SP-40 VT Level	O-05 End-of-Timeout Function	O-52 DC Brake Select	AO-02 Terminal X42/5 Mode
AN-63 Terminal X30/8 Output Bus Control	SP-41 Energy Savings Min. Magnetization	O-06 Reset Control Word Timeout	O-53 Start Select	AO-1# Analog Input X42/1
AN-64 Terminal X30/8 Output Timeout Preset	SP-42 Energy Savings Min. Frequency	O-07 Diagnosis Trigger	O-54 Reversing Select	AO-10 Terminal X42/1 Low Voltage
	SP-43 Motor Cosphi	O-1# Control Settings	O-55 Set-up Select	AO-11 Terminal X42/1 High Voltage
		O-10 Control Word Profile	O-56 Preset Reference Select Value	AO-14 Term. X42/1 Low Ref./Feedb.

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AO-15 Term. X42/1 High Ref./Feedb. Value	AO-6# Analog Out X42/11	PB-94 Changed Parameters (5)	EN-33 CIP Revision	BN-73 MS/TP Max Info Frames
AO-16 Term. X42/1 Filter Time Constant	AO-60 Terminal X42/11 Output	EN-# Ethernet	EN-34 CIP Product Code	BN-74 "I-Am" Service
AO-17 Term. X42/1 Live Zero	AO-61 Terminal X42/11 Min. Scale	EN-0# IP Settings	EN-# Other Ethernet Services	BN-75 Initialization Password
AO-2# Analog Input X42/3	AO-62 Terminal X42/11 Max. Scale	EN-00 IP Address Assignment	EN-80 FTP Server	DN-# DeviceNet Fieldbus
AO-21 Terminal X42/3 High Voltage	AO-63 Terminal X42/11 Bus Control	EN-01 IP Address	EN-81 HTTP Server	DN-0# Common Settings
AO-21 Terminal X42/3 High Voltage	AO-64 Terminal X42/11 Timeout Preset	EN-02 Subnet Mask	EN-82 SMTP Service	DN-00 DeviceNet Protocol
AO-24 Term. X42/3 Low Ref./Feedb. Value	PB-# Profibus	EN-03 Default Gateway	EN-89 Transparent Socket Channel Port	DN-01 Baud Rate Select
AO-25 Term. X42/3 High Ref./Feedb. Value	PB-15 PCD Write Configuration	EN-04 DHCP Server	EN-9# Advanced Ethernet Services	DN-02 MAC ID
AO-26 Term. X42/3 Filter Time Constant	PB-16 PCD Read Configuration	EN-05 Lease Expires	EN-90 Cable Diagnostic	DN-05 Readout Transmit Error Counter
AO-27 Term. X42/3 Live Zero	PB-18 Node Address	EN-06 Name Servers	EN-91 MDI-X	DN-06 Readout Receive Error Counter
AO-3# Analog Input X42/5	PB-22 Telegram Selection	EN-07 Domain Name	EN-92 GMP Snooping	DN-07 Readout Bus Off Counter
AO-30 Terminal X42/5 Low Voltage	PB-23 Parameters for Signals	EN-08 Host Name	EN-93 Cable Error Length	DN-1# DeviceNet
AO-31 Terminal X42/5 High Voltage	PB-27 Parameter Edit	EN-09 Physical Address	EN-94 Broadcast Storm Protection	DN-10 Process Data Type Selection
AO-34 Term. X42/5 Low Ref./Feedb. Value	PB-28 Process Control	EN-1# Ethernet Link Parameters	EN-95 Broadcast Storm Filter	DN-11 Process Data Config Write
AO-35 Term. X42/5 High Ref./Feedb. Value	PB-53 Profibus Warning Word	EN-10 Link Status	EN-98 Interface Counters	DN-12 Process Data Config Read
AO-36 Term. X42/5 Filter Time Constant	PB-63 Actual Baud Rate	EN-11 Link Duration	EN-99 Media Counters	DN-13 Warning Parameter
AO-37 Term. X42/5 Live Zero	PB-70 Edit Set-up	EN-12 Auto Negotiation	LN-# LONWORKS	DN-14 Net Reference
AO-4# Analog Out X42/7	PB-71 Profibus Save Data Values	EN-13 Link Speed	LN-0# LonWorks ID	DN-15 Net Control
AO-40 Terminal X42/7 Output	PB-72 Profibus DriveReset	EN-14 Link Duplex	LN-00 Neuron ID	DN-2# COS Filters
AO-41 Terminal X42/7 Min. Scale	PB-75 DO Identification	EN-2# Process Data	LN-1# LON Functions	DN-20 COS Filter 1
AO-42 Terminal X42/7 Max. Scale	PB-80 Defined Parameters (1)	EN-20 Control Instance	LN-10 Drive Profile	DN-21 COS Filter 2
AO-43 Terminal X42/7 Bus Control	PB-81 Defined Parameters (2)	EN-21 Process Data Config Write	LN-15 LON Warning Word	DN-22 COS Filter 3
AO-44 Terminal X42/7 Timeout Preset	PB-82 Defined Parameters (3)	EN-22 Process Data Config Read	LN-17 XIF Revision	DN-23 COS Filter 4
AO-5# Analog Out X42/9	PB-83 Defined Parameters (4)	EN-28 Store Data Values	LN-18 LonWorks Revision	DN-3# Parameter Access
AO-50 Terminal X42/9 Output	PB-84 Defined Parameters (5)	EN-29 Store Always	LN-2# LON Param. Access	DN-30 Array Index
AO-51 Terminal X42/9 Min. Scale	PB-90 Changed Parameters (1)	EN-3# EtherNet/IP	LN-21 Store Data Values	DN-31 Store Data Values
AO-52 Terminal X42/9 Max. Scale	PB-91 Changed Parameters (2)	EN-30 Warning Parameter	BN-# BACnet	DN-32 DeviceNet Revision
AO-53 Terminal X42/9 Bus Control	PB-92 Changed Parameters (3)	EN-31 Net Reference	BN-70 BACnet Device Instance	DN-33 Store Always
AO-54 Terminal X42/9 Timeout Preset	PB-93 Changed Parameters (4)	EN-32 Net Control	BN-72 MS/TP Max Masters	DN-34 DeviceNet Product Code



ID-## Drive Information	ID-42 Voltage	DR-12 Motor Voltage	DR-6# Inputs & Outputs	DR-95 Ext. Status Word 2
ID-0# Operating Data	ID-43 Software Version	DR-13 Frequency	DR-60 Digital Input	DR-96 Maintenance Word
ID-00 Operating Hours	ID-44 GE Model Number	DR-14 Motor Current	DR-61 Terminal 53 Switch Setting	LG-## Logs & I/O Opt Status
ID-01 Running Hours	ID-45 Actual Typecode String	DR-15 Frequency [%]	DR-62 Analog Input 53	LG-0# Maintenance Log
ID-02 kWh Counter	ID-46 GE Product No.	DR-16 Torque [Nm]	DR-63 Terminal 54 Switch Setting	LG-00 Maintenance Log: Item
ID-03 Power Up's	ID-47 GE Power Card Model No	DR-17 Speed [RPM]	DR-64 Analog Input 54	LG-01 Maintenance Log: Action
ID-04 Over Temp's	ID-48 Keypad ID Number	DR-18 Motor Thermal	DR-65 Analog Output 42 [mA]	LG-02 Maintenance Log: Time
ID-05 Over Volt's	ID-49 SW ID Control Card	DR-22 Torque [%]	DR-66 Digital Output [bin]	LG-03 Maintenance Log: Date and Time
ID-06 Reset kWh Counter	ID-50 SW ID Power Card	DR-3# Drive Status	DR-67 Freq. Input #29 [Hz]	LG-1# Fire Mode Log
ID-07 Reset Running Hours Counter	ID-51 Drive Serial Number	DR-30 DC Link Voltage	DR-68 Freq. Input #33 [Hz]	LG-10 Fire Mode Log: Event
ID-08 Number of Starts	ID-53 Power Card Serial Number	DR-32 Brake Energy /s	DR-69 Pulse Output #27 [Hz]	LG-11 Fire Mode Log: Time
ID-1# Data Trending Settings	ID-6# Option Ident	DR-33 Brake Energy /2 min	DR-70 Pulse Output #29 [Hz]	LG-12 Fire Mode Log: Date and Time
ID-10 Trending Source	ID-60 Option Mounted	DR-34 Heatsink Temp.	DR-71 Relay Output [bin]	LG-3# I/O Option Status
ID-11 Trending Interval	ID-61 Option SW Version	DR-35 Drive Thermal	DR-72 Counter A	LG-30 Analog Input X42/1
ID-12 Trigger Event	ID-62 Option Ordering No	DR-36 Drive Nominal Current	DR-73 Counter B	LG-31 Analog Input X42/3
ID-13 Trending Mode	ID-63 Option Serial No	DR-37 Drive Max. Current	DR-75 Analog In X30/11	LG-32 Analog Input X42/5
ID-14 Samples Before Trigger	ID-9# Parameter Info	DR-38 Logic Controller State	DR-76 Analog In X30/12	LG-33 Analog Out X42/7 [V]
ID-2# Historic Log	ID-92 Defined Parameters	DR-39 Control Card Temp.	DR-77 Analog Out X30/8 [mA]	LG-34 Analog Out X42/9 [V]
ID-20 Historic Log: Event	ID-93 Modified Parameters	DR-40 Trending Buffer Full	DR-8# Fieldbus & Drive Port	LG-35 Analog Out X42/11 [V]
ID-21 Historic Log: Value	DR-## Data Readouts	DR-43 Timed Actions Status	DR-80 Fieldbus CTW 1	AP-## HVAC Appl. Param.
ID-22 Historic Log: Time	DR-0# General Status	DR-49 Current Fault Source	DR-82 Fieldbus REF 1	AP-0# Miscellaneous
ID-23 Historic Log: Date and Time	DR-00 Control Word	DR-5# Ref. & Feedb.	DR-84 Comm. Option STW	AP-00 External Interlock Delay
ID-3# Alarm Log	DR-01 Reference [Unit]	DR-50 External Reference	DR-85 Drive Port CTW 1	AP-2# No-Flow Detection
ID-30 Alarm Log: Error Code	DR-02 Reference [%]	DR-52 Feedback [Unit]	DR-86 Drive Port REF 1	AP-20 Low Power Auto Set-up
ID-31 Alarm Log: Value	DR-03 Status Word	DR-53 Digi Pot Reference	DR-9# Diagnosis Readouts	AP-21 Low Power Detection
ID-32 Alarm Log: Time	DR-05 Main Actual Value [%]	DR-54 Feedback 1 [Unit]	DR-90 Alarm Word	AP-22 Low Speed Detection
ID-33 Alarm Log: Date and Time	DR-09 Custom Readout	DR-55 Feedback 2 [Unit]	DR-91 Alarm Word 2	AP-23 No-Flow Function
ID-4# Drive Identification	DR-1# Motor Status	DR-56 Feedback 3 [Unit]	DR-92 Warning Word	AP-24 No-Flow Delay
ID-40 Drive Type	DR-10 Power [kW]	DR-58 PID Output [%]	DR-93 Warning Word 2	AP-26 Dry Pump Function
ID-41 Power Section	DR-11 Power [hp]		DR-94 Ext. Status Word	AP-27 Dry Pump Delay

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AP-3# No-Flow Power Tuning	AP-71 Compressor Start Max Speed [Hz]	FB-09 Fire Mode Alarm Handling	T-14 Maintenance Date and Time	CL-03 Feedback 2 Source
AP-30 No-Flow Power	AP-72 Compressor Start Max Time to Trip	FB-1# Drive Bypass	T-15 Reset Maintenance Word	CL-04 Feedback 2 Conversion
AP-31 Power Correction Factor	AP-73 Starting Acceleration Time	FB-10 Drive Bypass Function	T-16 Maintenance Text	CL-05 Feedback 2 Source Unit
AP-32 Low Speed [RPM]	AP-75 Short Cycle Protection	FB-11 Drive Bypass Delay Time	T-5# Energy Log	CL-06 Feedback 3 Source
AP-33 Low Speed [Hz]	AP-76 Interval between Starts	FB-20 Locked Rotor Function	T-50 Energy Log Resolution	CL-07 Feedback 3 Conversion
AP-34 Low Speed Power [kW]	AP-77 Minimum Run Time	FB-21 Locked Rotor Coefficient 1	T-51 Period Start	CL-08 Feedback 3 Source Unit
AP-35 Low Speed Power [HP]	AP-8# Flow Compensation	FB-22 Locked Rotor Coefficient 2	T-53 Energy Log	CL-12 Reference/Feedback Unit
AP-36 High Speed [RPM]	AP-80 Flow Compensation	FB-23 Locked Rotor Coefficient 3	T-54 Reset Energy Log	CL-13 Minimum Reference/Feedb.
AP-37 High Speed [Hz]	AP-81 Square-linear Curve Approximation	FB-24 Locked Rotor Coefficient 4	T-6# Trending	CL-14 Maximum Reference/Feedb.
AP-38 High Speed Power [kW]	AP-82 Work Point Calculation	FB-30 Missing Motor Function	T-60 Trend Variable	CL-20 Feedback Function
AP-39 High Speed Power [HP]	AP-83 Speed at No-Flow [RPM]	FB-31 Missing Motor Coefficient 1	T-61 Continuous Bin Data	CL-21 Setpoint 1
AP-4# Sleep Mode	AP-84 Speed at No-Flow [Hz]	FB-32 Missing Motor Coefficient 2	T-62 Timed Bin Data	CL-22 Setpoint 2
AP-40 Minimum Run Time	AP-85 Speed at Design Point [RPM]	FB-33 Missing Motor Coefficient 3	T-63 Timed Period Start	CL-23 Setpoint 3
AP-41 Minimum Sleep Time	AP-86 Speed at Design Point [Hz]	FB-34 Missing Motor Coefficient 4	T-64 Timed Period Stop	CL-3# Feedback Adv. Conv
AP-42 Wake-up Speed [RPM]	AP-87 Pressure at No-Flow Speed	T-## Timed Functions	T-65 Minimum Bin Value	CL-30 Refrigerant
AP-43 Wake-up Speed [Hz]	AP-88 Pressure at Rated Speed	T-0# Timed Actions	T-66 Reset Continuous Bin Data	CL-31 User Defined Refrigerant A1
AP-44 Wake-up Ref./FB Difference	AP-89 Flow at Design Point	T-00 ON Time	T-67 Reset Timed Bin Data	CL-32 User Defined Refrigerant A2
AP-45 Setpoint Boost	AP-90 Flow at Rated Speed	T-01 ON Action	T-8# Payback Counter	CL-33 User Defined Refrigerant A3
AP-46 Maximum Boost Time	FB-## Fire/Bypass Operation	T-02 OFF Time	T-80 Power Reference Factor	CL-34 Duct 1 Area [m2]
AP-5# End of Curve	FB-0# Fire Mode	T-03 OFF Action	T-81 Energy Cost	CL-35 Duct 1 Area [in2]
AP-50 End of Curve Function	FB-00 Fire Mode Function	T-04 Occurrence	T-82 Investment	CL-36 Duct 2 Area [m2]
AP-51 End of Curve Delay	FB-01 Fire Mode Configuration	T-08 Timed Actions Mode	T-83 Energy Savings	CL-37 Duct 2 Area [in2]
AP-6# Broken Belt Detection	FB-02 Fire Mode Unit	T-09 Timed Actions Reactivation	T-84 Cost Savings	CL-38 Air Density Factor [%]
AP-60 Broken Belt Function	FB-03 Fire Mode Min Reference	T-1# Maintenance	CL-## PID Closed Loop	CL-7# PID Autotuning
AP-61 Broken Belt Torque	FB-04 Fire Mode Max Reference	T-10 Maintenance Item	CL-0# Feedback	CL-70 Closed Loop Type
AP-62 Broken Belt Delay	FB-05 Fire Mode Preset Reference	T-11 Maintenance Action	CL-00 Feedback 1 Source	CL-71 PID Performance
AP-7# Compressor	FB-06 Fire Mode Reference Source	T-12 Maintenance Time Base	CL-01 Feedback 1 Conversion	CL-72 PID Output Change
AP-70 Compressor Start Max Speed [RPM]	FB-07 Fire Mode Feedback Source	T-13 Maintenance Time Interval	CL-02 Feedback 1 Source Unit	CL-73 Minimum Feedback Level



CL-74 Maximum Feedback Level	XC-22 Ext. 1 Integral Time	XC-64 Ext. 3 Dif. Gain Limit	PC-52 Alternation Time Interval	LC-43 Logic Rule Operator 2
CL-79 PID Autotuning	XC-23 Ext. 1 Differentiation Time	PC-## Pump Controller	PC-53 Alternation Timer Value	LC-44 Logic Rule Boolean 3
CL-8# PID Basic Settings	XC-24 Ext. 1 Dif. Gain Limit	PC-0# System Settings	PC-54 Alternation Predefined Time	LC-5# States
CL-81 PID Normal/ Inverse Control	XC-3# Ext. CL 2 Ref/Fb.	PC-00 Pump Controller	PC-55 Alternate if Load < 50%	LC-51 Logic Controller Event
CL-82 PID Start Speed [RPM]	XC-30 Ext. 2 Ref./Feedback Unit	PC-02 Motor Start	PC-56 Staging Mode at Alternation	LC-52 Logic Controller Action
CL-83 PID Start Speed [Hz]	XC-31 Ext. 2 Minimum Reference	PC-04 Pump Cycling	PC-58 Run Next Pump Delay	B-## Braking Functions
CL-84 On Reference Bandwidth	XC-32 Ext. 2 Maximum Reference	PC-05 Fixed Lead Pump	PC-59 Run on Line Delay	B-0# DC-Brake
CL-9# PID Controller	XC-33 Ext. 2 Reference Source	PC-06 Number of Pumps	PC-8# Status	B-00 DC Hold Current
		PC-10 Minimum Run Time		
CL-91 PID Anti Windup	XC-34 Ext. 2 Feedback Source	Override	PC-80 Pump Status	B-01 DC Brake Current
CL-93 PID Proportional Gain	XC-35 Ext. 2 Setpoint	PC-11 Minimum Run Time	PC-81 Pump Status	B-02 DC Braking Time
CL-94 PID Integral Time	XC-37 Ext. 2 Reference [Unit]	Override Value	PC-82 Lead Pump	B-03 DC Brake Cut In Speed [RPM]
CL-95 PID Differentiation Time	XC-38 Ext. 2 Feedback [Unit]	PC-2# Bandwidth Settings	PC-83 Relay Status	B-04 DC Brake Cut In Speed [Hz]
CL-96 PID Diff. Gain Limit	XC-39 Ext. 2 Output [%]	PC-20 Staging Bandwidth	PC-84 Pump ON Time	B-1# Brake Energy Funct.
XC-## Ext. PID Closed Loop	XC-4# Ext. CL 2 PID	PC-21 Override Bandwidth	PC-85 Relay ON Time	B-10 Brake Function
XC-0# Ext. CL Autotuning	XC-40 Ext. 2 Normal/Inverse Control	PC-22 Fixed Speed Bandwidth	PC-86 Reset Relay Counters	B-16 AC brake Max. Current
XC-00 Closed Loop Type	XC-41 Ext. 2 Proportional Gain	PC-23 SBW Staging Delay	PC-9# Service	B-17 Over-voltage Control
XC-01 PID Performance	XC-42 Ext. 2 Integral Time	PC-24 SBW Destaging Delay	PC-90 Pump Interlock	
XC-02 PID Output Change	XC-43 Ext. 2 Differentiation Time	PC-25 OBW Time	PC-91 Manual Alternation	
XC-03 Minimum Feedback Level	XC-44 Ext. 2 Dif. Gain Limit	PC-26 Destage At No-Flow	LC-## Logic Controller	
XC-04 Maximum Feedback Level	XC-5# Ext. CL 3 Ref/Fb.	PC-27 Stage Function	LC-0# LC Settings	
XC-09 PID Autotuning	XC-50 Ext. 3 Ref./Feedback Unit	PC-28 Stage Function Time	LC-00 Logic Controller Mode	
XC-1# Ext. CL 1 Ref/Fb.	XC-51 Ext. 3 Minimum Reference	PC-29 Destage Function	LC-01 Start Event	
XC-10 Ext. 1 Ref./Feedback Unit	XC-52 Ext. 3 Maximum Reference	PC-30 Destage Function Time	LC-02 Stop Event	
XC-11 Ext. 1 Minimum Reference	XC-53 Ext. 3 Reference Source	PC-4# Staging Settings	LC-03 Reset Logic Controller	
XC-12 Ext. 1 Maximum Reference	XC-54 Ext. 3 Feedback Source	PC-40 Decel Ramp Delay	LC-1# Comparators	
XC-13 Ext. 1 Reference Source	XC-55 Ext. 3 Setpoint	PC-41 Accel Ramp Delay	LC-10 Comparator Operand	
XC-14 Ext. 1 Feedback Source	XC-57 Ext. 3 Reference [Unit]	PC-42 Staging Threshold	LC-11 Comparator Operator	
XC-15 Ext. 1 Setpoint	XC-58 Ext. 3 Feedback [Unit]	PC-43 Destaging Threshold	LC-12 Comparator Value	
XC-17 Ext. 1 Reference [Unit]	XC-59 Ext. 3 Output [%]	PC-44 Staging Speed [RPM]	LC-2# Timers	
XC-18 Ext. 1 Feedback [Unit]	XC-6# Ext. CL 3 PID	PC-45 Staging Speed [Hz]	LC-20 Logic Controller Timer	
XC-19 Ext. 1 Output [%]	XC-60 Ext. 3 Normal/Inverse Control	PC-46 Destaging Speed [RPM]	LC-4# Logic Rules	
XC-2# Ext. CL 1 PID	XC-61 Ext. 3 Proportional Gain	PC-47 Destaging Speed [Hz]	LC-40 Logic Rule Boolean 1	
XC-20 Ext. 1 Normal/Inverse Control		PC-5# Alternation Settings		
	XC-62 Ext. 3 Integral Time	PC-50 Lead Pump Alternation	LC-41 Logic Rule Operator 1	
XC-21 Ext. 1 Proportional Gain	XC-63 Ext. 3 Differentiation Time	PC-51 Alternation Event	LC-42 Logic Rule Boolean 2	

5.6 Remote Programming with DCT-10

GE has a software program available for developing, storing, and transferring drive programming. The DCT-10 allows the user to connect a PC to the drive and perform live programming rather than using the keypad. Also, all drive programming can be done off-line and simply downloaded into drive. Or the entire drive profile can be loaded onto the PC for back up storage or analysis.

The USB connector or RS-485 terminal are available for connecting to the drive.



6 Application Set-Up Examples

6.1 Introduction

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 *K-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

6.2 Application Examples

Parameters	
Function	Setting
AN-22 Terminal 54 Low Current	4mA*
AN-23 Terminal 54 High Current	20mA*
AN-24 Terminal 54 Low Ref./Feedb. Value	0*
AN-25 Terminal 54 High Ref./Feedb. Value	50*
* = Default Value	
Notes/comments:	

Table 6.1 Analog Current Feedback Transducer

Parameters	
Function	Setting
AN-20 Terminal 54 Low Voltage	0.07V*
AN-21 Terminal 54 High Voltage	10V*
AN-24 Terminal 54 Low Ref./ Feedb. Value	0*
AN-25 Terminal 54 High Ref./ Feedb. Value	50*
* = Default Value	
Notes/comments:	

Table 6.2 Analog Voltage Feedback Transducer (3-wire)

Parameters	
Function	Setting
AN-20 Terminal 54 Low Voltage	0.07V*
AN-21 Terminal 54 High Voltage	10V*
AN-24 Terminal 54 Low Ref./ Feedb. Value	0*
AN-25 Terminal 54 High Ref./ Feedb. Value	50*
* = Default Value	
Notes/comments:	

Table 6.3 Analog Voltage Feedback Transducer (4-wire)

Application Set-Up Examples

AF-600 FP Operating Instructions

Parameters	
Function	Setting
AN-10 Terminal 53 Low Voltage	0.07V*
AN-11 Terminal 53 High Voltage	10V*
AN-14 Terminal 53 Low Ref./ Feedb. Value	0*
AN-15 Terminal 53 High Ref./ Feedb. Value	50*
* = Default Value	
Notes/comments:	

FC

+24 V 12○

+24 V 13○

D IN 18○

D IN 19○

COM 20○

D IN 27○

D IN 29○

D IN 32○

D IN 33○

D IN 37○

+10 V 50○

A IN 53○

A IN 54○

COM 55○

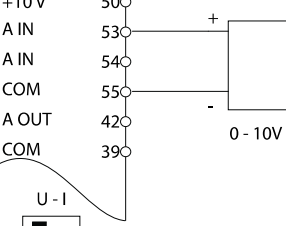
A OUT 42○

COM 39○

U - I

A53

130BB678.10



0 - 10V

Table 6.4 Analog Speed Reference (Voltage)

Parameters	
Function	Setting
AN-12 Terminal 53 Low Current	4mA*
AN-13 Terminal 53 High Current	20mA*
AN-14 Terminal 53 Low Ref./ Feedb. Value	0*
AN-15 Terminal 53 High Ref./ Feedb. Value	50*
* = Default Value	
Notes/comments:	

FC

+24 V 12○

+24 V 13○

D IN 18○

D IN 19○

COM 20○

D IN 27○

D IN 29○

D IN 32○

D IN 33○

D IN 37○

+10 V 50○

A IN 53○

A IN 54○

COM 55○

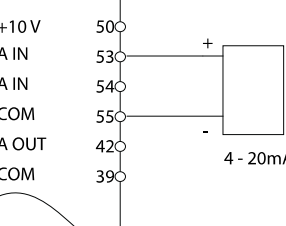
A OUT 42○

COM 39○

U - I

A53

130BB679.10



4 - 20mA

Table 6.5 Analog Speed Reference (Current)

Parameters	
Function	Setting
E-01 Terminal 18 Digital Input	[8] Start*
E-03 Terminal 27 Digital Input	[7] External Interlock
* = Default Value	
Notes/comments:	

FC

+24 V 12○

+24 V 13○

D IN 18○

D IN 19○

COM 20○

D IN 27○

D IN 29○

D IN 32○

D IN 33○

D IN 37○

+10 V 50○

A IN 53○

A IN 54○

COM 55○

A OUT 42○

COM 39○

130BB680.10

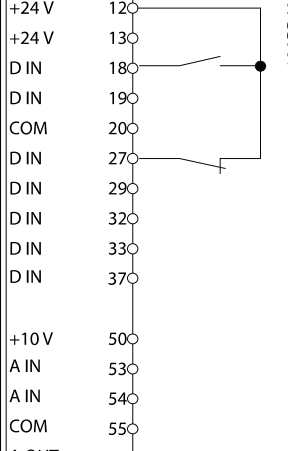


Table 6.6 Run/Stop Command with External Interlock

Parameters	
Function	Setting
E-01 Terminal 18 Digital Input	[8] Start*
E-03 Terminal 27 Digital Input	[0] No operation*
* = Default Value	
Notes/comments:	

FC

+24 V 12○

+24 V 13○

D IN 18○

D IN 19○

COM 20○

D IN 27○

D IN 29○

D IN 32○

D IN 33○

D IN 37○

+10 V 50○

A IN 53○

A IN 54○

COM 55○

A OUT 42○

COM 39○

R1

R2

130BB681.10

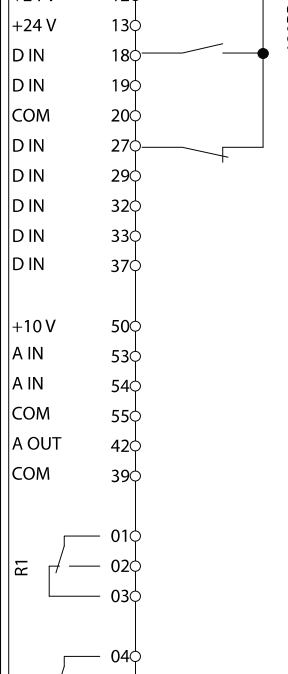


Table 6.7 Run/Stop Command without External Interlock



Parameters	
Function	Setting
E-02 Terminal 19 Digital Input	[1] Reset
* = Default Value	
Notes/comments:	

Table 6.8 External Alarm Reset

Parameters	
Function	Setting
AN-10 Terminal 53 Low Voltage	0.07V*
AN-11 Terminal 53 High Voltage	10V*
AN-14 Terminal 53 Low Ref./ Feedb. Value	0*
AN-15 Terminal 53 High Ref./ Feedb. Value	50*.
* = Default Value	
Notes/comments:	

Table 6.9 Speed Reference (using a manual potentiometer)

Parameters	
Function	Setting
E-01 Terminal 18 Digital Input	[8] Start*
E-02 Terminal 19 Digital Input	[52] Run Permissive
E-03 Terminal 27 Digital Input	[7] External Interlock
E-24 Function Relay	[167] Start command act.
* = Default Value	
Notes/comments:	

Table 6.10 Run Permissive

Hand Off Auto (HOA), without the use of the Drive keypad

To have a HOA system with an external 0-10V potentiometer for the hand reference and a 4-20mA signal for the auto reference, 2 set-ups should be used. In this example set-up 1 is used for the hand mode and set-up 2 for the auto mode. Analog input 53 is used for the hand reference (0-10V potentiometer) and analog input 54 for the auto reference (4-20mA) and digital input 27 for the set-up selector. Please ensure that the analog inputs have the correct dip settings (A-53 [U] and A-54 [I]).

In the upper right corner of the keypad 2 numbers are shown – like 1(1). The number outside the parenthesis is the active set-up and the number inside the parenthesis is the set-up which will be edited. Default will always be 1(1). Make sure you edit set-up 1.

1. Make all the parameter changes you need, that will be common for auto and hand mode, like motor parameters etc.
2. Set par. K-10 Active set-up to [9] Multi Set-up. This parameter change is needed to be able to change set-up from an external source, like a digital input.
3. Set par. K-11 Edit Set-up to [9] Active Set-up. This is recommended because then the active setup

Application Set-Up Examples

AF-600 FP Operating Instructions

will always be the set-up that is edited. If you prefer you can also ignore this and manually control what set-up you want to edit through par. K-11.

4. Set par. E-03 Terminal 27 Digital Input to [23] Set-up select bit 0. When terminal 27 is OFF, set-up 1 (hand) is active, when it is ON, set-up 2 (auto) is active.
5. Set par. F-01 Frequency Setting 1 to Analog input 53 (hand mode).
6. Copy set-up 1 to set-up 2. Set par. K-51 Set up Copy to [2] Copy to set-up 2. Now setup 1 and 2 are identical.
7. If you need to be able to change between hand and auto mode while the motor is running you will have to link the 2 set-ups together. Set par. K-12 This Set-up Linked to to [2] set-up 2.
8. Change to set-up 2 by setting input 27 ON (if par. K-11 is [9]) or by setting par. K-11 Edit Set-up to set-up 2.
9. Set par. F-01 Frequency Setting 1 to Analog input 54 (auto mode). If you want different settings in hand and auto mode, like different accel/decel ramps, speed limits etc. you can now programme them. You just have to make sure you edit the correct set-up. Set-up 1 is Hand mode and set-up 2 is Auto mode.

Parameters	
Function	Setting
O-30 Protocol	Drive*
O-31 Address	1*
O-32 Drive Port Baud Rate	9600*
* = Default Value	
Notes/comments: Select protocol, address and baud rate in the above mentioned parameters.	

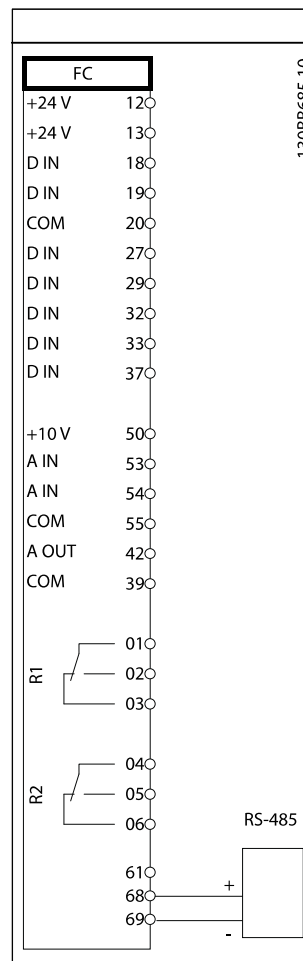


Table 6.12 RS-485 Network Connection (N2, FLN, Modbus RTU, Drive)

CAUTION

Thermistors must use reinforced or double insulation to meet PELV insulation requirements.

Parameters	
Function	Setting
E-01 Terminal 18 Digital Input	[8] Start*
E-03 Terminal 27 Digital Input	[23] Set-up select bit 0
* = Default Value	
Notes/comments: GE 30mm HOA Cat# (1) 104PSG34B & (3) CR104PXC1	

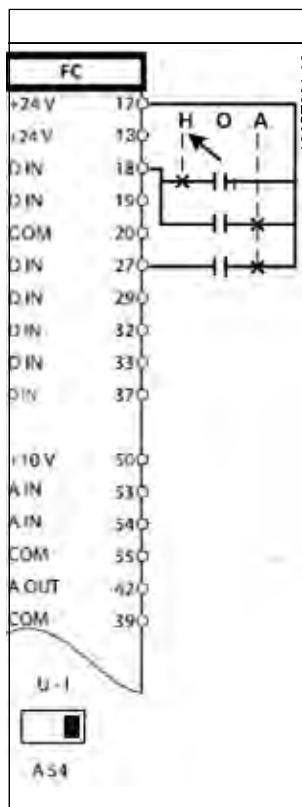


Table 6.11 HOA



Parameters	
Function	Setting
F-10 Electronic Overload	[2] Thermistor trip
F-12 Motor Thermistor Input	[1] Analog input 53
* = Default Value	
Notes/comments: If only a warning is desired, F-10 Electronic Overload should be set to [1] Thermistor warning.	

FC

130BB686.11

+24 V 12

+24 V 13

D IN 18

D IN 19

COM 20

D IN 27

D IN 29

D IN 32

D IN 33

D IN 37

+10 V 50

A IN 53

A IN 54

COM 55

A OUT 42

COM 39

U - I

A53

Table 6.13 Motor Thermistor

Parameters	
Function	Setting
E-02 Terminal 19 Digital Input	[37] Fire mode
FB-00 Fire Mode Function	[0] Disabled*
FB-01 Fire Mode Configuration	[0] Open Loop*
FB-02 Fire Mode Unit	[3] Hz*
FB-03 Fire Mode Min Reference	0Hz*
FB-04 Fire Mode Max Reference	50Hz*
FB-05 Fire Mode Preset Reference	0%*
FB-06 Fire Mode Reference Source	[0] No function*
FB-07 Fire Mode Feedback Source	[0] No function*
FB-09 Fire Mode Alarm Handling	[1] Trip, Critical Alarms*
* = Default Value	
Notes/comments: Parameters to setup Fire Mode are all in the FB-## group.	

FC

130BB687.10

+24 V 12

+24 V 13

D IN 18

D IN 19

COM 20

D IN 27

D IN 29

D IN 32

D IN 33

D IN 37

+10 V 50

A IN 53

A IN 54

COM 55

A OUT 42

COM 39

Table 6.14 Fire Mode

7 Status Messages

7.1 Status Display

When the drive is in status mode, status messages are generated automatically from within the drive and appear in the bottom line of the display (see *Illustration 7.1*.)

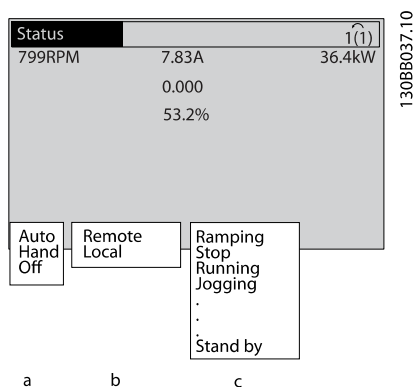


Illustration 7.1 Status Display

- The first word on the status line indicates where the stop/start command originates.
- The second word on the status line indicates where the speed control originates.
- The last part of the status line gives the present drive status. These show the operational mode the drive is in.

NOTE

In auto/remote mode, the drive requires external commands to execute functions.

7.2 Status Message Definitions Table

The next three tables define the meaning of the status message display words.

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

	Reference Site
Remote	The speed reference is given from external signals, serial communication, or internal preset references.
Local	The drive uses [Hand] control or reference values from the keypad.

	Operation Status
AC Brake	AC Brake was selected in <i>B-10 Brake Function</i> . The AC brake over-magnetizes the motor to achieve a controlled slow down.
Auto Tune finish OK	Auto Tune was carried out successfully.
Auto Tune ready	Auto Tune is ready to start. Press [Hand] to start.
Auto Tune running	Auto Tune process is in progress.
Coast	- Coast inverse was selected as a function for a digital input. The corresponding terminal is not connected. - Coast activated by serial communication
Ctrl. Ramp-down	Control Ramp-down was selected in <i>SP-10 Line failure</i> . - The mains voltage is below the value set in <i>SP-11 Line Voltage at Input Fault</i> at mains fault - The drive ramps down the motor using a controlled ramp down
Current High	The drive output current is above the limit set in <i>H-71 Warning Current High</i> .
Current Low	The drive output current is below the limit set in <i>H-70 Warning Current Low</i>



Status Messages

AF-600 FP Operating Instructions

	Operation Status
DC Hold	DC hold is selected in <i>H-80 Function at Stop</i> and a stop command is active. The motor is held by a DC current set in <i>B-00 DC Hold Current</i> .
DC Stop	The motor is held with a DC current (<i>B-01 DC Brake Current</i>) for a specified time (<i>B-02 DC Braking Time</i>). - DC Brake is activated in <i>B-03 DC Brake Cut In Speed [RPM]</i> and a Stop command is active. - DC Brake (inverse) is selected as a function for a digital input. 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 <i>H-77 Warning Feedback High</i> .
Feedback low	The sum of all active feedbacks is below the feedback limit set in <i>H-76 Warning Feedback Low</i> .
Freeze output	The remote reference is active which holds the present speed. - Freeze output was selected as a function for a digital input. The corresponding terminal is active. Speed control is only possible via the terminal functions speed up and speed down. - Hold ramp is activated via serial communication.
Freeze output request	A freeze output command has been given, but the motor will remain stopped until a run permissive signal is received.
Freeze ref.	<i>Freeze Reference</i> was chosen as a function for a digital input. The corresponding terminal is active. The drive saves the actual reference. Changing the reference is now only possible via terminal functions speed up and speed down.
Jog request	A jog command has been given, but the motor will be stopped until a run permissive signal is received via a digital input.
Jogging	The motor is running as programmed in <i>C-21 Jog Speed [RPM]</i>. <i>Jog</i> was selected as function for a digital input. 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.

	Operation Status
OVC control	<i>Overvoltage</i> control was activated in <i>B-17 Overvoltage Control</i> . The connected motor is supplying the drive with generative energy. The overvoltage control adjusts the V/Hz ratio to run the motor in controlled mode and to prevent the drive from tripping.
PowerUnit Off	(For frequency converters with an external 24V power supply installed only.) Mains supply to the drive is removed, but the control card is supplied by the external 24V.
Protection md	Protection mode is active. The unit has detected a critical status (an overcurrent or overvoltage). - To avoid tripping, switching frequency is reduced to 4kHz. - If possible, protection mode ends after approximately 10sec. - Protection mode can be restricted in <i>SP-26 Trip Delay at Drive Fault</i>
QStop	The motor is decelerating using <i>C-23 Quick Stop Decel Time</i>. <i>Quick stop inverse</i> was chosen as a function for a digital input. 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 <i>H-75 Warning Reference High</i> .
Ref. low	The sum of all active references is below the reference limit set in <i>H-74 Warning Reference Low</i> .
Run on ref.	The drive is running in the reference range. The feedback value matches the setpoint value.
Run request	A start command has been given, but the motor is stopped until a run permissive signal is received via digital input.
Running	The motor is driven by the drive.
Sleep Mode	The energy saving function is enabled. This means that at present the motor has stopped, but that it will restart automatically when required.
Speed high	Motor speed is above the value set in <i>H-73 Warning Speed High</i> .
Speed low	Motor speed is below the value set in <i>H-72 Warning Speed Low</i> .
Standby	In Auto mode, the drive will start the motor with a start signal from a digital input or serial communication.

Status Messages

AF-600 FP Operating Instructions

	Operation Status
Start delay	In <i>F-24 Holding Time</i> , a delay starting time was set. A start command is activated and the motor will start after the start delay time expires.
Start fwd/rev	Start forward and start reverse were selected as functions for two different digital inputs. The motor will start in forward or reverse depending on which corresponding terminal is activated.
Stop	The drive has received a stop command from the keypad, digital input or serial communication.
Trip	An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, the 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 drive. The drive can then be reset manually by pressing [Reset] or remotely by control terminals or serial communication.



8 Warnings and Alarms

8.1 System Monitoring

The drive monitors the condition of its input power, output, and motor factors as well as other system performance indicators. A warning or alarm may not necessarily indicate a problem internal to the drive itself. In many cases it indicates failure conditions from input voltage, motor load or temperature, external signals, or other areas monitored by the frequency converter's internal logic. Be sure to investigate those areas exterior to the drive as indicated in the alarm or warning.

8.2 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 drive issuing an alarm. A warning clears by itself when the abnormal condition is removed.

Alarms

Trip

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

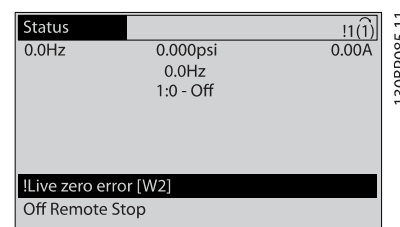
A trip can be reset in any of 4 ways:

- Press [RESET] on the keypad
- Digital reset input command
- Serial communication reset input command
- Auto reset

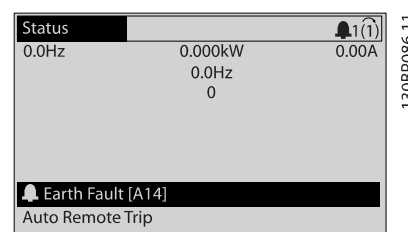
Trip-lock

An alarm that causes the drive to trip-lock requires that input power be cycled. The motor will coast to a stop. The drive logic will continue to operate and monitor the drive status. Remove input power to the drive and correct the cause of the fault, then restore power. This action puts the drive into a trip condition as described above and may be reset in any of those 4 ways.

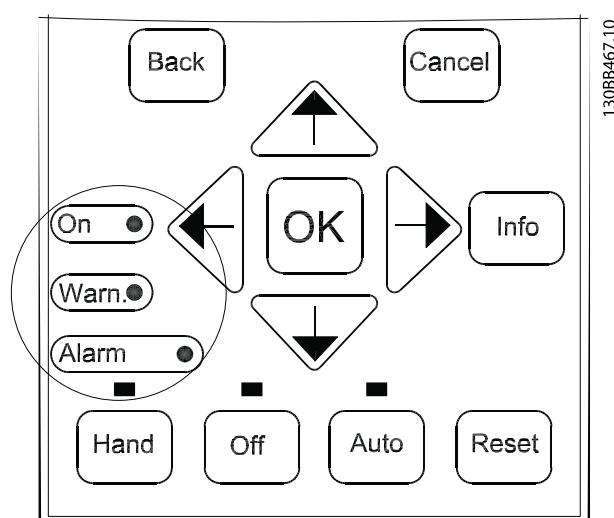
8.3 Warning and Alarm Displays



An alarm or trip-lock alarm will flash on display along with the alarm number.



In addition to the text and alarm code on the drive display, the status indicator lights operate.



	Warn. LED	Alarm LED
Warning	ON	OFF
Alarm	OFF	ON (Flashing)
Trip-Lock	ON	ON (Flashing)



Warnings and Alarms

AF-600 FP Operating Instructions

8.4 Warning and Alarm Definitions

Table 8.1 defines whether a warning is issued prior to an alarm, and whether the alarm trips the unit or trip locks the unit.

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
1	10 Volts low	X			
2	Live zero error	(X)	(X)		AN-01 Live Zero Timeout Function
4	Mains phase loss	(X)	(X)	(X)	SP-12 Function at Line Imbalance
5	DC link voltage high	X			
6	DC link voltage low	X			
7	DC over voltage	X	X		
8	DC under voltage	X	X		
9	Inverter overloaded	X	X		
10	Motor Electronic Thermal Overload over temperature	(X)	(X)		F-10 Electronic Overload
11	Motor thermistor over temperature	(X)	(X)		F-10 Electronic Overload
12	Torque limit	X	X		
13	Over Current	X	X	X	
14	Earth fault	X	X	X	
15	Hardware mismatch		X	X	
16	Short Circuit		X	X	
17	Control word timeout	(X)	(X)		O-04 Control Word Timeout Function
18	Start Failed				
23	Internal Fan Fault	X			
24	External Fan Fault	X			SP-53 Fan Monitor
29	Drive over temperature	X	X	X	
30	Motor phase U missing	(X)	(X)	(X)	H-78 Missing Motor Phase Function
31	Motor phase V missing	(X)	(X)	(X)	H-78 Missing Motor Phase Function
32	Motor phase W missing	(X)	(X)	(X)	H-78 Missing Motor Phase Function
33	Inrush fault		X	X	
34	Fieldbus communication fault	X	X		
35	Option Fault	X	X		
36	Mains failure	X	X		
38	Internal fault		X	X	
39	Heatsink sensor		X	X	
40	Overload of Digital Output Terminal 27	(X)			E-00 Digital I/O Mode, E-51 Terminal 27 Mode
41	Overload of Digital Output Terminal 29	(X)			E-00 Digital I/O Mode, E-52 Terminal 29 Mode
42	Overload of Digital Output On X30/6	(X)			E-56 Term X30/6 Digi Out (OPCGPIO)
42	Overload of Digital Output On X30/7	(X)			E-57 Term X30/7 Digi Out (OPCGPIO)
45	45 Earth Fault 2				
46	Pwr. card supply		X	X	
47	24V supply low	X	X	X	
48	1.8V supply low		X	X	
49	Speed limit	X	(X)		H-36 Trip Speed Low [RPM]



Warnings and Alarms

AF-600 FP Operating Instructions

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
50	Auto Tune calibration failed		X		
51	Auto Tune check U_{nom} and I_{nom}		X		
52	Auto Tune low I_{nom}		X		
53	Auto Tune motor too big		X		
54	Auto Tune motor too small		X		
55	Auto Tune Parameter out of range		X		
56	Auto Tune interrupted by user		X		
57	Auto Tune timeout		X		
58	Auto Tune internal fault	X	X		
59	Current limit	X			
60	External Interlock	X			
62	Output Frequency at Maximum Limit	X			
64	Voltage Limit	X			
65	Control Board Over-temperature	X	X	X	
66	Heat sink Temperature Low	X			
67	Option Configuration has Changed		X		
69	Pwr. Card Temp		X	X	
70	Illegal Drive configuration			X	
76	Power Unit Setup	X			
79	Illegal PS config		X	X	
80	Drive Initialized to Default Value		X		
91	Analog input 54 wrong settings			X	
92	NoFlow	X	X		AP-2#
93	Dry Pump	X	X		AP-2#
94	End of Curve	X	X		AP-5#
95	Broken Belt	X	X		AP-6#
96	Start Delayed	X			AP-7#
97	Stop Delayed	X			AP-7#
98	Clock Fault	X			K-7#
201	Fire M was Active				
202	Fire M Limits Exceeded				
203	Missing Motor				
204	Locked Rotor				
243	Brake IGBT	X	X		
244	Heatsink temp	X	X	X	
245	Heatsink sensor		X	X	
246	Pwr.card supply		X	X	
247	Pwr.card temp		X	X	
248	Illegal PS config		X	X	
250	New spare parts			X	
251	New Type Code		X	X	

Table 8.1 Alarm/Warning code list

(X) Dependent on parameter

¹⁾ Cannot be Auto reset via *H-04 Auto-Reset (Times)*

8.4.1 Fault Messages

The warning/alarm information below defines the 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 .

This condition can be caused by a short in a connected potentiometer or improper wiring of the potentiometer.

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

WARNING/ALARM 2, Live zero error

This warning or alarm will only appear if programmed by the user in *AN-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. This condition can be caused by broken wiring or faulty device sending the signal.

Troubleshooting

Check connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common. OPCGPIO terminals 11 and 12 for signals, terminal 10 common. OPCAIO terminals 1, 3, 5 for signals, terminals 2, 4, 6 common).

Check that the 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 mains voltage imbalance is too high. This message also appears for a fault in the input rectifier on the drive. Options are programmed at *SP-12 Function at Line Imbalance*.

Troubleshooting: Check the supply voltage and supply currents to the 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 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 drive voltage rating. The unit is still active.

WARNING/ALARM 7, DC overvoltage

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

Troubleshooting

Connect a brake resistor

Extend the ramp time

Change the ramp type

Activate the functions in *B-10 Brake Function*

Increase *SP-26 Trip Delay at Drive Fault*

WARNING/ALARM 8, DC under voltage

If the intermediate circuit voltage (DC link) drops below the under voltage limit, the drive checks if a 24V DC backup supply is connected. If no 24V DC backup supply is connected, the drive trips after a fixed time delay. The time delay varies with unit size.

Troubleshooting:

Check that the supply voltage matches the drive voltage.

Perform input voltage test

Perform soft charge circuit test

WARNING/ALARM 9, Inverter overload

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

The fault is that the drive is overloaded by more than 100% for too long.

Troubleshooting

Compare the output current shown on the keypad with the drive rated current.

Compare the output current shown on the keypad with measured motor current.

Display the Thermal Drive Load on the keypad and monitor the value. When running above the drive continuous current rating, the counter should increase. When running below the drive continuous current rating, the counter should decrease.

See the derating section in the *Design Guide* for more details if a high switching frequency is required.

WARNING/ALARM 10, Motor overload temperature

According to the electronic thermal protection, the motor is too hot. Select whether the drive gives a warning or an alarm when the counter reaches 100% in *F-10 Electronic Overload*. The fault occurs when the motor is overloaded by more than 100% for too long.

Troubleshooting

Check for motor overheating.

Check if the motor is mechanically overloaded

Check that the motor current set in *P-03 Motor Current* is correct.

Ensure that Motor data in parameters P-02, P-03, P-06, P-07, F-04 and F-05 are set correctly.

If an external fan is in use, check in *F-11 Motor External Fan* that it is selected.

Running Auto tune in *P-04 Auto Tune* may tune the drive to the motor more accurately and reduce thermal loading.

WARNING/ALARM 11, Motor thermistor over temp

The thermistor might be disconnected. Select whether the drive gives a warning or an alarm in *F-10 Electronic Overload*.

**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 (+10V supply) and that the terminal switch for 53 or 54 is set for voltage. Check *F-12 Motor Thermistor Input* 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 *F-12 Motor Thermistor Input* selects terminal 18 or 19.

WARNING/ALARM 12, Torque limit

The torque has exceeded the value in *F-40 Torque Limiter (Driving)* or the value in *F-41 Torque Limiter (Braking)*. *SP-25 Trip Delay at Torque Limit* can change this 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. Be sure the system can operate safely at a higher torque.

Check the application for excessive current draw on the motor.

WARNING/ALARM 13, Over current

The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts about 1.5 secs., then the drive trips and issues an alarm. This fault may be caused by shock loading or fast acceleration with high inertia loads. If extended mechanical brake control is selected, trip can be reset externally.

Troubleshooting:

Remove power and check if the motor shaft can be turned.

Check that the motor size matches the drive.

Check parameters P-02, P-03, P-06, P-07, F-04 and F-05. for correct motor data.

ALARM 14, Earth (ground) fault

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

Troubleshooting:

Remove power to the drive and repair the earth fault.

Check for earth 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 your GE supplier:

ID-40 Drive Type

ID-41 Power Section

ID-42 Voltage

ID-43 Software Version

ID-45 Actual Typecode String

ID-49 SW ID Control Card

ID-50 SW ID Power Card

ID-60 Option Mounted

ID-61 Option SW Version (for each option slot)

ALARM 16, Short circuit

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

Remove power to the drive and repair the short circuit.

WARNING/ALARM 17, Control word timeout

There is no communication to the drive.

The warning will only be active when *O-04 Control Word Timeout Function* is NOT set to OFF.

If *O-04 Control Word Timeout Function* is set to *Stop* and *Trip*, a warning appears and the drive ramps down until it stops then displays an alarm.

Troubleshooting:

Check connections on the serial communication cable.

Increase *O-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 *AP-70 Compressor Start Max Speed [RPM]* during start within the allowed time. (set in *AP-72 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 *SP-53 Fan Monitor* ([0] Disabled).

For the 4x, 5x and 6x Frame filters, the regulated voltage to the fans is monitored.



Warnings and Alarms

AF-600 FP Operating Instructions

Troubleshooting:

- Check for proper fan operation.
- Cycle power to the drive and check that the fan operates briefly at start up.
- 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 *SP-53 Fan Monitor* ([0] Disabled).

Troubleshooting:

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

ALARM 29, Heatsink temp

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

Troubleshooting:

Check for the following conditions.

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

ALARM 30, Motor phase U missing

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

Remove power from the drive and check motor phase U.

ALARM 31, Motor phase V missing

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

Remove power from the drive and check motor phase V.

ALARM 32, Motor phase W missing

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

Remove power from the 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, communication fault

The network 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 drive is lost and *SP-10 Line failure* is NOT set to [0] *No Function*. Check the fuses to the drive and mains power supply to the unit.

ALARM 38, Internal fault

When an internal fault occurs, a code number defined in the table below 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 GE supplier or service department. Note the code number for further troubleshooting directions.

No.	Text
0	Serial port cannot be initialised. Contact yourGE supplier or GEService Department.
256-258	Power EEPROM data is defect or too old
512-519	Internal fault. Contact yourGE supplier or GE Service Department.
783	Parameter value outside of min/max limits
1024-1284	Internal fault. Contact your GE supplier or the GE Service Department.
1299	Option SW in slot A is too old
1300	Option SW in slot B is too old
1302	Option SW in slot C1 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)
1318	Option SW in slot C1 is not supported (not allowed)
1379-2819	Internal fault. Contact yourGE supplier or GEService Department.
2820	keypad 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
5125	Option in slot C0: Hardware incompatible with control board hardware
5126	Option in slot C1: Hardware incompatible with control board hardware
5376-6231	Internal fault. Contact yourGE supplier or GEService 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 *E-00 Digital I/O Mode* and *E-51 Terminal 27 Mode*.

WARNING 41, Overload of digital output terminal 29

Check the load connected to terminal 29 or remove short-circuit connection. Check *E-00 Digital I/O Mode* and *E-52 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 short-circuit connection. Check *E-56 Term X30/6 Digi Out (OPCGPIO)*.

For X30/7, check the load connected to X30/7 or remove short-circuit connection. Check *E-57 Term X30/7 Digi Out (OPCGPIO)*.

ALARM 45, Earth fault 2

Earth (ground) fault on start up.

Troubleshooting

Check for proper earthing (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: 24V, 5V, +/- 18V. When powered with three phase mains voltage, all three supplied are monitored.

Troubleshooting

Check for a defective power card.

Check for a defective control card.

Check for a defective option card.

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

WARNING 47, 24V supply low

The 24 V DC is measured on the control card. The external 24V DC backup power supply may be overloaded, otherwise contact your GE supplier.

WARNING 48, 1.8V supply low

The 1.8V 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 F-18 and F-17, the drive will show a warning. When the speed is below the specified limit in *H-36 Trip Speed Low [RPM]* (except when starting or stopping) the drive will trip.

ALARM 50, Auto tune calibration failed

Contact your GE supplier or GE Service Department.

ALARM 51, Auto tune check U_{nom} and I_{nom}

The settings for motor voltage, motor current, and motor power are wrong. Check the settings in parameters P-02, P-03, P-06, P-07, F-04 and F-05.

ALARM 52, Auto tune low I_{nom}

The motor current is too low. Check the setting in *F-43 Current Limit*.

ALARM 53, Auto tune motor too big

The motor is too big for the Auto tune to operate.

ALARM 54, Auto tune motor too small

The motor is too small for the Auto tune to operate.

ALARM 55, Auto tune Parameter out of range

The parameter values of the motor are outside of the acceptable range. Auto tune will not run.

ALARM 56, Auto tune interrupted by user

The Auto tune has been interrupted by the user.

ALARM 57, Auto tune timeout

Try to restart Auto tune again. Repeated restarts may over heat the motor.

ALARM 58, Auto tune internal fault

Contact your GE supplier.

WARNING 59, Current limit

The current is higher than the value in *F-43 Current Limit*. Ensure that Motor data in parameters P-02, P-03, P-06, P-07, F-04 and F-05 are set correctly. Possibly increase the current limit. Be sure 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 drive. An external interlock has commanded the drive to trip. Clear the external fault condition. To resume normal operation, apply 24V DC to the terminal programmed for external interlock. Reset the drive.

WARNING 62, Output frequency at maximum limit

The output frequency has reached the value set in *F-03 Max Output Frequency 1*. 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 will clear when the output drops below the maximum limit.

WARNING/ALARM 65, Control card over temperature

The cutout temperature of the control card is 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 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 drive whenever the motor is stopped by setting *B-00 DC Hold Current* at 5% and *H-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 temperaturePower 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 drive configuration

The control card and power card are incompatible. Contact your supplier with the type code of the unit from the nameplate and the part numbers of the cards to check compatibility.

ALARM 80, Unit Restored to Factory Settings

Parameter settings are restored to factory settings after a manual reset. Reset the unit to clear the alarm.

ALARM 92, No flow

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

ALARM 93, Dry pump

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

ALARM 94, End of curve

Feedback is lower than the set point. This may indicate leakage in the system. *AP-50 End of Curve Function* is set for alarm. Troubleshoot the system and reset the 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. *AP-60 Broken Belt Function* is set for alarm. Troubleshoot the system and reset the drive after the fault has been cleared.

ALARM 96, Start delayed

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

WARNING 97, Stop delayed

Stopping the motor has been delayed due to short cycle protection. *AP-76 Interval between Starts* is enabled. Troubleshoot the system and reset the 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 *K-70 Date and Time*.

WARNING, 200 Fire mode

This indicates the 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 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 a drive operating multi-motors, an under-load condition was detected. This could indicate a missing motor. Inspect the system for proper operation.

WARNING 204, Locked rotor

With a 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 drive has been replaced. Reset the drive for normal operation.

WARNING 251, New typecode

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



9 Basic Troubleshooting

9.1 Start Up and Operation

Symptom	Possible Cause	Test	Solution
Display dark / No function	Missing input power	See <i>Table 3.1</i> .	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 keypad	Check the keypad cable for proper connection or damage.	Replace the faulty keypad or connection cable.
	Shortcut on control voltage (terminal 12 or 50) or at control terminals	Check the 24V control voltage supply for terminal 12/13 to 20-39 or 10V supply for terminal 50 to 55.	Wire the terminals properly.
	Wrong contrast setting		Press [Status] + Up/Down arrows to adjust the contrast.
	Display (keypad) is defective	Test using a different keypad.	Replace the faulty keypad 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 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 shorts or incorrect connections. If the display continues to cut out, follow the procedure for display dark.
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 mains power with 24V DC option card	If the display is functioning but no output, check that mains power is applied to the drive.	Apply mains power to run the unit.
	Keypad Stop	Check if [Off] has been pressed.	Press [Auto] or [Hand] (depending on your operation mode) to run the motor.
	Missing start signal (Standby)	Check <i>E-01 Terminal 18 Digital Input</i> for correct setting for terminal 18 (use default setting).	Apply a valid start signal to start the motor.
	Motor coast signal active (Coasting)	Check if a coast inv command is programmed for the terminal in parameter group E-0# Digital Inputs	Apply 24V on terminal or program this terminal to <i>No operation</i> .
	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 <i>F-02 Operation Method</i> Set preset reference active in parameter <i>C-05 Multi-step Frequency 1 - 8</i> . Check for correct wiring. Check scaling of terminals. Check reference signal.



Basic Troubleshooting

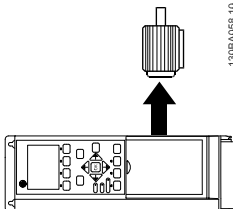
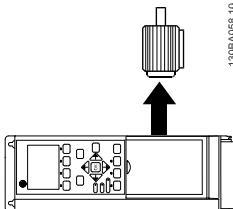
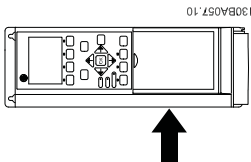
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Symptom	Possible Cause	Test	Solution
Motor running in wrong direction	Motor rotation limit	Check that <i>H-08 Reverse Lock</i> is programmed correctly.	Program correct settings.
	Active reversing signal	Check if a reversing command is programmed for the terminal in parameter group <i>E-0# Digital inputs</i> .	Deactivate reversing signal.
	Wrong motor phase connection		See 3.5 <i>Check Motor Rotation</i> in this manual.
Motor is not reaching maximum speed	Frequency limits set wrong	Check output limits in <i>F-17 Motor Speed High Limit [RPM]</i> , <i>F-15 Motor Speed High Limit [Hz]</i> and <i>F-03 Max Output Frequency 1</i>	Program correct limits.
	Reference input signal not scaled correctly	Check reference input signal scaling in AN-## reference limits in parameter group <i>F-5# Extended Reference</i> .	Program correct settings.
Motor speed unstable	Possible incorrect parameter settings	Check the settings of all motor parameters, including all motor compensation settings. For closed loop operation, check PID settings.	Check settings in parameter group AN-##. For closed loop operation check settings in parameter group CL-0#
Motor runs rough	Possible over-magnetization	Check for incorrect motor settings in all motor parameters.	Check motor settings in parameter groups <i>P-0# Motor Data</i> , <i>P-3# Adv Motor Data</i> , and <i>H-5# Load Indep. Setting</i> .
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 <i>B-0# DC brake</i> and <i>F-5# Extended Reference</i> .
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 to for shorts.	Eliminate any shorts detected.
	Motor overload	Motor is overloaded for the application.	Perform startup 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-startup check for loose connections.	Tighten loose connections.
Mains current imbalance greater than 3%	Problem with mains power (See <i>Alarm 4 Mains phase loss</i> description)	Rotate input power leads into the drive one position: A to B, B to C, C to A.	If imbalanced leg follows the wire, it is a power problem. Check mains power supply.
	Problem with the drive unit	Rotate input power leads into the 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 supplier.
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 drive unit	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 supplier.



10 Specifications

10.1 Power-dependent Specifications

Mains Supply 1 x 200-240V AC - Light duty 110% for 1 minute													
	Typical Shaft Output [kW]						1.5	2.2	3.7	5.5	7.5	15	22
	Typical Shaft Output [HP] at 240 V						2.0	3.0	5.0	7.5	10	20	30
	IP 21 / NEMA 1						21	21	21	21	22	31	32
	IP 55 / NEMA 12						21	21	21	21	22	31	32
	Output current												
	Continuous (3 x 200-240 V) [A]						7.5	10.6	16.7	24.2	30.8	59.4	88
	Intermittent (3 x 200-240 V) [A]						8.3	11.7	18.4	26.6	33.4	65.3	96.8
	Continuous kVA (208 V AC) [kVA]									5.00	6.40	12.27	18.30
Max. input current													
	Continuous (1 x 200-240 V) [A]						15	20.5	32	46	59	111	172
	Intermittent (1 x 200-240 V) [A]						16.5	22.6	35.2	50.6	64.9	122.1	189.2
	Max. pre-fuses ¹⁾ [A]						30	40	60	80	100	150	200
Additional Specifications													
Estimated power loss at rated max. load [W] ⁴⁾							30	44	74	110	150	300	440
Max. cable size (mains, motor, brake) [mm ² / AWG] ²⁾										10/7	35/2	50/1/0	95/4/0
Weight enclosure IP21 [kg]							23	23	23	23	27	45	65
Weight enclosure IP55 [kg]							23	23	23	23	27	45	65
Efficiency ³⁾							0.98	0.98	0.98	0.98	0.98	0.98	0.98

Specifications

AF-600 FP Operating Instructions

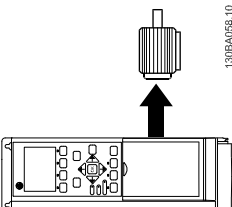
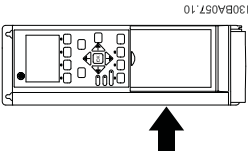
Mains Supply 3x200-240V AC						
Light duty (LD) 110% for 1 minute						
Typical Shaft Output [kW]						
IP 20 / Chassis	0.75	1.5	2.2	3.7		
IP 55 / NEMA 12	12	12	12	13		
	15	15	15	15		
	1.0	2.0	3.0	5.0		
Typical Shaft Output [HP] at 208 V						
Output current						
 130BA058.10	Continuous (3 x 200-240 V) [A]		4.6	7.5	10.6	16.7
	Intermittent (3 x 200-240 V) [A]		5.1	8.3	11.7	18.4
	Continuous kVA (208 V AC) [kVA]		1.66	2.70	3.82	6.00
	Max. cable size: (mains, motor) [mm ² /AWG] ²⁾		4/10			
Max. input current						
 130BA057.10	Continuous (3 x 200-240 V) [A]		4.1	6.8	9.5	15.0
	Intermittent (3 x 200-240 V) [A]		4.5	7.5	10.5	16.5
	Max. pre-fuses ¹⁾ [A]		10	20	20	32
	Environment					
	Estimated power loss at rated max. load [W] ⁴⁾		54	82	116	185
Weight enclosure IP20 [kg]		4.9	4.9	4.9	6.6	
Weight enclosure IP55 [kg]		13.5	13.5	13.5	13.5	
Efficiency ³⁾		0.95	0.96	0.96	0.96	

Table 10.1 Mains Supply 3x200-240V AC

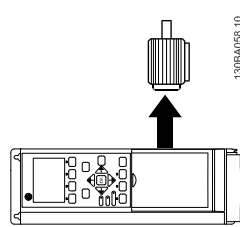
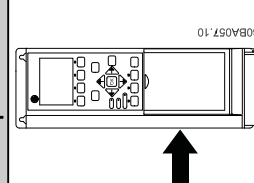
Mains Supply 3x200-240V AC - Light duty (LD) 110% for 1 minute																						
IP20/Chassis	23	23	23	23	24	24	24	33	33	34	34	34	34									
	21	21	21	21	22	22	31	31	31	32	32	32	32									
IP55/NEMA 12																						
Frequency converter																						
Typical Shaft Output [kW]																						
Typical Shaft Output [HP] at 208 V																						
Output current																						
	Continuous (3 x 200-240 V) [A]			24.2	30.8	46.2	59.4	74.8	88.0	115	143	170	170									
	Intermittent (3 x 200-240 V) [A]			26.6	33.9	50.8	65.3	82.3	96.8	127	157	187	187									
	Continuous kVA (208 V AC) [kVA]			8.7	11.1	16.6	21.4	26.9	31.7	41.4	51.5	61.2	61.2									
Max. input current																						
	Continuous (3 x 200-240 V) [A]			22.0	28.0	42.0	54.0	68.0	80.0	104.0	130.0	154.0	154.0									
	Intermittent (3 x 200-240 V) [A]			24.2	30.8	46.2	59.4	74.8	88.0	114.0	143.0	169.0	169.0									
Additional Specifications																						
Estimated power loss at rated max. load [W] ⁴⁾														269	310	447	602	737	845	1140	1353	1636
Max. cable size (mains, motor) [mm ² /AWG] ²⁾														10/7			35/2	50/1/0 (24=35/2)			95/4/0	120/250 MCM
Weight enclosure IP20 [kg]														12	12	12	23.5	23.5	35	35	50	50
Weight enclosure IP55 [kg]														23	23	23	27	45	45	45	65	65
Efficiency ³⁾														0.96	0.96	0.96	0.96	0.96	0.97	0.97	0.97	0.97

Table 10.2 Mains Supply 3x200-240V AC



Specifications

AF-600 FP Operating Instructions

Mains Supply 1x 380 VAC - Light duty 110% for 1 minute						
Typical Shaft Output [kW]	7.5	11	18.5	37		
Typical Shaft Output [HP] at 460 V	10	15	25	50		
IP 21 / NEMA 1	21	22	31	32		
IP 55 / Type 12	21	22	31	32		
Output current						
Continuous (3 x 380-440 V) [A]	16	24	37.5	73		
Intermittent (3 x 380-440 V) [A]	17.6	26.4	41.2	80.3		
Continuous (3 x 441-480 V) [A]	14.5	21	34	65		
Intermittent (3 x 441-480 V) [A]	15.4	23.1	37.4	71.5		
Continuous kVA (400 V AC) [kVA]	11.0	16.6	26	50.6		
Continuous kVA (460 V AC) [kVA]	11.6	16.7	27.1	51.8		
Max. cable size: (mains, motor, brake) [[mm ² / AWG] ²⁾	10/7	35/2	50/1/0	120/4/0		
Max. input current						
Continuous (1 x 380-440 V) [A]	33	48	78	151		
Intermittent (1 x 380-440 V) [A]	36	53	85.8	166		
Continuous (1 x 441-480 V) [A]	30	41	72	135		
Intermittent (1 x 441-480 V) [A]	33	46	79.2	148		
Max. pre-fuses ¹⁾ [A]	63	80	160	250		
Environment						
Estimated power loss at rated max. load [W] ⁴⁾	300	440	740	1480		
Weight enclosure IP 21 [kg]	23	27	45	65		
Weight enclosure IP 55 [kg]	23	27	45	65		
Efficiency ³⁾	0.96	0.96	0.96	0.96		

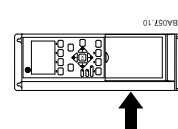
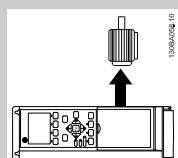


Table 10.3 Mains Supply 1x 380V AC

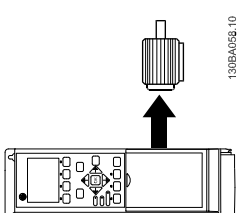
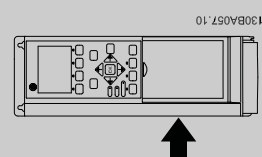
Mains Supply 3 x 380 - 480 VAC - Light duty (LD) 110% for 1 minute									
Typical Shaft Output [kW]									
Typical Shaft Output [HP] at 460 V									
IP 20 / Chassis									
IP 55 / Type 12									
Output current									
	Continuous (3 x 380-440 V) [A]			2.4	4.1	5.6	10	13	16
	Intermittent (3 x 380-440 V) [A]			2.6	4.5	6.2	11	14.3	17.6
	Continuous (3 x 440-480 V) [A]			2.1	3.4	4.8	8.2	11	14.5
	Intermittent (3 x 440-480 V) [A]			2.3	3.7	5.3	9.0	12.1	15.4
	Continuous kVA 400 V AC [kVA]			1.7	2.8	3.9	6.9	9.0	11.0
	Continuous kVA (460 V AC) [kVA]			1.7	2.7	3.8	6.5	8.8	11.6
Max. cable size:									
(mains, motor)									
[mm ² / AWG] ²⁾									
4/10									
Max. input current									
	Continuous (3 x 380-440 V) [A]			2.2	3.7	5.0	9.0	11.7	14.4
	Intermittent (3 x 380-440 V) [A]			2.4	4.1	5.5	9.9	12.9	15.8
	Continuous (3 x 440-480 V) [A]			1.9	3.1	4.3	7.4	9.9	13.0
	Intermittent (3 x 440-480 V) [A]			2.1	3.4	4.7	8.1	10.9	14.3
	Max. pre-fuses ¹⁾ [A]			10	10	20	20	32	32
	Environment								
	Estimated power loss at rated max. load [W] ⁴⁾			46	62	88	124	187	255
	Weight enclosure IP20 [kg]			4.8	4.9	4.9	4.9	6.6	6.6
	Weight enclosure IPø55 [kg]			13.5	13.5	13.5	13.5	14.2	14.2
Efficiency ³⁾			0.96	0.97	0.97	0.97	0.97	0.97	

Table 10.4 Mains Supply 3 x 380 - 480 VAC



Specifications

AF-600 FP Operating Instructions

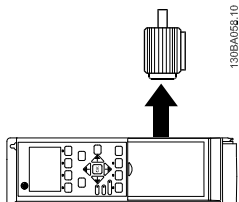
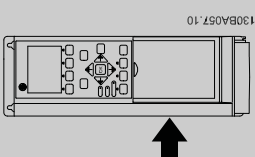
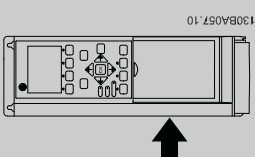
Mains Supply 3 x 380 - 480 VAC - Light duty (LD) 110% for 1 minute												
	Typical Shaft Output [kW]											
	Typical Shaft Output [HP] at 460 V											
	IP20/Chassis											
	IP55/Type 12											
Output current												
	Continuous (3 x 380-439 V) [A]											
	Intermittent (3 x 380-439 V) [A]											
	Continuous (3 x 440-480 V) [A]											
	Intermittent (3 x 440-480 V) [A]											
	Continuous kVA (400 V AC) [kVA]											
	Continuous kVA 460 V AC [kVA]											
Max. input current												
	Continuous (3 x 380-439 V) [A]											
	Intermittent (3 x 380-439 V) [A]											
	Continuous (3 x 440-480 V) [A]											
	Intermittent (3 x 440-480 V) [A]											
Additional specifications												
Estimated power loss at rated max. load [W] ⁴⁾												
Max. cable size (mains, motor) [mm ² / AWG] ²⁾												
Weight enclosure IP20 [kg]												
Weight enclosure IP55 [kg]												
Efficiency ³⁾												

Table 10.5 Mains Supply 3 x 380 - 480 VAC

Specifications

AF-600 FP Operating Instructions

Mains supply 3x525-600V AC Light duty (LD) 110% for 1 minute																			
Typical Shaft Output [kW]		0.75	1.5	2.2	3	4	5.5	7.5	10	15	20	25	30	30	37	45	55	75	90
Typical Shaft Output [HP]		1	2	3	5	6.4	9.5	11.5	15	21	28	36	43	43	54	65	87	105	137
Output current																			
IP 20 / Chassis		12	12	12	12	12	13	13	13	23	23	23	24	24	24	33	33	34	34
IP 55 / NEMA 12		15	15	15	15	15	15	15	15	21	21	21	22	22	22	31	31	32	32
Continuous (3 x 525-550 V) [A]		2.6	2.9	4.1	6.4	9.5	11.5	11.5	15	19	23	28	36	43	54	65	87	105	137
Intermittent (3 x 525-550 V) [A]		2.9	3.2	4.5	7.0	10.5	12.7	12.7	15	21	25	31	40	47	59	72	96	116	151
Continuous (3 x 525-600 V) [A]		2.4	2.7	3.9	6.1	9.0	11.0	11.0	18	22	27	34	41	41	52	62	83	100	131
Intermittent (3 x 525-600 V) [A]		2.6	3.0	4.3	6.7	9.9	12.1	12.1	20	24	30	37	45	45	57	68	91	110	144
Continuous kVA (525 V AC)		2.5	2.8	3.9	6.1	9.0	11.0	11.0	18.1	21.9	26.7	34.3	41	41	51.4	61.9	82.9	100	130.5
[kVA]																			
Continuous kVA (575 V AC)		2.4	2.7	3.9	6.1	9.0	11.0	11.0	17.9	21.9	26.9	33.9	40.8	40.8	51.8	61.7	82.7	99.6	130.5
[kVA]																			
Max. cable size, IP 55 (mains, motor) [mm ²]/[AWG] ²⁾				4/ 10						10/ 7			25/ 4			50/ 1/0	95/ 4/0	120/ MCM25 0	
Max. cable size, IP 20 (mains, motor) [mm ²]/[AWG] ²⁾				4/ 10						16/ 6			35/ 2			50/ 1/0	95/ 4/0	150/ MCM25 0 ⁵⁾	
Max. input current																			
Continuous (3 x 525-600 V) [A]		2.4	2.7	4.1	5.8	8.6	10.4	10.4	17.2	20.9	25.4	32.7	39	39	49	59	78.9	95.3	124.3
Intermittent (3 x 525-600 V) [A]		2.7	3.0	4.5	6.4	9.5	11.5	11.5	19	23	28	36	43	43	54	65	87	105	137
Max. pre-fuses ¹⁾ [A]		10	10	20	20	32	32	32	63	63	63	63	80	80	100	125	160	250	250
Environment:																			
Estimated power loss at rated max. load [W] ⁴⁾		50	65	92	145	195	261	261	300	400	475	525	700	700	750	850	1100	1400	1500
Weight enclosure IP20 [kg]		6.5	6.5	6.5	6.5	6.6	6.6	6.6	12	12	12	23.5	23.5	23.5	23.5	35	35	50	50
Weight enclosure IP55 [kg]		13.5	13.5	13.5	13.5	14.2	14.2	14.2	23	23	23	27	27	27	27	45	45	65	65
Efficiency ⁴⁾		0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98

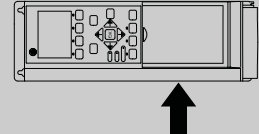
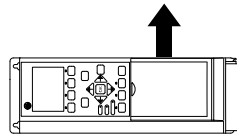


Table 10.6 Mains supply 3x525-600V AC

Specifications

AF-600 FP Operating Instructions

10.2 General Technical Data

Mains supply (L1, L2, L3):

Supply voltage 200-240V $\pm 10\%$, 380-480V $\pm 10\%$, 525-600V $\pm 10\%$,

Mains voltage low / mains drop-out:

During low mains voltage or a mains drop-out, the drive continues until the intermediate circuit voltage drops below the minimum stop level, which corresponds typically to 15% below the drive's lowest rated supply voltage. Power-up and full torque cannot be expected at mains voltage lower than 10% below the drive's lowest rated supply voltage.

Supply frequency 50/60Hz $\pm 5\%$

Max. imbalance temporary between mains phases 3.0% of rated supply voltage

True Power Factor () ≥ 0.9 nominal at rated load

Displacement Power Factor (cos) near unity (> 0.98)

Switching on input supply L1, L2, L3 (power-ups) $\leq$ unit size 1x maximum twice/min.

Switching on input supply L1, L2, L3 (power-ups) $\geq$ unit sizes 2x, 3x maximum once/min.

Switching on input supply L1, L2, L3 (power-ups) $\geq$ unit sizes 4x, 5x, 6x maximum once/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, 480/600 V maximum.

Motor output (U, V, W):

Output voltage 0 - 100% of supply voltage

Output frequency 0 - 1000 Hz*

Switching on output Unlimited

Accel/Decel Times 1 - 3600 sec.

* Dependent on power size.

Torque characteristics:

Starting torque (Constant torque) maximum 110% for 1 min.*

Starting torque maximum 135% up to 0.5 sec.*

Overload torque (Constant torque) maximum 110% for 1 min.*

*Percentage relates to the frequency converter's nominal torque.

Cable lengths and cross sections:

Max. motor cable length, screened/armoured 150 m

Max. motor cable length, unscreened/unarmoured 300 m

Max. cross section to motor and mains*

Maximum cross section to control terminals, rigid wire 1.5 mm²/16 AWG (2 x 0.75 mm²)

Maximum cross section to control terminals, flexible cable 1 mm²/18 AWG

Maximum cross section to control terminals, cable with enclosed core 0.5 mm²/20 AWG

Minimum cross section to control terminals 0.25 mm²

* See 10.1 Power-dependent Specifications for more information!

Digital inputs:

Programmable digital inputs 4 (6)

Terminal number 18, 19, 27¹⁾, 29, 32, 33,

Logic PNP or NPN

Voltage level 0 - 24V DC

Voltage level, logic '0' PNP $< 5V$ DC

Voltage level, logic '1' PNP $> 10V$ DC

Voltage level, logic '0' NPN $> 19V$ DC

Voltage level, logic '1' NPN $< 14V$ DC

Maximum voltage on input 28V DC

Input resistance, R_i approx. 4k Ω

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.



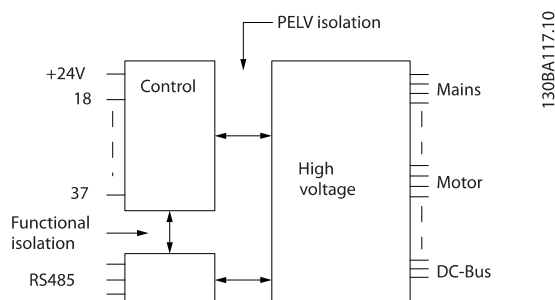
Specifications

AF-600 FP Operating Instructions

Analog inputs:

Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Switches A53 and A54
Voltage mode	Switch A53/A54 = (U)
Voltage level	0 to + 10V (scaleable)
Input resistance, R_i	approx. 10 k Ω
Max. voltage	± 20 V
Current mode	Switch A53/A54 = (I)
Current level	0/4 to 20 mA (scaleable)
Input resistance, R_i	approx. 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	200Hz

The analog inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.



Pulse inputs:

Programmable pulse inputs	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)
Min. frequency at terminal 29, 33	4 Hz
Voltage level	see section on Digital input
Maximum voltage on input	28 V DC
Input resistance, R_i	approx. 4 k Ω
Pulse input accuracy (0.1 - 1 kHz)	Max. error: 0.1% of full scale

Analog output:

Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4 - 20 mA
Max. resistor load to common at analog output	500 Ω
Accuracy on analog output	Max. 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.

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 seated from other central circuits and galvanically isolated from the supply voltage (PELV).

Specifications AF-600 FP Operating Instructions

Digital output:

Programmable digital/pulse outputs	2
Terminal number	27, 29 ¹⁾
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

1) Terminal 27 and 29 can also be programmed as input.

The digital output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Control card, 24 V DC output:

Terminal number	12, 13
Max. load	200mA

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.

Relay outputs:

Programmable relay outputs	2
Relay 01 Terminal number	1-3 (break), 1-2 (make)
Max. terminal load (AC-1) ¹⁾ on 1-3 (NC), 1-2 (NO) (Resistive load)	240V AC, 2A
Max. terminal load (AC-15) ¹⁾ (Inductive load @ cosφ 0.4)	240V AC, 0.2A
Max. terminal load (DC-1) ¹⁾ on 1-2 (NO), 1-3 (NC) (Resistive load)	60V DC, 1A
Max. terminal load (DC-13) ¹⁾ (Inductive load)	24V DC, 0.1A
Relay 02 Terminal number	4-6 (break), 4-5 (make)
Max. terminal load (AC-1) ¹⁾ on 4-5 (NO) (Resistive load) ²⁾³⁾	400V AC, 2A
Max. terminal load (AC-15) ¹⁾ on 4-5 (NO) (Inductive load @ cosφ 0.4)	240V AC, 0.2A
Max. terminal load (DC-1) ¹⁾ on 4-5 (NO) (Resistive load)	80V DC, 2A
Max. terminal load (DC-13) ¹⁾ on 4-5 (NO) (Inductive load)	24V DC, 0.1A
Max. terminal load (AC-1) ¹⁾ on 4-6 (NC) (Resistive load)	240V AC, 2A
Max. terminal load (AC-15) ¹⁾ on 4-6 (NC) (Inductive load @ cosφ 0.4)	240V AC, 0.2A
Max. terminal load (DC-1) ¹⁾ on 4-6 (NC) (Resistive load)	50V DC, 2A
Max. terminal load (DC-13) ¹⁾ on 4-6 (NC) (Inductive load)	24V DC, 0.1A
Min. terminal load on 1-3 (NC), 1-2 (NO), 4-6 (NC), 4-5 (NO)	24V DC 10mA, 24V AC 2 mA
Environment according to EN 60664-1	overvoltage category III/pollution degree 2

1) IEC 60947 t 4 and 5

The relay contacts are galvanically isolated from the rest of the circuit by reinforced isolation (PELV).

2) Overvoltage Category II

3) UL applications 300V AC 2A

Control card, 10 V DC output:

Terminal number	50
Output voltage	10.5 V ±0.5 V
Max. load	25 mA

The 10 V DC supply is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Control characteristics:

Resolution of output frequency at 0 - 1000 Hz	+/- 0.003 Hz
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: Maximum error of ±8 rpm

All control characteristics are based on a 4-pole asynchronous motor



Specifications

AF-600 FP Operating Instructions

Surroundings:

Unit Size 1x types	IP 20/Chassis, IP 21kit/Type 1, IP55/Type12
Unit Size 21 and 22 types	IP55/Type12
Unit Size 23 and 24 types	IP20/Chassis
Unit Size 31 and 32 types	IP55/Type 12
Unit Size 33 and 34 types	IP20/Chassis
Unit Size 41, 42, and 51 types	IP21/Type 1, IP54/Type12
Unit Size 43, 44, and 52 types	IP00/Chassis
Unit Size 61/63	IP21, 54/Type1, 12
Unit Size 62/64	IP21, 54/Type1, 12
IP21/Nema 1 kit for all unit sizes 1x, 2x, and 3x	IP21/NEMA 1/on top of enclosure
Vibration test all enclosure types	1.0g
Relative humidity	5% - 95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43) H ₂ S test	class Kd
Test method according to IEC 60068-2-43 H ₂ S (10 days)	
Ambient temperature (at 60 AVM switching mode)	
- with derating	max. 50°C ¹⁾
- with full output power of typical EFF2 motors (up to 90% output current)	max. 50 °C ¹⁾
- at full continuous Drive output current	max. 45 °C ¹⁾

¹⁾ For more information on derating see the AF-600 FP Design Guide, section on Special Conditions.

Minimum ambient temperature during full-scale operation	0°C
Minimum ambient temperature at reduced performance	- 10°C
Temperature during storage/transport	-25 - +65/70°C
Maximum altitude above sea level without derating	1000m
Maximum altitude above sea level with derating	3000m

Derating for high altitude, see section on special conditions

EMC standards, Emission	EN 61800-3, EN 61000-6-3/4, EN 55011, IEC 61800-3 EN 61800-3, EN 61000-6-1/2,
EMC standards, Immunity	EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6

See section on special conditions!

Control card performance:

Scan interval	5 ms
---------------	------

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 connection is not galvanically isolated from protection earth. Use only isolated laptop/PC as connection to the USB connector on drive or an isolated USB cable/converter.

Specifications**AF-600 FP Operating Instructions**

Protection and Features:

- Electronic thermal overload motor protection against overload.
- Temperature monitoring of the heatsink ensures that the drive trips if the temperature reaches $95^{\circ}\text{C} \pm 5^{\circ}\text{C}$. An overload temperature cannot be reset until the temperature of the heatsink is below $70^{\circ}\text{C} \pm 5^{\circ}\text{C}$ (Guideline - these temperatures may vary for different power sizes, enclosures etc.). The drive has an auto derating function to avoid it's heatsink reaching 95°C .
- The drive is protected against short-circuits on motor terminals U, V, W.
- If a mains phase is missing, the drive trips or issues a warning (depending on the load).
- Monitoring of the intermediate circuit voltage ensures that the drive trips if the intermediate circuit voltage is too low or too high.
- The drive is protected against earth faults on motor terminals U, V, W.



10.3 Fuse Tables

It is recommended to use fuses and/ or Circuit Breakers on the supply side as protection in case of component break-down inside the drive (first fault).

NOTE

This is mandatory in order to ensure compliance with IEC 60364 for CE or NEC 2009 for UL.

WARNING

Personnel and property must be protected against the consequence of component break-down internally in the drive.

Branch Circuit Protection

In order to protect the installation against electrical and fire hazard, all branch circuits in an installation, switch gear, machines etc., must be protected against short-circuit and over-current according to national/international regulations.

NOTE

The recommendations given do not cover Branch circuit protection for UL.

Short-circuit protection:

GE recommends using the fuses/Circuit Breakers mentioned below to protect service personnel and property in case of component break-down in the drive.

Over current protection:

The drive provides overload protection to limit threats to human life, property damage and to avoid fire hazard due to overheating of the cables in the installation. The drive is equipped with an internal over current protection (*F-43 Current Limit*) that can be used for upstream overload protection (UL-applications excluded). Moreover, fuses or Circuit Breakers can be used to provide the over current protection in the installation. Over current protection must always be carried out according to national regulations.

10.3.1 Recommendations

WARNING

In case of malfunction, not following the recommendation may result in personnel risk and damage to the drive and other equipment.

The following tables list the recommended rated current. Recommended fuses are of the type gG for small to medium power sizes. For larger powers, aR fuses are recommended. Circuit breakers must be used provided they meet the national/international regulations and they limit the energy into the drive to an equal or lower level than the compliant circuit breakers.

If fuses/Circuit Breakers according to recommendations are chosen, possible damages on the drive will mainly be limited to damages inside the unit.



Specifications

AF-600 FP Operating Instructions

10.3.2 CE Compliance

Fuses or Circuit Breakers are mandatory to comply with IEC 60364. GE recommend using a selection of the following.

The fuses below are suitable for use on a circuit capable of delivering 100,000 Arms (symmetrical), 240V, or 480V, or 500V, or 600V depending on the drive voltage rating. With the proper fusing the drive short circuit current rating (SCCR) is 100,000 Arms.

AF-600 3-phase	Recommended fuse size	Recommended max fuse	Recommended circuit breaker	Max trip level
[HP]				[A]
1	gG-16	gG-25	PKZM0-25	25
2				
3				
5	gG-20	gG-32		
7,5	gG-50	gG-63	PKZM4-50	50
10				
15				
20	gG-80	gG-125	NZMB1-A100	100
25				
30	gG-125	gG-150	NZMB2-A200	150
40	aR-160	aR-160		
50	aR-200	aR-200	NZMB2-A250	250
60	aR-250	aR-250		

Table 10.7 200-240V, IP20/Open Chassis

AF-600 3-phase	Recommended fuse size	Recommended max fuse	Recommended circuit breaker	Max trip level
[HP]				[A]
1	gG-20	gG-32	PKZM0-25	25
2				
3				
5				
7,5	gG-63	gG-80	PKZM4-63	63
10				
15				
20	gG-80	gG-100	NZMB1-A100	100
25	gG-125	gG-160	NZMB2-A200	160
30				
40	aR-160	aR-160	NZMB2-A250	250
50	aR-200	aR-200		
60	aR-250	aR-250		

Table 10.8 200-240V, IP55/Nema 12



Specifications

AF-600 FP Operating Instructions

AF-600 3-phase	Recommended fuse size	Recommended max fuse	Recommended circuit breaker	Max trip level
[HP]				[A]
1	gG-16	gG-25	PKZM0-25	25
2				
3				
5				
7,5	gG-20	gG-32		
10				
15	gG-50	gG-63	PKZM4-50	50
20				
25				
30	gG-80	gG-125	NZMB1-A100	100
40				
50				
60	gG-125	gG-150	NZMB2-A200	150
75	aR-160	aR-160		
100	aR-250	aR-250	NZMB2-A250	250
125				
150	gG-300	gG-300	-	-
200	gG-350	gG-350		
250	gG-400	gG-400		
300	gG-500	gG-500		
350	gG-630	gG-630		
450	aR-700	aR-700		
500	aR-900	aR-900		
550				
600				
650	aR-1600	aR-1600		
750				
900	aR-2000	aR-2000		
1000				
1200	aR-2500	aR-2500		
1350				

Table 10.9 380-480V, IP20/Open Chassis

Specifications

AF-600 FP Operating Instructions

AF-600 3-phase	Recommended fuse size	Recommended max fuse	Recommended circuit breaker	Max trip level
[HP]				[A]
1	gG-20	gG-32	PKZM0-25	25
2				
3				
5				
7,5				
10				
15	gG-50	gG-80	PKZM4-63	63
20				
25				
30	gG-80	gG-100	NZMB1-A100	100
40				
50	gG-125	gG-160	NZMB2-A200	160
60				
75				
100	aR-250	aR-250	NZMB2-A250	250
125				
150	gG-300	gG-300	-	-
200	gG-350	gG-350		
250	gG-400	gG-400		
300	gG-500	gG-500		
350	gG-630	gG-630		
450	aR-700	aR-700		
500	aR-900	aR-900		
550				
600				
650	aR-1600	aR-1600		
750				
900	aR-2000	aR-2000		
1000				
1200	aR-2500	aR-2500		
1350				

Table 10.10 380-480V, IP55/Nema 12



Specifications

AF-600 FP Operating Instructions

AF-600 3-phase	Recommended fuse size	Recommended max fuse	Recommended circuit breaker	Max trip level		
[HP]				[A]		
1	gG-10	gG-25	PKZM0-25	25		
2						
3						
5						
7,5	gG-16	gG-32				
10						
15	gG-35	gG-63	PKZM4-50	50		
20						
25						
30	gG-63	gG-125	NZMB1-A100	100		
40						
50						
60	gG-100	gG-150	NZMB2-A200	150		
75						
100	aR-250	aR-250	NZMB2-A250	250		
125						
150	aR-315	aR-315	-	-		
200	aR-350	aR-350				
250						
300						
350	aR-400	aR-400				
400	aR-500	aR-500				
450	aR-550	aR-550				
500	aR-700	aR-700				
600						
650	aR-900	aR-900				
750						
950	aR-1600	aR-1600				
1000						
1150						
1350	aR-2000	aR-2000				

Table 10.11 525-600V, IP20/Open Chassis



Specifications

AF-600 FP Operating Instructions

AF-600 3-phase	Recommended fuse size	Recommended max fuse	Recommended circuit breaker	Max trip level		
[HP]				[A]		
1	gG-16	gG-32	PKZM0-25	25		
2						
3						
5						
7,5						
10						
15	gG-35	gG-80	PKZM4-63	63		
20						
25						
30	gG-50	gG-100	NZMB1-A100	100		
40						
50	gG-125	gG-160	NZMB2-A200	160		
60						
75	aR-250	aR-250	NZMB2-A250	250		
100						
125						
150	aR-315	aR-315	-	-		
200	aR-350	aR-350				
250						
300						
350	aR-400	aR-400				
400	aR-500	aR-500				
450	aR-550	aR-550				
500	aR-700	aR-700				
600						
650	aR-900	aR-900				
750						
950						
1000						
1150	aR-1600	aR-1600				
1350						
	aR-2000	aR-2000				

Table 10.12 525-600V, IP55/Nema 12



10.3.3 NEC and UL Compliance

Fuses or Circuit Breakers are mandatory to comply with NEC 2009. We recommend using a selection of the following

The fuses below are suitable for use on a circuit capable of delivering 100,000 Arms (symmetrical), 240V, or 480V, or 600V depending on the drive voltage rating. With the proper fusing the drive Short Circuit Current Rating (SCCR) is 100,000 Arms.

Recommended max. fuse							
AF-600 1-phase Power	AF-600 3-phase Power	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann
HP	HP	Type RK1 ¹⁾	Type J	Type T	Type CC	Type CC	Type CC
	1	KTN-R-10	JKS-10	JJN-10	FNQ-R-10	KTK-R-10	LP-CC-10
	2	KTN-R-15	JKS-15	JJN-15	FNQ-R-15	KTK-R-15	LP-CC-15
2	3	KTN-R-20	JKS-20	JJN-20	FNQ-R-20	KTK-R-20	LP-CC-20
3	5	KTN-R-30	JKS-30	JJN-30	FNQ-R-30	KTK-R-30	LP-CC-30
5	7.5-10	KTN-R-50	KS-50	JJN-50	-	-	-
7.5	15	KTN-R-60	JKS-60	JJN-60	-	-	-
10	20	KTN-R-80	JKS-80	JJN-80	-	-	-
	25-30	KTN-R-125	JKS-125	JJN-125	-	-	-
20	40	KTN-R-150	JKS-150	JJN-150	-	-	-
30	50	KTN-R-200	JKS-200	JJN-200	-	-	-
	60	KTN-R-250	JKS-250	JJN-250	-	-	-

Table 10.13 200-240V

Recommended max. fuse					
AF-600 1-phase Power	AF-600 3-phase Power	SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
HP	HP	Type RK1	Type RK1	Type CC	Type RK1 ³⁾
	1	5017906-010	KLN-R-10	ATM-R-10	A2K-10-R
	2	5017906-016	KLN-R-15	ATM-R-15	A2K-15-R
2	3	5017906-020	KLN-R-20	ATM-R-20	A2K-20-R
3	5	5012406-032	KLN-R-30	ATM-R-30	A2K-30-R
5	7.5-10	5014006-050	KLN-R-50	-	A2K-50-R
7.5	15	5014006-063	KLN-R-60	-	A2K-60-R
10	20	5014006-080	KLN-R-80	-	A2K-80-R
	25-30	2028220-125	KLN-R-125	-	A2K-125-R
20	40	2028220-150	KLN-R-150	-	A2K-150-R
30	50	2028220-200	KLN-R-200	-	A2K-200-R
	60	2028220-250	KLN-R-250	-	A2K-250-R

Table 10.14 200-240V

Specifications

AF-600 FP Operating Instructions

Recommended max. fuse					
AF-600 1-phase	AF-600 3-phase	Bussmann	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
HP	HP	Type JFHR2 ²⁾	Type JFHR2	Type JFHR2 ⁴⁾	Type J
	1	FWX-10	-	-	HSJ-10
	2	FWX-15	-	-	HSJ-15
2	3	FWX-20	-	-	HSJ-20
3	5	FWX-30	-	-	HSJ-30
5	7.5-10	FWX-50	-	-	HSJ-50
7.5	15	FWX-60	-	-	HSJ-60
10	20	FWX-80	-	-	HSJ-80
	25-30	FWX-125	-	-	HSJ-125
20	40	FWX-150	L25S-150	A25X-150	HSJ-150
30	50	FWX-200	L25S-200	A25X-200	HSJ-200
	60	FWX-250	L25S-250	A25X-250	HSJ-250

Table 10.15 200-240V

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

Recommended max. fuse							
AF-600 1-phase	AF-600 3-phase	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann
[HP]	[HP]	Type RK1	Type J	Type T	Type CC	Type CC	Type CC
	1	KTS-R-6	JKS-6	JJS-6	FNQ-R-6	KTK-R-6	LP-CC-6
	2-3	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10
	5	KTS-R-20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20
	7.5	KTS-R-25	JKS-25	JJS-25	FNQ-R-25	KTK-R-25	LP-CC-25
	10	KTS-R-30	JKS-30	JJS-30	FNQ-R-30	KTK-R-30	LP-CC-30
	15-20	KTS-R-40	JKS-40	JJS-40	-	-	-
	25	KTS-R-50	JKS-50	JJS-50	-	-	-
10	30	KTS-R-60	JKS-60	JJS-60	-	-	-
15	40	KTS-R-80	JKS-80	JJS-80	-	-	-
	50	KTS-R-100	JKS-100	JJS-100	-	-	-
	60	KTS-R-125	JKS-125	JJS-125	-	-	-
25	75	KTS-R-150	JKS-150	JJS-150	-	-	-
50	100	KTS-R-200	JKS-200	JJS-200	-	-	-
	125	KTS-R-250	JKS-250	JJS-250	-	-	-

Table 10.16 380-480V, 125HP and below



Specifications

AF-600 FP Operating Instructions

Recommended max. fuse					
AF-600 1-phase	AF-600 3-phase	SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
[HP]	[HP]	Type RK1	Type RK1	Type CC	Type RK1
	1	5017906-006	KLS-R-6	ATM-R-6	A6K-10-6
	2-3	5017906-010	KLS-R-10	ATM-R-10	A6K-10-R
	5	5017906-020	KLS-R-20	ATM-R-20	A6K-20-R
	7.5	5017906-025	KLS-R-25	ATM-R-25	A6K-25-R
	10	5012406-032	KLS-R-30	ATM-R-30	A6K-30-R
	15-20	5014006-040	KLS-R-40	-	A6K-40-R
	25	5014006-050	KLS-R-50	-	A6K-50-R
10	30	5014006-063	KLS-R-60	-	A6K-60-R
15	40	2028220-100	KLS-R-80	-	A6K-80-R
	50	2028220-125	KLS-R-100	-	A6K-100-R
	60	2028220-125	KLS-R-125	-	A6K-125-R
25	75	2028220-160	KLS-R-150	-	A6K-150-R
50	100	2028220-200	KLS-R-200	-	A6K-200-R
	125	2028220-250	KLS-R-250	-	A6K-250-R

Table 10.17 380-480V, 125HP and below

Recommended max. fuse					
AF-600 1-phase	AF-600 3-phase	Bussmann	Ferraz- Shawmut	Ferraz- Shawmut	Littel fuse
[HP]	[HP]	Type JFHR2	Type J	Type JFHR2 ¹⁾	Type JFHR2
	1	FWH-6	HSJ-6	-	-
	2-3	FWH-10	HSJ-10	-	-
	5	FWH-20	HSJ-20	-	-
	7.5	FWH-25	HSJ-25	-	-
	10	FWH-30	HSJ-30	-	-
	15-20	FWH-40	HSJ-40	-	-
	25	FWH-50	HSJ-50	-	-
10	30	FWH-60	HSJ-60	-	-
15	40	FWH-80	HSJ-80	-	-
	50	FWH-100	HSJ-100	-	-
	60	FWH-125	HSJ-125	-	-
25	75	FWH-150	HSJ-150	-	-
50	100	FWH-200	HSJ-200	A50-P-225	L50-S-225
	125	FWH-250	HSJ-250	A50-P-250	L50-S-250

Table 10.18 380-480V, 125HP and below

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



Specifications

AF-600 FP Operating Instructions

	Recommended max. fuse					
AF-600	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann
[HP]	Type RK1	Type J	Type T	Type CC	Type CC	Type CC
1	KTS-R-5	JKS-5	JJS-6	FNQ-R-5	KTK-R-5	LP-CC-5
2-3	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10
5	KTS-R-20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20
7.5	KTS-R-25	JKS-25	JJS-25	FNQ-R-25	KTK-R-25	LP-CC-25
10	KTS-R-30	JKS-30	JJS-30	FNQ-R-30	KTK-R-30	LP-CC-30
15-20	KTS-R-35	JKS-35	JJS-35	-	-	-
25	KTS-R-45	JKS-45	JJS-45	-	-	-
30	KTS-R-50	JKS-50	JJS-50	-	-	-
40	KTS-R-60	JKS-60	JJS-60	-	-	-
50	KTS-R-80	JKS-80	JJS-80	-	-	-
60	KTS-R-100	JKS-100	JJS-100	-	-	-
75	KTS-R-125	JKS-125	JJS-125	-	-	-
100	KTS-R-150	JKS-150	JJS-150	-	-	-
125	KTS-R-175	JKS-175	JJS-175	-	-	-

Table 10.19 525-600V, 125HP and below

	Recommended max. fuse			
AF-600	SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
[HP]	Type RK1	Type RK1	Type RK1	Type J
1	5017906-005	KLS-R-005	A6K-5-R	HSJ-6
2-3	5017906-010	KLS-R-010	A6K-10-R	HSJ-10
5	5017906-020	KLS-R-020	A6K-20-R	HSJ-20
7.5	5017906-025	KLS-R-025	A6K-25-R	HSJ-25
10	5017906-030	KLS-R-030	A6K-30-R	HSJ-30
15-20	5014006-040	KLS-R-035	A6K-35-R	HSJ-35
25	5014006-050	KLS-R-045	A6K-45-R	HSJ-45
30	5014006-050	KLS-R-050	A6K-50-R	HSJ-50
40	5014006-063	KLS-R-060	A6K-60-R	HSJ-60
50	5014006-080	KLS-R-075	A6K-80-R	HSJ-80
60	5014006-100	KLS-R-100	A6K-100-R	HSJ-100
75	2028220-125	KLS-R-125	A6K-125-R	HSJ-125
100	2028220-150	KLS-R-150	A6K-150-R	HSJ-150
125	2028220-200	KLS-R-175	A6K-175-R	HSJ-175

Table 10.20 525-600V, 125HP and below

1) 170M fuses shown from Bussmann use the -/80 visual indicator. -TN/80 Type T, -/110 or TN/110 Type T indicator fuses of the same size and amperage may be substituted.



Specifications

AF-600 FP Operating Instructions

Recommended max. fuse							
AF-600	Bussmann PN	Alternate External Bussmann PN	Alternate External Bussmann PN	Alternate External Siba PN	Alternate External Littlefuse PN	Alternate External Ferraz-Shawmut PN	Alternate External Ferraz-Shawmut PN
[HP]	Type JFHR2	Type JFHR2	Type T/JDDZ	Type JFHR2	Type JFHR2	Type JFHR2	
150	170M3017	FWH-300	JJS-300	2028220-315	L50-S-300	A50-P-300	
200	170M3018	FWH-350	JJS-350	2028220-315	L50-S-350	A50-P-350	
250	170M4012	FWH-400	JJS-400	206xx32-400	L50-S-400	A50-P-400	
300	170M4014	FWH-500	JJS-500	206xx32-500	L50-S-500	A50-P-500	
350	170M4016	FWH-600	JJS-600	206xx32-600	L50-S-600	A50-P-600	
450	170M4017			20 610 32.700			6.9URD31D08A070 0
500	170M6013			22 610 32.900			6.9URD33D08A090 0
550	170M6013			22 610 32.900			6.9URD33D08A090 0
600	170M6013			22 610 32.900			6.9URD33D08A090 0
650	170M7081						
750	170M7081						
900	170M7082						
1000	170M7082						
1200	170M7083						
1350	170M7083						

Table 10.21 525-690V, above 125HP

AF-600	Bussmann PN	Rating	Alternate Siba PN
[HP]			
650	170M8611	1100A, 1000V	20 781 32.1000
750	170M8611	1100A, 1000V	20 781 32.1000
900	170M6467	1400A, 700V	20 681 32.1400
1000	170M6467	1400A, 700V	20 681 32.1400
1200	170M8611	1100A, 1000V	20 781 32.1000
1350	170M6467	1400A, 700V	20 681 32.1400

Table 10.22 380-480V, Frame Size 6, Inverter Module DC Link Fuses

Specifications

AF-600 FP Operating Instructions

AF-600	Bussmann PN	Alternate External Siba PN	Alternate External Ferraz-Shawmut PN
[HP]		Type JFHR2	Type JFHR2
150	170M3017	2061032,315	6.9URD30D08A0315
200	170M3018	2061032,35	6.9URD30D08A0350
250	170M4011	2061032,35	6.9URD30D08A0350
300	170M4012	2061032,4	6.9URD30D08A0400
350	170M4014	2061032,5	6.9URD30D08A0500
400	170M5011	2062032,55	6.9URD32D08A0550
450	170M4017	20 610 32.700	6.9URD31D08A0700
500	170M4017	20 610 32.700	6.9URD31D08A0700
600	170M6013	22 610 32.900	6.9URD33D08A0900
650	170M6013	22 610 32.900	6.9URD33D08A0900
750	170M7081		
950	170M7081		
1050	170M7081		
1150	170M7081		
1350	170M7082		
1550	170M7083		

Table 10.23 380-480V, above 125HP

AF-600	Bussmann PN	Rating	Alternate Siba PN
[HP]			
750	170M8611	1100A, 1000V	20 781 32.1000
950	170M8611	1100A, 1000V	20 781 32.1000
1050	170M8611	1100A, 1000V	20 781 32.1000
1150	170M8611	1100A, 1000V	20 781 32.1000
1350	170M8611	1100A, 1000V	20 781 32.1000
1550	170M8611	1100A, 1000V	20 781 32.1000

Table 10.24 525-690V, Frame Size 6, Inverter Module DC Link Fuses

*170M fuses from Bussmann shown use the -/80 visual indicator, -TN/80 Type T, -/110 or TN/110 Type T indicator fuses of the same size and amperage may be substituted for external use

**Any minimum 500V UL listed fuse with associated current rating may be used to meet UL requirements.



10.3.4 Substitute Fuses for 240 V

Original fuse	Manufacturer	Substitute fuses
KTN	Bussmann	KTS
FWX	Bussmann	FWH
KLNR	LITTEL FUSE	KLSR
L50S	LITTEL FUSE	L50S
A2KR	FERRAZ SHAWMUT	A6KR
A25X	FERRAZ SHAWMUT	A50X

10.4 Connection Tightening Torques

Unit	Power (HP)			Torque (Nm)					
	200-240V	380-480V	525-600V	Mains	Motor	DC connection	Brake	Earth	Relay
12	1-3	1-5	1-5	1.8	1.8	1.8	1.8	3	0.6
13	5	7.5-10	7.5-10	1.8	1.8	1.8	1.8	3	0.6
15	1-5	1-10	1-10	1.8	1.8	1.8	1.8	3	0.6
21	7.5-15	15-25	15-25	1.8	1.8	1.5	1.5	3	0.6
22	-	30	30	4.5	4.5	3.7	3.7	3	0.6
	20	40	40	4.5 ²⁾	4.5 ²⁾	3.7	3.7	3	0.6
23	7.5-15	15-25	15-25	1.8	1.8	1.8	1.8	3	0.6
24	20-25	30-50	30-50	4.5	4.5	4.5	4.5	3	0.6
31	25-40	50-75	50-75	10	10	10	10	3	0.6
32	50-60	100-125	100-125	14/24 ¹⁾	14/24 ¹⁾	14	14	3	0.6
33	30-40	60-75	60-75	10	10	10	10	3	0.6
34	50-60	100-125	100-125	14/24 ¹⁾	14/24 ¹⁾	14	14	3	0.6

Table 10.25 Tightening of Terminals

1) For different cable dimensions x/y, where $x \leq 95\text{mm}^2$ and $y \geq 95\text{mm}^2$.

2) Cable dimensions above 18.5kW $\geq 35\text{mm}^2$ and below 22kW $\leq 10\text{mm}^2$.

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The instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the GE company.

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