Operating Guide

TR-200 E1h-E4h Drives

355-800 kW (450-950 hp)

⚠SAFETY WARNING

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

November 2020 **BAS-SVX087A-EN**

Contents

1 Introduction and Safety

1.1 Purpose of this Operating Guide

This Operating Guide provides information for safe installation and commissioning of the AC drive. It is intended for use by qualified personnel. Read and follow the instructions to use the drive safely and professionally. Pay particular attention to the safety instructions and general warnings. Always keep this Operating Guide with the drive.

1.2 Manual and Software Version

This manual is regularly reviewed and updated. All suggestions for improvement are welcome.

Table 1: Manual and Software Version

Manual version	Remarks	Software version
BAS-SVX087A	Initial release	4.04

1.3 Approvals and Certifications

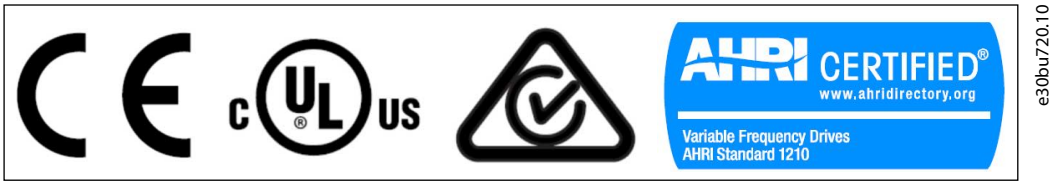

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Illustration 1: Approvals and Certifications

More approvals and certifications are available. Contact the local Trane office or partner. Drives of voltage T7 (525–690 V) are UL certified for only 525–600 V.

NOTICE

OUTPUT FREQUENCY LIMIT

From software version 3.92 onwards, the output frequency of the drive is limited to 590 Hz due to export control regulations.

1.4 Safety Symbols

The following symbols are used in this manual:

⚠ DANGER ⚠

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

⚠ WARNING ⚠

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

⚠ CAUTION ⚠

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Indicates information considered important, but not hazard-related (for example, messages relating to property damage).

1.5 Qualified Personnel

To allow trouble-free and safe operation of the unit, only qualified personnel with proven skills are allowed to transport, store, assemble, install, program, commission, maintain, and decommission this equipment.

Persons with proven skills:

- Are qualified electrical engineers, or persons who have received training from qualified electrical engineers and are suitably experienced to operate devices, systems, plant, and machinery in accordance with pertinent laws and regulations.
- Are familiar with the basic regulations concerning health and safety/accident prevention.
- Have read and understood the safety guidelines given in all manuals provided with the unit, especially the instructions given in the Operating Guide.
- Have good knowledge of the generic and specialist standards applicable to the specific application.

1.6 General Safety Precautions

When installing or operating the AC drive, pay attention to the safety information given in the instructions.

⚠ WARNING ⚠

LACK OF SAFETY AWARENESS

This document gives important information on how to prevent injury and damage to the equipment or the system. Ignoring them can lead to death, serious injury, or severe damage to the equipment.

– Make sure to fully understand the dangers and safety measures incurred in the application.

⚠ WARNING ⚠

HAZARDOUS VOLTAGE

AC drives contain hazardous voltage when connected to the AC mains or connected on the DC terminals. Failure to perform installation, start-up, and maintenance by skilled personnel can result in death or serious injury.

– Only skilled personnel must perform installation, start-up, and maintenance.

⚠ WARNING ⚠

DISCHARGE TIME (40 MINUTES)

The drive contains DC-link capacitors, which can remain charged even when the drive is not powered. High voltage can be present even when the warning indicator lights are off.

Failure to wait 40 minutes after power has been removed before performing service or repair work can result in death or serious injury.

– Stop the motor.
– Disconnect AC mains, permanent magnet type motors, and remote DC-link supplies, including battery back-ups, UPS, and DC-link connections to other drives.
– Wait 40 minutes for the capacitors to discharge fully before performing any service or repair work.
– Measure the voltage level to verify full discharge.

⚠ WARNING ⚠

UNINTENDED START

When the drive is connected to the AC mains, DC supply, or load sharing, the motor may start at any time, causing risk of death, serious injury, and equipment or property damage. The motor may start by activation of an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up software, or after a cleared fault condition.

– Press [Off] on the LCP before programming parameters.
– Disconnect the drive from the mains whenever personal safety considerations make it necessary to avoid unintended motor start.
– Check that the drive, motor, and any driven equipment are in operational readiness.

⚠ WARNING ⚠

ROTATING SHAFTS

Contact with rotating shafts and electrical equipment can result in death or serious injury.

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

⚠ CAUTION ⚠

INTERNAL FAILURE HAZARD

An internal failure in the drive can result in serious injury when the drive is not properly closed.

- Ensure that all safety covers are in place and securely fastened before applying power.

⚠ CAUTION ⚠

HOT SURFACES

The drive contains metal components that are still hot even after the drive has been powered off. Failure to observe the high temperature symbol (yellow triangle) on the drive can result in serious burns.

- Be aware that internal components, such as busbars, may be extremely hot even after the drive has been powered off.
- Do not touch exterior areas that are marked by the high temperature symbol (yellow triangle). These areas are hot while the drive is in use and immediately after being powered off.

1.7 Disposal

Do not dispose of equipment containing electrical components together with domestic waste. Collect it separately in accordance with applicable local regulations.

2 Receiving the Drive

2.1 Verifying the Shipment and the Contents

Make sure that the items supplied and the information on the nameplate correspond to the order confirmation.

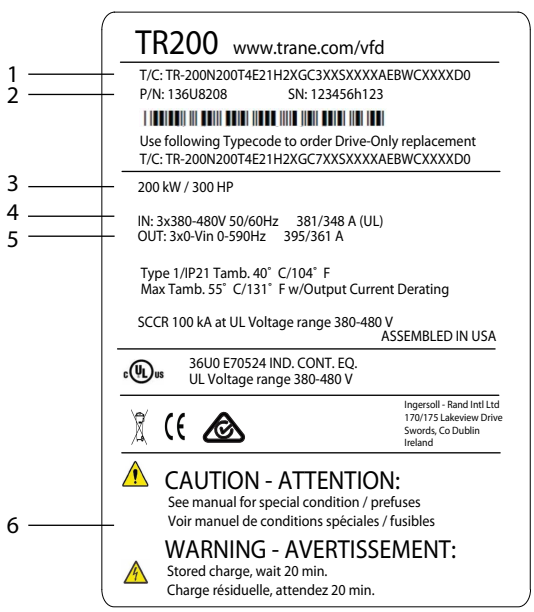

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Illustration 2: Example of the Model Code on the Product Nameplate

1	Type code	4	Input voltage, frequency, and current (at low/high voltages)
2	Part number and serial number	5	Output voltage, frequency, and current (at low/high voltages)
3	Power rating	6	Discharge time

N O T I C E

WARRANTY

Removing the nameplate from the drive can result in the loss of warranty.

Visually check the packaging and the drive for damage caused by inapproriate handling during shipment. File any claim for damage with the carrier. Retain damaged parts for verification. The frequency converter is shipped with a selection of loose components packed in plastic bags. The amount of these components depend on the enclosure size and product configuration.

2.2 Lifting the Drive

⚠ WARNING ⚠

LIFTING HEAVY LOAD

The weight of the drive is heavy and failure to follow local safety regulations for lifting heavy weights may cause death, personal injury, or property damage.

- Ensure that the lifting equipment is in proper working condition.
- Check the weight of the drive and verify that the lifting equipment can safely lift the weight.
- Always lift the drive using a lifting bar inserted into the lifting eyes. Maximum diameter for the lifting bar: 20 mm (0.8 in).
- The angle from the top of the drive to the lifting cable: 60° or greater.
- Test lift the unit approximately 610 mm (24 in) to verify the proper center of gravity lift point. Reposition the lifting point if the unit is not level.

2.3 Weight and Dimensions

Table 2: Maximum Weight and Dimensions for E1h–E4h Drives

Enclosure	E1h	E2h	E3h	E4h
Weight [kg (lb)]	295 (650)	318 (700)	272 (600)	295 (650)
Height [mm (in)]	2043 (80.4)	2043 (80.4)	1578 (62.1)	1578 (62.1)
Width [mm (in)]	602 (23.7)	698 (27.5)	506 (19.9)	604 (23.9)
Depth [mm (in)]	513 (20.2)	513 (20.2)	482 (19.0)	482 (19.0)

3 Mechanical Installation

3.1 Fastener Torque Ratings

Apply the correct torque when tightening fasteners in the locations that are listed in Table 3. Too low or too high torque when fastening an electrical connection results in a bad electrical connection. To ensure correct torque, use a torque wrench.

Table 3: Fastener Torque Ratings

Location	Bolt size	Torque [Nm (in-lb)]
Mains terminals	M10/M12	19 (168)/37 (335)
Motor terminals	M10/M12	19 (168)/37 (335)
Ground terminals	M8/M10	9.6 (84)/19.1 (169)
Load sharing terminals	M10/M12	19 (168)/37 (335)
Regen terminals (Enclosures E1h/E2h)	M8	9.6 (84)
Regen terminals (Enclosures E3h/E4h)	M10/M12	19 (168)/37 (335)
Relay terminals	–	0.5 (4)
Door/panel cover	M5	2.3 (20)
Cable entry plate	M5	2.3 (20)
Heat sink access panel	M5	2.3 (20)
Serial communication cover	M5	2.3 (20)

3.2 Tools Needed

- I-beam and hooks rated to lift the weight of the drive.
- Crane or other lifting aid to place the unit into position.
- Drill with a 12 mm (1/2 in) drill bit.
- Tape measurer.
- Phillips and flat bladed screwdrivers.
- Wrench with 7–17 mm metric sockets.
- Wrench extensions.
- T25 and T50 Torx drives.
- Sheet metal punch and/or pliers for cable entry plate.

3.3 Operating Environment

3.3.1 Overview

In environments with airborne liquids, particles, or corrosive gases, ensure that the IP/NEMA protection rating of the equipment matches the installation environment. Refer to the *Ambient Conditions* section.

NOTICE

CONDENSATION

Moisture can condense on the electronic components and cause short circuits.

- Avoid installation in areas subject to frost.
- Install an optional space heater when the unit is colder than the ambient air.
- Operating in standby mode reduces the risk of condensation as long as the power dissipation keeps the circuitry free of moisture.

NOTICE

EXTREME AMBIENT CONDITIONS

Hot or cold temperatures compromise unit performance and longevity.

- Do not operate in environments where the ambient temperature exceeds 50 °C (122 °F) for units rated at 400–500 V and 45 °C (113 °F) for units rated at 525–690 V unless the drive is derated. Refer to the *Derating section* in the design guide.
- The unit can operate at temperatures down to -10 °C (14 °F). However, proper operation at rated load is only guaranteed at 0 °C (32 °F) or higher. Also, temperature feedback is not shown when temperatures are below 0 °C (32 °F).
- Provide extra air conditioning for the cabinet or installation site when the temperature exceeds ambient temperature limits.

3.3.2 Gases

Aggressive gases, such as hydrogen sulphide, chlorine, or ammonia can damage the electrical and mechanical components. The unit uses conformal-coated circuit boards to reduce the effects of aggressive gases.

For conformal coating class specifications and ratings, see the *Ambient Conditions* section.

3.3.3 Dust

When installing the unit in a dusty environment, keep the following free from dust buildup:

- Electronic components.
- Heat sink.
- Fans.

Keep the heat sink and fans free from dust buildup. When dust accumulates on electronic components, it acts as a layer of insulation. This layer reduces the cooling capacity of the components, and the components become warmer. The hotter environment decreases the life of the electronic components. Dust can also accumulate on fan blades, causing an imbalance which prevents the fan from properly cooling the unit. Dust buildup can also damage fan bearings and cause premature fan failure.

3.3.4 Potentially Explosive Atmospheres

⚠ WARNING ⚠

EXPLOSIVE ATMOSPHERE

Installing the drive in a potentially explosive atmosphere can lead to death, personal injury, or property damage.

- Install the unit in a cabinet outside of the potentially explosive area.
- Use a motor with an appropriate ATEX protection class.
- Install a PTC temperature sensor to monitor the motor temperature.
- Install short motor cables.
- Use sine-wave output filters when shielded motor cables are not used.

As required by the EU Directive 2014/34/EU, any electrical or electronic device intended for use in an environment with a potentially explosive mixture of air, flammable gas, or dust must be ATEX-certified. Systems operated in this environment must fulfill the following special conditions to comply with the ATEX protection class:

- Class d specifies that if a spark occurs, it is contained in a protected area.
- Class e prohibits any occurrence of a spark.

Motors with class d protection

Does not require approval. Special wiring and containment are required.

Motors with class e or class n protection

When combined with an ATEX-approved PTC monitoring device, installation does not need an individual approval from an approbated organization.

Motors with class d/e protection

The motor itself has an e ignition protection class, while the motor cabling and connection environment are in compliance with the d classification. To attenuate the high peak voltage, use a sine-wave filter at the drive output.

3.4 Installation Requirements

- Place the unit as near to the motor as possible. See the Cabling Guidelines section for the maximum motor cable length.
- Enclosures E1h and E2h must be mounted vertically.
- Enclosures E3h and E4h can be mounted:
  - Vertically on the back plate of the panel (the typical installation).
  - Vertically upside down on the back plate of the panel. Consult the factory.
  - Horizontally on its back, mounted on the back plate of the panel. Consult the factory.
  - Horizontally on its side, mounted on floor of the panel. Consult the factory.
- Ensure drive stability by mounting the drive to a solid surface. Verify that the strength of the mounting location supports the drive weight.
- Ensure enough room for cable entry at the bottom of the drive.
- Ensure enough clearance to open the door.
- If the unit has the heat sink access panel option, ensure that there is enough clearance in the back of the drive to remove the panel.

3.5 Cooling Requirements

N O T I C E

OVERHEATING

Improper mounting can result in overheating and reduced performance.

– Install the drive following the installation and cooling requirements.

- Ensure at least 225 mm (9 in) clearance at top and bottom of drive for air cooling. Pedestals provide enough bottom clearance.
- Provide sufficient airflow flow based on enclosure size.
- Consider derating for temperatures starting between 45 °C (113 °F) and 50 °C (122 °F) and elevation 1000 m (3300 ft) above sea level. See the product-specific design guide for detailed information.

Duct cooling

Back-channel cooling kits are available to direct the heat sink cooling air out of the panel when IP20/Chassis drives are installed in Rittal enclosures. Use of these kits reduce the heat in the panel and smaller door fans can be specified.

Back-wall cooling

Installing top and bottom covers to the unit allows the back-channel cooling air to be ventilated out of the room.

Table 4: Airflow Rates for E1h–E4h Drives

Drive	Door fan/top fan [m^3/hr (cfm)]	Heat sink fan [m^3/hr (cfm)]
E1h	510 (300)	994 (585)
E2h	552 (325)	1053–1206 (620–710)
E3h	595 (350)	994 (585)
E4h	629 (370)	1053–1206 (620–710)

3.6 Mounting the Drive to the Floor

The E1h and E2h enclosures are designed to be mounted on a pedestal, which is secured to the floor. These enclosures have a metal gland plate installed between the drive and the pedestal. The pedestal provides air to cool the drive, and the gland plate provides cable entry while maintaining the the IP21/IP54 (Type1/Type 12) protection rating.

Procedure

NOTICE

OPTIONAL HEAT SINK ACCESS PANEL

If the unit has the optional heat sink access panel, leave enough clearance at the back of the drive to remove the panel and clean the heat sink.

1. Determine proper placement of the unit, concerning operating conditions and cable access.
2. Remove the front cover plate from the pedestal by unfastening the 4 M5 fasteners.
3. Secure the pedestal to the floor using 4 M10 bolts through the mounting holes in the bottom flange.
4. Lift the drive and position it on the pedestal. There are 2 bolts in the rear of the pedestal that slide into the 2 slotted holes in the rear of the enclosure. Position the drive by adjusting the bolts up or down. Loosely secure with 2 M10 nuts and locking brackets.
5. Verify that there is 225 mm (9 in) top clearance for air exhaust.
6. Verify that the air intake at the bottom front of the unit is not obstructed.
7. Secure the pedestal to the enclosure at the following locations. Loosely tighten each bolt until all bolts are installed, and then torque to 2.3 Nm (20 in lbs).
    a. Attach the side flanges of the pedestal to the side flanges on the drive. Use 2 M5 fasteners on each side flange.
    b. At the front of the pedestal, use 2 M5 fasteners to secure the top flange of the pedestal to the gland plate.
8. Torque the 2 M10 nuts at the rear of the enclosure to 19 Nm (169 in-lb).
9. Reinstall the cover onto the pedestal with 4 M5 fasteners. Torque to 2.3 Nm (20 in lbs)

Example

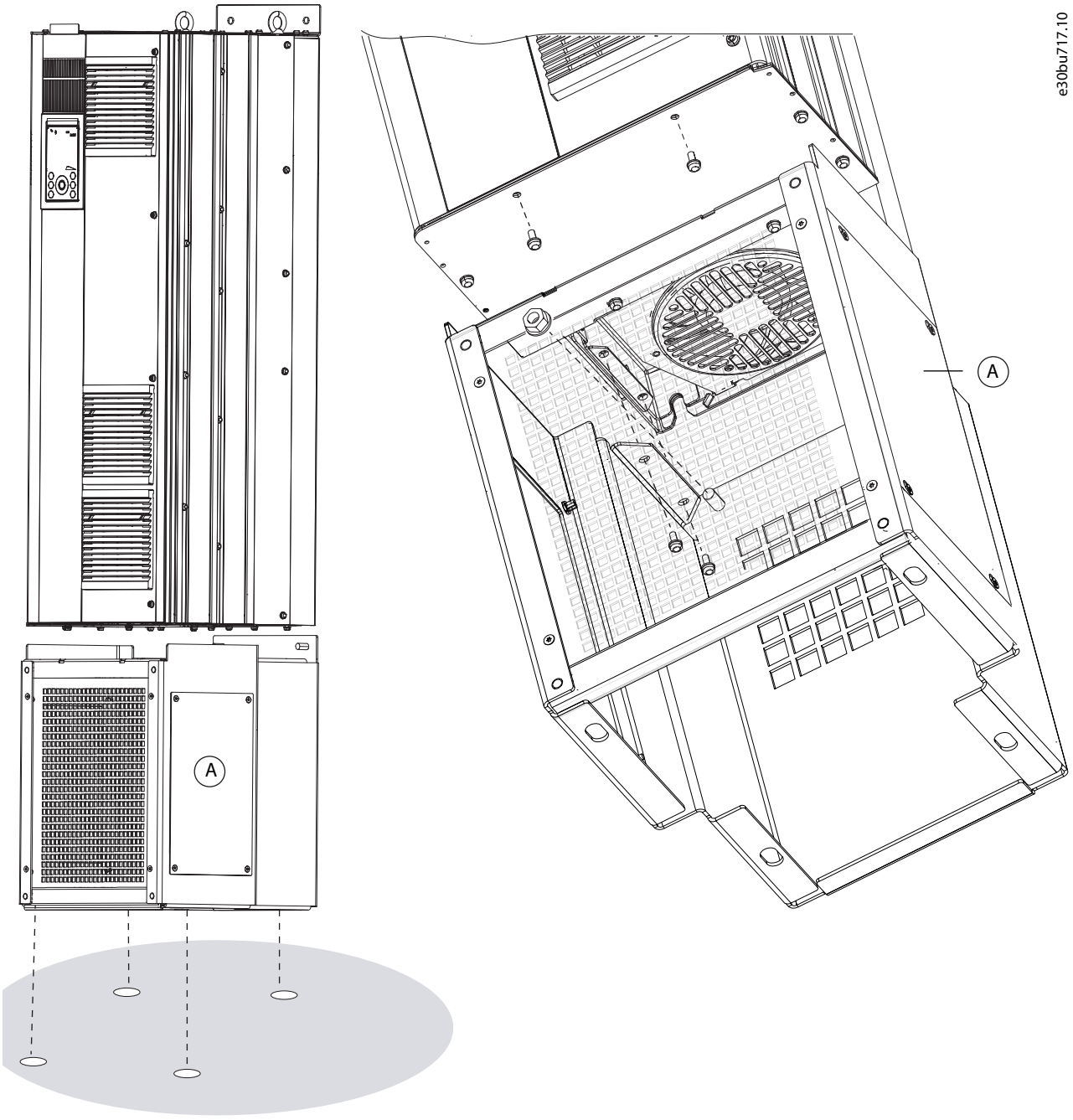
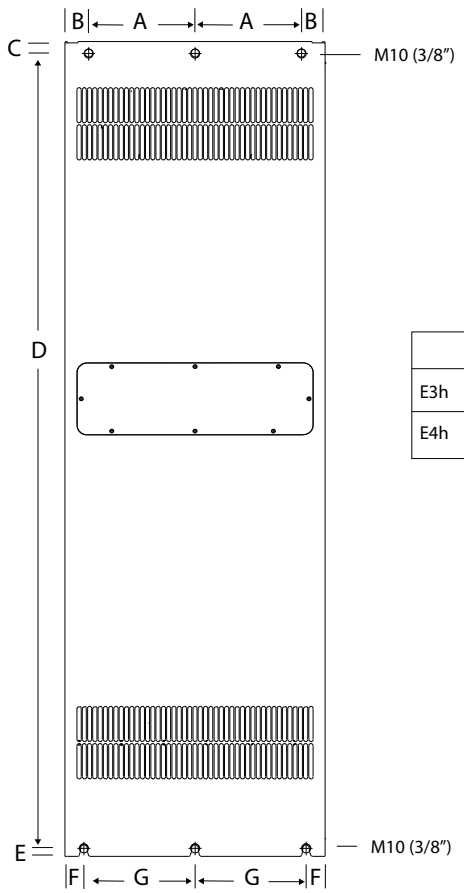


Illustration 3: Securing the Drive to the Floor

3.7 Mounting the Drive to the Wall or a Mounting Plate

The E3h/E4h enclosures are intended to be mounted on a wall or on a mounting panel within an enclosure. These enclosures have a plastic gland plate installed at the base of the unit to prevent unintentional access to the terminals.

3.7.1 Mounting Dimensions



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	A	B	C	D	E	F	G
E3h	206 (8.1)	46 (1.8)	18 (0.7)	1545 (60.8)	15 (0.6)	37 (1.4)	215 (8.5)
E4h	254 (10.0)	46 (1.8)	18 (0.7)	1545 (60.8)	15 (0.6)	37 (1.4)	263 (10.4)

Illustration 4: Mounting Locations

3.7.2 Securing the Drive to a Wall or Mounting Plate

Procedure

N O T I C E

OPTIONAL HEAT SINK ACCESS PANEL

If the unit has the optional heat sink access panel, allow space to remove the access panel and clean the heat sink.

- Leave enough clearance at the back of the drive.
- Cut out an opening in the mounting panel or wall to provide access.

1. Drill mounting holes. Refer to the Mounting Dimensions section.
2. Fasten M10 bolts in the wall to align with the fastener slots at the bottom of drive.
3. Slide the fastener slots over the M10 bolts.
4. Tip the drive against the wall, and secure the top with M10 bolts in the mounting holes.

Example

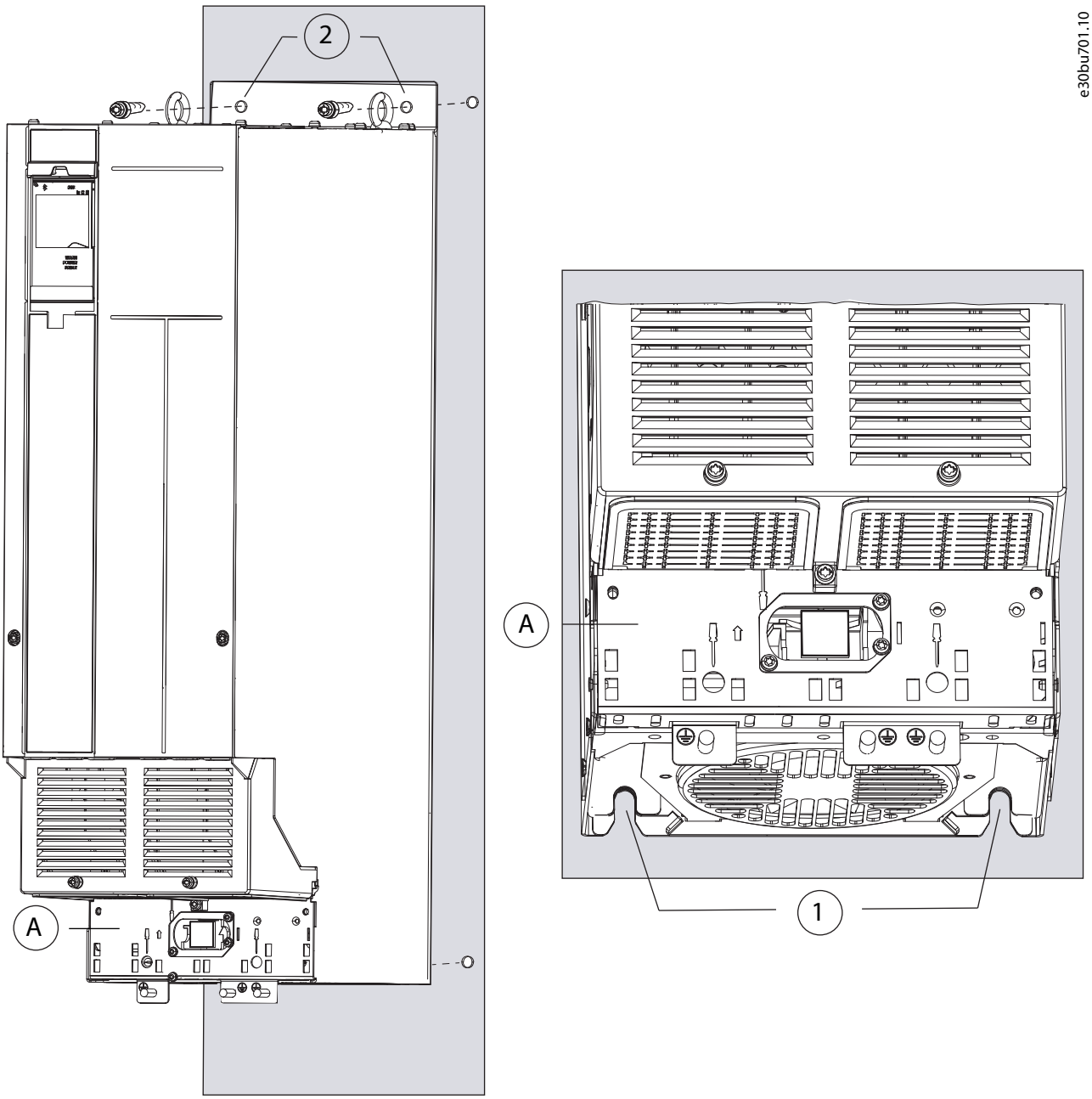

Illustration 5: Securing the Drive to the Wall or Mounting Plate

3.8 Creating Cable Openings

A gland plate provides cable entry and cable termination points, and must be installed to the enclosure to maintain its protection rating. The IP21/IP54 (Type 1/Type 12) enclosure uses a metal gland plate, while the IP20 (Chassis) enclosure uses a plastic gland plate.

Procedure

1. For an IP20 (Chassis) enclosure, use pliers to wiggle loose and snap off the plastic tabs to accommodate the cables.
2. For an IP21/IP54 (Type 1/Type 12) enclosure, perform the following steps.
    a. Remove the front cover plate from the pedestal.
    b. Remove the fasteners from the gland plate.
    c. Remove the gland plate through the front of the pedestal by lowering the gland plate and angling it slightly through the pedestal opening.
    d. Create cable entry holes in the gland plate using a sheet metal punch.

e. Insert a cable gland into each hole.
f. Reinstall and secure the gland plate to the drive.
g. Reinstall and secure the front cover plate to the pedestal.

Example

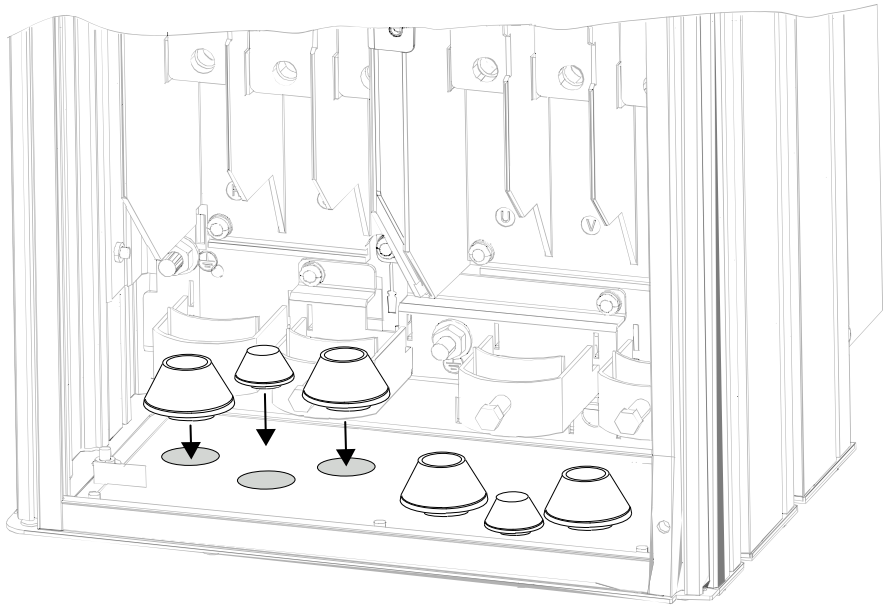

Illustration 6: Cable Openings in an IP21/IP54 (Type 1/Type 12) Enclosure (Left) and an IP 20/Chassis Enclosure (Right)

3.9 Installing Load Share/Regen Terminals

NOTICE

DC CONNECTION TERMINALS

Due to the exposed terminals at the top of the E3h/E4h enclosures, the enclosure protection rating changes from IP20 to IP00.

The load share/regen terminal option is not installed from the factory to prevent damage during shipping. Load share terminals are available only on the E3h and E4h enclosures.

- Size the wiring according to the current of the drive. For maximum wire sizes, see the Cable Specifications section.
- Comply with local and national electrical codes for cable sizes.

Procedure

1. Remove the terminal plate, 2 terminals, label, and fasteners from the accessory bag included with the drive.
2. Remove the cover from the load share/ regen opening on the top of the drive. Put aside the 2 M5 fasteners for reuse later.
3. Remove the plastic backing and install the terminal plate over the load share/regen opening. Secure with the 2 M5 fasteners and torque to 2.3 Nm (20 in-lb).
4. Install both the terminals to the terminal plate using 1 M10 fastener per terminal. Torque to 19 Nm (169 in-lb).
5. Install labels facing towards the front as shown in Illustration 7. Secure with 2 M4 screws and torque to 1.2 Nm (10 in-lb).

Example

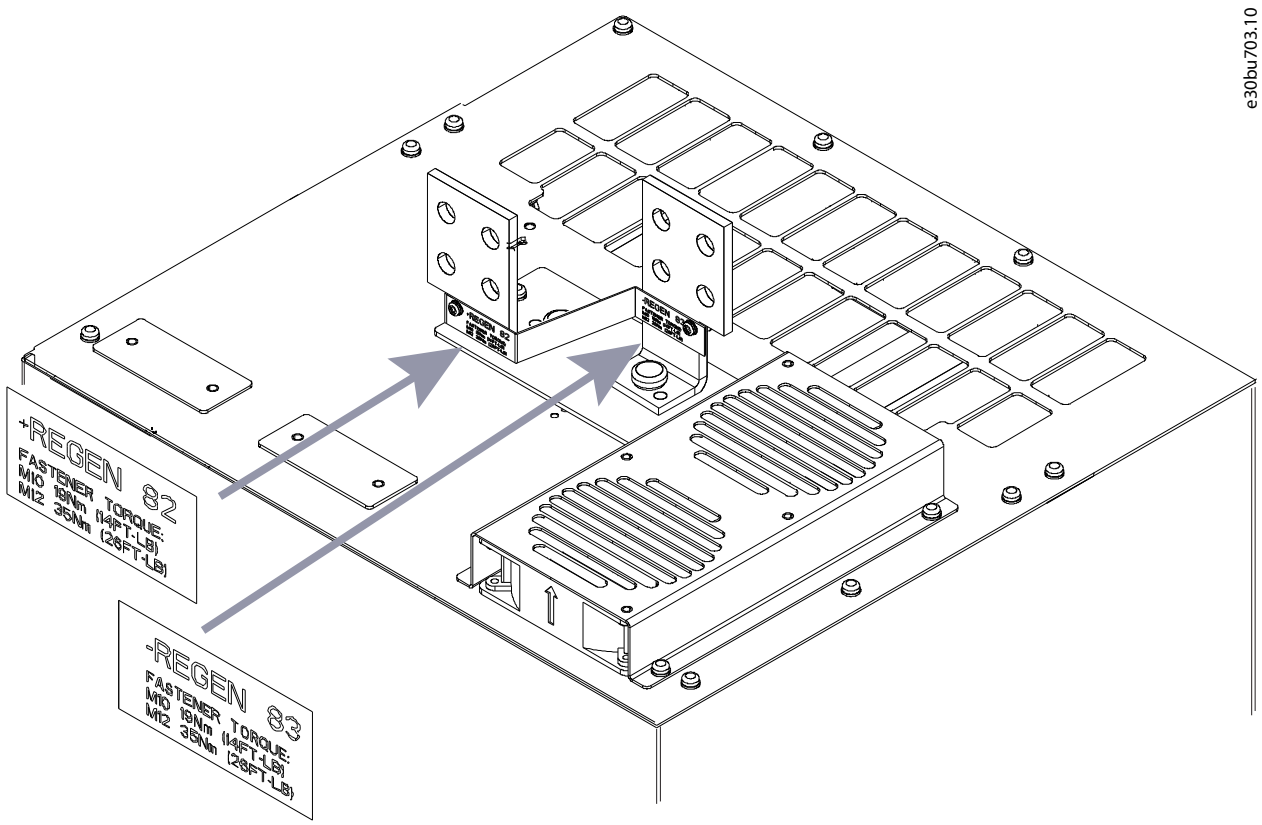

Illustration 7: Load share/Regen Terminals

4 Electrical Installation

4.1 Wiring Diagram

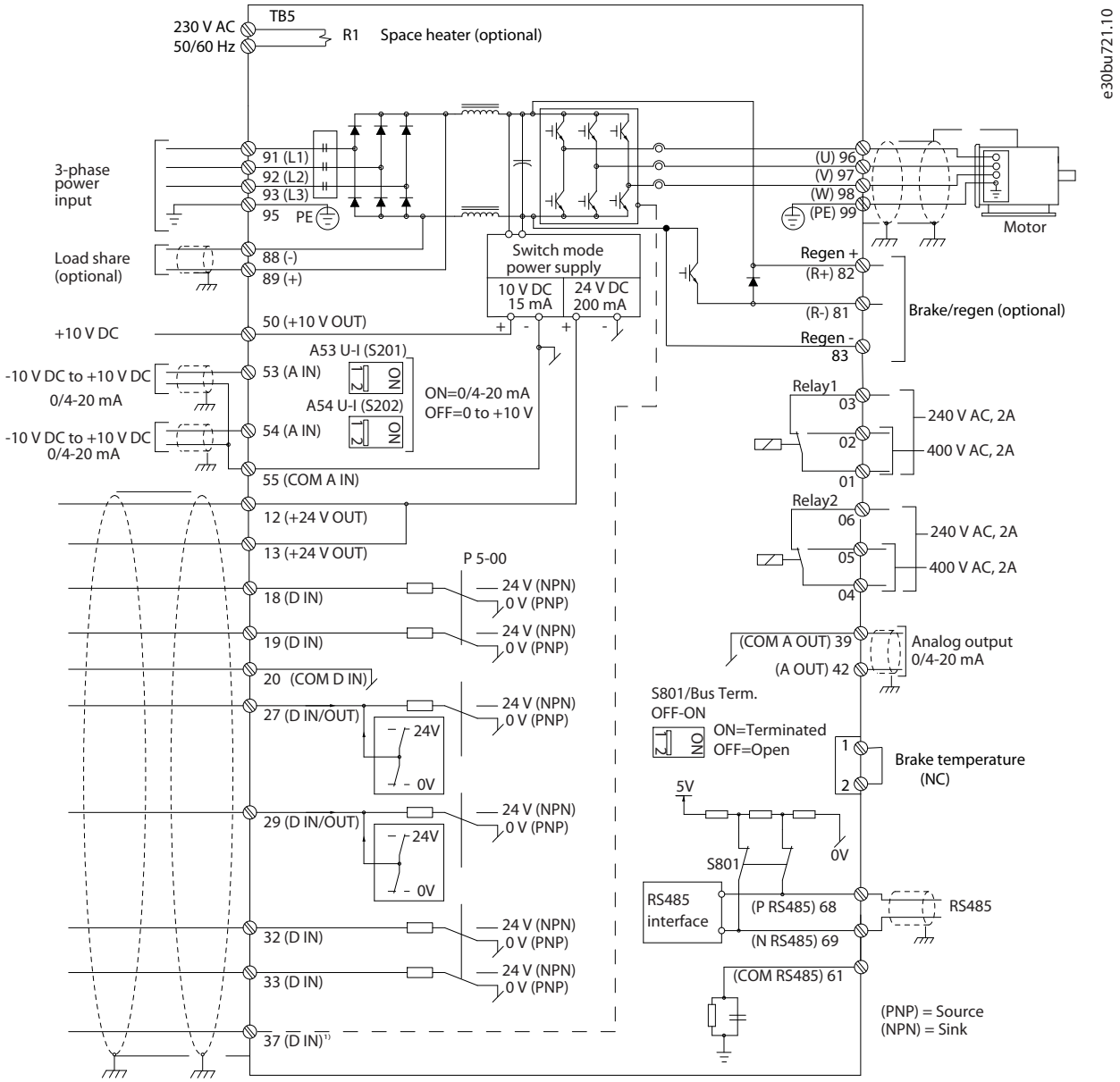

Illustration 8: Basic Wiring Schematic

1	Terminal 37 (optional) is used for Safe Torque Off. Refer to the Safe Torque Off Operating Guide for installation instructions.

4.2 EMC-compliant Installation

To obtain an EMC-compliant installation, refer to the wiring schematics and follow the instructions provided for:

- Connecting the motor.
- Connecting the AC mains.
- Connecting to ground.
- Control wiring.

Also, remember to practice the following:

- When using relays, control cables, a signal interface, fieldbus, or brake, connect the shield to the enclosure at both ends. If the ground path has high impedance, is noisy, or is carrying current, break the shield connection on 1 end to avoid ground current loops.
- Convey the currents back to the unit using a metal mounting plate. Ensure good electrical contact from the mounting plate through the mounting screws to the drive chassis.
- Use shielded cables for motor output cables. An alternative is unshielded motor cables within metal conduit.
- Ensure that motor and brake cables are as short as possible to reduce the interference level from the entire system.
- Avoid placing cables with a sensitive signal level alongside motor and brake cables.
- For communication and command/control lines, follow the particular communication protocol standards. For example, USB must use shielded cables, but RS485/ethernet can use shielded UTP or unshielded UTP cables.
- Ensure that all control terminal connections are PELV.

N O T I C E

TWISTED SHIELD ENDS (PIGTAILS)

Twisted shield ends increase the shield impedance at higher frequencies, which reduces the shield effect and increases the leakage current.

– Use integrated shield clamps instead of twisted shield ends.

N O T I C E

SHIELDED CABLES

If shielded cables or metal conduits are not used, the unit and the installation do not meet regulatory limits on radio frequency (RF) emission levels.

N O T I C E

EMC INTERFERENCE

Failure to isolate power, motor, and control cables can result in unintended behavior or reduced performance.

– Use shielded cables for motor and control wiring.
– Use separate cables for mains input, motor, and control wiring.
– Provide a minimum 200 mm (7.9 in) separation between mains input cables, motor cables, and control cables.

N O T I C E

INSTALLATION AT HIGH ALTITUDE

There is a risk for overvoltage. Isolation between components and critical parts could be insufficient, and may not comply with PELV requirements.

– Use external protective devices or galvanic isolation. For installations above 2000 m (6500 ft) altitude, contact Trane regarding PELV compliance.

N O T I C E

PELV COMPLIANCE

Prevent electric shock by using protective extra low voltage (PELV) electrical supply and complying with local and national PELV regulations.

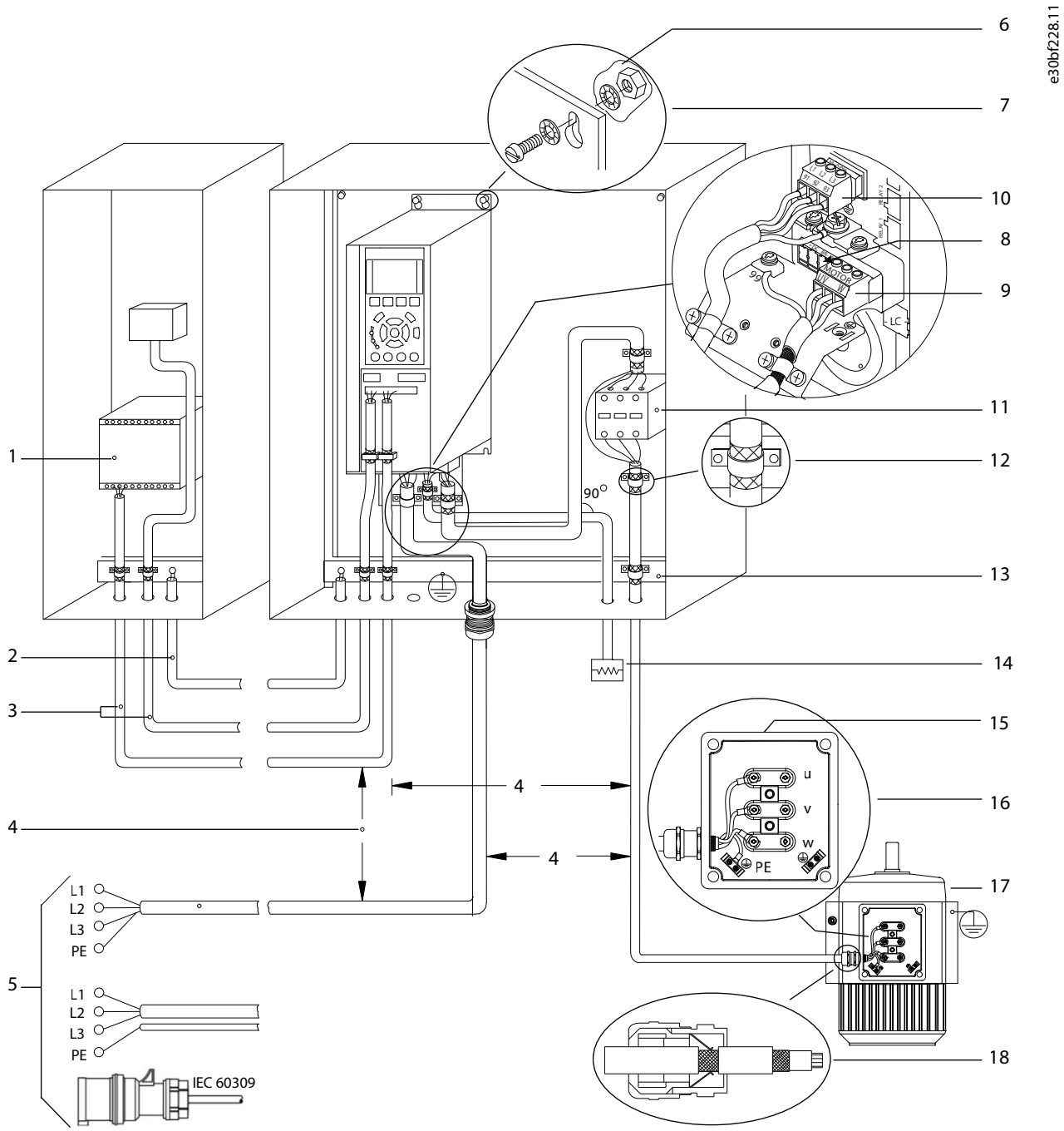

Illustration 9: Example of Proper EMC Installation

1	Controller	10	Mains cable (unshielded)
2	Minimum 16 mm^2 (6 AWG)equalizing cable	11	Output contactor, and so on
3	Control cables	12	Cable insulation stripped
4	Minimum 200 mm (7.9 in) between control cables, motor cables, and mains cables.	13	Common ground busbar. Follow local and national requirements for cabinet grounding.
5	Mains supply	14	Brake resistor
6	Bare (unpainted) surface	15	Metal box
7	Star washers	16	Connection to motor
8	Brake cable (shielded)	17	Motor
9	Motor cable (shielded)	18	EMC cable gland

4.3 Cabling Guidelines

- Before you start, make sure that none of the components of the AC drive is live. Read carefully the warnings in the Introduction and Safety section.
- Make sure that the motor cables are sufficiently far from other cables.
- The motor cables must go across other cables at an angle of 90°.
- Only use symmetrical and shielded motor cables.
- Maximum motor cable length:
  - Shielded/armored motor cables is 150 m (492 ft).
  - Unshielded/unarmored motor cables is 300 m (984 ft).

  If motor cables exceed recommended maximum length, contact Trane.

4.4 Cable Specifications

Table 5: Control Cable Specifications

Type of cable	Maximum cross-section [mm^2(AWG)	Minimum cross-section [mm^2(AWG)
Rigid cable	1.5 (16)	0.25 (24)
Flexible cable	1 (18)	0.25 (24)
Cable with enclosed core	0.5 (20)	0.25 (24)

Table 6: Maximum Number and Size of E1h/E2h Power Cables, 380–480 V

E1h/E2h	N355	N400	N450	N500	N560
Mains and motor without brake [mm2 (AWG)]	5x240 (5x500 mcm)	5x240 (5x500 mcm)	5x240 (5x500 mcm)	6x240 (6x500 mcm)	6x240 (6x500 mcm)
Mains and motor with brake [mm2 (AWG)]	4x240 (4x500 mcm)	4x240 (4x500 mcm)	4x240 (4x500 mcm)	5x240 (5x500 mcm)	5x240 (5x500 mcm)
Load share or regen [mm2 (AWG)]	2x185 (2x350 mcm)	2x185 (2x350 mcm)	2x185 (2x350 mcm)	2x185 (2x350 mcm)	2x185 (2x350 mcm)

Table 7: Maximum Number and Size of E3h/E4h Power Cables, 380–480 V

E3h/E4h	N355	N400	N450	N500	N560
Mains and motor [mm2 (AWG)]	6x240 (6x500 mcm)	6x240 (6x500 mcm)	6x240 (6x500 mcm)	6x240 (6x500 mcm)	6x240 (6x500 mcm)

E3h/E4h	N355	N400	N450	N500	N560
Brake [mm2 (AWG)]	2x185 (2x350 mcm)	2x185 (2x350 mcm)	2x185 (2x350 mcm)	2x185 (2x350 mcm)	2x185 (2x350 mcm)
Load share or regen [mm2 (AWG)]	4x185 (4x350 mcm)	4x185 (4x350 mcm)	4x185 (4x350 mcm)	4x185 (4x350 mcm)	4x185 (4x350 mcm)

Table 8: Maximum Number and Size of E1h/E2h Power Cables, 525–690 V

E1h/E2h	N450	N500	N560	N630	N710	N800
Mains and motor without brake [mm2 (AWG)]	5x240 (5x500 mcm)	5x240 (5x500 mcm)	5x240 (5x500 mcm)	6x240 (6x500 mcm)	6x240 (6x500 mcm)	6x240 (6x500 mcm)
Mains and motor with brake [mm2 (AWG)]	4x240 (4x500 mcm)	4x240 (4x500 mcm)	4x240 (4x500 mcm)	5x240 (5x500 mcm)	5x240 (5x500 mcm)	5x240 (5x500 mcm)
Load share or regen [mm2 (AWG)]	2x185 (2x350 mcm)	2x185 (2x350 mcm)	2x185 (2x350 mcm)	2x185 (2x350 mcm)	2x185 (2x350 mcm)	2x185 (2x350 mcm)

Table 9: Maximum Number and Size of E3h/E4h Power Cables, 525–690 V

E3h/E4h	N450	N500	N560	N630	N710	N800
Mains and motor [mm2 (AWG)]	6x240 (6x500 mcm)	6x240 (6x500 mcm)	6x240 (6x500 mcm)	6x240 (6x500 mcm)	6x240 (6x500 mcm)	6x240 (6x500 mcm)
Brake [mm2 (AWG)]	2x185 (2x350 mcm)	2x185 (2x350 mcm)	2x185 (2x350 mcm)	2x185 (2x350 mcm)	2x185 (2x350 mcm)	2x185 (2x350 mcm)
Load share or regen [mm2 (AWG)]	4x185 (4x350 mcm)	4x185 (4x350 mcm)	4x185 (4x350 mcm)	4x185 (4x350 mcm)	4x185 (4x350 mcm)	4x185 (4x350 mcm)

4.5 Grounding Guidelines

⚠ W A R N I N G ⚠

LEAKAGE CURRENT HAZARD

Leakage currents exceed 3.5 mA. Failure to ground the drive properly can result in death or serious injury.

– Ensure that the minimum size of the ground conductor complies with the local safety regulations for high touch current equipment.

For electrical safety:

- Ground the drive in accordance with applicable standards and directives.
- Use a dedicated ground wire for input power, motor power, and control cabling.
- Do not ground 1 drive to another in a daisy chain fashion.
- Keep the ground wire connections as short as possible.
- Follow motor manufacturer wiring requirements.
- Minimum cable cross-section: 10 mm^2 (6 AWG) (or 2 rated ground wires terminated separately).
- Tighten the terminals in accordance with the information provided in the Fastener Torque Rating section.

For EMC-compliant installation

- Establish electrical contact between the cable shield and the drive enclosure by using metal cable glands or by using the clamps provided on the equipment.
- Reduce burst transient by using high-strand wire.
- Do not use twisted shield ends (pigtails).

NOTICE

POTENTIAL EQUALIZATION

There is a risk of burst transient when the ground potential between the drive and the control system is different.

– Install equalizing cables between the system components. Recommended cable cross-section: 16 mm^2 (5 AWG).

4.6 Fuses

Fuses installed on the supply side ensure that if a component breakdown (first fault) occurs inside the drive, any potential damage is contained inside the drive enclosure. To ensure compliance with EN 50178, use identical Bussmann fuses as replacements. Refer to Table 10.

NOTICE

IEC 60364 (CE) AND NEC 2009 (UL) COMPLIANCE

Drives without supply side fuses do not meet IEC 60364 (CE) and NEC 2009 (UL) compliant installation standards.

– Install specified fuses on the supply side of the installation.

Table 10: Fuse Options for Drive Protection

Input voltage (V)	Model	Bussmann part number
380–480	N355–N400	170M6014
380–480	N450–N560	170M7309
525–690	All	170M7342

The fuses listed in Table 10 are suitable for use on a circuit capable of delivering 100000 A_{rms} (symmetrical), depending on the drive voltage rating. With the proper fusing, the drive short-circuit current rating (SCCR) is 100000 A_{rms}. E1h and E2h drives are supplied with internal drive fusing to meet the 100 kA SCCR. E3h and E4h drives must be fitted with Type aR fuses to meet the 100 kA SCCR.

NOTICE

DISCONNECT SWITCH SCCR REQUIREMENTS

All units ordered and supplied with a factory-installed disconnect switch require Class L branch circuit fusing to meet the 100 kA SCCR for the drive.

– If a circuit breaker is used, the SCCR rating is 42 kA. The input voltage and power rating of the drive determines the specific Class L fuse. The input voltage and power rating are found on the product nameplate.

Table 11: Disconnect Switch SCCR Requirements

Input voltage (V)	Model	Short circuit rating (A)	Required protection
380–480	N355–N450	42000	Circuit breaker
		100000	Class L fuse, 800 A
380–480	N500–N560	42000	Circuit breaker
		100000	Class L fuse, 1200 A
525–690	N450–N630	42000	Circuit breaker
		100000	Class L fuse, 800 A

Input voltage (V)	Model	Short circuit rating (A)	Required protection
525–690	N710–N800	42000	Circuit breaker
		100000	Class L fuse, 1200 A

4.7 Short-circuit Current Rating (SCCR)

The short-circuit current rating (SCCR) represents the maximum level of short-circuit current that the drive can safely withstand. With the proper fusing, the drive short-circuit current rating (SCCR) is 100000 A_{rms}. E1h and E2h drives are supplied with internal drive fusing to meet the 100 kA SCCR. E3h and E4h drives must be fitted with Type aR fuses to meet the 100 kA SCCR.

N O T I C E

DISCONNECT SWITCH SCCR REQUIREMENTS

All units ordered and supplied with a factory-installed disconnect switch require Class L branch circuit fusing to meet the 100 kA SCCR for the drive.

- If a circuit breaker is used, the SCCR rating is 42 kA. The input voltage and power rating of the drive determines the specific Class L fuse. The input voltage and power rating are found on the product nameplate.

Table 12: Disconnect Switch SCCR Requirements

Input voltage (V)	Model	Short circuit rating (A)	Required protection
380–480	N355–N450	42000	Circuit breaker
		100000	Class L fuse, 800 A
380–480	N500–N560	42000	Circuit breaker
		100000	Class L fuse, 1200 A
525–690	N450–N630	42000	Circuit breaker
		100000	Class L fuse, 800 A
525–690	N710–N800	42000	Circuit breaker
		100000	Class L fuse, 1200 A

4.8 Terminal Locations

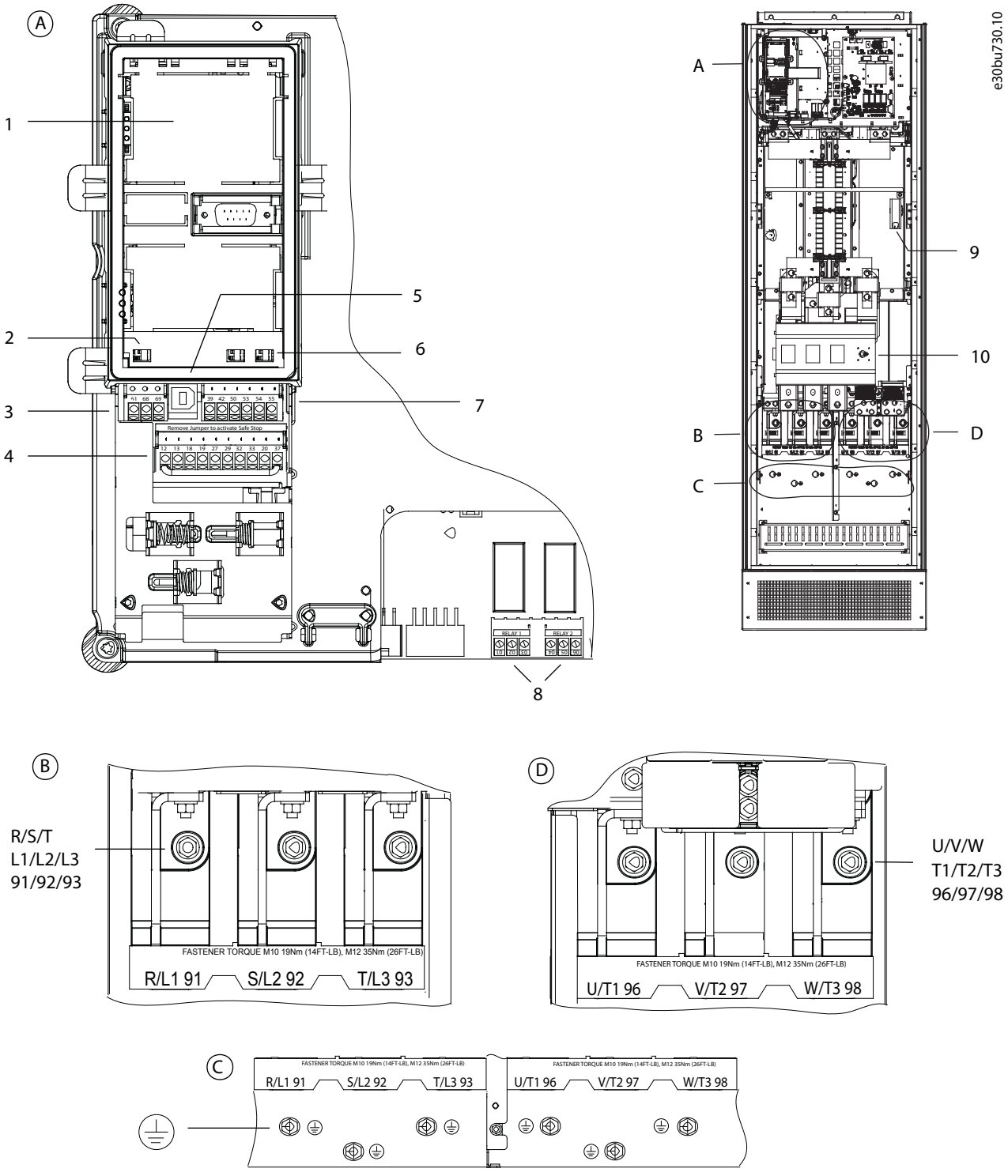

Illustration 10: Terminal Locations (E1h shown)

1	LCP cradle (LCP not shown)	6	Analog input switches A53/A54 (see 5.11 Selecting the Voltage/Current Input Signal)
2	Bus terminal switch (see 5.7.2 Configuring RS485 Serial Communication)	7	Analog input/output terminals (see Table 15)
3	Serial communication terminals (see Table 13)	8	Relay terminals (see 5.3 Relay Terminals)
4	Digital input/output terminals (see Table 14)	9	Space heater (see 5.9 Space Heater Wiring)
5	USB port	10	Auxiliary contact terminals (see 5.10 Auxiliary Contact Wiring for Disconnects)

4.9 Connecting the Mains and Motor Terminals

- Comply with local and national electrical codes for cable sizes. Refer to the Cable Specifications section.
- Size the power cabling based on the input current of the drive. The input current is listed on the drive nameplate.
- If using more than 1 cable per phase, make sure that the following applies:
  - All cables are the same type.
  - All cables have the same cross-section.
  - All cable lengths are within 10% of one another.
- Follow motor manufacturer wiring requirements.
- Use the gland plates provided with the drives to maintain proper protection ratings.
- Do not wire a starting or pole-changing device (for example Dahlander motor or slip ring asynchronous motor) between the drive and the motor.

Procedure

⚠ WARNING ⚠

INDUCED VOLTAGE

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

- Run output motor cables separately or use shielded cables.
- Simultaneously lock out all the drives.

NOTICE

OUTPUT CONTACTOR

Trane does not recommend using an output contactor on 525–690 V drives that are connected to an IT mains network.

NOTICE

IT MAINS/FLOATING DELTA/GROUNDED DELTA

If using an isolated mains source (IT mains or floating delta) or TT/TN-S mains with a grounded leg (grounded delta), ground capacity currents can be reduced and damage can occur to the DC link if *parameter 14-50 RFI Filter* is not turned off.

- Ensure that *parameter 14-50 RFI Filter* is set to *[0] Off*.

1. Strip a section of the outer cable insulation.
2. Secure the stripped end of the cable to a crimp lug or box lug.
3. Connect the ground wire to the holes in the busbar that correspond with the nearest grounding terminal. Refer to 4.5 Grounding Guidelines.
4. Secure the power connections. Refer to the *Terminal Locations* section.
   a. For motor connections, connect the 3-phase motor wiring to the holes in the busbar that correspond with terminals 96 (U), 97 (V), and 98 (W).

b. For mains connections, connect the 3-phase AC input power wiring to the holes in the busbar that correspond with terminals 91 (R), 92 (S), and 93 (T).

When supplied from an isolated mains source (IT mains or floating delta) or TT/TN-S mains with a grounded leg (grounded delta), ensure that parameter 14-50 RFI Filter is set to [0] Off to avoid damage to the DC link and to reduce ground capacity currents.

5. Tighten the terminals in accordance with the specifications shown in the Fastener Torque Ratings section.

5 Controls and Options Installation

5.1 Accessing and Routing Control Cables

All control terminals are inside the drive below the LCP. To access, either open the door or remove the front panel.

Procedure

1. Tie down and route all control cables down the left side of the enclosure.
2. Isolate control cables from high-power cables in the drive.
3. Connect the shields in a proper way to ensure optimum electrical immunity.
4. When the drive is connected to a thermistor, ensure that the thermistor control cable is shielded and reinforced/double insulated. A 24 V DC supply is recommended.
5. Connect the control cables to the relevant options on the control card. For more detail, see the relevant fieldbus instructions. The fieldbus cable must be tied down and routed along with the other control cables inside the unit

5.2 Control Terminals

For control terminal locations, see the Terminal Locations section.

Table 13: RS485 Serial Communication Terminals

Terminal	Parameter	Default setting	Description
61	–	–	Integrated RC-filter for cable shield. ONLY for connecting the shield if EMC problems exist.
68	*Parameter group 8-3* FC Port Settings*	–	RS485 interface. A switch (BUS TER.) is provided on the control card for bus termination resistance. See the Terminal Locations section.
69	*Parameter group 8-3* FC Port Settings*	–	

Table 14: Digital Input/Output Terminal Descriptions

Terminal	Parameter	Default setting	Description
12, 13	–	+24 V DC	24 V DC supply voltage for digital inputs and external transducers. Maximum output current 200 mA for all 24 V loads.
18	*Parameter 5-10 Terminal 18 Digital Input*	*[8] Start*	Digital inputs.
19	*Parameter 5-11 Terminal 19 Digital Input*	*[10] Reversing*	
32	*Parameter 5-14 Terminal 32 Digital Input*	*[0] No operation*	
33	*Parameter 5-15 Terminal 33 Digital Input*	*[0] No operation*	
27	*Parameter 5-12 Terminal 27 Digital Input*	*[2] Coast inverse*	For digital input or output. Default setting is input.
29	*Parameter 5-13 Terminal 29 Digital Input*	*[14] JOG*	
20	–	–	Common for digital inputs and 0 V potential for 24 V supply.
37	–	STO	(Optional feature) When not using the STO feature, a jumper wire is required between terminal 12 (or 13) and terminal 37. This setup allows the drive to operate with factory default programming values.

Table 15: Analog Input/Output Terminal Descriptions

Terminal	Parameter	Default setting	Description
39	–	–	Common for analog output.
42	*Parameter 6-50 Terminal 42 Output*	*[0] No operation*	Programmable analog output. 0–20 mA or 4–20 mA at a maximum of 500 Ω.
50	–	+10 V DC	10 V DC analog supply voltage for potentiometer or thermistor. 15 mA maximum.
53	*Parameter group 6-1* Analog Input 1*	Reference	Analog input. For voltage (V) or current (mA).
54	*Parameter group 6-2* Analog Input 2*	Feedback	
55	–	–	Common for analog input.

5.3 Relay Terminals

Relays 1 and 2 are standard relay terminals included on all drives. For relay terminal location, see the Terminal Locations section.

Table 16: Relay 1 Terminal Descriptions

Terminal	Parameter	Default setting	Description
01: common	*Parameter 5-40 Function Relay [0]*	*[0] No operation*	Form C relay output. For AC or DC voltage and resistive or inductive loads.
02: normally open			
03: normally closed			

Table 17: Relay 2 Terminal Descriptions

Terminal	Parameter	Default setting	Description
04: common	*Parameter 5-40 Function Relay [1]*	*[0] No operation*	Form C relay output. For AC or DC voltage and resistive or inductive loads.
05: normally open			
06: normally closed			

5.4 Connecting the Control Cable to the Control Terminals

The control terminals are located near the LCP, as shown in Illustration 10. The control terminal connectors can be unplugged from the drive for convenience when wiring. Either solid or flexible wire can be connected to the control terminals. For minimum and maximum control cable cross-section, refer to the Cable Specifications section.

NOTICE

ELECTRICAL INTERFERENCE

Minimize interference by keeping control wires as short as possible and separate from high-power cables.

Procedure

1. Strip 10 mm (0.4 in) of the outer plastic layer from the end of the wire.
2. Insert the control wire into the terminal.
   - For a solid wire, push the bare wire into the contact.
   - For a flexible wire, open the contact by inserting a small screwdriver into the slot between the terminal holes and push the screwdriver inward. Then insert the stripped wire into the contact, and remove the screwdriver.
3. Pull gently on the wire to ensure that the contact is firmly established.

Loose control cable can cause equipment faults or reduced performance.

Example

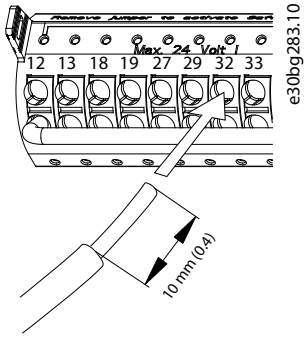

Illustration 11: Connecting a Solid Control Cable to the Terminal Box

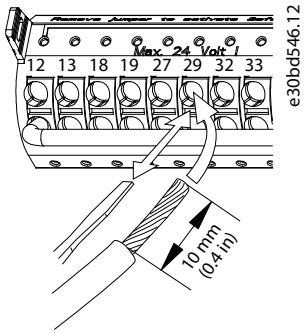

Illustration 12: Connecting a Flexible Control Cable to the Terminal Box

5.5 Disconnecting the Control Cable from the Control Terminals

Procedure

1. To open the contact, insert a small screwdriver into the slot between the terminal holes and push the screwdriver inward.
2. Pull gently on the wire to free it from the control terminal contact.

5.6 Enabling Motor Operation

If the status line at the bottom of the LCP reads AUTO REMOTE COAST, the unit is ready to operate, but is missing an input signal on terminal 27. Digital input terminal 27 is designed to receive a 24 V DC external interlock command that allows the drive to operate when using factory default programming values.

N O T I C E

FACTORY-INSTALLED OPTIONAL EQUIPMENT

Do not remove factory-installed wiring to terminal 27. If the drive does not run, refer to the documentation for the optional equipment that is wired into terminal 27.

Procedure

1. When no interlock device is used, wire a jumper between control terminal 12 (recommended) or 13 to terminal 27.

   This wire provides an internal 24 V signal on terminal 27. The drive is ready for operation.

5.7 Configuring RS485 Serial Communication

5.7.1 RS485 Features

RS485 is a 2-wire bus interface compatible with multi-drop network topology. This interface contains the following features:

- Several communication protocols to choose from.

- FC
- Modbus RTU
- Metasys N2
- FLN
- BACnet

- Functions can be programmed remotely using the protocol software and RS485 connection or in *parameter group 8-** Communications and Options*.
- Selecting a specific communication protocol changes various default parameter settings to match the specifications of the protocol, making more protocol-specific parameters available.
- Option cards for the drive are available to provide more communication protocols. See the option card documentation for installation and operation instructions.
- A switch (BUS TER) is provided on the control card for bus termination resistance.

5.7.2 Configuring RS485 Serial Communication

Procedure

1. Connect RS485 serial communication wiring to terminals (+)68 and (-)69.
   a. Use shielded serial communication cable (recommended).
   b. See the *Connecting to Ground* section for proper grounding.
2. Select the following parameter settings:
   a. Protocol type in *parameter 8-30 Protocol*.
   b. Drive address in *parameter 8-31 Address*.
   c. Baud rate in *parameter 8-32 Baud Rate*.

Example

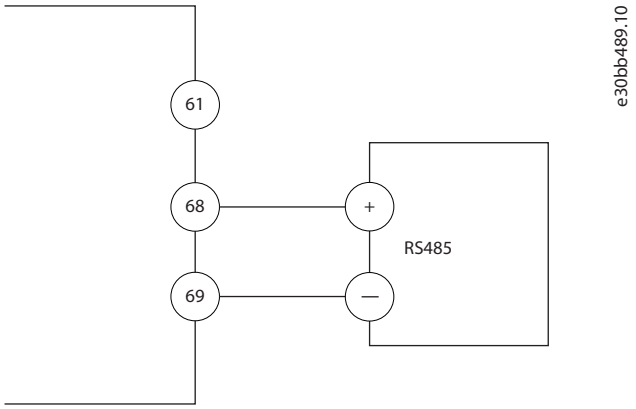

Illustration 13: Serial Communication Wiring Diagram

5.8 Safe Torque Off (STO) Wiring

The Safe Torque Off (STO) function is a component in a safety control system. STO is an optional feature that, if needed, should be selected when ordering the drive. This feature prevents the unit from generating the voltage required to rotate the motor. To run the STO function, more wiring for the drive is required. Refer to the *Safe Torque Off Operating Guide*.

5.9 Space Heater Wiring

The space heater is an option used to prevent condensation from forming inside the enclosure when the unit is turned off. It is field wired and controlled by an HVAC management system.

Specifications:

- Nominal voltage: 100–240
- Wire size: 12–24 AWG (4–0.25 mm^2)

5.10 Auxiliary Contact Wiring for Disconnects

The disconnect is an option that is installed at the factory. The auxiliary contacts, which are signal accessories used with the disconnect, are not installed at the factory to allow more flexibility during installation.

The contacts snap into place without the need for tools., but they must be installed in specific locations on the disconnect depending on their functions. Refer to the datasheet included in the accessory bag that comes with the drive.

Specifications:

- U_i/[V]: 690
- U_{imp}/[kV]: 4
- Pollution degree: 3
- I_{th}/[A]: 16
- Cable size: 1...2x18...14 AWG (0.75...2.5 mm^2)
- Maximum fuse: 16 A/gG
- NEMA: A600, R300, wire size: 18–14 AWG (0.75–2.5 mm^2), 1(2)

5.11 Selecting the Voltage/Current Input Signal

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

- *Parameter 16-61 Terminal 53 Switch Setting* shows the setting for A53.
- *Parameter 16-63 Terminal 54 Switch Setting* shows the setting for A54.

Procedure

1. Disconnect power to the drive.
2. Remove the LCP (local control panel). See the *Local Control Panel (LCP)* section.
3. Remove any optional equipment covering the switches.
4. Set switches A53 and A54 to select the signal type (U = voltage, I = current). See Illustration 14.

Example

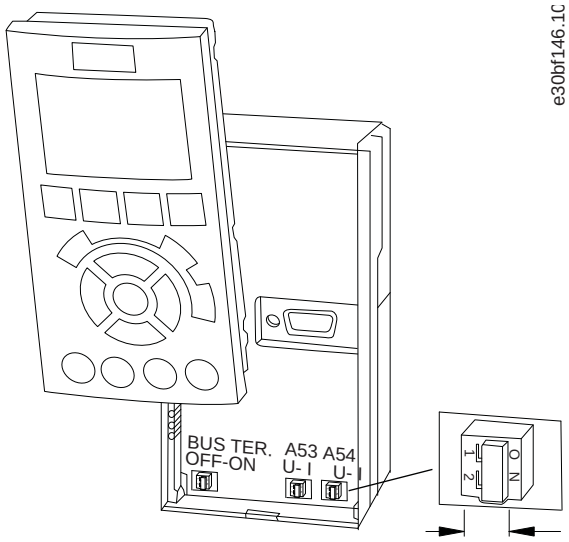

Illustration 14: Location of Switches A53 and A54

6 Operating the Drive

6.1 Pre-start Check List

Table 18: Pre-start Check List

Inspect	✓	Check for
Motor		Confirm continuity of the motor by measuring ohm values on U–V (96–97), V–W (97–98), and W–U (98–96).
		Confirm that the supply voltage matches the voltage of the drive and the motor.
Switches		Ensure that all switch and disconnect settings are in the proper positions.
Auxiliary equipment		Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers that reside on the input power side of the drive or output side to the motor. Ensure that they are ready for full-speed operation.
		Check function and installation of any sensors used for feedback to the drive.
		Remove any power factor correction capacitors installed between the drive and the motor..
		Adjust any power factor correction capacitors on the mains side and ensure that they are dampened.
Cable routing		Check that all cable glands are firmly tightened.
		Ensure that motor wiring, brake wiring (if equipped), and control wiring are separated or shielded, or in 3 separate metallic conduits for high-frequency interference isolation.
Control cables		Check for broken or damaged wires and loose connections.
		Check that control wiring is isolated from high-power wiring for noise immunity.
		Check the voltage source of the signals, if necessary.
		Use shielded cable or twisted pair and ensure that the shield is terminated correctly.
Input/output cables		Check for loose connections.
		Check that motor and mains are in separate conduit or separated shielded cables.
Grounding		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 grounding.
Fuses and circuit breakers		Check for proper fusing or circuit breakers
		Check that all fuses are inserted firmly and are in operational condition and that all circuit breakers (if used) are in the open position.
Cooling		Look for any obstructions in the airflow path.
		Measure top and bottom clearance of the drive to verify adequate airflow for cooling, see the *Cooling Requirements* section.
Ambient conditions		Check that requirements for ambient conditions are met. See the *Ambient Conditions* section.
Interior of the drive		Inspect that the unit interior is free of dirt, metal chips, moisture, and corrosion.
		Verify that all installation tools have been removed from unit interior.
		For IP20/Type 1 enclosures, ensure that the unit is mounted on an unpainted, metal surface.

Inspect	✓	Check for
Vibration		Check that the unit is mounted solidly, or that shock mounts are used, if necessary.
		Check for an unusual amount of vibration.

6.2 Applying Power to the Drive

Before applying power to the drive, verify that the drive and any associated equipment is ready for operation. Refer to the Pre-start Check List. For detailed commissioning and programming information, refer to the programming guide.

Procedure

⚠ WARNING ⚠

UNINTENDED START

When the drive is connected to the AC mains, DC supply, or load sharing, the motor may start at any time, causing risk of death, serious injury, and equipment or property damage. The motor may start by activation of an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up software, or after a cleared fault condition.

- Press [Off] on the LCP before programming parameters.
- Disconnect the drive from the mains whenever personal safety considerations make it necessary to avoid unintended motor start.
- Check that the drive, motor, and any driven equipment are in operational readiness.

NOTICE

MISSING SIGNAL

If the status line at the bottom of the LCP reads AUTO REMOTE COASTING, or *alarm 60, External interlock* is shown, it indicates that the unit is ready to operate but is missing an input signal on, for example, terminal 27.

- See 5.6 Enabling Motor Operation for details.

1. Confirm that the input voltage is balanced within 3%. If not balanced, correct the input voltage imbalance before proceeding. Repeat this procedure after the voltage correction.
2. Ensure that any optional equipment wiring matches the installation requirements.
3. Ensure that all operator devices are in the OFF position.
4. Close and securely fasten all covers and doors on the drive.
5. Apply power to the unit, but do not start the drive. For units with a disconnect switch, turn the switch to the ON position to apply power to the drive.
6. Power up the LCP.
7. Follow the prompts on the LCP to perform initial set up. For more information on the LCP functions or the initial set up, refer to the programming guide.

6.3 Local Control Panel (LCP)

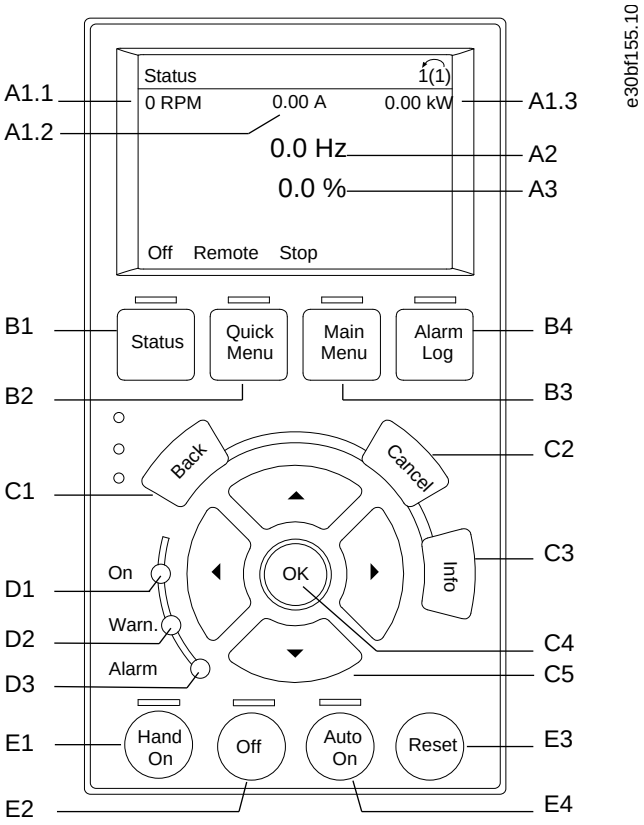

Illustration 15: Graphical Local Control Panel (LCP)

The local control panel (LCP) is the combined display and keypad on the front of the drive. The LCP is used to:

- Control the drive and motor.
- Access drive parameters and program the drive.
- Show operational data, drive status, and warnings.

A numeric local control panel (NLCP) is available as an option. The NLCP operates in a manner similar to the LCP, but there are differences. For details on how to use the NLCP, see the product-specific programming guide.

A. Display area

Each display readout has a parameter associated with it. The information shown on the LCP can be customized for specific applications. Refer to *My Personal Menu* in the *LCP Menu* section.

Table 19: LCP Display Area

Callout	Parameter	Default setting
A1.1	*Parameter 0-20 Display Line 1.1 Small*	ReferenceSpeed [%]
A1.2	*Parameter 0-21 Display Line 1.2 Small*	Motor current [A]
A1.3	*Parameter 0-22 Display Line 1.3 Small*	Power [kW]
A2	*Parameter 0-23 Display Line 2 Large*	Frequency [Hz]
A3	*Parameter 0-24 Display Line 3 Large*	kWh counter

B. Menu keys

Menu keys are used to access the menu for setting up parameters, toggling through status display modes during normal operation, and viewing fault log data.

Table 20: LCP Menu Keys

Callout	Key	Function
B1	Status	Shows operational information.
B2	Quick Menu	Allows access to parameters for initial set-up instructions. Also provides detailed application steps. Refer to *Quick Menu mode* in the *LCP Menu* section.
B3	Main Menu	Allows access to all parameters. Refer to *Main Menu mode* in the *LCP Menu* section.
B4	Alarm Log	Shows a list of current warnings and the last 10 alarms.

C. 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. The display brightness can be adjusted by pressing [Status] and [▵]/[▿] keys.

Table 21: LCP Navigation Keys

Callout	Key	Function
C1	Back	Reverts to the previous step or list in the menu structure.
C2	Cancel	Cancels the last change or command as long as the display mode has not changed.
C3	Info	Shows a definition of the function being shown.
C4	OK	Accesses parameter groups or enables an option.
C5	[▵][▹] [▿] [◃]	Moves between items in the menu.

D. Indicator lights

Indicator lights identify the drive status and provide a visual notification of warning or fault conditions.

Table 22: LCP Indicator Lights

Callout	Indicator	LED	Function
D1	On	Green	Activates when the drive receives power from the mains voltage or a 24 V external supply.
D2	Warn.	Yellow	Activates when warning conditions are active. Text appears in the display area identifying the problem.
D3	Alarm	Red	Activates during a fault condition. Text appears in the display area identifying the problem.

E. Operation keys and reset

The operation keys are found toward the bottom of the local control panel.

Table 23: LCP Operation Keys and Reset

Callout	Key	Function
E1	[Hand On]	Starts the drive in local control. An external stop signal by control input or serial communication overrides the local [Hand On].
E2	Off	Stops the motor but does not remove power to the drive.
E3	Reset	Resets the drive manually after a fault has been cleared.
E4	Auto On	Puts the system in remote operational mode so it can respond to an external start command by control terminals or serial communication.

6.4 LCP Menu

Quick Menus

The *Quick Menus* mode provides a list of menus used to configure and operate the drive. Select the *Quick Menus* mode by pressing the [Quick Menus] key. The resulting readout appears on the LCP display.

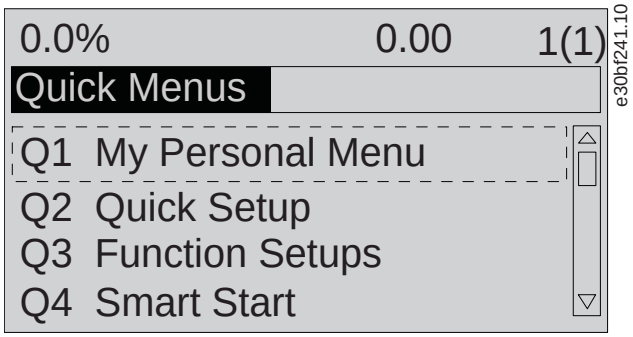

Illustration 16: Quick Menu View

Q1 My Personal Menu

The *Personal Menu* is used to determine what is shown in the display area. Refer to 6.3 Local Control Panel (LCP). This menu can also show up to 50 pre-programmed parameters. These 50 parameters are manually entered using *parameter 0-25 My Personal Menu*.

Q2 Quick Setup

The parameters found in the *Q2 Quick Setup* contain basic system and motor data that are always necessary for configuring the drive. See 6.5 Entering System Information for the set-up procedures.

Q3 Function Setups

The parameters found in the *Q3 Function Setups* contain data for fan, compressor, and pump functions. This menu also includes parameters for LCP display, digital preset speeds, scaling of analog references, closed-loop single zone, and multizone applications.

Q4 Smart Setup

Q4 Smart Setup guides the user through typical parameter settings used to configure 1 of the following 3 applications:

- Mechanical brake.
- Conveyor.
- Pump/fan.

The [Info] key can be used to see help information for various selections, settings, and messages.

Q5 Changes Made

Select *Q5 Changes Mode* for information about:

- The 10 most recent changes.
- Changes made from default setting.

Q6 Loggings

Use *Q6 Loggings* for fault finding. To get information about the display line readout, select Loggings. The information is shown as graphs. Only parameters selected in *parameter 0-20 Display Line 1.1 Small* through *parameter 0-24 Display Line 3 Large* can be viewed. It is possible to store up to 120 samples in the memory for later reference.

Table 24: Logging Parameter Examples

Q6 Loggings	
Parameter 0-20 Display Line 1.1 Small	Reference [%]
Parameter 0-21 Display Line 1.2 Small	Motor Current [A]
Parameter 0-22 Display Line 1.3 Small	Power [kW]
Parameter 0-23 Display Line 2 Large	Frequency
Parameter 0-24 Display Line 3 Large	kWh Counter

Main Menu

The *Main Menu* mode is used to:

- List the parameter groups available to the drive and drive options.
- Change parameter values.

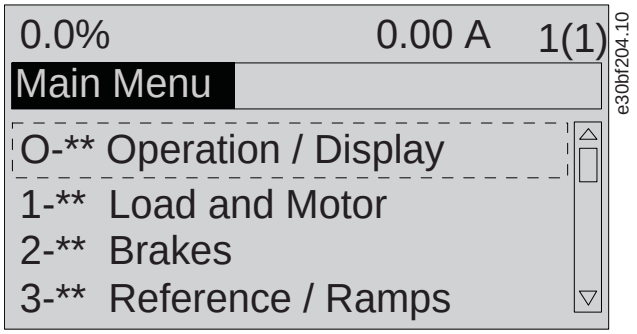

Illustration 17: Main Menu View

6.5 Entering System Information

The following steps are used to enter basic system information into the drive. Recommended parameter settings are intended for start-up and checkout purposes. Application settings vary.

Although these steps assume that an induction motor is used, a permanent magnet motor can also be used. For more information on specific motor types, see the product-specific programming guide.

N O T I C E

SOFTWARE DOWNLOAD

For commissioning via a PC, install the Motion Control Tool MCT 10 set-up software. A basic version, which is sufficient for most applications, is available for download.

– See https://www.tranedrives.com/software/index.html

Procedure

1. Press [Main Menu] on the LCP.
2. Select *0–** Operation/Display* and press [OK].
3. Select *0–0* Basic Settings* and press [OK].
4. Select *parameter 0-03 Regional Settings* and press [OK].
5. Select *[0] International* or *[1] North America* as appropriate and press [OK]. (This action changes the default settings for some basic parameters).
6. Press [Quick Menus] on the LCP and then select *02 Quick Setup*.
7. If needed, change the following parameter settings. Motor data is found on the motor nameplate.
    a. *Parameter 0-01 Language* (English)
    b. *Parameter 1-20 Motor Power [kW]* (4.00 kW)
    c. *Parameter 1-22 Motor Voltage* (400 V)
    d. *Parameter 1-23 Motor Frequency* (50 Hz)
    e. *Parameter 1-24 Motor Current* (9.00 A)
    f. *Parameter 1-25 Motor Nominal Speed* (1420 RPM)
    g. *Parameter 5-12 Terminal 27 Digital Input* (Coast Inverse)
    h. *Parameter 3-02 Minimum Reference* (0.000 RPM)
    i. *Parameter 3-03 Maximum Reference* (1500.000 RPM)
    j. *Parameter 3-41 Ramp 1 Ramp up Time* (3.00 s)
    k. *Parameter 3-42 Ramp 1 Ramp Down Time* (3.00 s)
    l. *Parameter 3-13 Reference Site* (Linked to Hand/Auto)
    m. *Parameter 1-29 Automatic Motor Adaptation (AMA)* (Off)

6.6 Testing Before System Start Up

⚠ WARNING ⚠

MOTOR START

Failure to ensure that the motor, system, and any attached equipment are ready for start can result in personal injury or equipment damage. Before start,

- Ensure that equipment is safe to operate under any condition.
- Ensure that the motor, system, and any attached equipment are ready for start.

6.6.1 Testing Motor Rotation

NOTICE

INCORRECT MOTOR ROTATION

If the motor runs in the wrong direction, it can damage equipment.

- Before running the unit, check the motor rotation by briefly running the motor.

Procedure

1. Press [Hand On].
2. Move the left cursor to the left of the decimal point by using the left arrow key.
3. Enter an RPM that slowly rotates the motor and press [OK].

   The motor runs briefly at either 5 Hz or the minimum frequency set in *parameter 4-12 Motor Speed Low Limit [Hz]*.
4. If the motor rotation is wrong, set *parameter 1-06 Clockwise Direction* to *[1] Inverse*.

6.7 Starting Up the Drive for the First Time

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

⚠ WARNING ⚠

MOTOR START

Starting the drive can cause the motor to start. Failure to ensure that the motor, system, and any attached equipment are ready for start can result in personal injury or equipment damage.

- Ensure that equipment is safe to operate under any condition.
- Ensure that the motor, system, and any attached equipment are ready for start.

1. Press [Auto On].

   If warnings or alarms occur, see the *Warnings and Alarms* section.
2. Apply an external run command. Examples of external run commands are a switch, button, or programmable logic controller (PLC).
3. Adjust the speed reference throughout the speed range.
4. Ensure that the system is working as intended by checking the sound and vibration levels of the motor.
5. Remove the external run command.

6.8 Status Messages

6.8.1 Status Message Overview

When the drive is in status mode, status messages automatically appear in the bottom line of the LCP display.

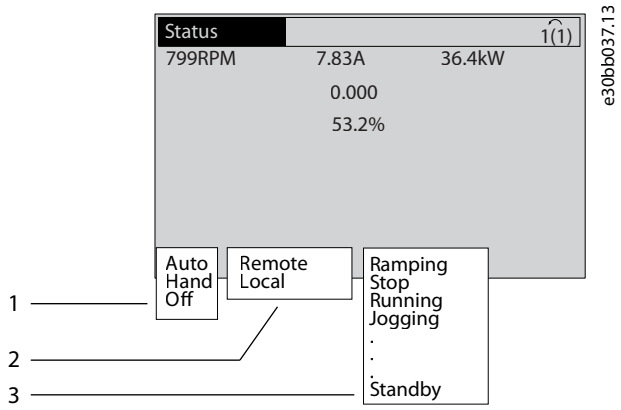

Illustration 18: Status Display

1	See 6.8.2 Status Messages - Operating Mode.	3	See 6.8.4 Status Messages - Operation Status.
2	See 6.8.3 Status Messages - Reference Site.		

6.8.2 Status Messages - Operating Mode

Table 25: Operating Mode

Operating mode	Description
Auto	The drive requires external commands to execute functions. The start/stop commands are sent via the control terminals and/or the serial communication.
Hand	The navigation keys on the LCP can be used to control the drive. Stop commands, reset, reversing, DC brake, and other signals applied to the control terminals override local control.
Off	The drive does not react to any control signal until [Auto On] or [Hand On] is pressed.

6.8.3 Status Messages - Reference Site

Table 26: Reference Site

Reference site	Description
Remote	The speed reference is given from: • External signals. • Serial communication. • Internal preset references.
Local	The drive uses reference values from the LCP.

6.8.4 Status Messages - Operation Status

Table 27: Operation Status

Operation status	Description
AC brake	AC brake was selected in *parameter 2-10 Brake Function*. The AC brake overmagnetizes the motor to achieve a controlled slow down.
AMA finish OK	Automatic motor adaptation (AMA) was carried out successfully.
AMA ready	AMA is ready to start. To start, press [Hand On].

Operation status	Description
AMA running	AMA process is in progress.
Braking	The brake chopper is in operation. The brake resistor absorbs the generative energy.
Braking max.	The brake chopper is in operation. The power limit for the brake resistor defined in *parameter 2-12 Brake Power Limit (kW)* has been reached.
Coast	• *[2] Coast inverse* was selected as a function for a digital input (*parameter group 5–1* Digital Inputs*). The corresponding terminal is not connected. • Coast activated by serial communication. • No output from the drive to the motor.
Ctrl. ramp-down	*[1] Ctrl. ramp-down* was selected in *parameter 14-10 Mains Failure*. • The mains voltage is below the value set in *parameter 14-11 Mains Voltage at Mains Fault*. • The drive ramps down the motor in a controlled manner.
Current high	The drive output current is above the limit set in *parameter 4-51 Warning Current High*.
Current low	The drive output current is below the limit set in *parameter 4-52 Warning Speed Low*.
DC hold	DC hold is selected in *parameter 1-80 Function at Stop* and a stop command is active. The motor is held by a DC current set in *parameter 2-00 DC Hold Current*.
DC stop	The motor is held with a DC current (*parameter 2-01 DC Brake Current*) for a specified time (*parameter 2-02 DC Braking Time*). • DC brake is activated in *parameter 2-03 DC Brake Cut In Speed [RPM]* and a stop command is active. • DC brake (inverse) is selected as a function for a digital input (*parameter group 5–1* Digital Inputs*). The corresponding terminal is not active. • The DC brake is activated via serial communication.
Feedback high	The sum of all active feedback is above the feedback limit set in *parameter 4-57 Warning Feedback High*.
Feedback low	The sum of all active feedback is below the feedback limit set in *parameter 4-56 Warning Feedback Low*.
Freeze output	The remote reference is active, which holds the present speed. • *[20] Freeze Output* was selected as a function for a digital input (*parameter group 5–1* Digital Inputs*). The corresponding terminal is active. Speed control is only possible via the terminal functions speed up and speed down. • Hold ramp is activated via serial communication.
Freeze output request	A freeze output command has been given, but the motor remains stopped until a run permissive signal is received.
Freeze ref.	*[19] Freeze Reference* was selected as a function for a digital input (*parameter group 5–1* Digital Inputs*). 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 is stopped until a run permissive signal is received via a digital input.
Jogging	The motor is running as programmed in *parameter 3-19 Jog Speed [RPM]*.

Operation status	Description
	• *[14] Jog* was selected as function for a digital input (*parameter group 5–1* Digital Inputs*). The corresponding terminal (for example, 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 (for example, No signal). The monitoring function is active.
Motor check	In *parameter 1-80 Function at Stop, [2] Motor Check* was selected. A stop command is active. To ensure that a motor is connected to the drive, a permanent test current is applied to the motor.
OVC control	Overvoltage control was activated by *[2] Enabled* in *parameter 2-17 Over-voltage Control*. 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.
Power unit off	(For drives with a 24 V external supply installed only.) Mains supply to the drive is removed, but the control card is supplied by the external 24 V.
Protection md	Protection mode is active. The unit has detected a critical status (an overcurrent or overvoltage). • To avoid tripping, the switching frequency is reduced to 1.5 kHz if *parameter 14-55 Output Filter* is set to *[2] Sine-Wave Filter Fixed*. Otherwise, the switching frequency is reduced to 1.0 kHz. • If possible, protection mode ends after approximately 10 s. • Protection mode can be restricted in *parameter 14-26 Trip Delay at Inverter Fault*.
Qstop	The motor is decelerating using *parameter 3-81 Quick Stop Ramp Time*. • *[4] Quick stop inverse* was selected as a function for a digital input (*parameter group 5–1* Digital Inputs*). The corresponding terminal is not active. • The quick stop function was activated via serial communication.
Ramping	The motor is accelerating/decelerating using the active ramp up/down. The reference, a limit value, or a standstill is not yet reached.
Ref. high	The sum of all active references is above the reference limit set in *parameter 4-55 Warning Reference High*.
Ref. low	The sum of all active references is below the reference limit set in *parameter 4-54 Warning Reference Low*.
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 drive is driving the motor.
Sleep mode	The energy-saving function is enabled. This function being enabled means that now the motor has stopped, but that it restarts automatically when required.
Speed high	The motor speed is above the value set in *parameter 4-53 Warning Speed High*.
Speed low	The motor speed is below the value set in *parameter 4-52 Warning Speed Low*.
Standby	In auto-on mode, the drive starts the motor with a start signal from a digital input or serial communication.
Start delay	In *parameter 1-71 Start Delay*, a delay starting time was set. A start command is activated and the motor starts after the start delay time expires.
Start fwd/rev	*[12] Enable Start Forward* and *[13] Enable Start Reverse* were selected as functions for 2 different digital inputs (*parameter group 5–1* Digital Inputs*). The motor starts in forward or reverse depending on which corresponding terminal is activated.

Operation status	Description
Stop	The drive has received a stop command from 1 of the following: • LCP. • Digital input. • Serial communication.
Trip/Trip lock	An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, reset the drive using 1 of the following: • Pressing [Reset]. • Remotely by control terminals. • Via serial communication.

6.9 Warnings and Alarms

6.9.1 Warning and Alarm Types

Alarm

An alarm indicates a fault that requires immediate attention. The fault always triggers a trip or trip lock. Reset the drive after an alarm using 1 of the following methods:

- Press [Reset]/[Off/Reset].
- Digital reset input command.
- Serial communication reset input command.
- Auto reset.

Warning

A state entered in fault situations, for example if the drive is subject to an overtemperature or when the drive is protecting the motor, process, or mechanism. The drive prevents a restart until the cause of the fault has disappeared. To cancel the trip state, restart the drive. Do not use the trip state for personal safety.

Trip

When tripping, the drive suspends operation to prevent damage to the drive and other equipment. When a trip occurs, the motor coasts to a stop. The drive logic continues to operate and monitor the drive status. After the fault condition is remedied, the drive is ready for a reset.

Trip lock

The drive enters this state in fault situations to protect itself. The drive requires physical intervention, for example when there is a short circuit on the output. A trip lock can only be canceled by disconnecting mains, removing the cause of the fault, and reconnecting the drive. Restart is prevented until the trip state is canceled by activating reset or, sometimes, by being programmed to reset automatically. Do not use the trip lock state for personal safety.

LCP notification

When a fault is triggered, the LCP indicates the type of fault (alarm, warning, or trip lock) and shows the alarm or warning number in the display.

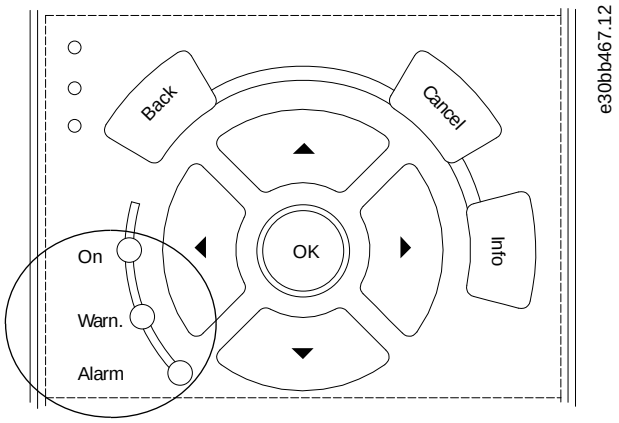

Illustration 19: Status Indicator Lights

Table 28: Fault Types

Type of fault	Warning indicator light	Alarm indicator light
Warning	On	Off
Alarm	Off	On (flashing)
Trip lock	On	On (flashing)

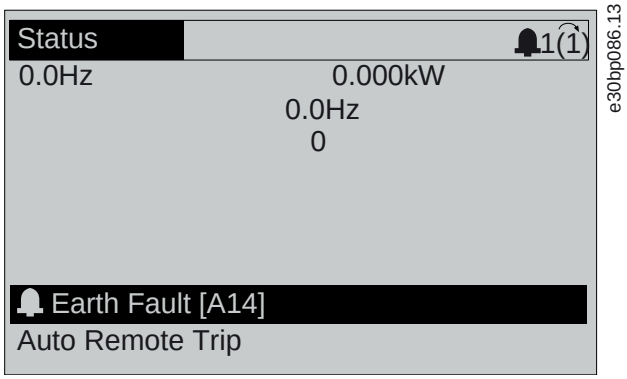

Illustration 20: Alarm Example

6.9.2 WARNING 1, 10 Volts Low

Cause

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

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

Troubleshooting

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

6.9.3 WARNING/ALARM 2, Live Zero Error

Cause

This warning or alarm only appears if programmed in *parameter 6-01 Live Zero Timeout Function*. The signal on 1 of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or a faulty device sending the signal can cause this condition.

Troubleshooting

- Check connections on all analog mains terminals.

- Control card terminals 53 and 54 for signals, terminal 55 common.
- General Purpose I/O MCB 101 terminals 11 and 12 for signals, terminal 10 common.

- Check that the drive programming and switch settings match the analog signal type.
- Perform an input terminal signal test.

6.9.4 WARNING/ALARM 3, No Motor

Cause

No motor is connected to the output of the drive.

6.9.5 WARNING/ALARM 4, Mains Phase Loss

Cause

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. Options are programmed in *parameter 14-12 Function at Mains Imbalance*.

Troubleshooting

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

6.9.6 WARNING 5, DC Link Voltage High

Cause

The DC-link voltage (DC) is higher than the high-voltage warning limit. The limit depends on the drive voltage rating. The unit is still active.

6.9.7 WARNING 6, DC Link Voltage Low

Cause

The DC-link voltage (DC) is lower than the low voltage warning limit. The limit depends on the drive voltage rating. The unit is still active.

6.9.8 WARNING/ALARM 7, DC Overvoltage

Cause

If the DC-link voltage exceeds the limit, the drive trips after a certain time.

Troubleshooting

- Extend the ramp time.
- Change the ramp type.
- Activate the functions in *parameter 2-10 Brake Function*.
- Increase *parameter 14-26 Trip Delay at Inverter Fault*.
- If the alarm/warning occurs during a power sag, use kinetic back-up (*parameter 14-10 Mains Failure*).
- Connect a brake resistor.

6.9.9 WARNING/ALARM 8, DC Undervoltage

Cause

If the DC-link voltage drops below the undervoltage limit, the drive checks for 24 V DC back-up supply. If no 24 V DC back-up 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 an input voltage test.
- Perform a soft-charge circuit test.

6.9.10 WARNING/ALARM 9, Inverter Overload

Cause

The drive has run with more than 100% overload for too long and is about to cut out. The counter for electronic thermal inverter protection issues a warning at 98% and trips at 100% with an alarm. The drive cannot be reset until the counter is below 90%.

Troubleshooting

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

6.9.11 WARNING/ALARM 10, Motor Overload Temperature

Cause

According to the electronic thermal protection (ETR), the motor is too hot.

Select 1 of these options:

- The drive issues a warning or an alarm when the counter is >90% if *parameter 1-90 Motor Thermal Protection* is set to warning options.
- The drive trips when the counter reaches 100% if *parameter 1-90 Motor Thermal Protection* is set to trip options.

The fault occurs when the motor runs with more than 100% overload for too long.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- Check that the motor current set in *parameter 1-24 Motor Current* is correct.
- Ensure that the motor data in *parameters 1-20* to *1-25* is set correctly.
- If an external fan is in use, check that it is selected in *parameter 1-91 Motor External Fan*.
- Running AMA in *parameter 1-29 Automatic Motor Adaptation (AMA)* tunes the drive to the motor more accurately and reduces thermal loading.

6.9.12 WARNING/ALARM 11, Motor Thermistor Overtemp

The motor thermistor indicates that the motor temperature is too high.

Troubleshooting

- Check for motor overheating.
- Check that the thermistor is securely connected.
- Check if the motor is mechanically overloaded.
- When using terminal 53 or 54, check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply). Also check that the terminal switch for 53 and 54 is set for voltage. Check that *parameter 1-93 Thermistor Resource* selects 53 or 54.
- When using terminal 18, 19, 31, 32, or 33 (digital inputs), check that the thermistor is connected correctly between the digital input terminal used (digital input PNP only) and terminal 50. Select the terminal to use in *parameter 1-93 Thermistor Resource*.

6.9.13 WARNING/ALARM 12, Torque Limit

Cause

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

Troubleshooting

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

6.9.14 WARNING/ALARM 13, Overcurrent

Cause

The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts approximately 1.5 s, then the drive trips and issues an alarm. Shock loading or quick acceleration with high-inertia loads can cause this fault. If the accelera-

tion during ramp-up is quick, the fault can also appear after kinetic back-up. If extended mechanical brake control is selected, a 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 that the motor data is correct in *parameters 1-20* to *1-25*.

6.9.15 ALARM 14, Earth (Ground) Fault

Cause

There is current from the output phase to ground, either in the cable between the drive and the motor, or in the motor itself. The current transducers detect the ground fault by measuring current going out from the drive and current going into the drive from the motor. Ground fault is issued if the deviation of the 2 currents is too large. The current going out of the drive must be the same as the current going into the drive.

Troubleshooting

- Remove power to the drive and repair the ground fault.
- Check for ground faults in the motor by measuring the resistance to ground of the motor cables and the motor with a megohmmeter.
- Reset any potential individual offset in the 3 current transducers in the drive. Perform a manual initialization or perform a complete AMA. This method is most relevant after changing the power card.

6.9.16 ALARM 15, Hardware Mismatch

Cause

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

Troubleshooting

Record the value of the following parameters and contact Trane.

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

6.9.17 ALARM 16, Short Circuit

Cause

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

Troubleshooting

⚠ W A R N I N G ⚠

HAZARDOUS VOLTAGE

AC drives contain hazardous voltage when connected to the AC mains or connected on the DC terminals. Failure to perform installation, start-up, and maintenance by skilled personnel can result in death or serious injury.

– Only skilled personnel must perform installation, start-up, and maintenance.

- Disconnect power before proceeding.
- Remove the power to the drive and repair the short circuit.

6.9.18 WARNING/ALARM 17, Control Word Timeout

Cause

There is no communication to the drive. The warning is only active when *parameter 8-04 Control Word Timeout Function* is NOT set to *[0] Off*.

If *parameter 8-04 Control Word Timeout Function* is set to *[5] Stop and trip*, a warning appears, and the drive ramps down to a stop and shows an alarm.

Troubleshooting

- Check the connections on the serial communication cable.
- Increase *parameter 8-03 Control Word Timeout Time*.
- Check the operation of the communication equipment.
- Verify that proper EMC installation was performed.

6.9.19 WARNING/ALARM 20, Temp. Input Error

Cause

The temperature sensor is not connected.

6.9.20 WARNING/ALARM 21, Parameter Error

Cause

The parameter is out of range. The parameter number is shown in the display.

Troubleshooting

- Set the affected parameter to a valid value.

6.9.21 WARNING/ALARM 22, Hoist Mechanical Brake

Cause

The value of this warning/alarm shows the type of warning/alarm.

0 = The torque reference was not reached before timeout (*parameter 2-27 Torque Ramp Up Time*).

1 = Expected brake feedback was not received before timeout (*parameter 2-23 Activate Brake Delay*, *parameter 2-25 Brake Release Time*).

6.9.22 WARNING 23, Internal Fan Fault

Cause

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

For drives with DC fans, a feedback sensor is mounted in the fan. If the fan is commanded to run and there is no feedback from the sensor, this alarm appears. For drives with AC fans, the voltage to the fan is monitored.

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 control card.

6.9.23 WARNING 24, External Fan Fault

Cause

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

For drives with DC fans, a feedback sensor is mounted in the fan. If the fan is commanded to run and there is no feedback from the sensor, this warning appears. For drives with AC fans, the voltage to the fan is monitored.

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 heat sink.

6.9.24 WARNING 25, Brake Resistor Short Circuit

Cause

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

Troubleshooting

- Remove the power to the drive and replace the brake resistor (refer to *parameter 2-15 Brake Check*).

6.9.25 WARNING/ALARM 26, Brake Resistor Power Limit

Cause

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

6.9.26 WARNING/ALARM 27, Brake Chopper Fault

Cause

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

Troubleshooting

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

6.9.27 WARNING/ALARM 28, Brake Check Failed

Cause

The brake resistor is not connected or not working.

Troubleshooting

- Check *parameter 2-15 Brake Check*.

6.9.28 ALARM 29, Heat Sink Temp

Cause

The maximum temperature of the heat sink is exceeded. The temperature fault is not reset until the temperature drops below a defined heat sink temperature. The trip and reset points are different based on the drive power size.

Troubleshooting

Check for the following conditions:

- The ambient temperature is too high.
- The motor cables are too long.
- Incorrect airflow clearance above and below the drive.
- Blocked airflow around the drive.
- Damaged heat sink fan.
- Dirty heat sink.

6.9.29 ALARM 30, Motor Phase U Missing

Cause

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

Troubleshooting

⚠ W A R N I N G ⚠

HAZARDOUS VOLTAGE

AC drives contain hazardous voltage when connected to the AC mains or connected on the DC terminals. Failure to perform installation, start-up, and maintenance by skilled personnel can result in death or serious injury.

– Only skilled personnel must perform installation, start-up, and maintenance.

- Disconnect power before proceeding.
- Remove the power from the drive and check motor phase U.

6.9.30 ALARM 31, Motor Phase V Missing

Cause

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

Troubleshooting

⚠ WARNING ⚠

HAZARDOUS VOLTAGE

AC drives contain hazardous voltage when connected to the AC mains or connected on the DC terminals. Failure to perform installation, start-up, and maintenance by skilled personnel can result in death or serious injury.

– Only skilled personnel must perform installation, start-up, and maintenance.

- Disconnect power before proceeding.
- Remove the power from the drive and check motor phase V.

6.9.31 ALARM 32, Motor Phase W Missing

Cause

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

Troubleshooting

⚠ WARNING ⚠

HAZARDOUS VOLTAGE

AC drives contain hazardous voltage when connected to the AC mains or connected on the DC terminals. Failure to perform installation, start-up, and maintenance by skilled personnel can result in death or serious injury.

– Only skilled personnel must perform installation, start-up, and maintenance.

- Disconnect power before proceeding.
- Remove the power from the drive and check motor phase W.

6.9.32 ALARM 33, Inrush Fault

Cause

Too many power-ups have occurred within a short time period.

Troubleshooting

- Let the unit cool to operating temperature.
- Check potential DC-link fault to ground.

6.9.33 WARNING/ALARM 34, Fieldbus Communication Fault

Cause

The fieldbus on the communication option card is not working.

6.9.34 WARNING/ALARM 35, Option Fault

Cause

An option alarm is received. The alarm is option-specific. The most likely cause is a power-up or a communication fault.

6.9.35 WARNING/ALARM 36, Mains Failure

Cause

This warning/alarm is only active if the supply voltage to the drive is lost and *parameter 14-10 Mains Failure* is not set to *[0] No Function*.

Troubleshooting

- Check the fuses to the drive and mains supply to the unit.

6.9.36 ALARM 37, Phase Imbalance

Cause

There is a current imbalance between the power units.

6.9.37 ALARM 38, Internal Fault

Cause

When an internal fault occurs, a code number defined in Table 29 is shown.

Troubleshooting

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

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

Table 29: Internal Fault Codes

Number	Text
0	The serial port cannot be initialized. Contact the Trane supplier or Trane service department.
256–258	The power EEPROM data is defective or too old. Replace the power card.
512–519	Internal fault. Contact the Trane supplier or Trane service department.
783	Parameter value outside of minimum/maximum limits.
1024–1284	Internal fault. Contact the Trane supplier or Trane service department.
1299	The option software in slot A is too old.
1300	The option software in slot B is too old.
1302	The option software in slot C1 is too old.
1315	The option software in slot A is not supported/allowed.
1316	The option software in slot B is not supported/ allowed.
1318	The option software in slot C1 is not supported/ allowed.
1379–2819	Internal fault. Contact the Trane supplier or Trane service department.
1792	Hardware reset of digital signal processor.
1793	Motor-derived parameters not transferred correctly to the digital signal processor.
1794	Power data not transferred correctly at power-up to the digital signal processor.
1795	The digital signal processor has received too many unknown SPI telegrams. The AC drive also uses this fault code if the MCO does not power up correctly. This situation can occur due to poor EMC protection or improper grounding.
1796	RAM copy error.
2561	Replace the control card.
2820	LCP stack overflow.
2821	Serial port overflow.
2822	USB port overflow.
3072–5122	Parameter value is outside its limits.

Number	Text
5123	Option in slot A: Hardware incompatible with the control board hardware.
5124	Option in slot B: Hardware incompatible with the control board hardware.
5125	Option in slot C0: Hardware incompatible with the control board hardware.
5126	Option in slot C1: Hardware incompatible with the control board hardware.
5376– 6231	Internal fault. Contact the Trane supplier or Trane service department.

6.9.38 ALARM 39, Heat Sink Sensor

Cause

No feedback from the heat sink 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 on the ribboncable between the power card and the gatedrive card.

6.9.39 WARNING 40, Overload of Digital Output Terminal 27

Troubleshooting

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

6.9.40 WARNING 41, Overload of Digital Output Terminal 29

Troubleshooting

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

6.9.41 WARNING 42, Ovrld X30/6-7

Troubleshooting

For terminal X30/6:

- Check the load connected to the terminal, or remove the short-circuit connection.
- Check *parameter 5-32 Term X30/6 Digi out (MCB 101)* (General Purpose I/O MCB 101).

For terminal X30/7:

- Check the load connected to the terminal, or remove the short-circuit connection.
- Check *parameter 5-33 Term X30/7 Digi Out (MCB 101)* (General Purpose I/O MCB 101).

6.9.42 ALARM 45, Earth Fault 2

Cause

Ground fault.

Troubleshooting

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

6.9.43 ALARM 46, Power Card Supply

Cause

The supply on the power card is out of range. Another reason can be a defective heat sink fan.

There are 3 supplies generated by the switch mode supply (SMPS) on the power card:

- 24 V.
- 5 V.
- ±18 V.

When powered with 24 V DC Supply MCB 107, only 24 V and 5 V supplies are monitored. When powered with 3-phase mains voltage, all 3 supplies are monitored.

Troubleshooting

- Check for a defective power card.
- Check for a defective control card.
- Check for a defective option card.
- If a 24 V DC supply is used, verify proper supply power.
- Check for a defective heat sink fan.

6.9.44 WARNING 47, 24 V Supply Low

Cause

The supply on the power card is out of range.

There are 3 supplies generated by the switch mode supply (SMPS) on the power card:

- 24 V
- 5 V
- ±18 V

Troubleshooting

- Check for a defective power card.

6.9.45 WARNING 48, 1.8 V Supply Low

Cause

The 1.8 V DC supply used on the control card is outside of the allowed limits. The supply is measured on the control card.

Troubleshooting

- Check for a defective control card.
- If an option card is present, check for overvoltage.

6.9.46 WARNING 49, Speed Limit

Cause

The warning is shown when the speed is outside of the specified range in *parameter 4-11 Motor Speed Low Limit [RPM]* and *parameter 4-13 Motor Speed High Limit [RPM]*. When the speed is below the specified limit in *parameter 1-86 Trip Speed Low [RPM]* (except when starting or stopping), the drive trips.

6.9.47 ALARM 50, AMA Calibration Failed

Troubleshooting

- Contact the Trane supplier or service department.

6.9.48 ALARM 51, AMA Check Unom and Inom

Cause

The settings for motor voltage, motor current, and motor power are wrong.

Troubleshooting

- Check settings in *parameters 1-20* to *1-25*.

6.9.49 ALARM 52, AMA Low Inom

Cause

The motor current is too low.

Troubleshooting

- Check the settings in *parameter 1-24 Motor Current*.

6.9.50 ALARM 53, AMA Motor Too Big

Cause

The motor is too big for the AMA to operate.

6.9.51 ALARM 54, AMA Motor Too Small

Cause

The motor is too small for the AMA to operate.

6.9.52 ALARM 55, AMA Parameter Out of Range

Cause

The AMA cannot run because the paramenter values of the motor are out of the acceptable range.

6.9.53 ALARM 56, AMA Interrupted by User

Cause

The AMA is manually interrupted.

6.9.54 ALARM 57, AMA Internal Fault

Cause

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

6.9.55 ALARM 58, AMA Internal Fault

Troubleshooting

Contact the Trane supplier.

6.9.56 WARNING 59, Current Limit

Cause

The current is higher than the value in *parameter 4-18 Current Limit*.

Troubleshooting

- Ensure that the motor data in *parameters 1-20* to *1-25* is set correctly.
- Increase the current limit if necessary. Ensure that the system can operate safely at a higher limit.

6.9.57 WARNING 60, External Interlock

Cause

A digital input signal indicates a fault condition external to the drive. An external interlock has commanded the drive to trip.

Troubleshooting

- Clear the external fault condition.
- To resume normal operation, apply 24 V DC to the terminal programmed for external interlock.
- Reset the drive.

6.9.58 WARNING/ALARM 61, Feedback Error

Cause

An error between calculated speed and speed measurement from feedback device.

Troubleshooting

- Check the settings for warning/alarm/disabling in *parameter 4-30 Motor Feedback Loss Function*.
- Set the tolerable error in *parameter 4-31 Motor Feedback Speed Error*.
- Set the tolerable feedback loss time in *parameter 4-32 Motor Feedback Loss Timeout*.

6.9.59 WARNING 62, Output Frequency at Maximum Limit

Cause

The output frequency has reached the value set in *parameter 4-19 Max Output Frequency*.

Troubleshooting

- Check the application for possible causes.
- Increase the output frequency limit. Be sure that the system can operate safely at a higher output frequency.

The warning clears when the output drops below the maximum limit.

6.9.60 ALARM 63, Mechanical Brake Low

Cause

The actual motor current has not exceeded the release brake current within the start delay time window.

6.9.61 WARNING 64, Voltage Limit

Cause

The load and speed combination demands a motor voltage higher than the actual DC-link voltage.

6.9.62 WARNING/ALARM 65, Control Card Overtemperature

Cause

The cutout temperature of the control card has exceeded the upper limit.

Troubleshooting

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

6.9.63 WARNING 66, Heat Sink Temperature Low

Cause

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

Troubleshooting

- Increase the ambient temperature of the unit.
- Supply a trickle amount of current to the drive whenever the motor is stopped by setting *parameter 2-00 DC Hold/Preheat Current* to 5% and *parameter 1-80 Function at Stop*.

6.9.64 ALARM 67, Option Module Configuration has Changed

Cause

One or more options have either been added or removed since the last power-down.

Troubleshooting

- Check that the configuration change is intentional and reset the unit.

6.9.65 ALARM 68, Safe Stop Activated

Cause

Safe Torque Off (STO) has been activated.

Troubleshooting

- To resume normal operation, apply 24 V DC to terminal 37, then send a reset signal (via bus, digital, or by pressing [Reset]).

6.9.66 ALARM 69, Power Card Temperature

Cause

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

Troubleshooting

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

6.9.67 ALARM 70, Illegal FC Configuration

Cause

The control card and power card are incompatible.

Troubleshooting

- To check compatibility, contact the Trane supplier with the type code from the unit nameplate and the part numbers on the cards.

6.9.68 WARNING 73, Safe Stop Auto Restart

Cause

STO activated.

Troubleshooting

- With automatic restart enabled, the motor can start when the fault is cleared.

6.9.69 ALARM 75, Illegal Profile Sel.

Cause

Do not write the parameter value while the motor is running.

Troubleshooting

- Stop the motor before writing the MCO profile to *parameter 8-10 Control Word Profile*.

6.9.70 WARNING 77, Reduced Power Mode

Cause

The drive is operating in reduced power mode (less than allowed number of inverter sections). The warning is generated on power cycle when the drive is set to run with fewer inverters and remains on.

6.9.71 ALARM 78, Tracking Error

Cause

The difference between setpoint value and actual value exceeds the value in *parameter 4-35 Tracking Error*.

Troubleshooting

- Disable the function or select an alarm/warning in *parameter 4-34 Tracking Error Function*.
- Investigate the mechanics around the load and motor. Check feedback connections from motor encoder to drive.
- Select motor feedback function in *parameter 4-30 Motor Feedback Loss Function*.
- Adjust the tracking error band in *parameter 4-35 Tracking Error* and *parameter 4-37 Tracking Error Ramping*.

6.9.72 ALARM 79, Illegal Power Section Configuration

Cause

The scaling card has an incorrect part number or is not installed. The MK102 connector on the power card could not be installed.

6.9.73 ALARM 80, Drive Initialized to Default Value

Cause

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

6.9.74 ALARM 81, CSIV Corrupt

Cause

The CSIV file has syntax errors.

6.9.75 ALARM 82, CSIV Parameter Error

Cause

CSIV failed to initialize a parameter.

6.9.76 ALARM 83, Illegal Option Combination

Cause

The mounted options are incompatible.

6.9.77 ALARM 84, No Safety Option

Cause

The safety option was removed without applying a general reset.

Troubleshooting

Reconnect the safety option.

6.9.78 ALARM 85, Dang Fail PB

Cause

PROFIBUS/PROFIsafe error.

6.9.79 ALARM 88, Option Detection

Cause

A change in the option layout is detected. *Parameter 14-89 Option Detection* is set to *[0] Frozen configuration* and the option layout has been changed.

Troubleshooting

- To apply the change, enable option layout changes in *parameter 14-89 Option Detection*.
- Alternatively, restore the correct option configuration.

6.9.80 WARNING 89, Mechanical Brake Sliding

Cause

The hoist brake monitor detects a motor speed exceeding 10 RPM.

6.9.81 ALARM 91, Analog Input 54 Wrong Settings

Troubleshooting

- Set switch S202 in position OFF (voltage input) when a KTY sensor is connected to analog input terminal 54.

6.9.82 ALARM 99, Locked Rotor

Cause

The rotor is blocked.

Troubleshooting

- Check if the motor shaft is locked.
- Check if the start current triggers the current limit set in *parameter 4-18 Current Limit*.
- Check if it increases the value in *parameter 30-23 Locked Rotor Detection Time [s]*.

6.9.83 WARNING/ALARM 104, Mixing Fan Fault

Cause

The fan is not operating. The fan monitor checks that the fan is spinning at power-up or whenever the mixing fan is turned on. The mixing fan fault can be configured as a warning or an alarm in *parameter 14-53 Fan Monitor*.

Troubleshooting

- Cycle power to the drive to determine if the warning/alarm returns.

6.9.84 WARNING/ALARM 122, Mot. Rotat. Unexp.

Cause

The drive performs a function that requires the motor to be at standstill, for example DC hold for PM motors.

6.9.85 WARNING 163, ATEX ETR Cur.Lim.Warning

Cause

The drive has run above the characteristic curve for more than 50 s. The warning is activated at 83% and deactivated at 85% of the allowed thermal overload.

6.9.86 ALARM 164, ATEX ETR Cur.Lim.Alarm

Cause

Running above the characteristic curve for more than 60 s within a period of 600 s activates the alarm, and the drive trips.

6.9.87 WARNING 165, ATEX ETR Freq.Lim.Warning

Cause

The drive has run for more than 50 s below the allowed minimum frequency (*parameter 1-98 ATEX ETR Interpol. Points Freq.*).

6.9.88 ALARM 166, ATEX ETR Freq.Lim.Alarm

The drive has run for more than 60 s (in a period of 600 s) below the allowed minimum frequency (*parameter 1-98 ATEX ETR Interpol. Points. Freq.*).

6.9.89 ALARM 244, Heat Sink Temperature

Cause

The maximum temperature of the heat sink has been exceeded. The temperature fault cannot reset until the temperature drops below the defined heat sink temperature. The trip and reset points are different based on the power size. This alarm is equivalent to *Alarm 29, Heat Sink Temp*.

Troubleshooting

Check for the following:

- Ambient temperature too high.
- Motor cables too long.
- Incorrect airflow clearance above or below the AC drive.
- Blocked airflow around the unit.
- Damaged heat sink fan.
- Dirty heat sink.

6.9.90 WARNING 251, New Typecode

Cause

The power card or other components have been replaced, and the typecode has changed.

6.9.91 ALARM 421, Temperature Fault

Cause

A fault caused by the on-board temperature sensor is detected on the fan power card.

Troubleshooting

- Check wiring.
- Check the on-board temperature sensor.
- Replace fan power card.

6.9.92 ALARM 423, FPC Updating

Cause

The alarm is generated when the fan power card reports it has an invalid PUD. The control card attempts to update the PUD. A subsequent alarm can result depending on the update. See *Alarm 424, FPC Update Successful* and *Alarm 425 FPC Update Failure*.

6.9.93 ALARM 424, FPC Update Successful

Cause

This alarm is generated when the control card has successfully updated the fan power card PUD.

Troubleshooting

- Press [Reset] to stop the alarm.

6.9.94 ALARM 425, FPC Update Failure

Cause

This alarm is generated after the control card failed to update the fan power card PUD.

Troubleshooting

- Check the fan power card wiring.
- Replace fan power card.
- Contact supplier.

6.9.95 ALARM 426, FPC Config

Cause

The number of found fan power cards does not match the number of configured fan power cards. See *parameter group 15-6* Option Ident* for the number of configured fan power cards.

Troubleshooting

- Check fan power card wiring.
- Replace fan power card.

6.9.96 ALARM 427, FPC Supply

Cause

Supply voltage fault (5 V, 24 V, or 48 V) on fan power card is detected.

Troubleshooting

- Check fan power card wiring.
- Replace fan power card.

6.10 Troubleshooting

Table 30: Troubleshooting

Symptom	Possible cause	Test	Solution
Display dark/No function	Missing input power.	Check for loose connections.	Check the input power source.
	Missing or open fuses.	See *Open power fuses* in this table for possible causes.	Follow the recommendations provided.
	No power to the LCP.	Check the LCP cable for proper connection or damage.	Replace the faulty LCP or connection cable.
	Short circuit on control voltage (terminal 12 or 50) or at control terminals.	Check the 24 V control voltage supply for terminal 12/13 to 20–39, or 10 V supply for terminals 50–55.	Wire the terminals properly.
	Wrong contrast setting.	–	To adjust the contrast, press [Status] + [▲]/[▼].
	Display (LCP) is defective.	Test using a different LCP.	Replace the faulty LCP or connection cable.
	Internal voltage supply fault or SMPS is defective.	–	Contact supplier.
Intermittent display	Overloaded supply (SMPS) due to improper control wiring or a fault within the AC drive.	To rule out a problem in the control wiring, disconnect all control wiring by removing the terminal blocks.	If the display stays lit, 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\No function*.
Motor not running	Service switch open or missing motor connection.	–	Connect the motor and check the service switch.
	No mains power with 24 V DC option card.	–	Apply mains power.
	LCP stop.	–	Depending on the operating mode, press [Auto On] or [Hand On].
	Missing start signal (Standby).	–	Apply a valid start signal.
	Motor coast signal active (Coasting).	–	Apply 24 V on terminal 27 or program this terminal to *[0] No operation*.

Symptom	Possible cause	Test	Solution
	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 *parameter 3-13 Reference Site*. Set preset reference active in *parameter group 3-1* References*. Check for correct wiring. Check scaling of terminals. Check reference signal.
Motor running in wrong direction	Motor rotation limit.	Check that *parameter 4-10 Motor Speed Direction* is programmed correctly.	Program correct settings.
	Active reversing signal.	Check if a reversing command is programmed for the terminal in *parameter group 5-1* Digital inputs*.	Deactivate reversing signal.
	Wrong motor phase connection.	–	Correct motor phase connection, or set *parameter 1-06 Clockwise Direction* to *[1] Inverse*.
Motor is not reaching maximum speed	Frequency limits set wrong.	Check output limits in *parameter 4-13 Motor Speed High Limit [RPM]*, *parameter 4-14 Motor Speed High Limit [Hz]*, and *parameter 4-19 Max Output Frequency*.	Program correct limits.
	Reference input signal not scaled correctly.	Check reference input signal scaling in *parameter group 6-0* Analog I/O mode* and *parameter group 3-1* References*.	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 1-6* Load Depen. Setting*. For closed-loop operation, check settings in *parameter group 20-0* Feedback*.
Motor runs rough	Possible overmagnetization.	Check for incorrect motor settings in all motor parameters.	Check motor settings in *parameter groups 1-2* Motor data*, *1-3* Adv Motor Data*, and *1-5* Load Indep. Setting*.
Motor does not brake	Possible incorrect settings in the brake parameters. Ramp-down times may be too short.	Check brake parameters. Check ramp time settings.	Check *parameter groups 2-0* DC Brake* and *3-0* Reference Limits*.
Open power fuses	Phase-to-phase short.	Motor or panel has a short phase-to-phase. Check motor and panel phases for shorts.	Eliminate any shorts detected.
	Motor overload.	Motor is overloaded for the application.	Perform start-up test and verify that motor current is within specifications. If motor current is exceeding the nameplate full load current, the motor can run only with reduced load. Review the specifications for the application.
	Loose connections.	Perform pre-start-up check for loose connections.	Tighten loose connections.

Symptom	Possible cause	Test	Solution
Mains current imbalance greater than 3%	Problem with mains power (see *Alarm 4, Mains phase loss* description).	Rotate input power leads into the 1 position: A to B, B to C, C to A.	If imbalanced leg follows the wire, it is a power problem. Check the mains supply.
	Problem with the AC drive.	Rotate input power leads into the AC drive 1 position: A to B, B to C, C to A.	If the imbalanced leg stays on same input terminal, it is a problem with the AC drive. Contact the supplier.
Motor current imbalance greater than 3%	Problem with motor or motor wiring.	Rotate output motor cables 1 position: U to V, V to W, W to U.	If the imbalanced leg follows the wire, the problem is in the motor or motor wiring. Check motor and motor wiring.
	Problem with AC drive.	Rotate output motor cables 1 position: U to V, V to W, W to U.	If the imbalanced leg stays on same output terminal, it is a problem with the unit. Contact the supplier.
AC drive acceleration problems	Motor data are entered incorrectly.	If warnings or alarms occur, refer to the *Warnings and Alarms* section. Check that motor data are entered correctly.	Increase the ramp-up time in *parameter 3-41 Ramp 1 Ramp Up Time*. Increase current limit in *parameter 4-18 Current Limit*. Increase torque limit in *parameter 4-16 Torque Limit Motor Mode*.
AC drive deceleration problems	Motor data are entered incorrectly.	If warnings or alarms occur, refer to the *Warnings and Alarms* section. Check that motor data are entered correctly.	Increase the ramp-down time in *parameter 3-42 Ramp 1 Ramp Down Time*. Enable overvoltage control in *parameter 2-17 Over-voltage Control*.

7 Specifications

7.1 Mains Supply

The unit is suitable for use on a circuit capable of delivering not more than 100 kA short circuit current rating (SCCR) at 480/600 V.

Supply terminals	L1, L2, L3
Supply voltage[1]	380–480 V ±10%, 525–690 V ±10%
Supply frequency	50/60 Hz ±5%
Maximum imbalance temporary between mains phases	3.0% of rated supply voltage[2]
True power factor (λ)	≥0.9 nominal at rated load
Displacement power factor (cos Φ)	Near unity (>0.98)
Switching on the input supply L1, L2, and L3 (power-ups)	Maximum 1 time/2 minutes
Environment according to EN 60664-1	Overvoltage category III/pollution degree 2

[1] Mains voltage low/mains drop-out: During low mains voltage or a mains drop-out, the drive continues until the DC-link 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.

[2] Calculations based on UL/IEC 61800-3.

7.2 Motor Output and Torque Characteristics

7.2.1 Motor Output

Voltage output	0–100% of supply voltage output
Output frequency	0–590 Hz[1]
Output frequency in flux mode	0–300 Hz
Switching on output	Unlimited
Ramp times	0.01–3600 s

[1] Dependent on voltage and power.

7.2.2 Torque Characteristics

The torque response time depends on application and load but as a rule, the torque step from 0 to reference is 4–5 x torque rise time.

Starting torque (constant torque)	Maximum 150% for 60 s once in 10 minutes.[1]
Overload torque (constant torque)	Maximum 150% for 60 s once in 10 minutes.[1]
Torque rise time in FLUX (for 5 kHz fsw)	1 ms
Torque rise time in VVC+ (independent of fsw)	10 ms

[1] Percentage relates to the drive's nominal current.

7.3 Ambient Conditions

Enclosure	IP20 (Chassis), IP21 (Type 1), IP54 (Type 12)
Vibration test (standard/ruggedized)	0.7 g/1.0 g
Relative humidty	5%-95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation)
Aggressive environment (IEC 60068-2-43) H_2S test	Class Kd
Aggressive gases (IEC 60721-3-3)	Class 3C3
Test method according to IEC 60068-2-43	H2S (10 days)
Ambient temperature (at 60 AVM switching mode)	
Ambient temperature (at SFAVM switching mode)	
- with derating	Maximum 55° C (131° F)[1]

- with full output power of typical EFF2 motors (up to 90% output current)	Maximum 50° C (122° F)[1]
- at full continuous FC output current	Maximum 45° C (113° F)[1]
Minimum ambient temperature during full-scale operation	0 °C (32 °F)
Minimum ambient temperature at reduced speed performance	-10 °C (14 °F)
Temperature during storage/transport	-25 to +65/70 °C (-13 to +149/158 °F)
Maximum altitude above sea level without derating	1000 m (3280 ft)
Maximum altitude above sea level with derating	3000 m (9842 ft)
EMC standards, Emission	IEC/EN 61800-3
EMC standards, Immunity	IEC/EN 61800-3
Energy efficiency class	IE2[2]

[1] For more information, see the Derating section in the design guide.

[2] Determined according to IEC 61800-9-2 (EN 50598-2) at:

- Rated load.
- 90% rated frequency.
- Switching frequency factory setting.
- Switching pattern factory setting.

7.4 Control Input/Output and Control Data

7.4.1 Digital Inputs

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

Programmable digital inputs	4 (6)
Terminal number[1]	18, 19, 27, 29, 32, 33
Logic	PNP or NPN
Voltage level	0–24 V DC
Voltage level, logic 0 PNP	<5 V DC
Voltage level, logic 1, PNP	>10 V DC
Voltage level, logic 0 NPN	>19 V DC
Voltage level, logic 1 NPN	<14 V DC
Maximum voltage on input	28 V DC
Pulse frequency range	0–110 kHz
(Duty cycle) minimum pulse width	4.5 ms
Input resistance, R_i	Approximately 4 kΩ

[1] Terminals 27 and 29 can also be programmed as output.

7.4.2 STO Terminal 37

Voltage level	0–24 V DC
Voltage level, logic 0 PNP	<4 V DC
Voltage level, logic 1 PNP	>20 V DC
Maximum voltage on input	28 V DC
Typical input current at 24 V	50 mA rms
Typical input current at 20 V	60 mA rms
Input capacitance	400 nF

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

For further information about terminal 37 and Safe Torque Off, see the Safe Torque Off Operating Guide.

When using a contactor with a DC coil inside with STO, it is important to make a return way for the current from the coil when turning it off. The return way can be created by using a freewheel diode (or, alternatively, a 30 V or 50 V MOV for quicker response time) across the coil. Typical contactors can be bought with this diode.

7.4.3 Analog Inputs

Number of analog inputs	2
Terminal number	53 (201), 54 (202)
Modes	Voltage or current
Mode select	Switch A53 (S201) and switch A54 (S202)
Voltage mode	Switch A53 (S201)/A54 (S202) = OFF (U)
Voltage level	0 V to +10 V (scalable)
Input resistance, R_i	Approximately 10 kΩ
Maximum voltage	±20 V
Current mode	Switch A53 (S201)/A54 (S202) = ON (I)
Current level	0/4 to 20 mA (scaleable)
Input resistance, R_i	Approximately 200 Ω
Maximum current	30 mA
Resolution for analog inputs	10 bit (+ sign)
Accuracy of analog inputs	Maximum error 0.5% of full scale
Bandwidth	100 Hz

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

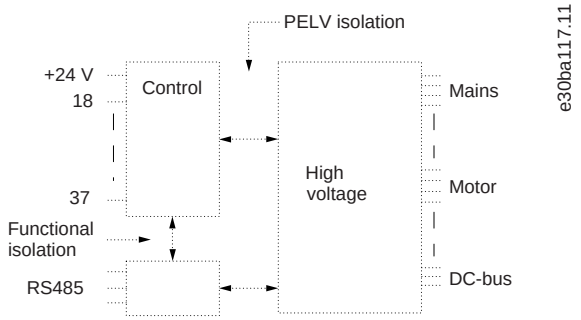

Illustration 21: PELV Isolation

7.4.4 Pulse Inputs

Programmable pulse inputs	2
Terminal number (pulse)	29/33
Maximum frequency at terminals 29, 33 (Push-pull driven)	110 kHz
Maximum frequency at terminals 29, 33 (Open collector)	5 kHz
Minimum frequency at terminals 29, 33	4 Hz
Voltage level	See *Digital Inputs*
Maximum voltage on input	28 V DC
Input resistance, R_i	Approximately 4 kΩ
Pulse input accuracy (0.1–1 kHz)	Maximum error: 0.1% of full scale

7.4.5 Analog Output

Number of programmable outputs	1
Terminal number	42
Current range at analog output	0/4 to 20 mA

Maximum load GND - analog output less than	500 Ω
Accuracy on analog output	Maximum error: 0.8% of full scale
Resolution of analog output	8 bit

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

7.4.6 Control Card, RS485 Serial Communication

Terminal number	68 (P, TX+, RX+), 69 (N, TX-, RX-)
Terminal number 61	Common for terminals 68 and 69

The RS485 serial communication circuit is galvanically isolated from the supply voltage (PELV).

7.4.7 Digital Outputs

Programmable digital/pulse outputs	2
Terminal number[1]	27, 29
Voltage level at digital/frequency output	0–24 V
Maximum output current (sink or source)	40 mA
Maximum load at frequency output	1 kΩ
Maximum 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	Maximum error: 0.1% of full scale
Resolution of frequency outputs	12 bit

[1] Terminals 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.

7.4.8 Control Card, 24 V DC Output

Terminal number	12, 13
Output voltage	24 V +1, -3 V
Maximum load	200 mA

The 24 V DC supply is galvanically isolated from the supply voltage (PELV), but has the same potential as the analog and digital inputs and outputs.

7.4.9 Relay Outputs

Programmable relay outputs	2
Maximum wire cross-section to relay terminals	2.5 mm^2 (12 AWG)
Minimum wire cross-section to relay terminals	0.2 mm^2 (30 AWG)
Length of stripped wire	8 mm (0.3 in)
Relay 01 terminal number	1–3 (break), 1–2 (make)
Maximum terminal load (AC-1)[1] on 1–2 (NO) (Resistive load)[2][3]	400 V AC, 2 A
Maximum terminal load (AC-15)[1] 1–2 (NO) (Inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Maximum terminal load (DC-1)[1] on 1–2 (NO) (Resistive load)	80 V DC, 2 A
Maximum terminal load (DC-13)[1] on 1–2 (NO) (Inductive load)	24 V DC, 0.1 A
Maximum terminal load (AC-1)[1] on 1–3 (NC) (Resistive load)	240 V AC, 2 A
Maximum terminal load (AC-15)[1] 1–3 (NC) (Inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Maximum terminal load (DC-1)[1] on 1–3 (NC) (Resistive load)	50 V DC, 2 A

Maximum terminal load (DC-13)[1] on 1–3 (NC) (Inductive load)	24 V DC, 0.1 A
Minimum terminal load on 1–3 (NC), 1–2 (NO)	24 V DC 10 mA, 24 V AC 2 mA
Environment according to EN 60664-1	Overvoltage category III/pollution degree 2
Relay 02 terminal number	4–6 (break), 4–5 (make)
Maximum terminal load (AC-1)[1] on 4–5 (NO) (Resistive load)[2][3]	400 V AC, 2 A
Maximum terminal load (AC-15)[1] 4–5 (NO) (Inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Maximum terminal load (DC-1)[1] on 4–5 (NO) (Resistive load)	80 V DC, 2 A
Maximum terminal load (DC-13)[1] on 4–5 (NO) (Inductive load)	24 V DC, 0.1 A
Maximum terminal load (AC-1)[1] on 4–6 (NC) (Resistive load)	240 V AC, 2 A
Maximum terminal load (AC-15)[1] 4–6 (NC) (Inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Maximum terminal load (DC-1)[1] on 4–6 (NC) (Resistive load)	50 V DC, 2 A
Maximum terminal load (DC-13)[1] on 4–6 (NC) (Inductive load)	24 V DC, 0.1 A
Minimum terminal load on 4–6 (NC), 4–5 (NO)	24 V DC 10 mA, 24 V AC 2 mA
Environment according to EN 60664-1	Overvoltage category III/pollution degree 2

[1] IEC 60947 parts 4 and 5.

[2] Overvoltage Category II

[3] UL applications 300 V AC 2 A.

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

7.4.10 Control Card, +10 V DC Output

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

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

7.4.11 Control Characteristics

Resolution of output frequency at 0–1000 Hz	±0.003 Hz
Repeat accuracy of precise start/stop (terminals 18, 19)	≤±0.1 ms
System response time (terminals 18, 19, 27, 29, 32, 33)	≤2 ms
Speed control range (open loop)	1:100 of synchronous speed
Speed accuracy (open loop)	30–4000 RPM: Error ±8 RPM

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

7.4.12 Control Card Performance

Scan interval	5 ms

7.4.13 Control Card, USB Serial Communication

USB standard	1.1 (full speed)[1]
USB plug	USB type B plug[2][3]

[1] Connection to PC is carried out via a standard host/device USB cable.

[2] The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

[3] The USB connection is not galvanically isolated from ground. Use only isolated laptop/PC as connection to the USB connector on the drive or an isolated USB cable/converter.

7.5 Warning and Alarm Trips Points

Table 31: Warning/Alarm Trip Points, E1h–E4h Drives, 380–480 V AC

380–480 V AC	N355	N400	N450	N500	N560
Heat sink overtemperature trip [°C (°F)]	110 (230)	110 (230)	110 (230)	110 (230)	100 (212)
Control card overtemperature trip [°C (°F)]	80 (176)	80 (176)	80 (176)	80 (176)	80 (176)
Power card overtemperature trip [°C (°F)]	85 (185)	85 (185)	85 (185)	85 (185)	85 (185)
Fan power card overtemperature trip [°C (°F)]	85 (185)	85 (185)	85 (185)	85 (185)	85 (185)
Active in-rush card overtemperature trip [°C (°F)]	85 (185)	85 (185)	85 (185)	85 (185)	85 (185)

Table 32: Warning and Alarm Trip Points, E1h–E4h Drives, 525–690 V AC

525–690 V AC	N450	N500	N560	N630	N710	N800
Heat sink overtemperature trip [°C (°F)]	110 (230)	110 (230)	110 (230)	110 (230)	110 (230)	110 (230)
Control card overtemperature trip [°C (°F)]	80 (176)	80 (176)	80 (176)	80 (176)	80 (176)	80 (176)
Power card overtemperature trip [°C (°F)]	85 (185)	85 (185)	85 (185)	85 (185)	85 (185)	85 (185)
Fan power card overtemperature trip [°C (°F)]	85 (185)	85 (185)	85 (185)	85 (185)	85 (185)	85 (185)
Active inrush card overtemperature trip [°C (°F)]	85 (185)	85 (185)	85 (185)	85 (185)	85 (185)	85 (185)

8 Maintenance

8.1 Maintenance and Service

To prevent breakdown, danger, and damage, examine the drive for loose terminal connections, excessive dust buildup, and so on, at regular intervals. Replace worn or damaged parts with Trane authorized parts. For service and support, contact the local Trane supplier.

8.2 Removing Dust Buildup from the Heat Sink

The drive can be ordered with an optional access panel in the back of the unit. This access panel provides access to the heat sink and allows the heat sink to be cleaned of any dust buildup.

N O T I C E

DAMAGE TO HEAT SINK

Using fasteners that are longer than the fasteners originally supplied with the heat sink panel can damage the heat sink cooling fins.

1. Remove power from the drive and wait for the capacitors to discharge completely. Refer to the *Safety Precautions* section.
2. Position the drive so that the back of the drive is fully accessible.
3. Remove the M5 fasteners securing the access panel to the back of the enclosure using a 3 mm hex bit.
4. Inspect the leading edge of the heat sink for damage or debris.
5. Remove material or debris with a vacuum.
6. Reinstall the panel and secure it to the back of the enclosure with the M5 fasteners. Tighten the fasteners securely. Refer to the *Fastener Torque Ratings* section.

Example

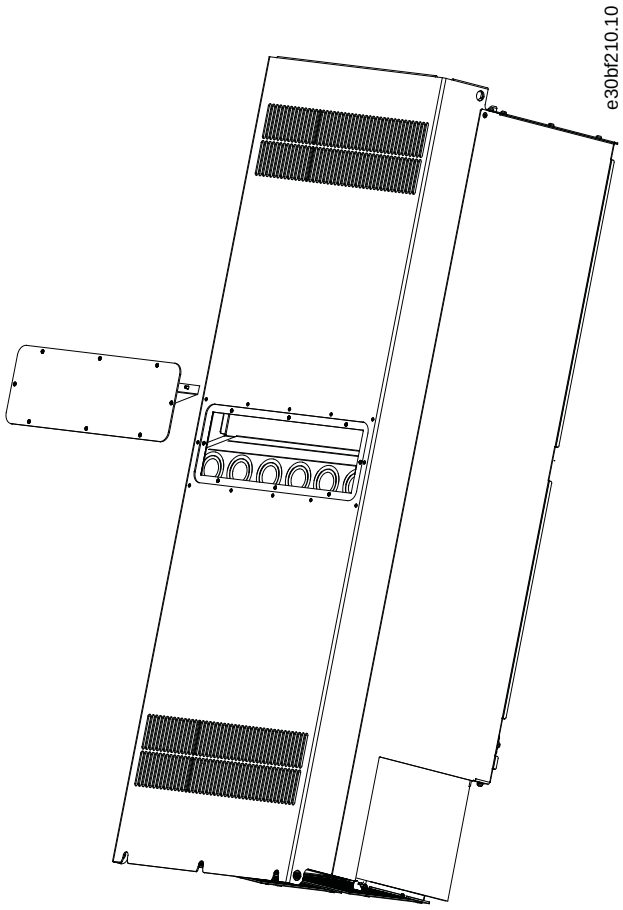

Illustration 22: Heat Sink Access Panel Removed from the Rear of the Drive

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