COMBIVERT F5

ELEVATOR DRIVE

Operation Manual

Version 3.33

00F5LUM-K333

KEB

This instruction manual describes the COMBIVERT F5 ELEVATOR DRIVE. Before working with the unit the user must become familiar with it. This especially applies to the knowledge and observance of the following safety and warning indications. The icons used in this instruction manual have the following meaning:

Danger
Discharge Time
Caution

Pay Attention
Important
Warning

Information
Help
Tip

The QR codes used in this instruction manual are linked to the KEB America Youtube Channel. Video examples of general start-up procedures will be linked to QR codes in this instruction manual.

Scan the QR code with the QR code reader on your smart phone to access videos. For your phone to be able to read QR codes you will need to download a QR code scanning app from your mobile app store.

KEB America Youtube Channel URL: http://qrs.ly/vq4hd9q

For online elevator support, pdf manuals, and instructional videos, visit our blog at https://www.kebamerica.com/elevator-support/.

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READ FIRST - SAFETY PRECAUTIONS

KEB

Danger to Life

AC motor controls and servo drives contain dangerous voltages which can cause death or serious injury. During operation they can have live "energized" un-insulated parts, moving parts, as well as hot surfaces. Care should be taken to ensure correct and safe operation in order to minimize risk to personnel and equipment.

Only Qualified Personnel

All work involving this product, installation, start up as well as maintenance, may only be performed by qualified electrical technical personnel. According to this manual "qualified" means: those who are able to recognize and acknowledge the possible dangerous conditions based on their training and experience and those who are familiar with the relevant standards and installation codes as well as the field of power transmission.

Protect Against Accidental Contact

AC motor controls and servo drives must be protected against physical damage during transport, installation, and use. Components or covers must not be bent or deformed as this may decrease insulation distances inside the unit resulting in an unsafe condition. On receipt of the unit visual damage should be reported immediately to the supplier. DO NOT ATTEMPT TO POWER UP A UNIT WITH VISIBLE PHYSICAL DAMAGE. This unit contains electrostatically sensitive components which can be destroyed by incorrect handling. For that reason, disassembly of the unit or contact with the components should be avoided.

Note Capacitor Discharge Time

Before any installation and connection work can be done, the supply voltage must be turned off and locked out. After turning off the supply voltage, dangerous voltages may still be present within the unit as the bus capacitors discharge. Therefore it is necessary to wait 5 minutes before working on the unit after turning off the supply voltage.

Secure Isolation

The low voltage control terminal strip and communication ports are securely isolated in accordance with EN50178. When connecting to other systems, it is necessary to verify the insulation ratings of these systems in order to ensure the EN requirements are still met. When connecting the unit to a grounded delta power system, the control circuit can no longer be classified as a "securely isolated circuit".

Before putting the motor control into operation be sure the connection terminals are tight and all covers removed for installation have been replaced.

Damage to Property and Injury to Persons

The AC motor control or servo system can be adjusted to self initiate an automatic restart in the event of a fault or error condition. The design of the system must take this into account, such that personnel are safe guarded against potentially dangerous circumstances.

Redundant Safety Mechanisms

Software functions in the AC motor control or servo system can be used to control or regulate external systems. However, in the event of failure of the motor control or servo system there is no guarantee these software function(s) will continue to provide the desired level of control. As a result, when operator or machine safety is at stake, external elements must be used to supplement or override the software function within the AC motor control or servo system.

1. Technical Information

1.1. Mounting Instruction

1.1.1. Classification

The elevator drive is classified as an "Open Type" inverter with an IP20 rating and is intended for "use in a pollution degree 2 environment." The unit must be mounted inside of a control cabinet offering proper environmental protection.

1.1.2. Physical Mounting

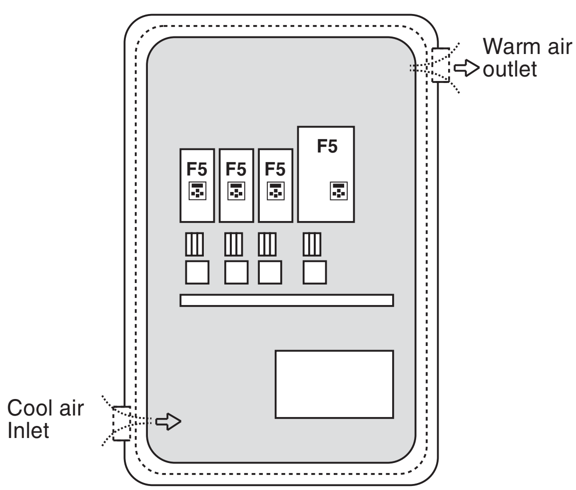
Install the inverter in a stationary location offering a firm mounting point with low vibration.

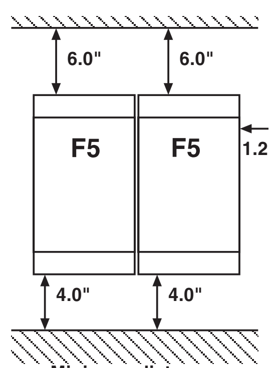
Installation of the inverter on a moving system may require special earth ground connections to the inverter.

For best high frequency grounding, install the inverter on a bare metal sub-panel, i.e. zinc plated steel or galvanized steel.

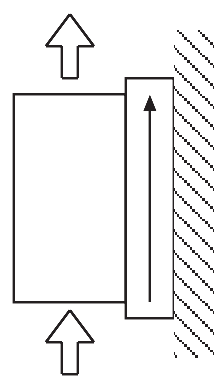
Use manufacturer recommended tightening torque for all bolts used to mount the enclosure.

Take into consideration the minimum clearance distances when positioning the inverter (see drawing below). The F5 series inverters are designed for vertical installation and can be aligned next to each other. Maintain a distance of at least 2 inches in front of the unit. Make sure cooling is sufficient.





Minimum distances



Direction of cooling fins

1.1.3. Harsh Environments

For extended life, prevent dust and other contaminants from getting into the inverter.

When installing the unit inside a sealed enclosure, make sure the enclosure is sized correctly for proper heat dissipation or that a cooling system has been installed in the panel.

Protect the inverter against conductive and corrosive gases, liquids and other contaminants. Water or mist should not be allowed into the inverter.

The F5 elevator drive must be installed in an explosion-proof enclosure when operating in an explosion-proof environment.

1.1.4. Ambient Conditions

Maximum Surrounding Air Temperature 45°C! The operating temperature range of the unit is -10°C to + 45°C (14°F to +113°F). Operation outside of this temperature range can lead to shut down of the inverter.

The unit can be stored (power off) in the temperature range -25°C to 70°C (-13°F to +158°F).

The power rating of the inverter must be derated for operation above 3,300 ft (1000 m). Reduce the rated power 1% for each additional 330 ft (100 m). The maximum elevation for operation is 6,560 ft (2000 m).

The relative humidity shall be limited to 95% without condensation.

1.2. Electrical Connections

1.2.1. Safety First

CAUTION - RISK OF ELECTRIC SHOCK! Always disconnect supply voltage before servicing the F5 Elevator Drive.

After disconnecting the supply voltage, always wait 5 minutes before attempting to change the wiring. The internal DC BUS capacitors must discharge.

1.2.2. Voltage Supply

Pay attention to the supply voltage and be sure the supply voltage matches that of the inverter. A 240V unit can be supplied with voltage in the range 180 to 260VAC +/-0%, for a 480V unit the range is 305 to 528VAC +/- 0%, 48Hz to 62 Hz.

All 240V models are suitable for use on a circuit capable of delivering not more than ___ kA rms symmetrical amperes, 240 volts maximum when protected by class ___ fuses rated ___ Amperes as specified in table 2.2.4.1 or when protected by a circuit breaker having an interrupt rating not less than ___ kA rms symmetrical amperes, 240V maximum, rated ___ amperes as specified in table 1.2.4.1.

All 480V models are suitable for use on a circuit capable of delivering not more than ___ kA rms symmetrical amperes, 480 volts maximum when protected by class ___ fuses rated ___ Amperes as specified in table 1.2.4.2 or when protected by a circuit breaker having an interrupt rating not less than ___ kA rms symmetrical amperes, 480V maximum, rated ___ amperes as specified in table 1.2.4.2.

Connection of the F5 series inverters to voltage systems configured as a corner grounded delta, center tap grounded delta, open delta, or ungrounded delta, may defeat the internal noise suppression of the inverter. Increased high frequency disturbance in the controller and on the line may be experienced. A balanced, neutral grounded wye connection is always recommended. The three phase voltage imbalance must be less than 2% phase-to-phase. Greater imbalance can lead to damage of the inverter's power circuit.

1.2.3. Disconnect Switch

A disconnect switch or contactor should be provided as a means of turning off the supply voltage when the unit is not in use or when it must be serviced.

Repetitive cycling on and off of the input supply voltage more than once every two minutes can lead to damage of the inverter.

1.2.4. Fusing

Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Manufacturer Instructions, National Electrical Code (NFPA70 or CSA22.1) and any additional local codes.

The minimum voltage rating for protection devices used with 240V inverters shall be 250VAC. The minimum voltage rating for protection devices used with 480V inverters shall be 600VAC.

Fuses shall not be installed between the drive and the motor.

In PM motor applications where the drive input current can be lower than the output current, it is allowed to use a protection device with a lower current rating thus being able to optimize line side wiring and ancillary components.

If the controller / elevator drive is supplied through an individual isolation transformer, the maximum fuse amperage rating shall not be greater than 125% of the secondary current rating of the transformer per NFPA70 and CSA 22.1. This value may be significantly lower than the values in the following tables.

Branch circuit protection for the F5 must be provided using the fuses as listed in the tables 1.2.4.1 and 1.2.4.2 below. Fast Acting class J fuses are recommended due to size and trip speed. Note the amperage value is the maximum value. Lower values may be used based on the relative sizing of the motor to the inverter. If there is an isolation transformer and a harmonic filter installed, a high speed class J fuse must be used (only Ferraz type HSJ or Bussmann type XXXX are approved).

Table 1.2.4.1 - 230V Units

Unit Size / Housing	SCCR [kA] rms	UL 248 Class J Rating [A]	Semiconductor Fuse Number* / Rating [A]	UL 489 MCCB [A] / Siemens Cat. No.
13 / E	10	40	50 140 06 80 / 80	
14 / G	10	50	50 140 06 100 / 100	
15 / G, H	10, 18	70	50 140 06 80 / 80	
16 / H	18	90	- -	
17 / H	18	110	- -	
18 / R	100	125	- -	150A / DG-frame 3VL 150 UL
19 / R	100	150	- -	150A / DG-frame 3VL 150 UL
20 / R	100	175	- -	250A / FG-frame 3VL 250 UL
21 / R	100	200	- -	250A / FG-frame 3VL 250 UL
23 / U	100	350	- -	400A / JG-frame 3VL 400 UL

* Semiconductor fuses are manufactured by Siba Fuse Inc. When using this type of fuse, this is the model number of the fuse that must be used.

Table 1.2.4.2 - 480V Units

Unit Size / Housing	SCCR [kA] rms	UL 248 Class J Rating [A]	Semiconductor Fuse Number* / Rating [A]	UL 489 MCCB [A] / Siemens Cat. No.
13 / E	10	25	50 140 06 40 / 40	
14 / E	10	30	50 140 06 50 / 50	
14 / G	10	30	50 140 06 80 / 80	
15 / E	10	40	50 140 06 80 / 80	
15 / G, H	10, 18	40	50 140 06 40 / 40	
16 / G, H	10, 18	50	50 140 06 63 / 63	
17 / G, H	10, 18	60	50 140 06 80 / 80	
18 / H	18	70	50 140 06 80 / 80	
19 / H	18	90	50 140 06 100 / 100	
19 / R	100	90	- -	150A / DG-frame 3VL 150 UL
20 / H	18	100	- -	
20 / R	100	100	- -	150A / DG-frame 3VL 150 UL
21 / R	100	150	- -	150A / DG-frame 3VL 150 UL
22 / R	100	175	- -	150A / DG-frame 3VL 150 UL
23 / R,U	100	200	- -	250A / FG-frame 3VL 250 UL
24 / R,U	100	225	- -	250A / FG-frame 3VL 250 UL
25 / U	100	275	- -	400A / JG-frame 3VL 400 UL
26 / U	100	300	- -	400A / JG-frame 3VL 400 UL
27 / U	100	350	- -	400A / JG-frame 3VL 400 UL
28 / W	100	400	- -	400A / JG-frame 3VL 400 UL

* Semiconductor fuses are manufactured by Siba Fuse Inc. When using this type of fuse, this is the model number of the fuse that must be used.

1.2.5. Line Chokes

A line choke with minimum 3% impedance is required for all 230 V inverters 50hp (size 20) and greater. A line choke with minimum 3% impedance is required for all 480V inverters 100hp (size 23) and greater.

Alternately, an isolation transformer installed between the main line and the elevator drive will satisfy the same requirement.

The line choke (or transformer) is used to prevent nuisance errors and damage caused by voltage spikes. Additionally, the use of a line choke will double the operational lifetime of the DC bus capacitors in the unit. At the same time the choke will reduce the harmonic distortion of the line current from very high values of 80-100% THiD to around 45% THiD.

If lower values of line current distortion are required, Contact KEB regarding an applicable harmonic filter. With such a device it is possible to reduce the harmonic distortion below 8% THiD.

1.2.6. Motor Thermal Protection

The F5 series elevator drive is UL approved as a solid state motor overload protection device. It is necessary to adjust the current trip level in parameter LM09 Electric Motor Protection Current (IM) or LM03 Motor Current (PM). The function assumes the use of a non-ventilated motor. The function meets the requirements set forth in VDE 0660 Part 104, UL508C section 42, NFPA 70 Article 430 part C. See the description for parameter LM08 Electric Motor Protection for the trip characteristics.

A motor winding sensor can also be used for additional safety and the highest level of protection. Either a normally closed contact (rating: 15V / 6mA) or a PTC (positive temperature coefficient) resistor can be connected to the T1, T2 terminals on the inverter. The thermal device should be connected as indicated in Sections 1.7 and 1.8.

The F5 Elevator drive can also accept a KTY type temperature sensor. This sensor will give an analog temperature reading which can be displayed directly in the diagnostic parameters. Additionally, a temperature level can be set to give a warning signal to the controller to indicate the motor is becoming too hot. This allows the controller to stop taking calls or adjust door open time in an effort to reduce motor temp. A KTY sensor is standard on drive sizes with R-housing and above or as an added option to drive sizes in housings H and below.

The KTY device is a solid state device. The approved model number is KTY-84 (1000Ω at 100° C).

1.2.7. Motor Cable Length

In some conventional installations and many MRL applications, the motor can be a considerable distance (greater then 40 feet) from the elevator drive. Under these circumstances the long cable length can cause high voltage peaks or high dV/dt (rate of voltage rise) on the motor windings. Depending on the design of the motor, the long runs can cause damage to the motor winding. Therefore, in these installations the use of a special dV/dt filter is highly recommended.

The standard approved solution is a special output choke. The choke is designed to be used with a maximum of 16kHz switching frequency and low inductance so it does not drastically influence the motor's equivalent circuit model.

There are three sizes available for motors rated up to 100A - All chokes are rated for use up to 550VAC. The part numbers and current ratings are listed below.

Part Number	Rated Current
15Z1F04-1005	22A
17Z1F04-1005	42A
21Z1F04-1005	100A

The use of a conventional line or motor choke on the output of the drive is not recommended since the inductance value is high enough that it would distort the values in the motor model and result in poor control of the motor. In addition, these chokes may not be designed to handle the heating incurred from 16kHz switching operation.

1.2.8. High Voltage Connections

Always note inverter voltage. Select appropriate over current protection devices, select disconnect device, and select proper wire size before beginning the wiring process. Wire the drive according to NFPA 70 Class 1 requirements.

The correct wire gauge for each size inverter can be selected from the charts in Sections 1.4-1.5. The wire gauge is based on the maximum fuse rating for the inverter. The terminal tightening torque can be found for each unit in the same charts.

Always use UL listed and CSA approved wire. Use 60/75°C copper conductors only for equipment rated 100 Amperes or less and use 75°C copper conductors only for equipment rated greater than 100 Amperes! Use minimum 300V rated wire with 230V systems and minimum 600V rated wire with 480V systems.

To prevent coupling high frequency noise, the following wires must be spatially separated from each other a minimum distance of 8 inches (20 cm) when they are laid parallel to each other.

- AC supply power and motor lines not connected to inverters
- Motor lines connected to inverters
- Control and data lines (low-voltage level < 48 V)

When using EMI filters, use only the wire provided with the filter to connect the filter to the inverter. Do not add additional wire between the filter and the inverter as this will have a negative effect on the operation of the filter.

1.2.9. Ground Connections

When working with high frequencies (> 1kHz) and power semiconductors it is recommended to make all ground connections with large exposed metal surfaces to minimize the ground resistance.

The metal sub-plate the inverter is mounted on is regarded as the central ground point for the machine or the equipment. For best results use an unpainted, galvanized or plated sub-panel.

An additional high frequency ground wire should be connected between the inverter and the sub-panel. Use a stranded wire equal in size to the main line conductor or a thick ground strap. This is in addition to the ground wire required by NFPA 70, UL 508, CSA 22.1.

All ground connections should be kept as short as possible and as close as possible to the ground system, sub-panels.

If other components in the system exhibit problems due to high frequency disturbances, connect an additional high frequency ground wire between them and the sub-panel.

The EMI filter should be mounted to the drive or as close as possible to the inverter and on the same sub-panel as the inverter. Good metallic surface contact to the sub-panel is required to provide adequate high frequency grounding of the filter.

1.2.10. High Frequency Shielding

Use of shielded cable is recommended when high frequency emissions or easily disturbed signals are present. Examples are as follows:

- Motor wires: Connect shield to ground at both the drive and motor. NOTE the shield should never be used as the protective ground conductor required by NFPA70 or CSA22.1. Always use a separate conductor for this.
- Digital control wires: Connect shield to ground at both ends.
- Analog control wires: Connect shield to ground only at the inverter.

The connection of meshed shields to the ground connection should not be done through a single strand or drain wire of the shield, but with metallic clamps to provide 360° contact around the surface of the shield to the ground point. Connection with a single wire from the braided shield reduces the effectiveness of the shield 70%. Metal conduit clamps work well for this. Be sure the fit is tight.

Rigid metal conduit can be used as the shield of the motor wires. Always observe the following points:

- Remove all paint from the control cabinet and motor housing where the conduit is fastened.
- Securely fasten all conduit fittings.
- Run only the motor wires through the conduit, all other wires, high voltage AC and low voltage signal, should be pulled through a separate conduit.
- Connect the control panel to the Sub-panel with a heavy ground strap.

Should EMI filters be used, they should be mounted to the inverter or as close as possible to the inverter and on the same sub-panel as the inverter. Good metallic surface contact to the sub-panel is required to provide adequate high frequency grounding of the filter. Always use the shielding plate provided with the filter when connecting the filter to the inverter.

Shielding of control wires:

- If digital signal wires are terminated on a terminal block in the control panel, the shields should be firmly connected to the sub-panel on both sides of the terminal block.
- The shields of digital signal wires originating outside the control cabinet which are not terminated on a terminal block, must be connected to the sub-panel at the point where the cable enters the control panel and at the inverter.
- If the shield is terminated to the sub-panel within 8 inches (20cm) of the inverter, then the shield no longer needs to be connected to the inverter.
- When using un-shielded signal wires, they should always be installed as a twisted pair (signal and common).
- Low voltage signal wires should cross high voltage wires at right angles

1.2.11. Storage of Unit

The DC bus of the KEB F5 is equipped with electrolytic capacitors. If the electrolytic capacitors are stored de-energized, the oxide film working as a dielectric fluid reacts with the acidic electrolyte and destroys itself slowly. This affects the dielectric strength and capacity of the unit. If the capacitors start running with rated voltage again, the oxide film tries to build up quickly. This causes heat and gas and leads to the destruction of the capacitors.

To avoid failures, the KEB F5 must be started up according to the following specification based on duration of storage period (powered off):

Storage Period: < 1 Year		
Start up normally, without any additional precautions		
Storage Period: 1 - 2 Years		
Power on frequency inverter for one hour without any modulation		
Storage Period: 2 - 3 Years		
Remove all cables from power circuit, including braking resistor connections		
Remove drive enable command		
Connect variable voltage supply to inverter input		
Increase voltage slowly to indicated input level and remain for specified time.		
Voltage Class	**Input Voltage**	**Minimum Time**
230V	0 - 160V	15 minutes
	160 - 220V	15 minutes
	220 - 260V	1 hour
480V	0 - 280V	15 minutes
	280 - 400V	15 minutes
	400 - 500V	1 hour
Storage Period: > 3 Years		
Input voltage same as above, however double the amount of time for each additional year. Eventually consider changing capacitors.		

1.2.12. Dielectric Testing

The KEB Elevator drive is dielectric tested after assembly as part of the factory end test routine. This dielectric test is harmonized and in accordance with the requirements set forth in UL 508C, CSA C22.2 No. 274-17, ASME A17.5-2019, CSA B44.1-19, EN81, IEC61800-5 and EN 60204-1. The factory dielectric test is conducted using a voltage of 3640 VDC for one second.

EN 60204-1 states that it is permissable to disconnect already tested components, such as the KEB elevator drive, because it has been 100% factory tested. This is the recommended approach.

However, if subsequent testing is required in the integrated system (control panel), the following points must be observed:

- High voltage LINE side (L1,L2,L3), DC (++, PA+, PB, --) and motor side load connections (U, V, W) must all be jumpered together.
- All 24V control signals must be connected to earth ground.
- Only DC Voltage can be used for the test. Testing with AC voltage will damage the semiconductors and capacitors within the elevator drive thereby voiding the warranty.
- The maximum permitted voltage must be reduced to 80% of the previously tested factory value. This is 2112 VDC for one second or 1760 VDC for 60 seconds.
- The suggested slew rate of the voltage, to minimum leakage current resulting from capacitor charging, is 2000VDC/sec.

1.2.13. Insulation Measurement

An insulation measurement (in accordance with EN 60204-1 chapter 18.2) is permissable with 500VDC. The following points must be observed:

- High voltage LINE side (L1, L2, L3), DC (++, PA+, PB, --) and motor load side connections (U,V,W) must all be jumpered together.
- All 24V control signals must be connected to earth ground.
- Only a DC voltage (maximum 500V) can be used for the test. Testing with AC voltage will damage the semiconductors and capacitors within the elevator drive.

The resulting insulation resistance shall be greater than 1MΩ

1.2.14. Brake Transistor Monitor

The brake transistor monitor circuit monitors the brake transistor circuit and indicates to the elevator controller that a shutdown of the system is required in the event of a brake transistor failure.

Monitor Circuit

The brake transistor monitor circuit is part of the braking resistor circuit and monitors the brake transistor to confirm the transistor is switching correctly. If the brake transistor fails, the monitor circuit opens terminals K1/K2. It is the responsibility of the OEM (elevator control manufacturer) to monitor terminals K1/K2 and to bring the system to a safe halt in the event of a brake transistor failure.

The K1/K2 terminals are a normally closed contact and shall be connected either to a line contactor to disconnect the drive from the high voltage supply, or to a DC contactor to disconnect the brake resistor from the drive. The DC contactor may be either single pole or double pole. If single pole the contact should be wired in series with the positive terminal of the brake resistor.

Through the K1/K2 and connected power contactor, the source of energy is removed from the brake resistor in the event of a brake transistor failure, thereby preventing dangerous overheating of the brake resistor.

Contactors are not included with the drive and must be purchased separately. Contact KEB for assistance on selecing the right contactor option for your application. See below for sizing.

No Monitor Circuit

On drives without the brake transistor monitor (K1/K2) contacts, a temperature sensor shall be connected to the brake resistor to provide a warning of brake transistor failure. If the brake transistor fails, the brake resistor begins to overheat, thus opening the normally closed temperature sensor on the brake resistor.

The temperature sensor shall be connected to either line contactor to disconnect the drive from the high voltage supply, or to a DC contactor to disconnect the brake resistor from the drive. The DC contactor may be either single pole or double pole. If single pole the contact should be wired in series with the positive terminal of the brake resistor.

Component Rated Values

The line contactor shall be rated for the rated main line voltage and have an AC-1 current rating not less than the expected FLA of the elevator drive.

The DC contactor shall be rated for a minimum of 1000VDC and have a resistive current rating not less than the maximum braking transistor current of the connected F5 elevator drive.

The control voltage is typically either 120VAC or 24VDC depending on the coil voltage of the contactors, I/O on the elevator control, and the ratings of the temperature sensor on the resistor.

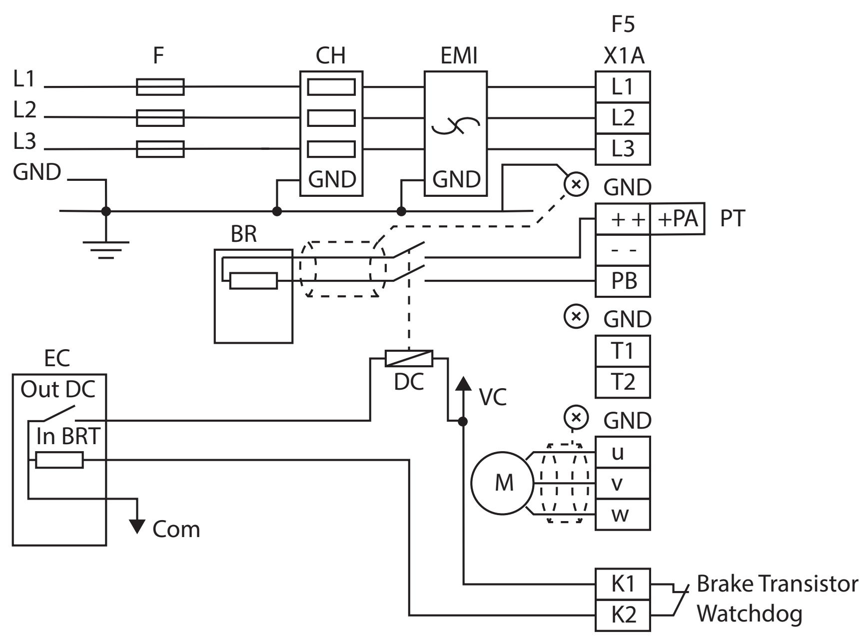
The K1/K2 relay contact in the monitor circuit is rated for pilot duty, 2A at 120VAC or 2A at 24VDC.

1.2.15. Monitor Circuit Wiring Diagrams

The monitor circuit controls a normally closed relay output at terminals K1 and K2 near the power terminal. K1 and K2 are connected to either the elevator controler or a DC or line contactor as shown in the following wiring diagrams.

Brake Transistor Monitor with Elevator Controller Supervision: DC Contactor

F	Branch Circuit Fuses
CH	Line Choke
EMI	EMI Filter
BR	Brake Resistor
DC	DC Contactor
EC	Elevator Control
VC	Control Voltage
M	Motor
PT	Power Terminal
	++ for housings E,G,H
	+PA for housings R,U,W



Brake Transistor Monitor

Brake Transistor Monitor with Elevator Controller Supervision: Line Contactor

F Branch Circuit Fuses
CH Line Choke
EMI EMI Filter
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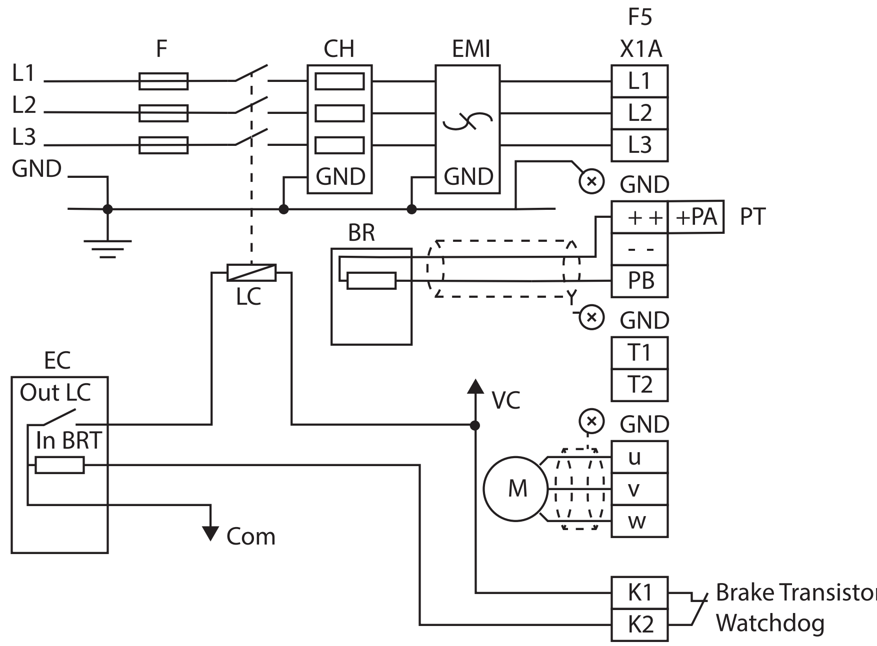
LC Line Contactor
EC Elevator Control
VC Control Voltage
M Motor
PT Power Terminal
++ for housings E,G,H
+PA for housings R,U,W



Brake Transistor Monitor without Elevator Controller Supervision: DC Contactor

F Branch Circuit Fuses
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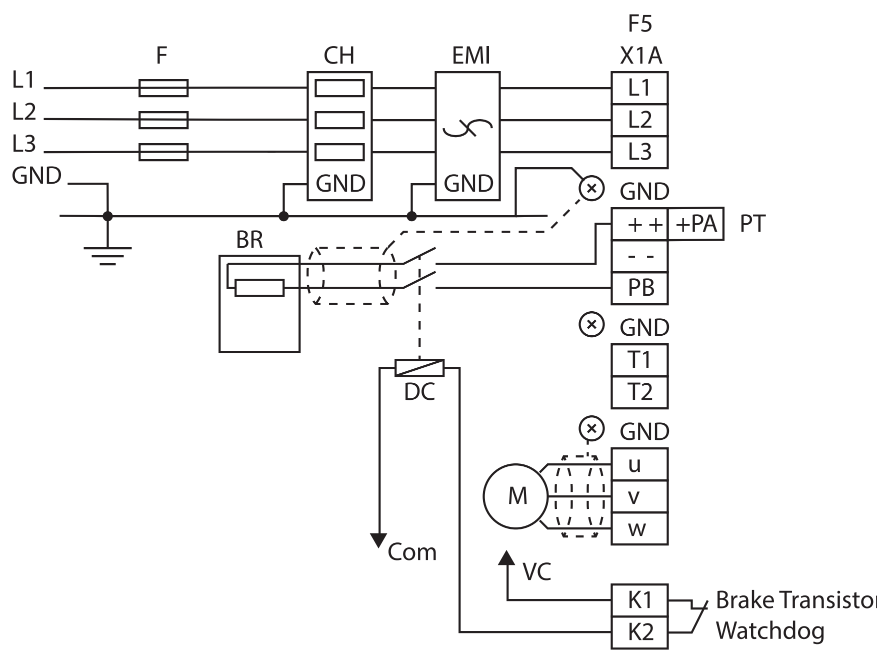
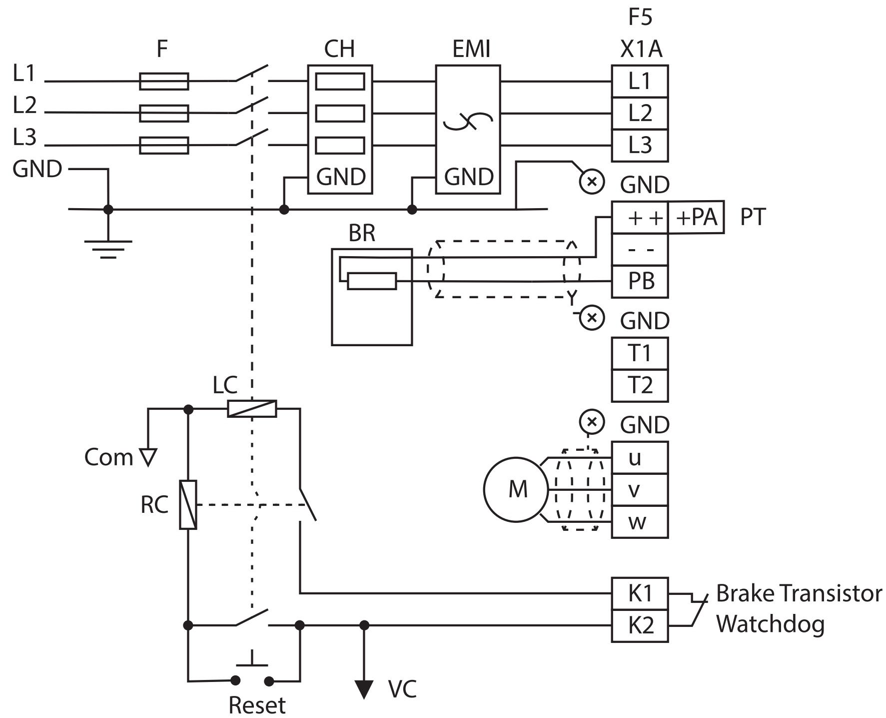


Brake Transistor Monitor without Elevator Controller Supervision: Line Contactor

F Branch Circuit Fuses
CH Line Choke
EMI EMI Filter
BR Brake Resistor
LC Line Contactor
EC Elevator Control
VC Control Voltage
M Motor
RC Reset Contactor
Reset Reset Button
PT Power Terminal
++ for housings E,G,H
+PA for housings R,U,W

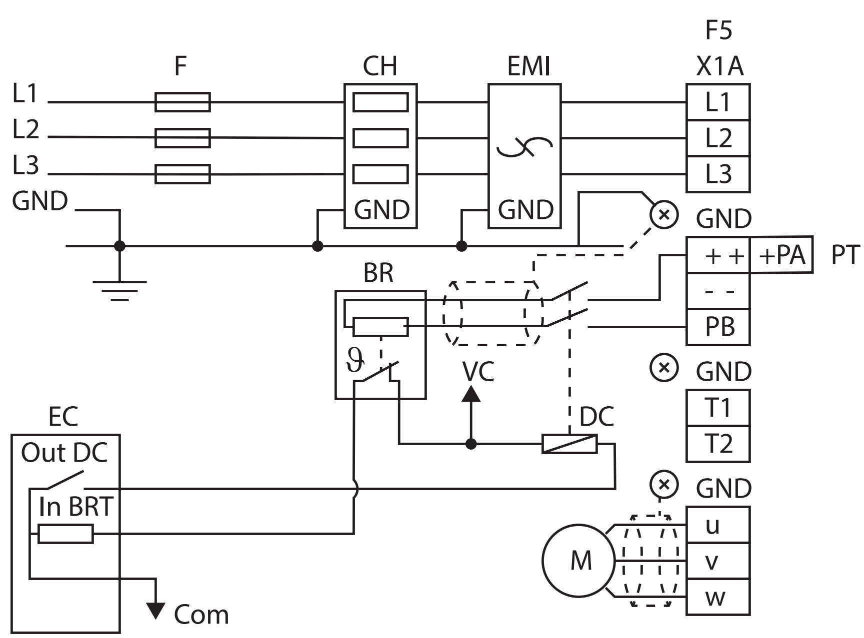


1.2.16. Temperature Sensor Wiring Diagrams

For drives without the monitor circuit, a normally closed temperature sensor on the brake resistor is wired either to the elevator controller or to a contactor. If the temperature sensor indicates an over temperature condition, either the elevator controller or the connected contactor must remove the source of energy from the braking resistor. This can be done either on the AC line side of the drive or the DC side with a resistor as shown in the following wiring diagrams.

Temperature Sensor Monitor Circuit; Elevator Controller Supervision: DC Contactor

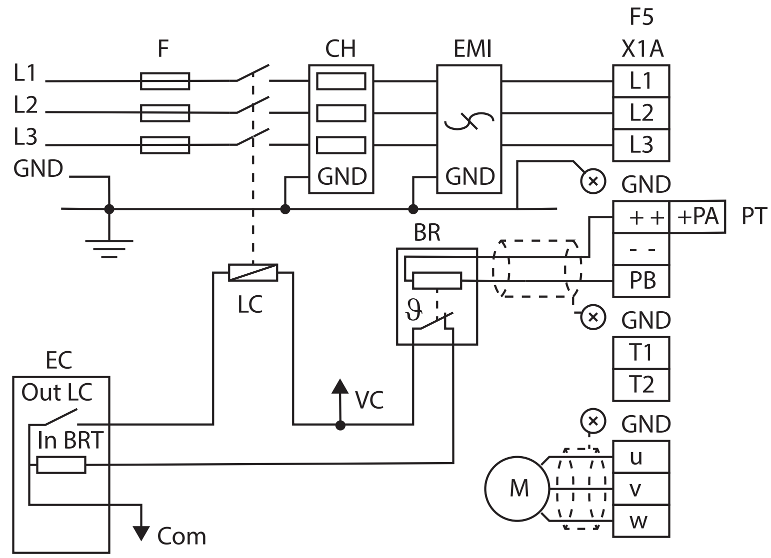
F Branch Circuit Fuses
CH Line Choke
EMI EMI Filter
BR Brake Resistor
DC DC Contactor
EC Elevator Control
VC Control Voltage
M Motor
PT Power Terminal
++ for housings E,G,H
+PA for housings R,U,W



Brake Transistor Monitor

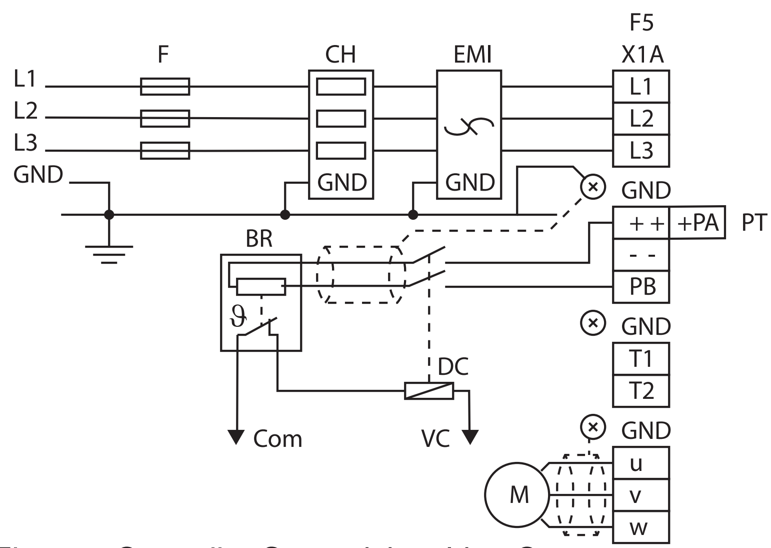
Temperature Sensor Monitor Circuit; Elevator Controller Supervision: Line Contactor

F Branch Circuit Fuses
CH Line Choke
EMI EMI Filter
BR Brake Resistor
LC Line Contactor
EC Elevator Control
VC Control Voltage
M Motor
PT Power Terminal
++ for housings E,G,H
+PA for housings R,U,W



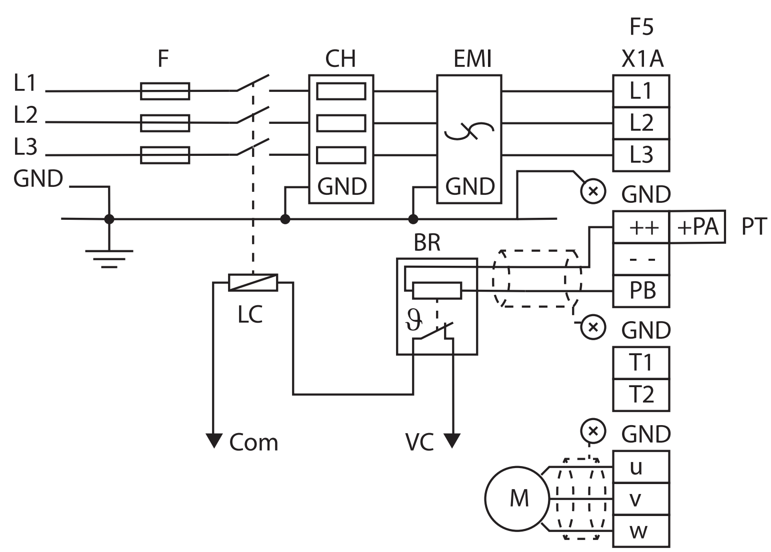
Temperature Sensor Monitor Circuit; No Elevator Controller Supervision: DC Contactor

F Branch Circuit Fuses
CH Line Choke
EMI EMI Filter
BR Brake Resistor
DC DC Contactor
EC Elevator Control
VC Control Voltage
M Motor
PT Power Terminal
++ for housings E,G,H
+PA for housings R,U,W



Temperature Sensor Monitor Circuit; No Elevator Controller Supervision: Line Contactor

F Branch Circuit Fuses
CH Line Choke
EMI EMI Filter
BR Brake Resistor
LC Line Contactor
EC Elevator Control
VC Control Voltage
M Motor
PT Power Terminal
++ for housings E,G,H
+PA for housings R,U,W



1.3. Model Number Information

Part Number

17.F5.A1G-RLBB

Unit Ident.	B= LCD Oper. with Serial/CAN D = LCD Oper. with Serial/CAN + boosted peak output
Feedback Card	0 = None installed at the factory B = Incremental TTL (terminal)....TTL output D = Incremental TTL (SubD) ....TTL output F = Hiperface ....TTL output M = Sin/Cos ....TTL output P = EnDat ....TTL output V = SSi ....TTL output 9 = UVW ....TTL output *Additional interfaces types and channel configurations available
Application	L = KEB Elevator Drive
Voltage Ident.	R = 480V, 3-Phase P = 230V, 3-Phase
Housing Type	E, G, H, R, U, W
Accessories	1 = Braking transistor[1] standard 3 = Braking transistor and EMI filter
Control Stage	A = Standard Board - all motor types K = Safety Board - all motor types, STO
Unit Type	F5
Unit Size	see below

Unit Size:

10 = 3 hp	17 = 25 hp	23 = 100 hp
12 = 5 hp	18 = 30 hp	24 = 125 hp
13 = 7.5 hp	19 = 40 hp	26 = 175 hp
14 = 10 hp	20 = 50 hp	28 = 250 hp
15 = 15 hp	21 = 60 hp	
16 = 20 hp	22 = 75 hp	

1 For F5 housing sizes G, H, R, U and W the braking transistor monitor circuit will be included on all units delivered after May 2021.

1.4. Technical data 230V (size 13 to 23)*

Inverter Size	**13**	**14**	**15**		**16**	**17**	
Max Motor Power [hp]	**7.5**	**10**	**15**		**20**	**25**	
Housing Size	**E**	**E**	**G**	**G**	**H**	**H**	
Unit Hardware	**B**	**B**	**B**	**D**	**B**	**B**	**D**
Input Ratings							
Supply voltage [V]	180...260 +/- 0 (240V Nominal Voltage)						
Supply voltage frequency [Hz]	50 / 60 +/- 2						
Input phases	3	3	3	3	3	3	
Rated input current [A]	28	36	52		63	92	
UL minimum wire gauge [1)] [awg]	24	24	16	16	12	12	
UL maximum wire gauge [1] [awg]	10	10	4	4	0	0	
Output Ratings							
Rated output power [kVA]	9.5	13	19		26	33	
Rated motor power [kW]	5.5	7.5	11		15	18.5	
Rated output current [A]	22	28	42		57	84	
Peak current (30 seconds) [2)] [A]	36	49.5	72	86	118	151	168
Over current fault (E.OC) trip level [A]	43	59	86	104	142	181	201
Output voltage [V]	3 x 0...V input (3 x 0...255V [2)])						
Output frequency [Hz]	Generally 0 to 599Hz (limited by control board and carrier frequency)						
Rated switching frequency [3)] [kHz]	8	4	8	4	16	4	4
Maximum switching frequency [kHz]	16	16	16	16	16	16	16
Power loss at rated operation [4)] [W]	290	350	420	420	550	850	850
Stall current at 4kHz [A]	24	33	36	60	73	126	118
Stall current at 8kHz [A]	24	24	31	53	73	109	97
Stall current at 16kHz [A]	16.8	16.8	26	43	73	92	59
Braking Circuit							
Min. braking resistance[Ohm]	16	16	8.0	5.6	4.5	4.5	
Typ. braking resistance[Ohm]	27	20	13	13	10	7.0	
Max. braking current [A]	25	25	50	70	90	90	
Installation Information							
Max. shielded motor cable length [5)] [ft]	330	330	330		330	330	
Tightening torque for power terminals [in lb]	11	11	11		35	35	
Environmental							
Max. heat sink temperature TOH [°C]	90°C / 194°F						
Storage temperature [°C]	-25...70 °C / -13…158°F						
Operating temperature [°C]	-10...45 °C / 14…113°F						
Housing design / protection	Chassis / IP20 / Pollution Degree 2						
Relative humidity	max. 95% without condensation						
Approvals							
Tested in accordance with…	EN 61800-3 /UL508C						
Standards for emitted interference	EN 55011 Class B / EN 55022 Class A						
Standards for noise immunity	IEC 1000-4-2 / -3 / -4 / -5/ -6						
Climatic category	3K3 in accordance with EN 50178						

*Smaller sizes available

i

The recommended motor rating is for 4/6 pole standard motors. When using motors with different numbers of poles, the inverter must be dimensioned based on the motor rated current. Contact the manufacturer for special frequency motors.
The power rating of the inverter must be de-rated for operation above 3,300 ft (1000 m). Reduce the rated power 1% for each additional 330 ft (100 m). The maximum elevation for operation is 6,560 ft (2000 m)

Inverter Size	19	20	21	23	
Max Motor Power [hp]	40	50	60	100	
Housing Size	R	R	R	U	
Unit Hardware	B	B	B	B	D
Input Ratings					
Supply voltage [V]	180...260 +/- 0 (240V Nominal Voltage)				
Supply voltage frequency [Hz]	50 / 60 +/- 2				
Input phases	3	3	3	3	
Rated input current [A]	126	143	169	264	
UL minimum wire gauge [1] [awg]	2	2	6	2	
UL maximum wire gauge [1] [awg]	4/0	4/0	1/0	300 kcmil	
Output Ratings					
Rated output power [kVA]	46	59	71	115	
Rated motor power [kW]	30	37	45	75	
Rated output current [A]	115	130	154	264	
Peak current (30 seconds) [2] [A]	230	217	270	363	450
Over current fault (E.OC) trip level [A]	276	270	315	435	
Output voltage [V]	3 x 0...V input (3 x 0...255V [2])				
Output frequency [Hz]	Generally 0 to 599Hz (limited by control board and carrier frequency)				
Rated switching frequency [kHz]	8	8	8	4	
Maximum switching frequency [3] [kHz]	16	16	16	8	
Power loss at rated operation [4] [W]	1200	1400	1700	3000	
Stall current at 4kHz [A]	123	160	198	319	396
Stall current at 8kHz [A]	115	145	180	203	252
Stall current at 16kHz [A]	70	101	101	–	
Braking Circuit					
Min. braking resistance [Ohm]	3.9	2.0	2.0	1.2	1.2
Typ. braking resistance [Ohm]	4.7	3.9	3.0	1.5	1.5
Max. braking current [A]	102	160	160	340	340
Installation Information					
Max. shielded motor cable length [5] [ft]	165				
Tightening torque for power terminals [in lb]	53			220	
Environmental					
Max. heat sink temperature TOH [°C]	90°C / 194°F				
Storage temperature [°C]	-25...70 °C / -13…158°F				
Operating temperature [°C]	-10...45 °C / 14…113°F				
Housing design / protection	Chassis / IP20 / Pollution Degree 2				
Relative humidity	max. 95% without condensation				
Approvals					
Tested in accordance with…	EN 61800-3 /UL508C				
Standards for emitted interference	EN 55011 Class B / EN 55022 Class A				
Standards for noise immunity	IEC 1000-4-2 / -3 / -4 / -5/ -6				
Climatic category	3K3 in accordance with EN 50178				

1) The wire gauge is based on the maximum fuse rating, copper wire with a 75°C insulation rating, THHW or equivalent. If circuit protection is selected based on the actual input current, the wire size could be reduced.

2) This is the peak output current limited by hardware regulation. The software current control reserves 5% for closed loop regulation.

3) This is the maximum carrier frequency the power stage can support. The actual operating carrier frequency is adjusted and limited by the control card.

4) This is the power dissipation at the rated carrier frequency, rated voltage and rated load. Operation at reduced carrier frequencies or reduced load will decrease this value.

5) Max motor cable length when using shielded cable, KEB EMI filter, and the installation must conform to EN55011 / EN55022.

1.5. Technical data 480V (size 13 to 28)*

Inverter Size	13	14	15	16	16	17	17	18	19
Max Motor Power [hp]	**7.5**	**10**	**15**	**20**	**15**	**25**	**18.5**	**30**	**40**
Housing Size	**E**	**E**	**E**	**G**	**H**	**G**	**H**	**H**	**H**
Unit Hardware	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**
Input Ratings									
Supply voltage [V]	305...528 ±0 (480 V Nominal voltage)								
Supply voltage frequency [Hz]	50 / 60 +/- 2								
Input phases	3	3	3	3	3	3	3	3	3
Rated input current 400VAC [A]	17	23	31	43	43	55	55	65	66
(UL) Rated input current 480VAC [A]	15.4	19.6	27.3	35	35	44	44	52	57
UL minimum wire gauge 2) [awg]	24	24	24	16	8	16	6	12	12
UL maximum wire gauge 2) [awg]	10	10	10	4	0	4	1/0	0	0
Output Ratings									
Rated output power [kVA]	8.3	11	17	23	23	29	29	35	42
Rated motor power [kW]	5.5	7.5	11	15	15	18.5	18.5	22	30
Rated output current 400VAC [A]	12	16.5	24	33	33	42	42	50	60
(UL) Rated output current 480VAC [A]	11	14	21	27	27	34	34	40	52
Peak current (30 seconds) 3) [A]	21.6	29.7	36	49.5	49.5	63	63	75	90
Over current fault (E.OC) trip level [A]	25.9	35.6	43.2	59.4	59	75.6	75	90	108
Output voltage [V]	3 x 0…Vsupply								
Output frequency [Hz]	Generally 0 to 599Hz (limited by carrier frequency)								
Rated switching frequency 4) [kHz]	8	8	4	8	16	4	8	8	8
Maximum switching frequency [kHz]	16	16	16	16	16	16	16	16	16
Power loss at rated operation 5) [W]	250	320	350	310	490	360	470	610	540
Stall current at 4kHz [A]	12	16.5	24	33	41.91	42	42	60	60
Stall current at 8kHz [A]	12	16.5	16	21.5	33	21.5	42	50	54
Stall current at 16kHz [A]	12	10	10	9.5	19.8	-	25.2	30	36
Braking Circuit									
Min. braking resistance [Ohm]	39	36	36	19	19	19	19	9	9
Typ. braking resistance [Ohm]	100	85	56	39	39	28	28	22	16
Max. braking current [A]	21	21	21	40	40	40	40	90	90
Installation Information									
Max. shielded motor cable length 7) [ft]	300		330	330	330	330	330	330	330
Tightening torque for power terminals [in lb]	4.5	4.5	11	11	35	11	35	35	35
Environmental									
Max. heat sink temperature TOH [°C]	90°C / 194°F								
Storage temperature [°C]	-25...70 °C / -13…158°F								
Operating temperature [°C]	-10...45 °C / 14…113°F								
Housing design / protection	Chassis/IP20 /Pollution Degree 2								
Relative humidity	max. 95% without condensation								
Approvals									
Tested in accordance with…	EN 61800-3 /UL508C								
Standards for emitted interference	EN 55011 Class B/EN 55022 Class A								
Standards for noise immunity	IEC 1000-4-2 / -3 / -4 / -5/ -6								
Climatic category	3K3 in accordance with EN 50178								

*Additional sizes available

i **The recommended motor rating is for 4/6 pole standard motors. When using motors with different numbers of poles, the inverter must be dimensioned based on the motor rated current. Contact the manufacturer for special frequency motors.**
The power rating of the inverter must be de-rated for operation above 3,300 ft (1000 m). Reduce the rated power 1% for each additional 330 ft (100 m). The maximum elevation for operation is 6,560 ft (2000 m)

Technical data 480V (size 13 to 28)*

KEB

Inverter Size	20	22		24	26		28
Max Motor Power [hp]	**50**	**75**		**125**	**175**		**250**
Housing Size	**H**	**R**		**U**	**U**		**W**
Unit Hardware	**B**	**B**	**D**	**B**	**B**	**D**	**B**
Input Ratings							
Supply voltage [V]	305...528 ±0 (480 V Nominal voltage)						
Supply voltage frequency [Hz]	50 / 60 +/- 2						
Input phases	3	3		3	3		3 or 2x3 1)
Rated input current 400VAC [A]	83	127		198	275		385
(UL) Rated input current 480VAC [A]	72	105		172	231		362
UL minimum wire gauge 2) [awg]	12	6		2	2		16mm stud terminals. Use UL approved ring crimp connector
UL maximum wire gauge 2) [awg]	0	1/0		4/0	300 kcmill		
Output Ratings							
Rated output power [kVA]	52	80		125	173		256
Rated motor power [kW]	37	55		90	132		200
Rated output current 400VAC [A]	75	115		180	250		370
(UL) Rated output current 480VAC [A]	65	96		172	231		332
Peak current (30 seconds) 3) [A]	135	172	230	270	375	450	740
Over current fault (E.OC) trip level [A]	162	207	276	324	450	540	888
Output voltage [V]	3 x 0…Vsupply						
Output frequency [Hz]	Generally 0 to 599Hz (limited by control board and carrier frequency)						
Rated switching frequency 4) [kHz]	4	8	8	8	4	4	2
Maximum switching frequency [kHz]	16	16	16	8	8	12	8
Power loss at rated operation 5) [W]	900	1500	1500	2400	2800	2800	3500
Stall current at 4kHz [A]	83	115	173	198	330	330	574
Stall current at 8kHz [A]	83	115	150	180	180	225	407
Stall current at 16kHz [A]	45	63	98	–	–	125 6)	–
Braking Circuit							
Min. braking resistance [Ohm]	9	7.5		4	2.2 8)		1.2
Typ. braking resistance [Ohm]	13	9		6	4.3		2.3
Max. braking current [A]	90	104		200	364		660
Installation Information							
Max. shielded motor cable length 7) [ft]	165						
Tightening torque for power terminals [in lb]	35	53		133	220		
Environmental							
Max. heat sink temperature TOH [°C]	90°C / 194°F				60°C / 140 °F		90°C / 194 °F
Storage temperature [°C]	-25...70 °C / -13…158°F						
Operating temperature [°C]	-10...45 °C / 14…113°F						
Housing design / protection	Chassis / IP20 / Pollution Degree 2						
Relative humidity	max. 95% without condensation						
Approvals							
Tested in accordance with…	EN 61800-3 /UL508C						
Standards for emitted interference	EN 55011 Class B / EN 55022 Class A						
Standards for noise immunity	IEC 1000-4-2 / -3 / -4 / -5/ -6						
Climatic category	3K3 in accordance with EN 50178						

1) The 28 W housing can either be fed with one large set of wires or two smaller sets of wires, double feed. See Mat. No. 00F50EB-KW00 from KEB.

2) The wire gauge is based on the maximum fuse rating, copper wire with a 75°C insulation rating, THHW or equivalent. If circuit protection is selected based on the actual input current, the wire size could be reduced.

3) This is the peak output current limited by hardware regulation. The software current control reserves 5% for closed loop regulation.

4) This is the maximum carrier frequency the power stage can support. The actual operating carrier frequency is adjusted and limited by the control card.

5) This is the power dissipation at the rated carrier frequency, rated voltage and rated load. Operation at reduced carrier frequencies or reduced load will decrease this value.

6) 12kHz

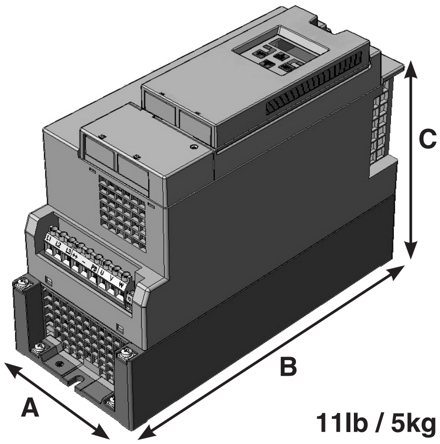
7) Max motor cable length when using shielded cable, KEB EMI filter, and the installation must conform to EN55011 / EN55022.

8) Min. resistance applies to 50% duty cycle.

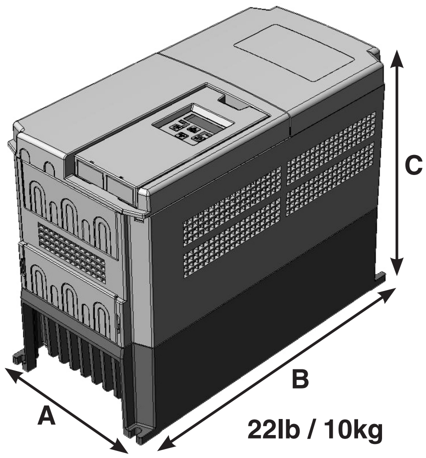
Dimensions and weight

1.6. Dimensions and weight

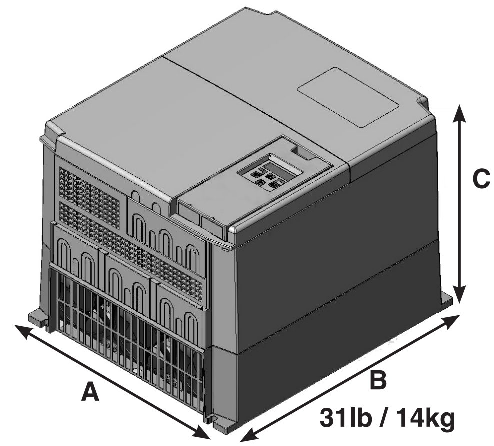
E Housing



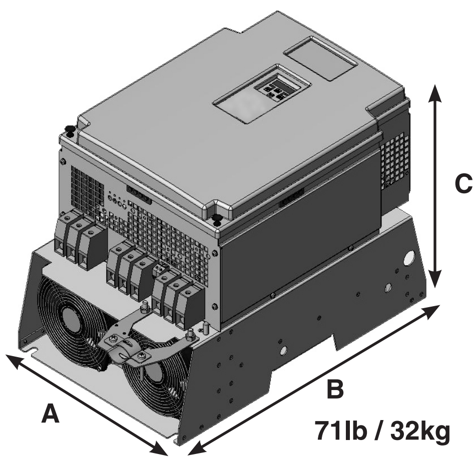
G Housing



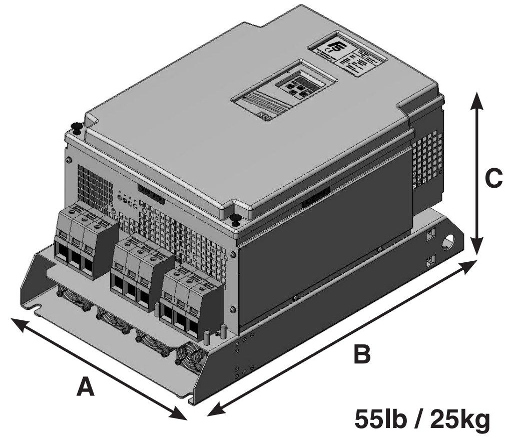
H Housing



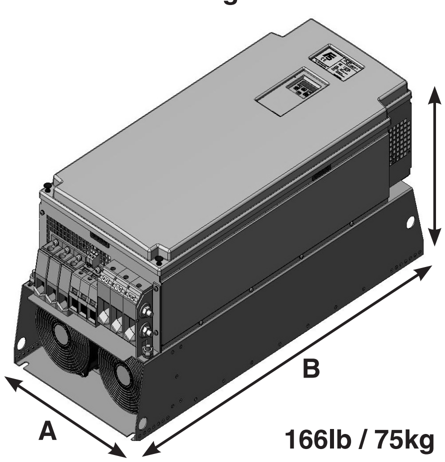
R Housing



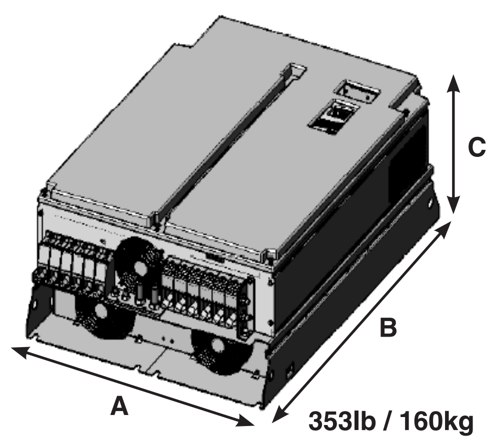
R Housing (peak unit)*



U Housing



W Housing



See next page for dimension tables.

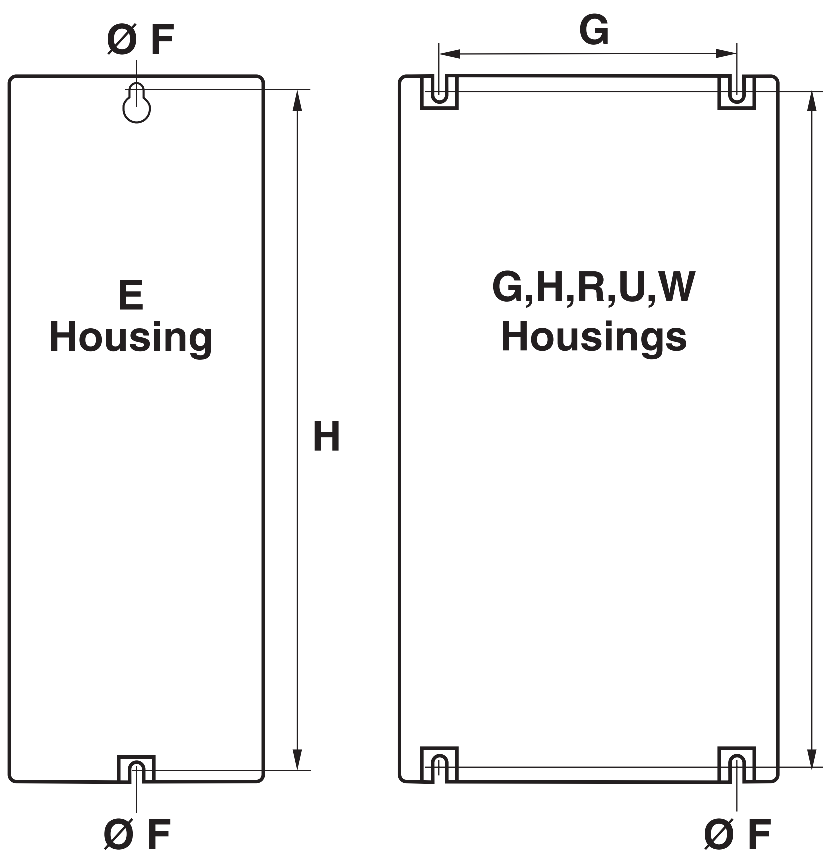
Dimensions in inches

Housing	A	B	C	F	G	H
E	5.12	11.4	8.75	0.28	-	10.8
G	6.7	13.4	10.0	0.28	5.9	13.0
H	11.7	13.4	10.0	0.28	9.8	13.0
R	13.5	20.5	14.0	0.394	11.8	19.5
R*	13.5	20.5	10.9	0.394	11.8	19.5
U	13.5	31.5	14.0	0.394	11.8	30.5
W	26.4	37.0	14.5	0.512	24.8	35.8

Dimensions in mm

Housing	A	B	C	F	G	H
E	130	290	222	7	-	275
G	170	340	255	7	150	330
H	297	340	255	7	250	330
R	340	520	357	11	300	495
R*	340	520	278	11	300	495
U	340	800	357	11	300	775
W	670	940	368	13	630	910

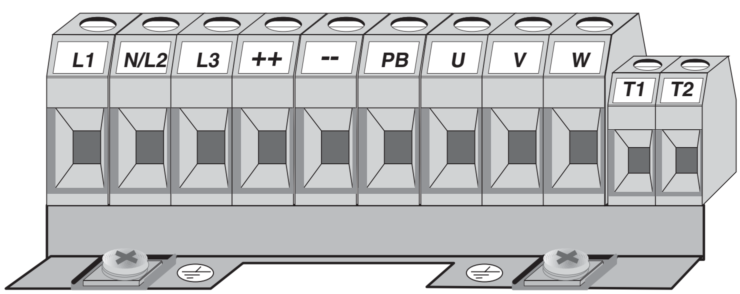
Mounting Holes



1.7.Power Circuit Terminal Summary

Housing Size E

Verify input voltage with name plate for proper connection 230V or 480V

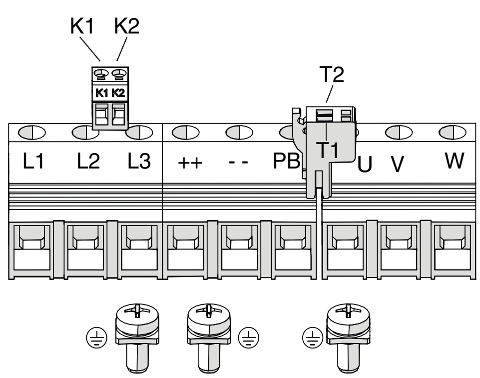


L1, L2, L3	3 phase supply voltage
++, - -	Connection for DC supply
++, PB	Connection for braking resistor
U, V, W	Motor connection
T1, T2	Connection for temperature sensor
⏚	Connection for earth ground

Terminal Tightening Torque: 4.5 inlbs (0.5Nm)

Housing Size G

Verify input voltage with name plate for proper connection 230V or 480V

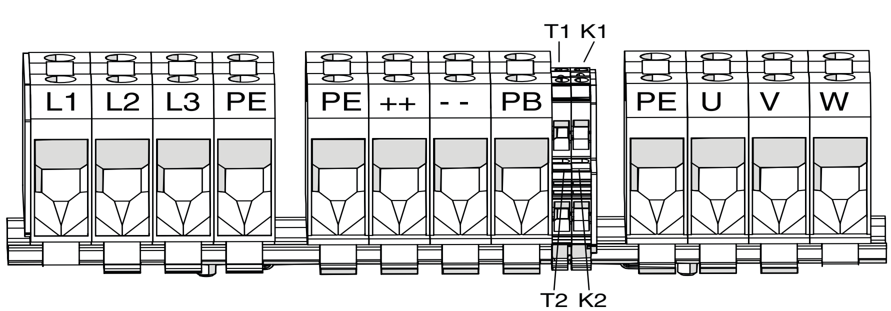


L1, L2, L3	3 phase supply voltage
++, - -	Connection for DC supply
++, PB	Connection for braking resistor
K1,K2	Brake transistor monitor terminals
T1, T2	Connection for temperature sensor
U, V, W	Motor connection
⏚	Connection for earth ground

Terminal Tightening Torque: 11 inlbs (1.2Nm)

Housing Size H

Verify input voltage with name plate for proper connection 230V or 480V



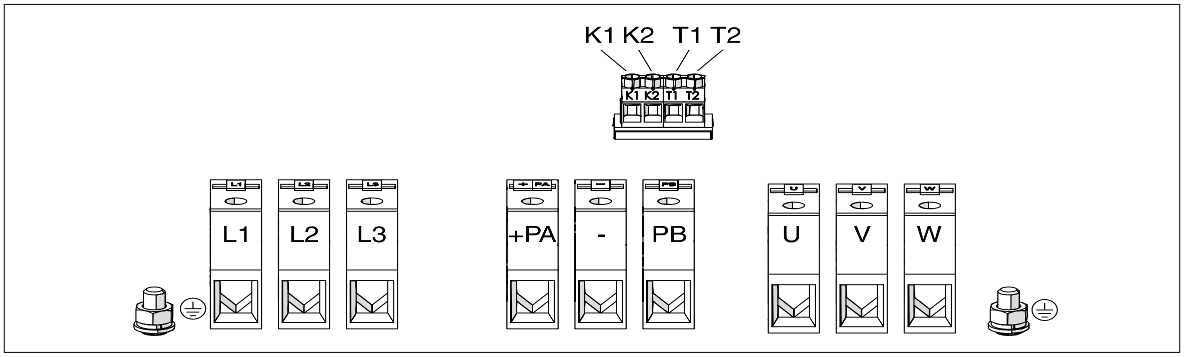
L1, L2, L3	3 phase supply voltage	**T1, T2**	Connection for temperature sensor
+ +, - -	DC supply connection	**K1,K2**	Brake transistor monitor terminals
+ +, PB	Connection for braking resistor	**U, V, W**	Motor connection
		PE	Connection for earth ground

Terminal Tightening Torque: 35 inlbs (4Nm)

Housing Size R

⚠ Verify input voltage with name plate for proper connection 230V or 480V

Note always verify input voltage with name plate for proper connection



L1, L2, L3	3 phase supply voltage	**T1, T2**	Connection for temperature sensor
+PA, -	DC supply connection	**K1,K2**	Brake transistor monitor terminals
+PA, PB	Connection for braking resistor	**U, V, W**	Motor connection
		⏚	Connection for earth ground M8 stud.

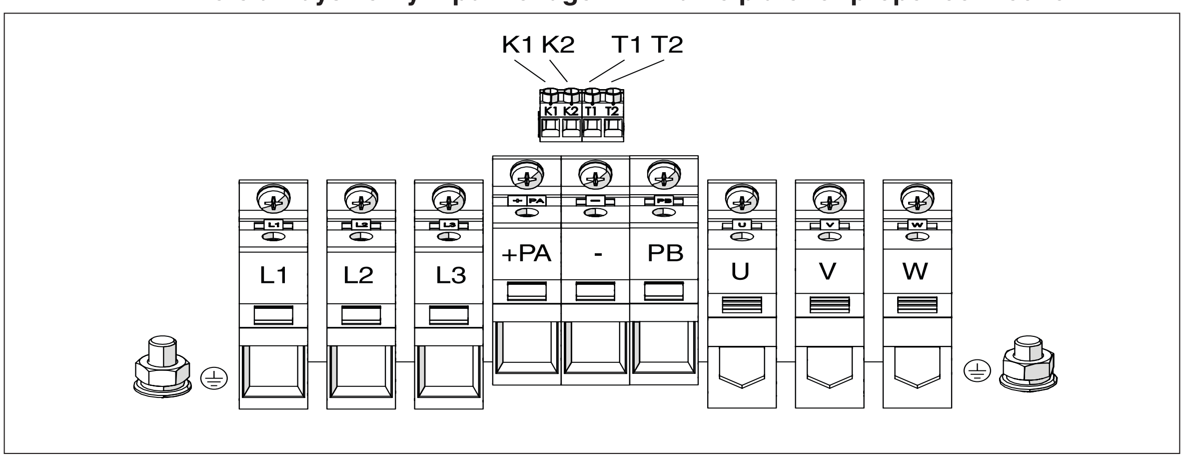
Note: Ground Stud and Nut shall be connected with UL Listed Ring Connectors (ZMVV), rated suitable.

Terminal Tightening Torque: **housings size <= 22: 53 inlb (6Nm)**
housings size 23/24: 133inlbs (15Nm)
Ground nut on R housing: 89inlbs (10Nm)

Housing Size U

⚠ Verify input voltage with name plate for proper connection 230V or 480V

Note always verify input voltage with name plate for proper connection



L1, L2, L3	3 phase supply voltage	**T1, T2**	Connection for temperature sensor
+PA, -	DC supply connection	**K1,K2**	Brake transistor monitor terminals
+PA, PB	Connection for braking resistor	**U, V, W**	Motor connection
		⏚	Connection for earth ground M8 stud.

Note: Ground Stud and Nut shall be connected with UL Listed Ring Connectors (ZMVV), rated suitable.

Terminal Tightening Torque: **U housings size 23/24: 133inlbs (15Nm)**
U housings sizes > 24: 221inlbs (25Nm)
Ground nut on U housing: 89inlbs (10Nm)

Housing Size W - Refer to power stage manual, Material Number **00F50EB-KW00**

1.8. Connection of the power circuit

See technical data in Sections 1.4-1.5 to match the wiring diagram to inverter size and housing type.

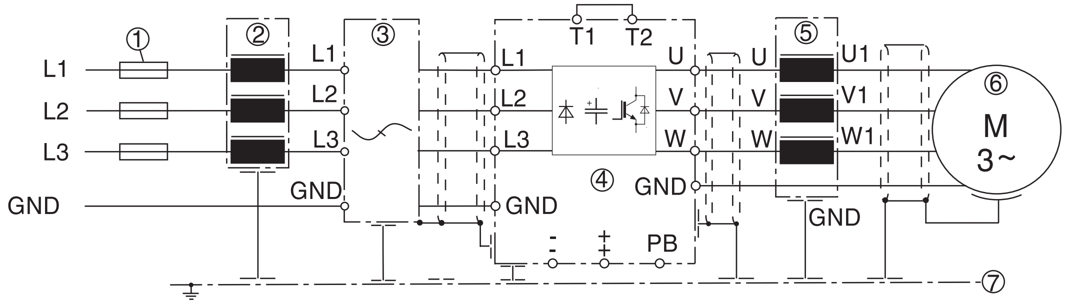
If the supply voltage is connected to the motor terminals, the unit will be destroyed!

Pay attention to the supply voltage 230/480V and the correct polarity of the motor!

IMPORTANT: See Section 2.2.4 for Fusing Specifications

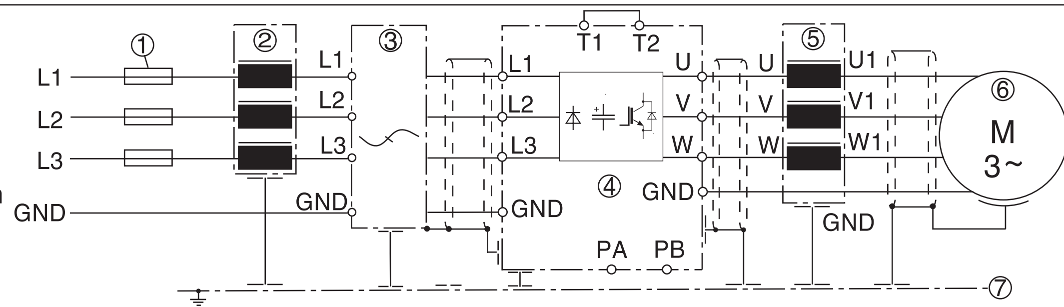
Wiring diagram 1

***Main disconnect / feeder circuit not shown**



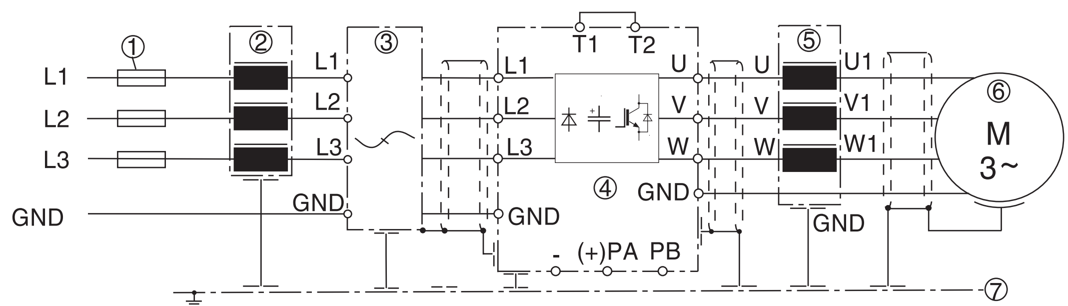
Wiring diagram 2

***Main disconnect / feeder circuit not shown**



Wiring diagram 3

***Main disconnect / feeder circuit not shown**



①	**Supply fuse**	⑤	**Motor Choke or Output Filter**
②	**Line Choke**	⑥	**Motor**
③	**Interference Suppression Filter**	⑦	**Sub-Panel in Control Cabinet**
④	**COMBIVERT F5**		

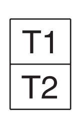
External motor temperature sensor

(for all units)

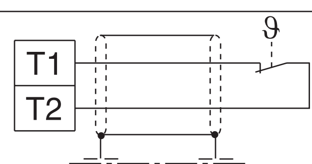
Don't install sensor wires with control wires!

Must use double shield when running these wires with motor wires!

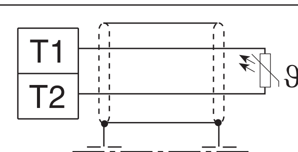
It is necessary to activate this function via software parameter! See LX10



No jumper required, when a sensor is not connected



Thermal switch (NC-contact)



Temperature sensor (PTC)
1650Ω...4kΩ tripping resistance
750Ω...1650Ω reset resistance

Connection of braking resistor

(Braking circuit installed as standard in housing sizes E,G,H, R and U.)

Refer to section 1.2.15 for wiring diagrams

1.8.1. Ferrite Ring Installation

All PWM type frequency inverters generate high frequencies as a result of fast switching of the IGBT output transistors. As these high frequencies travel along the motor wires they can easily be coupled to other wires in proximity to the motor leads. This is especially true for low voltage encoders. The included ferrite rings can be used to limit the high frequency noise which is transmitted on the motor wires by inserting a small amount of inductance on each motor lead. These rings can also be useful when shielded cables are used, since they will limit the available high frequencies even before the shield on the cable. Refer to the following table for quantity and part numbers.

Housing Size	Quantity All Phases *(Part Number)*
'E'	**1** *(00.90.390-K000)*
'G'	**1** *(00.90.390-K000)*
'H'	**1** *(00.90.390-K000)*
'R'	**1** *(00.90.395-K001)*
'U'	**2** *(00.90.395-K001)*
'W'	**2** *(00.90.395-K001)*

1.9.

1.10.

Part Number	Overall Dimensions in mm (inches)
00.90.390-K000	56 x 32 x 18 (2.2 x 1.3 x 0.7)
00.90.395-K001	63 x 38 x 25 (2.5 x 1.5 x 1.0)

Installation

The ferrite rings are to be installed on the motor wires as close to the inverter as possible.

Take the ferrite(s) and pass all three motor phases through the center. Use a wire tie to secure the ferrite(s) to the wire. Note: **Do not pass the earth ground wire through the ferrite(s)**. Connect the motor wires to the U,V, W terminals on the inverter using the specified terminal tightening torque. When using shielded motor cable, the ferrites are to be installed on an unshielded section of the cable before the shielding begins. Terminate the shield of the cable either to the inverter or directly to the bare metal sub panel in the control cabinet.

Use with regen units

Ferrite rings are required to limit common mode noise and minimize electrical disturbances on the DC bus connections between the inverter and regen unit(s). Ferrite rings are to be installed over both the ++ and -- DC bus connectors and should be installed as close to the inverter as possible. **Do not pass ground conductors through the ferrite rings**. When multiple regen units in parallel are used with a single inverter, the number of ferrite rings on the DC bus to be installed should be the same as the number of regen units.

Each KEB R6 regen unit is provided with a ferrite ring with the following part number and dimension:

Part Number	Overall Dimensions in mm (inches)
00.90.390-K000	56 x 32 x 18 (2.2 x 1.3 x 0.7)

i

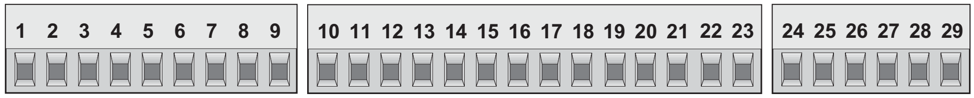
If the regen unit is not installed inside the same control cabinet as the inverter, a second ferrite ring is required between the inverter and regen to further limit common mode noise on the DC bus.

2. Control Connections

2.1. Control Circuit

2.1.1. Terminal Strip Connections F5-A

X2A



Terminal tightening torque = 0.5 Nm

PIN	Function	Name	Description	
1	Analog Input 1 +	AN1+	Pattern speed input	Resolution: 12 bit
2	Analog Input 1 -	AN1-		
3	Analog Input 2 +	AN2+	Pre-torque input	Scan time: 1 ms
4	Analog Input 2 -	AN2-		
5	Analog Output 1	ANOUT1	Analog output of the motor speed closed loop, calculated open loop	Voltage range: 0...±10V
6	Analog Output 2	ANOUT2	Analog output of the motor torque 0...10VDC (0...2x$T_{Rated\ (motor)}$)	Ri = 100 kOhm, resolution: 12 bit
7	+10V Output	CRF	Analog supply voltage for speed ref.	+10VDC +5%, max. 4mA
8	Analog Common	COM	Common for analog in- and outputs	
9	Analog Common	COM		
10	Prog. Input LI04	I1	When I1...I6, I8 are assigned as speed selection, I1>I2>...I8	Ri = 2.1 kOhm, scan time: 1msec,
11	Prog. Input LI05	I2		
12	Prog. Input LI06	I3	Inputs not used for speed selection can be assigned special functions.	LI02 digital filter reduces false trigger due to relay chatter, filter time: 10-100msec (adjustable)
13	Prog. Input LI07	I4		
14	Prog. Input LI08	I5	When I1...I8 are assigned as direction inputs, both directions cannot be signaled together	
15	Prog. Input LI09	I6		
16	Drive Enable	I7	Enable/Disable; response time < 1 msec; Enable instantly turns off motor current	
17	Prog. Input LI11	I8	Same as I1...I6	
18	Digital Out 1	O1	Programmable output LO05 - Default = At Speed	
19	Digital Out 2	O2	Programmable output LO10 - Default = Deceleration Active	
20	24V-Output	V_{out}	Approx. 24V output (max.100 mA load)	
21	20...30V-Input	V_{in}	Voltage input when an external 24VDC supply is used	
22	Digital Common	0V	Common for digital in-/outputs	
23	Digital Common	0V	Common for digital in-/outputs	
24	Relay 1	NO	Programmable output LO15 - Default "Off"	max. 30VDC, 1A
25		NC		
26		COM		
27	Relay 2	NO	Programmable output LO20 - Default - "Brake Control"	
28		NC		
29		COM		

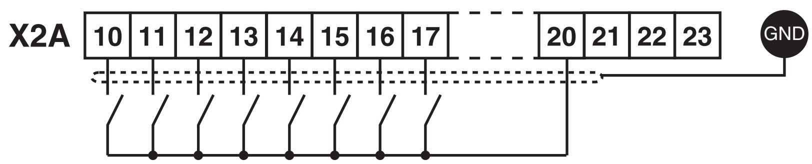
2.1.2. Connection of the control signals

To prevent a malfunction caused by interference voltages on the control inputs, the following steps should be observed:

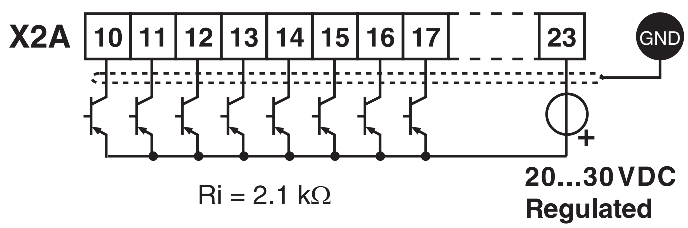
- Establish a true earth ground for all ground connections!
- Do not connect drive signal commons to earth ground!
- Use shielded cable with twisted pair wires!
- Terminate shield wires to earth ground, only at inverter!
- Separate control and power wires by 8" or more!
- Control and power wires should cross at a right angle!

2.1.3. Digital Input

Use of **internal** voltage supply

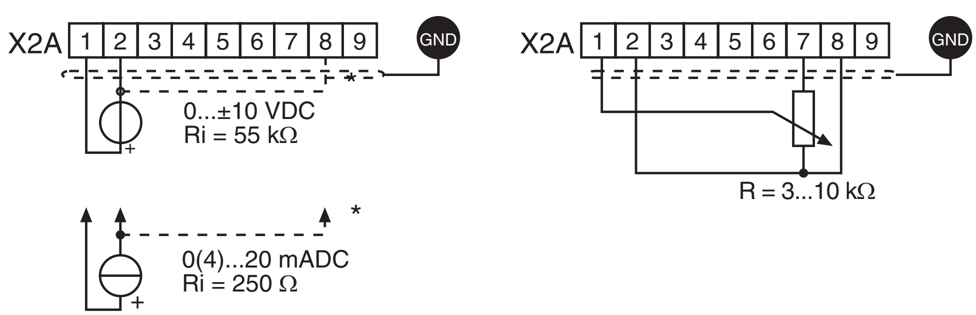


Use of **external** voltage supply



2.1.4. Analog Inputs

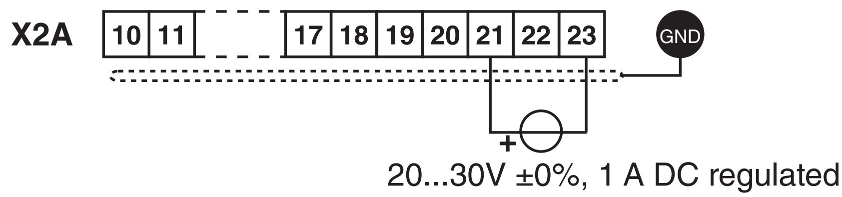
Speed Pattern, Torque Command



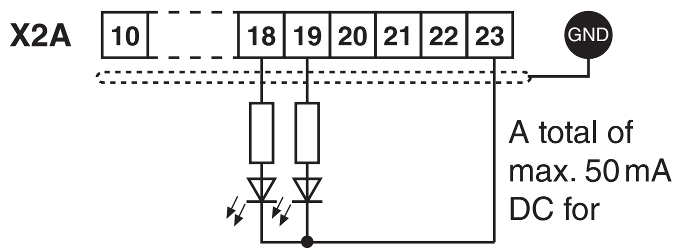
Connect unused analog inputs to common to eliminate noise signals!

2.1.5. Voltage Input / External Power Supply

The supply to the control circuit through an external voltage source keeps the control in operational condition even if the power stage is switched off. The external power supply should have the 0VDC connected to ground, preferably at the supply device itself. To prevent undefined conditions (false triggering), first switch on the power supply then the inverter.

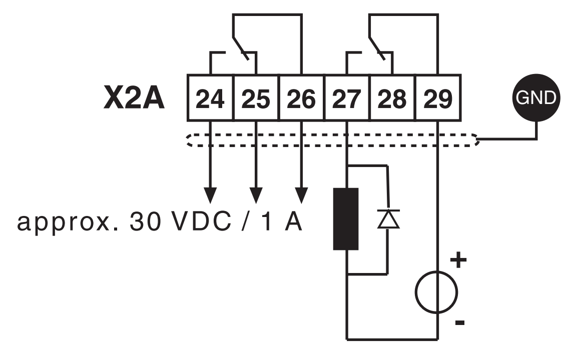


2.1.6. Digital Outputs

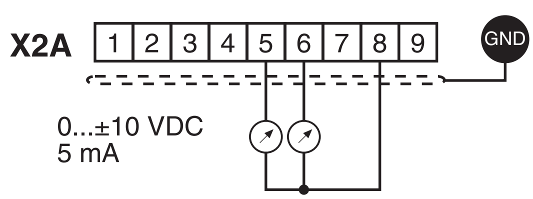


2.1.7. Relay Outputs

In case of inductive loads on the relay outputs, protective wiring must be provided (e.g. RC or diode arc suppression)!

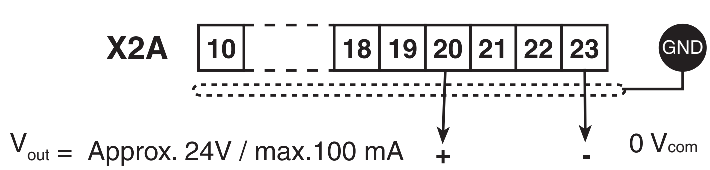


2.1.8. Analog Outputs



2.1.9. Voltage Output

The voltage output serves for triggering the digital inputs as well as for supplying external control devices. Do not exceed the maximum output current of 100 mA. This output is short circuit protected.



2.2. Control Circuit - STO

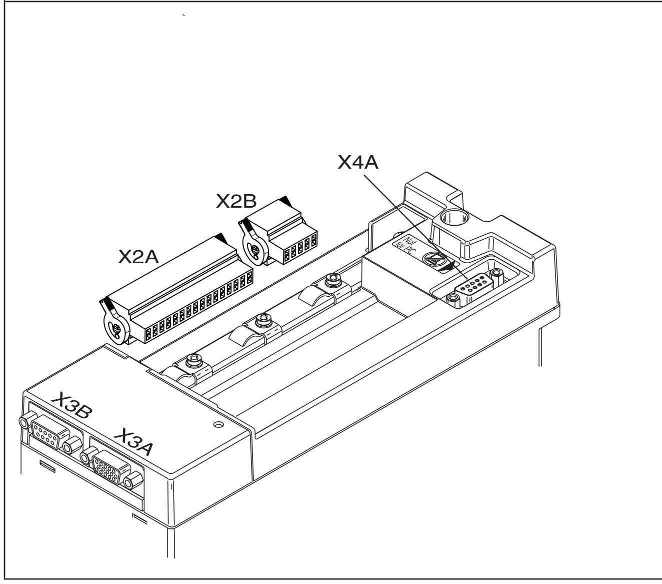
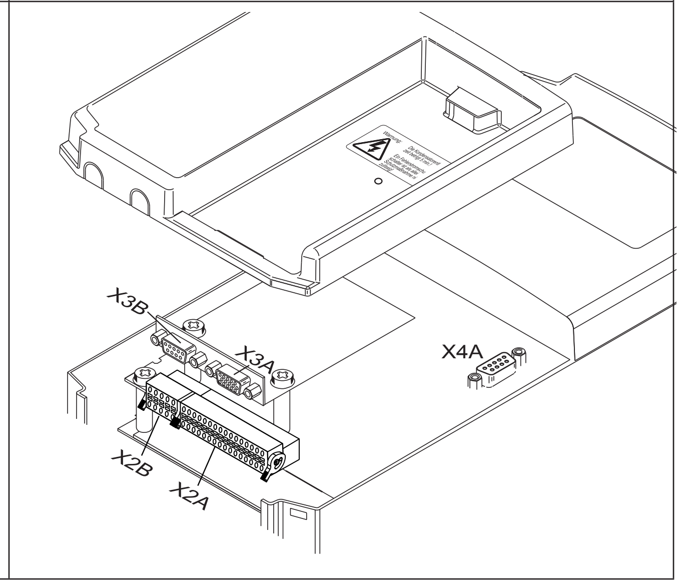
An optional Safe Torque Off (STO) control card can be used with the F5 drive. The safety control card provides Safe Torque Off functionality in accordance to IEC 61800-5-2.

These inverter units with a safety control card can be identified by the KEB part number and will have a “K” in the 5th placeholder (e.g. xx.F5.Kxx-xxxx)

The KEB STO card meets performance levels (ISO13849-1) and SIL 3 (IEC 61508 and IEC62061).

For more information on the control card, see KEB document (00F5NES-K000).

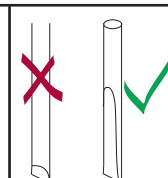
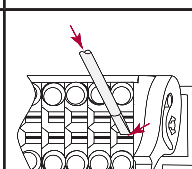
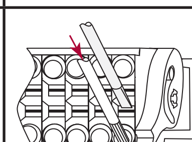
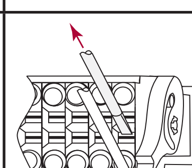
Control Circuit - STO

D, E Housings	G, H, R, U, W Housings
	

Terminal	Description
X2A	Control terminal strip
X2B	STO terminal block
X3A	Encoder Interface channel 1
X3B	Encoder Interface channel 2
X4A	HSP5 interface

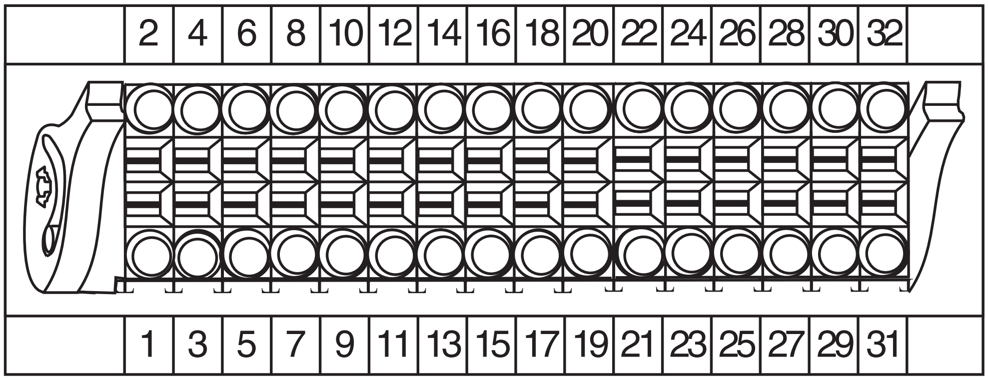
2.2.1. Assembly of the wires (F5-K)

The STO control card uses a spring-loaded terminal strip. Use the following instructions when wiring the control terminals

	Required Tools: Screw Driver SD 0.4 x 2.5 (DIN 5264)	
1	Strip the line about 7mm	
2	Plug screw driver into the middle square slot	
3	Plug stranded wire into the round slot; be sure no wire is seen from the outside	
4	Remove screw driver and check if the wire is fixed. Make sure that the stranded wire and not the insulation is clamped	

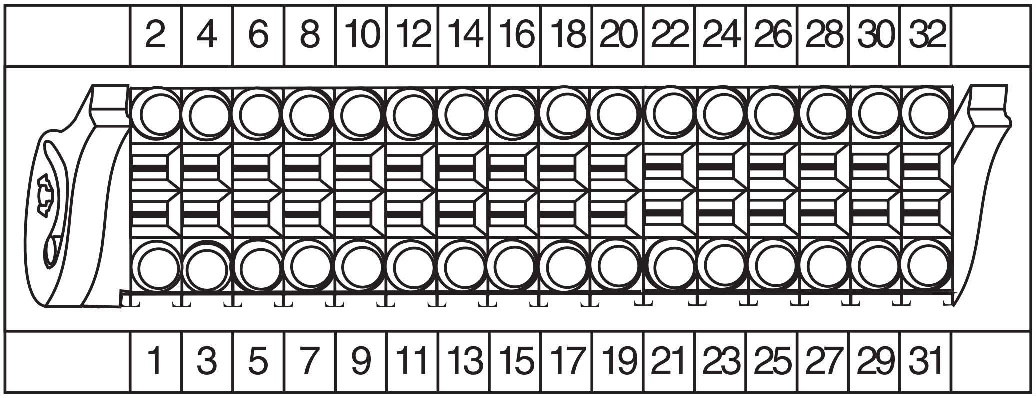
2.2.2. Terminal Strip Connections (F5-K)

X2A - Control



Pin	Function	Name	Description	
1	Digital Common	0V	Reference potential for digital inputs/outputs	
2	20 ...24V Input	V_{in}	Voltage input when an external 24VDC supply is used	V = 24VDC +20%/-15% I_{MAX} = 1A
3	Digital Common	0V	Reference potential for digital inputs/outputs	
4	24V-Output	V_{out}	Approx. 24V output (max. 100 mA load)	V = 24VDC ± 25% I_{MAX} (Pin 4 +32) = 100 mA
5	Prog. Input LI11	I8	See Pins 8-12	Inputs according to: IEC61131-2 Type 1 “0” = -3...5VDC “1” = 15...30VDC Scan time <= 1ms LI02 digital filter reduces false trigger due to relay chatter, filter time 10-100msec (adjustable)
6	Drive Enable	I7	Enable/Disable; response time < 1ms; Enable instantly turns off motor current	
7	Prog. Input LI09	I6	When I1...16, I8 are assigned as speed selection, I1>I2>...I8 When I1...I8 are assigned as direction inputs, both cannot be signaled together Inputs not used for speed selection can be assigned special functions.	
8	Prog. Input LI08	I5		
9	Prog. Input LI05	I2		
10	Prog. Input LI04	I1		
11	Prog. Input LI07	I4		
12	Prog. Input LI06	I3		
13	Digital Out 2	O2	Programmable Output Lo10 Default = Deceleration Active	Short-circuit proof digital 24VDC outputs specified according to IEC61131-2. I_{MAX} = 100mA per output
14	Digital Out 1	O1	Programmable Output Lo05 Default = At Speed	
15	Digital Common	0V	Reference potential for digital inputs/outputs	
16	+10V Output	CRF	Analog Supply Voltage for speed ref.	+10VDC, +5%, max. 4 mA
17	Analog Input 1-	AN1-	Pattern Speed Input	0... ± 10VDC (R_i = 55kΩ) Resolution: 11Bit + sign Scan time: 1 ms
18	Analog Input 1+	AN1+		
19	Analog Input 2-	AN2-	Pre-torque Input	
20	Analog Input 2-	AN2+		
21	Analog Common	COM	Common for analog in- and outputs	V = 0...± 10VDC (max. 11.5VDC) I_{MAX} = 10mA; R_i = 100Ω Resolution: 11Bit + sign
22	Analog Output 1	ANOUT1	Analog output of the motor speed closed loop, (open loop = calculated)	
23	Analog Common	COM	Common for analog in- and outputs	
24	Analog Output 2	ANOUT2	Analog output of the motor torque 0 ... 10VDC (0 ... $2xT_{Rated(motor)}$)	

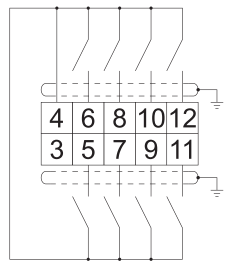
Control Circuit - STO



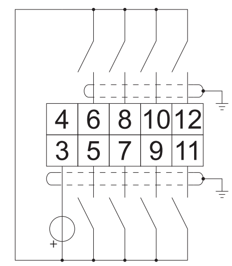
Pin	Function	Name	Description	
25	Relay 2 Common	COM	See pin 29	V_{MAX} = 30VDC I = 0.01...1A
26	Relay 1 Common	COM	See pin 30	
27	Relay 2 NC Contact	NC	See pin 29	
28	Relay 1 NC Contact	NC	See pin 30	
29	Relay 2 NO Contact	NO	Programmable Output LO20 Default = Brake Control	
30	Relay 1 NO Contact	NO	Programmable Output LO15 Default = Off	
31	Digital Common	0V	Reference potential for digital inputs/outputs	
32	24V Output	V_{out}	Approx. 24VDC output (max. 100mA load)	

2.2.3. Digital Inputs
(F5-K)

Use of **internal** voltage supply

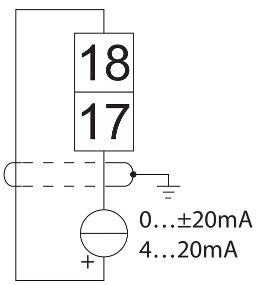


Use of **external** voltage supply

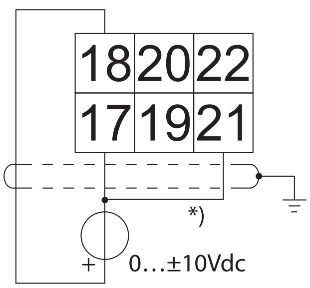


2.2.4. Analog Inputs
(F5-K)

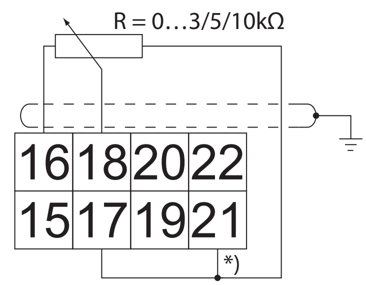
Current



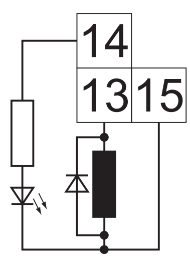
Voltage

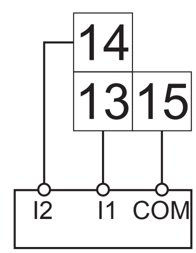


Potentiometer

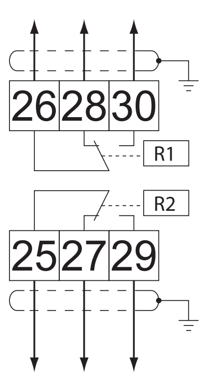


2.2.5. Digital Outputs
(F5-K)





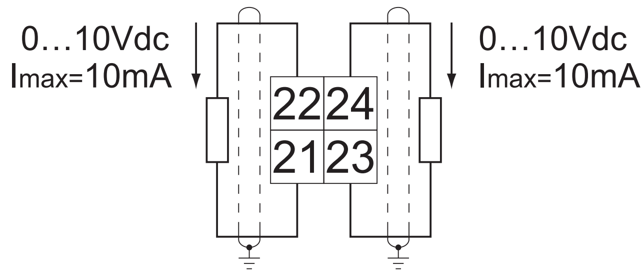
2.2.6. Relay Outputs
(F5-K)



In case of inductive loads on the relay outputs, protective wiring must be provided (e.g. RC or diode arc suppression)

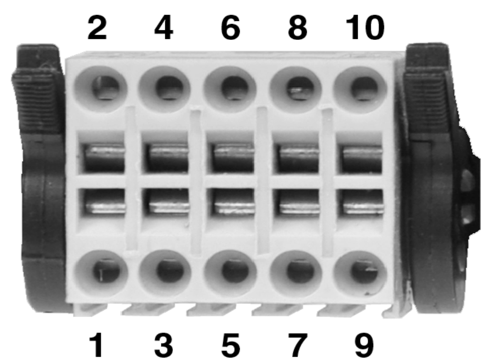
Specifications:
Voltage = max. 30VDC
I = 0.01 ... 1A

2.2.7. Analog Outputs
(F5-K)



2.2.8. STO Connections (F5-K)

X2B - Safety Control



Pin	Name	Description
1	STO1+	Input STO Channel 1
2	STO1+	
3	STO1-	
4	STO1-	
5	STO2+	Input STO Channel 2
6	STO2+	
7	STO2-	
8	STO2-	
9	STO-OUT	Output STO
10	STO-OUT	

The individual channels are designed potential-free, so 24V and 0V can be connected. The inputs are designed by way that safety switchgear units with test pulses (OSSD signals) can be connected. The signals are not evaluated, they are only filtered. The OSSD test interval is limited to 10 ms.

2.2.9. STO Inputs (F5-K)

Specification of the STO inputs

STO Inputs	Status 0		Status 1	
	UL (V)	IL (mA)	UH (V)	IH (mA)
max.	5	25	30	25
min.	-3	not defined	15	5

The maximum short-term starting current of the input is limited to 300 mA.

2.2.10. STO Output (F5-K)

The short-circuit proof, digital output is specified in accordance with IEC 61131-2. The output current is 100 mA at 24VDC.

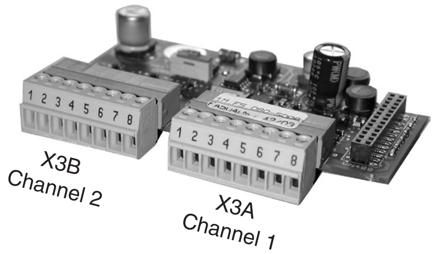
2.2.11. STO Input Control Sequence (F5-K)

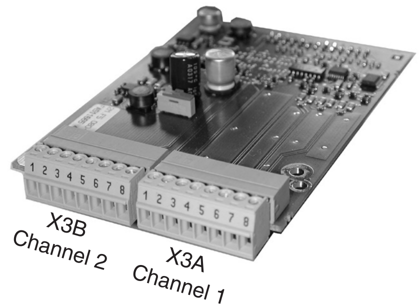
The output is 24VDC if modulation is possible. Inputs STO1, STO2 and ST must be set for it.

The STO circuitry requires a control sequence specific to the F5-K card. **The X2A.16 hardware enable and all X2B STO inputs are ANDED to activate the I7 drive enable. In addition if either the X2A.16 hardware enable or any X2B STO inputs are deactivated the I7 drive enable will also deactivate preventing drive modulation.** Verification of the hardware enable and STO inputs can be seen in DG.01. The X2A.16 hardware enable will be displayed as ST-EXT (8192) and the STO input will be displayed as STO (4096) in the DG.01 input status. Once ST-EXT and STO are activated the I7 (1) input will be activated.

2.2.3. Incremental TTL Encoder Interface X3A Screw Terminals

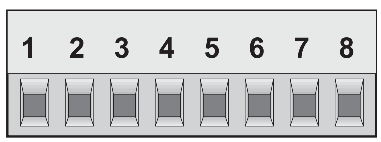
Connect the incremental encoder mounted on the motor to the 8 position terminal connector at X3A. This connection provides speed feedback and is imperative to the proper operation of the F5.





ONLY when the inverter is switched off and the voltage supply is disconnected may the feedback connectors be removed or connected!

Plug in screw terminal X3A



Pin No.	Signal	Description
1	A+	TTL incremental encoder track A
2	A-	Differential signal to A+
3	B+	TTL incremental encoder track B
4	B-	Differential signal to B+
5*	N+	TTL Zero track
6*	N-	Differential signal to N+
7**	15/24 V	Voltage output 15/20...30V, power supply for the encoder, switchable with dip switch S100
8	COM	0V reference for voltage supply
-	GND	Connect the outer cable shield to an earth ground connection on the elevator drive

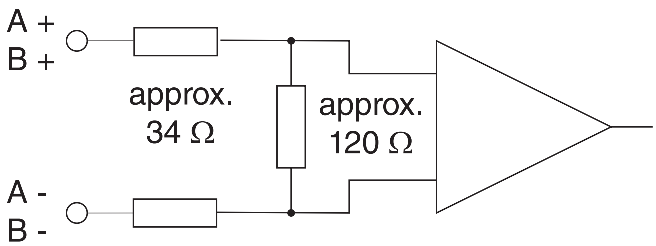
***If the encoder has no zero channel, connect N+ (X3A.5) to 5V (X3B.7) and N- (X3A.6) to 0V common (X3A.8 or X3B.8) to avoid 'Error Encoder1' faults.**

****For 5V supply TTL encoders, a 5V supply is available on the second interface channel, X3B.7.**

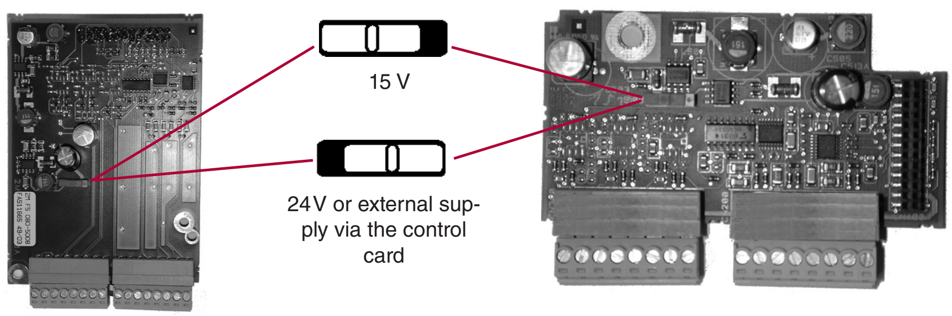
The following specifications apply to encoder interface X3A, channel 1

- Max. operating frequency: 300 kHz.
- Internal terminating resistance: R_t = 120 Ω
- RS422 or TTL level square wave voltage level: 2...5 Vdc

Input equivalent circuit



Selection of the supply voltage



The maximum load capacity is dependent on the selected voltage supply.

- Max. load capacity with 15V internal supply:300 mA
- Max. load capacity with 24 V internal supply:170 mA
- Max. load capacity with an external 24V supply 1 A (dependent on the external voltage source)

The specified currents are reduced by any current drawn on the second interface X3B (see Section 3.3.9).

For maximum noise immunity, the encoder cable shall consist of individually shielded twisted pairs with one overall shield. The individual shields should be connected to 0V (com) pin 8 on the X3A terminal strip and be kept electrically isolated from the outer shield. The outer shield should be connected to earth ground on the elevator drive.

The cable shall be kept a minimum of 8 inches (20 cm) away from all wires having greater than 24VDC on them. For best results run the encoder cable in a separate conduit from the controller to the motor.

2.2.4. EnDat Encoder Interface X3A

The EnDat encoder provides two differential analog channels for incremental position and one serial data channel with clock for communication with the encoder. This serial data channel can provide the drive with the absolute position of the motor as well as other operating data. The EnDat encoder must be version 2.1 or greater for compatibility reasons; EnDat 2.2 and only digital EnDat 2.1 utilize the EnDat 2.2 / BiSS interface, Section 3.3.5.

The analog cosine and sine wave signals of tracks A and B have a voltage of 1 Vpp with an Offset of 2.5 V. This analog voltage is measured and a high resolution position value is determined as a result. This high resolution position value is very important for good speed control of a gearless motor.

Therefore it is absolutely necessary to ensure these signals are well shielded! Noise on the analog signals resulting from breaks in the shield or improper shield termination will result in vibration in the motor and poor ride quality.

The internal stored ppr value is compared to the adjusted value in LE02. If the two are not the same the drive will trigger the 'Error Encoder Interface' fault. Refer to parameter LE12 for more information.

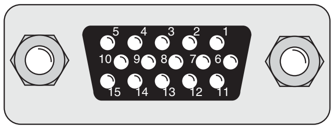
During start-up and then every 30 ms a request is transmitted to the encoder and the absolute position is read out via serial communication. This initial readout of the absolute position provides the drive with the commutation angle for permanent magnet motors. On the very first operation of a permanent magnet motor it is necessary to synchronize the encoder position to one of the pole pairs of the motor. See parameter LE06 for more information and section 4.10.

During normal operation, the difference between the internal absolute position of the encoder and the measured position value in the drive is compared. If the two deviate by more than 2.8 degrees, the drive will trigger the 'Error Encoder Interface' fault. Refer to parameter LE12 for more information.

The clock signal serves as synchronization for the serial data channel.

If there is an excess length of cable (10 feet or less), it is OK to coil it into a loop in the controller. Maintain a minimum diameter of 1 foot and keep the cable at least 8 inches away from all high voltage power wires.

ENDAT
Drive connection X3A
Female SUBD 15 HD



Pin No.	Signal	Description
3	A-	Signal input A-
4	B-	Signal input B-
6	CLOCK +	Synch. signal for serial data
7	CLOCK -	Synch. signal for serial data
8	A+	Signal input A+ (absolute track for counter and direction detection)
9	B+	Signal input B+ (absolute track for counter and direction detection)
12	+ 5V	Supply voltage for encoder
13	COM	Reference potential for supply voltage
14	DATA -	Data channel RS485
15	DATA +	Data channel RS485

ONLY when the inverter is switched off and the voltage supply is disconnected may the feedback connectors be removed or connected!

Encoder Card Part Number: Housing Size ≤ E, 1MF5K8G-PZ43. Housing Size ≥ G 2MF5K8G-PY33

- Max. Load capacity depending on Voltage Supply
- Max. Load capacity at +5.0V; 300 mA. The specified current is reduced by the current taken from the second encoder interface X3B interface (see Section 3.3.9).

EnDat Cable

Pre-manufactured EnDat cables offer the best solution against noise and disturbance while at the same time saving installation time. The cables come in standard lengths of 5m, 10m, 15m, 20m, 25m and 30m. Specially designed cables are available for applications 40m, 50, 75, 85 and 110m. **The maximum length of KEB cable offered is 110m.**

Cable Part Number

00F50C1-40xx xx = length in meters, 10 = 10 meters
For lengths above 30 m a different cable is used.
00F50C1-L0xx xx = length in meters, 40 = 40 meters

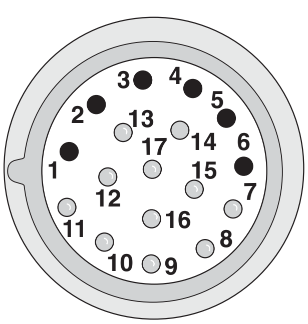
Mating Connector

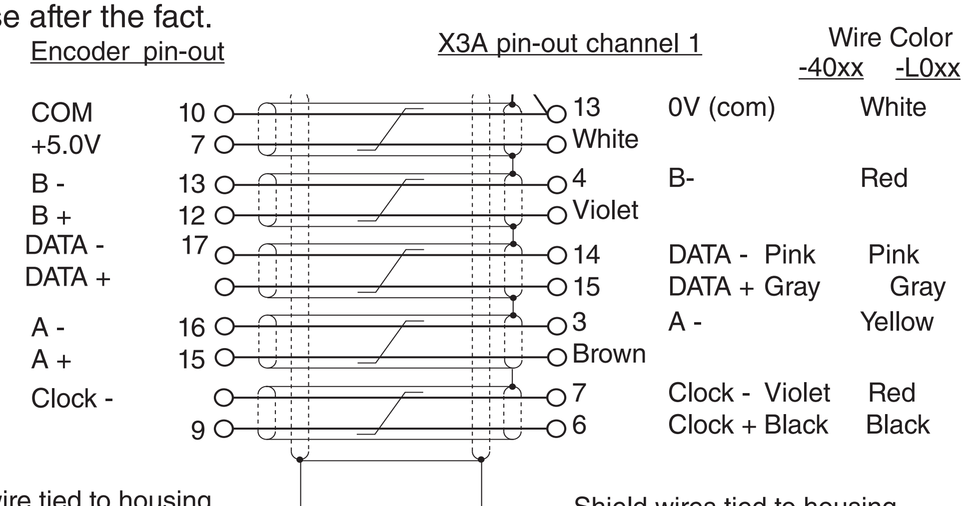
0090912-004U for encoder (solder type), Torin Adaptor 00F50C2-T0P3

Running in Conduit

When this cable must be pulled through metallic conduit, it is necessary to over size the conduit! Use of a 1 1/2 inch trade size conduit will allow the connectors to pass without removal of the connectors. Cutting the cable, or removal of the connectors or their housings voids the warranty and will result in problems with electrical noise after the fact.

Circular connector on EnDat encoder.





Note: Inner pair shields are tied to 0V (com), pin 13, not earth ground!

Technical Data

- Input resistance: 120 Ohm
- Process data channel: 1Vpp
- Parameter channel: EIA RS485 half duplex
- Clock signal output: EIA RS485
- Maximum input frequency: 200 kHz
- Encoder line number: 1...2048 inc
- Maximum cable length: 100 m *(based on signal levels, otherwise see below)*
  Cable length based on cable resistance
  The maximum cable length is calculated as follows:

$$\text{Length} = \frac{V - V_{min}}{I_{max} * R} = \frac{5.25V - 4.75V}{0.2A * 0.03\ \Omega/m} = 83.3\ m$$

where

I_{max} = supply current of encoder [amps]
V = voltage supply of the drive = 5.25V
V_{min} = minimum supply voltage of the encoder
R = cable resistance (0.07 Ω/m) for Standard KEB cables
(0.03 Ω/m) for type "L" KEB cables

The following ENDAT encoders have been tested for use:

- **Heidenhain ECN 1313, 413, 113 single turn**

However, this does not restrict the use of rotary encoder with same specifications of other manufacturers

The recognition of encoder loss or exchange is a software function and dependent on the encoder type. If the drive senses that the serial communication to the encoder has stopped, it will trigger the 'Error Encoder Interface' fault.

If the encoder is replaced or disconnected, the drive will trigger an error or warning that the encoder was changed. The drive will display the error message 'Error Encoder Interface'.

If the encoder was exchanged the drive will auto reset the 'Error Encoder Interface' fault. The user will need to learn the new encoder position before operation can continue. See section 5.10.

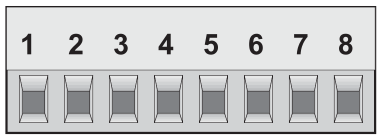
If there is an encoder triggered fault or problems with the encoder cable the 'Error Encoder Interface' fault will not clear and the problems must be diagnosed through parameter LE12. To clear the 'Error Encoder Interface' fault, it is necessary to go to parameter LE01, press "Enter" and then press "Enter" again to confirm.

2.2.5. X3B Output TTL Incremental

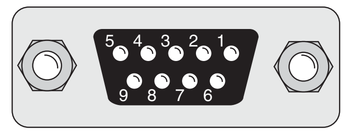
ONLY when the inverter is switched off and the voltage supply is disconnected may the feedback connectors be removed or connected!

The second incremental encoder connection serves as a buffered output of the motor encoder. This can be used by other control systems for speed or position control. The output signals are according to the RS422 line driver signal standard.

Plug in screw terminal



9 Pin Sub D - Female



Pin No. (Terminal)	Signal	Pin No. (SubD)
1	A+	1
3	B+	2
5	N+	3
7	+5.0V	4
-	24 ... 30V	5
2	A-	6
4	B-	7
6	N-	8
8	0V Com	9
Inverter Housing	Earth GND	Sub-D Housing

Encoder Card Part Number: Housing Size ≤ E, 1MF5K81-DZ19. Housing Size ≥ G 2MF5K81-DZ19.

The internal 24VDC power supply has a maximum load capacity of 170mA . The 5V supply has a maximum load capacity of 500mA. Both of these values assume no loading on the supplies of connection X3A. If connections or loads are placed on both terminals, the total load between the two must not exceed these values.

The following specifications apply to encoder interface X3B, channel 2

- Max. operating frequency: 200 kHz.
- External terminating resistance: R_t = 120 Ohm
- RS422 level square wave voltage level: 2...4 Vdc

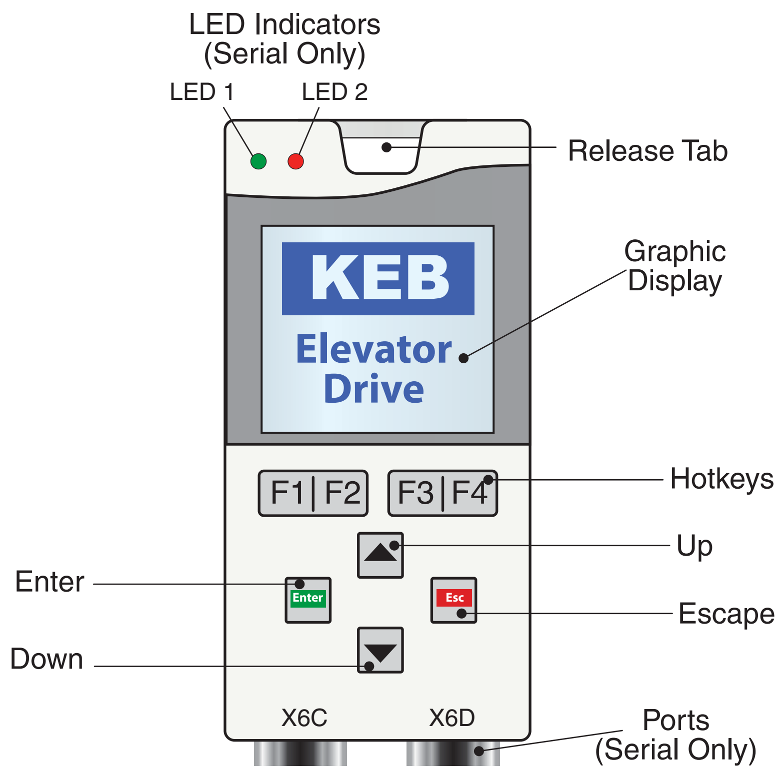
For proper noise immunity, the RS422 standard requires a termination resistor be placed at the device which is receiving the simulated encoder signal. The resistors shall be connected from A+ to A-, B+ to B-, N+ to N- (only when used).

3. Operation of the unit

3.1. LCD Operator

The KEB Elevator drive uses a special operator keypad which provides a user interface and functionality specific to elevator applications. The operator must be plugged into the drive in order for the drive to function properly.

Unplugging the operator while the drive is in operation will result in an immediate shutdown of the drive and will cause the ready relay to drop and the fault output to activate.
If it is necessary to remove the operator, do so while the elevator is standing still!

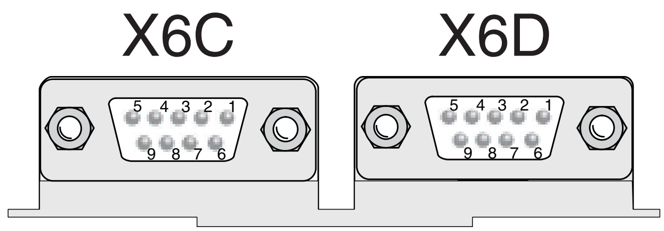


Serial - CAN/RS485 (KEB Part#: 00F5060-KL10)

3.1.1. Keypad Buttons

Button	Name	Function
▲ ▼	**Up/Down**	Increment/Decrement through menu or values
Enter	**Enter**	Selects a parameter or group, Enters *Edit Mode*, Save parameter setting
Esc	**Escape**	Backs out of parameter group or exits *Edit Mode*
F1 | F2 F3 | F4	**Hotkeys**	Keys correspond to display LCD text above Allows a user to quickly jump menus

3.2. Serial/CAN Hardware Version



	X6C	X6D
Hardware	CAN I RS 485	RS 232/485
Use	Bus Communications	Diagnostics
Pin	**Signal**	**Signal**
1	CAN V+	
2	CAN L	TxD, RS232
3	CAN H	RxD, RS232
4	RxD A -, RS485	RxD B +, RS485
5	RxD B +, RS485	RxD A -, RS485
6	CAN GND)	VP +5V (10mA)
7	Bus Ground	Bus Ground
8	TxD A -, RS485	TxD B +, RS485
9	TxD B +, RS485	TxD A -, RS485

3.2.1. LED Indicators

The LED indicators are available only on the Serial LCD Operator. The LEDs are used to indicate operational status. They can be used for troubleshooting and diagnostics. In addition, the function of the LED can be changed with parameters CH10 - 15.

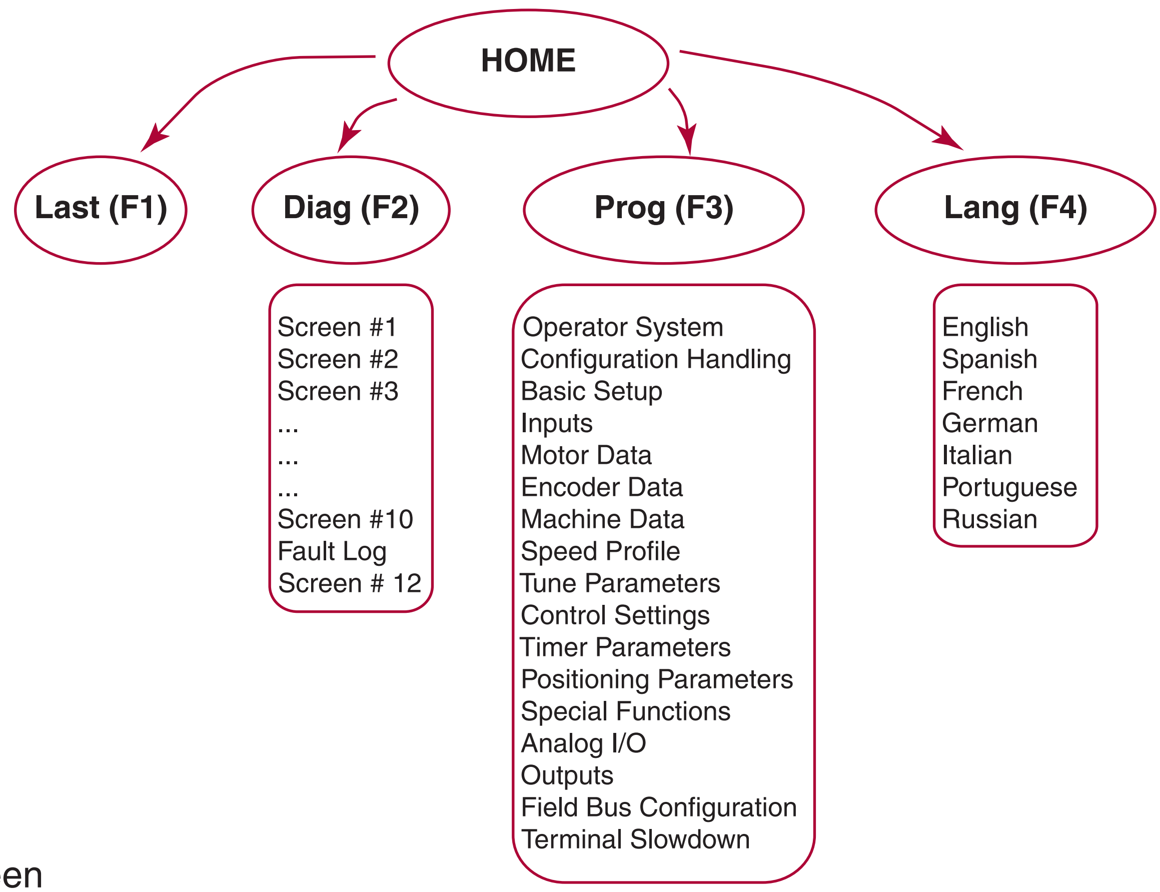
	LED 1	LED 2
Off	No operation (noP) Drive not enabled	
● **(Green)**	Inverter running the motor	Run mode Drive is able to run
● **(Orange)**	-	Stop mode: Drive is being programmed or making calculations; FTP file transfer mode.
● **(Red - Blinking)**	A limit has been reached: Torque, Current, or Voltage (not yet implemented)	-
● **(Red - Solid)**		Drive is faulted

3.3. Backward Compatibility

The Serial LCD v3.33 is supported by control card v4.3 or higher. The F5 control card software version can be found in Diagnostics Screen #9 (See section 3.8 for more information on Diagnostics).

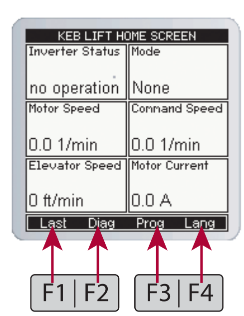
v3.33 can upload and synchronize with drives that have been programmed with previous versions, beginning with v3.21. However, previous versions cannot upload and synchronize with drives that have been programmed with v3.33.

3.4. Menus and Navigation Overview



3.11. Home Screen

The home screen provides a split menu with basic diagnostics. The F2 hotkey accesses the diagnostic menus. The F3 hotkey accesses the programming menu. The F4 hotkey accesses the language settings.



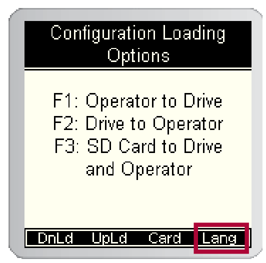
3.5. Languages

The LCD Keypad supports 7 different languages:

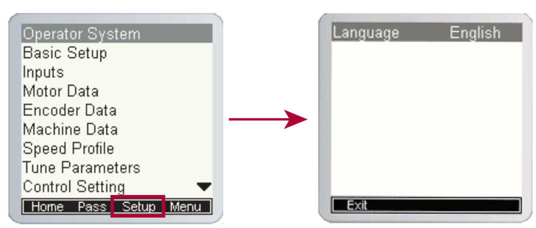
- English
- Spanish
- French
- Portuguese
- Italian
- German
- Russian

The language can be adjusted in several ways:

- During boot-up, if the operator & keypad are not synchronized, the user can access the language menu via the (F4) Hotkey

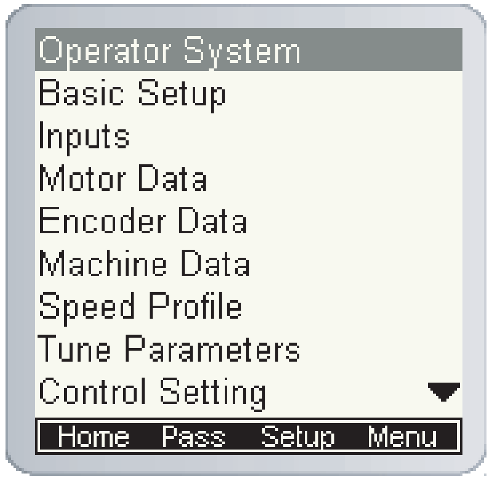


- At the Home screen, selecting the (F4) hotkey will take you directly to the language settings.
- Or the language settings can be accessed from the programming menu by selecting *Setup (F3)* > *Language*



3.6. Programming Menu

The programming menu is where all manual parameter adjustments are made and can be accessed at Home > Prog (F3).



The Parameter menu contains the following groups:

- Operator System (OS)
- Basic Setup (US)
- Inputs (LI)
- Motor Data (LM)
- Encoder Data (LE)
- Machine Data (LN)
- Speed Profile (LS)
- Tune Parameters (LL)
- Control Setting (LC)
- Timer Parameters (LT)
- Positioning Parameters (LP)
- Special Functions (LX)
- Configuration Handling (CH)
- Analog I/O (LA)
- Outputs (LO)
- Diagnostic Parameters (DG)
- Field Bus Configuration (FB)
- Terminal Slowdown (TS)

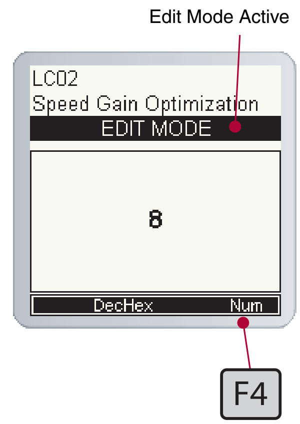
Complete parameter descriptions are listed in Section 6.

Not all parameters may be viewable and changeable, depending on the password accessibility. Refer to Section 3.8.2 for additional information on password access.

3.6.1. Parameter Adjustment

When adjusting a parameter, press “ENTER” to access Edit Mode. Parameter values can only be changed in Edit Mode.

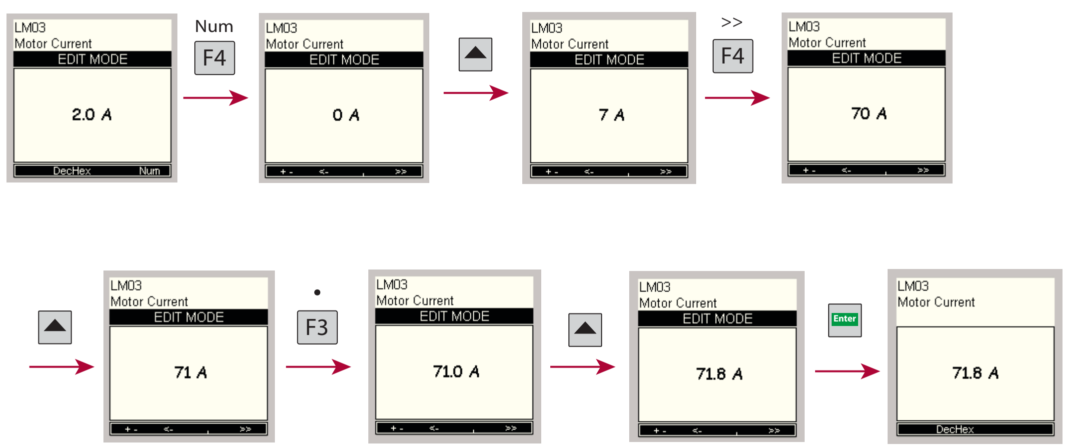
- Up/Down - Can be used to increment or decrement the number. Press the ENTER key to save the change.



- F4 Hotkey (NUM) - Pressing the F4 key in Edit Mode allows a user to adjust each placeholder value. The other Hotkeys change the placeholder or add a decimal point. Press “ENTER” to save the changes.

  - >> : Used to move placeholder for adjustment.
  - . : Inserts decimal point.
  - <- : Used as a backspace to move placeholder for adjustment
  - + - : Used to change the sign of the value.

  An example of using the NUM function to change a parameter is shown below:



The NUM function can be useful for selecting parameter options from a list using its assigned value as opposed to scrolling through the text descriptions. Most parameters with a large list option will have a corresponding NUM column listed in the parameter description of the manual for quick and easy adjustment.

The NUM function can also be very quick and useful for adjusting large numbers as opposed to scrolling.

With parameters that allow multiple items to be selected together, the NUM value would correspond to the sum of the individual selections.

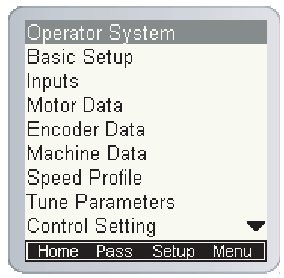
3.6.2. Setting the Password

The LCD keypad has different access levels that are password protected. Different levels provide access to more parameters and give the read and write privileges.

If you expect to see more parameters or need higher access to change parameters, please contact KEB.

A user can change the password by:

- Parameter OS01 at *Home > Prog > Operator System > OS01*
- *Home > Prog (F3) > Pass (F2)*



The following passwords are used to gain access levels:

User	Access Level	Password	Typical Access*
KEB	R/W		All background parameters
OEM	R/W	479	Control Type Motor Type Input/Output Functions
Adjuster	R/W	119	Advanced motor, speed, & control parameters
User	R/W	27	Basic Level with Write privileges
Basic	Read only	11	Diagnostics, Fault Logs

The password must be entered with the NUM method of adjustment described in Section 3.7.1.

From the OEM level, parameters can be hidden in the Adjust, User, and Basic access levels (ie. unused or OEM specific settings). Refer to Section 3.11 for additional information.

Temporary OEM Password Access

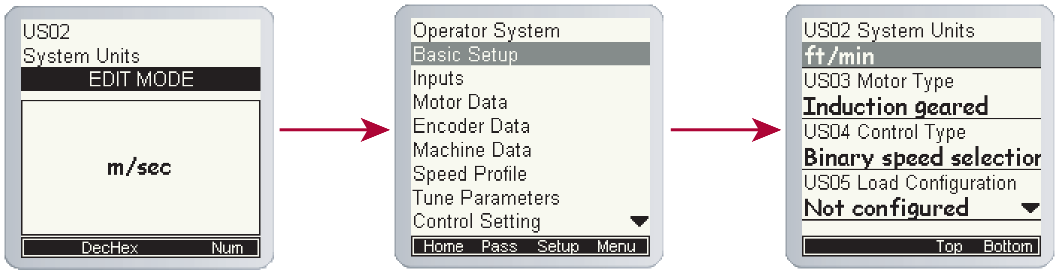
A unique, temporary password can be generated to provide OEM level access for a period of one day for troubleshooting purposes.

Using the program **Elevator Password Generator.exe**, enter the date set in the keypad operator. This can be changed at: Home > Prog > Setup > Date. The program will generate a unique password based on the date set in the keypad operator which will provide temporary OEM password access which is valid until the date in the keypad operator changes.

3.6.3. Units

The KEB LCD operator supports both imperial and metric units. Toggling between unit settings only scales the parameters and does not change any internal values.

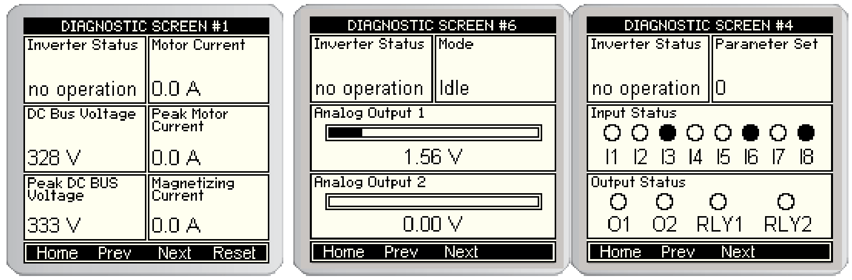
The units can be changed at *Home > Prog > Basic Setup > US02*



The ability to change units is dictated by the user access level.

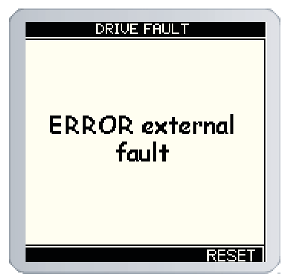
3.7. Diagnostics Screen

The LCD operator has split-view diagnostic screens. The diagnostics are grouped together which makes it easier to view several related parameters. The screens can be accessed at *Home > Diag*



3.7.1. 4.8.1 Error Messages & Fault Log

If a malfunction occurs during operation, the drive shuts down operation and the keypad will display an error. Error messages can be reset by pressing "RESET" F4 hotkey.



The LCD operator incorporates a real-time clock. This enables faults and special events to be recorded with a time-stamp in the Diagnostics Screen Log. To set the date and time, refer to Section 4.10. With Serial/CAN keypad operator, the clock continues even when not powered on.

The Diagnostics Screen Log can be accessed in the Diagnostics menu and is the last screen. To access: Home > Diag > Prev.

The Diagnostics Screen Log includes drive faults (Error Overcurrent, Overvoltage, Overload, Encoder, etc.), operation faults (eg. Drive Enable Dropped, Unintended Movement, Speed Following Error) Speed/Direction Selection Error, Analog Signal/Serial Speed Command Failure, Main Contact/ Brake Switch Failure, etc.), special operation modes (Emergency Slowdown, UPS Mode, etc.).

The EEProm will automatically create and store a new .txt file in flash memory every 50 events. A .txt file can also be created by pressing F4 from the diagnostic screen log. This will clear the fault log screen.

For more information on inverter status/error messages see Section 6 - Diagnostics & Troubleshooting.

3.7.2. Fault Data Logging

The fault data logging function can be used to capture a scope trace of up to four parameters in high resolution before and after a drive fault is triggered. The scope file is then saved to flash memory on the keypad operator and the file can be transferred from the keypad operator via FTP and be imported within Combivis 6 to evaluate the scope trace.

The function is available under Prog > File > Fault Logging Menu.

Parameter Selection

Up to four parameters from the Diagnostics Parameters and/or Field Bus Configuration parameters can be selected for the scope trace. For each scope channel, select the channel number 1 - 4, then select either Diagnostics Parameters or Field Bus Configuration, then scroll through the corresponding parameter list to select the parameter for the corresponding channel.

Function Enabled/Disabled

Select whether the logging function is active.

Base Block Checking

The Base Block status indicates the output transistors have been safely shut off and are being blocked from further operation. It is not an error, but will appear before an error. Another typical occurence would be if the drive enable is dropped while current is being output.

When Base Block Checking is off the scope is triggered only by a drive fault. When active, the scope trace will be triggered additionally by the base block status.

Sample Time

Select the sample time of the scope trace in 5ms resolution.

Trigger Value

Percentage of the scope trace that is recorded before the trigger occurs with the remainder of the trace after the trigger.

Last Fault Code

Indicates the last fault code. Refer to Section 6.16 Diagnostics Parameters DG02 for text description of numerical fault code.

3.8. Date & Time

The LCD keypad has a real-time clock and stores the date. This allows the operator to keep time stamps of faults and track total run hours.

The Serial/CAN operator does keep track of the time/date and will do so for several weeks without power.

3.8.1. Setting the date

The date can be initialized from the home screen by selecting Prog > Setup > Date. Press enter, scroll to edit the parameter and press enter again to save the changes.

The date format is mm/dd/yyyy.

3.8.2. Setting the time

The time can be initialized from the home screen by selecting Prog > Setup > Time. Press enter, scroll to edit the parameter and press enter again to save the changes.

The time format is 24-hour.

3.9. Customizing Parameter Lists

Custom parameter lists can be made to mask off parameters from view, depending on user access password level.

The OEM password level provides read and write access to all applicable keypad operator parameters. A custom parameter list applies to all lower password levels, although whether a parameter is viewable or has write access also depends on each password level which has precedence over the custom parameter list. Minimum password access levels for parameters are listed in Section 8.1.

To create a custom parameter list, the syntax of the list to be created in a text files is:

XXXX Y

XXXX = Hex Address of keypad operator parameter
Y = 1 -> ON (viewable),
0 -> OFF

Keypad operator parameter hex addresses are listed in Section 8.1.
Only parameter addresses listed as ON will be made available from the custom parameter list.
A parameter address not listed is set as OFF.
Any information listed past Y is ignored.

Example:

LS01 Leveling Speed
Hex Address = 0881h
Password Level = Basic

LS02 High Speed
Hex Address = 0882h
Password Level = Basic

LC41 System Inertia
Hex Address = 0BA9h
Password Level = Adjuster

The list to be created:

0881 1
0882 0
0BA9 1

LC41 will be accessible regardless in the OEM password level.
LC41 will be accessible in the Adjust password level.

LC41 will not be accessible in the User or Basic password Levels

LS02 will be accessible in the OEM password level only.

LS01 will be accessible in all password levels: OEM, Adjuster, User, Basic.
LS01 will read-only in the Basic password level

Once the text file for a custom parameter list has been created, it must be saved as the following: para_dis.txt.

The para_dis.txt file must then be saved to the keypad operator flash memory.

The text file must be transferred via FTP.

To save the custom parameter list text file to flash, OEM password level is required. From the Programming Menu, the 'File' option (F4) will then be listed. Under the 'File' list, select 'File Operations'. Under 'File Operations' select FTP'(F2) When the text file has been transferred to the keypad operator flash memory, select 'Menu' (F1), then 'Prog' (F1) to return to the Programming Menu.

3.10. Customizing Defaults

A pre-saved parameter file can be used to create custom defaults settings.

The pre-saved parameter file can either be created using the Combivis computer program or taken as an upload from a drive already programmed. The file type needs to be .dw5.

The .dw5 file must then be saved to the keypad operator flash memory.

The .dw5 file must be transferred via FTP.

To save the custom parameter list text file to flash, OEM password level is required. From the Programming Menu, the 'File' option (F4) will then be listed. Under the 'File' list, select 'File Operations'. Under 'File Operations' select 'FTP'(F2) When the .dw5 file has been transferred to the keypad operator flash memory, select 'Menu' (F1), then 'Prog' (F1) to return to the Programming Menu.

To load the .dw5 parameter file to the keypad operator, set CH03 Restore Parameters = Load Motor Data.

To save the current settings as the new defaults, set US05 = Create OEM Default.

To revert to the custom .defaults, set CH03 = Factory Reset or US05 = Restore OEM Defaults

4. Initial Start Up

4.1. Connecting the drive and operator

The drive and operator must be "synched" before being able to operate. When the operator/drive are initially booted up, the parameters of each are compared and it is determined if the units are synched. If they are not, the user will be given programming options.

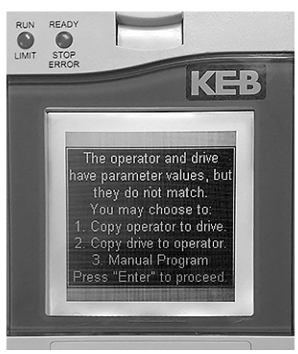
A drive/operator will not be synched under the following conditions:
- **A default drive and/or operator is being installed**
- **The operator was used to program another drive.**

4.1.1. Default Operator and Drive

If the drive and operator are default the user will be prompted to program the drive manually. See the next section 5.2 for manual programming.

4.1.2. Previously Programmed Operator or Drive

If either the drive or operator have been programmed previously, the user will be given three options: 1. Copy operator to drive, 2. Copy drive to operator or 3. Manual program.



Copy operator to drive (Previously Programmed Operator):

1. Install the operator keypad, the boot sequence will begin and the display will indicate that the settings between the drive and operator do not match and that they are not synchronized; press the ENTER button to proceed.
2. Press the F1 button under "Dnld". The operator parameters will be downloaded to the drive.
3. Once the process is complete, the home screen will be displayed. The mode window will display "idle" and the Ready / Stop / Error light will be green to indicate that the drive is ready for operation.

Copy drive to operator (Previously Programmed Drive):

1. Install the operator keypad, the boot sequence will begin and the display will indicate that the settings between the drive and operator do not match and that they are not synchronized; press the ENTER button to proceed.
2. Press the F2 button under "Upld". The display will show "Reading Configuration from Drive" along with a progress bar.
3. Once the parameters have been read from the drive, the user will be instructed to verify the uploaded parameter values and to navigate to Basic Setup parameter US05. Press the ESC button to continue to the home screen.
4. At the home screen, the mode window will display "not configured" and the Ready / Stop / Error LED will be orange. Press the F3 button under "Prog" to display the programming menu. With the programming menu displayed, press the down button to navigate to Basic Setup. (If Basic Setup is not visible in the menu, it will be necessary to enter the OEM password 479 in order to access the Basic Setup parameters and finish the download process – see section 3.7.2, "Setting the Password")
5. Press the ENTER button to select Basic Setup. Then press the down button to navigate to US05 Load Configuration – the status will show "0: not configured". Press the ENTER button to access US05.
6. Press the ENTER button again and the keypad will enter edit mode. Press the up button, search for and select "2: Write Config. To Drive", then press the ENTER button. The display will show "Writing Configuration to Drive" along with a progress bar.
7. Once the process is complete, the home screen will be displayed. The mode window will display "idle" and the Ready / Stop / Error light will be green to indicate that the drive is ready for operation.

4.2. Manual Programming

This section serves as a quick guide to manually program a KEB Elevator drive from default. Please note that advanced functionality or settings might not be listed in this section.

For more information on specific parameters see section 6.0 - Parameter Descriptions

4.2.1. Getting Started

The KEB drive can be programmed manually. When powering up at default for the first time, press the F1 button under "Prog" or if already at the home screen, press the F3 button under "Prog" to access the programming menu.

i To manually program the LCD keypad, the user should begin at the top of the programming menu with "Basic Setup" and work their way downwards, filling in the required information. The OEM Password level must be set to make changes.

4.2.2. KEB Elevator

The KEB drive can also be programmed via the mobile lift app. The KEB Elevator app works connects to the F5 elevator drive via a phone's bluetooth connection. Setup, adjustment and troubleshooting of the F5 drive can be done using the mobile app.

Features

- Real-time diagnostic and troubleshooting dashboard.
- View and adjust parameters.
- Save parameters and email parameter reports.
- View PDF manuals for the F5 drive.

Requirements

The mobile app communicates with the F5 drive through a bluetooth dongle connected to the drive. Contact the OEM to order the bluetooth dongle to enable the mobile app.

- Part # 0058060-KT31

More Information

For more information about the mobile app, speak with a KEB elevator engineer at 952-224-1400 or email elevator@kebamerica.com.

4.3. Basic Setup

The Basic Setup is where the initial programming must begin. Here, the application fundamentals are established prior to configuration.

Note: In most cases the elevator control manufacturer will make the adjustments in Basic Set-up but it is good to verify the correct settings.

Prior to configuring the elevator drive, view the controller reference parameter list (provided by the elevator control manufacturer) to verify the parameters required for the particular installation of the elevator drive.

The Basic Setup menu can be accessed by: *Home > Prog (F3) > Basic Setup.* All these parameters must be adjusted:

- US02 - System Units (Imperial/Metric)
- US03 - Motor Type (i.e. Induction geared or PM synch gearless)
- US04 - Control Type (i.e. Binary, Serial, Analog)

Next, the configuration must be loaded using US05. This step serves to load the KEB drive with the correct limits and internal settings according to the application:

- US05 - Load Configuration *(Write config. to drive)*

If loaded successfully, US05 should change from *Not configured to Configuration OK,* indicating the drive and operator are synched.

If the US04 Control Type or US02 System Units settings are changed after a configuration has been loaded, a new configuration must be written to the drive. Writing the new configuration will NOT default all previous settings.

If the US03 Motor Type must be changed after a configuration has been loaded, a new configuration must be written to the drive and writing the new configuration WILL default all previous settings.

Then, enter the contract speed of the application, this will set the speed safety limits internal to the drive:

- US06 - Contract Speed

SETUP OF THE BASIC INFO IS NOW COMPLETE!

4.4. Inputs/Output Configuration

Next, the inputs and outputs must be configured and assigned functionality depending on the controller requirements.

4.4.1. Inputs

Enter the following input parameters (Home > Prog > Inputs) depending on the controller requirements.

- LI01 - Type of Input (PNP or NPN logic)
- LI04-11 - Input Function

SETUP OF THE INPUTS IS NOW COMPLETE!

4.4.2. Ouputs

Enter the following output parameters (Home > Prog > Outputs) depending on the controller requirements.

- LO05 - Output Function O1
- LO10 - Ouput Function O2
- LO15 - Output Function RLY1
- LO20 - Output Function RLY2

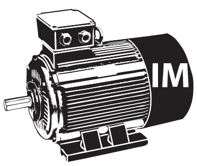
SETUP OF THE OUTPUTS IS NOW COMPLETE!

4.5. Motor Data

Next, the basic motor parameters must be entered before doing an automatic motor learn (Home > Prog > Motor Data).

The KEB F5 inverter is capable of driving either AC induction motors or AC permanent magnet motors. From here on, induction motors will be referred to as "IM" and permanent magnet motors will be referred to as "PM".

4.5.1. Induction Motors

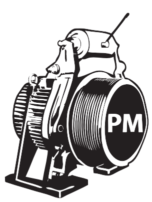


For induction motors, enter the following parameters from the nameplate:

- LM01 - Motor Power (note correct units)
- LM02 - Motor Speed (RPM - Make sure it is rated "slip speed")
- LM03 - Motor Current
- LM04 - Motor Frequency
- LM05 - Motor Voltage
- LM06 - Motor Power Factor

Further induction motor data parameters will be determined during the Motor Tune process, described later.

4.5.2. Permanent Magnet Motors



For PM motors, enter the following parameters from the nameplate:

- LM02 - Motor Speed (RPM)
- LM03 - Motor Current
- LM04 - Motor Frequency
- LM05 - Motor Voltage (EMF rms @ rated speed)
- LM07 - Motor Torque (note units)

For synchronous motors it is important that the relationship between the motor speed and rated frequency correlate to the number of poles. The # of poles should always be an even number. *It is important to verify the following relationships! Refer to Calculated Motor Pole on Diagnostic Screen #12 for verification.*

$$\text{Motor Speed (RPM)} = \frac{\text{Rated Motor Frequency (Hz)} * 120}{\text{\# of Motor Poles}}$$

$$\text{LM02} = \frac{\text{LM04} * 120}{\text{\# of Motor Poles}}$$

$$\text{LM04} = \frac{\text{LM02} * \text{\# of Motor Poles}}{120}$$

$$\text{\# of Motor Poles} = \frac{\text{Rated Motor Frequency (Hz)} * 120}{\text{Motor Speed (RPM)}}$$

Torque units will change depending on which units are set in US02. For reference, here are the equations to convert between Imperial and Metric units provided different nameplate information:

$$\text{lb-ft} = \frac{\text{Nm}}{1.355} = \frac{\text{HP} * 5252}{\text{Rated Motor Speed}} = \frac{\text{kW} * 7051}{\text{Rated Motor Speed}}$$

Further PM motor data parameters will be determined during the Motor Tune process, described later.

SETUP OF THE MOTOR DATA IS NOW COMPLETE!

4.6. Encoder Data

Next, the basic encoder parameters must be entered:

- LE02 - Encoder Pulse Number (ppr)

For absolute encoders, additional parameters may need to be adjusted.

SETUP OF THE ENCODER DATA IS NOW COMPLETE!

4.7. Machine Data

Next, the basic machine data must be entered. The machine data determines a scalar internal to the drive which translates a familiar linear speed (e.g. fpm) to a rotary speed (e.g. rpm) which the drive uses:

Note: Incorrect Machine Data would cause the elevator to run too fast or too slow.

The following data would need to be entered:

- LN01 - Sheave Diameter (note the units)
- LN02 - Gear Ratio (x:1)
- LN03 - Roping Ratio (x:1)

If the sheave diameter is not known, it can be measured with a tape measure. Some sheave manufacturers will show “Minimum Groove Diameter” on a plate attached to the sheave. This is the diameter to the bottom of the groove, which is normally about one inch smaller than the actual diameter at which the rope lies. Therefore, when this dimension is provided, add one inch to it and enter that value in LN01.

For a gearless job, the Gear Ratio would be 1. If the gear ratio is unknown for a geared machine, LN05 will calculate an Estimated Gear Ratio from the motor rated speed, contract speed, roping ratio and sheave diameter. This value could then be entered as the gear ratio in LN02.

SETUP OF THE MACHINE DATA IS NOW COMPLETE!

4.8. Speed Profile

Next, the speed control parameters can be set for digital, binary, and positioning control.

The speed commands in Analog and Serial speed control are dictated by the controller, so these speed parameters will have no effect on the actual run speed. The LS02 High Speed must be set for Analog and Serial speed control. For Analog speed control, 10V corresponds to LS02 High Speed.

Enter the following speed settings if applicable:

- LS01 Leveling Speed
- LS02 High Speed
- LS03 Inspection Speed
- LS04 Correction Speed
- LS05 Intermediate Speed 1
- LS06 Intermediate Speed 2
- LS07 Intermediate Speed 3

Note: The nomenclature of the speeds above are defined (as default) by KEB. Although, the controller manufacturer may assign speeds differently (e.g. the controller manufacturer may use Intermediate Speed 1 for High Speed), it is suggested, however, that inspection and leveling speeds are assigned accordingly based on functionality and/or speed limits assigned to these speeds.

If the elevator does not move at the correct speed, verify which speed is selected and its corresponding setting, as well as verify whether the command speed and encoder speed match.

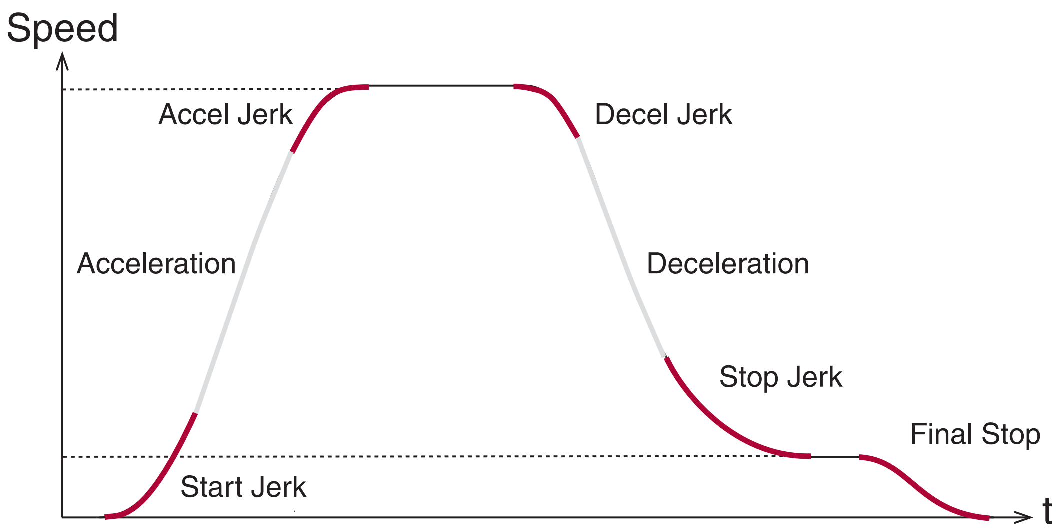
4.8.1. Profile Adjustment

For digital, binary, and positioning control, the available profile adjustments are shown below (for analog and serial speed control the controller will dictate the profile and these settings can only be used to limit the rates).

The KEB LCD operator can approximate all relevant profile parameters depending on the aggressiveness of the application. A user can select either a soft, medium, or hard profile. The adjustments can be made with:

- LS15 - High Speed Profile
- LS16 - One Floor Profile (Intermediate Speeds 1, 2)
- LS17 - Emergency Profile (Intermediate Speed 3)

Alternatively, if a user wants to customize the profile, they can adjust the different speed profiles based on the selected speed:



	High Speed	One Floor (Short Runs - Intermediate Speeds 1,2)	Inspection	Emergency (Intermediate Speed 3)
Acceleration	LS20	LS30	LS50	LS40
Start Jerk	LS21	LS31	LS51	LS41
Accel Jerk	LS22	LS32	LS52	LS42
Deceleration	LS23	LS33	LS53	LS43
Decel Jerk	LS24	LS34	LS54	LS44
Stop Jerk	LS25	LS35	LS55	LS45
Final Stop	LS43-45	LS43-45	LS43-45	LS43-45

SETUP OF THE SPEED PROFILES IS NOW COMPLETE!

4.9. Motor Learn

Next, the complete motor data must be learned with the automated learn function.

The motor characteristics, including the motor's inductance and resistance, can be learned with the drive's tuning function. The Motor Learn function can be found under the Tune Parameters group from the Programming menu (Home > Prog > Tune Parameters > LL01). Begin the procedure by setting:

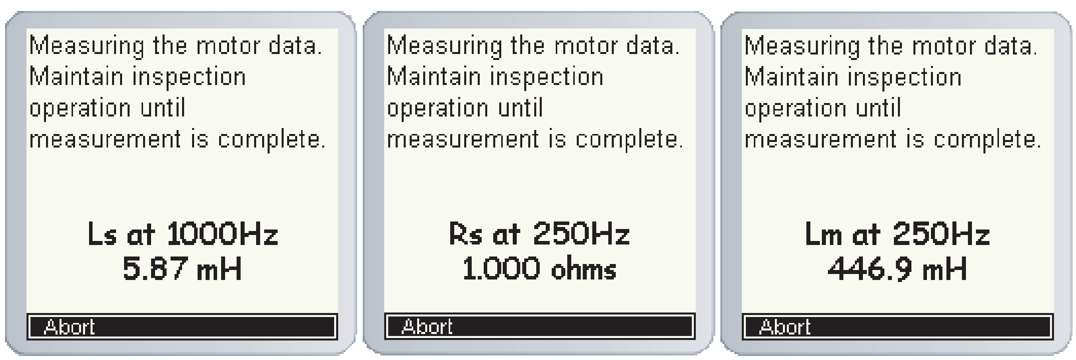
- Motor Tuning LL01 = Start

Note: It may be necessary to program the drive outputs accordingly for proper operation with the controller. Refer to Section 6.13 for setting the output functions.

Follow the instructions on the LCD screen. The user is instructed to:

1. Disable the brake.
2. If the speed is generated by the controller (Analog or Serial), then set external speed command to zero.
3. Press and hold inspection (speed + direction + enable inputs) until completed. Upon successful completion LED 1 and LED 2 will blink green and red until inspection is dropped.

The process should take 2-5 minutes and will emit a high pitched noise while the drive measures various motor parameters.



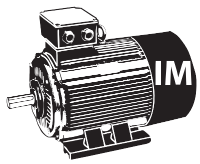
Re-establish proper brake operation wire and return the inspection speed if changed on the controller.

SETUP OF THE MOTOR LEARN IS NOW COMPLETE!

Scan the QR code to the left to view a walkthrough video of the Motor Tune Procedure.

4.10. Encoder Learn

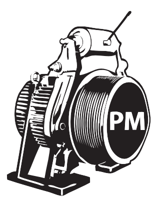
Next, the encoder needs to initialized and configured.



In applications with Induction Motors, the Encoder Synchronization function can be used to determine the correct A/B phasing of the encoder channels and whether the direction needs to be inverted for the correct direction of travel.
For IM motors, the Encoder Synchronization can be adjusted at parameter:

- Encoder Synchronization LL07 = Start

Proceed to section 4.10.3 (IM only)



When using PM motors, the encoder position/pole must also be learned. This step is unique to PM applications and does not need to be done with IM machines. Knowing the motor pole position relative to the encoder allows the KEB drive to apply the proper stator magnetic field commutation angle for maximum torque.

For absolute encoders on PM motors, if at any time the physical relation between the motor shaft and encoder changes (i.e. encoder replaced, encoder slippage, etc.) the encoder position must be relearned.

There are 2 functions available to determine the encoder pole position with PM machines:

1. Stationary Pole Identification (SPI) - The SPI process can learn the encoder position without movement (i.e. ropes on and brake set), but does not determine whether the A/B encoder channels must be swapped - this would be determined iteratively and is described later.

2. Encoder Pole Learn - This function will determine the encoder position but requires sheave movement with a relatively frictionless load (i.e. balanced car or unroped sheave). The benefit of this method is that proper A/B phasing can be determined automatically.

4.10.1. SPI Encoder Learn

SPI can be done with the ropes on and the brake set. To start the SPI functionality go to LL05 and follow the instructions on the LCD:

- LL05 - SPI ("START")

The user will be prompted to:

1. Disable the brake
2. If the speed is generated by the controller (Analog or Serial), then set external speed command to zero
3. Press and hold inspection (speed + direction + enable inputs) until finished. Upon successful completion LED 1 and LED 2 will blink green and red until inspection is dropped.

During the SPI process, the motor will make a series of chirps and the LCD display will show the encoder position samples. During the tune nine samples will be taken, the first is dropped and an average will be taken of the last eight. Upon completion the display will show the last sample taken and an average of the samples. The encoder pole position found by SPI will be written to parameter LE06.

After the process has completed, the user will be prompted to complete the Encoder Synchronization procedure to establish the correct A/B encoder channel phasing and direction of rotation. Proceed to Section 4.10.3 for further details. If the Encoder Synchronization process has previously been completed, the user may Abort the Encoder Synchronization step without losing the learned Encoder Pole Position.

Re-establish proper brake operation wire and return the inspection speed if changed on the controller.

Scan the QR code to the left to view a walkthrough video of the SPI procedure.

4.10.2. Encoder Pole Position Learn

As an alternative to using the SPI function, a user can use the Encoder Pole Position Learn. The advantage of the Encoder Pole Position Learn is that it learns the correct A/B channel phasing in addition to the pole position. However, the procedure does require frictionless movement (unroped sheave or balanced car).

For an unroped machine, the speed gains may need to be reduced beforehand to prevent vibration during the encoder synchronization...

KP Speed Acceleration (LC03) = 300
KI Speed Acceleration (LC08) = 50
KI Offset Acceleration (LC11) = 0

To begin the process, set Encoder Position Pole Learn to “Start”:

- LL06 - Encoder Pole Position Learn = Start

The user will be prompted to:

1. Press and hold the inspection (speed + direction + enable inputs) until finished

During the process, the sheave will align to a motor pole and move back and forth a few degrees. During this time the encoder position will be shown on the keypad.

If the A/B phasing is incorrect the process will stop and notify the user. Then it will resume and automatically make the change and prompt the user to hold the inspection again.

When the process is complete, the keypad will prompt the user to release the inspection. The encoder position and A/B phasing information will be automatically written to parameters LL06 and LL03, respectively.

After the process has completed, the user will be prompted to complete the portion of the Encoder Synchronization procedure to establish the correct direction of rotation. Proceed to Section 4.10.3 for further details. If the Encoder Synchronization process has previously been completed, the user may Abort the Encoder Synchronization step without losing the learned Encoder Pole Position.

4.10.3. Encoder Synchronization

The Encoder Synchronization process will determine the correct A/B encoder channel phasing and direction of rotation for both IM and PM motors. For PM motors, the Encoder Synchronization process immediately follows either method of learning the encoder pole position.
Begin the process by setting:

- LL07 - Encoder Synchronization to "Start"

Then follow the directions on the keypad. The drive will iteratively run the elevator and swap the phasing and direction of the A/B channels as needed.

SETUP OF THE ENCODER LEARN IS NOW COMPLETE!

4.11. Running the Motor

At this point, the drive should be set up far enough to run reasonably well on inspection speed. At this point, the user should run the elevator in both the up/down directions, verifying that the current in both directions is reasonable. The current can be viewed from the Home or Diagnostics screens. For a balanced car, the current should be reasonably low. For an empty car, the running current should be less than motor rated current in both directions.

If operation on inspection speed in both directions shows no issues, the next step is to run the elevator up to high speed.

Before this is done, there may be a few parameters which need adjustment:

LC30 - Maximum Torque is used to limit the output current to the motor. It is primarily used to protect the motor from extreme or prolonged high currents, which may occur during initial setup or troubleshooting. Default is 150%; Under normal operation, this will typically need to be set in the range of 200 - 250%.

4.11.1. Running at High Speed

Now, the elevator should be able to run at high speed with no major issues. At this point, if the user is satisfied, no further adjustments may be needed to increase ride quality since the default settings for the speed control provide a very good starting point in most cases.

4.12. Advanced Ride

4.12.1. Inertia Learn

For optimum control of the elevator, it is recommended to learn the system inertia and activate the feed forward torque controller (FFTC).

FFTC reduces the dependence on the speed feedback from the motor by predicting what the system will do and providing the required torque command based on that prediction.

The first step in learning the system inertia is to get the car running at contract speed over multiple floors.

The next step is to balance the car and run on inspection in the middle of the hoist way and monitor the torque (Diag. screen #3). The motor torque in the up and down directions should be equal but in opposite direction. If this is not the case, adjust the counter weights before proceeding.

For buildings with 12 floors or less, run the car from bottom to top and top to bottom. For taller buildings, run between at least 10 floors in the middle of the hoist way (5 above and 5 below). This function will also take into account rope compensation or lack there of. So it is necessary to make this measurement in the middle of the hoist way.

When ready, run the car between floors at high speed. High speed must be reached! If it can't, then lower the speed such that the car reaches a stable speed for at least two seconds.

Begin the process by setting:

- LL10 - Inertia Learn to "Start"

Then follow the directions on the keypad. After each run, the user will have the option to calculate the inertia for that run. After four runs, the drive will automatically calculate the inertia based on the averages.

Note: During the Inertia Learn process, the drive reduces the acceleration to a fixed rate (1.5 ft/sec^2). It may be necessary to adjust any speed following or tach error settings in the controller to prevent shutdowns.

4.12.2. Internal Pretorque

Internal pre-torque is a feature of the drive which can be used to minimize, if not totally eliminate, the rollback which may occur at brake pick, without the need for external load weighing devices. Pretorque is available when the LC01 Control Mode is set for Closed Loop FOC or Closed Loop Synthetic Pretorque.

Adjust the brake spring tension, brake voltage, and brake timing first. Note that it is often advantageous to use a lower spring tension and lower brake pick voltage to provide a softer lifting of the brake. This allows for a smoother transition from brake to motor. It should be noted that any subsequent changes to the brake could require readjustment of the pre-torque.

The pre-torque is active at the beginning of a run, according to the timer parameters LT02-03. When a run command has been given by the controller, the drive will first perform a brief phase current check of the motor before attempting to run. Upon successful completion it is safe to pick the brake and the LT02 Control Hold Off timer begins. During the LT02 Control Hold Off period, the speed gains are held low to prevent any disturbances under brake. After the LT02 Control Hold Off timer expires, the pre-torque period becomes active and the LT03 Speed Start Delay timer becomes active. The LT02 Control Hold Off timer should be set such that it expires briefly before the brake is picked so the pretorque period before the speed profile begins, LT03 Speed Start Delay, is active when rollback would occur.

During the pre-torque period, the corresponding speed gains for pretorque, LC05 KP Speed Pretorque and LC10 KI Speed Pretorque, are active; These can be adjusted generally by increasing LC10 in steps of 1000. Typical LC10 ranges between 10,000 - 20,000. After the LT03 Speed Start Delay timer has expired, the pretorque period expires, the acceleration begins and the corresponding speed gains for acceleration and high speed are now active. For control modes which dictate the speed profile and when it begins (i.e. analog or serial) the pretorque period will expire as the acceleration begins.

For best adjustment, delay the start of the run profile by either delaying the pattern with LT02,LT03 (binary, digital,...) or via the controller for external speed command (serial, analog,...). Suggested delay is 2 seconds. This will allow the brake to pick, rollback to occur, and a stabilized hold at zero speed before acceleration. This will help assess the amount of rollback and timers can be reduced for normal timing sequence after synthetic pretorque has been optimally adjusted.

4.12.5. Closed Loop Analog Pretorque

Setting the Control Mode LC01 = 3, Closed Loop Analog Pretorque allows the drive to use an external pretorque input signal via AN2+ and AN2- on terminal strip X2A for use with an analog load weighing device.

The first step is to ensure the load-weigher is calibrated according to the manufacturer's instructions. Have the car in an empty load situation and set LC01 = 3, Closed Loop Analog Pretorque.

Set the inspection speed in the controller to zero. Set LT01, Brake Pick Delay and LT03, Speed Start Delay, to values larger than one second.

Change the keypad display to Diagnostic Screen #3 to monitor "Actual Torque."

Pick a direction so that the motor holds at zero speed. Monitor "Actual Torque" on the keypad and make a note of the value before the brake lifts and the value after the brake lifts with the motor holding at zero speed.

Adjust LA16 and LA17, Analog Input 2 X & Y offsets and repeat the previous step until the value of "Actual Torque" before the brake lifts matches the value after the brake lifts. When this occurs, there should be no noticeable rollback when the brake lifts.

Load the car with weights. Full load is preferred, but not required.

Monitor the value of "Actual Torque" before the brake picks and when the motor holds zero speed. Adjust LA15, Analog Input 2 Gain until the value of "Actual Torque" before the brake lifts matches the value after the brake lifts. When this occurs there should be no noticeable rollback when the brake lifts.

Remove the load, repeat the previous step, and adjust LA15 as needed.

Return the inspection speed, LT01 Brake Pick Delay, and LT03 Speed Start Delay to their original values.

4.12.7. Closed Loop Digital Pretorque

By setting the Control Mode LC01 = 4, Closed Loop Digital Pretorque, a fixed digital pretorque value (% of the motor rated torque) is set with LC34 Digital Pretorque. This applies to US04 Control Types Digital (0), Binary (1), Absolute Analog (2), Bi-Polar Analog (3) and Serial Binary Speed DIN66019 Service 50 (6).

LC34 is NOT ACTIVE with US04 Control Types Serial Speed DIN66019 Service 49 (4) and Serial Speed DIN66019 Service 50 (5). Instead, the pretorque value is sent serially to the drive via the controller, utilizing a load weigher. The load weigher should be properly calibrated and the associated controller settings should be correct. The pretorque value can be viewed in FB03 Field Bus Pretorque.

In most applications, if the load weigher and controller are set up properly, no further drive adjustment should be necessary. However, if further adjustment is required, LA15 Analog Input 2 Gain and LA17 Analog Input 2 Y Offset can be adjusted. See section 6.13 for more information.

Processed pretorque value= (FB03 + LA17)*LA15

4.12.6. Predictive Synthetic Pretorque

By setting the Control Mode LC01 = 5, Closed Loop Synthetic Pretorque the drives internal pre-torque function is activated with **predictive** synthetic pretorque and brake release timing.

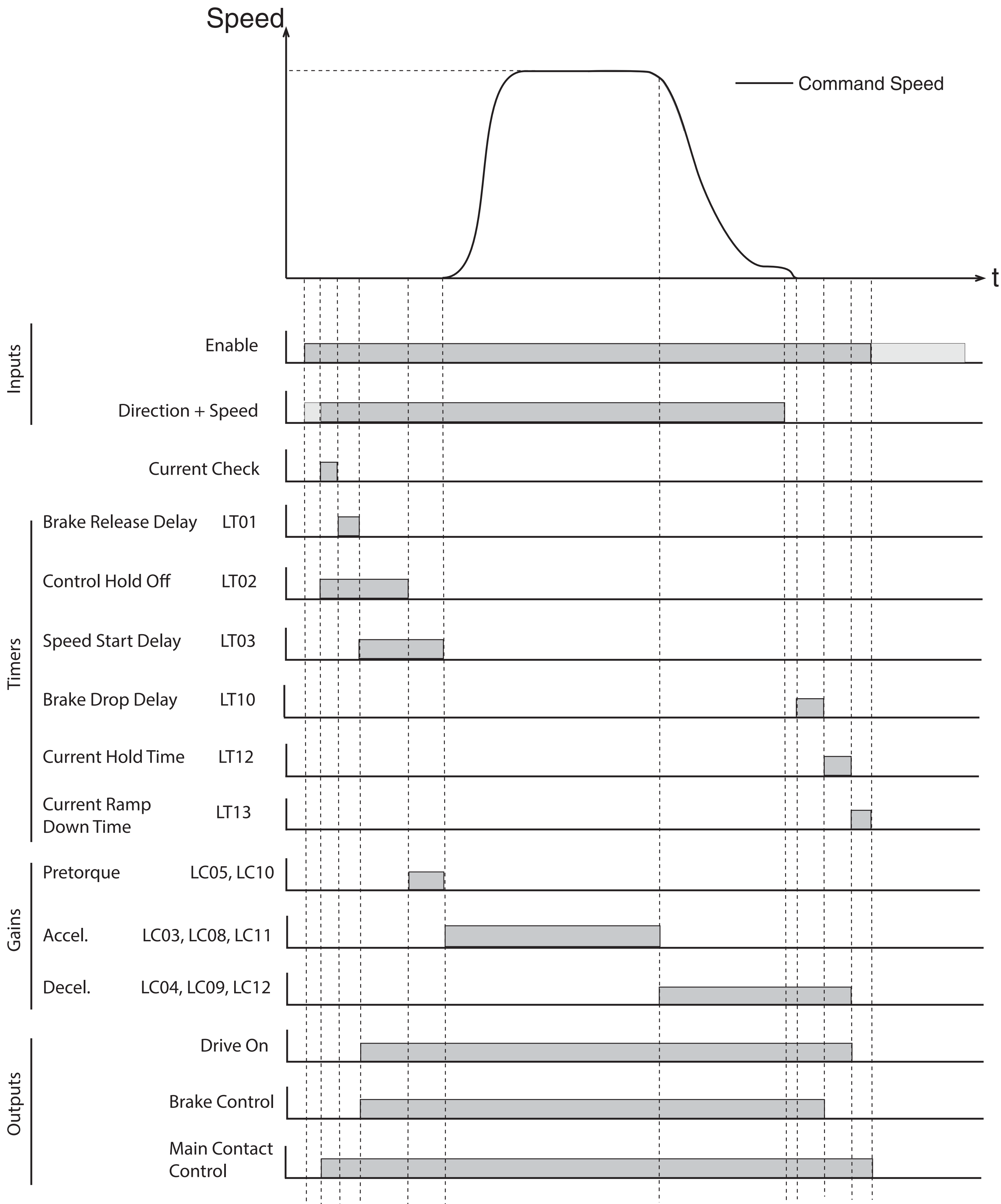
Brake Release Timing

This function dynamically measures the time that was taken for the brake to release from the point when the enable signal was given. Brake release time is displayed in DG59 Brake Release Time. This allows for the adjustment of the LT02-LT03 timers, reducing the difficulty in calculating this time. The time measured is from when the enable signal is received to when the torque of the motor changes.

Predictive Synthetic Pre-Torque Function

Adjust the internal pretorque with LC01 = 2, Closed Loop FOC as outlined in section 5.12.2, before setting LC01 = 5, Closed Loop Synthetic Pretorque. This function will calculate the required holding torque based on the load inside of the car and then use 90% of the holding torque value as the anticipated pretorque requirement for the next run. This function requires that the brake is open before the end of the Speed Start Delay Timer LT03 in order to accurately determine the load percentage and calculate the required pretorque. The load percentage of the preceding run can be seen in DG58 Car Load.

Pre-torque Timing Chart



5. Diagnostics and Troubleshooting

5.1. Diagnostics Screens

Home Screen	
Inverter Status	Mode
Motor Speed	Command Speed
Elevator Speed	Motor Current
Diagnostic Screen # 1	
Inverter Status	Motor Current
DC Bus Voltage	Peak Current
Peak DC Volts	Magnetizing Current
Diagnostic Screen # 2	
Inverter Status	Command Speed
Elevator Speed	Motor Speed
Peak Speed	Modulation Grade
Diagnostic Screen # 3	
Inverter Status	Motor Speed
Output Condition State	Output Frequency
Actual Torque	Output Voltage
Diagnostic Screen # 4	
Inverter Status	Parameter Set
Input Status	
Output Status	
Diagnostic Screen # 5	
Inverter Status	Command Speed
Raw Pattern	Raw Pretorque
Processed Pattern	Post Pretorque
Diagnostic Screen # 6	
Inverter Status	Mode
Analog Output 1	
Analog Output 2	
Diagnostic Screen # 7	
Heatsink Temperature	Motor Current
Motor Temperature	Carrier Frequency
Electric Power	Motor Power
Diagnostic Screen # 8	
Power On Counter	Overload Counter
Run Time Counter	Drive Load
Braking Energy	Peak Load

Diagnostic Screen # 9	
Operator Software Date (ddmm.y)	Operator Software Version
Drive Software Version	Drive Config ID
Drive Software Date (ddmm.y)	Enc. Interface Software Date
Diagnostic Screen # 10	
Inverter Status	Active Profile
Elevator Speed	Active Speed
Elevator Position	Leveling Distance
Diagnostic Screen # 11	
NTSD Speed 1 Up	NTSD Speed 1 Down
NTSD Speed 2 Up	NTSD Speed 2 Down
NTSD Speed 3 Up	NTSD Speed 3 Down
Diagnostic Screen # 12	
Total Runs	Motor Frequency
Calculated Motor Pole	Motor Power
Motor Speed	Motor Current
Diagnostic Screen # 13	
Car Load	Post Pretorque
Brake Release Time	Elevator Position
Field Bus Pretorque	Actual Torque
Serial Diagnostics (*For Development Purposes)	
Field Bus Control Word 0000 0000 0000 0000 Raw Com Data 0000 0000 0000 0000 0000 0000 0000 0000	
CAN Diagnostics	
Control Word and Status Word information	
Diagnostic Screen Log	
MM/DD/YYYY HH:MM:SS (Most Recent) Fault or Special Operating Mode . . . . MM/DD/YYYY HH:MM:SS (Oldest) Fault or Special Operating Mode	

5.2. Drive Faults

Faults and errors, listed alphabetically. Additional troubleshooting of operational problems is listed in Section 5.3 and diagnostics solutions in Section 5.4.

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Abnormal Stop Bus	EBus	Indicates no serial communication between keypad operator and controller	Parameters FB50 - 53 show the error count, service, and value of both serial ports X6C and X6D. If the service is 99 and the error is 9, then there is a framing or parity error. This could indicate if the baud rate is incorrect, telegrams invalid, or potentially loss of serial communication due to noise. Check setting of FB11 DIN66019 Fb Baud Rate. Invalid serial telegrams being received. Increase FB12 Fieldbus Watchdog.
Analog Signal Failure*	- (157)	Analog speed command not present at the beginning of a run.	When US04 = Absolute Analog Speed (2), Bipolar Analog Speed (3), the speed command must be received within t=2.5(LT01+LT03) sec. at beginning of run. Refer to additional information at end of section.
Base Block	bbL (76)	This message precedes most faults and indicates the drive enable (I7) was removed while the drive was outputting current. This is not a drive fault.	Indicates the output transistors have been safely shut off and are being blocked from further operation. This generally indicates the drive enable input (I7) was dropped prematurely or abruptly while the drive was still outputting current. This is not a drive error or fault, but a status message.
Brake Switch Failure*	- (151)	Brake switch not open/closed at beginning/end of run.	When LI04-11 input is set as Brake Release confirmation, the brake switch must open at the beginning of the run within t=LT01+LT03+2.5 sec and close at the end of the run within t=LT10+LT12. Refer to additional information at end of section.

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Data Unspecified	-	When LE12 = Data Unspecified, the encoder memory is not formatted.	Encoder memory has not been formatted. To fix, enter 2503 into Password to access drive parameters. Next, from the Program menu, hit F4 for File. Select Inverter parameter and then scroll down to user definition parameters. Set ud.1 to 2206 for supervisor access. Hit ESC twice to get back to the inverter parameter menu. Scroll to encoder parameter and set ec.38 = 2. Power cycle drive and LE12 should read "Position Transfer."
Direction Selection Failure*	- (161)	Both directions signaled at beginning of run.	For LI15 = Up (I5) and Down (I6) inputs, the up/down directions must independently be selected. If both are selected simultaneously, the 'Direction Selection Failure' fault will occur, but not during UPS Operation Mode (refer to LI04 UPS Operation for further details).
Drive Enable Switched Off*	- (162)	Drive Enable (I7) input dropped while current output.	Will occur whenever the Drive Enable (I7) is dropped while current is being output. Check input signal connections, sequence, or reason for abrupt stop. (eg. emergency stop, clip door lock, etc.)
Error Calculate Motor Data	ECdd (60)	The inverter is unable to learn a value during the Motor Learn procedure, SPI, or during automatic learn of the encoder position during each run.	Verify correct motor data is entered in LM01-07 and re-try. Make sure motor contactor is closing. Make sure motor is wired correctly. Change LM27 to 1, Ld = Lq and test again. If the problem occurs during an SPI, the following procedure can be done instead... Verify LM27 Motor Inductance Mode is set to Ld = Lq. Set LE07 Rotor Detection Mode to NOP. Prevent brake from releasing, set inspection speed = 0. Give inspection command to allow sample to be taken. Check the value in LE06 Encoder Pole Position. Repeat several times to ensure consistency in LE06. Samples should not vary by more than 2,000 counts. Set LE07 to OFF and proceed as normal.

Drive Faults

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Error Charge Relay Fault	ELSF (15)	Load shunt fault	Load-shunt relay has not picked up, occurs for a short time during the switch-on phase, but would automatically be reset immediately. If the error message remains the following causes may be applicable: Load-shunt defective - Replace inverter Input voltage incorrect or too low Braking resistor connected to wrong terminals or braking transistor defective (See Appendix on how to test braking transistor). Failure of the load shunt could result from excessive power cycling of the inverter without allowing the unit to fully power down, which may also be a result of frequent brown-outs. Use of a 230V single phase UPS power supply with a 480V drive is permitted and can be accomplished with the input function UPS Operation to reduce the under voltage error limit, although if the waveform is not a sine wave then the DC bus voltage may be less than the 280VDC required to reset the fault. It is suggested to let the drive power down completely before powering up with the UPS supply.

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Error Encoder1	EEnC1 (32)	Loss of incremental encoder channel or differential voltages for the signal pairs are the same for TTL encoders.	For an incremental encoder interface, the recognition of encoder channel breakage or defective track triggers a fault if the voltage between two signal pairs (A+/A-, B+/B-, N+/N-) is smaller than 2V. That is, a signal pair cannot be at the same level. Channel pair voltages can be measured to confirm. **If an incremental encoder does not have N+/N- (or Z+/Z-) tracks, then the corresponding inputs on the encoder interface card must be jumpered high/low.** That is, jumper X3A.5 (N+) to X3B.7 (+5V) and X3A.6 (N-) to X3A.8 or X3B.8 (0V Common). In any case, the N+/N- are not needed and these inputs could always be jumpered high/low. If performing a Motor Learn in open-loop, the incremental encoder interface card could be removed if an encoder is not connected. Verify the encoder power ratings & connections (e.g. Powering a 8-30VDC rated encoder with 5V) During a Pole Position Learn for a PM motor, the correct direction was not detected indicating that either the direction was incorrect due to the A/B channel phasing or that movement did not occur either due to excessive friction, brake not lifting, etc. If the encoder A/B phasing is incorrect during the Pole Position Learn for a PM motor, this can be changed in LE03 Swap Encoder Channels. This is automatically done during the Encoder Synchronization procedure. During the Pole Position learn, the motor must be able to move with little friction which may require either a balanced car or unroped sheave. Additionally, verify the brake is picking and fully released. If all other troubleshooting steps fail, the encoder card may be faulty. Replace the encoder card.

Drive Faults

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Error Encoder Card	EHyb (52)	Invalid encoder interface identifier	Check for correct encoder connections/pinout. Incorrect pinout may drag the encoder board power supply down. Check encoder card connection to control board for bent or missing pins and proper connection. Otherwise, the board may be defective and should be replaced.
Error Encoder Card Changed	EHybC (59)	Indicates the encoder interface card has been changed.	This error should automatically clear itself. If not, re-Enter the read-only setting in parameter LE01.
Error Encoder Interface	EENCC (35)	Loss of encoder channel or communication between encoder and drive for an absolute encoder.	This error should be accompanied with further information describing the nature of the fault. Refer to LE12 Serial Encoder 1 Status for further details.
Error External Fault	EEF (31)	A digital input can be programmed to trigger an error.	The digital input for an External Fault may come from the controller or may be jumpered from an inverter or regen digital output. The cause of the error will be variable. Identify the source of the External Fault input and the conditions which would trigger this input.
Error HSP5 Serial Com. (EBus)	EBus (18)	This message indicates that serial communication between the keypad operator and the drive or the drive and the elevator control has been lost (See parameter LX09 Ser.Com Watchdog Time to bypass this fault).	**Verify keypad operator is seated properly to the inverter.** Verify connection of the serial comm. to the keypad operator at port X6C. Verify there are no bent or missing pins where the serial comm. cable from the controller plugs into the keypad operator. **Verify serial comm. between controller and drive.** Verify connection of keypad operator and inverter control card. Verify there are no bent or missing pins where the keypad operator connects to the control card.

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Error Initialization MFC	EInI (57)	Control card processor unable to boot.	Replace control card.
Error Low Motor Current	Ebr (56)	Error current check. Prior to every run the drive sends current to each phase of the motor to verify the connection. Afterward, the drive applies magnetizing current (Induction Motors) and monitors whether the motor is magnetized or not.	Possible causes for low motor current error during current check: Motor contactor contacts are burnt or damaged. **Bypass motor contactor** (do not simply jumper!) to test and replace as needed. One or more motor leads is not connected. Motor contactor is not closing or not closing in time Bypass motor contactor or verify switching time. Motor windings are damaged. Measure motor resistance. The phase current check can be bypassed by setting LX08 = Magnetizing Current Check (Induction Motors only). If the error occurs when trying to run on open loop, increase LC32 Low Speed Torque Boost; suggested value is 5%.

Drive Faults

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Error Low Speed Over-load	EOL2 (19)	Occurs if the low frequency, stand-still constant cur-rent is exceeded (see Technical Data for stall cur-rent levels and overload charac-teristics). The error can only be reset if the cooling time has elapsed and E.nOL2 is dis-played.	The cause of the Low Speed Overload would be due to excessive current at low speed (typically below 3Hz). The following may be causes of excessive current: Incorrect motor data. Verify motor data, specifically the motor rated speed and frequency relationship (Diagnostic Screen #12) for PM Synchronous Motors (see Section 5.5.2, LM02 or LM04, for details). Verify correct encoder settings including: LE02 Encoder Pulse Number LE03 Swap Encoder Channels (A/B setting) LE06 Encoder Pole position for PM Synchronous Motors. Relearn Encoder Pole Position as needed (see Section 4.10.1 or 4.10.2). High mechanical load/issues (friction).
Error Motor Overheat	EdOH (9)	The external mo-tor temperature sensor tripped.	If a motor PTC temperature sensor, relay, or KTY (special hardware required) is connected to terminals T1, T2 and the motor overheat function LX10 EdOH Function = On, then if the PTC resistance exceeds 1650 Ohms, relay opens, or the KTY sensor is above the set value in LM10 Motor Overload temp, then a motor overheat is detected. Cause of excessive motor heating may include: Excessive current. Verify correct motor data. Verify correct encoder settings including: LE02 Encoder Pulse Number LE03 Swap Encoder Channels (A/B setting) LE06 Encoder Pole position for PM Synchronous Motors. High mechanical load/issues (friction). Insufficient motor cooling.

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Error Motor Protection	EOH2 (30)	Electronic Motor Overload protection was activated.	Excessive RMS motor current according to the LM08 Electric Motor Protection overload curve or if the LM11 Peak Motor Current Factor is exceeded for more than 3 seconds for PM Synchronous Motors. For induction motors the baseline current for Electric Motor Protection corresponds to the LM09 Electric Motor Overload Current. For PM Synchronous Motors the baseline current for Electric Motor Protection corresponds to the LM03 Motor Current and the Peak Motor Current Factor is LM11. Causes of excessive RMS current would be: Incorrect motor data. Verify motor data, specifically the motor rated speed and frequency relationship for PM Synchronous Motors (see Section 5.5.2, LM02 or LM04 for details). Verify correct encoder settings including: LE02 Encoder Pulse Number LE03 Swap Encoder Channels (A/B setting) LE06 Encoder Pole position for PM Synchronous Motors. Relearn Encoder Pole Position as needed (see Section 4.10.1 or 4.10.2). High mechanical load/issues (friction).

Drive Faults

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Error Over Current	EOC (4)	Occurs when the specified peak output current is exceeded or if there is a ground fault.	The current and peak current may be viewed in Diagnostic Screen #1 or DG06 and DG31. To reset the logged peak value, press the F4 Reset key from the Diagnostic Screen. Causes for over current errors: If the error occurs instantly at the start of each run, the issue may be: Ground fault on motor leads. Damaged or slow to close motor contactor. Shorted output transistor. Motor failure. If the error is intermittent, the issue may be due to: Damaged or slow to close motor contactor. Loose motor connections. Electrical noise, faulty grounding. To determine if the over current is caused by the inverter, motor, or intermediate component (e.g. motor contactor), systematically remove these items from the system. Start by bypassing the motor contactor (do not simply jumper!). Checking of the motor and motor cables for short circuits or opens: Resistance checks should be done with the motor disconnected from the inverter. With the motor cable disconnected from the inverter, make a resistance check from phase to phase. This should read the winding resistance, as specified by the motor manufacturer. Phase to ground resistance should read an open circuit. If measurements indicate a fault, disconnect cables at motor side and remake the test to determine if the fault is with the motor or cabling. ...continued on next page.

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Error Over Current (continued)	EOC (4)		Meg tests to check motor winding insulation can only be performed with the motor disconnected from the inverter. Failure to do so will result in damage to the output section of the inverter due to high voltage from the meg tester. The inverter can be operated in open loop induction mode without being connected to the motor: Power off and after appropriate discharge time, disconnect the motor leads from the inverter. If not an induction motor, change motor configuration to induction motor in US03 (if US03 was previously set to a PM synchronous motor, performing this step will erase and default all parameters; make note of settings as needed before continuing), then Write Configuration to Drive in US05. Program drive as needed from default for the drive to output current when given an inspection run command. Set to LC01 Control Mode = Open Loop V/Hz Run the system with the motor leads disconnected in open-loop. If the over current error occurs, then the inverter output is faulty. If an overcurrent error does not occur, then the fault may be in the motor, motor cabling or motor contactor. If the over current error stays with the inverter, then one of the outputs may be shorted. See Appendix for diode check measurements of inputs and outputs. Notes: Under normal operation, the drive would limit the output to the current corresponding to the maximum torque in LC30. Maximum Output Current = LC03 Motor Current x LC30 Maximum Torque. The drive would also limit the output current to the hardware current limit, listed as the Peak Current (30sec.) rating in the Technical Data tables in Sec.1.4 and 1.5. The Peak Current rating will be less than the overcurrent.

Drive Faults

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Error Overheat Power Module	EOH (8)	The heat sink temperature rises above the permissible limit.	The heatsink temperature can be viewed in Diagnostics Screen #7 or DG37. The overheat limit is 90 degrees Celsius for most drives (See Technical Data for units 175HP and larger). Under normal operation, the heatsink temperature should usually be below 65 degrees Celsius. Causes of inverter heatsink overheat include: Insufficient cooling or ambient temperature too high Verify operation of fans. The fans are thermostatically controlled to come on at about 45 degrees Celsius. To turn all fans on high, LX06 Function Test can be set to Fans On. Make sure fans are not clogged. Increase airflow around inverter or add cabinet fans. Faulty temperature sensor. Power down the inverter or let it stand idle to allow for the heatsink temperature to cool. If the heatsink temperature read by the drive diagnostics seems unreasonably high for a heatsink cool to the touch, then the heatsink temperature sensor may be faulty and would need to be repaired by KEB.

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Error Overload	EOL (16)	Time dependent overload (See overload curves under Technical Data, Section 2.9). Error cannot be reset until display shows E.nOL!	Cause of excessive motor overload may include: Excessive current. Verify correct motor data. Verify correct encoder settings including: LE02 Encoder Pulse Number LE03 Swap Encoder Channels (A/B setting) LE06 Encoder Pole position for PM Synchronous Motors. High mechanical load/issues (friction).

Drive Faults

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Error Over-speed	EOS (58)	The internal overspeed limit is exceeded.	The inverter internal overspeed is dictated as 110% of the US06 Contract Speed. This level is fixed and cannot be adjusted, except for when performing the Overspeed Test function (refer to parameters LL15, LL16 for further information). Possible causes of an overspeed error include: Incorrect setting of the Machine Data parameters LN01-03. The Machine Data parameters are used as a scalar to convert a linear speed (e.g. ft/min) to a rotary speed (rpm) used by the inverter. If the machine data is not set correctly, the overspeed limit may be calculated too low when control modes which dictate the drive speed exceed this limit (e.g. it is possible in Serial Speed control mode for the controller to command a speed higher than the overspeed error limit calculated from the machine data parameters, which could cause inadvertent overspeed errors). Lack of control Maximum Torque limit or peak inverter current reached. Monitor the motor current to see if it reaches a current corresponding to the LC30 Maximum Torque or the drive Peak Current rating. Maximum Torque may be set too low (default = 150%; Typical for high speed/full load operation = 200-250%) ...continued on next page....

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Error Over-speed (continued)	EOS (58)		Excessive current Incorrect motor data, specifically the motor rated speed and frequency relationship for PM Synchronous Motors (see Section 4.5.2, LM02 or LM04 for details). Incorrect Encoder Pole Position for PM Synchronous Motors. Relearn Encoder Pole Position as needed (see Section 4.10.1 or 4.10.2 Speed gains set too high or low). For an unloaded PM Synchronous Motor, then default speed gains LC03-12 may be too high, causing the machine to jerk quickly. If left too low for normal operation, the drive may not track the speed. Modulation grade exceeds maximum. If the modulation grade in Diagnostic Screen #2 or DG10 exceeds 100% there may be a loss of speed control. Sudden, excessive movement. Incorrect motor data, specifically the motor rated speed and frequency relationship for PM Synchronous Motors (see Section 4.5.2, LM02 or LM04 for details). Incorrect Encoder Pole Position for PM Synchronous Motors. Relearn Encoder Pole Position as needed (refer to Section 4.10.1 or 4.10.2).

Drive Faults

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Error Over Voltage	EOP (1)	The DC bus voltage rises above the permissible value either during motor regenerative operation or as a result of line side voltage spikes. For 460V drives, the over voltage level is 840VDC and for 230V drives, the over voltage level is 400VDC. The over voltage level cannot be adjusted.	The DC bus voltage DG08 and the peak DC bus voltage can be monitored in the Diagnostic screen #1 or DG08 and DG30. To reset the logged peak value, press the F4 Reset key from the Diagnostic Screen. When using a braking resistor to dissipate regenerated energy from overhauling or deceleration, the braking resistor should come on at the following levels: 460V = 760VDC 230V = 380VDC If a braking resistor is used: Ensure proper connection of the braking resistor to the to the braking transistor terminals PB, ++. Disconnect braking resistor and measure resistance to verify if correct. If a line regen unit is used: By default, the line regen unit will turn on at 103% of the idle DC bus voltage. Ensure proper connection between the drive and regen unit at the ++ and - - terminals at both units. **Ensure the regen unit is regenerating properly, is in regen status when it should be and there are no faults on the regen unit preventing operation.** If the over voltage is due to transient voltage spikes from the line: Install a 3-5% line reactor If the over voltage is due to high line voltage: Step-down down the line voltage with a transformer. If there is an issue with the DC bus voltage measurement circuit: ...continued on next page.

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Error Over Voltage (continued)	EOP (1)		Measure DC bus directly and verify against DC bus voltage read from the Diagnostics screen. The DC bus should be approximately 1.41xAC Input phase-to-phase. If a braking resistor is used and there is an issue with the braking transistor: Test the braking transistor. (See Appendix) If there is an issue due to high frequency noise: Verify proper mains grounding.
Error Power Unit	EPU (12)	General power circuit fault	Inverter must be inspected and repaired by KEB or replaced.
Error Power Unit Changed	EPuch (50)	The control card recognizes a new power stage (the control card was changed).	This error should automatically clear itself.
Error Power Unit Invalid	EPuci (49)	During the initialization the power circuit could not be recognized or was identified as invalid	This error could occur from noise. Disconnect terminal strip, encoder cable and serial comm. (if used) and power cycle the drive. Check phase-to-phase and phase-to-ground line voltages to make sure they are balanced and not causing noise. Re-seat ribbon cable connecting control card to power stage.
Error Rotor Learn Deviation	(168)		When LE07 Rotor Detection Mode = NOP and LX23 Encoder Deviation Enable = On with Error. Learned encoder pole position and average encoder position having a difference value greater than LX22 Encoder Deviation Value Refer to Encoder slippage/mounting problems in Section 5.3 for additional information.

Drive Faults

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Error Rotor Learn COM	(169)	-	When Error Rotor Learn Deviation occurs 10 times. Refer to Error Rotor Learn Deviation Causes for additional information.
Error Under Voltage	EUP (2)	The DC bus voltage drops below the permissible value. For 460V drives, the under voltage level is 240VDC and for 230V drives, the under voltage level is 216VDC. The under voltage level cannot be adjusted.	Causes for under voltage include: Input voltage too low or unstable. Verify input voltage and wiring. The DC bus should measure approximately 1.41 x AC Input phase-to-phase and should match the DC bus measurement by the drive in the Diagnostics Menu. One phase of the line input is missing. Line input phases are imbalanced. The phase-to-phase voltage measurement should not exceed 2%. Isolation transformer undersized or wired incorrectly. If there is an issue with the DC bus voltage measurement circuit: Measure DC bus directly and verify against DC bus voltage read from the Diagnostics screen. The DC bus should be approximately 1.41xAC Input phase-to-phase. Note: A 460V drive can operate on a 230V, single phase power supply if programmed for UPS mode operation.
ESD Input Failure*	- (160)	ESD input missing.	When an input programmed as ESD (Emergency Slowdown) in LI04-11 is not present (high) at the beginning of run. Refer to additional information at end of section.
ETS Input Failure*	- (154)	ETS input missing.	When an input programmed as ETS (Emergency Terminal Slowdown) in LI04-11 is not present (high) at the beginning of run. Refer to additional information at end of section.
Main Contact Failure*	- (150)	Motor contactor not closed	When an input programmed as Main Contactor Check in LI04-11 not present (high) at the beginning of run. Refer to additional information at end of section.

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
no Error Low Speed Over-load	nEOL2 (20)	No more over-load.	Low speed overload has cleared and can be reset.
no Error Motor Overheat	nEdOH (11)	Over temperature reset possible	Motor overheat sensor reset and Error Motor Overheat can be reset.
no Error Over-load	nEOL (17)	No more over-load.	Overload counter has reached 0%, allowing motor to cool and the error overload error may be reset.
Power Unit Not Ready	no_PU (13)	Control card is powered up, but the power stage is not, so conse-quently it is not seen by control card.	The Power Unit Not Ready message may occur due to the following conditions: Control card powered up by external power supply, but drive is not powered up by line. Since the drive is not being powered by the line, the power stage cannot be identified. Connection issue between control card and power stage. For inverter housing sizes G, H, R, U, remove then reconnect the ribbon cable connecting the control card to the power stage at the control card connec-tion. For inverter housing sizes D, E, remove the control card then re-seat, ensuring pin connections. Switching power supply. If reseating the ribbon cable does not resolve the issue, then there may be a failure of the switching power supply and the drive would need to be re-placed or inspected and repaired by KEB.
Serial Com-mand Speed Error	(166)	Serial speed command not present at the be-ginning of a run	When US04 = Serial Speed DIN66019 Service 49 (4), Serial Speed DIN66019 Service 50 (5), the speed com-mand must be received within t=2.5(LT01+LT03) sec. at beginning of run. Not active on inspection run.Refer to additional information at end of section

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Speed Following Error	- (152)		The encoder speed deviates from the command speed by more than the amount set in LX14 Speed Difference for more than 1 second (fixed). The Speed Following Error can be ignored as a drive fault by setting LX13 Speed Following Error = Warning - Digital Output (if any of the outputs LO05, 10, 15, or 20 are set for At Speed, the controller may still generate a fault). Possible causes of a speed following error include: Lack of control Maximum Torque limit or peak inverter current reached. Monitor the motor current to see if it reaches a current corresponding to the LC30 Maximum Torque or the drive Peak Current rating. Maximum Torque may be set too low (default = 150%; Typical for high speed/full load operation = 200-250%) Excessive current Incorrect motor data, specifically the motor rated speed and frequency relationship (Diagnostic Screen #12) for PM Synchronous Motors (see Section 4.5.2, LM02 or LM04 for details). Incorrect Encoder Pole Position for PM Synchronous Motors. Relearn Encoder Pole Position as needed (refer to Section 4.10.1 or 4.10.2). ...continued on next page.

Error/Message	Alt. / (NUM)	Description	Cause/Solution/Troubleshoot
Speed Following Error (continued)	- (152)		Speed gains set too low. If the speed following error occurs during acceleration or deceleration, the speed tracking may lag if the speed control gains are too low. Increase corresponding proportional speed gain for acceleration or deceleration. Learn system inertia. If the speed following error occurs at takeoff, there may be high break away friction. Increase LC11 KI Speed Offset Acceleration. Mechanical Issues/High Friction. Modulation grade exceeds maximum. If the modulation grade in Diagnostic Screen #2 or DG10 exceeds 100% there may be a loss of speed control. This may also prevent the motor from reaching the command speed.
Speed Selection Error*	- (153)	Speed command input missing at beginning of run.	For digital, binary and serial binary input speed selection control modes, the Speed Selection Error is triggered if a speed input is not given before the LT01, LT03 timers expire. These timers start after the drive enable and direction have been given. Not active on inspection run. Refer to additional information at end of section.
Unintended Movement*	- (158)	After a normal high speed run, if the motor moves by more than the value set in LX25 then Unintended Movement will occur and can only be reset manually by pressing F1 and F4 simultaneously on the keypad.	Unintended Movement is not monitored from inspection speed selection. For analog and serial speed control modes, an input can be programmed to indicate inspection runs. Refer to additional information at end of section.

5.2.1. Additional Information

Analog Signal Failure

The Analog Signal Failure event will occur when no speed command is given within a certain time period at the beginning of a run with external profile pattern generation US04 Control Type = Analog (2,3) modes, and Serial (4,5) modes

The timer is defined as:

t = 2.5 x (LT01 + LT03)
= 2.5 x (Brake Release Delay + Speed Start Delay)

Default = 2.5 x (0.05s + 0.70s) = 1.875s

Maximum: 20.0 seconds

While the inspection bit is active (field-bus control word or digital input) the zero-speed timer is ignored. If the inspection bit is released after 20 seconds, the *Analog Signal Failure* or *Serial Command Speed* fault will occur as a typical zero-speed timeout fault. If a speed command is detected during the LT03 Speed Start Delay, the timer will automatically expire at the phase of the profile where pre-torque speed control gains (LC05, 10) are active and the drive will switch to the acceleration phase (LC03, 08, 11).

Brake Switch Failure

When a digital (LI04-11) or serial (Fb21-27) input is programmed for Brake Release Confirmation (18), the drive checks if the brake opens or closes within a set amount of time. The timers are defined as:

Starting:

t = LT01 + LT03 + 2.5
= Brake Release Delay + Speed Start Delay + 2.5s

Default = 0.05s + 0.70s + 2.5s = 3.25s

Stopping:

t = LT10 + LT12
= Brake Drop Delay + Current Hold Time

Default = 0.10s + 0.50s = 0.60s

Two inputs can be programmed for the brake switch. During stop, the switches should be closed and open during run. If the brake switch is open during the Idle Mode, then the Brake Switch Failure event will also occur. If during the run, the brake switch closes, the Brake Switch Failure event will not occur.

Direction Selection Failure

The Direction Selection Failure will occur if both direction inputs are signaled when the Drive Enable is initially signaled at the beginning of a run.

Drive Enable Dropped

Whenever the drive enable is dropped, output current will instantly be shut off. If the drive enable is dropped any time during the course of a normal run a Drive Enable Dropped event is logged.

A normal run is considered any run profile that is not inspection. A Drive Enable Dropped event will not occur on an inspection run.

- For US04 Control Type = Binary Speed (1), Digital Speed (0) Selection, or Serial Binary Speed DIN66019 Serv. 50 (6), the speed signaled for inspection speed must match the corresponding inspection speed according to the LI03 Speed Input Decoding.
- For US04 Control Type = Serial or Analog, a run is considered an inspection run when the digital input (LI04-11) programmed as Inspection Speed (32) is on for the length of the entire run.

If a Drive Enable Dropped event occurs, a potential ensuing Unintended Movement event will not be logged.

ESD/ETS Input Failure

When a digital (LI04-11) or serial (Fb21-27) input is programmed for Emergency Slowdown (ESD) or Emergency Terminal Slowdown (ETS), the input must be active at the start of a run, otherwise an ESD or ETS Input Failure event will occur.

Main Contact Failure

When a digital (LI04-11) or serial (Fb21-27) input is programmed for Main Contactor Check (19), the drive checks for the signal that the contactor has closed at the beginning of a run. If not, the Main Contact Failure event will occur.

NTS Input Failure

When a digital (LI04-11) or serial (Fb21-27) input is programmed for Normal Terminal Slowdown (NTS), the input must be active at the start of a run, otherwise an NTS Input Failure event will occur.

Speed Selection Error

The Speed Selection Error event will occur when no speed command input is given within a certain time period at the beginning of a run with US04 Control Type = Binary Speed (1), Digital Speed (0), or Serial Binary Speed (6). The speed inputs must be selected before the expiration of LT03 + 20 seconds. Toggling the speed before this does not reset the timer and does not have any effect; the speed command must be present at the expiration of the timers.

The timer is defined as:

t = LT03 + 20.0 seconds
= Speed Start Delay + 20.0 seconds

Default = 0.70s + 20.0s = 20.7s

This timer is not active during an inspection run. Speed Selection Error will not occur.

The default setting for programmable digital inputs (LI04-11) is No Function (Off). Likewise, for Serial Binary Speed control (US04 = 6) the (Fb21-27) serial inputs are also set as No Function (Off) by default. The inputs must be assigned accordingly for Speed Selection (27).

Serial Command Speed Error

The Serial Command Speed Error event will occur when no speed command is given within a certain time period at the beginning of a run with external profile pattern generation US04 Control Type = Serial (4,5) modes. The speed pattern must be received before the expiration of LT03 + 20 seconds.

The timer is defined as:

t = LT03 + 20.0 seconds
= Speed Start Delay + 20.0 seconds

Default = 0.70s + 20.0s = 20.7s

If a speed command is detected during the LT03 Speed Start Delay, the timer will automatically expire at the phase of the profile where pretorque speed control gains (LC05, 10) are active and the drive will switch to the acceleration phase (LC03, 08, 11).

This timer is not active during an inspection run. Serial Command Speed Error will not occur.

Unintended Movement

The Unintended Movement event occurs when the difference between the motor position during idle after a normal run, changes by more than the value set in parameter LX25 Unintended Motion Distance. The event is logged and requires a forced reset.

A normal run is considered any run profile that is not inspection. An Unintended Movement event will not occur after an inspection run.

- For US04 Control Type = Binary Speed (1), Digital Speed (0) Selection, or Serial Binary Speed DIN66019 Serv. 50 (6), the speed signaled for inspection speed must match the corresponding inspection speed according to the LI03 Speed Input Decoding.
- For US04 Control Type = Serial or Analog, a run is considered an inspection run when the digital input (LI04-11) programmed as Inspection Speed (32) is on for the length of the entire run.

After a normal run, the motor position is determined after the Brake Control output conditions have set and the Enable input has been dropped. During idle until the next normal run, the motor position is compared against the level set in LX25 before an Unintended Movement event occurs. The level of comparison can be adjusted and the function can be turned off in Special Functions, LX21. The Elevator Position can be monitored in Diagnostics Screen #10 or DG04. Since the motor position is determined from the motor encoder, movement of the elevator car itself from rope stretch, etc., would not cause an Unintended Movement event.

Once an Unintended Movement event has occurred, a forced reset is required by simultaneously pressing the F1 and F4 hotkeys on the keypad operator. The event cannot be cleared by signaling the reset on the drive or cycling power.

If the cause of unintended movement is from the drive enable being dropped, then a Drive Enable Dropped event will occur instead of Unintended Movement.

The Unintended Movement Function can be turned off with LX21 Unintended Movement OFF.

No Visible Change When Adjusting LM07

If no visible change is seen when adjusting LM07 (motor torque), use the NUM function to change the number.

1. Go to the parameter to be changed.
2. Press Enter to enter Edit mode.
3. Press F4 for NUM.
4. Change the number using the arrow and function keys (F2 = change digit left; F3 = add decimal; F4 change digit right)
5. Press Enter to save values.
6. Press Escape to go back to parameter list.

5.3. Operation Problems

Troubleshooting Operation Problems and potential solutions. Refer to Section 5.4 for additional Diagnostics Solutions. Additional troubleshooting of learn procedures are listed as well at the end of this section.

Problem	Cause/Solution/Troubleshoot
Motor Does Not Move	**Check the Motor Current. Refer to Motor Draws High Current for additional troubleshooting.** Make sure the brake is picking and/or not dragging. Make sure speed is set correctly in LS02. Check the Inverter Status to determine whether there is indication a run command is being given (i.e. Up/Down Constant Speed/Acceleration/Deceleration, etc.). Check Input Status to determine whether the correct inputs are being signaled for a run command. Check the Command Speed to determine what the dictated speed command is. Check the Active Speed and Active Profile to determine what speed setting is being selected. For digital inputs, check setting of the selected Active Speed or Active Profile. For analog speed commands, check the Raw and Processed (Analog) Patterns, the High Speed setting, and speed settings for any Active Profile. Check to make sure the speed control gains (KP, KI Offset) are not set too low. For open loop induction motors, the Low Speed Torque Boost may need to be increased to lift the load or decreased if either the Maximum Torque of Inverter Peak Current limit is reached.

Problem	Cause/Solution/Troubleshoot
Motor Draws High Current	Verify correct motor data. For PM motors, verify the correct relationship between the Motor Rated Speed, Motor Rated Frequency and the number of motor poles (Diagnostic Screen #12). Refer to the text for further description. Perform a Motor Learn if this has not already been completed. **For PM motors, verify the encoder/motor pole position is correct. Make note of the present LE06 Encoder Pole Position value and re-learn as needed. Refer to Encoder slippage/mounting (PM motors) for additional information.** **For PM motors, the encoder channel A/B phasing (LE03 Swap Encoder Channels) must be correct and the encoder/rotor position learned with the correct setting. The correct A/B phasing can be determined by the LL07 Encoder Synchronization procedure.** For induction motors, set LC01 Control Mode to Open Loop V/Hz to determine if the issue is due to encoder, encoder settings or speed control settings. For open loop induction motors, the Low Speed Torque Boost may need to be decreased or increased. **Verify the brake picks and does not drag and that there are no other mechanical issues preventing the motor from rotating freely.**

Operation Problems

Problem	Cause/Solution/Troubleshoot
Encoder slippage/mounting (PM motors)	The position of the rotor must be known for synchronous (PM) motors for the drive to properly commutate the stator magnetic field and generate torque. Performing a encoder/rotor position learn (LL05 SPI or LL06 Encoder Pole Position Learn) determines a corresponding encoder position offset value for a given rotor position. The encoder is a mechanical extension of the rotor and therefore acts as an electrical commutator. If the **mechanical relationship** (eg. mounting) between the motor and encoder changes (eg. slippage), the position information from the encoder does not accurately reflect the actual rotor position resulting in the actual commutation angle being incorrect. When the commutation angle is not correct, more current is required to produce a given amount of torque. Large enough changes will result in very high current draw and low torque production. This leads to the motor being unable to move (stalling) or unable to hold the load (movement in direction of load, eg. empty car counter weights pull car up). In this case, the current is often reaching the corresponding LC30 Maximum Torque limit or the peak current rating of the drive, **If the encoder/rotor position is re-learned and determined to be different than the previous value of the LE06 Encoder Pole Position by more than 2,000 counts**, then this is a clear indication that the **mechanical relationship between the motor and encoder has changed**. **In most cases, encoder slippage has occurred or there is an encoder mounting issue**. The accumulation of slippage may occur over distance (between a few inches to the entire hoistwaydistance), over time (sometimes after several years of operation), or from a change in direction (sometimes due to loose encoder mounting). The suggested course of action is to first inspect the encoder mounting (in many cases, the encoder may actually be mounted tight), remove the encoder and inspect again, and re-install the encoder then relearn the encoder position. If issues persist, re-learn the encoder/rotor position. If large difference between learns persist (it is important to move car between learns to accumulate slippage, if this is the issue), continue to inspect the motor and encoder for mounting issues, or replace the encoder as a last resort.

Problem	Cause/Solution/Troubleshoot
Motor does not go the correct speed or cannot reach high speed.	**Check whether the Command Speed and Encoder Speed match (Home Screen or Diagnostics Screen #1). .** Verify whether the Motor (Encoder) Speed is tracking the Command Speed. Check which Active Speed and/or Active Profile is selected. Check the speed setting for the corresponding Active Speed/Active Profile selected. Check whether the Machine Data parameters (LN) are set correct. Check whether the (Voltage) Modulation Grade is reaching 100%. Refer to Voltage Modulation Grade limit reached for further troubleshooting. Check whether the Maximum Torque Limit or Inverter Peak Current limit are being reached. Check if the speed control gains (KP Proportional, KI Integral Offset) are set too low.
Overshoot into floor	**Check the motor current, whether the Maximum Torque Limit or Inverter Peak Current limit are being reached**. Check whether the Motor (Encoder) Speed is tracking the Command Speed. Check if the speed control gains (KP Proportional, KI Integral Offset) are set too low. Raise as needed.
Cannot lift full load	**Check the motor current, whether the Maximum Torque Limit or Inverter Peak Current limit are being reached. Refer to Motor Draws High Current for additional troubleshooting.** Check if the speed control gains (KP Proportional, KI Integral Offset) are set too low. For open loop induction motors, the Low Speed Torque Boost may need to be increased or decreased if reaching the Maximum Torque Limit or Inverter Peak Current.

Operation Problems

Problem	Cause/Solution/Troubleshoot
Motor only moves one direction; direction of weighting (e.g. counterweights pulling up for empty car)	**Check the motor current. Refer to Motor Draws High Current for additional troubleshooting.** Check the Command Speed for dictated speed direction and whether it changes between directions.
Motor only moves slightly or jerks briefly	**Check the motor current. Refer to Motor Draws High Current for additional troubleshooting.** Refer to Motor Does Not Move for additional troubleshooting.
Output current is limited (clamped)	Check the setting for Maximum Torque. Refer to Peak current limit or Maximum Torque limit reached for additional troubleshooting. Verify the current is not being limited by the Inverter Peak Current Limit. Refer to Peak current limit or Maximum Torque limit reached for additional troubleshooting. Check if motor current is excessive. Refer to Motor Draws High Current for additional troubleshooting.
Maximum Torque limit or Peak Current limit reached.	**Check the setting for Maximum Torque. For full load and/or high speed automatic operation, this value should be in the range of 200-250%.** Note, anytime any motor data parameters are changed or re-entered, the Maximum Torque LC30 will automatically be reset to 150% ! Note, anytime a drive and keypad operator are synchronized the Maximum Torque LC30 will automatically be reset to 150% ! Verify the current is not being limited by the Inverter Peak Current Limit. **Check if motor current is excessive. Refer to Motor Draws High Current for additional troubleshooting.**

<table>
<tr><th>Problem</th><th>Cause/Solution/Troubleshoot</th></tr>
<tr><td>Motor noise (Vibration)</td><td>Increase the Sample Rate for Encoder (LE04) from 4ms (default) to 8ms.

Verify correct motor data and whether motor learn has been performed.

Reduce speed control gains (KP Proportional, KI Integral, KI Offset). Note, the default settings for an unroped PM motor may be too high.

For induction motors, set the LC01 Control Mode to Open Loop V/Hz. If the issue is still present, then it is a mechanical issue.

Check whether the (Voltage) Modulation Grade limit is being reached (100% or above). Refer to Voltage Modulation Grade limit reached for further troubleshooting.

If occurs after Inertia/ FFTC Learn with Serial or Analog Speed control reduce LC44 Torque Command Filter.</td></tr>
<tr><td>Motor noise (squealing/grinding sound), but not vibration; does not affect ride quality</td><td>Check whether the Sample Rate for Encoder (LE04) is too high or too low; 4-8ms is typical.

Check whether the setting for Encoder Multiplier Factor (LE05) is correct. For TTL incremental encoder, this value can only be set to a value of 2; for absolute encoders (e.g. EnDat) typically found on PM motors, the setting should be a value of 8.

Verify correct motor data. Re-enter as needed.

Perform a motor data learn if not yet completed.</td></tr>
<tr><td>Unable to run induction motor in open loop.</td><td>For open loop induction motors, the Low Speed Torque Boost may need to be decreased or increased.

Verify there are no mechanical issues preventing the motor from rotating freely.</td></tr>
</table>

Operation Problems

Problem	Cause/Solution/Troubleshoot
(Voltage) Modulation Grade limit Reached	**Verify correct wiring of the motor**, in particular with motors which have multiple voltage winding arrangements (eg. dual rated 230/460V motors, wye-star/delta) For IM motor, reduce the Field-Weakening Corner LM24 to 60% of synchronous speed (720-480 rpm for 6-pole/60 Hz motor). A setting of 45% of synchronous speed should be used as the practical lower limit of this parameter. For IM motor, try reducing Field Weakening Speed LM25 in steps of 100RPM. For PM motor, check the current, particularly the peak current during acceleration. Refer to Motor Draws High Current for additional troubleshooting. Reduce the acceleration and jerk rates into high speed. Verify there is not excessive sag of the DC bus during acceleration.
Motor turns in the wrong direction (both directions)	Perform Encoder Synchronization procedure. **Inverter directions via LE03. Note, do not change A-B settings (Not inverted/Swap A-B) to invert direction.** For PM motors, do not change (U,V,W) motor phasing !
Clunk at end of run after brake sets	Verify drive enable input is not being dropped prematurely while drive is still outputting torque to motor. Adjust LT12 Current Hold and/or LT13 Current Ramp Down timers.
High peak current at either start or stop	Check the brake timing such that the motor is not starting against the brake and that the brake is not stopping the load. For digital input speed control, the Speed Start Delay LT03 can be extended to prevent starting under the brake. For analog and serial speed controls, this may need adjustment on the controller.
Erratic / glitching behavior of keypad or drive	Ensure the keypad is securely connected to the drive. Press on the keypad until a click or snap is heard. Load US05 - write configuration to the drive.

5.4. Diagnostic Solutions

Typical solutions in reference to operational problems in section 5.3.

Item #	Check/Solution
Monitor the Input Status to Determine Active Speed and/or Active Profile (digital input control modes)	For the given combination of inputs selected, verify which speed command is selected according to the Control Type (US04) and Special Input Functions (LI03). This should match the Active Speed (Diagnostics Screen #10). Verify the corresponding speed setting in the Speed Profile (LS) parameter group. In addition, monitor the status of inputs assigned as any special operation modes (e.g. Earthquake Speed, UPS/Battery Operation Speed, Emergency Power Speed) assigned to any inputs (LI04, 05, 11).
Determine the correct motor speed in rpm.	For a given command speed in FPM, the corresponding speed in rpm is calculated as: Digital Input Speed Commands: RPM = (12 * Roping Ratio * Gear Ratio * FPM) / (Sheave Diameter * 3.14) Analog Speed Control: RPM = (Processed Analog Pattern * High Speed *12 * Roping Ratio * Gear Ratio * FPM) / (Sheave Diameter * 3.14 * 100) Refer to Analog I/O (LA) parameter group for calculation of Processed (Analog) Pattern from Raw (Analog) Pattern.

Diagnostic Solutions

Item #	Check/Solution
Monitor the Command Speed and Motor (Encoder) Speed	If the Command Speed and Motor (Encoder) Speed match, but the elevator does not travel at the correct speed: Check Active Speed and Active Profile from Diagnostics and check whether the corresponding speed setting in the LS parameters is correct. Refer to Monitor the Active Speed and Active Profile for additional info. Ensure the Machine Data parameters LN01-03 are correct. Incorrect data may cause the elevator to run too fast or too slow. Refer to LN parameter descriptions for further information. If the US04 Control Type is analog type, verify correct US06 Contract Speed and LS02 High Speed settings. US06 Contract Speed dictates the maximum setting for the LS02 High Speed and the LS02 High Speed dictates the speed corresponding to 10V. If the US04 Control Type is analog type, verify the correct Raw and Processed (Analog) Patterns in Diagnostics Screen #5 as well as any Analog Pattern Gain in LA05. If the US04 Control Type is serial type, verify the correct Field Bus Control Word and Raw Com Data in Serial Diagnostics Screen as well as proper field bus configuration (Refer to FB parameter descriptions for further information. If the Command Speed and Motor (Encoder) Speed do NOT match: See Check whether Maximum Torque setting is reached and high enough for normal operation. See Check whether Inverter Maximum Current Limit is being reached. See (Voltage) Modulation Grade limit Reached
Monitor the Active Speed and Active Profile (Diagnostic Screen #11)	The Active Speed will indicate which speed setting is selected according to the US04 Control Type and LI03 Special Functions. The Active Profile will indicate if any modes of operation (eg. UPS Operation, Earthquake, Emergency) corresponding to programmed input functions (LI04-11) are active. In the case of certain modes of operation, the maximum speed may be limited to a speed lower than that selected and show as the Active Speed (above).

Item #	Check/Solution
Verify correct Machine Data (LN) parameter settings.	The Machine Data parameters are used as a scalar to translate the command speeds programmed in FPM to an rpm value used by the drive. Incorrect setting of the machine data parameters may cause the command speed in rpm to be too high or too low. For example, if a machine has a 1:1 roping ratio, then setting this value in the drive as 2 (:1) will cause the speeds to be calculated as twice as fast. If the Motor (Encoder) Speed matches the Command Speed (rpm), but the calculated Elevator Speed or the actual speed measured by hand tach (FPM) are slightly off, then the Machine Data can be adjusted slightly so the numbers agree. This would typically be done by adjusting the Gear Reduction Ratio (LN02) or the Traction Sheave Diameter (LN01). Refer to Determine the Correct Motor Speed in RPM for further details.
Encoder/Motor Pole Position Incorrect	For PM motors, the absolute encoder position is used to properly indicate the position of the rotor. If the connection of the encoder to the motor shaft changes (removed/replaced, slippage, etc.), the absolute encoder position relative to the motor poles is no longer valid and will require the position to be relearned. **If the LE06 Encoder Pole Position has changed by more than 2,000 from the previous value, this indicates a change in physical position relation of the encoder to the rotor, generally due to encoder slippage over time (potentially distance or change in direction as well), mounting issues, or mechanical aspects.** When the encoder/motor pole position is incorrect, the motor will tend to draw high current, hitting the LC30 Maximum Torque setting or Inverter Peak Current Limit, and tending to stall or only move in the direction of weighting.
Motor Data Incorrect	Check the motor data against the nameplate values and perform a LL01 Motor Tune if not previously completed. For PM motors, ensure the relationship between the motor rated speed, motor rated frequency and number for motor poles is correct in case of any nameplate rounding. Refer to the LM02 Motor Speed for further details.

Item #	Check/Solution
Check whether Maximum Torque setting is reached and high enough for normal operation.	The LC30 Maximum Torque is used to limit the output current to the motor. It is primarily to protect the motor from extreme or prolonged high currents, which may occur during initial setup or troubleshooting. The limiting current can be calculated as LM07 Motor Torque x LC30 Maximum Torque (%) / LM03 Motor Current. Under normal operation, this will typically need to be set in the range of 200-250%. Anytime any of the LM Motor Data parameters are changed, the LC30 Maximum Torque will be reset to 150%. This may be too low for normal, automatic operation. Anytime a keypad operator and drive are synched, the LC30 Maximum Torque will be reset to 150%. This may be too low for normal, automatic operation. The maximum output current rating of the inverter will be the limiting factor, if reached. The LC30 Maximum Torque setting will not provide a current beyond the drive's peak rating. If the maximum torque limit is being reached, this may be due to: Incorrect Motor Data. Refer to Motor Data Incorrect for additional information. Encoder Position Incorrect. Refer to Encoder/Motor Pole Position Incorrect Mechanical Issues (eg. Brake not releasing) For open loop induction motors, the LC32 Low Speed Torque Boost may be too high or too low.

Item #	Check/Solution
Check whether Inverter Maximum Current Limit is being reached.	The drive will limit the maximum current to the inverter's peak current rating. Refer to Section 2.4 and 2.5 for ratings. If the peak current limit is being reached, this may be due to: Incorrect Motor Data. Refer to Motor Data Incorrect for additional information. Encoder Position Incorrect. Refer to Encoder/Motor Pole Position Incorrect Mechanical Issues (eg. Brake not releasing) For open loop induction motors, the LC32 Low Speed Torque Boost may be too high or too low.

5.5. Learn Procedure Troubleshooting

Problem:	Troubleshoot:
Unable to start learn procedure.	Check input signals: The Motor Tune, SPI, and the Encoder Pole Position Learn only require the Drive Enable (I7) to begin (for serial speed control modes, this includes the enable of the Control Word). The Encoder Synchronization and Inertia Learn require a run command (Drive Enable, Direction, and speed command).
Unable to complete learn procedure successfully	If 'Measurement Stopped by Controller' or 'Measurement Interrupted' is displayed, this indicates the Drive Enable (I7) input was dropped during the procedure. User dropped the run command. Controller dropped the run command. Controller timeout due to run command and no movement. Controller speed following error if controller inspection speed not set to zero. Check Event Log to see if a drive fault occurred and troubleshoot the fault as necessary.

Problem:	Troubleshoot:
Unable to complete SPI procedure successfully	Ensure correct motor data and that a Motor Tune has been completed. During the procedure, if a ‘Values are not consistent’ is displayed, then a learned value falls out of range of the average of previous values and the process will not complete successfully, but can be done again as necessary. If the LE03 Swap Encoder Channels setting for whether A/B Channels Swapped is incorrect, this may cause more variance in the encoder/pole position samples. High motor inductance (> 100mH) values may have more variance in the encoder/pole position samples. The drive should automatically determine the correct LE07 Rotor Position Mode based on the learned motor data. It may be possible to try the other setting. If “Error Calc. Motor Data” occurs, change LM27 from Ld <> Lq to Ld = Lq. This may provide better results.
Unable to complete Encoder Synchronization procedure successfully	The motor must be able to run normally during this procedure. Check for any mechanical issues preventing movement. Ensure current is not excessive; if so, troubleshoot as necessary. For PM motors, the LE03 Swap Encoder Channels setting for the A/B phasing must be correct, which cannot be determined from the SPI procedure. If the SPI procedure was used to learn the encoder/pole position, change LE03 as needed and relearn encoder/pole position with SPI again before doing the Encoder Synchronization procedure. For Induction motors, the motor must be able to run in open loop. Adjust the LC32 Low Speed Torque Boost as necessary. If unable to run the car in the down direction as described in the procedure because it is at or near the bottom terminal limit, run the car in the up direction instead. When prompted with whether or not the elevator traveled in the down direction, answer No if it did and Yes if it didn’t.

Learn Procedure Troubleshooting

Problem:	Troubleshoot:
Unable to complete Encoder Pole Position Learn successfully	Ensure brake picks and the sheave is free to move relatively easily; should be able to rotate by hand. If the displayed position does not appear to change and the sheave does not move back and forth by a few inches, then the sheave is unable to move freely and the procedure cannot be complete. Ensure correct motor U, V, W phasing.

5.6. v1.72 Crossover Reference

v1.72 Parameter	Description		v3.33 Parameter	v3.33 Description
LF.2	Steering Mode		US04	Control Type
LF.3	Drive Configuration		LL01-10	Tuning Parameters
	Run		-	
	config		-	
	Stop (Econfig)		-	
	S Lrn		LL01	Motor Tuning
	I Lrn		LL10	Inertia Learn
	P Lrn		LL06	Encoder Pole Position Learn
	SPI		LL05	SPI
LF.4	Motor Mode		-	
LF.5	Auto Reset		LX01	Auto Reset
LF.8	Electronic Motor Protection		LM08	Electric Motor Protection
LF.9	Electronic Motor Protection (IM)		LM09	Electric Motor Protection Current
LF.9	Peak Current Limit (PM)		LM11	Peak Motor Current Factor
LF.10	Rated Motor Power		LM01	Motor Power
LF.11	Rated Motor Speed		LM02	Motor Speed
LF.12	Rated Motor Current		LM03	Motor Current
LF.13	Rated Motor Frequency		LM04	Motor Frequency
LF.14 (IM)	Rated Motor Voltage		LM05	Motor Voltage
LF.14 (PM)	VAC(rms) at Rated Speed		LM05	Motor Voltage
LF.15	Power Factor		LM06	Motor Power Factor
LF.16	Field Weakening Speed		LM24	Field Weakening Corner
LF.17	Rated Motor Torque		LM07	Motor Torque
LF.18	Motor Resistance		LM21	Motor Rs
LF.19	Motor Inductance		LM20	Motor Ls
LF.20	Contract Speed		US06	Contract Speed
LF.21	Traction Sheave Diameter		LN01	Traction Sheave Diameter
LF.22	Gear Reduction Ratio		LN02	Gear Reduction Ratio
LF.23	Roping Ratio		LN03	Roping Ratio
LF.24	Load		LN04	Load
LF.25	Estimated Gear Ratio		LN05	Estimated Gear Ratio
0.LF.26	Encoder Feedback Interface		LE01	Encoder 1 Interface
1.LF.26	Encoder Type		LE11	Serial Enc. 1 Type
2.LF.26	Encoder Status		LE12	Serial Enc. 1 Status
3.LF.26	Read/Write Encoder		-	
LF.27	Encoder Pulse Number		LE02	Encoder Pulse Number
LF.28	Swap Encoder Channels		LE03	Swap Encoder Channels
LF.29	Sample Rate for Encoder		LE04	Sample Rate for Encoder
LF.30	Control Mode		LC01	Control Mode
A.LF.31	KP Speed (Accel)		LC03	KP Speed Acceleration
d.LF.31	KP Speed (Decel)		LC04	KP Speed Deceleration

v1.72 Crossover Reference

v1.72 Parameter	Description		v3.33 Parameter	v3.33 Description
P.LF.31	KP Speed (Pre-torque)		LC05	KP Speed Pretorque
A.LF.32	KI Speed (Accel)		LC08	KI Speed Acceleration
d.LF.32	KI Speed (Decel)		LC09	KI Speed Deceleration
P.LF.32	KI Speed (Pre-torque)		LC10	KI Speed Pretorque
A.LF.33	KI Speed Offset (Accel)		LC11	KI Speed Offset Acceleration
d.LF.33	KI Speed Offset (Decel)		LC12	KI Speed Offset Deceleration
0.LF.36	Maximum Torque		LC30	Maximum Torque
1.LF.36	Maximum Torque (Emergency)		LC31	Reduced Maximum Torque
LF.37	Low Speed Torque Boost		LC32	Low Speed Torque Boost
LF.38	Switching Frequency		LX02	Switching Frequency
LF.41	Leveling Speed		LS01	Low Speed
LF.42	High Speed		LS02	High Speed
LF.43	Inspection Speed		LS03	Inspection Speed
LF.44	High Leveling Speed		LS04	Correction Speed
LF.45	Intermediate Speed 1		LS05	Intermediate Speed 1
LF.46	Intermediate Speed 2		LS06	Intermediate Speed 2
LF.47	Intermediate Speed 3		LS07	Intermediate Speed 3
0.LF.50	Start Jerk (High, Int.1-3 Speeds)		LS21 LS31	Start Jerk High Speed Start Jerk One Floor
1.LF.50	Start Jerk (Inspection, High Level)		LS51	Start Jerk Inspection
2.LF.50	Start Jerk (Emergency)		LS41	Start Jerk Emergency
0.LF.51	Acceleration (High, Int.1-3 Speeds)		LS20 LS30	Acceleration High Speed Acceleration One Floor
1.LF.51	Acceleration (Inspection, High Level)		LS50	Acceleration Inspection
2.LF.51	Acceleration (Emergency)		LS40	Acceleration Emergency
0.LF.52	Acceleration Jerk (High, Int.1-3 Speeds)		LS22 LS32	Accel. Jerk High Speed Accel. Jerk One Floor
1.LF.52	Acceleration Jerk (Inspection, High Level)		LS52	Accel. Jerk Inspection
2.LF.52	Acceleration Jerk (Emergency)		LS42	Accel. Jerk Emergency
0.LF.53	Deceleration Jerk (High, Int.1-3 Speeds)		LS24 LS34	Decel. Jerk High Speed Decel. Jerk One Floor
1.LF.53	Deceleration Jerk (Inspection, High Level)		LS54	Decel. Jerk Inspection
2.LF.53	Deceleration Jerk (Emergency)		LS44	Decel. Jerk Emergency
0.LF.54	Deceleration (High, Int.1-3 Speeds)		LS23 LS33	Deceleration High Speed Deceleration One Floor
1.LF.54	Deceleration (Inspection, High Level)		LS53	Deceleration Inspection

v1.72 Parameter	Description		v3.33 Parameter	v3.33 Description
2.LF.54	Deceleration (Emergency)		LS43	Deceleration Emergency
0.LF.55	Flare Jerk (High, Int.1-3 Speeds)		LS25 LS35	Stop Jerk High Speed Stop Jerk One Floor
1.LF.55	Flare Jerk (Inspection, High Level)		LS55	Stop Jerk Inspection
2.LF.55	Flare Jerk (Emergency)		LS45	Stop Jerk Emergency
LF.56	Stop Jerk		LS43 LS44 LS45	Deceleration Emergency Deceleration Jerk Emergency Stop Jerk Emergency (Final Jerk, All Speeds)
LF.57	Speed Following Error		LX13	Speed Following Error
LF.58	Speed Difference		LX14	Speed Difference
LF.59	Following Error Time		-	
LF.61	Emergency Power Mode		LI04, 05, 11	Input Function 1, 2, 8
LF.62	ETS Speed		LX17	EDS Speed
LF.67	Pre-torque Gain		LA15	Analog Input 2 Gain
LF.68	Pre-torque Offset		LA17	Analog Input 2 Y Offset
LF.69	Pre-torque Direction		-	
LF.70	Speed Start Delay		LT03	Speed Start Delay
LF.71	Brake Release Delay		LT01	Brake Release Delay
LF.76	Encoder Multiplier		LE05	Encoder Multiplier Factor
LF.77	Absolute Encoder Position		LE06	Encoder Pole Position
LF.78	Brake Engage Time		LT12	Current Hold Time
LF.79	Current Ramp Down Time		LT13	Current Ramp Down Time
LF.80	Keypad Operator Software Version		Diag. #9	Operator Software Version
LF.81	Keypad Operator Software Date		Diag. #9	Operator Software Date
LF.82	X2A Input State		Diag. #4	Input Status
LF.83	X2A Output State		Diag. #4	Output Status
LF.86	Operation Phase / Set		Diag. #4	Parameter Set
LF.87	Inverter Load		Diag. #8	Drive Load
LF.88	Motor Command Speed		Home, Diag. #2, 5	Command Speed
LF.89	Actual Motor Speed (Encoder)		Home, Diag. #2, 3	Motor Speed
LF.90	Actual Elevator Speed		Home, Diag. #2, 10	Elevator Speed
LF.93	Phase Current		Home, Diag. #1, 7	Motor Current
LF.94	Peak Phase Current		Diag. #1	Peak Current
LF.95	Actual DC Voltage		Diag. #1	DC Bus Voltage
LF.96	Peak DC Voltage		Diag. #1	Peak DC Volts

v1.72 Crossover Reference

v1.72 Parameter	Description		v3.33 Parameter	v3.33 Description
LF.97	Actual Output Frequency		Diag. #3	Output Frequency
LF.98	Last Fault		Diag. Log	
LF.99	Inverter State		Diag #1-6,10	Inverter Status
Ld.18	Field Weakening Corner		LM25	Field Weakening Speed
Ld.19	Field Weakening Curve		-	
Ld.20	Stator Resistance		LM21	Motor Rs
Ld.21	Sigma Inductance		LM20	Motor Ls
Ld.22	Rotor Resistance		LM22	Motor Rr
Ld.23 (IM)	Magnetizing Inductance		LM23	Motor Lm
Ld.23 (PM)	Maximum Inductance		LM26	Maximum Ls
Ld.24	Motor Control		LM30	Motor Control
Ld.25	Vmax Regulation		LM31	Vmax Regulation
Ld.26	Rotor Position Mode		LM27	Motor Inductance Mode
Ld.27	KP Current		LM32	Kp Current
Ld.28	KI Current		LM33	Ki Current
Ld.29	Acceleration Torque		LC40	Acceleration Torque
Ld.30	System Inertia		LC41	System Inertia
Ld.31	FFTC Filter		LC42	FFTC Filter
Ld.32	FFTC Gain		LC43	FFTC Gain
Ld.33	Torque Command Filter		LC44	Torque Command Filter
US.1	Password		'Pass' hotkey option from Prog. Menu	
US.3	Default All LF Parameters		CH01 US05	Default Parameters Load Configuration
US.4	Load Configuration		US05	Load Configuration
US.10	Select Configuration		US03	Motor Type
US.16	E.OL2 Function		LX07	Carrier Frequency Handling
US.17	Pre-torque Timer Ramp Up		LT02	Control Hold Off
US.18	Pre-torque Timer Ramp Down		-	
US.20	Max. Speed for Max. KI		LC13 LC15	Speed for Max KI Accel Speed for Max KI Decel
US.21	Speed for Min. KI		LC14 LC16	Speed for Min KI Accel Speed for Min KI Decel
US.22	Speed Dependent KP Gain		-	
US.23	Min. KP Gain at High Speed		LC25	KP High Speed
US.24	KD Speed Gain		-	
US.25	Phase Current Check		LX08	Phase Current Check
US.28	Analog Input Noise Clamp		LA04	AnIn 1 Dead Band
US.29	HSP5 Watchdog Time		LX09	SerCom. Watchdog Time
US.33	EdOH Function		LX10	EdOH Function
US.34	Analog Pattern Gain		LA05	AnIn 1 Gain

v1.72 Parameter	Description		v3.33 Parameter	v3.33 Description
US.35	Reference Splitting		LX11	Reference Splitting
US.36	External Serial Comm. Baud Rate		Fb11/LX12	Baud Rate
US.37	Test Function		LX06	Function Test
US.83	Encoder 2 Output PPR		LE35	Encoder Output PPR
US.84	Analog Out 2 Signed		LA36	AnOut2 Function
di.00	Input Type		LI01	Type of Input
di.03	Noise Filter		LI02	Digital Input Filter
do.42	Output Inversion		LO01	Output Inversion
do.80	Output X2A.18		LO05	Output Function O1
do.81	Output X2A.19		LO10	Output Function O2
do.82	Output X2A.24/26		LO15	Output Function RLY1
do.83	Output X2A.27/29		LO20	Output Function RLY2
LP.1	One Floor Positioning		LP01	Position Control
LP.2	Minimum Slowdown Distance		LP02	Minimum Slowdown Distance
LP.3	Slowdown Distance		LP03 LP04	High Speed Slowdown Short Floor Slowdown Distance
LP.4	Correction Distance		LP05	Correction Distance
LP.12	Current Position		Diagnostic Screen #10	Elevator Position
LP.21	Scaling Increments High		LP06	Scaling Increments High
LP.22	Scaling Increments Low		LP07	Scaling Increments Low
LP.23	Scaling Distance		LP08	Scaling Distance
ru.00	Inverter State		DG02	Inverter State
ru.02	Ramp Output Speed		DG03	Command Speed
ru.03	Actual Frequency Display		DG17	Output Frequency
ru.09	Encoder 1 Speed		DG07	Motor Speed
ru.11	Set Torque Display		DG16	Command Torque
ru.12	Actual Torque Display		DG05	Actual Torque
ru.13	Actual Utilization		DG46	Drive Load
ru.14	Peak Utilization		DG47	Peak Load
ru.15	Apparent Current		DG06	Motor Current
ru.16	Peak Apparent Current		DG31	Peak Current
ru.18	Actual DC Voltage		DG08	DC Volts
ru.19	Peak DC Voltage		DG30	Peak DC Volts
ru.20	Output Voltage		DG18	Output Voltage
ru.21	Input Terminal State		DG01/Diag. #4	Input Status
ru.26	Active Parameter Set		DG19/Diag. #4	Parameter Set
ru.27	AN1 Pre-Amplifier Display		DG20/Diag. #5	Raw Pattern
ru.28	AN1 Post Amplifier Display		DG21/Diag. #5	Processed Pattern
ru.29	AN2 Pre-Amplifier Display		DG33/Diag. #5	Raw Pretorque

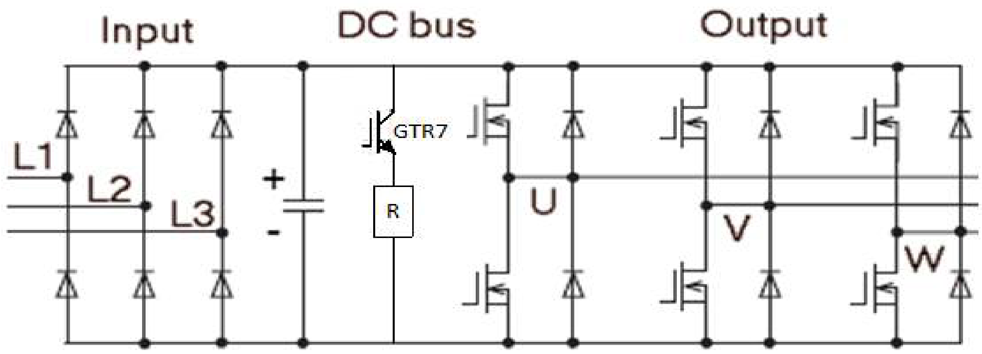
v1.72 Crossover Reference

v1.72 Parameter	Description	v3.33 Parameter	v3.33 Description
ru.30	AN2 Post Amplifier Display	DG34/Diag. #5	Processed Pretorque
ru.34	ANOUT1 Post Amplified Display	DG35/Diag. #6	Analog Output 1
ru.36	ANOUT2 Post Amplified Display	DG36/Diag. #6	Analog Output 2
ru.38	Power Module Temperature	DG37/Diag. #7	Heatsink Temp
ru.39	OL Counter Display	DG45/Diag. #8	Overload Counter
ru.40	Power On Counter	DG43/Diag. #8	Power On Counter
ru.41	Modulation On Counter	DG44/Diag. #8	Run Time Counter
ru.42	Modulation Grade	DG10/Diag. #2	Modulation Grade
ru.45	Actual Switching Frequency	DG39/Diag. #7	Carrier Frequency
ru.46	Motor Temperature	DG38	Motor Temp
ru.54	Actual Position	DG72	Elevator Position
ru.81	Active Power	DG41	Motor Power
ru.85	Peak Encoder 1 Speed	DG32/Diag. #2	Peak Speed
ru.87	Magnetizing Current	DG09/Diag. #1	Magnetizing Current
ru.91	Energy Over GTR7	DG42/Diag. #8	Braking Energy
ru.92	Input Power	DG40/Diag. #7	Electric Power

5.7. Transistor Tests

The input and output circuits of the inverter can be checked externally with the inverter power off and the motor leads disconnected by use of a multi-meter set to **diode check**.

Note: Different drive housings will have different readings. Measured values per housing are given in tables below.

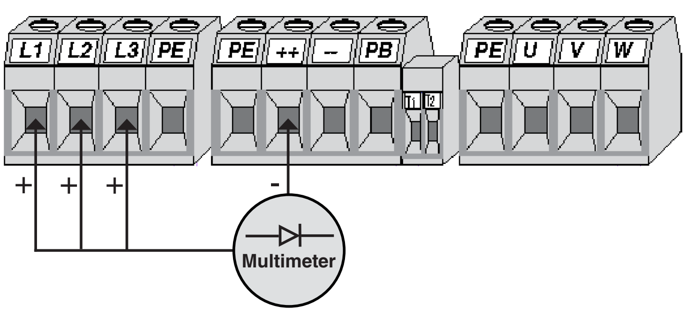


The inverter power must be de-energized and locked out for these tests! Disconnect the mains wiring, motor wiring, and braking resistor from the inverter before taking measurements.

Testing the rectifier, input circuit measurement

Positive Side

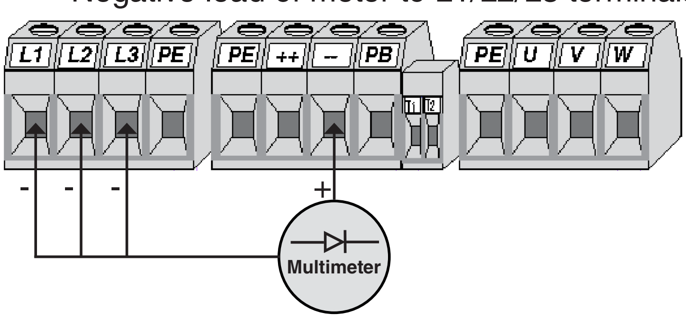
Negative lead of meter to positive DC terminal.
Positive lead of meter to L1/L2/L3 terminals.



E, G, and H Housings					
Measurement	To	Value	Measurement	To	Value
+ Terminal	L1	0.4 - 0.5	- Terminal	L1	0.4 - 0.5
+ Terminal	L2	0.4 - 0.5	- Terminal	L2	0.4 - 0.5
+ Terminal	L3	0.4 - 0.5	- Terminal	L3	0.4 - 0.5

Negative Side

Positive lead of meter to negative DC terminal.
Negative lead of meter to L1/L2/L3 terminals.



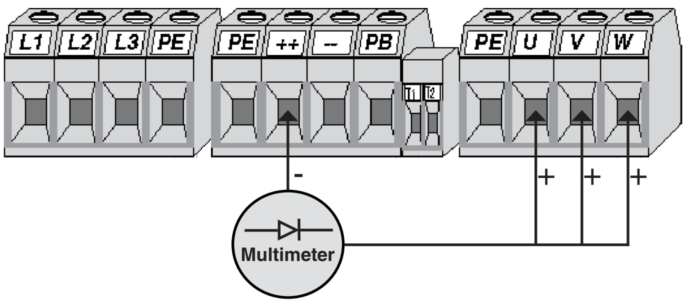
R, U, and W Housings					
Measurement	To	Value	Measurement	To	Value
+ Terminal	L1	0.4 - 0.5	- Terminal	L1	0.4
+ Terminal	L2	Open	- Terminal	L2	0.4
+ Terminal	L3	Open	- Terminal	L3	0.4

Transistor Tests

Testing the IGBTs, output circuit measurement

Positive Side

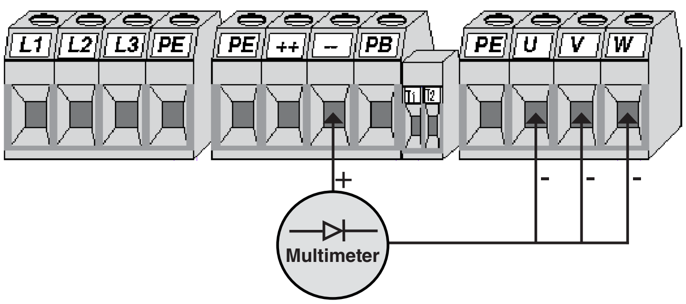
Negative lead of meter to positive DC terminal.
Positive lead of meter to U/V/W terminals.



E, G, and H Housings					
Measurement	To	Value	Measurement	To	Value
+ Terminal	U	0.3 - 0.4	- Terminal	U	0.3 - 0.4
+ Terminal	V	0.3 - 0.4	- Terminal	V	0.3 - 0.4
+ Terminal	W	0.3 - 0.4	- Terminal	W	0.3 - 0.4

Negative Side

Positive lead of meter to negative DC terminal.
Negative lead of meter to U/V/W terminals.

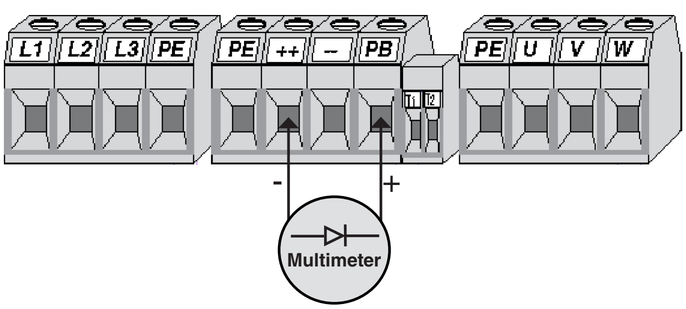


R, U, and W Housings					
Measurement	To	Value	Measurement	To	Value
+ Terminal	U	0.2 - 0.4	- Terminal	U	0.2 - 0.4
+ Terminal	V	0.2 - 0.4	- Terminal	V	0.2 - 0.4
+ Terminal	W	0.2 - 0.4	- Terminal	W	0.2 - 0.4

Testing the braking circuit

Positive Side

Negative lead of meter to positive DC terminal.
Positive lead of meter to PB terminal.

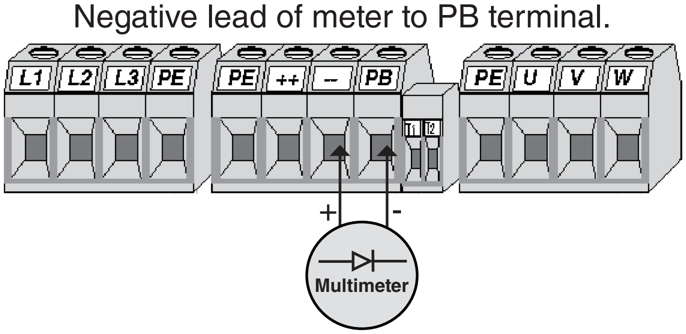


E Housing					
Measurement	To	Value	Measurement	To	Value
+ Terminal	PB	0.4	- Terminal	PB	Open

G Housing					
Measurement	To	Value	Measurement	To	Value
+ Terminal	PB	0.4	- Terminal	PB	1.5

Negative Side

Positive lead of meter to negative DC terminal.
Negative lead of meter to PB terminal.



H Housing					
Measurement	To	Value	Measurement	To	Value
+ Terminal	PB	0.3	- Terminal	PB	0.3

R, U, and W Housings					
Measurement	To	Value	Measurement	To	Value
+ Terminal	PB	0.3	- Terminal	PB	0.3

6. Appendix

Certification

CE Marking

CE	CE marked frequency inverter and servo drives were developed and manufactured to comply with the regulations of the Low-Voltage Directive 2006/95/EC.

The inverter or servo drive must not be started until it is determined that the installation complies with the Machine directive (2006/42/EC) as well as the EMC-directive (2004/108/EC)(note EN 60204).
The frequency inverters and servo drives meet the requirements of the Low-Voltage Directive 2006/95/EC. They are subject to the harmonized standards of the series EN61800-5-1.
This is a product of limited availability in accordance with IEC 61800-3. This product may cause radio interference in residential areas. In this case the operator may need to take corresponding measures.

UL Marking

c UL ® US LISTED	Acceptance according to UL is marked at KEB inverters with the adjacent logo on the type plate.

This device has been investigated by UL according to United States Standard UL508C, Third Edition (Power Conversion Equipment) and to the Canadian Standard CSA C22.2 No.14-2010, 11th Edition (Industrial Control Equipment).

Notes:

KEB AMERICA INC.
5100 Valley Industrial Blvd.
Shakopee, MN 55379
Phone: 952-224-1400
Elevator Drives: **kebblog.com/elevator-drives**
Elevator Support: **kebblog.com/elevator-support**

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