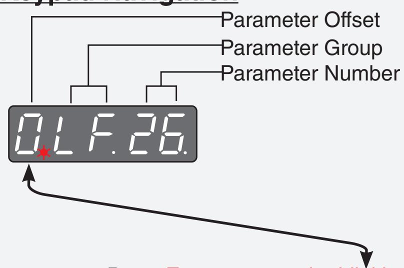
ELEVATOR QUICK-START GUIDE (v 1.72)

00F5LUZ-K001_B

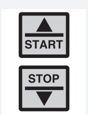
Quick-start guide

This guide is intended to be a supplement to the full KEB elevator/escalator drive manual.
Read KEB document#: 00F5LUB-K172 thoroughly before powering up the drive.

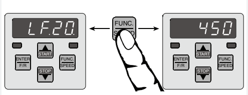
Keypad Navigation



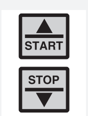
Press Enter to move the blinking dot laterally.
The number/group to the left of the blinking dot is the active (changeable) part of the parameter



Press Up/Down to scroll through the menu options

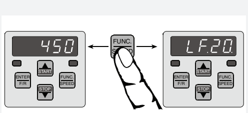


Press "Func" to access the parameter and make adjustments



Press Up/Down to change numberical values

After making adjustments in the parameter, press Enter to save changes.
If the change is saved, the decimal to the right of the number will disappear.



Press "Func" to escape the parameter and return to the menu

1

Start-up Process

Check Drive Connections
- Power (inc. resistor/regen)
- Control wiring
- Encoder wiring

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(A) Basic Set-Up
- Set/Load Configuration
- Configure I/O

↓

(B) Speed Settings
- Speed Control Mode
- Speed Profiles

↓

(C) Motor/Machine Data
- Enter Motor Info
- Motor Auto-tune

↓

(D) Encoder Settings
- Pole Learn (PM only)
- Verify encoder phasing

↓

(E) Run the Motor
- Torque Limit
- Accel/Decel rates

↓

(F) Inertia Learn & Gains
- Inertia Learn
- Adjusting Gains

↓

(G) Pre-torque
- Synthetic Pre-torque

↓

(H) Troubleshooting

(A) Basic Setup

Note: The basic setup might already have been done by the controller mfg.

A1 – Determine the motor/machine type and enter in US.10:

ICLSd = Induction Geared
I9LSS = Induction Gearless
PCLSd = PM Geared
P9LSS = PM Gearless

A2 - Load the configuration:
- US. 4 - LoAd

The display will show LProg as the configuration for the motor type is being loaded.
When completed successfully, the display will change to LF.99 and show noP status.

A3 - Configure the I/O:
- di. 0 - digital input type

PnP (+24V is ON) or nPn (0V is ON)
- Set the relay and digital output functionality (according to the controller prints)

Param	Terminals	Function	Default
do.80	X2A.18	Digital Output 1	ASd
do.81	X2A.19	Digital Output 2	FLt
do.82	X2A.24 - 26	Relay 1	rdY
do.83	X2A.27 - 29	Relay 2	dro

Programmable output options include:

FLt = Fault	HSd = High Speed
rdY = Ready	ASd = At Speed
brC = Brake Control	mcc = Motor Contactor Control
dro = Drive On (current out)	

(B) Speed Settings

B1 - Determine Speed Control Mode and enter in LF. 2:

bnSPd = Digital discrete, binary logic
SErSP = Serial speed control
A SPd = Analog, Bi-polar (-10V ... +10V)
A tor = Analog torque control
d SPd = Digital discrete, 4 input
AbSPd = Analog, Unipolar (0 ... 10V)

B2 - Set the contract speed:
LF.20 = contract speed (fpm)

Analog and serial speeds are dictated by the controller.
If using digital discrete speed command settings, set the speed settings in the drive.

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Consult the controller prints - Nomenclature of the speeds may differ between KEB and the OEM:

LF.41 = Leveling Speed
LF.42 = High Speed
LF.43 = Inspection Speed
LF.44 = High Leveling Speed
LF.45 = Intermediate Speed 1
LF.46 = Intermediate Speed 2
LF.47 = Intermediate Speed 3

The adjustment of the Accel/Decel rates is covered in section E2.

(C) Motor/Machine Data

For PM machines go to section C1
For Induction machines to section C2

C1 - For PM motors, enter the basic motor information from the motor nameplate:
- LF.8 = on (motor protection)
- LF.11 = Motor RPM
- LF.13 = Motor rated frequency

For synchronous motors it is important that the relationship between the motor speed and rated frequency correlate to the number of poles!
The number of poles will always be a whole, even number. If not, assume the nearest whole number and solve for the rated frequency or motor speed.

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

$$\text{LF.11} = \frac{\text{LF.13} * 120}{\text{\# of Motor Poles}}$$

$$\text{LF.13} = \frac{\text{LF.11} * \text{\# of Motor Poles}}{120}$$

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

- LF.12 = Motor rated current or FLA
- LF.17 = Rated Motor Torque (lb-ft.) - Note units!

For reference, here are the equations to convert between Imperial and Metric units provided different nameplate information:

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

- The following data can be learned during the Motor Auto-tune (section C3):
- LF.14 = EMF Voltage (V)
- LF.18 = Motor Resistance (Ω)
- LF.19 = Motor Inductance (mH)

PM motor info is now entered, proceed to section C3.

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C2 - For Induction motors, enter the basic motor information from the motor nameplate:

- LF.8 = on (motor protection)
- LF.9 = Motor rated current (motor protection current)
- LF.10 = Motor HP
- LF.11 = Motor nameplate RPM (including slip)
- LF.12 = Motor rated current or FLA
- LF.13 = Motor rated frequency (Hz)
- LF.14 = Motor voltage
- LF.15 = Power Factor (use 0.90 if not listed)

Induction motor info is now entered, proceed to section C3.

C3 - Enter Machine Data

- LF.20 = Contract Speed (fpm)
- LF.21 = Sheave diameter (inches)
- LF.22 = Gear Ratio (x:1)
- LF.23 = Roping Ratio (x:1)

For reference, the drive calculated gear ratio is displayed in LF.25. This can be used to estimate the gear ratio needed in order to reach contract speed given the entered sheave diameter and motor speed.

- LF.25 = Calculated est. Gear Ratio (Read-only)

C4 - Motor Auto-tune

- LF.27 = Encoder Pulse Number (ppr); typically,
  TTL encoders = 1024
  EnDat encoders = 2048
- Set inspection speed in controller to 0
- Prevent the brake from releasing during inspection

LF. 3 = S Lrn to begin the Auto-tune process

- Press and hold the inspection command (enable + direction inputs) until the process is complete and donE is displayed or a failure message occurs (eg. FAIL, FAILE, FAILd). In case of failure, see section H1.

Note: This process should take 2-5 minutes and will emit a high pitched noise while the drive measures various motor parameters. Continue to provide the inspection command throughout the learn process

- Upon successful completion, the display will show CALC; then the drive will display noP when finished and automatically save the learned motor data.
- Return the brake connection and inspection speed.

(D) Encoder Settings

Verify encoder settings:

- LF.27 = Encoder ppr
- LF.76 = Encoder multiplier (Incremental = 2; EnDat = 8)

D1 – Encoder Learn, *PM motors*

When using PM motors, the encoder position/pole must be learned.

This step does not apply to Induction motors → If using an induction motor, proceed to section D2 to verify phasing.

If at any time the physical relation between the PM 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:

A. SPI (Stationary Pole Identification) – <u>This process is preferred and can learn the encoder position without movement</u> (i.e. with ropes on + brake set). This method does require an extra step to verify correct encoder phasing.

OR

B. Encoder Pole Learn – Process requires sheave movement with little friction (i.e. <u>unroped or balanced car</u>) but can accurately determine encoder phasing.

A. SPI Encoder Learn

To start the SPI Learn procedure:

- Disable the brake
- Set inspection speed to zero. If the speed is generated by the controller (Analog or Serial), then set external speed command to zero
- LF.3 = SPI
- Press and hold inspection (speed + enable inputs) until finished.

During the learn, several position samples will be taken and displayed on the keypad. Upon successful completion, the display will go to nOP and the encoder pole position will be written to parameter LF.77.

Return the brake wire and inspection speed. At this point, the encoder phasing needs to be confirmed. Proceed to D2.

B. Encoder Pole Learn

This procedure requires relatively frictionless movement:

- Balance or unrope car
- Verify correct phasing at the output of drive-motor (U-U, V-V, W-W)
- Set inspection speed to zero; allow brake to pick
- LF.3 = P Lrn
- Press and hold inspection (speed + enable inputs) until finished.

During the learn, the sheave will align to a motor pole and move back and forth while the encoder position is displayed. After completion, the drive will display donE.

If the error EEnC 1 occurs, release the inspection command and rEtrY will be displayed. The drive will automatically swap the encoder channel phasing.

Next, press and hold the inspection command again until the process is complete and donE is displayed. The inspection command can be released and the drive will go to nOP status and the encoder position will be saved to LF.77.

Return the inspection speed. At this point, the encoder position and phasing have been learned. Proceed to section E.

D2 – Encoder Synchronization

The Encoder Synchronization function can be used to determine the correct A/B phasing of the encoder channels and whether the direction needs to inverted for the correct direction of travel It should be done for both PM and IM applications. Begin the process by setting:

- Set LF.3 = rUn
- Run the elevator on inspection and monitor the drive current in LF.93.
- If the current is excessive or the motor operation is erratic, then swap the encoder channels in LF.28.
  Swap A/B channels: 0↔1 or 2↔3

If using a PM motor with SPI Learn, you must then redo the SPI process!

- If the current is reasonable but the elevator runs in the opposite direction, then invert the direction of the encoder channels in LF.28:
  Invert direction: 0↔2 or 1↔3

The elevator is now ready to run at full speed. Proceed to section E for further adjustments.

(E) Running the Motor

E1 – Adjusting the Torque Limit

At this point, the maximum torque limit in 0.LF.36 (lb.ft.) may need to be increased in order to run at high speed and full load. For PM motors, the default setting is 150% of Rated Motor Torque (LF.17). This may need to be increased to 250% of Rated Motor Torque. For induction motors, the default is set to 300% of the Rated Motor Torque.

E2 - Adjust Profile Settings

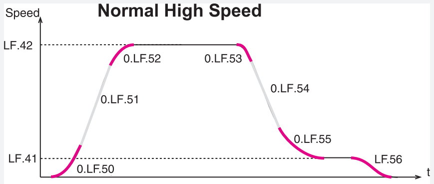
The setting of the speed control and speeds (discrete speed only) are outlined in section B2.

Profile settings refer to Digital Discrete Speed command inputs only. Serial and analog speeds are dictated by the controller and LF.50-56 should be set to “off.”

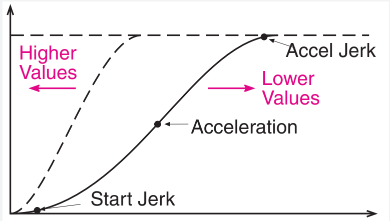
Parameter	Adjustment
xx.LF.50	Start Jerk
xx.LF.51	Acceleration
xx.LF.52	Acceleration Jerk
xx.LF.53	Deceleration Jerk

Parameter	Adjustment
xx.LF.54	Deceleration
xx.LF.55	Flare Jerk
xx.LF.56	Stop Jerk

xx = 0, High and Intermediate Speeds
1, Inspection and Leveling Speeds
2, Emergency Profile Speeds



In general, higher values result in hard/fast profile, while lower values give softer, slower transitions:



(F) Inertia Learn and Gain Adjustments

F1 – *Inertia Learn*

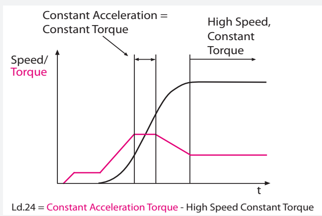
Learning the system inertia activates and pre-adjusts the feed forward torque control, which provides a more dynamic response without further adjustment to the speed controller gains.

Preperation:

- The car must run at high speed on automatic under normal operating conditions; Counter-weighting and compensation must be in their final state.
- The car must be balanced. Determine this with the drive by viewing the torque (not current) in ru.12 in the up and down directions between two floors. When balanced, the torque should be fairly equal, although opposite in signed direction.
- Adjust the speed (tach) following error in the controller to the maximum value (if applicable).

Process:

- Set LF.3 = I Lrn
- Run the car between two floors. The acceleration rate will be extended (reason for increasing speed following error), so make sure the elevator is able to reach a sustained high speed between these two floors. If not, increase the number of floors to run between.
- During the process, the torque will be displayed. Make note of the peak torque during constant acceleration, as well as the constant torque during high speed. Continue putting in car calls to determine an average value of each from a number of runs.



- To continue, press ENTER and the display will show 'VALUE' and be brought to parameter Ld.29 where the acceleration torque should be entered as the difference between the noted acceleration torque and the constant high speed torque. If there is no compensation note the torque at constant speed while passing the middle of the hoistway. Otherwise to abort the rest of the process press FUNCTION.
- Once an acceleration torque has been entered in Ld.29, the system inertia will automatically be calculated in Ld.30 and the feed forward torque control pre-adjusted in Ld.31 and Ld.32.
- A.LF.33 and d.LF.33 can be reduced by a factor of 10 (optional)
- For serial and analog speed control, it may be necessary to increase Ld.31 from 32 to 64ms if the inertia learn causes vibration
- Set LF.3 = rUn

F2 - *Gain Adjustment (in lieu of Inertia Learn)*

Instead of learning the system inertia, the speed control gains can be manually adjusted. The default gain values should provide a good starting point.

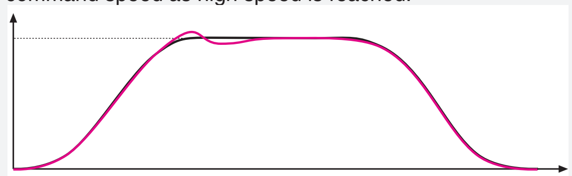
The speed control gains are split into two primary values; one for the acceleration and constand speed (denoted by **A**.LF.xx) and the other for deceleration and leveling (denoted by **d**.LF.xx).

Some speed gains also have an adjustment for pre-torque (denoted by **P**.LF.xx) and are discussed later.

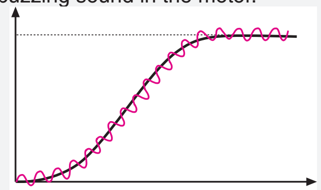
Proportional Gain

The proportional gain (LF.31) maintains general control and stability over the entire speed range. In general, it provides the magnitude of response. When adjusting the speed gains, focus is given mostly to the proportional gain.

Lower values (1000) may result in loose control and overshoot of the command speed as high speed is reached.



High values (10,000) can cause high frequency oscillation resulting in vibration or a buzzing sound in the motor.



Integral Gain

The integral gains (LF.32, LF.33) are responsible for correcting long-term average error in speed as well as providing increased control and rigidity at lower speeds for starting and stopping. The integral offset (LF.33) is the amount added to the integral gain (LF.32) at low speeds.

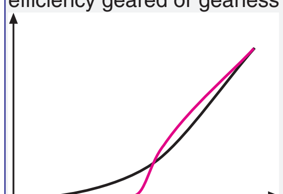
When adjusting speed gains, the integral gains are usually adjusted after the proportional gains and adjustment is usually only made to the integral offset (LF.33).

Integral Gain Offset

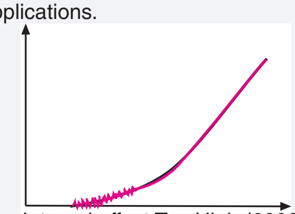
The integral offset gain values are effective only at low speeds. Values which are too low will cause the actual speed to lag the command speed. Values too high will cause vibration or steps at the final approach.

A.LF.33 - KI Offset Acceleration

The offset acceleration gain will assist the motor in catching the load during starting - this setting is especially important for high efficiency geared or gearless applications.



Integral offset Too Low (500)

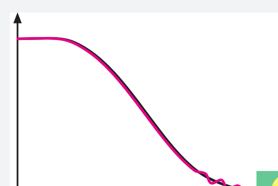


Integral offset Too High (6000)

d.LF.33 - KI Offset Deceleration

The offset deceleration gain will assist the motor in tracking when coming into the floor

Integral Offset Too Low (500)



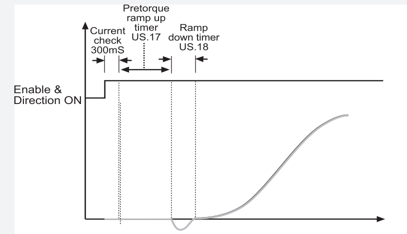
Integral Offset too high (5000)

(G) Synthetic Pre-Torque

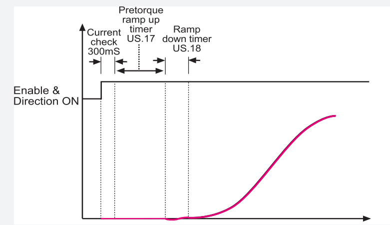
G1 - Synthetic pre-torque allows the drive to compensate for rollback without an external load weighing device. The result is a more consistent take off.

Note: Adjust brake spring tension, brake voltage, and brake timing first. It is often advantageous to use 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 also be noted that any subsequent changes to the brake could require readjustment of the synthetic pre-torque.

The goal is to adjust timer US.17 such that the pre-torque ramp down phase occurs exactly when the brake releases and the roll back occurs.



When adjusted properly, the brake should pick, the motor holds the load for a short period (about 1/4 second) and then the acceleration begins.



Process:

- Set the speed to zero in order to clearly see the rollback.
- Run the car on inspection and note the rollback
- Turn on the synthetic pre-torque by setting LF.30 = 5.
- Set US.17 = .2 sec and US.18 = .2 sec
- Run the car on inspection. If there is any vibration or audible noise at the start, lower the value of P.LF.32 by 2500 and try again.
- Increase the value of US.17 by .05 sec. If the rollback is reduced, proceed to the next step, otherwise continue raising the value of US.17 in steps of .05 until a difference in the roll back is perceived.
- Note the value of US.17 and raise it again by .05 seconds. If the roll back gets better try raising it again. Keep raising US.17 until it gets worse. Then back off the value by .05 seconds. There may still be some rollback at this point.
- Increase the value of P.LF.32 in steps of 2,000 and run the car. Roll back should be further reduced. Values as high as 20,000 are normal. If there is vibration or audible noise during the start, reduce P.LF.32. In some cases it may help to raise the value of P.LF.31 to minimize vibration during the pre-torque phase. Adjust in steps of 1,000. Finally reduce US.18 by .05 seconds.
- Return the pattern gain or inspection speed to the original values.

(H) Troubleshooting

H1 - Motor Learn Fail Messages

FAIL - Drive enable was dropped before learn completed.
FAILE - Drive fault occurred during learn; view fault in 0.LF.98.
FAILd - Drive unable to learn motor data.

H2 - Drive Error and Fault Messages (abbreviated list).
For full listing see section 13 of the full drive manual.

Active drive faults are displayed in the inverter status LF.99 and the red keypad LED will blink. The fault log is 0.LF.98...7.LF.98 (0 = most recent ... 7 = oldest).
The fault log can be cleared by setting any entry to 10.

EOP Error Over Voltage

Trip Voltage (460V drive) = 800VDC
Trip Voltage (230V drive) = 400VDC

Braking resistor should shunt at:
760VDC (460V drives)
380VDC (230V drives)

Check:
- Brake resistor connection
- Disconnect resistor - measure resistance
- Measure DC bus terminals (≈ 1.41x VAC_{IN})
- Proper mains grounding
- Is the Brake transistor functioning?
- Is the regen unit faulted?

EUP Error Under Voltage

Trip Voltage (460V drive) = 240VDC
Trip Voltage (230V drive) = 216VDC

Check:
- Input voltage and wiring
- Missing input phase
- Imbalanced input phases (not to exceed 2%)
- Proper mains grounding

EOL Error Overload

Time dependent overload - excessive current
See section 2.6 of manual

Causes:
- Excessive Current
- Incorrect motor data
- Incorrect encoder data
- High mechanical load/issues (friction)
- Brake is not releasing at start of run

EOL2 Error Low Speed Overload

Excessive current at low speed (< 3Hz)
See section 2.7

Causes:
- Excessive Current
- High duty at low speeds
- Incorrect motor data
- Incorrect encoder data
- Incorrect encoder position (PM only)
- High mechanical load/issues (friction)
- Brake is not releasing at start of run

EOC Error Over Current

If error occurs instantly at the start of each run, the issue may be:
- Ground fault on motor leads
- Damaged or slow closing motor contactor
- Motor Failure
- Shorted output transistor in drive

If error is intermittent, the issue may be:
- Damaged or slow to close motor contactor
- Loose motor connections
- Electrical noise, faulty grounding
- Faulty cabling

Ebr Error Low Motor Current

Low current during initial current check

Causes:
- One or more motor leads not connected
- Motor contactor not closing (or in time)
- Motor contactor contacts are damaged
- Motor windings are damaged

Bypass the motor contactor to test (jumper not sufficient)

EOH Error Overheat Power Module

The heatsink temperature can be monitored in rU.38

Typically, the heatsink temperature should be below 65° C. Error trips at 90° C.

Causes:
- Insufficient cooling or high ambient temp.
  - Check operation of fans (US.37)
  - Make sure fans are not clogged
  - Increase airflow around inverter
  - Faulty temperature sensor
  - Does error happen when drive is cool?

EOH2 Error Motor Protection

Excessive RMS motor current - according to LF.9 (IM) or LF.12 (PM motor)

Causes:
- Excessive Current
- Incorrect motor data
- Incorrect encoder data
- High mechanical load/issues (friction)

Torque Limit Being Reached

Overshoot into the floor
Is the current (LF.93) being clipped?

Causes:
- 0.LF.36 is too low
- Incorrect motor data
- Incorrect encoder data
- Incorrect encoder position (PM only)
- Incorrect gains
- Modulation grade being reached

Motor Noise

Vibration
- Increase sample rate of encoder (LF.29)
- Reduced speed control gains (LF.31)
- Check if modulation grade is reached

Squealing/Grinding
- Check sample rate of encoder; 4-8ms typ.
- Check encoder multiplier (LF.76)
- Verify motor data

"Clunk" at the end of the run
Verify the drive enable is not being dropped prematurely while drive is still outputting torque to the motor (i.e. enable is dropped before the speed and direction are dropped)

EOS Error Overspeed

The internal overspeed limit is exceeded

Internal overspeed limit is 125% of contract speed (LF.20). This cannot be adjusted.

Causes:
- Incorrect machine data settings (LF.20-23)
- Lack of motor control
  - Peak current reached (LF.94)
  - Max. torque might be too low (0.LF.36)
  - Incorrect motor data (i.e. LF.10-17)
  - Incorrect encoder pole position
- Speed gains too high or too low
  - Unloaded motor might require low gains
- Modulation grade exceeds minimum
  - Monitor rU.42
  - Modulation should not exceed 100%
- Sudden, Excessive movement
  - Incorrect Motor data
  - Incorrect encoder data

EEnC 1 Loss of Incremental Encoder Signal

Incremental channels do not have complement signals

Causes:
Incremental encoder input tracks missing (e.g. Z+/Z- tracks not connected or jumpered high/low)
Unable to move sheave during P Lrn (too much friction or brake not picking)

See section 3.2.2 for more information on correct encoder wiring.

Selected Parameters - See section A.1 of drive manual for complete listing

Protective Parameters

Param.	Name	Value
LF.08	Motor Protection (ON/OFF)	
LF.09	Motor Protection Current	

Motor Parameters

Param.	Name	Value
LF.10	Motor Power (HP)	
LF.11	Rated Motor Speed (rpm)	
LF.12	Rated Motor Amps	
LF.13	Rated Motor Frequency	
LF.14	Rated Motor Voltage	
LF.15	Power Factor	

Machine Parameters

Param.	Name	Value
LF.21	Sheave Diameter (inches)	
LF.22	Gear Ratio (x:1)	
LF.23	Roping Ratio (x:1)	

Encoder Parameters (Closed Loop)

Param.	Name	Value
LF.27	Encoder PPR	
LF.28	Encoder Channel/Direction	
LF.77	Absolute Encoder Position	

Speed Parameters

Param.	Name	Value
LF.20	Contract Speed	
LF.41	Leveling Speed	
LF.42	High Speed	
LF.43	Inspection Speed	
LF.44	High Leveling Speed	
x.LF.50	Start Jerk	
x.LF.51	Acceleration	
x.LF.52	Acceleration Jerk	
x.LF.53	Deceleration Jerk	
x.LF.54	Deceleration Jerk	
x.LF.55	Flare Jerk	
x.LF.56	Stop Jerk	

Configuration Parameters

Param.	Name	Value
US.10	Select Configuration	
US.04	Load Configuration	
LF.02	Speed Control Mode	
LF.03	Configuration	
LF.04	Drive Mode	
LF.30	Control Mode	
x.LF.31	KP Speed (Closed Loop)	
x.LF.32	KI Speed (Closed Loop)	
x.LF.33	KI Offset (Closed Loop)	
LF.37	Voltage Boost (Open Loop)	

Inputs/Output Parameters

Param.	Name	Value
di.0	Input type (PNP or NPN)	
do.80	Digital Output 1	
do.81	Digital Output 2	
do.82	Relay 1	
do.83	Relay 2	

Diagnostic Parameters

Param.	Name	Value
LF.82	X2A Control Input State	
LF.83	X2A Control Output State	
LF.88	Motor Command Speed (rpm)	
LF.89	Encoder Speed (rpm)	
LF.90	Actual Escalator Speed (FPM)	
LF.93	Phase Current	
LF.94	Peak Phase Current	
LF.95	DC Bus Voltage	
LF.96	Peak DC Bus Voltage	
LF.97	Actual Output Frequency	
0.LF.98	Last Fault	
1.LF.98	2nd to Last Fault	
LF.99	Inverter State	

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