INTERNATIONAL LIFT EQUIPMENT LTD

FUJI FRENIC INVERTER

USER GUIDE

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Drive overview

FUJI FRENIC – Lift series inverters is specially designed for operation of induction and permanent magnet synchronous motors used in lift applications. Also induction motors without encoder (open loop) can be controlled obtaining good performance and high positioning accuracy at stop.

The main characteristics of FUJI FRENIC Lift are:

- ✓ Compact dimensions with high output power
- ✓ Rescue operation possible with Battery or UPS with indication of recommended direction
- ✓ Short floor operation with distance based control
- ✓ 200% overload for 10 Seconds
- ✓ Incremental encoder input (12V or 15V / Open Collector)
- ✓ Optional cards for different encoder types (EnDat 2.1, SinCos...)
- ✓ Pole tuning and Auto tuning without removing the ropes
- ✓ Multifunctional, detachable keypad
- ✓ Braking transistor is integrated in all capacities
- ✓ Operation of Induction motor without encoder (open loop)
- ✓ Different S curves and accel/decel profiles for all speed inputs (medium and reduced power speeds)
- ✓ High switching frequency for reduced motor noise (15Khz standard)

Conformity to European standards

The CE marking on Fuji Electric products indicates that they comply with the essential requirements of the Electromagnetic Compatibility (EMC) Directive 89/336/EEC issued by the Council of the European Communities and the Low Voltage Directive 73/23/EEC.

Inverters with built-in EMC filter that bear a CE marking are in conformity with EMC directives. Inverters having no built-in EMC filter can be in conformity with EMC directives if an optional EMC compliant filter is connected to them.

General purpose inverters are subject to the regulations set forth by the Low Voltage Directive in the EU. Fuji Electric declares the inverters bearing a CE marking are compliant with the Low Voltage Directive.

FRENIC Lift inverters are in accordance with the regulations of following council directives and their amendments:

EMC Directive 2004/108/EC (Electromagnetic Compatibility)

Low Voltage Directive 2006/95/EC (LVD)

For assessment of conformity the following relevant standards have been taken into consideration:

EN61800-3:2004

EN50178:1997

⚠CAUTION
The FRENIC-Lift inverters are categorized as category C2 according to EN61800-3:2004. When you use these products in the domestic environment, you may need to take appropriate countermeasures to reduce or eliminate any noise emitted from these products.

Keypad operation

To operate, commission and Set up FRENIC Lift inverter there are two possibilities: using inverter keypad or PC. For operation using a PC it is necessary to use the dedicated software ***Lift Loader***. This software is free of charge and can be downloaded from our website www.ileweb.co.uk (a USB to RS485 converter is required)

The keypad is connected to the inverter through the RJ-45 connector. This connection is also used for the connection with the PC or the lift controller using DCP 3 protocol

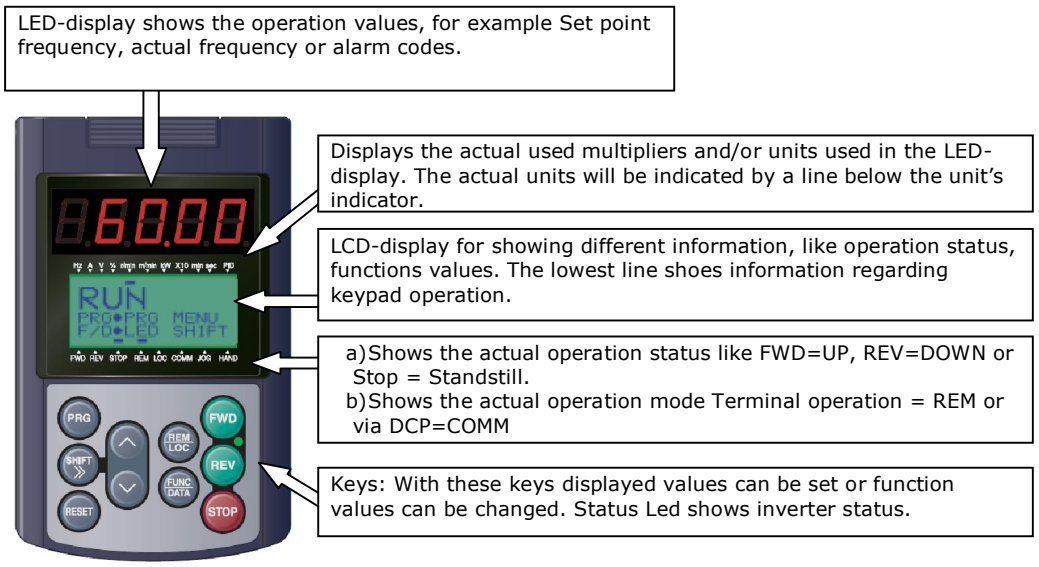


Figure 12: Overview of keypad

Keys explanation:

PRG — Use this key to change between operation and programming mode.

SHIFT — Use this key to move the cursor to the right in programming mode

RESET — In Alarm mode: Alarm reset
In Programming mode: leave the parameter changing in the settings

▲ ▼ — In Programming mode: Function selection inside the menu or change the function value
In Programming mode: Scroll to the next parameter

FUNC DATA — In Programming mode: Parameter edit or saving
In Operation mode: for choosing the displayed value (and units)

REM LOC — Change between Remote (Terminal control) and Local (keypad operation)

FWD REV STOP — These 3 keys may not be used in lift application. In local mode with these keys the motor can be started and/or stopped.

Keypad operation

Keypad menus

The complete menu list can be accessed by pressing the **PRG** key. The LCD display shows the 4 first menus from the complete list.

0. QUICK SET
1. DATA SET
2. DATA CHECK
3. OPR MNTR
4. I/O CHECK
5. MAINTENANCE
6. ALM INF
7. ALM CAUSE
8. DATA COPY
9. LOAD FCTR

Figure 1: Complete menus list

Detailed menus description

0 QUICK SET

This menu contains all of the parameters required for set up and commissioning of the Frenic inverter specific to ILE installations. The parameters in this menu will allow all the motor data to be set, all autotune functions and all S curve settings. After selecting a parameter it can be checked and/or changed (edited) if needed by pressing key. FUNC/DATA

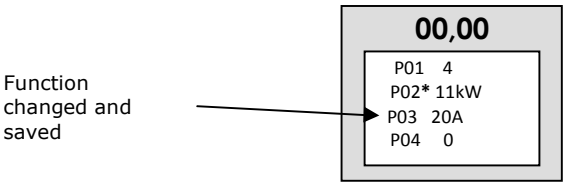
1 DATA SET

This menu is used for accessing all parameters. It displays the function codes list and describes the function of that code. Every function has a number and name assigned. After selecting a function it can be checked and/or changed (edited) if needed by pressing key. FUNC/DATA

2 DATA CHECK

Also using this menu parameters can be changed. In this menu only function codes and parameter values are shown (without the names) and the set values can be directly read. Parameter values changed from default are indicated by a star on the right side of the parameter number. By pressing FUNC/DATA key the selected function can be changed.

Figure 2: DATA CHECK menu.



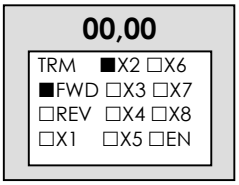
3 OPR MNTR (OPERATION MONITOR)

In this menu different operating values can be shown in the LCD display. There are 4 different screens showing 4 lines each, for example output frequency, output current, output voltage and calculated torque.

4 I/O CHECK

Used for checking the I/O status and if FRENIC Lift is receiving the correct control signals from the ILE controller and the output signals are being issued correctly. Input and output signals are displayed in different screens.

Figure 3: Example with digital inputs displayed. In this Example ■X2 and ■FWD inputs are active.



5 MAINTENANC (MAINTENANCE)

Shows the inverter condition: runtime, main capacitors capacitance, firmware version.

6 ALM INF (ALARM INFORMATION)

In this menu the alarm memory is shown. After the selection of an alarm by pressing key the most relevant information of each alarm is shown. FUNC DATA

7 ALM CAUSE (ALARM CAUSE)

In this menu the possible alarm causes are shown. After the selection of an alarm by pressing FUNC DATA key a possible cause of this alarm is shown.

8 DATA COPY

With this menu the complete inverter parameter set can be saved to the keypad and transfered from one inverter to another. This may be helpful to set up different installations with the same motor and same characteristics. Be aware that function protection (F00) is no copied. Motor data and communication set are copied only between inverters of same range.

9 LOAD FCTR (LOAD FACTOR)

In this menu the maximum current, the average current and the average braking torque during a preset measuring time can be measured in the real application.

Example of parameter setting

Figure 4: LCD display of the first 4 menus after pressing **PRG** key

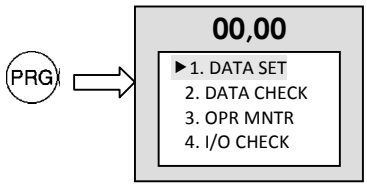


Figure 5: Menu selection (in this figure maintenance menu is selected)

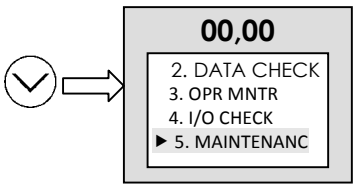


Figure 6: Selection of Menu 1

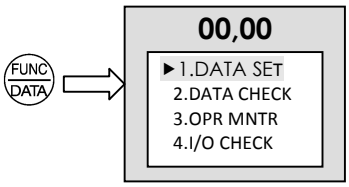


Figure 7: Function code selection. In this figure **P03 Rated current** from the P Group (Motor functions)

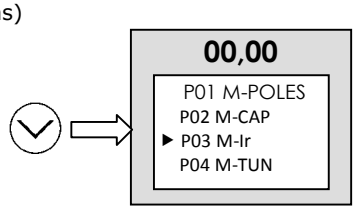


Figure 8: To edit (go inside) the function

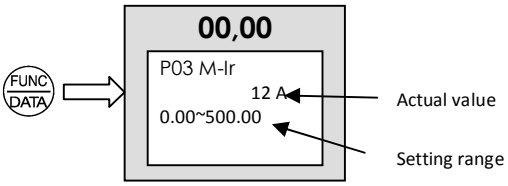
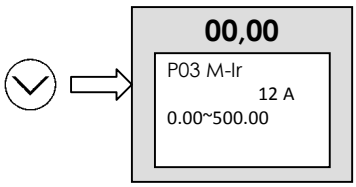


Figure 9: Changing the value of P03 (motor rated current), in this example to 12.



After changing the value using the arrow keys, it can be saved by pressing FUNC DATA key.

Exiting a parameter without saving is possible by pressing the RESET key.

Encoder connections

Standard (Built-in) input connection for 12V/15V incremental encoder

The FRENIC Lift control board includes an interface for the connection of an encoder for applications with induction motors. The connection is via screw terminals.
The output supply voltage is 12 or 15VDC and is compatible with standard HTL 10-30VDC encoders. Pulse resolution from 360 to 6000 can be set using function L02.

Supply voltage

The supply voltage of the encoder can be selected by setting the slide switch SW5 located on the inverter control board. The default setting is 12V, which can be used for standard encoders with supply voltages from 10 to 30 VDC.

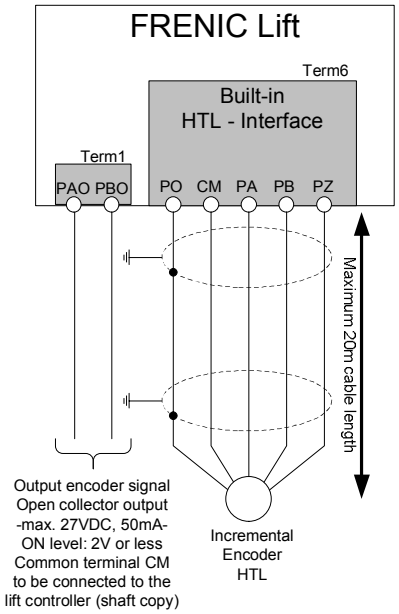


Figure 10: Connection using HTL encoder interface

The encoder cable must always be shielded. The shield must be connected at the inverter and the encoder end using the ground terminal or dedicated terminal.

Option card OPC-LM1-PR for synchronous motors

- ✓ For permanent magnet synchronous motors
- ✓ For encoder Heidenhain Type ERN1387 or ERN487 or compatible
- ✓ Output signal: 2048 Sin/Cos pulses (periods) per revolution
- ✓ Operating supply voltage: 5VDC±5% (maximum current is 300 mA)
- ✓ Absolute signal: 1 Sin/Cos signal with 1 Period/turn

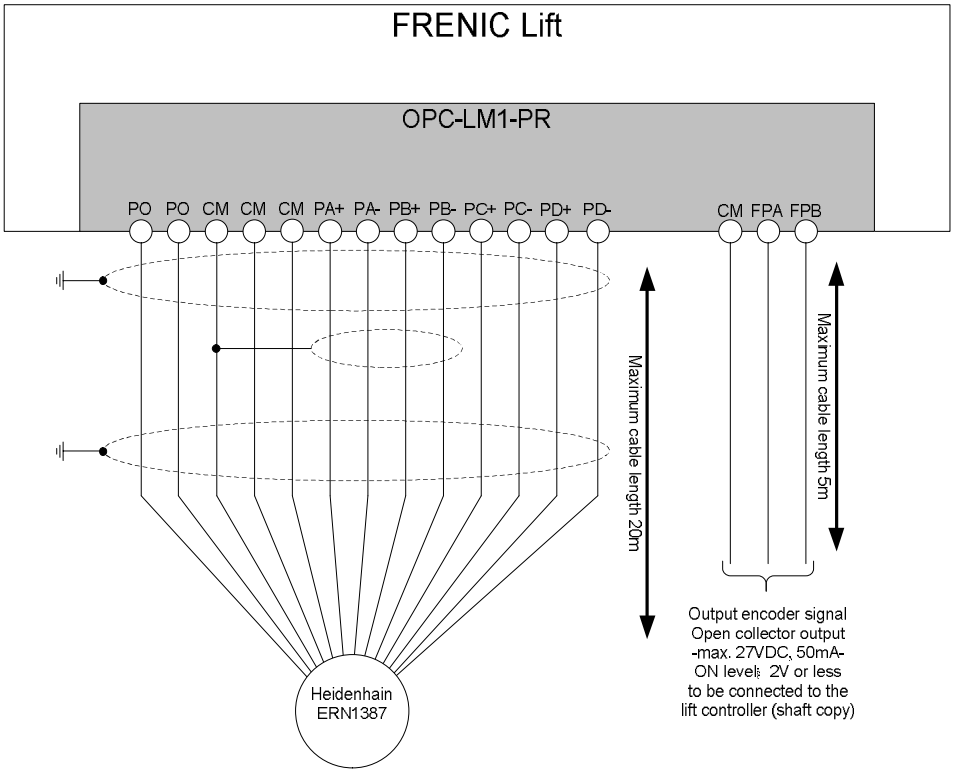


Figure 11: Connection option card OPC-LM1-PR

Table 1: Connection description of terminals for OPC-LM1-PR

Terminal description in the option card	Signal name from Heidenhain	Description
P0	Up und Up Sensor	Supply voltage 5V, connection of Up Sensor mandatory for cable length >10m
CM	0V (Up) und 0V Sensor	Common 0 V for the power supply
PA+	A+	A phase
PA-	A-	A phase inverted
PB+	B+	B phase
PB-	B-	B phase inverted
PC+	C+	C phase (Absolute signal)
PC--	C-	C phase inverted (Absolute signal)
PD+	D+	D phase (Absolute signal)
PD-	D-	D phase inverted (Absolute signal)

- **Prior to the commissioning, the encoder resolution (pulses per revolution) has to be set using parameter L02.**
- **For synchronous motors it is also necessary to set the encoder type in function L01.**

Option card OPC-LM1-PS1 for synchronous motors

- ✓ For permanent magnet synchronous motors
- ✓ For encoder Heidenhain Type ECN1313 or ECN413 or ECN113
- ✓ Output signal: 2048 Sin/Cos pulses (periods) per revolution
- ✓ Operating voltage: 5VDC±5%; 300mA
- ✓ Data connection: EnDat 2.1

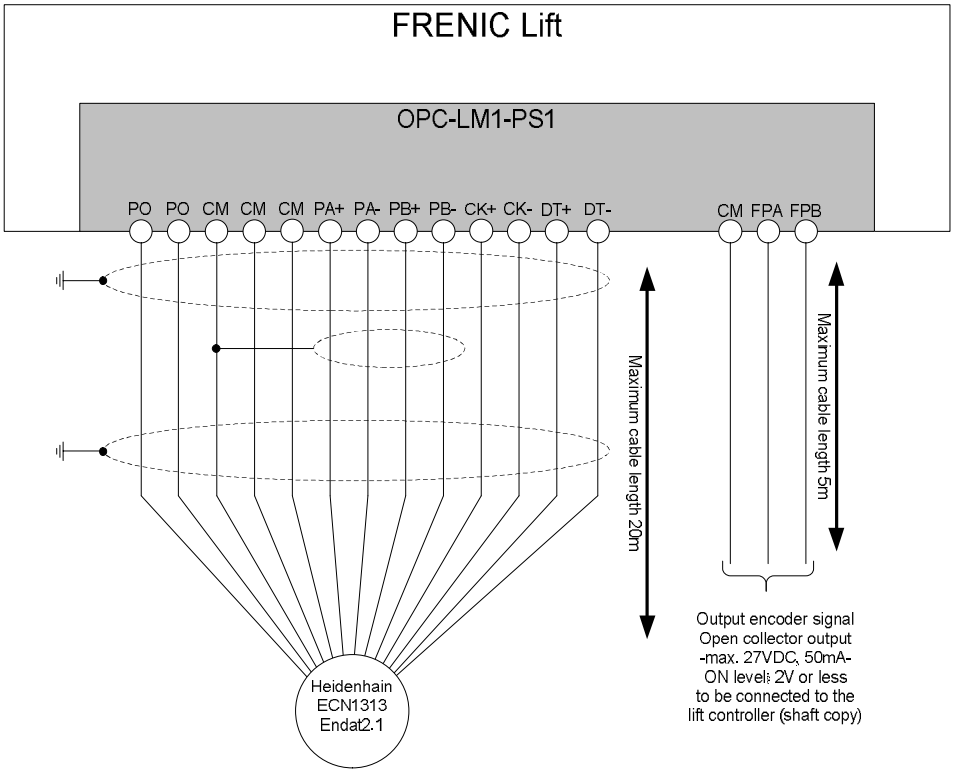


Figure 12: OPC-LM1-PS1 option card connection

Table 2: Connection description of terminals for OPC-LM1-PS1

Terminal name in the option card	Signal name from Heidenhain	Description
P0	Up and Up Sensor	Supply voltage 5V, connection of Up Sensor mandatory for cable length >10m
CM	0V (Up) and 0V Sensor	Common 0 V for the power supply
PA+	A+	A signal
PA-	A-	A signal inverted
PB+	B+	A signal
PB-	B-	A signal inverted
CK+	Clock+	Clock signal for serial communication
CK-	Clock-	Clock signal inverted for serial communication
DT+	DATA+	Data line for communication of the absolute information
DT-	DATA-	Data line inverted for communication of the absolute information

- **Prior to the commissioning, the encoder resolution (pulses per revolution) has to be set using parameter L02.**
- **For synchronous motors it is also necessary to set the encoder type in function L01.**

Getting running for the first time and auto tuning

Open loop operation

Before running for the first time the site motor parameters have to be checked and adjusted to suit. It is recommended that an autotune is then performed. The auto tune is non rotating so the ropes can be left on. The lift should be on inspection, should be ready to run i.e. all emergency stops, car doors and landing locks made.

Check the motor data parameters in table 3 are set correctly in menu 0 (quick set)

Table 3: Parameters to be set prior to auto tuning

Parameter	Description	Default value	New setting
P01	Number of motor poles	4	4=1500 rpm 6=1000rpm
P02	Motor capacity (KW)	As per drive size	Set as motor data plate
P03	Motor rated Current (Amps)	As per drive size	Set as motor data plate
F04	Motor speed (RPM)	1500	Set as motor data plate
F05	Motor Voltage (Volts)	380	Set as motor data plate

If you wish to switch to open loop so you can run the lift before the motor encoder is fitted set parameter F42 to 2 (torque vector control)

Once the motor parameters are set carry out the following procedure.

- ✓ Make sure the motor is correctly connected
- ✓ Set parameter P04 to 3 and FUNC DATA press
- ✓ Give the drive a run command by pressing test up or test down. MC & MC1 will come in and there will be an audible motor noise
- ✓ Once the tune is complete release the test direction

Closed loop operation

For closed loop installations the set up procedure is the same as for open loop, it is also recommended that an autotune is performed before the first travel. The auto tune procedure is carried out the same as for an open loop application. The motor data needs to be set as in table 3, but the additional parameter in table 4 also has to set and checked.

Table 4: Parameters to be set prior to auto tuning on closed loop

Parameter	Description	Default value	New setting
L02	Encoder resolution (PPR)	2048	As per encoder data plate

Once the motor parameters are set carry out the auto tune as open loop (see section above).

Gearless machines (permanent magnet)

For gearless applications the procedure for auto tuning is the same as for the open and closed loop applications above. Once an auto tune is completed a second tune is required for finding the offset of the poles in relation to the permanent magnets, this is known as a pole tune.

After carrying out the auto tune set the additional parameter in table 5 below.

Table 5: Parameters to be set prior to carrying out a pole tune

Parameter	Description	Default value	New setting
L05	Current loop controller	1.5	As per following formula

$$L05 = 4{,}33 \cdot \frac{I_n \times L}{V_n} \quad [\text{mH}]$$

L=Motor inductance (minimum value between Ld and Lq)

V_n=Motor rated voltage [V] (F05)
I_n=Motor rated current [A] (P03)

The pole tune can now be carried out as follows. This tune checks for wiring abnormalities so it is important that the motor phasing is correct

- ✓ Make sure the motor is correctly connected i.e U-U, V-V, W-W
- ✓ Set parameter L03 to 1 and FUNC DATA press
- ✓ Give the drive a run command by pressing test up or test down. MC & MC1 will come in and there will be an audible motor noise and the screen should show "executing" this tune lasts approximately 4 seconds
- ✓ Once the tune is complete "executing" disappears from the screen release the test direction

If "ER7" appears whilst tuning it may be because the motor has surface mounted magnets or the motor wiring is incorrect. To check motor wiring is correct rotate the motor a quarter of a turn and make a note of the value in parameter L04 carry out another tune (as above procedure) if the value of L04 is more than 15° different from the previous value the motor wiring is incorrect. If the value is less than 15° out the motor wiring is correct but the motor may have surface mounted magnets. If so set L03 to 4 and tune again. If "ER7" still appears contact the ILE technical support department.

Final setting prior to running for the first time.

The parameters in table 6 have to be worked out and set so the inverter knows how far the lift will travel for 1 revolution of the motor. It needs this information so the speed references and distance based short floor operation work correctly.

Table 6: Parameters set before running for the first time

Parameter	Description	Default value	New setting
F03	Motor RPM at full lift speed	1500	See formula below

To work out the above parameter use the formula below.

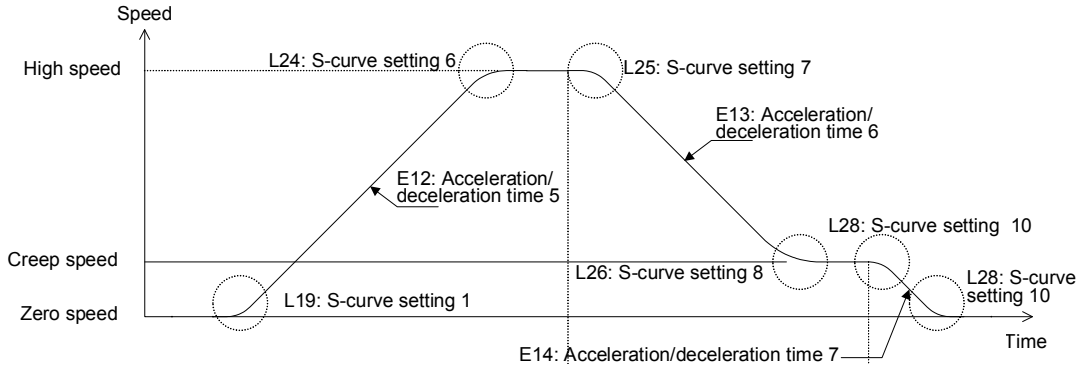
$$\square 03 = \frac{19.1 \times \square \times \square}{\square \times \square}$$

(R=ROPING RATIO (1 FOR 1:1; 2 FOR 2:1); V=LIFT SPEED IN M/S; D=SHEAVE DIAMETER IN METERS; P= GEAR RATIO e.g. IF THE GEAR RATIO IS 53:2 DIVIDE 2 BY 53 AND INSERT THE RESULT INTO THE FORMULA)

Setting speeds, acceleration, deceleration and jerks for High speed

S curve for high speed (HS on Skycom Solo, HS or DTS on Skycom)

Figure 13: High speed S curve showing parameters.



From the diagram above we can see the parameters for tuning the high speed S curve the parameters are listed below in table 7

Table 7: High speed parameter settings

Parameter	Description	Default value	New setting
C07	Creep (level) speed	4Hz, 6m/min, 150RPM	Site specific
C11	High speed	50Hz, 60 m/min, 1500RPM	Site specific
L19	Jerk 1	20%	Site specific
E12	Acceleration rate	1.8 seconds	Site specific
L24	Jerk 2	20%	Site specific
L25	Jerk 3	20%	Site specific
E13	Deceleration rate	1.8 seconds	Site specific
L26	Jerk 4	20%	Site specific
L28	Jerk 56	20%	Site specific
E14	Decel from creep to zero speed	1 .8 seconds	Site specific

The parameters in the above table are all of the speed and comfort settings for a high speed run. All speeds on Geared machines will be set so the units are in Hertz, if it is a gearless application we will set the units as meters/minutes to work these back to meters/second divide by 60.

All acceleration / deceleration units are in seconds the bigger the figure the softer the accel / decel.
All jerks units are percentages of the S curve you are on, the higher the figure the softer the jerk.

Setting speeds, acceleration, deceleration and jerks for medium speed

S curve for medium speed (MS1 on Skycom)

Figure 14: Medium speed S curve showing parameters.

From the diagram above we can see the parameters for tuning the high speed S curve the parameters are listed below in table 8

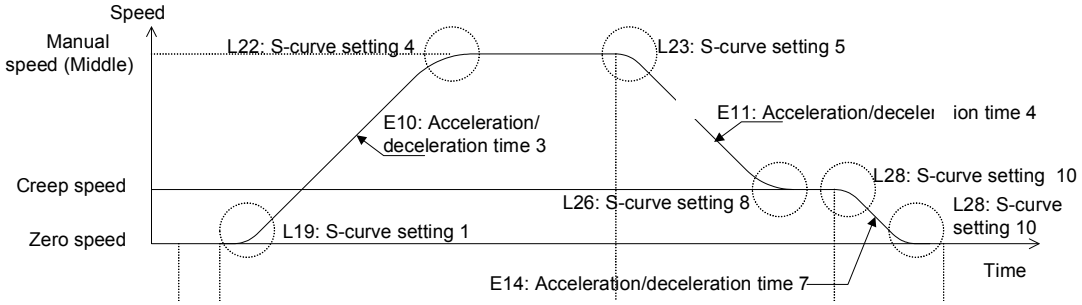


Table 8: Medium speed parameter settings

Parameter	Description	Default value	New setting
C07	Creep (level) speed	4Hz, 6m/min, 150RPM	Site specific
C10	Medium speed	50Hz, 60 m/min, 1500RPM	Site specific
L19	Jerk 1	20%	Site specific
E10	Acceleration rate	1.8 seconds	Site specific
L22	Jerk 2	20%	Site specific
L23	Jerk 3	20%	Site specific
E11	Deceleration rate	1.8 seconds	Site specific
L26	Jerk 4	20%	Site specific
L28	Jerk 56	20%	Site specific
E14	Decel from creep to zero speed	1 .8 seconds	Site specific

The parameters in the above table are all of the speed and comfort settings for a high speed run. All speeds on Geared machines will be set so the units are in Hertz, if it is a gearless application we will set the units as meters/minutes to work these back to meters/second divide by 60.

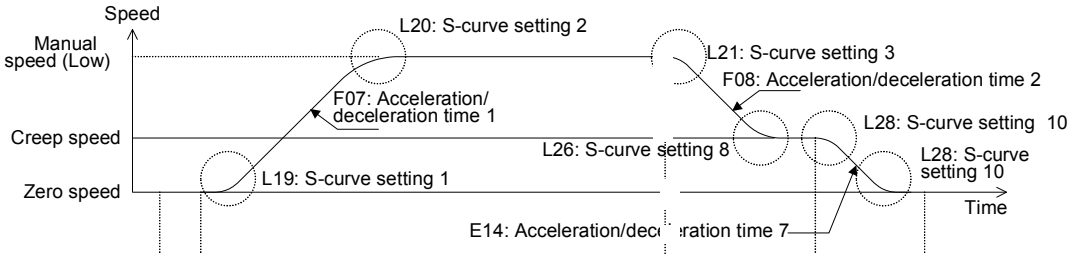
All acceleration / deceleration units are in seconds the bigger the figure the softer the accel / decel.
All jerks units are percentages of the S curve you are on, the higher the figure the softer the jerk.

Setting speeds, acceleration, deceleration and jerks for reduced power mode

S curve for reduced power mode (RPR on Skycom / Skycom Solo)

The Skycom can be parameterised to give an output which when on a non essential journey i.e. Homing and when in a group on no specific traffic pattern, the lift can run at a reduced acceleration, high speed and deceleration rate thus saving energy. The drive parameters for this speed input are as below.

Figure 14: Medium speed S curve showing parameters.



From the diagram above we can see the parameters for tuning the high speed S curve the parameters are listed below in table 9

Table 9 : Reduced power mode speed parameter settings

Parameter	Description	Default value	New setting
C07	Creep (level) speed	4Hz, 6m/min, 150RPM	Site specific
C09	Reduced power speed	50Hz, 60 m/min, 1500RPM	Site specific
L19	Jerk 1	20%	Site specific
F07	Acceleration rate	1.8 seconds	Site specific
L20	Jerk 2	20%	Site specific
L21	Jerk 3	20%	Site specific
F08	Deceleration rate	1.8 seconds	Site specific
L26	Jerk 4	20%	Site specific
L28	Jerk 56	20%	Site specific
E14	Decel from creep to zero speed	1 .8 seconds	Site specific

The parameters in the above table are all of the speed and comfort settings for a high speed run. All speeds on Geared machines will be set so the units are in Hertz, if it is a gearless application we will set the units as meters/minutes to work these back to meters/second divide by 60.

All acceleration / deceleration units are in seconds the bigger the figure the softer the accel / decel.

All jerks units are percentages of the S curve you are on, the higher the figure the softer the jerk.

Inspection speed

Inspection speed is set in our test department at 15Hz for geared machines or 10 meters/minute for gearless machines if the speed needs increasing or decreasing table 10 highlights the parameter.

Table 10 : inspection speed parameter settings

Parameter	Description	Default value	New setting
C06	Inspection speed	15Hz, 10m/min	Site specific

Performance related settings

Brake lift / release timers

The FRENIC inverter controls the lifting of the brake via a relay output (terminals Y5C & Y5A) this in turn drives the BKC contactor on the controller, which then switches the brake voltage. If the brake lifts or drops particularly fast or slow there may be issues with rollback, snatch or general ride discomfort at the start and stop of operation. Table 11 shows the parameters for controlling the brake.

Table 11: Brake parameter settings

Parameter	Description	Default value	New setting
L82	Brake lift time	0.2 seconds	Site specific
L83	Brake drop time	0.2 seconds	Site specific

Critical settings for open loop

No load current (parameter P06)

The no-load current (function P06) defines the value of the current of the motor when no load is applied to the motor (exciting current).
Typical values of the no-load current range from 30 % of P03 up to 70 % of P03. In the majority of the cases the value measured by the auto-tuning procedure will be correct. In some cases the auto-tuning procedure cannot be finished correctly (due to unusual behaviour of the motor). In this later case the value of P03 must be set manually. To calculate the no-load current you can use the formula $P06 = \sqrt{(P03)^2 - \left(\frac{P02 * 1000}{1.47 * F05}\right)^2}$

If the value of P06 is too low you will find that the motor does not have enough torque. I the value is too high the motor oscillates (this oscillation will cause a vibration in the motor that is transmitted to the cabin).

Slip frequency (parameter P12)

The slip frequency function defines the value of the slip frequency of the motor. It is the key function for good slip compensation by the inverter; this means that this function is very important in open loop control of induction motors for good floor levelling accuracy because it will ensure that the rotating frequency of the motor is the same regardless of the load condition of the motor.
In the majority of the cases the value measured by the auto-tuning procedure will be correct. In some cases the auto-tuning procedure cannot be finished correctly (due to unusual behaviour of the motor). In this later case the value of P12 must be set manually.

To set function P12 manually we can calculate it from the following formula:

$$P12 = \frac{(Synchronous\_speed(rpm) - Rated\_speed(rpm)) \times No\_Poles}{120} \times 0{,}7$$

Slip compensation gains (parameter P09 for driving, P10 for braking)

The slip frequency can be also compensated in both driving and braking mode. The method for adjusting these values is as follows. You need to measure one floor level with car empty both going up and down:

- If the car speed going up is lower than the desired speed (the car doesn't reach floor level) decrease the value of P10 by 10% (braking mode).
- If the cabin speed going down is higher than the desired speed (the car goes past floor level) decrease the value of P09 by 10% (driving mode).

Adjust these parameters until good floor levelling accuracy is achieved.

Gains (closed loop and Gearless)

The driving and braking gains of the FRENIC inverter may be adjusted to increase performance with respect to undershoot, overshoot, hunting during high speed and noise / vibration in the motor. The parameters are shown in table 12 below.

Table 12: Gain parameter settings

Parameter	Description	Default value	New setting
L36	ASR P CONSTANT (high speed)	10%	Site specific
L37	ASR I CONSTANT (high speed)	0.02	Site specific
L38	ASR P CONSTANT (low speed)	10%	Site specific
L39	ASR I CONSTANT (low speed)	0.02	Site specific
L38	ASR P CONSTANT (low speed)	10%	Site specific

The higher the percentage value the tighter the control of the motor will be, also the smaller the time constant the tighter the control will be.

All gain parameters should be adjusted in small increments, too high or low value can cause the motor to lose control of the load. Consult ILE's Technical support department if you are unfamiliar with adjusting these parameters.

Anti roll back parameters (gearless only)

The FRENIC inverter has an extra set of gain parameters for controlling high out of balance loads in gearless applications. Once enabled the time, P gain and I gain can be adjusted to eliminate any roll back.

Anti roll back parameters should only be enabled after the brake release and drop timers have been set and the gains adjusted (see section 12.1 and 12.2)

The parameters are shown in table 13 below.

Table 13: Anti roll back parameters (ULC Compensation)

Parameter	Description	Default value	New setting
L65	ULC ENABLE	0	1 (to enable)
L66	ULC ACTIVATION TIMER	1	Site specific
L68	ULC ASR P CONSTANT	10	Site specific
L69	ULC ASR I CONSTANT	0.5	Site specific
L73	ULC ASR GAIN	5	Site specific

Anti roll back is enabled by changing parameter L65 to 1
The time the anti roll back is enabled for is set using parameter L66 (this should not need to be more than default)
The gains in parameters L68, 69 & 73 should then be adjusted until the roll back is adjusted out.

The default parameters set by ILE should eliminate any roll back, if you are unfamiliar with adjusting these parameters consult ILE's Technical support department

Fault codes and their meanings

Table 14 is a list of all the event codes on the FRENIC inverter, if any events persist please consult ILE's technical support department

Table 14: Fault codes

Alarm message Displayed	Description	Possible causes
OC	Motor overloaded: OC1= Overload during acceleration OC2= Overload during deceleration OC3= Overload during constant speed	Check if the motor is connected correctly Check motor data has been entered correctly Check brake operation
OU	Overvoltage in inverter DC link: OU1= Overvoltage during acceleration OU2= Overvoltage during deceleration OU3= Overvoltage during constant speed	Braking is resistor not connected or defective Lift not balanced correctly Deceleration time too short Check mains connection
LU	Under voltage in inverter DC link	Supply voltage too low Mains supply failure Acceleration too fast Load too high Check connection of the input signal
Lin	Input phase loss	Check mains input fuses Check input connections
OH1	Inverter heat sink temperature too high	Inverter fan defective Ambient temperature too high
OH2	External Alarm	Not used in ILE controller
OH3	Ambient temperature around inverter too high	Check temperature inside controller cabinet
OH4	Motor over temperature detected	Not used in ILE controller
PG	Encoder error	Check encoder cable Motor not rotating (safety gear in) Brake did not lift
OL1	Motor overload	Check brake Motor, car or counterweight safety gear in Inverter at current limit, possibly too small Check functions F10~F12
OLU	Inverter overload	Over temperature in IGBT Failure in the cooling system Switching frequency (function F26) too high Lift load too high.
Er1	Save error	Data has been lost
Er2	Keypad communication error	Keypad was removed while inverter in was running
Er3	CPU error	Failure in the inverter CPU
Er4	Option card communication error	Option card not correctly installed. Check cables and shield connection.
Er5	Option card error	Check configuration (switches and bridges correct?) Check cables and shield connection.
Er6	Operation error	Check parameter L80, L82, L83, L84

		If gearless carry out pole tuning
Er7	Error during auto tuning / pole tuning	Check MC contactors are not open Check encoder cable Check encoder
Er8	RS485 Comms error	High noise level Check connection
ErE	Speed error	Check brake Check safety gear is not in Check parameters L90-L92 Current limiter active If gearless was pole tuning successful
ErH	Option card hardware fault	Option card not correctly installed Inverter software not compatible with the option card
OS	Motor speed greater than $\frac{L32xF03}{100}$ (rpm)	Check encoder resolution parameter L02 Check parameter F03, P01, L32