

APPLICATION NOTE	AN-Lift2-0013v100EN
Emergency sensorless for PMSM	


Inverter type	FRENIC-Lift (LM2A)
Software version	0600 (or later)
Required options	Speed feedback option for PMSM
Related documentation	INR-SI47-1909a-E
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Use	Public, web
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Version	1.0.0
Languages	English


1. Introduction

FRENIC Lift LM2A series includes closed loop control for PMSM. In case of lift applications, closed loop control on a PMSM is a must for safety and for efficiency reasons.

On the other hand, it may happen that encoder breaks while lift is travelling with people inside. In such case an open loop (or sensorless) control is needed, otherwise the only alternative is to rescue people by a hoist system (or gravity unbalanced movement).

This application note explains how to properly use the Emergency sensorless function for PMSM.

 CAUTION	Depending on the usage of this function, inverter and motor can be using more current than rated values. If this situation is prolonged in time, it can cause inverter and motor failure.
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 CAUTION	Take special care to not use this function during rescue operation (inverter supplied by means of UPS or batteries). This function can easily discharge UPS or batteries.
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2. Related parameters

Table 1 shows the parameters related to this control mode.

Table 1. Parameters related to Emergency sensorless for PMSM.

Parameter	Name	Setting range	Units	Recommended setting
F42	Control mode	0~3	-	1
L140	Emergency sensorless for PMSM (Current command)	10 to 200% (Percentage to the rated current of the motor)	%	Depends on the usage. Default setting is 80%.
L141	Emergency sensorless for PMSM (Operation setting)	0: Disable 1: Enable	-	1

- Motor control mode
(Parameter F42)

Emergency sensorless operation can be activated only when control mode used is Vector control with PG (for synchronous motors). In other words, if F42 setting is different than 1, this operation will not work.

- Current command for Emergency sensorless for PMSM
(Parameter L140)

This parameter defines the current level inverter will apply to the motor during this operation. The current defined will be applied during all the movement constantly, in other words, current will not increase or decrease because of load acceleration or because braking condition.

It is recommended to perform Emergency sensorless operation always in braking direction, doing so, current needed will be normally lower than motor (and inverter) rated current, including accelerations and decelerations. In case of braking direction, default setting of 80% should be enough in all the cases.

If we want to perform this operation in driving (load) direction, then we need to check which is the current overload in this condition. We will set L140 to a value higher than maximum overload needed.

Figure 1 shows a lift movement in normal operation in load direction (driving).

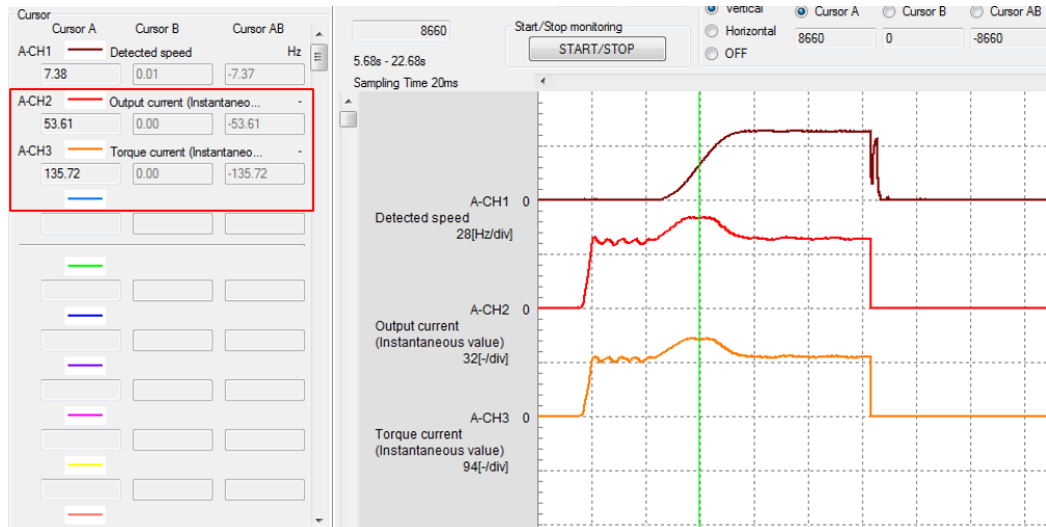


Figure 1. Normal lift movement recorded by Loader software

As it can be observed, during acceleration we have the highest current peak. This peak will define L140 level. In this case we have peak output current of around 53,61 A, which is equivalent to around 135,72% of motor rated current.

Figure 2 shows a lift movement when Emergency sensorless for PMSM is enabled.

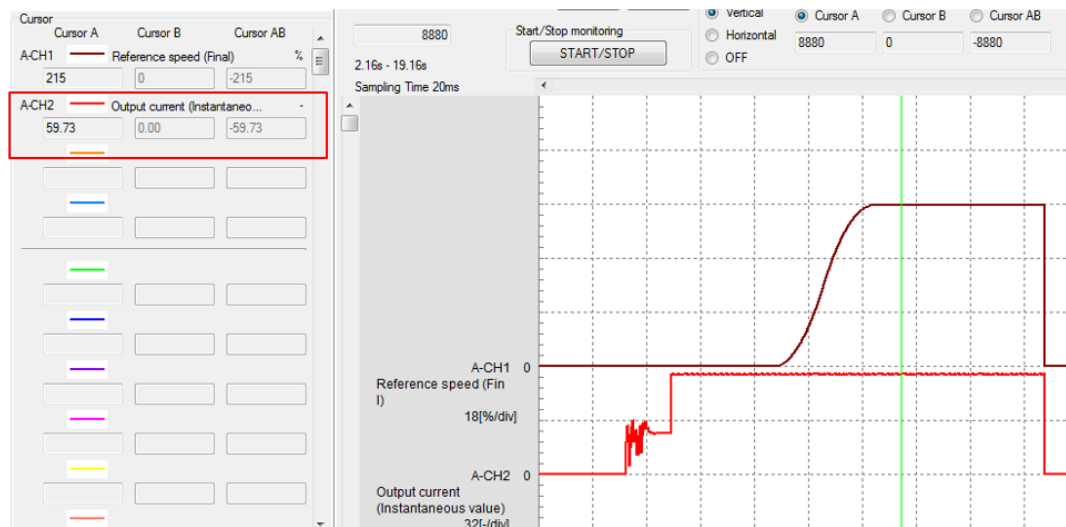


Figure 2. Emergency sensorless lift movement recorded by Loader software

As it can be observed, during all the lift movement the output current is 59,73 A, which is just a bit bigger than 53,61 A. In this case, L140 has been set to 150%.

- Operation setting for Emergency sensorless for PMSM (Parameter L141)

Emergency sensorless operation is activated by L141 parameter. For safety reasons, L141 requires double-key operation in order to change the setting: press UP arrow + STOP at same time to modify L141 setting.

In order to disable this operation, we need to remove completely inverter's power supply (until keypad's display light, or charging LED, are completely OFF).

Setting back L141 to 0 will not disable this function. When L141 is set to 0 inverter will trip Er6 SUB 0002.

This function will not be copied on the keypad's memory.

Before operation starts, inverter will perform an automatic pole tuning (same as L07 different from zero), because we cannot trust encoder's information as it might be broken.

3. Signals sequence

Figure 3 shows time diagram with signals sequence during Emergency sensorless operation.

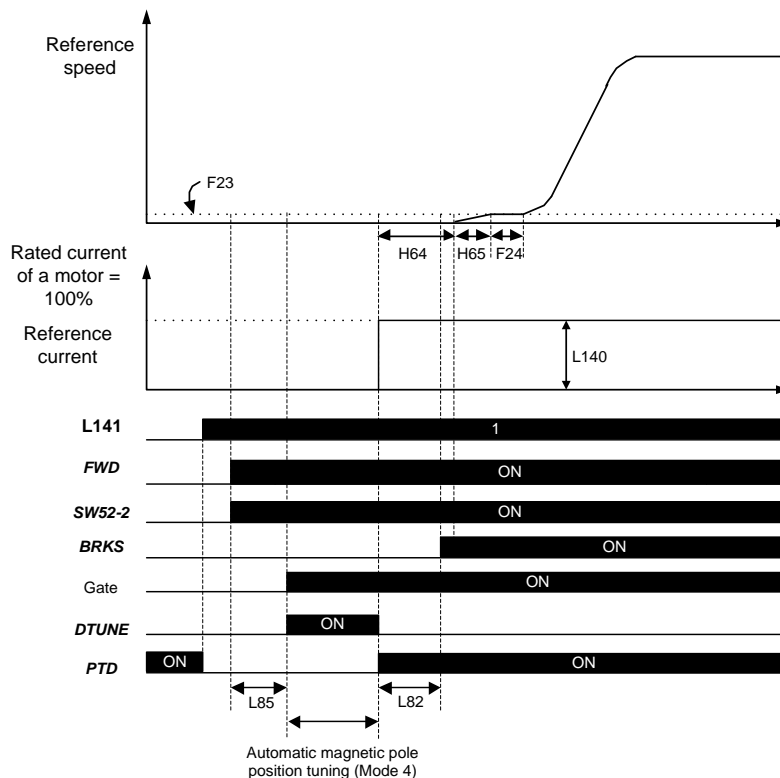


Figure 3. Emergency sensorless for PMSM time diagram

As it can be observed, before lift movement starts we must ensure L141 is set to value 1. As soon as RUN command is given (FWD in this case) inverter starts normal sequence. Automatic pole tuning will be carried out between timers L85 (current delay) and L82 (brake open delay).

Automatic pole tuning will be carried out every time after RUN command independently on the setting on L04 or L198 (bit5).

During all the movement, independently if we are at constant speed, accelerating, or decelerating, the output current applied will be according to L140 setting.

4. Other parameters or functions affected by this operation

Table 2 shows other parameters or functions affected by Emergency sensorless operation due to encoder information not available.

Table 2. Other parameters or function codes affected by Emergency sensorless

Parameter or function	Description
H66	Regardless of the setting, inverter uses mode 1.
FAR/FAR	Reference speed will be used (same as torque vector control).
FDT/FDT2	Reference speed will be used (same as torque vector control).
DNZS	Always 0.
DSAG	Always 0.
DACC/DDEC	Reference speed will be used (same as torque vector control).
DZR	Reference speed will be used (same as torque vector control).
DOPEN	Reference speed will be used (same as torque vector control).
FRUN/RRUN	Always 0.
RRD	Always 0.
DSD	Always 0.

5. Conclusions

By means of “Emergency sensorless operation on PMSM”, end user will be able to rescue people, in the case of encoder failure, without necessity of a hoist (or moving the car uncontrolled by gravity).

6. Document history

Version	Changes applied	Date	Written	Checked	Approved
1.0.0	First version	11/01/2022	J. Alonso	C. Arjona	J. Català