Fuji Electric
e-Front runners

APPLICATION NOTE	AN-MEGA-0010v104EN
Deliverance Operation by the customizable logic of FRENIC MEGA	

Inverter type	FRENIC MEGA
Software version	5th software version or later
Required options	Not required
Related documentation	MEGA IM INR-SI47-1335a-E
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Use	Public, Web
Date	22/10/2010
Version	1.0.4
Languages	English

1. Introduction.

FRENIC MEGA inverter does have the Low Voltage cancellation from the fifth software version. It means that, by means of an input, is possible to cancel the Low Voltage (*lu*) alarm, in order to feed the inverter with a UPS system or batteries. In this way, the inverter provides a function to move the motor in an emergency case, when the main power supply has been lost. For further information about this function, please refer to the manual.

While the inverter is fed by means of an auxiliary power supply system, the motor speed and torque will be limited, because the power supply rated voltage and current in this case normally are smaller compared to the main supply or the inverter size.

In addition, in applications with a vertical load and a counterweight (like in lift applications), the best rotating direction (the one with lower torque requirements) for the rescue will not be always to descend the cabin, it will depend on the installed counterweight and the cabin weight at the moment of the rescue (in principle unknown).

By means of FRENIC MEGA Customizable Logic function, it is possible to set a “Deliverance Operation” for rescuing the load in vertical applications, minimizing the auxiliary power supply size by choosing the best direction for the rescue.

2. Application Implementation.

The inverter’s behaviour, in order to perform properly the intended function should be:

- When main power supply is lost, inverter stops the motor before the inverter is switched off.

- Once the rescue is decided (by the application controller or an operator), the inverter is fed by the auxiliary supply system, and an input is activated to the inverter in order to indicate that the inverter is being supplied by an auxiliary input power. This input should be activated during the whole “Deliverance Operation”, otherwise, the rescue will be cancelled. For further information about the signal timing, please refer to the “BATRY” input function information.
- Some time after the activation of the BATRY input function (depicted in the information referred above), the inverter is ready for moving the motor.
- Then, in order to start up the “Deliverance Operation”, the FWD input must be activated. This input signal must be kept ON during all the operation. Please take into account that the motor may test in both FWD and REV direction, even though only the FWD input has been activated.
- After the DC link voltage in the inverter has been established, the inverter will try to move the motor always in FWD direction first.
- If, during FWD movement, the output torque limit previously defined is not reached then the inverter keep the motor turning until the input FWD is set to OFF again. The behaviour in this case is depicted in Figure 1.

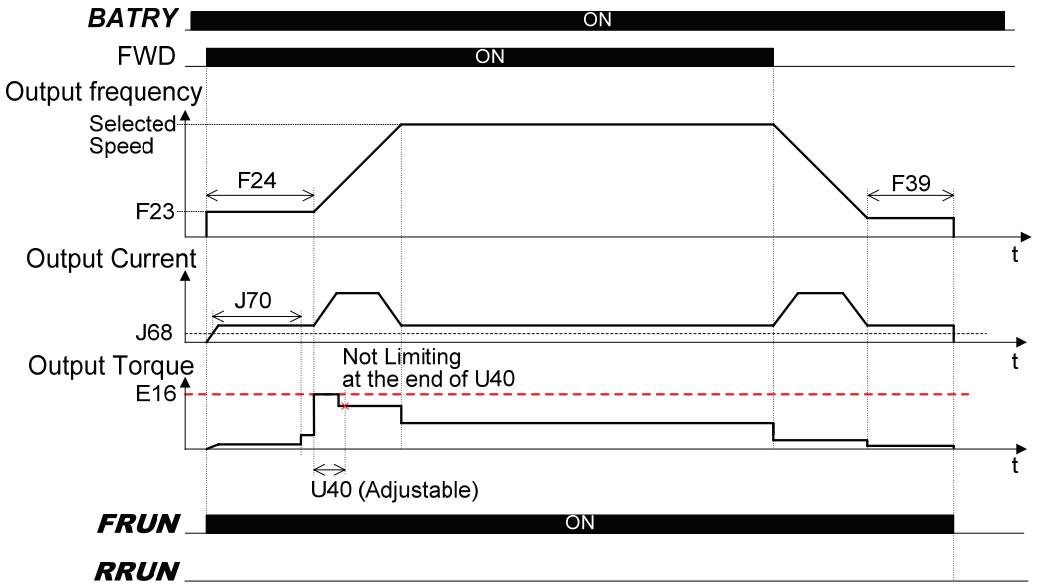

Figure 1: Behaviour when Torque Limit is not reached in FWD direction

- If, during FWD movement, the output torque limit is surpassed, the inverter will stop the motor and try the REV direction.

- If, during REV movement, the output torque limit previously defined is not reached then the inverter keeps the motor turning until the input is set to OFF again, as depicted in figure 2.

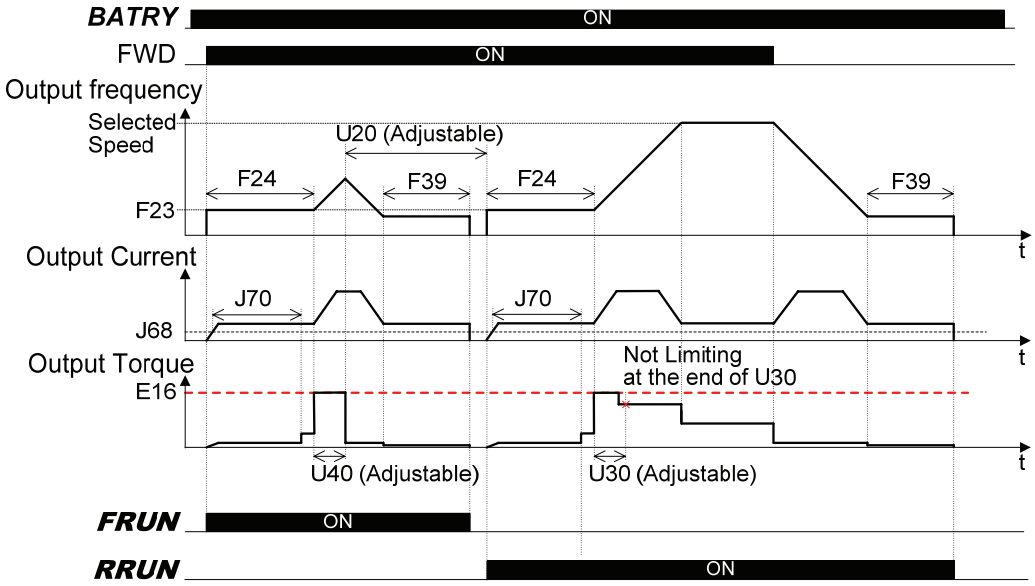

Figure 2: Behaviour when torque limit is reached in FWD but no REV direction

- If the output torque limit is surpassed in REV direction as well, the inverter will stop the motor, as depicted in figure 3.

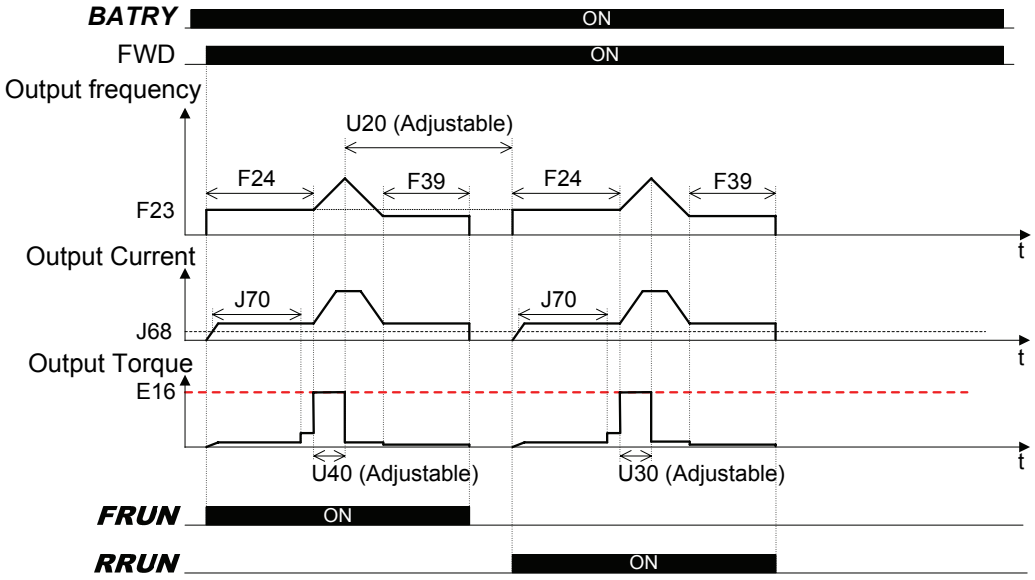

Figure 3: Behaviour when torque limit is reached in both directions

3. Customizable Logic Set-up.

Using inverter's customizable logic, it is possible to design a logic circuit with the desired behaviour. The logic circuit that has been implemented is depicted in Figure 4.

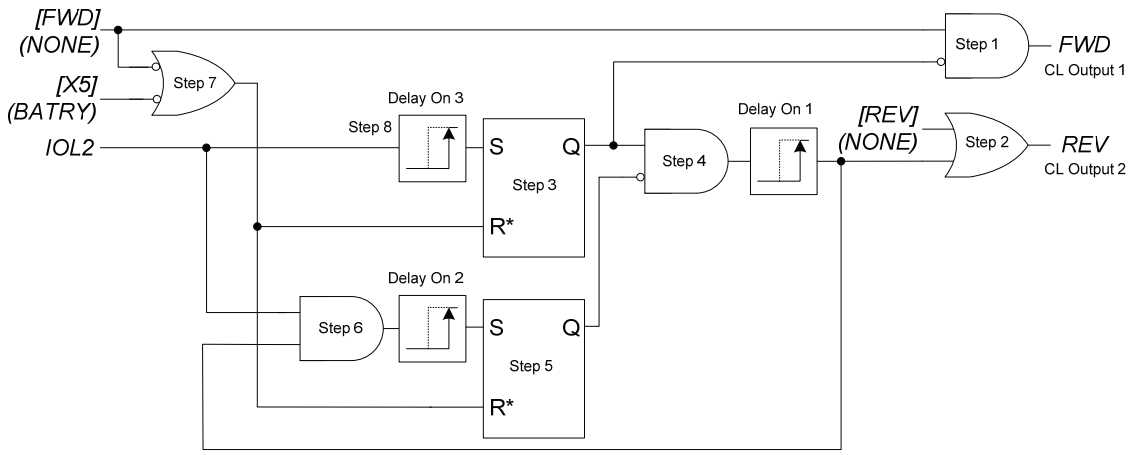

Figure 4: Logic Circuit designed

Reset Priority Flip-Flops are used

This logic circuit is based in the use of IOL2 inverter function (inverter output limiting, filtered 20 ms) for resetting the FWD or the REV command, depending on which direction is being tested. Therefore, the inverter torque limit will become the adjustable output limit (depending on the auxiliary power supply capacity).

As depicted in Figures 4 and 5, [X5] has been chosen as the input terminal for activating the “BATRY” function, and the “Deliverance Operation” will be started as soon as the [FWD] is activated. In order to reset both flip-flops used in this logic circuit (and therefore resetting the rescue), the user will only have to deactivate the [X5] or the [FWD] input terminals.

Additionally, [FWD] and [REV] terminals respective function codes will have to be set to 100 (NONE). Otherwise, the circuit logic depicted in Figure 4 will not work properly.

Following, the purpose of each “Delay – ON” and “Delay – OFF” timers is clarified, in order to ease the commissioning process:

- Delay-ON 1: During the sequence it is possible that the direction of the load must be changed from FWD direction to REV. For doing this properly some timing must be considered. This timer is used to delay the REV command input to allow to the inverter to stop the motor when a change from FWD to REV direction is needed during the rescue. The proposed delay value is, approximately, the time that takes from running at rescue speed till when the inverter closes the brake when run command is removed.

- Delay-ON 2: Although the direction of the load is the less consumption in terms of power sometimes during the transient of accelerating the limit of torque is reached, due to this, it is necessary to wait certain time for being sure that that direction of movement is not the correct one. Therefore, this timer is used to filter the IOL2

function that provides the direction change from FWD to REV during rescue. If we increase this delay timer, the inverter will ignore torque output peaks (like when the motor starts up against the brake), but we will increase the energy consumption if the FWD direction is not the minimum torque direction.

- Delay-ON 3: Same explanation than for Delay-ON 2. This timer is used to filter the IOL2 function that indicates that the output limit torque value has been reached during the rescue in REV direction. If we increase this value, the inverter will ignore output torque peaks, like when the motor starts up against the brake. The proposed value of the Delay-ON 3 Timer value is the same than the one of Delay-ON 2.

4. Control Schematics.

To use this function, as explained above, it is needed to use the output limiting torque function in FRENIC MEGA (IOL2). But we only need this limiting function during the rescue operation and, because the limit in normal operation is different than during rescue operation we need to change the torque limit when we use “Deliverance operation”. Therefore, a bridge is needed between the input terminal used to activate the “Deliverance Operation” and another input terminal set as TL2/TL1 input function.

The control terminals connections required are drawn in figure 5.

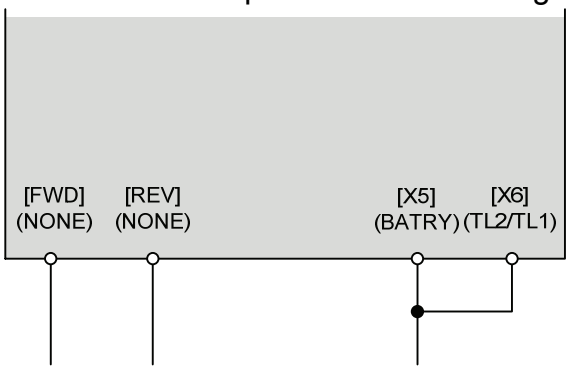

Figure 5: Control terminals connections

Additionally, the user may need to connect an input terminal set as one of the speed selection functions (SS1, SS2, SS4 or SS8) in order to select the rescue speed during the “Deliverance Operation”.

5. Inverter set up.

Table 1 below describes the required function settings of the FRENIC MEGA inverter (different from default).

Table 1. Required function settings different from default

Function	Value	Description
U00	1: Enable	Customizable Logic (Mode Selection)
U01	4010: FWD	Customizable Logic Step 1 (Input 1)
U02	3003: Step 3 Output (Neg)	Customizable Logic Step 1 (Input 2)
U03	2: AND	Customizable Logic Step 1 (Logic Circuit)
U06	4011: REV	Customizable Logic Step 2 (Input 1)
U07	2004: Step 4 Output	Customizable Logic Step 2 (Input 2)
U08	3: OR	Customizable Logic Step 2 (Logic Circuit)
U11	2008: Step 8 Output	Customizable Logic Step 3 (Input 1, SET)
U12	2007: Step 7 Output	Customizable Logic Step 3 (Input 2, RESET)
U13	6: Reset priority flip-flop	Customizable Logic Step 3 (Logic Circuit)
U16	2003: Step 3 Output	Customizable Logic Step 4 (Input 1)
U17	3005: Step 5 Output (Neg)	Customizable Logic Step 4 (Input 2)
U18	2: AND	Customizable Logic Step 4 (Logic Circuit)
U19	1: On-Delay Timer	Customizable Logic Step 4 (Type of Timer)
U20	2 s	Customizable Logic Step 4 (Timer) **Time ADJUSTABLE by the USER depending on the Customer requirements (0.0s to 600.0s)**
U21	2006: Step 6 Output	Customizable Logic Step 5 (Input 1, SET)
U22	2007: Step 7 Output	Customizable Logic Step 5 (Input 2, RESET)
U23	6: Reset priority flip-flop	Customizable Logic Step 5 (Logic Circuit)
U26	2004: Step 4 Output	Customizable Logic Step 6 (Input 1)
U27	22: IOL2	Customizable Logic Step 6 (Input 2)
U28	2: AND	Customizable Logic Step 6 (logic Circuit)
U29	1: On-Delay Timer	Customizable Logic Step 6 (Type of Timer)
U30	0.3 s	Customizable Logic Step 6 (Timer) **Time ADJUSTABLE by the USER depending on the Customer requirements (0.0s to 600.0s)** **U30 should be equal than U40**
U31	5010: FWD (Neg)	Customizable Logic Step 7 (Input 1)
U32	5005: X5 (Neg)	Customizable Logic Step 7 (Input 2)
U33	3: OR	Customizable Logic Step 7 (Logic Circuit)

Function	Value	Description
U36	22: IOL2	Customizable Logic Step 8 (Input 1)
U38	1: Through output	Customizable Logic Step 8 (Logic Circuit)
U39	1: On-Delay Timer	Customizable Logic Step 8 (Type of Timer)
U40	0.3 s	Customizable Logic Step 8 (Timer) **Time ADJUSTABLE by the USER depending on the Customer requirements (0.0s to 600.0s)** **U30 should be equal than U40**
U71	1: Step 1 Output	Customizable Logic Output Signal 1 (Output Selection)
U72	2: Step 2 Output	Customizable Logic Output Signal 2 (Output Selection)
U81	98: FWD	Customizable Logic Output Signal 1 (Function Selection)
U82	99: REV	Customizable Logic Output Signal 2 (Function Selection)
F02	1:Terminal	Operation Method
E05	59: (BATRY)	Terminal [X5] Function
E06	14 (TL2/TL1)	Terminal [X6] Function
E16	30%	Torque Limiter 2-1 **ADJUSTABLE Level, depending on the application**
E98	100 (No use)	Terminal [FWD] Function
E99	100 (No use)	Terminal [REV] Function

(end of Table 1)

6. Conclusion

Using FRENIC MEGA Customizable Logic it is possible to adapt the inverter behavior, adding certain functions, to make the inverter more suitable for certain applications.

In this document it has been demonstrated that the Customizable Logic and Low Voltage cancellation function can be useful to adapt FRENIC MEGA to perform an automatic rescue operation for vertical loads with a counterweight (lift application).

7. Document history.

Version	Changes applied	Date	Written	Checked	Approved
1.0.0	Draft	23/09/2009	JM Ibáñez		
1.0.1	Small Corrections		J Català		
1.0.2	Adapted to new logic version. Sequence drawings added.	13/10/2010	JM Ibáñez		
1.0.3	Small Correction. Figure numbers has been corrected.	18/10/2010	JM Ibáñez	J. Català	D. Bedford
1.0.4	Changed from F01 to F02 setting in setup table.	22/10/2010	JM Ibáñez	D. Bedford	D. Bedford