INSTRUCTION MANUAL

DIGITAL LIFTING MAGNET CONTROLLER

FDR-series

HANMI TECHWIN

TEL: +82-31-498-9270
FAX: +82-31-498-9275

Contents

1. Features

① **Compact Construction**

This digital lifting magnet controller is designed to have good durability against various operation conditions. Also, the control system becomes one board by designing the
system as programmable software using full digital system.

② **Adjusting Parameter Setting and Monitoring Functions**

Because the parameters are inputted to meet the specified conditions using the keypad during the commissioning, the operation is simple.
This magnet system can memorize and recall up to ten times of former faults and Display them on LCD and thus fault finding is improved.
Also, the actual running condition of this unit can be recalled and displayed on LCD and thus the maintenance becomes easy.
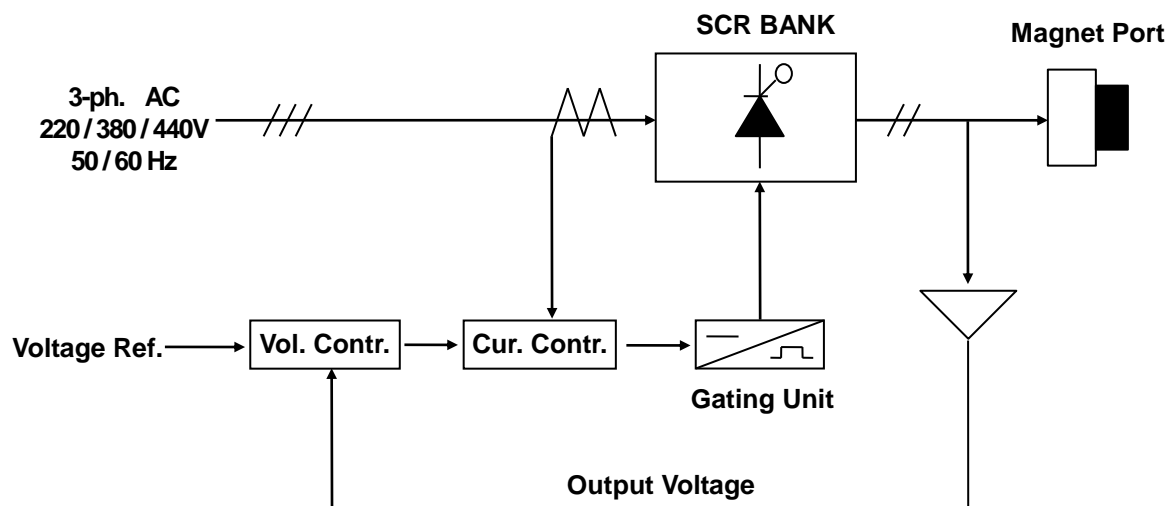
③ **Protection**

This system has the function that prevents the dropping of load by maintaining the output voltage with the storage battery when a fault occurs such as over current, over voltage, power failure or over heat, etc.
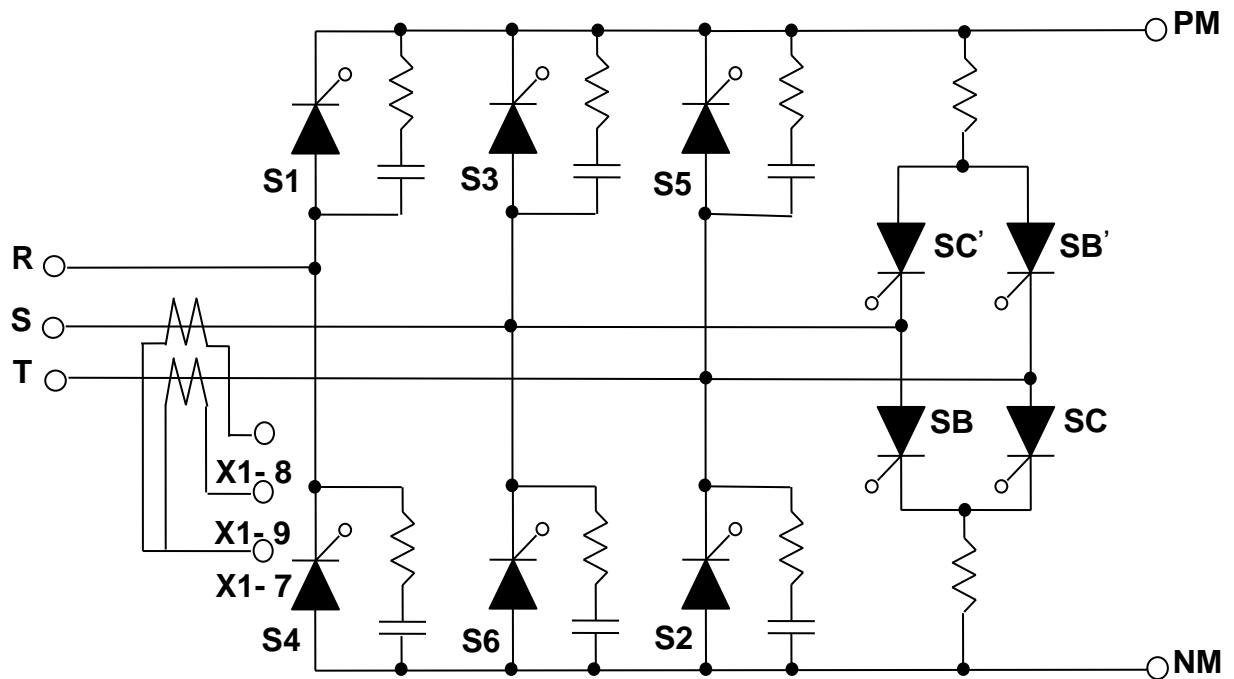
④ **Improved Reliability**

The input and output control parts of the PCB circuit are divided by a photo coupler to avoid being influenced by noises. Therefore, the reliability is improved.

2. Control Circuit Diagram

SCR BANK   Magnet Port

3-ph. AC
220 / 380 / 440V
50 / 60 Hz

Voltage Ref. ⟶ Vol. Contr. ⟶ Cur. Contr. ⟶ Gating Unit

Output Voltage
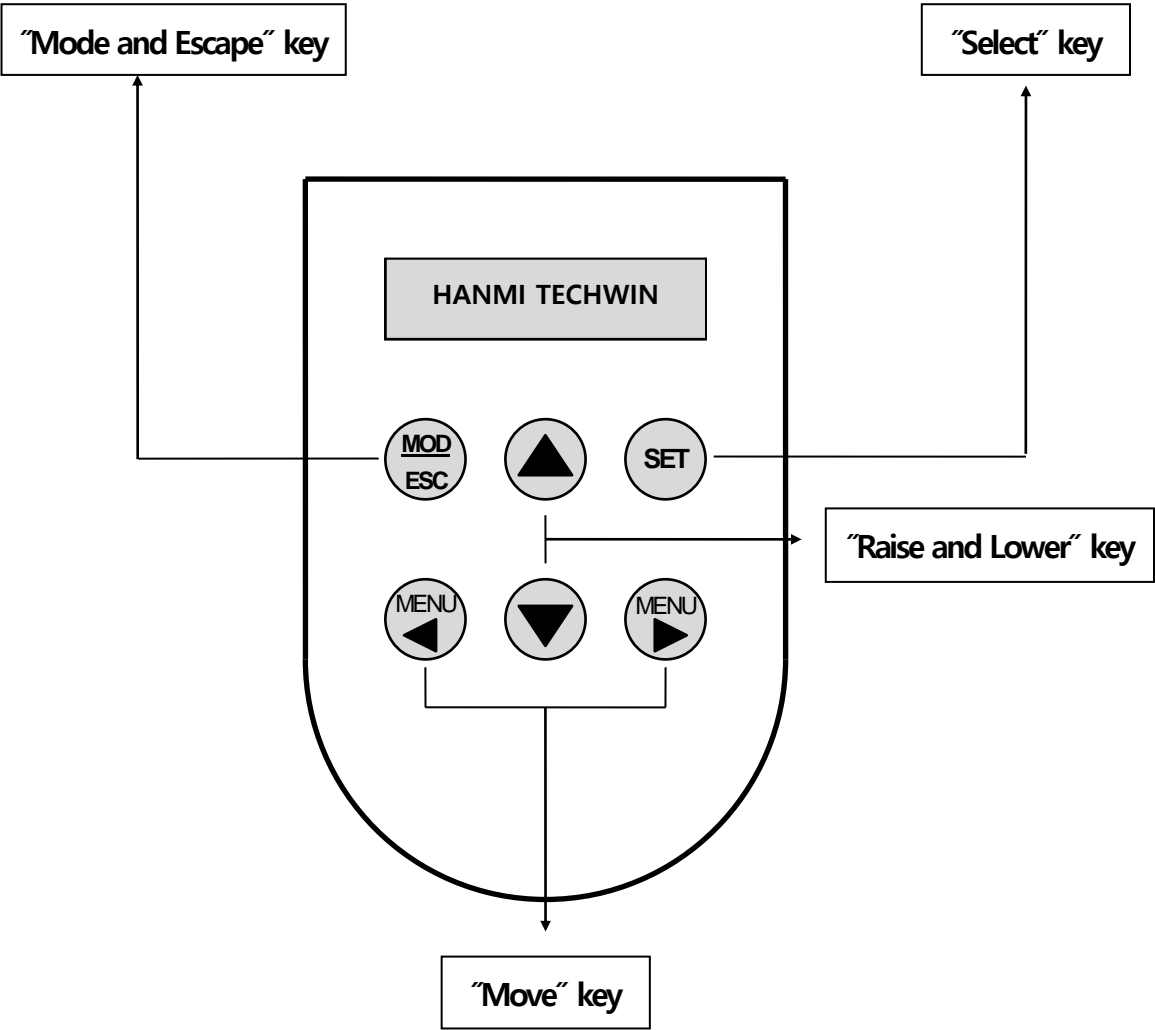
3. Power Circuit Diagram

● S1, S2, S3, S4, S5, S6 :   3-ph. Converter for **LIFT**.

● SB, SB′, SC, SC′:   2-ph. Converter for **DROP**.

## 4. Keypad

"Mode and Escape" key

"Select" key

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MOD
ESC

SET

MENU
◄

▼

MENU
►

"Raise and Lower" key

"Move" key

5. Menu Structure

	Menu - Level 1	Menu - Level 2	Range	Default
			Explanation	
Mode setting	Parameter	K_P of AVR	1~999	200
		K_I of AVR	0~999	200
		K_{PC} of ACR	1~999	50
		K_{IC} of ACR	0~999	50
		Ref 1	65~120	100 [%]
		Ref 2	100~185	165 [%]
		Ref 3	140~200	200 [%]
		NR_ref 1	10~30	20 [%]
		NR_ref 2	30~50	40 [%]
		NR_ref 3	50~70	60 [%]
		NR_ref 4	70~90	80 [%]
		NR_ref 5	90~100	100 [%]
		t 1	2000~7000	5000 [ms]
		t 2	2000~7000	5000 [ms]
		Holding time	0~5000	1500 [ms]
		Drop voltage	0~150	100 [%]
		Overload	120~200	150 [%]
		Over current	150~300	200 [%]
		DC vtg. gain	80~110	100 [%]
		ACCT cur. gain	80~110	100 [%]
		Magnet cur.DG	10~999	100 [A/100%]
		Magnet vtg.DG	50~999	220 [V/100%]
		LIFT of Max. Vtg.	130~200	140 [%]
	Select set	Operator	Stick / Potential	Stick
		Control object	Voltage/Current control	Voltage control
		Unit (%/real)	Percent / Real unit	Percent unit
		Control mode	NR/CR/OE/OS mode	NR mode
	Initialize	Fault init	All the memory of the former faults is erased	
		Parameter init	All the parameter values are initialized as default	
		System reset	System is restarted	
	Fault scan		The former faults can be shown on the keypad (10 faults)	

6. Control Keypad

In order to enter the mode setting function, you should press $\overset{\text{MOD}}{\text{ESC}}$ key continuously more than 3 seconds. After pressing more than 3 seconds, "touch off" message is displayed on LCD and if you stop pressing the key under this state, you can enter the mode setting function.
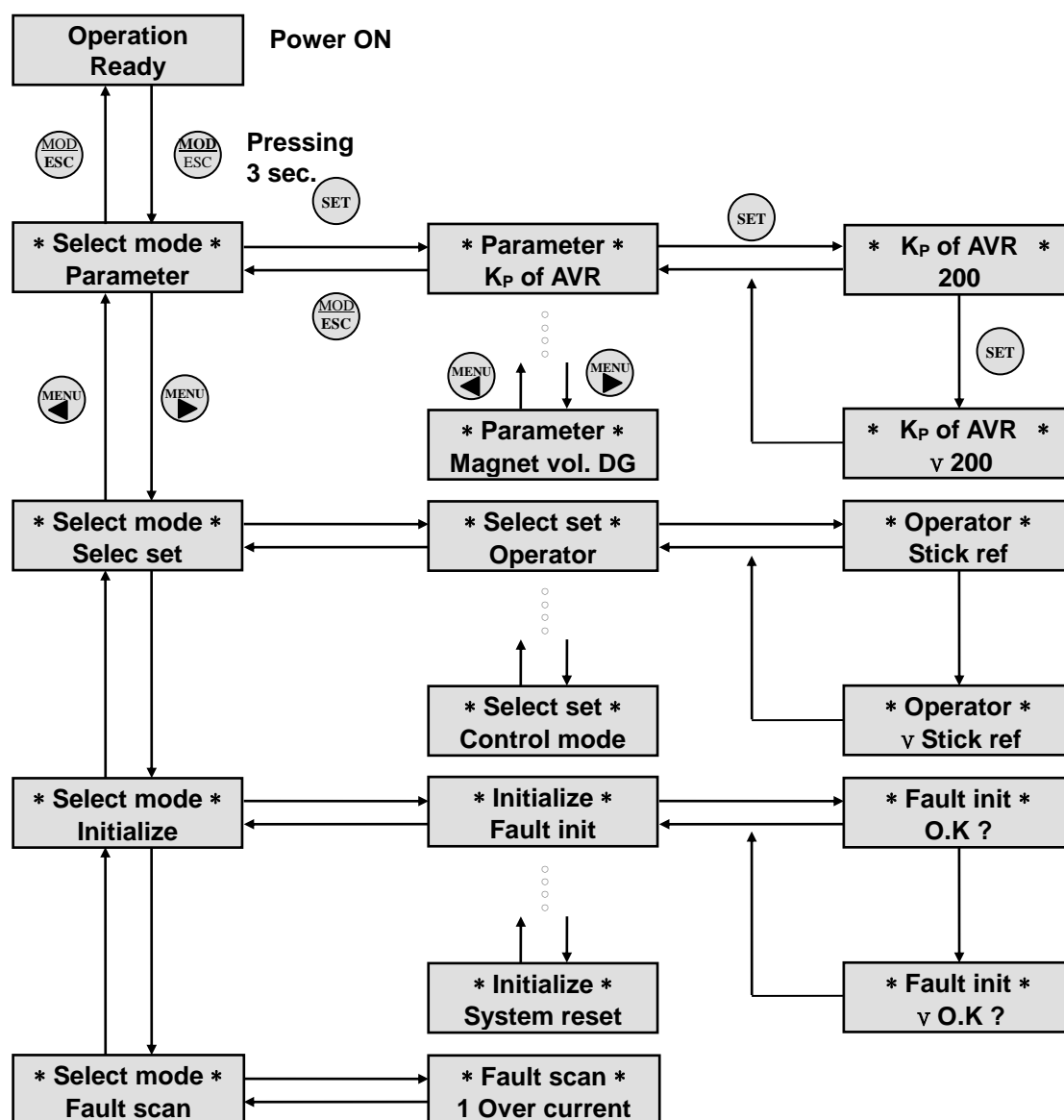
7. Operator Selection

The operation of lifting magnet is divided into two types of control systems.
One is potential type which allows the stepless command value and the other is stick type which generates only the step command value, already designated.
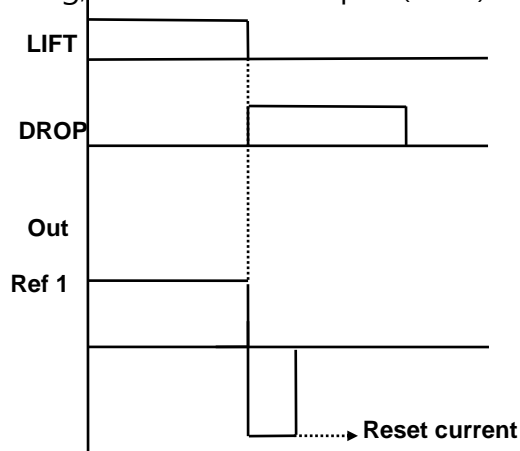
① **Stick Type** : There are 4 modes according to the operational characteristics.

・NR Mode : A constant output is generated according to each one of the notch signals
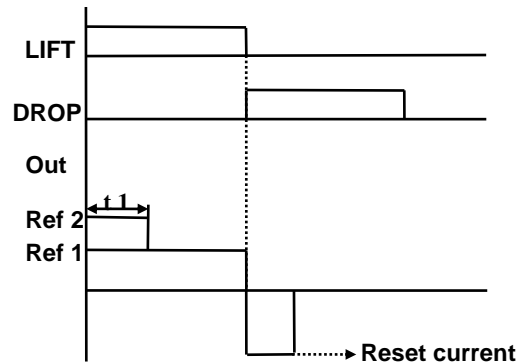(**2N**, **3N**, **4N**, **5N**).
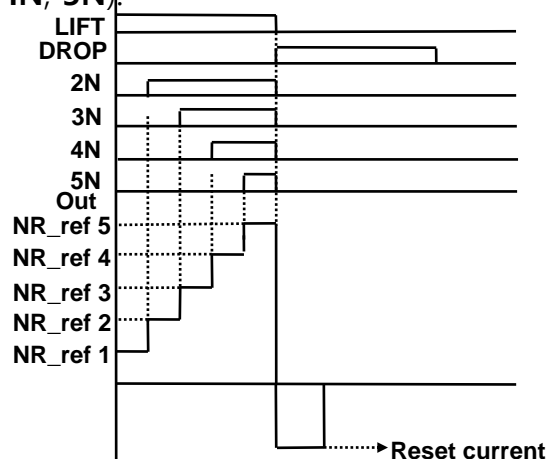
・CR Mode : In case of lifting, the constant output (**Ref1**) is generated.

· OE Mode : At the initial stage of lifting, the output (**Ref2**) more than the rated voltage

(220[V]) is generated for a certain period of time (**t1**).

· OS Mode : In case of lifting, a constant output (**Ref3**) is generated within the time (**t1**) and secondly, the other output (**Ref2**) is generated for a certain time (**t2**). The range of **Ref2** and **Ref3** is 100[%]~200[%] of the rated voltage.
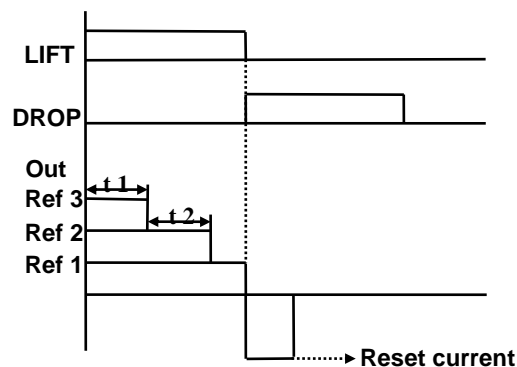
② **Potential Type**

Potential type operation is closely connected with **LIFT** or **DROP** signal and the output is generated according to **Vref** signal (0~4[V]).

③ **Drop**

In case of drop order, the system removes the current of magnet very fast by applying the maximum reverse voltage from the negative converter. Therefore, the separating time becomes very short and operating efficiency is improved. The amount of reverse voltage and applying time can be adjusted by drop voltage and holding time.

8. Control Method Selection

The reference value can be voltage or current. In case of voltage control, one mode is selected among CR, OE, OS and NR mode and in case of current control, one is selected between CR and NR mode.

Control object : Voltage / Current,   Default : Voltage control
Control mode : NR mode / CR mode / OE mode / OS mode,   Default : NR mode

① **Voltage control**

The structure of AVR (Adjustment of Voltage Regulator) is the same as a proportional-integral controller. To have proper response and stability, proportional gain (Kp) and integral gain (Ki) should be adjusted.

K_P -   Range :   1 ~ 999,   Default : 200
K_I -   Range :   0 ~ 999,   Default : 200

● At the maximum magnet voltage, the feedback signal of the voltage between PM and NM is 4[V] (**TP1**) where the maximum magnet voltage is 200 [%] of the rated voltage (220[V]).

② **Current Control**

● ACR (Adjustment of Current Regulator) decides current response characteristics.
so, to have proper current response and stability, proportional gain (Kpc) and integral gain (Kic) should be adjusted.

K_{PC} -   Range :   1 ~ 999,   Default : 50
K_{IC} -   Range :   0 ~ 999,   Default : 50

● The upper value of current feedback coming from ACCT (AC Current Transformer) is 1 [V] at 100 [%] of the rated magnet current. The current loop is used as the inside loop of voltage control or controlled as the main loop if current control function is selected.

● Firing angle is generated as the output of current controller.
The range of firing angle is 0°~160°.

● Zero current detection
Zero current detection is for safe commutation of thyristor in forward-reverse operation.
When reverse operation is changed to forward operation, forward thyristor should be turned on after confirming zero current.

9. Gain Adjustment

In case of receiving the numerical values from analog data, if the conversion gain is not correct, errors occur in the processor. Thus the conversion gain should be adjusted.

DC voltage gain adjusts magnet voltage gain and ACCT current gain adjusts current measurement gain coming from ACCT up to 10 [%].

10. Initialization

There are three kinds of Initializations.

① **Fault Initialization** : This makes "Ready" state by removing the records of former faults.

② **Parameter Initialization** : This sets every parameter or selection function to default values.

③ **System Reset** : This function restarts the system.

11. Display Monitor

① **Operation condition monitoring**

In this magnet system, operation condition, every kind of voltage, current (variable according to display gain setting) and firing angle can be displayed on LCD as percent unit or real unit (Select "Percent Unit" or "Real Unit" in the Unit mode (%/real). In order to monitor a parameter, the menu key is used in pointing out the parameter. The meanings of parameters displayed on LCD are as follows. (In case that the display gain is set to default value)

V_d = 100 [%] (220V)   ;   Present PN voltage
i_d = 100 [%] (100A)   ;   Present PN current
Ref = 100 [%]   ;   Voltage reference value
i_d_ref = 100 [%]   ;   Current reference value
α =   66 [°]   ;   Firing angle

Also, "**L**" or "**D**" mark shows whether the three phase converter of the dual converter for **LIFT** is applied or the single phase converter for **DROP** is applied.

● Display condition during operation

LIFT   L   S   NR

V_d = 100 %

Lifting now ← Present output → Operator : Stick type , NR mode
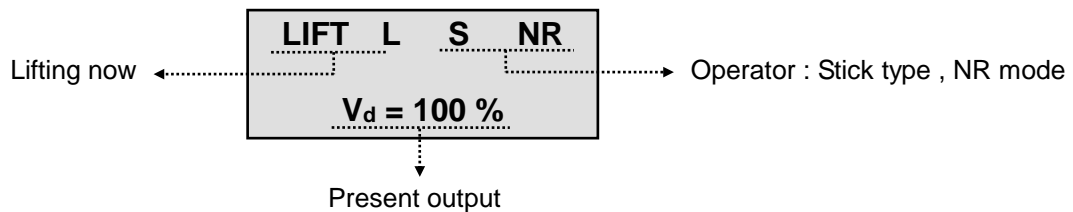
② **Fault**

When a fault occurs, the content of the fault is displayed on LCD until "Reset" signal comes in. The following figure shows the display in case of over current.

∗ Fault ∗

Over current

RESET

Operation

Ready
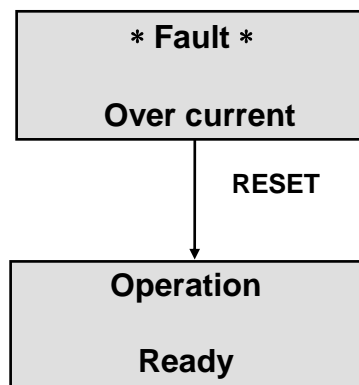
12. Protective Functions

① **Over current**

This system has a protection function that protects SCRs and Magnets from over current.

② **Over load**

③ **Fuse or Over heat**

Due to fuse damage or the operation of the temperature sensor, if temperature becomes higher than 85°, the operation of the system stops.

④ **Line Power off**

The thyristor firing angle is decided by having the voltage between S and T among the input R, S, T voltages go through the phase-locking system. In this case, if the voltage between S and T and between R and S are not detected, "Line Power Off" mark appears in LCD. If the order of R, S, T is changed, the firing order becomes changed according to the changed order of R, S, T.

⑤ **Sensor Fault**
   If abnormal condition is detected in the PCB by two current sensors and magnet sensor, the lifting magnet stops and "V & Sensor Fault" mark appears on LCD.

13. Terminal Assignment

① **Ref Analog Input**
   This input is the reference value of potential type and the maximum value is 4 [V], which means 100 [%] of the rated voltage. In case of current control, the maximum value becomes 100 [%] of the rated current.

② **Lift Input and Drop Input**
   Lift and drop inputs are used for the direction control and composed of the short-circuits of lift or drop input terminal.
   If the reference is neither lift nor drop input, the former state is maintained.

③ **Stick Input Terminal**
   2N, 3N, 4N and 5N terminals according to the reference are used for setting NR-ref2...NR-ref5 as the reference value. If 2N, 3N, 4N and 5N terminals are all open, the reference value becomes NR-ref1.

④ **SO (Safe Operation) Input**
   This function is for preventing the falling due to the swaying in case of crane moving.
   When safe operation signal comes into the short-circuit signal, NR mode or Potential type generates the output of 100 [%] of the rated voltage (Voltage Control) or rated current (Current Control).

⑤ **Current Detector Input**
   This function is detecting the input current of the converter by using two ACCTs.
   At 100 [%] of the rated current, 1 [V] is the input value.

⑥ **Voltage Detector**
   This function is detecting the magnet input voltage through the positive and negative voltage input terminals. In case of lifting, the feedback voltage signal is 4 [V] at the maximum voltage.

⑦ **MX Output**
   This function prevents the falling of load by using the battery with MX relay operating when the supplying of current to the magnet is impossible due to the occurrence of fault and protection function under lifting state.

14. Standard Specifications

TYPE ITEM	FDR-35	FDR-50	FDR-70		FDR-110		FDR-150		FDR-180		FDR-250	
OUT PUT [kW]	6KW	9KW	12KW	15KW	19KW	22KW	26KW	29KW	31KW	38KW	42KW	52KW
RATED CURRENT [A]	28A	42A	55A	68A	87A	100A	120A	131A	141A	173A	205A	237A
HEAT SINK	252 × 60 × 440											
CT PRIMARY TURNS	2	1										
R-C SNUBBER	RCS-02 (10W 68Ω, 0.1μF2000V)											
COOLING FAN	120 × 120 × 38 (AC 110, 220V)-2EA										120 × 120 × 38(AC110,220V)-4EA	
THERMOSTART	85℃ NORMALLY CLOSE											
TRANSFORMER	CAP. : 35VA Freq. : 50 / 60 Hz Primary vtgt. : 220V, 380V, 440V, 460V Secondly : 8V, 10V											

15. Dimension Drawings (UNIT: mm)