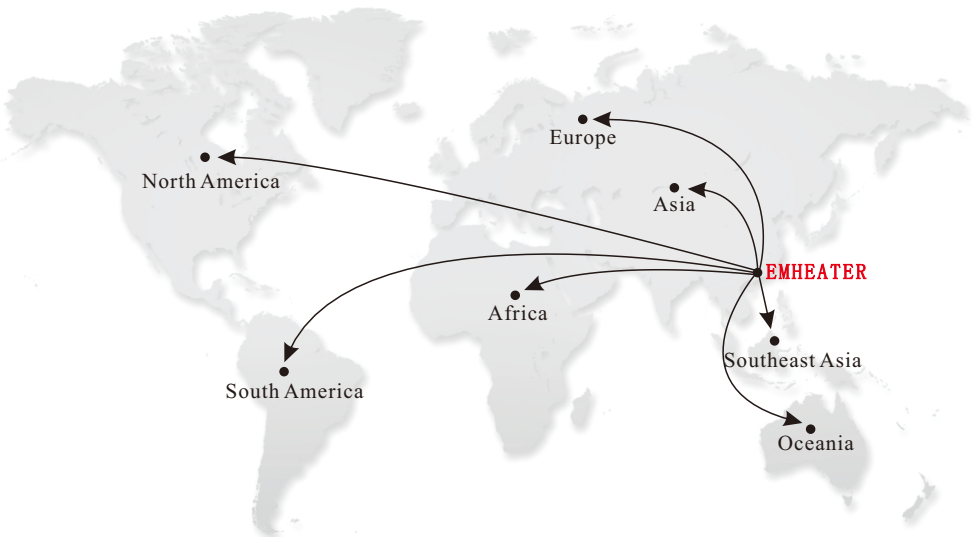
EMHEATER

User's Manual

EM-BU Series Braking Unit



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China EM Technology Limited

Preface

Thanks for your interest in EM-BU Dynamic Braking Unit manufactured.

EM-BU Dynamic Braking Unit is a high-performance braking product with Canada technology and has been applied extensively to elevator, crane, production machinery, mine hoist, centrifuger and oil pump in oil field, etc.

EM-BU Dynamic Braking Unit is able to release the energy regenerated during motor speed regulation by brake resistance so as to produce enough braking torque to ensure normal operation of transducer and other devices.

This manual is provided for things needing your attention when installation, wiring, parameter setting and troubleshooting. To ensure install and operate this product properly to exert its advantages, please refer to this manual in detail before installation.

This manual is attached with the machine; please keep it appropriately and present to its users.

Table of content

Open box and inspection

Check and confirm the following things:

Whether the product is damaged or not?

Whether marks on the nameplate are according to your order?

The production and packaging to leave factory have passed strict inspection, if you possibly find any defect, please contact us or the supplier to solve.

Testing method

After unpacking, set the diode shift of digital multimeter while red and black probes are connected with DC (+), DC (-), RL1 and RL2 respectively to test the performance of the unit simply, and results should be shown in the following tables:

(Table 1) Test results for EM-BU1/BU2/BU3

Red probe	Black probe	Results when normal
DC(+)	DC(-)	The voltage drop is infinite.
DC(-)	DC(+)	The voltage drop is 600~900mV.
RL1	RL2	The voltage drop is infinite.
RL2	RL1	The voltage drop is 300-600mV.

(Table2) Test results for EM-BU3H/BU4H/BU5H

Red probe	Black probe	Results when normal
DC(+)	DC(-)	The voltage drop will rise from zero to infinite , and final stable at infinite
DC(-)	DC(+)	The voltage drop is between 300~700mV.
RL1	RL2	The voltage drop is between 200~500mV.
RL2	RL1	The voltage drop will rise from zero to infinite.

(Table 3) Test results for EM-BU3HA/BU4HA/BU5HA

Red probe	Black probe	Results when normal
DC(+)	DC(-)	The voltage drop will rise from zero to infinite , and final stable at infinite
DC(-)	DC(+)	The voltage drop is between 300~700mV.
RL1	RL2	The voltage drop will rise from zero to infinite.
RL2	RL1	The voltage drop is between 200~500mV.

Remark

This method is only suitable for testing the performance of modules, but not for the whole machine.

Chapter I Safety clause

1.1 Definition of safety

Danger	It indicates the operator or user may be exposed to damage by violating instructions when operating.
Caution	It indicates the machine may be damaged or fail to operate when it is not operated according to the instructions.
Remark	Some prompts for better using this machine and realizing satisfactory effects.

1.2 Precaution of installation and wiring

Danger
Wiring must be finished by professional and qualified persons, or else the electric shock may happen. When installation and wiring, braking unit and the connected transducer, etc. must be power off and after 5-10 minutes, confirm electric quantity in the internal capacitors of related device is discharged completely, then operate to ensure safety. Earthing terminal of the unit must be grounded reliably to prevent electric shock.
Caution
The cathode and anode of the DC bus of the unit should be properly connected, otherwise, the unit will not work and it will even cause damage to the unit and other devices, and fire disaster. The unit should be installed in the place with sound ventilation; otherwise, the unit will not work normally and may be damaged.

1.3 Caution of using

Danger
After be electrified, all internal parts of the unit possess high voltage that will endanger life when the body is contacted directly.

Caution
Be careful not to have bolt and gasket, etc. inside the unit so as to prevent damage to the machine. When using, do cover the case properly.
Danger
When necessary, scrap the machine according to the process of industrial waste, otherwise, explosion may be triggered.

Chapter II Product model and specification

2.1 Models and specifications

(Table 2.1) Models and specifications of the dynamic braking unit

Models	Specific occasion	Min. resistance	Rated current	Peak current	Match inverter
EM-BU1	Dynamic braking	20 ohm	6A	33A	0.75~18KW
EM-BU2	Dynamic braking	15 ohm	10A	50A	22~45KW
EM-BU3	Dynamic braking	7 ohm	15A	100A	55~110KW
EM-BU3H	Dynamic braking	5 ohm	40A	150A	132~160KW
EM-BU4H	Dynamic braking	3.5 ohm	50A	200A	187~220KW
EM-BU5H	Dynamic braking	2.5 ohm	60A	300A	250~315KW
EM-BU3HA	Dynamic braking	5 ohm	40A	150A	132~160KW
EM-BU4HA	Dynamic braking	3.5 ohm	50A	200A	187~220KW
EM-BU5HA	Dynamic braking	2.5 ohm	60A	300A	250~315KW

Remark

Rated current is the max. Average current when the unit works. Peak current is the max. Current allowable when the unit works and it can be maintained for at most 20 seconds.

Caution

The min. resistance is the min. braking resistance for the unit, which must be determined by considering the capacity of the machine and the needed braking torque and must not be lower than the min. resistance.

2.2 Technical specification

(Table 2.2) Product technical specifications

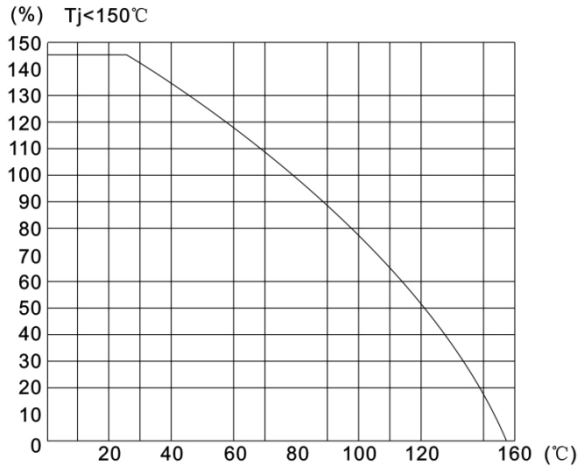
Items		Specifications
Power	Grid voltage	Three-phase 220V/380V/460/660V (it depends on the models)
	Grid frequency	45Hz～65Hz
Control	Braking mode	Automatic voltage tracking
	Response time	Within 1ms, multiple noise filtering algorithm
	Response voltage	It depends on the models.
	Hysteresis voltage	Less than 10V
	Protective function	Overheating, over-current and short circuit
	Overheating protection	75℃
	Digital input port	One, and function setting by software
	Digital output port	One, and function setting by software
Indications and setting	Status indication	All types are with power and working indications. Types with operation panels are with power, fault, blown fuse and braking status indications.
	Operation monitoring	Types with operation panels are available with operating parameters for monitoring DC bus voltage and inside temperature.
	Response voltage setting	For EM-BU2/BU3 series, it can be set by the jumper wire in short circuit. For EM-3HA/4HA/5HA series, it can be set directly by operation panels. For others, it can be set when leaving factory.
Conditions	Installation site	Indoor, less than 1000m altitude, no direct sunlight, without conductive dust or corrosive gas.
	Ambient temperature	-10~40℃ and sound ventilation
	Ambient humidity	Below 90％RH （no dewing)
	Vibration	Below 0.5g

Remark

"*" means suitability for EM-3HA/4HA/5HA series.

2.3 Temperature-current curve

With the change of the temperature of the radiator in the unit, the allowed max. Current is varying; the max. Current and temperature have connection as follows:

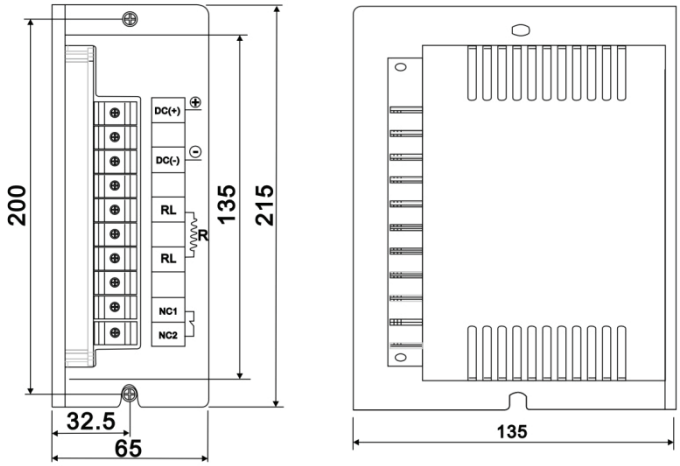


(Illustration 2.1) Temperature-current curve

From the figure, when the temperature of the radiator is above 75℃, the allowed max. Current will drop, in this sense, the temperature when the unit works should be controlled.

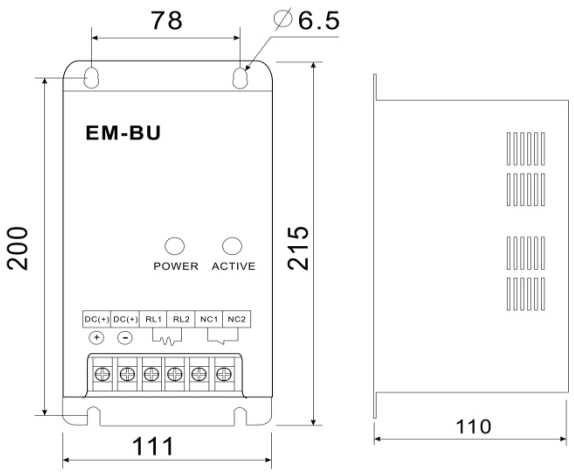
2.4 Installation dimension

2.4.1 Dimensions of EM-BU1 braking units



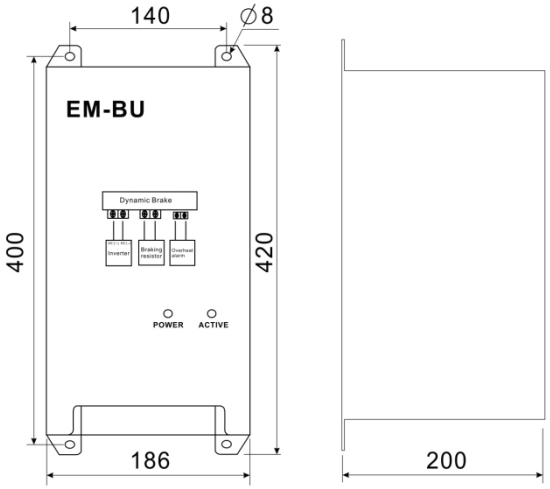
(Illustration 2.2) Dimensions of EM-BU1 braking units

2.4.2 Dimensions of EM-BU1/ BU2 braking units



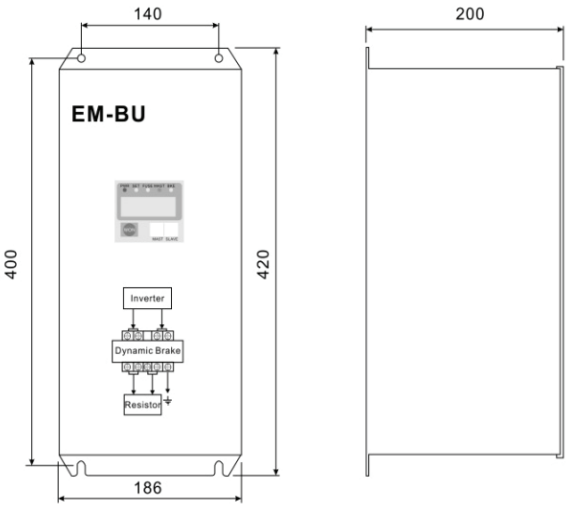
(Illustration 2.3) Dimensions of EM-BU2/BU3 braking units

2.4.3 Dimensions of EM-BU-3H/4H/5H braking units



(Illustration 2.4) Dimensions of EM-BU-3H/4H/5H braking units

2.4.4 Dimensions of EM-BU-3HA/4HA/5HA braking units



(Illustration 2.5) Dimensions of EM-BU-3HA/4HA/5HA braking units

2.4.5 Mechanical parameter table

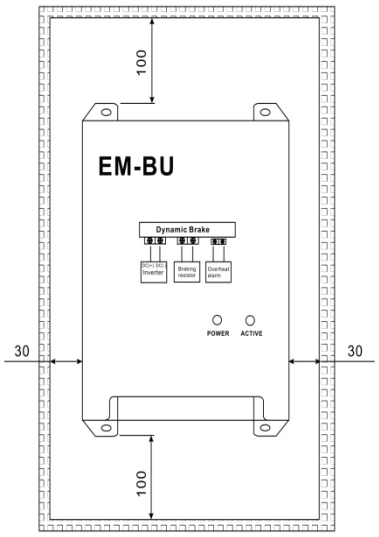
(Table 2.3) EM series of braking unit mechanical parameter table

Model	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	Mounting hole (mm)	G.W (KG)
EM-BU1	200	185	215	65	32.5	135	7	2
EM-BU2	200	215	111	78	110	-	6.5	3
EM-BU3								5
EM-BU3H	400	420	186	140	200	-	8	10
EM-BU4H								
EM-BU5H								
EM-BU3HA								12
EM-BU4HA								
EM-BU5HA								

Chapter III Product installation guide

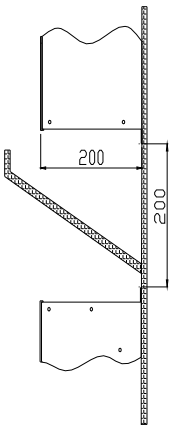
3.1 Installation way of the unit

The braking unit needs to be installed on the noninflammable and firm surface while taking ventilation, heat dissipation and safety into consideration since it will produce heat. Enough space should be reserved surrounding the unit, which should be at least 100mm from the upper and lower parts, and 30mm from left and right.



(Illustration 3.1) Installation space for EM-BU braking units

When several braking units need to be installed in a vertical row, they should be with a vertical distance of at least 200mm. Meanwhile, a baffle should be configured to prevent the lower unit having influence on the upper one for it will produce heat. The installation is as follows:



(Illustration 3.2) Installation for two braking units in a vertical row

⚠ Caution

The braking unit must be installed in a place with sound ventilation. When it should be in the cabinet, the cabinet must have openings for heat dissipation and be necessarily set with fans properly located to ensure perfect dissipation.

⚠ Caution

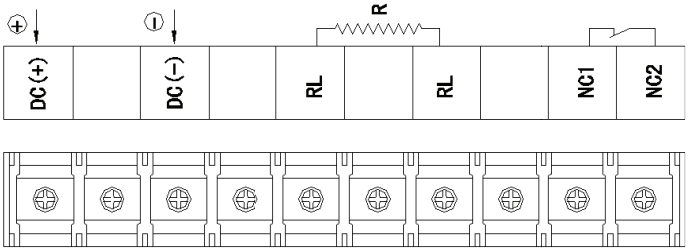
The brake resistance must be mounted in a separate cabinet to be isolated from transducer, the braking unit and other devices for it will produce a large amount of heat when working. It should be noticed that the improper position for the brake resistance will probably result in abnormal operation of or damage to other devices.

⚠ Caution

The brake resistance must be placed far away from the inflammable and explosive, and out of touch.

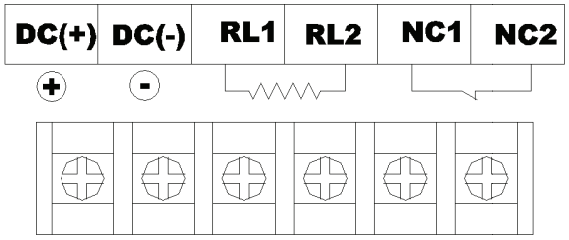
3.2 Array of main loop terminals of braking units

3.2.1 Array of terminals of EM-BU1 braking units



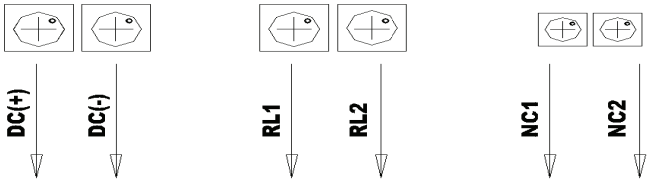
(Illustration 3.3) array of terminals of EM-BU1 braking units

3.2.2 Array of terminals of EM-BU2/BU3 braking units



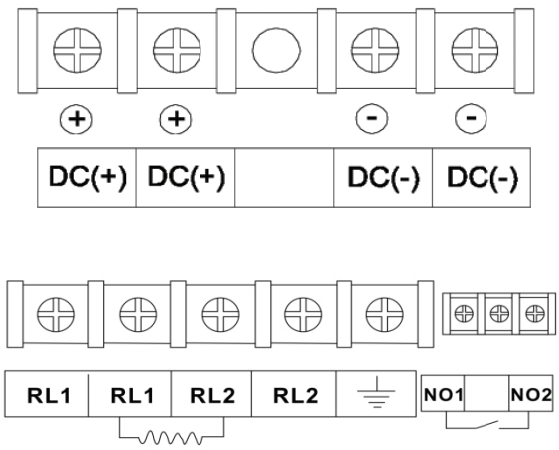
(Illustration 3.4) array of terminals of EM-BU2/BU3 braking units

3.2.3 Array of terminals of EM-BU-3H/4H/5H braking units



(Illustration 3.5) array of terminals of EM-BU-3H/4H/5H braking units

3.2.4 Array of terminals of EM-BU-3HA/4HA/5HA braking units



(Illustration 3.6) array of terminals of EM-BU-3HA/4HA/5HA braking units

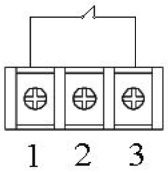
3.3 Connection of main loop

3.3.1 Power supply input terminal

DC(＋) and DC(-) are respectively the positive and negative input ends of the DC bus of the unit, which should be connected correctly to the positive and negative input ends of the DC bus of the transducer. When the transducer needs to be connected with a DC reactor, the anode of the DC bus of the unit should be behind the DC reactor. The distance between the DC bus of the transducer and that of unit should be short as much as possible.

3.3.2 Brake resistance, fault protection and earthing terminal

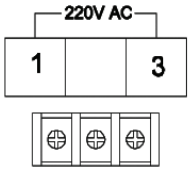
RL1 and RL2 are connection terminals of brake resistance and should be connected correctly to the brake resistance of which the resistance value and power should be determined properly.
NC1 and NC2 are dry contact outputs for internal fault protection. When overheat inside the unit happens, the internal contact responses. The dry contact may cooperate with the external control loop to alarm and display PLC state.



(Illustration 3.7) Temperature switch leading-out terminal

Special earthing terminals are available for EM-BU-3HA/4HA/5HA braking units, which should be reliably grounded according to requirements.

3.3.3 Auxiliary power terminals

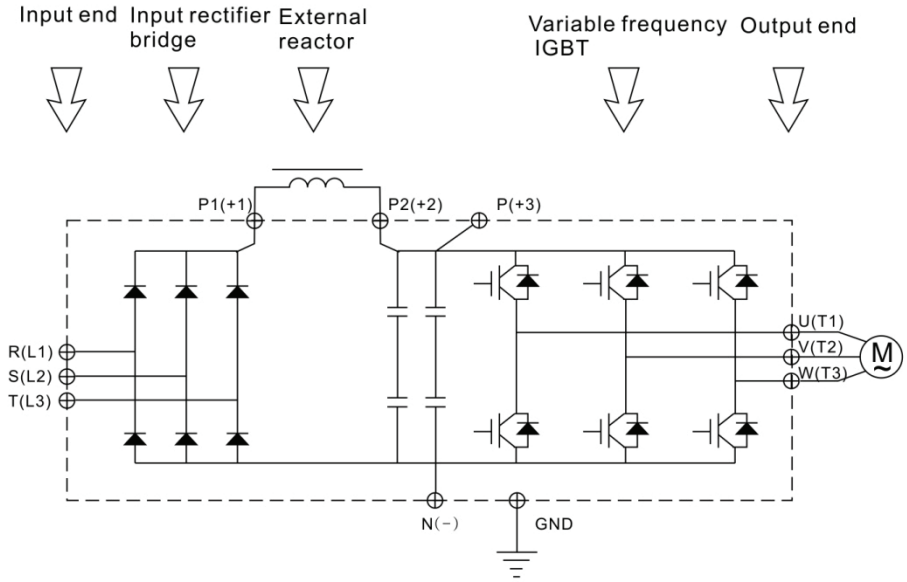


(Illustration 3.8) Auxiliary power terminals

Auxiliary power terminals are available for EM-BU-3HA/4HA/5HA braking units with 660V voltage, which should be connected correspondingly to AC 220V when using. Meanwhile it should ensure to get through 220V before the DC bus is applied voltage. If it is electrified in improper order and the auxiliary power is too much high, the unit will not work normally and even be damaged.
Braking units with 220V/380V/460V have no such auxiliary power terminals which may not be connected when using.

3.3.4 Recognition of the DC bus terminal of the transducer

When EM-BU braking unit is used together with transducer, DC input ends "DC(+)" and "DC(-)" of the unit must be connected correctly to the positive and negative input ends of the DC bus of the transducer. Frequently, there is many main loop terminals related to the DC bus, so it is somewhat difficult in recognizing the ends of the DC bus of the transducer. The followings are mostly terminals for transducer.



(Illustration 3.9) Connection terminals for main loop of transducer

Whereof, "P1","P2","P" and "N" are related to DC bus. "N" is negative terminal of the DC bus and easily to be recognized, and it should be connected with DC(-) of the unit.

"P1" and "P2" are terminals of external DC reactor and connected by a short circuit copper bar because the transducer is without external DC reactor when leaving factory.

"P" is external terminal of the braking unit and positive terminal of DC bus and it should be connected with DC(+)of the unit.

Remark

Owing to different manufacturers and powers, the transducer may be provided with terminals with number not as defined in the illustration. In such a case, please refer to the instruction carefully to find out the DC bus terminal for the transducer rightly.

Remark

Terminals "P1" and "P2"of the external DC reactor may be "P1" and"P2" sometimes. Some transducers with small powers do not provide with the external DC reactor terminals; Terminals "P2" and "P" may also be led out as combined positive end of the DC bus. Usually, it will be indicated as "P+" or "+", etc. The terminal to the cathode of the DC bus of the transducer may be indicated as "N-" or "-". For this, please refer to the instruction accordingly.

(Table 3.1) Main circuit wiring specification

Model	Rated current(A)	Peak current(A)	Copper cable cross section(mm2)
General type			
EM-BU1	6	33	4
EM-BU3H	40	150	10
EM-BU4H	50	200	10
EM-BU5H	60	300	10
Model	**Rated current(A)**	**Peak current(A)**	**Copper cable cross section(mm2)**
Economic type			
EM-BU2	10	50	4
EM-BU3	12	100	4
High-end type			
EM-BU3HA	70	150	10
EM-BU4HA	85	200	10
EM-BU5HA	120	300	16

Remark

BX cables have preferable flexibility and cables may have contact with high-temperature devices, so it is recommended to adopt copper core and heat resistant BX cables or flame retardant cables.

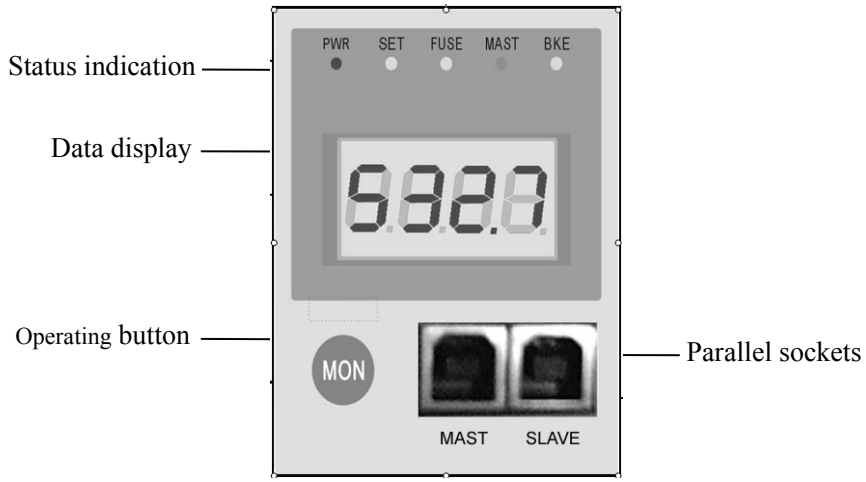
Caution

Distance between the braking unit and transducer should be short as much as possible, that is, it is better 1m at most. Alternatively, the cables at the DC side should be stranded to relief radiation and inductance.

Chapter IV Introduction to operation panel

4.1 Illustration of operation panel

To facilitate convenience, the operation panel consists of status indication area, data display area, operating button and parallel sockets is set in the panel of EM-BU-3HA/4HA/5HA braking units, as follows:



(Illustration 4.1) Operation panel

Except for EM-BU-3HA/4HA/5HA braking units, other EM-BU braking units mentioned in this manual are not set with operation panels.

4.2 Status indication area

Status indication area of EM-BU-3HA/4HA/5HA braking units consists of five light indicators which will be for different meanings when lightened, as table 4.1 below.

(Table 4.1) Definition of status indicators of operation panel

Indicators	Functions	Explanations
PWR	Power supply indication	It will be on after electrifying.
SET	Parameters setting state indication	When it is on, it means in a state of parameters inquiry, including rated voltage, max, current, response voltage, radiator temperature, fault history and software version. When it glitters, it means in a state of setting rated voltage or response voltage.
FUSE	Blown fuse indication	When it is on, it replies burnout of fuse inside the unit.
MAST	Master and slave status indication	When it is on, it replies the unit is working in main mode, or else in slave mode.
BKE	Braking indication	When it is on, it replies the unit is working for braking.

4.3 Data display area

Four-digit LED data tube in the data display area of the operation panel are used for displaying data. There are three displays considering "SET" indicator is on or off in the status indication area.

When "SET" indicator in the status indication area is off, it displays the current voltage value of the DC bus of the braking unit.

When "SET" indicator in the status indication area is on, it displays rated voltage, rated current, response voltage, radiator temperature, fault history and software version in the format as in table 4.2.When "SET" indicator in the status indication area glitters, it displays the set value of rated voltage or response voltage.

(Table 4.2) Display parameter and format

Displayed item	Display format	Explanation
Rated voltage	L380	Grid voltage (remark: Be noticed that change of voltage level will cause difference of relevant parameters)
Max. current	A300	Max. current of the braking unit
Response voltage	P 675	Displaying the set value of the current response voltage
Radiator temperature	H31.0	Displaying the temperature of the radiator of the unit.
Fault history	E .- - -	Displaying the previous faults to the unit.
Software version	U2.02	Displaying the software version of the unit.

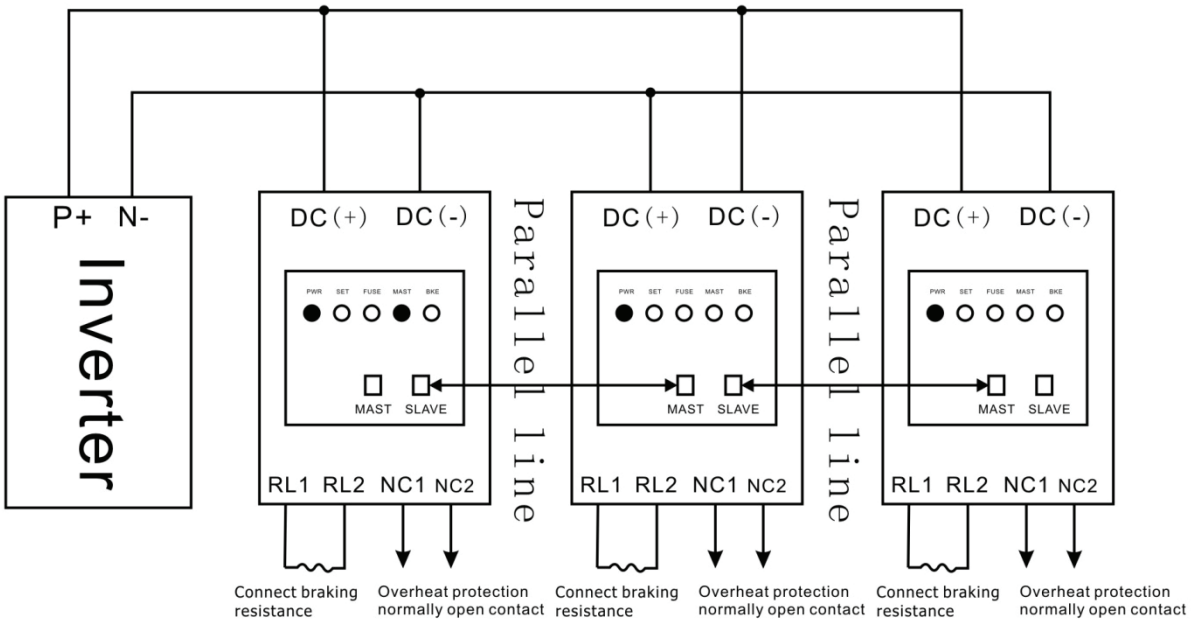
4.4 Introduction to buttons

Buttons on the operation panel of EM-BU-3HA/4HA/5HA braking units are used for changing display status and setting parameters.

By default, "SET" indicator on the operation panel is off and displays the voltage of the DC bus. When press button "MON" on the panel, it will switch to parameters inquiry while "SET" indicator turns on. By pressing the button once, it is able to automatically convert among the items in table 4.2. Under this state, if the button is not pressed within successive 5 seconds, it will recover to display the voltage of the DC bus while "SET" indicator turns off.

If it is displaying the response voltage of the unit, it may enter the state of setting the response voltage by pressing "MON" for above 2.5 seconds. This moment, "P" before "SET" indicator and rated voltage will glitter every 0.75 seconds periodically. Under this state, by pressing slightly the button, the displayed value of the response voltage will change among the corresponding 10 set values of the rated voltage of the unit. After setting the response voltage, press "MON" for above 2.5 seconds, it is able to save the current response voltage and recovers to display the voltage of the DC bus by default.

4.5 Parallel sockets and switch between master and slave modes



(Illustration 4.2) Diagram of HA Parallel Connection

To facilitate parallel connection of EM-BU-3HA/4HA/5HA braking units, parallel sockets are provided on the operation panel. When braking units need to be in parallel connection, the "MAST" of the following unit should be connected with the "SLAVE" of the previous unit orderly by a special line. To ensure all braking units in parallel connection work simultaneously, it may press "MON" for above 2.5 seconds in the state of displaying the voltage

of the DC bus (until "MAST" indicator changes its indication status) so as to switch between master and slave modes of the unit. When "MAST" indicator is on, it shows the braking unit is host machine and slave machine when it is off. Of all braking units in parallel connection, one should be set as host machine and the others are slave machines.

⚠ Caution

When used alone, the braking unit must be set as host machine (default mode when leaving factory), otherwise it cannot work normally.

⚠ Caution

When in parallel connection, only one of them should be set as host machine and the others are slave machines. It is prohibited to set more than one unit as host machine or all units as slave machine. Otherwise they cannot work normally.

⚠ Caution

When in parallel connection, special line must be adopted to connect all braking units together, otherwise they cannot work normally.

Chapter V Selection of braking unit

The braking unit is an electronic device working for short time and at intervals. It has limited capability to work under heavy current for long time, so the type should be selected reasonably to ensure it will not be damaged as a result of over-current and overheat when working.

The braking unit should be selected based on the rated and peak currents. The rated current is direct ratio to the current needed for the unit to work constantly for long time, and the peak current is the max. current passing the unit. To ensure normal operation of the unit, the max. Current passing the unit must be lower than the peak current and the product of the max. current and the braking frequency Kc is less than the rated current.

5.1 General load quick selection

(Table 5.1) General load quick selection

Model	Rated current(A)	Peak current(A)	Light load power(KW)	Heavy load power(KW)
General type				
EM-BU1	6	33	0.75~22	0.75~15
EM-BU3H	40	150	160~180	75~132
EM-BU4H	50	200	200~250	150~220
EM-BU5H	60	300	280~400	250~315
Economic type				
EM-BU2	10	50	30~55	18.5~37
EM-BU3	12	100	75~132	45~55
High-end type				
EM-BU3HA	70	150	160~180	75~132
EM-BU4HA	85	200	200~250	150~220
EM-BU5HA	120	300	280~400	250~315

When the braking period for the speed control system is more than 200s, and the frequency Kc<10% in a period, type of the braking unit may be determined according to the load.

Remark

When the motor has actual load power less than 60% of the motor power, the machine can be regarded as underloading device or else as overloading device.

When the braking period for the speed control system is less than 200s, or the frequency Kc>10% in a period, type of the braking unit merely be determined according to table 5.1 for the result is that it will not ensure normal operation of the unit. If so, rated and peak currents for braking should be calculated according to the requirements for braking of the actual loads, and then the unit with rated and peak currents meeting the requirements and type may be selected according to table 2.1.

5.2 Selection of loads with periodical braking

For loads with periodical braking, the braking unit may be selected properly as follows:

5.2.1 I_{max} (peak current)

Determination of peak braking current (I_{max}) of the system

Peak braking current should be the current passing the braking unit to ensure the normal operation of the system and enough braking torque for the load.

(1) Normally, for the speed control system with 380V, when the braking torque is 100% rated torque, the max. braking current may be estimated by the following formula:

I_{max}(A) ≈ power of motor (KW)

(2) When the brake resistance is determined properly, the max. braking current may be estimated based on the resistance by the following formula:

I_{max}(A)≈700(V)/ brake resistance (Ω)

(3) For considerable inertia loads to be braked urgently, the necessary braking torque may be more than 100%,, for this reason, a higher peak braking current may be required.

5.2.2 Determination of average braking current (I_{av}) of the system

(1) Firstly, it should decide the braking frequency K_c of the system, which is defined as the ratio between the system braking duration and the braking period of the system.

K_c =braking duration/braking period ×100%

For different types of loads, the actual braking frequency K_c is varying. Considering this, K_c should be determined according to the operation conditions of the actual speed control system. When it seems impossible to decide the operation conditions of the actual load, the followings may be refereed for determination:

Elevator: K_c=10-15%

Oil pumping unit in oil field: K_c=10-20%

Uncoiling and recoiling machines: K_c =50-60%

Centrifuger: K_c =5-20%

Crane with descending height of above 100m: K_c =20-40%

Loads with incidental braking: K_c =5%

Others: K_c =10%

(2) Average braking current of the system may be estimated by the following formula:

I_{av}＝K_c×I_{max}

5.2.3 Recommendation by experience:

Generally, average braking current of the system may be referred to the peak current when braking duration is less than 15s (excluding frequent braking) and to rated current when braking duration is more than 15s.

5.2.4 Type selection of braking unit based on I_{max} and I_{av}

It only needs to ensure the rated current and peak current of the braking unit cannot be lower than Imax and I_{av} calculated.

⚠ Caution

Basis for proper selection of type of braking unit is that in no way can the current passing the braking units exceed the max. Current of the unit. In this way, it will ensure the unit will not be destroyed due to over-current. Meanwhile, the temperature of the unit cannot be above 70℃ anyhow to prevent damage to the unit due to overheat.

Chapter VI Common troubleshooting

1. When there is sound (squeak) for braking, yet the transducer is still with overvoltage

1) The transducer slows down for short time, so it should extend the time.
2) The brake resistance is excessive, so it should check the parameters for brake resistance and select a braking unit.
3) The braking unit has insufficient capacity, so it should check the unit to determine whether it meets specifications.

2. When there is no sound for braking

1) Type of the braking is not suitable or working voltage is not matched.
2) Resistance is disconnected or cable is not connected properly, so the braking is invalid.
3) Resistance has short circuit, so the brake stops output automatically.
4) The braking unit has faults.

3. Overheat of the brake resistance

1) The selected brake resistance has low power, so it should enhance the power.

4. When the resistance become heat while the transducer is out of service

2) Type of the braking is not suitable or working voltage is not matched.
3) Heavy fluctuation for the grid voltage at the site to exceed the response voltage of the braking unit.
4) The response voltage of the braking unit is set wrongly.

5. When braking, the transducer produces over-current protection

1) The brake resistance is too low and braking torque is excessive, so it should improve the resistance or extend the time spent by transducer to slow down.
2) The system is not designed in a proper way.

6. When the transducer fails to be electrified

1) The input wire of the braking unit is connected incorrectly by anode and cathode.

7. Overheat of the braking unit

2) Poor ventilation, so it may be installed again.
3) The unit is braking much frequently, so it may shift the braking unit into higher gear or adopt parallel connection of many units.