Operation Manual

Dynamic Braking Unit and Energy Feedback Unit

SHENZHEN INVT ELECTRIC CO., LTD.

Contents

Dynamic Braking Unit Manual

Safety precautions

Read the manual carefully before installing, operating, servicing, and inspecting the dynamic braking unit.

Safety precautions in the manual are classified as "Danger" and "Warning".

 Danger	Serious physical injury or even death may occur if related requirements are not followed.
 Warning	Physical injury or damage to the equipment may occur if related requirements are not followed.
Note	Actions taken to ensure proper running.

Warnings caution you about conditions that can result in severe injury or death and/or equipment damage and advice on how to prevent dangers.

Note:

- Do not use any incomplete or damaged braking unit or braking resistor.
- Confirm that the braking unit and braking resistor are set properly.
- Do not carry out a voltage-endurance test on the braking unit, otherwise, damage to the semiconductor devices of the braking main circuit may occur.
- Screws shall be tightened during wiring, otherwise, fire or leakage may occur.
- When multiple braking units are installed in the same one chassis and used in parallel connection, a fan or other cooling device shall be installed.
- After the braking unit is wired, there is high voltage DC power supply inside it. Do not touch the braking unit, internal components and printed boards with your hands, otherwise, electric shock may occur.
- The braking resistor shall be equipped with temperature protection and other protections.

	- The braking unit and braking resistor shall be mounted on flame-retardant mediums (e.g. metal). - Ensure all the power supplies are disconnected and fully discharged before wiring. - Only professionals are allowed to carry out the wiring operation. - Check whether the wiring is proper before operation. - Check whether the master/slave selection and voltage class settings are proper before operation.

	● Ensure that the POWER indicator is completely off and confirm that the charging voltage has dropped to zero with a voltmeter before adjusting and servicing the braking unit. ● Do not touch any components inside the braking unit during the operation. ● The braking unit is an accessory device of the VFD, so if it is used improperly, the device failure and VFD fault may occur. Exercise caution before using it. ● If the VFD fails, regardless of whether it is related to the braking unit, we will not bear any responsibility. The fuse for semiconductor is user purchased.

1 Inspection

INVT braking units have been tested and inspected for quality before leaving the factory. After receiving products, check whether the packing box is damaged due to careless transportation and whether the product specifications and model are consistent with the purchased model. If any problem is found, contact the INVT supplier.

Note: Only trained personnel are allowed to operate this device. Read the safety, installation, operation and maintenance sections of this manual before use. The safe operation of the device depends on proper transportation, installation, operation and maintenance.

2 Installation

2.1 Running environment

The braking unit shall be installed in a well-ventilated indoor place with wall mounting.

2.2 Ambient environment

- Ambient temperature is -10°C to 40°C.
- Prevent electromagnetic interference and keep away from interference sources.
- Ensure foreign objects like dust, dirt, cotton wool, and metal powder will not fall into the device.
- Away from oil, salt, and corrosive gas.
- Avoid vibration.
- Away from high temperature and humidity, no rain, and humidity is less than 90%RH (no condensation)
- Away from flammable, combustible, explosive gas, liquid or solid.

2.3 Outline dimensions

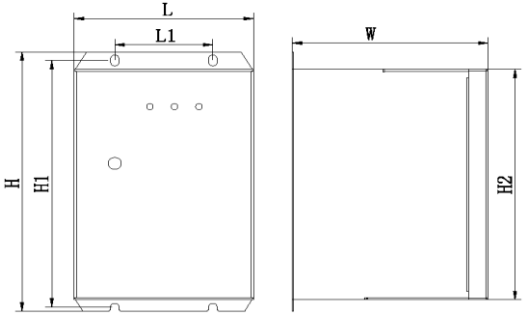
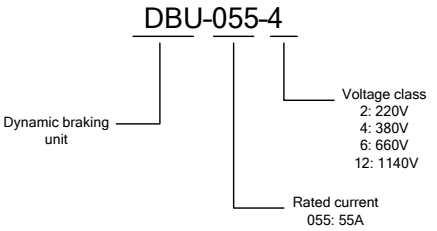


Figure 2-1 Outline dimensions (unit: mm)

Model	Range	L	L1	W	H	H1	H2
DBU-055-2	11-55kW	110	60	120	180	171	160
DBU-055-4	18.5-55kW	110	60	120	180	171	160
DBU-315-4	132-315kW	180	120	164	285	277	260
DBU-350-6	22-350kW	200	120	162	385	377	361

Note: The structure and dimensions of DBU-160-4, DBU-220-4 and DBU-315-4 are the same. 660V 22–350kW energy braking units use same structure and volume.

3 Product name, model definition and use



INVT dynamic braking unit is mainly used in cases where the VFD needs to be rapidly slowed down, positioned and braked. When the VFD brakes, due to large load inertia, the kinetic energy is transformed into electrical energy during braking, so that the DC bus voltage of the VFD rises. In order not to affect the normal operation of the VFD, the braking unit is needed to consume the regenerated electrical energy, otherwise, the VFD will enable the overvoltage protection, affecting the normal operation of the VFD.

The braking unit can be applied in cases where the VFD driving a high-inertia load decelerates abruptly, such as elevators, textile machines, paper machinery, centrifuges, washing machines, wire-drawing machines, winding machines, proportional linkage systems, overhead cranes and other systems.

4 Installation instruction and parameter setting

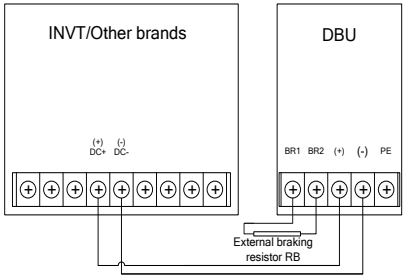


Figure 4-1 Main circuit wiring between the braking unit and the VFD

Note:

- The connection cables between the VFD and the braking unit shall be shorter than 5m.
- The connection cables between the braking resistor (Rb) and the braking unit shall be shorter than 10m.
- DC+ and DC- are "+" and "-" terminals of the DC bus inside the VFD. DC+ is positive terminal while DC- is negative terminal.
- The braking unit can continuously brake up to 5 minutes at 100% braking ratio. The temperature of the chassis is high when braking continuously. Do not touch it with your hands to avoid burns. If you require longer continuous braking time, you need to choose a braking unit with larger power or operate the braking unit at 50% braking ratio, as

shown in the following figure.

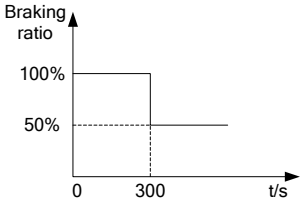


Figure 4-2 Derating of the braking unit

	• Improper main circuit wiring may cause damage to the braking unit and the VFD.

Main circuit terminal description of the braking unit

BR1	BR2	(+)	(-)	PE

BR1, BR2----------Terminals for connecting to the external braking resistor.

(+)----------Positive terminal of the VFD DC bus

(-)----------Negative terminal of the VFD DC bus

PE----------Grounding terminal

Main control terminal description of the braking unit

RST	EFI	PI	COM	PO1	PO2

ROA	ROB	ROC

	Name	Description
Control terminal	RST	External reset terminal. Short connect to COM terminal for resetting when a braking unit fault occurs.
	EFI	External fault input terminal. When an external fault occurs, the braking unit outputs a fault signal.
	PI	Braking unit parallel input terminal. When multiple braking units are used in parallel, this terminal can be used to monitor the operation of other braking units.
	COM	Common terminal of RST, EFI, PI

	PO1 PO2	Braking unit parallel output terminal. When multiple braking units are used in parallel, this terminal outputs signals to enable other braking units to monitor the operation.
	ROA ROB ROC	Fault output terminal. When a braking unit fault occurs, the fault relay acts to output a fault alarm signal. ROA–ROB NC, ROA–ROC NO

When there is only one braking unit, connect the VFD, braking unit and braking resistor according to Figure 4-1. Set the voltage class and braking threshold, and then the operation starts.

4.1 Regulation

There is no need to adjust braking resistor units and braking units (except in the case of the "voltage selection setting").

4.2 Voltage selection setup

Braking voltage threshold setting:

Set the braking unit voltage according to the VFD input power voltage. Disconnect the power supply during voltage selection. The following table shows the relationship between the voltage selection setting and braking starting/stopping voltage.

SN	S1 selection		220V system		380V system		660V system		1140V system	
	50% braking ratio	100% braking ratio	Braking starting value (V)	Braking stopping value (V)	Braking starting value (V)	Braking stopping value (V)	Braking starting value (V)	Braking stopping value (V)	Braking starting value (V)	Braking stopping value (V)
0			330	320	640	620	1080	1060	1950	1920
1			350	340	660	640	1100	1080	2000	1970
2	 (Factory setting)		370	360	680	660	1120	1100	2050	2020
3			380	370	700	680	1140	1120	2100	2070
4			390	380	720	700	1160	1140	2150	2120

SN	S1 selection		220V system		380V system		660V system		1140V system	
	50% braking ratio	100% braking ratio	Braking starting value (V)	Braking stopping value (V)	Braking starting value (V)	Braking stopping value (V)	Braking starting value (V)	Braking stopping value (V)	Braking starting value (V)	Braking stopping value (V)
5			400	390	740	720	1180	1160	2200	2170
6			Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
7			Slave mode	Slave mode	Slave mode	Slave mode	Slave mode	Slave mode	Slave mode	Slave mode

Note:

- If the grid voltage is 20% higher than the normal power supply, you shall set a larger braking voltage.
- Ensure that the braking starting voltage of the VFD matches with the device.

- Do not perform the live operation. Do not adjust any setting until the POWER indicator is utterly off.

5 Parallel operation

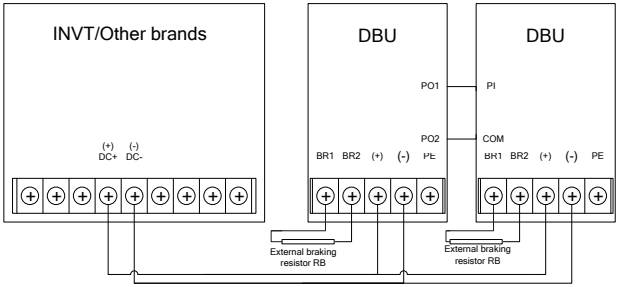


Figure 5-1 Connection between braking units in parallel operation and the VFD

When more than two braking units are in parallel operation, connect the VFD, multiple braking units and braking resistors according to Figure 5-1.

Control terminal wiring instruction

When multiple braking units are in parallel connection, take the first braking unit as the master and the others as slaves. For the slave parameter setting, refer to item 7 of "Brake voltage threshold setting" table in section 4.2. The braking ratios of the slave and the master shall be consistent. The parallel output terminals PO1 and PO2 of the first braking unit are connected to the parallel input terminals PI and COM of the second braking unit, and the parallel output terminals PO1 and PO2 of the second braking unit are connected to the parallel input terminals PI and COM of the third braking unit, and so on, so that the whole parallel braking unit system can monitor each other's operation.

6 Fault analysis and handling

Item	Fault state	Cause	Handling method
1	Severe heating of the braking resistor occurs during braking	The power of the braking resistor is too small.	Replace a braking resistor with larger power.
2	Serious heating of the braking resistor occurs when not braking	Main circuit power IGBT of the braking unit is damaged	Replace the braking unit.
		The voltage setting of the braking unit does not match the voltage.	Reset
		Braking unit fault.	Replace the braking unit.
3	The VFD enables the overvoltage function.	The braking capacity of the braking resistor is insufficient.	Recheck the braking conditions.
		Improper wiring	Check and correct it.
		The voltage setting of the braking unit does not match the voltage.	Reset
		Braking unit fault	Replace the braking unit.
4	The fault relay outputs signals.	External fault input is valid	Recheck the operating conditions

Item	Fault state	Cause	Handling method
		The braking current is too large while the braking resistor is too small.	Select a resistor with larger resistance.
		Continuous braking time is too long.	Reduce the braking frequency.
		Internal power fault.	Replace the braking unit.

Note: The grid voltage is too high, you shall select larger voltage setting.

- The control circuit of the braking unit is a non-isolated circuit. Disconnect the connection between DC+ and DC-, and ensure there is no voltage between DC+ and DC- before operating and checking the device.

7 Model selection specification

7.1 Braking voltage reference

- The braking voltage shall be set to be high enough to avoid braking unit misoperation caused by increase of grid voltage.
- The braking voltage shall be set to be low enough. The VFD shall be operated at rated voltage, ensuring safe operation of the equipment. A high braking voltage can ensure that the braking unit does not operate mistakenly, but too high voltage has a great impact on the long-term safe operation of the equipment.

7.2 Calculation of braking resistance and braking current (calculated by 100% braking torque)

The braking current indicates DC current flowing through the braking resistor and braking unit during braking.

Calculated on the basis of a 380V standard AC motor.

P————Rated motor power (kW)

V————DC operating point of the braking unit, generally set to be 700V

I———— Braking current (A)

η ————Conversion efficiency of mechanical energy during feedback, generally set η = 0.7

Calculation basis: The braking resistor must completely absorb the regenerative electrical energy of the motor.

Braking resistor absorbed power (V*I) = Motor regenerative electrical energy (watt) = 1000 * P * η

7.3 Calculation and selection of braking resistor (calculated by 100% braking torque)

The value of the braking resistance indirectly reflects the value of the braking torque of the system. If the braking torque is too small, the VFD still enables the overvoltage protection.

Calculation based on a standard 380V AC motor.

P————Rated motor power (kW)

P_R ————Rated dissipated power of the braking resistor (kW)

V————DC operating point of the braking unit, generally set to be 700V

R————Equivalent resistance of the braking resistor (Ω)

η ————Conversion efficiency of mechanical energy during feedback, generally set η = 0.7.

ε ————Power dissipation safety factor of the braking resistor, set ε = 1.4.

K_f ———Braking frequency, indicating the time proportion that the regeneration process accounts for the entire motor operation.

Generally, the values of K_f are as follows.

Uncoiling and reeling K_f =50–60%

Oil pumping machine K_f =10–20%

Elevator K_f =10–15%

Centrifuge K_f =5–20%

Crane whose lowering height exceeds 100m K_f =20–40%

The load that brakes occasionally K_f =5%

Others K_f =10%

Resistance calculation basis: The braking resistor must completely absorb the regenerative electrical energy of the motor.

Resistor absorbed power (V*V/R) = Motor regenerative electrical energy (watt) = 1000*P* η

Resistor power calculation basis:

The regenerative electrical energy of the motor must be absorbed by the resistor, and transformed into thermal energy for release.

P_R =P* K_f * η * ε =P* K_f *0.7*1.4

7.4 Input voltage class specifications and model selection for 380V VFDs

This table shows a model selection reference based on DC operating point 700V of the braking unit.

Motor power (kW)	Braking unit model	Adaptive braking resistor (Ω)	Dissipated power of braking resistor (kW)			Min. braking resistance (Ω)	Recommended resistor model
		100% braking torque	10% braking frequency	50% braking frequency	80% braking frequency		
18.5	DBU-055-4	26.5	2.59	12.95	20.72	6.4	20Ω@6000W
22	DBU-055-4	22.3	3.08	15.4	24.64		20Ω@6000W
30	DBU-055-4	16.3	4.2	21	33.6		20Ω@6000W
37	DBU-055-4	13.2	5.18	25.9	41.44		13.6Ω@9600W
45	DBU-055-4	10.9	6.3	31.5	50.4		13.6Ω@9600W
55	DBU-055-4	8.9	7.7	38.5	61.6		13.6Ω@9600W
75	DBU-055-4 Quantity: Two	13*2	5.25*2	26.3*2	42*2	6.4*2	13.6Ω@9600W*2
90	DBU-055-4 Quantity: Two	10.8*2	6.3*2	31.5*2	50.4*2		13.6Ω@9600W*2
110	DBU-055-4 Quantity: Two	9*2	7.7*2	38.5*2	61.6*2		13.6Ω@9600W*2
132	DBU-160-4	3.7	18.48	92.4	147.84	2.2	4Ω@30kW
160	DBU-160-4	3.1	22.4	112	179.2		4Ω@30kW
185	DBU-220-4	2.6	25.9	129.5	207.2	1.6	3Ω@40kW
200	DBU-220-4	2.4	28	140	224		3Ω@40kW

Motor power (kW)	Braking unit model	Adaptive braking resistor (Ω)	Dissipated power of braking resistor (kW)			Min. braking resistance (Ω)	Recommended resistor model
		100% braking torque	10% braking frequency	50% braking frequency	80% braking frequency		
220	DBU-220-4	2.2	30.8	154	246.4		3Ω@40kW
250	DBU-315-4	2	35	175	280	1.1	4Ω@30kW*2
280	DBU-315-4	1.75	39.2	196	313.6		4Ω@30kW*2
315	DBU-315-4	1.56	44.1	220.5	352.8		4Ω@30kW*2

Note: The braking current shall not exceed the rated current.

7.5 Input voltage class specifications and model selection for 660V VFDs

This table shows a model selection reference based on DC operating point 1120V of the braking unit.

Motor power (kW)	Braking unit Model	Adaptive braking resistor (Ω)	Dissipated power of braking resistor (kW)			Min. allowable brake resistance (Ω)	Recommended resistor model
		100% braking torque	10% braking frequency	50% braking frequency	80% braking frequency		
75	DBU-090-6	16.73	10.5	52.5	84	12.4	24Ω@7500W
90	DBU-090-6	13.94	12.6	63	100.8		20Ω@9000W
110	DBU-160-6	11.40	15.4	77	123.2	7	16Ω@11kW
132	DBU-160-6	9.50	18.48	92.4	147.84		13.6Ω@13.2kW
160	DBU-160-6	7.84	22.4	112	179.2		11Ω@16kW
185	DBU-220-6	6.78	25.9	129.5	207.2	5.1	9.6Ω@18.5kW
200	DBU-220-6	6.27	28	140	224		9Ω@20kW
220	DBU-220-6	5.70	30.8	154	246.4		8Ω@22kW
250	DBU-350-6	5.02	35	175	280	3.2	7Ω@25kW

Motor power (kW)	Braking unit Model	Adaptive braking resistor (Ω)	Dissipated power of braking resistor (kW)			Min. allowable brake resistance (Ω)	Recommended resistor model
280	DBU-350-6	4.48	39.2	196	313.6		6.4Ω@28kW
315	DBU-350-6	3.98	44.1	220.5	352.8		5.6Ω@31.5kW
350	DBU-350-6	3.58	49	245	392		5.1Ω@35kW

Note: The braking current shall not exceed the rated current.

7.6 Braking resistor selection

- It is recommended to use non-inductive resistors as braking resistors to reduce inductance.
- The braking resistor must be equipped with an overheating automatic isolation protection device.
- Ensure that no grounding fault to the braking resistor occurs, otherwise, major failure to the device and VFD may occur.
- The capacity of the braking resistor uses the reference value and is modified according to load inertia, braking frequency, braking voltage threshold, and other characteristics. If any questions, please contact us.
- We have cement resistors, high power lacquered resistors, metal case, and other non-inductive resistors available for purchase.

Note:

- Braking units in parallel connection can expand the braking capacity.
- The braking capacity of two braking units in parallel connection is twice that of a single braking unit.

  DBU-110-4=DBU-055-4*2

Energy Feedback Unit Manual

Safety precautions

Read the manual carefully before installing, operating, servicing, and inspecting the energy feedback unit.

Safety precautions in the manual are classified as "Danger" and "Warning".

 Danger	Serious physical injury or even death may occur if related requirements are not followed.
 Warning	Physical injury or damage to the equipment may occur if related requirements are not followed.
Note	Actions taken to ensure proper running.

Warnings caution you about conditions that can result in severe injury or death and/or equipment damage and advice on how to prevent dangers.

1 Overview

1.1 Overall technical characteristics

Voltage class	380V/660V/1140V
Braking torque	100% of rated torque: 1min (duty ratio: 25%). The energy feedback units of 380V 90kW and higher & 660V 160kW and higher can work continuously at 50% of rated torque, and energy feedback units of other powers can work continuously at 80% of rated torque.
AC-side power supply	380VAC/660VAC/1140VAC, 50/60Hz
AC-side power supply voltage fluctuation	From +10% to -15% with phase imbalance of less than 2%
AC-side power frequency fluctuation	Below 3Hz
Control mode	Current control method with the angle of 120 degrees
AC-side power factor	More than 0.9
Overload capacity	150% of rated current: 30s
Operation mode	External terminals, keypad
Fault output	Relay output
Status indication	LED keypad
Analog output	Voltage signal (0–10V)
Overcurrent protection	220% of rated current
Overload protection	150% of rated current: 30s
Overvoltage	830V/1250V/2400V on DC side
Overtemperature	Temperature resistance detection
AC-side phase loss fault	AC-side phase loss
AC-side frequency fault	Fluctuation is >3Hz
Power light indication	More than 50V on DC side

1.2 Nameplate description

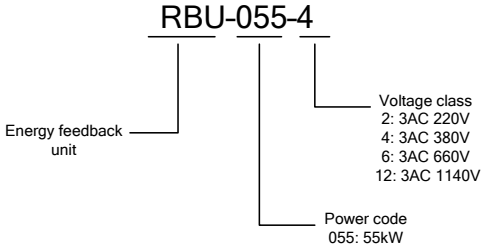


Figure 1-1 Nameplate description

1.3 Series models

Energy feedback unit model	Input voltage	Rated capacity (kW)	DC-side rated current (A)	AC-side rated current (A)	Accessories			
					Energy feedback output reactor		VFD input reactor	
					Current (A)	Inductance (uH)	Current (A)	Inductance (uH)
RBU-7R5-4	380V	7.5	13	10	10	780	20	750
RBU-011-4		11	19	15	15	520	30	600
RBU-015-4		15	26	20	25	390	40	420
RBU-018-4		18.5	32	25	25	390	50	350
RBU-022-4		22	37	30	30	260	60	280
RBU-030-4		30	51	40	50	200	80	190
RBU-037-4		37	64	50	50	200	90	190
RBU-045-4		45	77	60	75	130	120	130
RBU-055-4		55	96	75	75	130	150	100
RBU-075-4		75	128	100	100	80	200	80
RBU-090-4		90	150	120	120	45	250	65
RBU-110-4		110	183	145	145	39	250	65
RBU-132-4		132	220	176	176	36	290	50
RBU-160-4		160	267	213	213	30	330	50

Energy feedback unit model	Input voltage	Rated capacity (kW)	DC-side rated current (A)	AC-side rated current (A)	Accessories			
					Energy feedback output reactor		VFD input reactor	
					Current (A)	Inductance (uH)	Current (A)	Inductance (uH)
RBU-185-4		185	308	246	246	26	390	44
RBU-200-4		200	333	266	266	24	490	35
RBU-220-4		220	366	292	292	21	490	35
RBU-055-6		55	52	42	42	380	63	380
RBU-075-6		75	71	56	56	280	86	280
RBU-090-6		90	86	68	68	240	98	240
RBU-110-6		110	105	84	84	200	121	200
RBU-132-6		132	126	100	100	160	150	160
RBU-160-6	660V	160	152	122	122	130	175	130
RBU-185-6		185	176	140	140	120	198	120
RBU-200-6		200	190	152	152	110	218	110
RBU-220-6		220	209	167	167	100	237	100
RBU-250-6		250	238	190	190	90	270	90
RBU-055-12	1140V	55	30	24	38	1100	38	1100
RBU-160-12		160	90	72	102	410	102	410

1.4 Outline dimensions

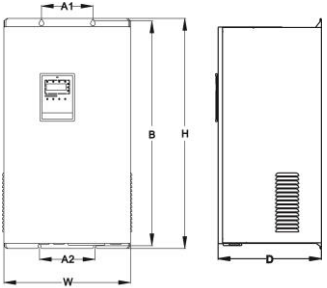


Figure 1-2 Outline dimensions and installation dimensions of wall-mounted energy feedback unit

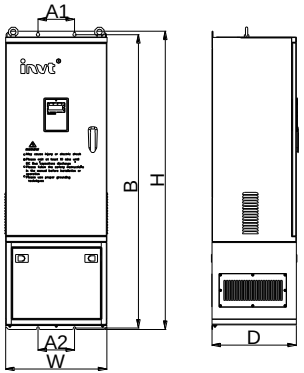


Figure 1-3 Outline dimensions and installation dimensions of the cabinet-type energy feedback unit

Voltage class	Model	A1 (mm)	A2 (mm)	B (mm)	H (mm)	W (mm)	D (mm)	Installation hole diameter (mm)
		Installation dimensions			Outline dimensions			
380V (wall-mounted)	7.5–22kW	130	140	401.5	415	240	216	6
	30–75	130	140	563.5	577	220	236	6
	90kW-220kW	130	140	563.5	577	320	261	6
660V (wall-mounted)	55kW-250kW	130	140	563.5	577	320	261	6
1140V (cabinet-type)	55kW-160kW	/	/	/	1064	360	300	6

2 Unpacking inspection

- Do not install or operate any energy feedback unit that has been damaged or equipped with faulty parts, otherwise, physical injury may occur.

Check as follows after receiving the energy feedback unit.

- Confirm that the energy feedback unit has not been damaged in any way during the transportation (damage or chips on the body).
- Confirm that the operation manual and warranty card are placed in the packing box.
- Check the nameplate of the energy feedback unit and confirm that it is the product you purchased.
- If you purchase optional parts of the energy feedback unit, confirm that the optional parts you received are the ones you need.
- If you find any damage to the energy feedback unit or optional parts, contact the local dealer immediately to resolve the problem.

3 Disassembly and installation

	• If unqualified personnel operate on the devices and systems of the energy feedback unit or failure to comply with the relevant provisions of "**Warning**", serious physical injury or substantial property damage may occur. Only qualified and certified professionals trained in the design, installation, commissioning and operation of the equipment are allowed to operate on the devices and systems of the equipment. • Input power cables shall be fastened permanently and the equipment must be reliably grounded. • Even if the energy feedback unit is not in operation, the following terminals may still carry hazardous voltage. -Power terminals R, S, T, r, s, t -Terminals (+), (-) connected to the VFD • Disconnect the power switch before performing installation operations, and wait for five minutes until the energy feedback unit is discharged off. • The mini. cross-sectional area of the grounding conductor must be equal to or greater than the cross-sectional area of the power supply cable.
	• Hold the base to lift the cabinet and do not grab the panel to lift it when moving the energy feedback unit, otherwise, the main unit may fall and physical injury may occur. • Install the energy feedback unit on flame-retardant materials (e.g. metal), otherwise, fire may occur. • If you need to install more than two energy feedback units in one cabinet, you shall install a cooling fan and control the air temperature below 45°C, otherwise, overheating may cause fire or damage to the device.

3.1 Running environment conditions

- The ambient temperature is from -100°C to +400°C. Derating is required when the temperature exceeds 40°C.
- The relative humidity of the air is ≤95% (no consideration).
- When the altitude of the site where the energy feedback unit is installed is lower than 1000m, the energy feedback unit can run at the rated power. When the altitude exceeds 1000m, the output power will be decreased. The specific derating amplitude is shown in the following figure.

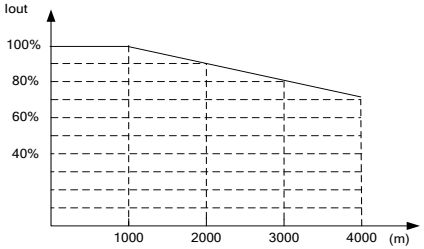


Figure 3-1 Altitude of the installation site

- Ensure that the energy feedback unit does not fall into the ground or suffer a sudden impact. Install the energy feedback unit in a place away from frequent vibration.
- Install the energy feedback unit in a place away from the electromagnetic radiation sources.
- Install the energy feedback unit in a place away from water or condensation.
- Install the energy feedback unit in a place away from atmospheric pollution, such as dust, corrosive gases, etc.
- Install the energy feedback unit in a place away from direct sunlight, oil mist, steam and vibration.

3.2 Installation space and distance

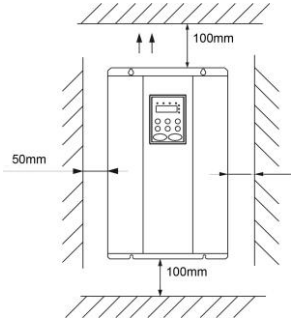


Figure 3-2 Installation space and distance

When two energy feedback units are installed with top and bottom, a flow deflector shall be added between them.

3.3 Installation dimensions of external keypad

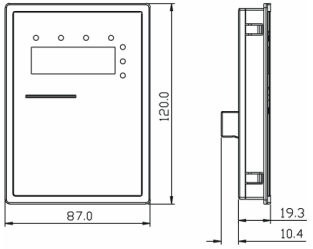


Figure 3-3 Installation dimensions of external keypad (large)

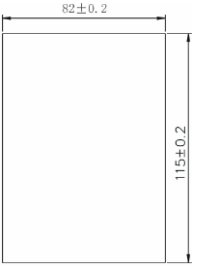


Figure 3-4 Opening size of external keypad (large)

3.4 Disassembly and installation of the cover plate

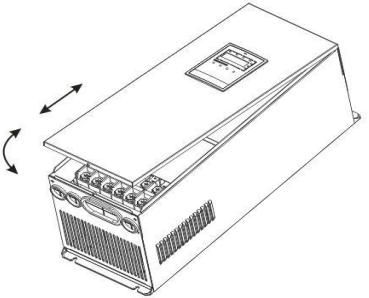


Figure 3-5 Disassembly and installation of the cover plate

4 Wiring

	● Only certified and qualified professional electrical personnel are allowed to perform operations, ensuring a safe and proper running of the energy feedback unit. ● Do not test the insulation of the cables connected to the energy feedback unit with high-voltage insulation test equipment. ● The power input cables and DC circuit terminals may still carry hazardous voltage even if the energy feedback unit is not in operation. Therefore, you must wait for five minutes after disconnecting the switch to ensure that the energy feedback unit is discharged off before starting operation. ● The grounding terminals of the energy feedback unit must be reliably grounded. ● The 400V grounding resistance shall be 10Ω or less, otherwise, electric shock or fire may occur. ● Do not connect the power terminals (R, S, T, r, s, t) to feedback terminals ((+), (-)) of the energy feedback unit in a wrong way, otherwise, damage to the energy feedback unit may occur. ● Do not wire or operate the energy feedback unit with wet hands, otherwise, electric shock may occur.
	● Check whether the rated voltage of the energy feedback unit is consistent with the AC supply voltage. ● Ensure that the power cables and feedback cables must be permanently connected and tightened.

4.1 Wiring terminal diagram and function description

4.1.1 Main circuit terminals and function description

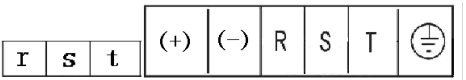


Figure 4-1 Main circuit terminal diagram

The functions of the main circuit terminals are described as follows.

Terminal name	Function description
R, s, t	Connected to three-phase grid power (see Figure 4-4 for details)
(+), (-)	Energy feedback input terminals
R, S, T	Connected to the energy feedback output reactor (see Figure 4-4 for details)
⏚	Connected to the power earth lines (PE).

4.1.2 Control circuit terminals and function description

Figure 4-2 Control circuit terminal diagram

The functions of the control circuit terminals are described as follows.

Terminal name	Function description
S1–S4	Digital input terminals, forming an optocoupler isolation input with +24V and COM, and valid for short connection with COM. S1: Automatic mode input when terminal control mode is valid S2: Manual mode input when terminal control mode is valid S3: Multi-function terminal (external fault input by default) S4: Multi-function terminal (fault reset input by default)
Y	Open collector output terminal with COM as common terminal External voltage range: 0–24V; Output current range: 0–50mA
+24V	Locally provided +24V power supply. (current: 150mA)
COM	+24V common terminal
AO	Analog output terminal. Output range: voltage (0–10V)
GND	Reference zero potential of AO. (**Note:** GND is isolated from COM)
RO1A, RO1B, RO1C	RO1 output; RO1A: common; RO1B: NC; RO1C: NO. Contact capacity: AC250V/3A, DC30V/1A.

4.2 Standard wiring diagram

4.2.1 380V 7.5kW-75kW

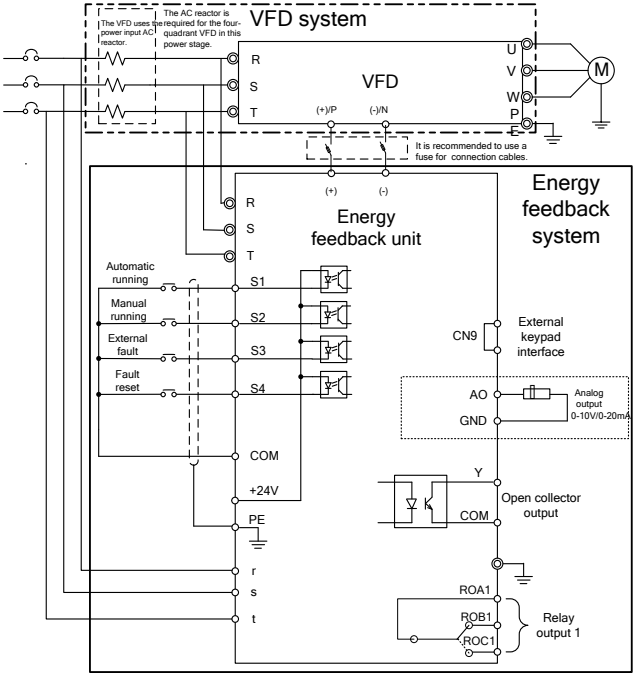


Figure 4-3 Standard wiring diagram of 380V 7.5kW-75kW energy feedback units

4.2.2 380V 90kW-220Kw/660V 55kW-250kW/1140V 55kW-160kW

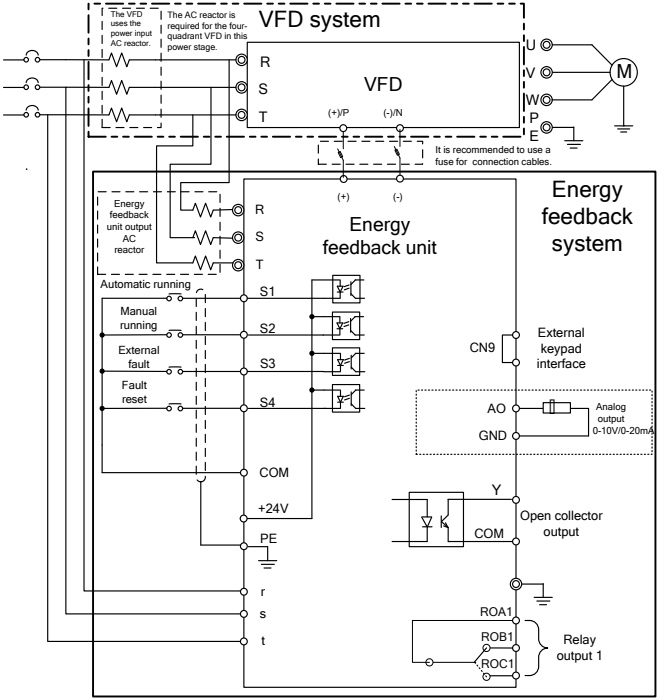


Figure 4-4 Standard wiring diagram of 380V 90kW-220kW/660V 55kW-250kW/1140V 55kW-160kW energy feedback units

5 Operations

5.1 Operation panel description

5.1.1 Panel diagram

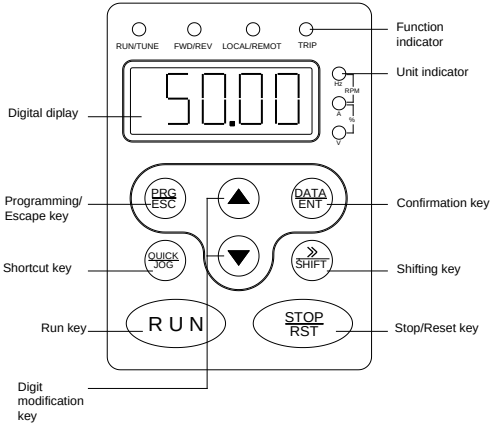


Figure 5-1 Operation panel diagram

5.1.2 Key function description

Key symbols	Name	Function description
PRG ESC	Programming key	Press it to enter or exit level-1 menus or delete a parameter.
DATA ENT	Confirmation key	Press it to enter menus in cascading mode or confirm the setting of a parameter.
▲	UP key	Press it to increase data or move upward.
▼	Down key	Press it to decrease data or move downward.

Key symbols	Name	Function description
	Shifting key	Press it to select display parameters in the interface for the VFD in stopped or running state or to select digits to change during parameter setting.
	Run key	Press it to run the VFD when using the keypad for control.
	Stop/Reset key	Press it to stop the VFD that is running, and the function of this key is restricted by P0.00. In fault alarm state, press it to reset the fault, and the function of this key is not restricted by P0.00.

5.1.3 Indicator description

1. Function indicator description:

Name	Description
RUN/TUNE	Energy feedback unit running status indicator. Off: The energy feedback unit is stopped. On: The energy feedback unit is running.
LOCAL/REMOT	Indicates whether the energy feedback unit is controlled through the keypad, terminals, or remote communication. LED off: The energy feedback unit is controlled through the keypad. LED blinking: The energy feedback unit is controlled through terminals. LED on: The energy feedback unit is controlled through remote communication.
TRIP	Fault indicator LED on: in fault state LED off: in normal state

2. Unit indicator description:

Symbols	Description
Hz	Frequency unit
A	Current unit
V	Voltage unit
RPM	Rotation speed unit
%	Percentage
	System temperature

3. Digital display zone:

Five-digit LED displays various monitoring data and alarm codes such as bus voltage, grid voltage, output current, and system temperature.

5.2 Function parameter list

Function code	Name	Description	Default	Modify
P0.00	Control mode selection	0–1 0: Keypad control 1: Terminal control Terminal S1 is valid: automatic mode Terminal S2 is valid: manual mode	1	◎
P0.01	Keypad control mode	0–1 0: Automatic 1: Manual	0	◎
P0.02	Digital filter times	1–10	1	◎
P0.03	Current protection threshold at power-off	0.0–30.0%	0.0%	○
P0.04	Voltage difference of starting feedback	Range: 0.0–240.0V 380V voltage class 690V voltage class 1140V voltage class	40.0V 60.0V 120.0V	○
P0.05	Voltage difference of stopping feedback	Range: 0.0–120.0V 380V voltage class 690V voltage class 1140V voltage class	10.0V 15.0V 30.0V	○
P0.06	Feedback stopping time	0.1–10.0s	1.0s	○
P0.07	Input power frequency	0–1 0: 50Hz 1: 60Hz	0	◎

Function code	Name	Description	Default	Modify
P0.08	Terminal S3 function selection	1–15 3: S3 is valid after short connecting to COM. Other functions are reserved.	3 (External fault)	◎
P0.09	Terminal S3 function selection	1–15 2: S4 is valid after short connecting to COM. Other functions are reserved.	2 (Fault reset)	◎
P0.10	Reserved		1	○
P0.11	AO output	0–8 0: DC bus voltage (0–1000V/1500V/3000V) 1: Output current (0–200.0%) 2–8: Reserved	1	○
P0.12	AO output lower limit	0.0%–100.0%	0.0%	○
P0.13	AO output corresponding to lower limit	0.00V–10.00V	0.00V	○
P0.14	AO output upper limit	0.0%–100.0%	100.0%	○
P0.15	AO output corresponding to upper limit	0.00V–10.00V	10.00V	○
P0.16	Cooling-fan running mode	0–1 0: Run after starting 1: Start when the temperature of the radiator is greater than 45°C	1	○
P0.17	Y digital output selection	0–15 0: No output 1: Valid running command 2: Feedback in operation 3: Reserved 4: Fault output 5–15: Reserved	0	○
P0.18	Relay output selection		4 (Fault output)	○

Function code	Name	Description	Default	Modify
P0.19	Undervoltage protection	Range: 300.0–1500.0V 380V voltage class 690V voltage class 1140V voltage class	380.0V 470.0V 1100.0V	○
P0.20	Fault reset count	0–3	0	◎
P0.21	Fault reset time	0.1–10.0s	3.0s	◎
P0.22	Reserved			◎
P0.23	Feedback current limit point	100–200	165	◎
P0.24	Running time	0–XXXXXH		●
P0.25	Function parameter restoration	0–2 0: Unchanged 1: Restore to default value 2: Clear fault records	0	◎
P0.26	Software version			●
P0.27	3rd-last fault type	0–26 0: No fault 1: Reserved 2: Reserved 3: Inverter unit protection (OUt3) 4: Reserved 5: Reserved 6: Overcurrent (OC3) 7: Reserved 8: Reserved 9: Overvoltage (OV3) 10: Bus undervoltage fault (UV) 11: Reserved 12: Overload (OL2) 13: Reserved 14: Input power phase loss (SPO)		●
P0.28	2nd-last fault type			●

Function code	Name	Description	Default	Modify
P0.29	Last fault type	15: Reserved 16: Module overheat (OH2) 17: External fault (EF) 18: Reserved 19: Current detection fault (ItE) 20: Reserved 21: EEPROM operation error (EEP)		●
P0.30	Present fault type	22: Reserved 23: Reserved 24: Reserved 25: Control power fault (CP) 26: Parameter setting error (PEr)		●
P0.31	Output current at present fault			●
P0.32	Bus voltage at present fault			●
P0.33	Parameter locking	0–10 0: None 1: Lock	0	○
P1.00	Factory password	0–65535	*****	◎

5.3 Function description

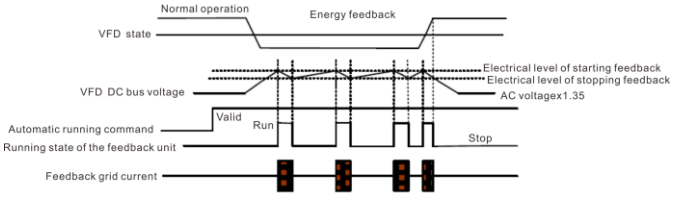
Function code	Name	Description	Default	Modify
P0.00	Control mode selection	0–1 0: Keypad control 1: Terminal control Terminal S1 is valid: automatic mode Terminal S2 is valid: manual mode	1	◎
P0.01	Keypad control mode	0–1 0: Automatic 1: Manual	0	◎

Automatic mode:

During automatic operation, when the feedback unit detects the bus voltage, the operation stops automatically.

When bus voltage of the VFD minus the standard bus voltage is greater than the setting value of P0.04 (Voltage difference of starting feedback), feedback starts.

When bus voltage of the VFD minus the standard bus voltage is less than the setting value of P0.05 (Voltage difference of stopping feedback), feedback stops.



Manual mode:

When the running command is given, the feedback unit keeps feeding back.

6 Troubleshooting

Fault code	Fault type	Possible cause	Solution
OUt3	Inverter unit fault	1. IGBT module is damaged. 2. Misoperation caused by interference. 3. The grounding is poor.	1. Check whether there is strong interference surrounding the peripheral device, and press STOP/RST to reset. 2. Ask for technical support.
OC3	Overcurrent during running	1. Feedback energy transient or exception occurred. 2. The power of the energy feedback unit is too small.	1. Check whether the wiring of phase detection signal r/s/t corresponds to the main circuit R/S/T. 2. Select an energy feedback unit with larger power. 3. Ask for technical support.
OV3	Overvoltage during running	1. Feedback energy exception occurred. 2. The energy feedback voltage threshold is set too high. 3. The capacity of feedback unit is insufficient.	1. Check the input feedback energy. 2. Reduce the feedback voltage threshold. 3. Select an energy feedback unit with larger power. 4. Ask for technical support.
OL2	Energy feedback unit overload	1. The energy feedback voltage threshold is set too low. 2. Feedback energy exception occurred. 3. The power of the energy feedback unit is too small.	1. Reset the feedback energy voltage threshold. 2. Reduce the transient of feedback energy. 3. Select an energy feedback unit with larger power. 4. Ask for technical support.
SPO	Input power phase loss	1. AC-side power failure occurred.	1. Detect the AC-side input power. 2. Ask for technical support.

Fault code	Fault type	Possible cause	Solution
OH2	Inverter module overheat	1. Air duct is blocked or fan is damaged. 2. Ambient temperature is too high.	1. Ventilate the air duct or replace the fan. 2. Lower the ambient temperature. 3. Check and reconnect it. 4. Ask for technical support.
EF	External fault	S3 external fault input terminal acts.	1. Check external device input. 2. Ask for technical support.
ItE	Current detection fault	1. The connector of the control board is in poor contact.	1. Check the connector and re-plug. 2. Ask for technical support.
EEP	EEPROM read/write fault	1. Error in reading or writing control parameters. 2. EEPROM is damaged.	1. Press STOP/RST to reset. 2. Ask for technical support.
CP	Control power fault	The auxiliary power supply is damaged.	1. Ask for technical support.
PEr	Parameter setting error		

7 Maintenance

- Maintenance personnel must carry out the operations as specified in this chapter.
- Maintenance personnel shall be professional and qualified.
- Disconnect the power of the energy feedback unit, and wait for ten minutes before carrying out maintenance work.
- Do not touch the components on the PCB board, otherwise, the damage to the energy feedback unit caused by static electricity may occur.
- Ensure that all screws are tightened after maintenance.

7.1 Routine maintenance

To prevent the failure of the energy feedback unit, ensure the normal operation of the equipment and prolong the service life of the energy feedback unit, routine maintenance is required for the energy feedback unit. The following table follows the items of the routine maintenance.

Item	Content
Temperature/humidity	Confirm that the ambient temperature is from 0°C to 50°C and the humidity is from 20% to 95%.
Oil mist and dust	Confirm that there is no oil mist, dust, and water condensation inside the energy feedback unit.
Energy feedback unit	Check whether there is abnormal heat and vibration in the energy feedback unit.
Fan	Confirm that the fan is running normally and there is no debris stuck in it.
Input power	Confirm that the voltage and frequency of the input power are within the allowable range.

7.2 Periodic maintenance

To prevent the failure of the energy feedback unit and ensure its high performance and stable operation for a long time, you shall conduct the periodic inspection (within six months) on the energy feedback unit. The following table follows the items of the periodic inspection.

Item	Content	Toubleshooting
External terminal screws	Check whether the screws loose.	Screw them up.
PCB board	Check whether there are dust	Completely eliminate the debris

Item	Content	Toubleshooting
	and dirt attached.	with dry compressed air.
Fan	Check whether the accumulated time of abnormal noise and vibration exceeds 20,000 hours.	1. Clear the debris. 2. Replace the fan.
Electrolytic capacitor	Check whether there is discoloration or unusual smell.	Replace the electrolytic capacitor.
Radiator	Check whether there are dust and dirt attached.	Completely eliminate the debris with dry compressed air.
Power components	Check whether there are dust and dirt attached.	Completely eliminate the debris with dry compressed air.

7.3 Wearing part replacement

The fan and electrolytic capacitor in the energy feedback unit are wearing parts. To ensure long-term, safe and failure-free operation of the energy feedback unit, the wearing parts shall be replaced regularly. The replacement time of wearing parts is as follows.

- Fan: The fan must be replaced if it has been used for more than 20,000 hours.
- Electrolytic capacitor: The electrolytic capacitor must be replaced if it has been used for 30,000 to 40,000 hours.

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