

RGNF-30B Automatic Tube Filling & Sealing Machine



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Chapter I Summary

Thank your for your using the automatic tube filling & sealing machine produced by our company.

With the design, manufacturing, assembly, debugging, as well as main parts and materials being fully in accordance with GMP requirements, the automatic tube filling & sealing machine produced by our company has such features as smooth and flat surface, free of dead corner, being innoxious and non-smell, free of pollution, easy cleaning, and easy maintenance and servicing.

Thanks to the compact structure, simple and convenient operation, the machine is applicable to the demands of users from the industries such as medicine, food and daily chemical industry etc. The machine can smoothly and accurately fill various paste, ointment and viscous fluids etc. materials into the tube. Hot air heating will be carried out inside the tube through the heating head (made in Switzerland) and the operations such as sealing and batch No. printing etc. can be finished for plastic tubes and composite tubes. The highest production capacity of the machine can reach 2400 pieces/hour with an error of filling volume not more than 1%. The equipment is a kind of filling & sealing machine used to carry out internal hot air heating for plastic tubes

and composite tubes through the operations of touch screen.

Chapter II Working Principle

Put in order the tubes to be filled on the tube bucket. After the tubes are arranged, through the automatic tube feeding device, they will be automatically inserted into the cup seats. The cup seats will rotate with the rotary table so that they will be positioned at different work stations. Put the ointments for filling into the lockable cone hopper. Through the plunger type quantitative filling valve directly connecting with the hopper, they will be accurately and automatically filled into the tubes staying at intervals on the work stations of filling. The large plate will continue its rotation and rapidly bring the tubes that have been filled with ointments to different work stations of sealing. The clamp mechanical hand will instantly seal the tube tail. Different filling volumes can be achieved through adjusting the filling volume adjusting dial. The hot sealing operation of full-plastic tubes and composite tubes of different tube diameters can be finished through changing different molds. After the sealing is finished, the mechanical hand for code printing will automatically print the words such as date of manufacturing and production batch No. onto the tube tail. Through the automatic tube discharging structure, the finished tube will be automatically sent into the tube collecting vessel.

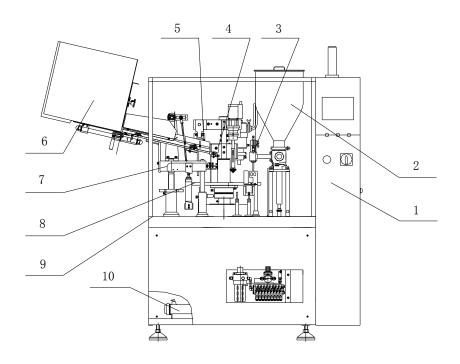
Chapter III Technical Parameters

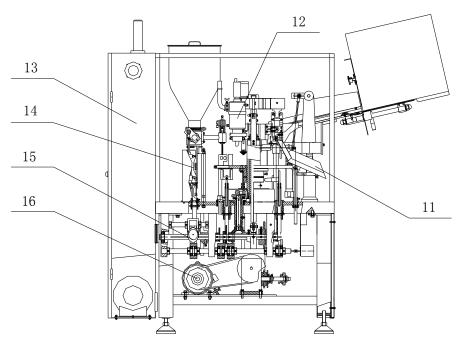
Model/name	RGNF-30B	Automatic Tube Filling & Sealing Machine		
Rated voltage	380/220V (optional)	Rated current	20A	
Maximum speed	40 tubes/min	Production speed	1800-2400 tubes/hour	
Tube diameter	Ф10- 50mm	Tube length	210mm (max. length)	
Hopper volume	40 L	Heating temperature	450 (max.)	

Min. hydraulic pressure	2bar	Water consumption	Max. 2 L/min at 2 bar
Filling range	5-250ml/tube	Filling accuracy	≤±1%
Air pressure	0.5-0.7 MPa	Machine power	5KW
Outline dimensions	1900×850×1900mm	Gross weight	About 750kg

Figure 4-1

Chapter IV Structural Features





1. Operation panel	2. Hopper	3. Filling head	4. Translational mechanical hand for code clamping
5. Mechanical hand for trimming	6. Tube bucket	7. Tube feeding system	8. Rotary table
9. Support	10. Cooler	11. Tube discharging bucket	12. Heater
13. Electric cabinet	14. Plunger filling valve	15. Filling volume adjusting handwheel	16. Main motor

Figure 5-1

- 1. Reasonable structure design. The machine has fully embodied the design conception of advancement, reliability, reasonability of pharmaceutical equipment required by GMP, and artificial factors have been reduced during the use. Linkage design is adopted for the automatic feeding of tubes, the automatic positioning of tube direction, filling, sealing, batch No. printing and discharging of finished products so that all the actions are synchronously completed.
- 2. The requirements of materials to filling technology have been fully satisfied.
 - a. The machine has compact structure with short time from filling to sealing.
 And complicate sealing forms can be completed.
 - b. It is guaranteed that there is no pollution during the filling process. The parts in the machine that contact the materials are all made of 316L stainless steel materials and complete polishing treatment is carried out on the contacting surfaces.
 - c. High filling accuracy. The machine adopts reliable piston type quantitative filling valve, which is provided with convenient and reliable adjustment of the filling volume and high filling accuracy.
 - d. Easy assembly and disassembly of filling assemblies. The bucket valve body and piston filling head etc. can be rapidly disassembled and it is easy to carry out cleaning, disinfection and sterilization.
 - e. During the filling, the filling nozzle can be extended into the tube, so as ensure effective filling and prevent the sealing quality from being influenced as a result of material adhesion on the tube wall.
 - f. The air blowing device is additionally installed. The filling head adopts the combined blow-out and cut-out filling mode so as to prevent the sealing quality and filling volume being influenced as a result of long wire drawn out by the materials of high viscosity.
- 3. The operating parts of mechanical hand completely adopt fully enclosed ball bearings, and the upper and lower sliding shafts on the machine table surface adopt linear bearing and self-lubricating system so as to avoid pollution.

- 4. The automatic filling & sealing machine adopts frequency conversion stepless speed adjusting system, and the operation implements coordinated linkage control so as to achieve a higher production speed. The pneumatic control system is provided with precise filter with stable pressure of certain amount being maintained.
- 5. The movement system is allocated with safety clutch, which can effectively realize protection for fault overload.
- 6. With beautiful appearance and compact structure, the machine is elaborately made by adopting stainless steel polishing, and its table surface is easy to be cleaned without any dead corner, which are fully in accordance with GMP requirements for medicine production.

Chapter V Equipment Transportation and Installation

1. Transportation and Placement

It is transported by wood pallet and forklift. Select a flat and dry indoor place, after the filling & sealing machine is stably placed and unpacked, adjust the base bolts to level the main machine. The installation plan is as follows:

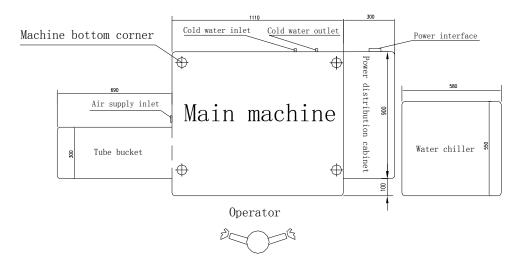


Figure 6-1

2. After it is unpacked, please check the followings:

Check if the machine is in accordance with your order according to the instructions.

Check if there is any damage or cut that may influence the use caused during the transportation. If the above problems are found, please immediately contact the sales department of our company for a proper treatment.

3. Installation of tube bucket

Install the tube bucket onto the main machine and adjust the position of the tube bucket, which shall be kept vertically upward with nuts tightened.

4. Allocation of power supply

The equipment adopts a 3-phase 380V four-line or a 3-phase 220V AC power supply. The user shall make sure there is reliable grounding when connecting it with the power supply, so as to guarantee personal security.

5. Allocation of air supply

The equipment adopts an air supply of 0.5-0.7Mpa. The air supply allocated by the user shall be stable and the air displacement shall be not less than 0.6m³/min so as to guarantee the reliable operation of cylinder.

Chapter VISafety Notes

- 1. The operator must strictly abide by the safety operation rules.
- 2. Before using the machine, please clean the surroundings. There shall have no dangerous articles or other foreign matters.
- 3. The machine is provided with protection of safety door. After the door protection functions, the machine will be stopped when the door is opened. It is strictly forbidden to operate the machine without starting the door protection, or else, accidents may take place.
- 4. There is high voltage inside the electric control box of the machine. Unprofessional or untrained persons are forbidden to open it.
- 5. Make sure that the machine body is reliably grounded before the machine is operated.
- 6. The operator shall pay special attention to the parts where safety warning marks are labeled on the machine body.
- 7. It is strictly forbidden to open the back cover of casing at the transmission part when the machine is operated, or else, personal injury may be caused during the operation.
- 8. Parts that do not conform to the machine performance can't be additionally installed and the machine can't be modified. Otherwise accidents may take place.
- 9. In case of emergency, please press the red emergency stop button and eliminate the malfunction in time. If it is necessary to restart the machine, make sure that the malfunction has bee fully eliminated.
- 10. The main drive system of the machine is located at the bottom of the machine table and is closed by a stainless steel door with a lock. When adjusting the filling volume, a special person (an operator or a maintenance technician) shall be designated to carry out the adjustment. Before restarting the machine, make sure that all the doors are fully closed.

Chapter VII Operations of Touch Screen

1. Basic Interface

On the touch screen of the machine, there are three windows that can be operated, such as main operation, parameter setting and debugging. First connect the machine with the power supply. Turn on the main power switch, turn on the power switch for touch screen and the touch screen will be on. Click any place on the window, the menu interface will be displayed (figure 8-1). Then click **OPERATION** button to enter into the main operation interface (figure 8-2). Click the corresponding button to activate the operation.



Figure 8-1 Figure 8-2

Click **MENU** button to enter into the interface for parameter setting (figure 8-3) to carry out temperature setting, resetting, door protection setting, as well as setting of time delay and angle of clamp. Refer to the relevant chapters and sections for the detail setting. Click **NEXT PAGE** button to enter into the interface for setting of coder parameters and refer to the relevant chapters and sections for the detail setting. Click **DEFAULT DATA** to restore the ex-factory data.

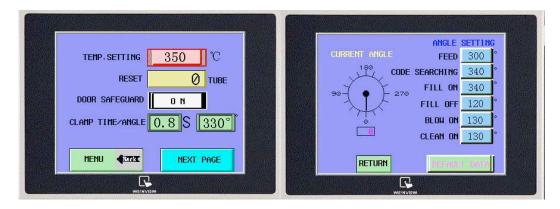


Figure 8-3 Figure 8-4

Click **DEBUGGING** button to enter into the interface for debugging operation to carry out inching operation and inching code searching.

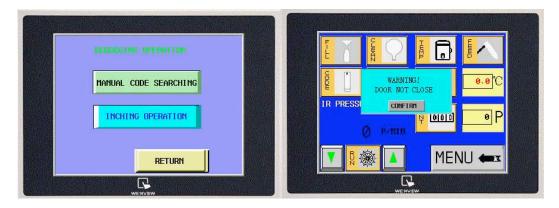


Figure 8-5 Figure 8-6

2. Safety Protection

The machine is provided with function of machine stopping in case of door opening (figure 8-6), protection function for heating (figure 8-7), and protection function for overloading (figure 8-8).

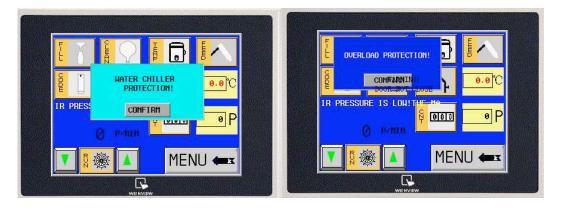


Figure 8-7 Figure 8-8

Chapter VIII Basic Operation Procedures

Before the debugging, please select the suitable cup seat, turning plate, cooling ring, heating sprayer, code searching hammer, tube pressing hammer, filling nozzle and material cylinder according to the tube diameter and filling volume. Refer to the relevant chapters and sections for the detail specifications.

It is suggested to replace tubes of different specifications according to the following procedures. Refer to the relevant chapters and sections for the details:

- Put the cup seats with tubes inside them into the holes of rotary table.
 Manually rotate the pulley to make the tubes keep close to the scissors.
 Loosen the fastening screws of rotary table and turn the rotary table handle to adjust the tube height, so as to make the tail end of the tube be 3-5mm away from the bottom of internal blade.
- 2. After the rotary table is adjusted, continue to adjust the heating ejector pin. Disassemble the cooling protection ring for a convenient debugging. Manually rotate the pulley to turn the cup seats with tubes inside them to the work stations of heating. Loosen the locking nuts of the heating ejector pin and manually eject the heating ejector pin to make the tail end of the tube be 3-5mm away from the holes at the top row of the heating sprayer. After the positioning is finished, tighten the nuts.
- 3. According to the size of the tube, select the suitable auxiliary jig to adjust the pressure of clamp.
- 4. Rock the pulley manually and turn the rotary table to raise the tube discharging ejector pin to the highest position. Loosen the nuts of the ejector pin to raise the ejector pin to a height 10mm higher than that of the cup seat. Tighten the nuts.
- 5. Adjust the height of the filling and lifting ejector pin (refer to section III filling).

- 6. Adjust the color code (refer to section II code searching).
- 7. Adjust tube feeding (refer to section I tube feeding).
- 8. Turn on power switch of water chiller, and turn on heating switch of touch screen to carry out debugging of tube sealing.

Section I Tube Feeding

The section will explain how to complete the adjustment of tube feeding and tube pressing through 8 simple procedures. Before the adjustment, the height of the rotary table shall be firstly adjusted (for the height adjustment of rotary table, refer to the heating section --- basic adjustment for the heating ejector pin) according to the processed tubes. Rock the pulley manually to align a certain hole on the rotary table with the center of the code searching ejector pin. Thus, with the reference location, the adjustment can be carried out. Then, make the debugging according to the procedures ①—⑧ by referring to figure 9-1.

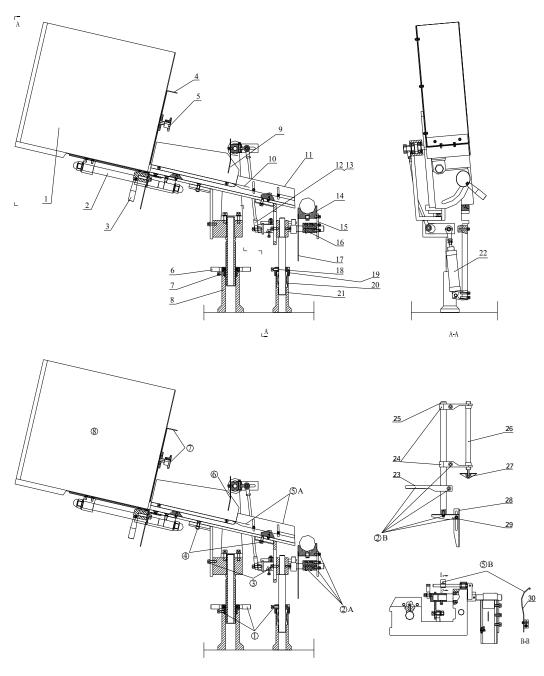


Figure 9-1

1. Tube bucket	2. Dotomy shoft	3. Locking	4. Right fender of	5. Donto gonal mut	
1. Tube bucket	2. Rotary shaft	handle	tube bucket	5. Pentagonal nut	
6. Handle	7. M8 screw	0 1 - 64	9. Stainless steel	10. Adjustable side	
6. Handle	7. IVIO SCIEW	8. Left support	turning plate	fender	
11. Adjustable	12 Jainsthanning	12 Deall and	14. Nylon turning	15. Retaining plate	
fender	12. Joint bearing	13. Pull rod	plate	of turning plate	

16. Turning plate base	17. Tube feeding fender of turning plate	18. M8 screw	19. Right support	20. Linear bearing
21. Right support	22. SI32*65 cylinder	23. Retaining plate	24. Cylinder retaining plate	25. Cylinder fixed shaft
26. Cylinder	27. Tube pressing hammer	28. Vertical tube positioning plate	29. Horizontal tube positioning plate	30. Flexible fender

①. Basic adjustment of integral height

Loosen screws 7 and 18, turn handle 6 to adjust the integral height to the required one, which shall make that the nylon turning plate shall be 10-20mm away from the cup seat at its bottom when the nylon turning plate turns upwards at a angle of 90° .

②A. Adjustment of nylon turning plate

Change a suitable turning plate, adjust retaining plate of turning plate 15 to achieve different heights and adjust turning plate base 16 to achieve different angles, which shall make that the nylon turning plate shall be 3mm away from the tube pressing hammer that drops when the nylon turning plate turns upwards at a angle of 90°.

②B. Adjustment of tube pressing

Adjust retaining plate 23 to adjust the forward and backward positions, adjust cylinder retaining plate 24 to adjust the height of tube pressing cylinder.

③. Adjustment of height of tube feeding bottom board

According to the height of nylon turning plate, adjust the two screws at ③, so as to make the tube feeding bottom board be 3-5mm higher than nylon turning plate.

①. Forward and backward adjustment of tube feeding bottom board

According to the position of nylon turning plate, adjust the two screws at \oplus , so as to make the tube feeding bottom board be 3-5mm away from the center of nylon

turning plate.

⑤ A. Adjustment of adjustable fender

According to the size of the tube, adjust the height of adjustable side fender 10 and the position of adjustable fender 11.

⑤B. Adjustment of flexible fender

When the nylon turning plate does not turn upwards, the flexible fender 30 will block the tube, and when the nylon turning plate turns upwards, the fender will be separated from the tube so as to make the tube smoothly slide down.

6. Adjustment of stainless steel fender

The fender is 5mm higher than the tube and its angle is about vertical to the tube feeding bottom board.

②. Adjustment of tube bucket outlet

Adjust fender 4 to make the height of the outlet higher than that of three rows of tubes.

Adjustment of tube feeding

Unpack the packaging box for plastic tubes and feed all the tubes in the box onto the tube bucket. Loosen the locking handle 3, the tube bucket 1 will rotate backwards at a certain angle around the rotary shaft 2. Take out the packaging box. After the plastic tubes are arranged in order, turn the tube bucket forward and tighten the locking handle 3.

After the above 8 procedures are completed, manually put the tubes into the tube feeding bottom board and carry out debugging again. Before connecting with the air supply to carry out automatic debugging for tube feeding, make sure that the tubes can be smoothly inserted into the cup seats.

Section II Code Searching

1. Basic adjustment of code searching photoelectric detector

01) Adjustment of height and angle

Rock the pulley manually to align a certain hole on the rotary table with the

INCHING OPERATION button (figure 9-2①). Lift the ejector pin to the highest point (the step shall be omitted if it is not pneumatic code searching). Or the ejector pin can be ejected manually. Adjust the height of the ejector pin to appropriately separate the cup seat from the rotary table for about 3mm (figure 9-2-②). Tighten the ejector pin nuts, and adjust the height of photoelectric support to make the lights sent out irradiate the center of the color code (figure 9-2-③). Also, adjust the inclination between the photoelectric detector and the color code of the tube to be 15°, with thin and long lights sent out (figure 9-2-④).

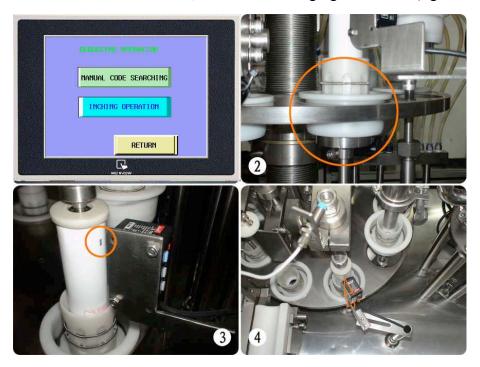


Figure 9-2

Note: If your company adopts pneumatic code searching, when adjusting the height of code searching ejector pin, please firstly lift the code searching ejector pin to the highest position (manually or pneumatically both acceptable) before adjusting it to the required height. Otherwise the machine may bend the ejector pin when it is operated!

02) Adjustment of color code

After the height and angle are adjusted, continue to adjust the color code. We will introduce a basic setting method by taking the example of "2-point teaching".

Press MODE button to select TEACH mode (figure 9-3).



Figure 9-3

Align the light spot and the color code and press ON button. Then turn the tube, align the light spot with the bottom color and press OFF button.

After the setting is finished, figure 9-4 is displayed, which indicates that the teaching has been finished. The best LCD will be automatically selected and RUN mode will be automatically resumed.



Figure 9-4

2. Common problems and solutions

- O1) Problem: The color code is not at the center of the tube. How to solve it?

 Solution: Place the tube at a suitable adjusting position before adjusting the color code. In case of deviation, turn the tube leftwards or rightwards to carry out adjustment, and at the same time, the positions and angles of photoelectric detector and tube shall be adjusted. Refer to the basic adjustment.
- 02) Problem: There is deviation that the color code is sometimes at the center of the tube and sometimes not. How to solve it?
 - Solution: 1. Refer to the basic adjustment to carry out the adjustment again.
- 3. Check if the heights of the color codes of tubes are same (figure 9-5-①).



Figure 9-5

01) Problem: When the horizontal code and vertical code are both present (figure 9-5-②), how to solve it?

Solution: To avoid being disturbed by the horizontal code, appropriately tone down the lights irradiated by the photoelectric detector to the tube.

02) Problem: How to adjust a transparent tube?

Solution: Because a transparent tube can't shade the lights sent out by the photoelectric detector, the color code may not be found. We need to machine a code searching hammer which can be inserted into the tube diameter and shade the lights irradiated by the photoelectric detector to the tube (figure 9-6-A). In this way, this kind of problem can be solved.

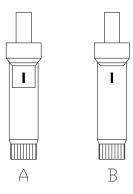


Figure 9-6

Section III Filling

1. Basic adjustment of the filling ejector pin

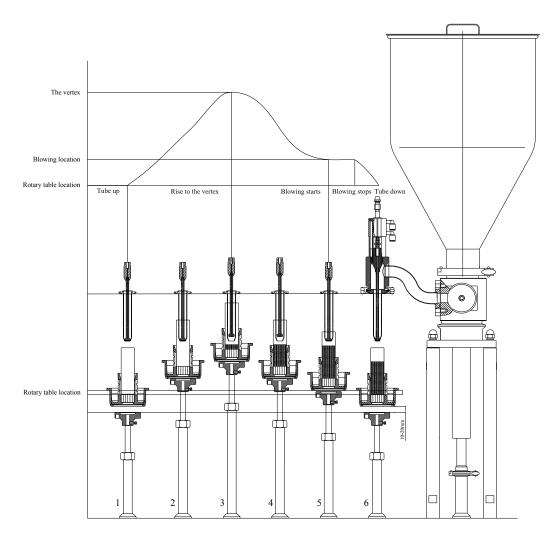


Figure 9-7 (1-6)

Preparation:

- 1. According to the tube diameter and filling volume, select suitable material cylinder and filling nozzle (figure 9-10).
- 2. According to the tube length, appropriately adjust the filling height dial (figure 9-8-1) to make the filling and lifting ejector pin work within an effective stroke range.

3. Blowing position

Rock the pulley manually and observe that when the filling and lifting ejector pin drops from the highest position (9-7-3) to the position (9-7-5) there is a

transient pause. At the time, the gas will be blown out from the filling core along the blowing pipe. The materials remaining at the filling nozzle will be blown into the tube and the cutting and wire drawing will be carried out effectively. This position is called as blowing position.

Debugging:

Loosen the nuts on the filling and lifting ejector pin to lower the ejector pin to the lowest position. Avoid mis-operation, or else, the ejector pin may be bent. Rock the pulley manually to the blowing position. Manually eject the ejector pin to make the filling nozzle insert into about 15mm of the tube. Tighten the nuts and continue rotating the pulley to lower the ejector pin to the lowest position. At the time, if the distance between the bottom of the cup seat and the cup holder is found to be more than 10-20mm, or the cup seat and the cup holder are kept close without interval between them, the cause may be that the stroke range of the filling and lifting ejector pin is not well adjusted. Please adjust the filling height dial again to make the distance between the bottom of the cup seat and the cup holder be within 10-20mm. Repeat the above 2-step operations to complete the debugging.

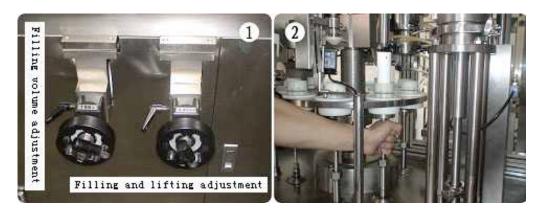


Figure 9-8

Hint Please firstly fix the height of the rotary table before adjusting the height of the filling and lifting ejector pin.

2. Blowing adjustment

Please appropriately adjust the blowing level according to the viscosity of materials. During the filling for materials of higher viscosity such as lipstick, adjust the values of **FILL ON**, **FILL OFF** and **BLOW ON** to be respectively 5°, 80° and 110° so as to achieve a satisfactory effect (figure 9-9).

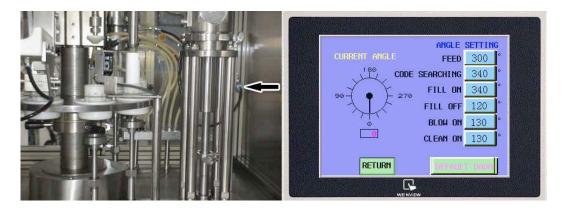


Figure 9-9

3. Adjustment of filling volume

Rock manually the filling volume adjusting dial. Turn it clockwise to decrease the filling volume and turn it counterclockwise to increase the filling volume.

Form for selecting material cylinder and filling nozzle							
Filling volume		ml	3-20	25-45	50-90	100-200	250-300
Material cylinder	D	d*D (mm)	ф 16*86	ф 25*86	ф 35*86	ф 53*86	ф 66*86
Filling nozzle	D	D*L (mm)	ф 10*110 ф 13*110	ф 15*110 ф 19*110	ф 25*110	ф 32*110	ф 32*110 ф 40*110

Figure 9-10

4. Cleaning and maintenance

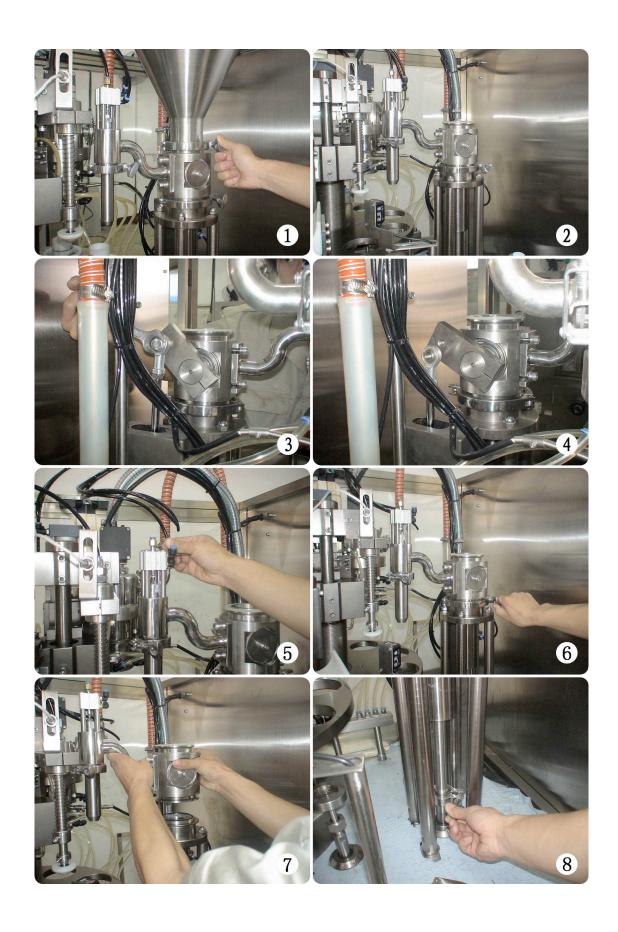
During the first time use, please clean the parts by using solution made of edible detergent and then flush them with clear water, and finally scrub the internal wall with alcohol and make them dry in the air. Refer to figure 9-11 to disassemble the filling part according to the following procedures:

① Remove the ferrule of valve body and hopper ② Remove the hopper ③ — ④ Loosen the screws of valve body and cylinder ⑤ S

Remove the air pipe ⑥ Loosen the ferrule of valve body and flange ⑦ Take out the filling part ⑧ Loosen the ferrule of material cylinder ⑨ 9

Take out the material cylinder ⑥ Loosen the screws of nozzle body and valve body ⑥ Loosen the ferrule of nozzle body ⑥ Take out the filling nozzle and core ⑥ Loosen the screws of dust cover and take out the dust cover ⑥ Take out the snap ring ⑥ Gently hit the valve spool with a rubber hammer ⑥ Take out the valve spool. The cleaning is completed as shown in figure 9-12.

Note When removing the valve body and spool shaft, please do not damage the valve spool and collide with the internal cavity of valve.



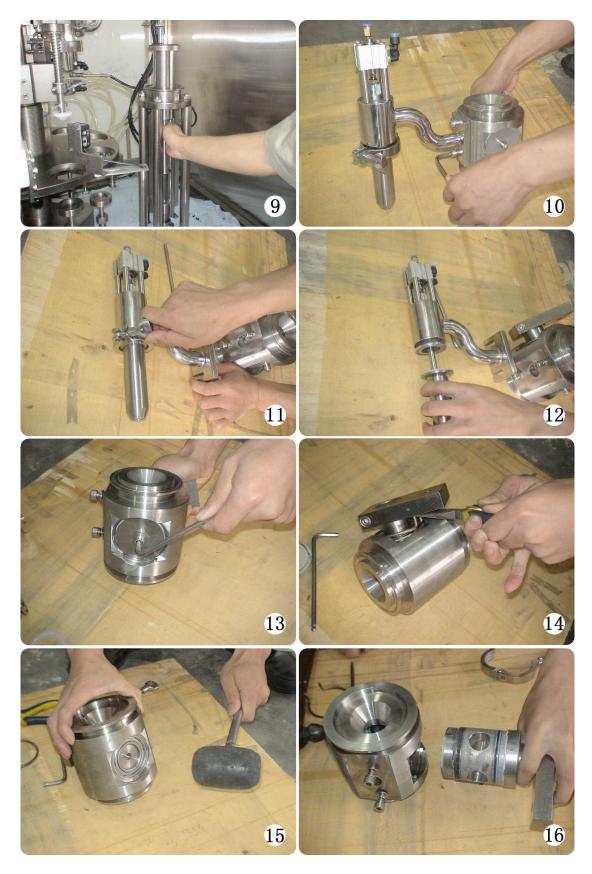


Figure 9-11



Figure 9-12

Note When installing the valve body, pay attention to the direction of the valve spool tee (figure 9-13).

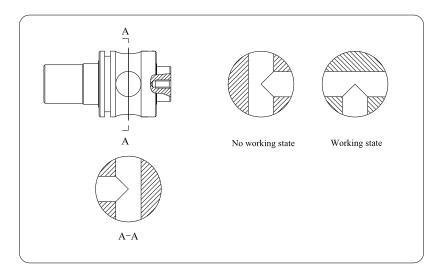


Figure 9-13

Section IV Heating

1. Adjustment of the height of the rotary table

Put the cup seats with tubes inside them into the holes of rotary table. Manually rotate the pulley to make the tubes keep close to the scissors. Loosen the fastening screws of rotary table (figure 9-14-①) and turn the rotary table handle to adjust the tube height, so as to make the tail end of the tube be 3-5mm away from the bottom of internal blade (figure 9-14-③). It is certain that the distance can be appropriately adjusted according to the actual production requirements, but it shall not exceed 10mm.

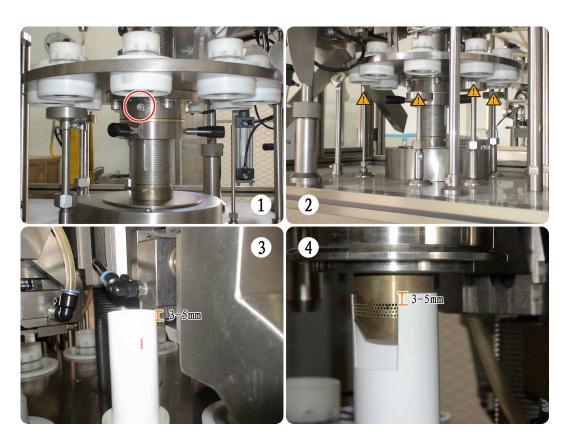


Figure 9-14

2. Adjustment of height of the heating ejector pin

After the rotary table is adjusted, continue to adjust the heating ejector pin. Disassemble the cooling protection ring for a convenient debugging. Manually rotate the pulley to turn the cup seats with tubes inside them to the work stations of heating. Loosen the locking nuts of the heating ejector pin and manually eject

the heating ejector pin to make the tail end of the tube be 3-5mm away from the holes at the top row of the heating sprayer (figure 9-14-4). After the positioning is finished, tighten the nuts.

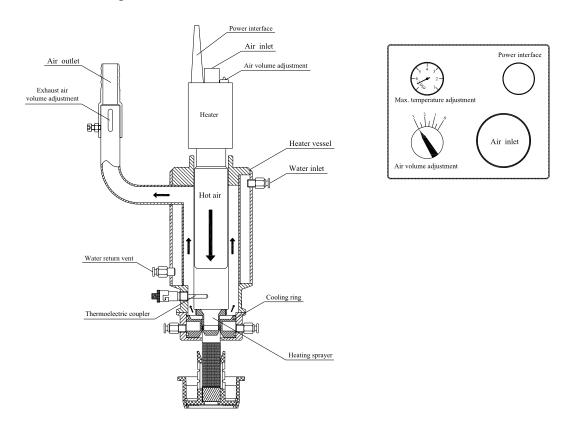


Figure 9-15

Warning When lowering the height of the rotary table, make sure to lower the ejector pins for code searching, filling, heating and tube discharging! Figure 9-15

Warning Before the machine leaves the factory, the main heating temperature has been adjusted to the maximum value 650, which can't be adjusted any more! Figure 9-15

Warning The air inlet of the heater can't be adjusted to level 0, or else, the heater may be damaged! Figure 9-15

Hint The thermoelectric coupler must be inserted into the heating device.

Otherwise, the temperature rise may not be stable!

3. Basic parameters

The following data are only for reference. Please adjust the parameter values according to actual materials of the tube.

Tube	Rotation	Heating	Cooling	Clamp angle//time
diameter	speed	temperature	temperature	delay
mm	p/m			S/°
φ13-20	40	280-350	20	0.7-0.8/330
φ20-30	40	330-360	20	0.8/330
φ30-40	40	340-380	20	0.8/330
φ40-50	40-35	350-430	20	0.8-1.0/320-330

4. Cooling circulation

Please connect the main machine with the water chiller for water way circulation according to the following figure.

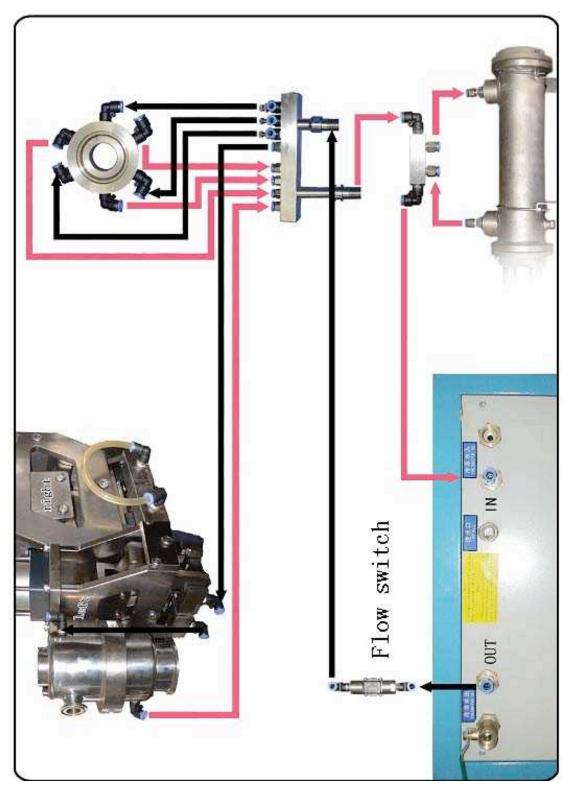


Figure 9-16

Note Normal heating will not be realized when the water chiller is not operated!

Hint It is suggested that the working water of the water chiller be set at

15-20 .

5. Common problems and solutions.

- 01) Problem: In the tube, one side sealing is firm and another side sealing is not firm. Furthermore, the scald takes place at one side.
 - Solution: 1. Check the firmness between the cooling ring and the tube. If too loose, the above occurrence may take place. Replace the cooling ring.
- 2. Adjust the central position of the heating device (it is suggested that the heating device be aligned with the center of the hole of the rotary table vertically).

Note The size error permitted of outside diameter of the tube shall be within 0.1mm. Too small or too large diameter is the main cause that leads to the loose sealing at one side. Any size that exceeds the permitted size range shall be confirmed by Rigao Company.

- 02) Problem: The bottom of the heating sprayer contacts the materials, and the heating holes of the heating sprayer are always blocked.
 - Solution: 1. Too many materials are filled into the tube.
- 2. Materials adhere to the tube wall. Adjust the filling blowing to stop the materials spattering.
 - 03) Problem: The tube can't be pulled out from the cooling ring after it is heated.
 - Solution: 1. The cooling ring is too tight.
 - 2. The heating temperature is too high.
 - 3. The distance between the tube and the heating device is adjusted to be higher than 5mm, so the heating ejector pin can't be lowered within the limited time.

Note We have adjusted the distance between the tube and the heating device to be 5mm as shown in figure 9-17, which can't be randomly adjusted.



Figure 9-17

Section V Sealing

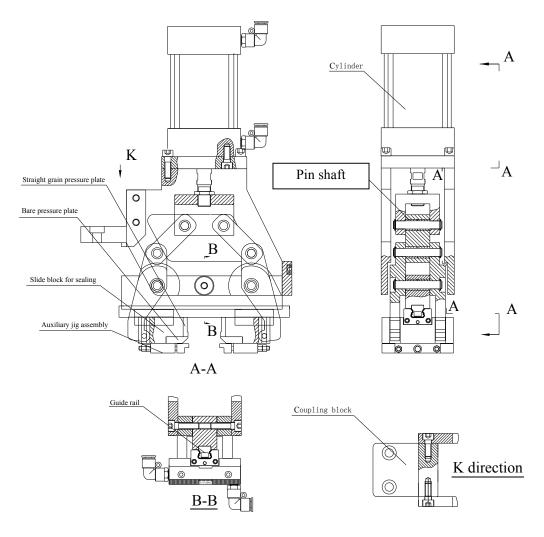


Figure 9-18

1. Pressure adjustment

The following data are only for reference. Please adjust the parameter values according to actual materials of the tube.

Tube diameter mm	Rotation speed p/m	Heating temperature	Cooling temperature	Pressure Mpa	Clamp angle//time delay S/°
φ13-20	40	280-350	20	0.4	0.7-0.8/330
φ20-30	40	330-360	20	0.4/0.5	0.8/330
φ30-40	40	340-380	20	0.5/0.6	0.8/330
φ40-50	40-35	350-430	20	0.6/0.7	0.8-1.0/320-330

Figure 9-19

2. Selection of auxiliary jig

Select the suitable auxiliary jig according to the following form

Specification of	Tube	Matched	
auxiliary jig	diameter	auxiliary jig	
	φ13-35mm	A	
A B B	φ35-50mm	В	

Figure 9-20

3. Common problems and solutions

01) Problem: Sharp edges exist at two sides. How to solve it?

Solution: 1. The heating temperature is too high, which shall be appropriately lowered.

- 2. The clamp pressure is too high, which shall be appropriately reduced.
- 02) Problem: Sharp edge exists at one side. How to solve it?

Solution: 1. Adjust the heating device to align it with the center of the hole of the rotary table vertically.

- 2. Appropriately adjust the incoming volume of cooling water at one side.
 - 03) Problem: Scalds exist at both sides. How to solve it?

Solution: 1. The heating ejector pin ejects the tube too high, which shall be lowered.

- 2. Increase the strength of auxiliary jigs at both sides.
- 04) Problem: The scald exists at one side. How to solve it?

Solution: 1. Increase the strength of the auxiliary jig at the side where the scald exists.

- 2. Appropriately adjust the incoming volume of cooling water at one side.
- 3. In case the above two measures still can't solve the problem, use the following method. As shown in figure 9-21, the scald exists at the side where the color code is present on the tube. Please synchronously tighten the two screws under the circle as shown in figure 9-21. Contrarily, if the scald exists at the other side, please adjust the two screws at the top.



Figure 9-21

- 05) Problem: In the tube, one side sealing is firm and another side sealing is not firm. Furthermore, the scald takes place at one side.
 - Solution: 1. Check the firmness between the cooling ring and the tube. If too loose, the above occurrence may take place. Replace the cooling ring.
- 2. Adjust the central position of the heating device (it is suggested that the heating device be aligned with the center of the hole of the rotary table vertically).



Hint Refer to the heating section for the solutions.

Section VI Shearing

After the two blades become blunt, remove them for grinding. Please tighten the screws when installing them.

1. The tail sealing width of the tube can be adjusted through two methods: one is to

realize the width adjustment through adjusting the height of the rotary table. This method is used to adjust the integral height of the tube, which can be used during the first debugging of the tube. The other is only to adjust the height of the scissors partially. This method is used for the adjustment of individual sealing width. Loosen the screws of coupling block to adjust the height of the scissors.

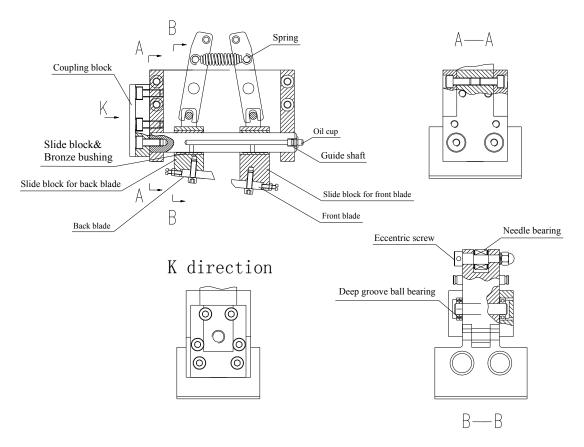


Figure 9-22

2. The blowing volume for cleaning of scissors can be adjusted through the adjustable solenoid valve as shown in figure 9-23-1. The blowing time for cleaning of scissors can be adjusted through CLEAN ON as shown in figure 9-23-2.

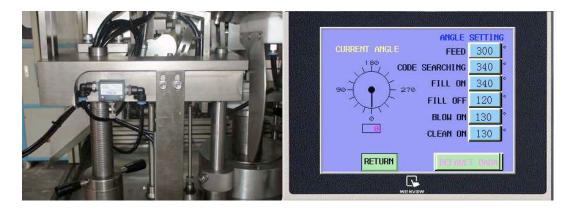


Figure 9-23

3. At the front end of the scissors, there are two oil filling holes, which shall be regularly lubricated (figure 9-22).

Section VII Tube Discharging

Rock the pulley manually to turn the rotary table, and raise the tube discharging ejector pin to the highest position. Loosen the nuts of the ejector pin to raise the ejector pin to a height 10mm higher than that of the cup seat. Tighten the nuts (figure 9-24).



Figure 9-24

Chapter IX Safety Protection

1. The machine is provided with the protection function of safety door. Operate the machine when the door protection button in the touch screen is activated. If the safety door is suddenly opened, the machine will be stopped. Restart the machine for operation after the safety door is closed.

- 2. The machine is provided with the power cutoff function in case the power distribution cabinet is opened.
- 3. The machine is provided with protection function for overload. In case of fault overload, the clutch will be automatically released and the warning lamp will flash to give indications. At the time, cut off the main power switch, and eliminate the malfunction immediately. After the malfunction is eliminated, rock the pulley manually to reset the clutch, and then restart the main machine according to the starting procedures (figure 10-1).
- 1. Screw the round nuts in for 8-15mm, with moderate overload withstanding capacity.
- 2. When overloading occurs, the output shaft will be separated from the clutch sprocket wheel, which will contact the switch and the machine will stop its operation.



Figure 10-1

Chapter X Daily Maintenance

1. Machine body

After work of each shift, the workers shall cut off the power supply, clean and wipe the filling nozzles, cup seats, rotary table, sealing and code printing clamp mouths with absorbent cotton dipped into medicinal alcohol to maintain all parts clean without dusts.

2. Scale structure

The lubricating grease of the large table column bushing and scale structure shall be replaced once half a year and they shall be checked and oiled once a week.

3. Speed reducer

Check once a week if the oil level is lower than 1/2 of that as shown on the window, if it is lower than 1/2, please add 30# engine oil in time.

- 4. The main drive system, chain and cam plate located at the bottom of the machine table shall be checked and oiled once a week.
- 5. If the machine is not used for a long time, before restarting the machine, please check if the screws of all parts are loose, and tighten and adjust them if necessary. Check the lubricating conditions of all transmission parts. After all the inspections are completed, start the main machine according to the starting procedures.

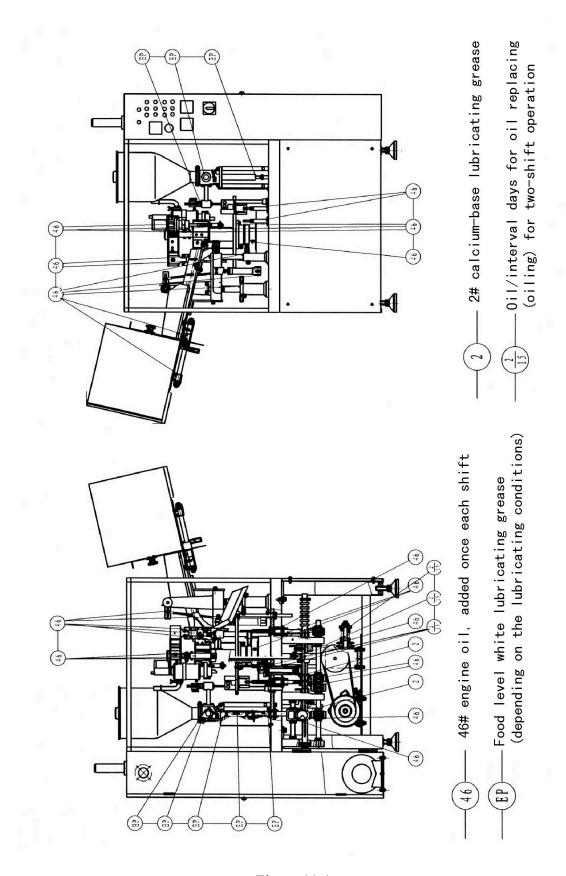


Figure 11-1
Chapter XI Certification and Packing List

RGNF-30B Automatic Tube Filling & Sealing Machine

Machine model	RGNF-30B
Machine No.	
Ex-factory date	
Date of purchasing	
Acceptance suggestion of user	
Unit seal of user	
User's address	
Responsible person of user	
Contact phone of user	
PC	
Supplier	

Product Certification

Product name:	Automatic tube filling & sealing machine
Product model:	RGNF-30B
Ex-factory No.:	
	The product has been inspected as qualified
	and is allowed to leave the factory.
Ingnactor	
Inspector:	
Date of	
inspection	

Packing List of RGNF-30B Automatic Tube Filling & Sealing

Machine

No.	Category	Name	Unit	Piece	Specification	Remark
1		Main machine	Set	1		
2	Tec	Use instructions	Сору	1		
3	hnical	Product certification	Сору	1		
4	Technical documents	Packing list	Copy	1		
5	nents	Acceptance form of installation and debugging	Copy	1		
6		Cup seat	Piece	10		
7		Hopper	Piece	1		
8		Tube bucket	Piece	1		
9		Plunger pump	Piece	1		Purchased by customer
10		Heating box	Piece	1		Purchased by customer
11	A	Blender	Piece	1		Purchased by customer
12	Accessories	Ultrasonic wave	Piece	1		Purchased by customer
13		Toolbox	Piece	1		
14		Seal ring	Set	1		
15		Dead wrench	Piece	4		
16		Flexible wrench	Piece	1		
17		Slotted screwdriver, Philips screwdriver	Piece	1 for each		
18		Inner hexagon wrench	Set	1		

19	Code granules	Set	1	
20	Grease gun	Piece	1	

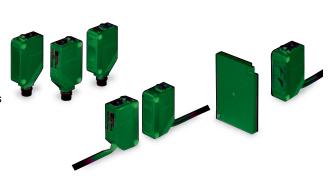
Inspector Packer Date of packing	Inspector	Packer	Date of packing
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E3Z

CSM_E3Z_DS_E_13_1

The Standard for Photoelectric Sensors with a Secure Track Record of One Million Sold Yearly.

- Long sensing distance of 30 m for Through-beam Models, 4 m for Retro-reflective Models, and 1 m for Diffuse-reflective Models.
- \bullet Mechanical axis and optical axis offset of less than $\pm 2.5^\circ$ simplifies optical axis adjustment.
- High stability with unique algorithm that prevents interference of external light.



 $C \in$



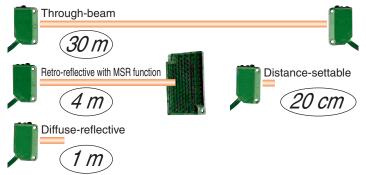
Be sure to read *Safety Precautions* on page 15.

Features

Industry's Top-level Sensing Distance with Built-in Amplifier

A separately sold filter is available to prevent mutual interference for Through-beam Models with red lights sources and a sensing distance of 10 m. Reflective Models include functionality to prevent mutual interference.

Long-distance, Through-beam Sensors with a detection distance of 30 m (response time: 2 ms) are also available.

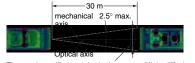


Low-temperature Operation for Applications in Cold-storage Warehouses

A wider ambient operating range from –40 to 55°C (main models with connectors). We also provide Sensor I/O Connectors with PUR Cables for high resistance to cold environments.

Improved Matching of Optical Axis and Mechanical Axis for Through-beam Models and Retro-reflective Models

The offset between the optical axis and the mechanical axis is kept within $\pm 2.5^{\circ}$, so the optical axis can be accurately set simply by mounting the Sensor according to the mechanical axis.



The receiver will always be in the range of light diffusion.

Sensor Protection against Incorrect Wiring

The Sensor includes output reverse polarity protection. (A diode to protect against reverse polarity is added to the output line.)

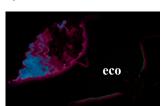
Through-beam Model receivers and Reflective Models (except the E3Z-LS) Operation Operation Operation Operation Orange) Stability Indicator Orange Operation Operatio

Protection for NPN output models

Complete Compliance with the EU's RoHS Directive

Lead, mercury, cadmium hexachrome, polybrominated biphenyl (PBB), and polybrominated diphenyl ether (PBDE) have all been eliminated. Also, burnable polyethylene packaging has been used.





OMRON 1

Ordering Information

Sensors [Refer to Dimensions on page 16.]

Sensing method	Appearance	Connection method	Sensing distance		del
	716600101100		Conomig dictance	NPN output	PNP output
		Pre-wired (2 m)	(() 15 m	E3Z-T61 2M Emitter E3Z-T61-L 2M Receiver E3Z-T61-D 2M	E3Z-T81 2M Emitter E3Z-T81-L 2M Receiver E3Z-T81-D 2M
		Standard M8 connector		E3Z-T66 Emitter E3Z-T66-L Receiver E3Z-T66-D	E3Z-T86 Emitter E3Z-T86-L Receiver E3Z-T86-D
Through-beam		Pre-wired (2 m)	10.00	E3Z-T61 A 2M Emitter E3Z-T61-A-L 2M Receiver E3Z-T61-A-D 2M	E3Z-T81 A 2M Emitter E3Z-T81-A-L 2M Receiver E3Z-T81-A-D 2M
Emitter + Receiver) 3		Standard M8 connector	10 m	E3Z-T66A Emitter E3Z-T66-A-L Receiver E3Z-T66-A-D	E3Z-T86A Emitter E3Z-T86-A-L Receiver E3Z-T86-A-D
		Pre-wired (2 m)		E3Z-T62 2M Emitter E3Z-T62-L 2M Receiver E3Z-T62-D 2M	E3Z-T82 2M Emitter E3Z-T82-L 2M Receiver E3Z-T82-D 2M
		Standard M8 connector	(2000	E3Z-T67 Emitter E3Z-T67-L Receiver E3Z-T67-D	E3Z-T87 Emitter E3Z-T87-L Receiver E3Z-T87-D
Emission stop		Pre-wired (2 m)		E3Z-T62-G0 2M *4 Emitter E3Z-T62-G0-L 2M Receiver E3Z-T62-G0-D 2M	E3Z-T82-G0 2M *4 Emitter E3Z-T82-G0-L 2M Receiver E3Z-T82-G0-D 2M
function		Standard M8 connector		E3Z-T67-G0 *4 Emitter E3Z-T67-G0-L Receiver E3Z-T67-G0-D	E3Z-T87-G0 *4 Emitter E3Z-T87-G0-L Receiver E3Z-T87-G0-D
Retro-reflective with	ு ந	Pre-wired (2 m)	4 m *2	E3Z-R61 2M	E3Z-R81 2M
MSR function	*1	Standard M8 connector	(100 mm)	E3Z-R66	E3Z-R86
		Pre-wired (2 m)	5 to 100 mm	E3Z-D61 2M	E3Z-D81 2M
		Standard M8 connector	(wide view)	E3Z-D66	E3Z-D86
Diff		Pre-wired (2 m)		E3Z-D62 2M	E3Z-D82 2M
Diffuse-reflective		Standard M8 connector	1 m	E3Z-D67	E3Z-D87
	Ť	Pre-wired (2 m)	90±30 mm	E3Z-L61 2M	E3Z-L81 2M
		Standard M8 connector	(narrow beam)	E3Z-L66	E3Z-L86
		Pre-wired (2 m)	20 to 40 mm (BGS min setting) 20 to 200 mm (BGS max setting)	E3Z-LS61 2M	E3Z-LS81 2M
Distance-settable Refer to E3Z-LS .	<u> </u>	Standard M8 Connector	40 min. Incident threshold (FGS min setting) 200 min. Incident threshold (FGS max setting)	E3Z-LS66	E3Z-LS86
		Pre-wired (2 m)	2 to 20 mm (BGS min setting)	E3Z-LS63 2M	E3Z-LS83 2M
		Standard M8 connector	2 to 80 mm (BGS max setting)	E3Z-LS68	E3Z-LS88
	1 axis	Pre-wired (2 m)		E3Z-G61 2M	E3Z-G81 2M
Slit-type Through- beam	2 axes	(2,	25 mm	E3Z-G62 2M	E3Z-G82 2M
Refer to E3Z-G .	1 axis	Pre-wired M8 connector		E3Z-G61-M3J	E3Z-G81-M3J
	2 axes			E3Z-G62-M3J	E3Z-G82-M3J
imited-reflective for		Pre-wired (2 m)	30±20 mm	E3Z-L63 2M	E3Z-L83 2M
ransparent glasses		Standard M8 connector		E3Z-L68	E3Z-J88
		Pre-wired (2 m)	*2	E3Z-B61 2M	E3Z-B81 2M
Retro-reflective with- out MSR function for		Standard M8 connector	500 mm (80 mm)	E3Z-B66	E3Z-B86
clear, plastic bottles		Pre-wired (2 m)	2 m (500 mm)	E3Z-B62 2M	E3Z-B82 2M
		Standard M8 connector	∠ III (300 IIIM)	E3Z-B67	E3Z-B87

^{*1.} The Reflector is sold separately. Select the Reflector model most suited to the application.
*2. The sensing distance specified is possible when the E39-R1S is used. Values in parentheses indicate the minimum required distance between the Sensor and Reflector.
*3. Through-beam Sensors are normally sold in sets that include both the Emitter and Receiver.
Orders for individual Emitters and Receivers are accepted. (Modifications are required for some models. Ask your OMRON representative for details.)
*4. Models with emission stop function. Refer to page 8, *Photoelectric Sensors Technical Guide* for details.

Variety of Connection Specifications

The models with the connection specifications marked with a black circle in the table are available. The model number indication is a combination of the basic model and the connection specification.

Basic model Connection specification

NPN Output

	Model		Model number example	E3Z-T61 -M1TJ 0.3M	E3Z-T61 0.5M	E3Z-T61 5M	E3Z-T61 -M1J 0.3M	E3Z-T61 -M3J 0.3M	E3Z-T61 -ECON 0.3M E3Z-T61 -ECON 0.5M	E3Z-T61 -ECON 2M
mathod Ing dis-	Main	g dis- Main	Connection specification	M12 pre- wired Smart- click connec- tor (cable length: 0.3 m)	Pre-wired (cable length: 0.5 m)	Pre-wired (cable length: 5 m)	M12 pre- wired stan- dard connec- tor (cable length: 0.3 m)	M8, 4-pin pre- wired con- nector (cable length: 0.3 m)	e-CON pre- wired con- nector (cable length: 0.3 m/ 0.5 m)	e-CON pre- wired con- nector (cable length: 2 m)
	tance		Basic model number	-M1TJ 0.3M	0.5M	5M	-M1J 0.3M	-M3J 0.3M	-ECON 0.3M -ECON 0.5M	-ECON 2M
	15 m	Infrared light	E3Z-T61	•	•	•	•	•	•	•
Through- beam	10 m	Red light	E3Z-T61A		•	•	•		•	•
	30 m	2-ms re- sponse	E3Z-T62		•					
Retro- reflective	4 m	MSR function	E3Z-R61	•	•	•	•	•	•	•
Diffuse-	100 mm	Wide view	E3Z-D61		•	•	•	•	•	•
reflective (narrow- beam re-	1 m	Long dis- tance	E3Z-D62	•	•	•	•	•	•	•
flective)	90 mm	Narrow beam	E3Z-L61	•	•	•	•		•	•
Distance-	200 mm	FGS function	E3Z-LS61		•	•	•	•	•	•
settable	80 mm	Small spot	E3Z-LS63		•					
Clit to me	0E	1 optical axis	E3Z-G61	•	•	•	•	•	•	•
Slit-type	25 mm	2 optical axes	E3Z-G62		•	•	•	•	•	•
Retro-	500 mm		E3Z-B61		•	•			•	•
reflective for clear, plastic bottles	2 m	No MSR function	E3Z-B62		•	•	•		•	•

Clamp-type e-CON pre-wired connectors are also available for models shaded in Add "-ECON-C 2M" after the basic model number to specify the connectors.

PNP Output

	Model		Model number example	E3Z-T81 -M1TJ 0.3M	E3Z-T81 0.5M	E3Z-T81 5M	E3Z-T81 -M1J 0.3M	E3Z-T81 -M3J 0.3M
Sensing method		Main features	Connection specification	M12 pre-wired Smartclick connector (cable length: 0.3 m)	Pre-wired (cable length: 0.5 m)	Pre-wired (cable length: 5 m)	M12 pre-wired standard con- nector (cable length: 0.3 m)	M8, 4-pin pre- wired connec- tor (cable length: 0.3 m)
	tance		Basic model number	-M1TJ 0.3M	0.5M	5M	-M1J 0.3M	-M3J 0.3M
	15 m	Infrared light	E3Z-T81	•	•	•	•	•
Through- beam	10 m	Red light	E3Z-T81A				•	
	30 m	2-ms re- sponse	E3Z-T82		•			
Retro- reflective	4 m	MSR function	E3Z-R81	•	•	•	•	•
Diffuse-	100 mm	Wide view	E3Z-D81	•	•	•	•	•
reflective (narrow- beam	1 m	Long dis- tance	E3Z-D82	•	•	•	•	•
reflective)	90 mm	Narrow beam	E3Z-L81	•	•	•	•	
Distance-	200 mm	FGS function	E3Z-LS81		•	•	•	•
settable	80 mm	Small spot	E3Z-LS83		•			
Slit-type	a	1 optical axis	E3Z-G81	•	•		•	•
Siit-type	25 mm	2 optical axes	E3Z-G82		•		•	•
Retro-	500 mm		E3Z-B81		•		•	
reflective for clear, plastic bottles	2 m	No MSR function	E3Z-B82		•	•	•	

Oil-resistive Sensors (Refer to Dimensions on page 16.)

Oil-resistive Sens	Oil-resistive Sensors [Refer to Dimensions on page 16.]								
Sensing method	Appearance	Connection meth-	Sensing distance		Model				
ocholing method	Appearance	od	ochonig diotanoc	NPN output	PNP output				
Through-beam		Pre-wired (2 m)		E3Z-T61K 2M Emitter E3Z-T61K-L 2M Receiver E3Z-T61K-D 2M	E3Z-T81K 2M Emitter E3Z-T81K-L 2M Receiver E3Z-T81K-D 2M				
(Emitter + Receiver) *3		Pre-wired M8 connector	\$\\$\]15 m	E3Z-T61K-M3J 0.3M Emitter E3Z-T61K-L-M3J 2M Receiver E3Z-T61K-D-M3J 2M	E3Z-T81K-M3J 0.3M Emitter E3Z-T81K-L-M3J 2M Receiver E3Z-T81K-D-M3J 2M				
Retro-reflective with	T _ N	Pre-wired (2 m)	*2	E3Z-R61K 2M	E3Z-R81K 2M				
MSR function	*1	Pre-wired M8 connector	3 m (150 mm)	E3Z-R61K-M3J 0.3M	E3Z-R81K-M3J 0.3M				
		Pre-wired (2 m)		E3Z-D61K 2M	E3Z-D81K 2M				
Diffuse-reflective	ি ←	Pre-wired M8 connector	5 to 100 mm (wide view)	E3Z-D61K-M3J 0.3M	E3Z-D81K-M3J 0.3M				
		Pre-wired (2 m)		E3Z-D62K 2M	E3Z-D82K 2M				
		Pre-wired M8 connector	1 m	E3Z-D62K-M3J 0.3M	E3Z-D82K-M3J 0.3M				

^{*1.} The Reflector is sold separately. Select the Reflector model most suited to the application.

Accessories (Order Separately)

Slit (A Slit is not provided with Through-beam Sensors) Order a Slit separately if required. [Refer to Dimensions on page 18.]

Slit width	Sensing	distance	Minimum detectable object	Model	Contents
Siit widtii	E3Z-T E3Z-T (typical)		(typical)	Model	Contents
0.5-mm dia.	50 mm	35 mm	0.2-mm dia.	E39-S65A	
1-mm dia.	200 mm	150 mm	0.4-mm dia.	E39-S65B	One set
2-mm dia.	800 mm	550 mm	0.7-mm dia.	E39-S65C	(contains Slits for
0.5 × 10 mm	1 m	700 mm	0.2-mm dia.	E39-S65D	both the Emitter and
1 × 10 mm	2.2 m	1.5 m	0.5-mm dia.	E39-S65E	Receiver)
2 × 10 mm	5 m	3.5 m	0.8-mm dia.	E39-S65F	

Reflectors (Reflector required for Retroreflective Sensors) A Reflector is not provided with the Sensor. Be sure to order a Reflector separately. [Refer to Dimensions on E39-L/F39-L/E39-S/E39-R]

Name		Model	Quantity	Remarks			
Ivallie	E3Z-R	E3Z-R□K	E3Z-B□1/-B□6	E3Z-B□2/-B□7	Model	Quantity	nemarks
	3 m (100 mm) (rated value)	2 m (100 mm) (rated value)			E39-R1	1	
Reflector	4 m (100 mm) (rated value)	3 m (150 mm) (rated value)	500 mm (80 mm) (rated value)	2 m (500 mm) (rated value)	E39-R1S	1	
	5 m (100 mm)				E39-R2	1	Retro-reflective
	2.5 m (100 mm)				E39-R9	1	models are not
	3.5 m (100 mm)				E39-R10	1	provided with Reflectors.
Fog Preventive Coating	3 m (100 mm)		500 mm (80 mm) (rated value)	2 m (500 mm) (rated value)	E39-R1K	1	The MSR function is enabled.
Small Reflector	1.5 m (50 mm)				E39-R3	1	is enabled.
	700 mm (150 mm)				E39-RS1	1	
Tape Reflector	1.1 m (150 mm)				E39-RS2	1	
	1.4 m (150 mm)				E39-RS3	1	

Note: The actual sensing distance may be reduced to approximately 70% of the typical sensing distance when using a Reflector other than E39-R1 or E39-R1S.

Mutual Interference Protection Filter A Filter is not provided with the Sensor (for the through-beam E3Z-T□□A). Order a Filter separately if required.

Sensing distance	Appearance/Dimensions	Model	Quantity	Remarks
3 m	10.8 7.4 1 1 1 2 0.2	E39-E11	Two sets each for the Emitter and Receiver (total of four pieces)	Can be used with the E3Z-T□□A Through- beam models. The arrow indicates the direc- tion of polarized light. Mutual interference can be prevented by altering the direction of polarized light from or to adjacent Emitters and Receivers.

^{*2.} The sensing distance specified is possible when the E39-R1S is used. Values in parentheses indicate the minimum required distance between the Sensor and Reflector.

^{*3.} Through-beam Sensors are normally sold in sets that include both the Emitter and Receiver. Orders for individual Emitters and Receivers are accepted. (Modifications are required for some models. Ask your OMRON representative for details.)

^{*1.} Refer to *Reflectors* on *E39-L/F39-L/E39-S/E39-R* for details.
*2. Values in parentheses indicates the minimum required distance between the Sensor and Reflector.

Mounting Brackets A Mounting Bracket is not enclosed with the Sensor. Order a Mounting Bracket separately if required. [Refer to Dimensions on E39-L/F39-L/E39-S/E39-R]

Appearance	Model (material)	Quantity	Remarks	Appearance	Model (material)	Quantity	Remarks
	E39-L153 (SUS304)	1			E39-L98 (SUS304)	1	Metal Protective Cover Bracket *
NO.	E39-L104 (SUS304)	1	Mounting Brackets		E39-L150 (SUS304)	1 set	(Sensor adjuster)
-	E39-L43 (SUS304)	1	Horizontal Mounting Brackets *	E39-L151		1 set	Easily mounted to the aluminum frame rails of conveyors and easily adjusted.
	E39-L142 (SUS304)	1	Horizontal Protective Cover Bracket *		(SUS304)	i set	For left to right adjust- ment
	E39-L44 (SUS304)	1	Rear Mounting Bracket		E39-L144 (SUS304)	1	Compact Protective Cover Bracket (For E3Z only) *

Note: 1. When using Through-beam models, order one bracket for the Receiver and one for the Emitter.

2. Refer to *Mounting Brackets* on *E39-L/F39-L/E39-S/E39-R* for details.

* Cannot be used for Standard Connector models.

Sensor I/O Connectors

(Models for Connectors and Pre-wired Connectors: A Connector is not provided with the Sensor. Be sure to order a Connector separately.) [Refer to Dimensions for XS3, XS2, XS5. For e-CON, inquire.]

Size	Cable	Appearance		Cable	type	Model
		Otro i mint *0		2 m		XS3F-M421-402-A
M8 *1		Straight *3	The second	5 m	4-wire	XS3F-M421-405-A
IVIO I		1 -1		2 m	4-wire	XS3F-M422-402-A
		L-shaped *3 *4		5 m		XS3F-M422-405-A
		Straight *3		2 m		XS2F-D421-DC0-A
M12 *1		Straight 3		5 m	3-wire	XS2F-D421-GC0-A
(For -M1J models)		Labored *0	2 m	3-Wile	XS2F-D422-DC0-A	
	Standard	L-shaped *3		5 m		XS2F-D422-GC0-A
M12		Object to both		2 m	4-wire	XS5F-D421-D80-A
(For -M1TJ models)		Straight		5 m		XS5F-D421-G80-A
		Single-end connector		2 m		E39-ECON2M
				5 m		E39-ECON5M
e-CON		Double-end conn	ectors	0.5 to 1 m	4-wire	E39-ECONW□M
				1.1 to 1.5 m		indicates cable length (in units
		الله		1.6 to 2 m		of m). Specify with 0.1-increments.
		Straight *3		2 m	4-wire	XS3F-M421-402-L
M8	PUR (Polyure-	5g.11 0	The second second	5 m		XS3F-M421-405-L
IVIO	thane) cable *2	L-shaped *3 *4		2 m		XS3F-M422-402-L
	,			5 m		XS3F-M422-405-L

Note: When using Through-beam models, order one connector for the Receiver and one for the Emitter.

*1. Refer to Introduction to Sensor I/O Connectors for details.

*2. The Sensor can be used in low-temperature environments (–25°C to –40°C). Do not use the Sensor in locations that are subject to oil.

^{*3.} The connector will not rotate after connecting.

 $^{^{\}star}4$. The cable is fixed at an angle of 180° from the sensor emitter/receiver surface.

Ratings and Specifications

Note PN Pre-wired E32-T66 E32-T67 E32-T66 E32-T67 E32-T66 E32-T66 E32-D66 E32-D67 E32 E32-T66 E32-D67 E32 E32-T66 E32-D67				Sensing method	7	Γhrough-beam	1	Retro-reflective		Diffuse-r	eflective	(Narrow- beam Models)
				Pre-wired	E3Z-T61	E3Z-T62	E3Z-T61A	E3Z-R61		E3Z-D61	E3Z-D62	E3Z-L61
No				Connector (M8)	E3Z-T66	E3Z-T67	E3Z-T66A	E3Z-R66		E3Z-D66	E3Z-D67	E3Z-L66
Sensing distance Sensing di	Mod	del -	•	Pre-wired	E3Z-T81	E3Z-T82	E3Z-T81A	E3Z-R81		E3Z-D81	E3Z-D82	E3Z-L81
Sensing distance	Item			Connector (M8)	E3Z-T86	E3Z-T87	E3Z-T86A	E3Z-R86		E3Z-D86	E3Z-D87	E3Z-L86
Standard sensing object Opaque: 12-mm dia. min. Opaque: 75-mm dia. min. Opaque	Sensing dista	ance	•		15 m	30 m	10 m	(when using E39- 3 m (100 mm) *1	,	(white paper:	(white paper:	90 + 30 mm (white paper, 100 x 100 mm)
Differential travel	Spot diamete	er (ty	pical)									(2.5 dia. and sensing dis- tance of 90 mm)
Differential travel Both emitter and receiver: 3 to 15° Light source (wavelength) Infrared LED (870 nm) Red LED (680 nm) Red LED (660 nm) Reversed power supply polarity protection, Output short-circuit protection, and Reversed output polarity protection. And Reversed output polarity protection and Reversed output polarity protection. And Reversed output polarity protection. And Reversed output polarity protection. The seat: 1 ms max. Degree of protection LEC, IP67 Connection method Pre-wired cable (standard length: 2 m and 0.5 m), Connector (M8) Weight (packedstate) Refer to 15 ma max. Protection circuits Reversed power supply polarity protection, Output short-circuit protection, and Reversed output polarity protection. Approx. 25 g Approx. 20 g Approx. 20 g Approx. 20 g Approx. 20 g Retro-reflective for clear, plastic bottles (without MSR function) NPN output E3Z-B61 E3Z-B66 E3Z-B62 E3Z-B67 Refer to 15 main and 16 method polyarylate Refer to 15 method polyarylate Refer to 15 main and 16 method polyarylate Refer to 15 method polyarylate Refer to 15 main and 16 method polyarylate Reversed power supply polarity protection, Output short-circuit protection, Mutual interference prevention and plastic bottles Reversed power supply polarity protection, Output short-circuit protection, Mutual interference prevention and plastic bottles Reversed power supply polarity protection, Output short-circuit protection, Mutual interference prevention and plastic bottles Reversed power supply polarity protection.	Standard sen	nsing	obje	ct	Opaque: 12-m	nm dia. min.		Opaque: 75-mm dia	a. min.			
Differential travel Both emitter and receiver: 3 to 15° 2 to 10°	Minimum det	ecta	ble ol	oject (typical)								0.1 mm (cop- per wire)
Light source (wavelength) Infrared LED (870 nm) Red LED (660 nm) Reversed power supply polarity protection. And Reversed output polarity protection. Mutual interference prevention, and Reversed output polarity protection. Peversed power supply polarity protection. And Reversed power supply polarity protection. Peversed power supply polarity protection.	Differential tr	ravel								20% max. of sett	ing distance	Refer to Engi- neering data on page 10.
Current consumption S mA max. (Emitter: 15 mA max., Receiver: 20 mA max.)	Directional ar	ngle			Both emitter a	nd receiver: 3	to 15°	2 to 10°				
Protection circuits Reversed power supply polarity protection, and Reversed power supply polarity protection, and Reversed output polarity protection, and Reversed output polarity protection, and Reversed power supply polarity protection, and Reversed output polarity protection, and Reversed output polarity protection. Response time Coperate or reset: 1 ms max.	Light source	(wav	/elen	gth)	Infrared LED ((870 nm)		Red LED (660 nm	n)	Infrared LED (86	0 nm)	Red LED (650 nm)
Protection circuits Output short-circuit protection, and Reversed output polarity protection. Response time Operate or reset: 1 ms max. Degree of protection IEC, IP67 Connection method Pre-wired cable (standard length: 2 m and 0.5 m), Connector (M8) Weight (packedstate) Pre-wired cable (2 m) Approx. 120 g Approx. 20 g PBT (polybutylene terephthalate) Lens Modified polyarylate Retro-reflective for clear, plastic bottles (without MSR function) NPN output E3Z-B61 E3Z-B66 E3Z-B62 E3Z-B67 Sensing distance Son mm (80 mm) *1 (using E39-R1S) 2 m (500 mm) *1 *2 (using E39-R1S) Standard sensing object Light source (wavelength) Red LED (660 nm) Current consumption Reversed power supply polarity protection, and Reversed output polarity protection, output short-circuit protection, Mutual interference prevention, and Reversed output polarity protection, output short-circuit protection, Mutual interference prevention.	Current cons	ump	tion				max., Receiv-	30 mA max.				
Perevired cable (standard length: 2 m and 0.5 m), Connector (M8) Pre-wired cable (standard length: 2 m and 0.5 m), Connector (M8) Weight (packedstate) Pre-wired cable (2 m) Approx. 120 g Approx. 65 g	Protection cir	rcuit	s		Output short-o	circuit protectio	n, and Re-	Reversed power supply polarity protection, Output short-circuit protect Mutual interference prevention, and Reversed output polarity protection				
Pre-wired cable (standard length: 2 m and 0.5 m), Connector (M8) Weight (packedstate) Pre-wired cable (2 m) Approx. 120 g Approx. 65 g	Response tin	ne			reset:	reset: Operate or reset: 1 ms max.						
Weight (packedstate) Pre-wired cable (2 m) Approx. 120 g Approx. 65 g Material Case PBT (polybutylene terephthalate) Lens Modified polyarylate Methacrylic resin Modified polyarylate Sensing method Retro-reflective for clear, plastic bottles (without MSR function) NPN output E3Z-B61 E3Z-B66 E3Z-B62 E3Z-B67 Protection circuits Sensing distance 500 mm (80 mm) *1 (using E39-R1S) 2 m (500 mm) *1 *2 (using E39-R1S) Standard sensing object 500-ml (65-mm dia.) transparent round plastic bottles Light source (wavelength) Red LED (660 nm) Current consumption 30 mA max. Protection circuits Reversed power supply polarity protection, Output short-circuit protection, Mutual interference previous	Degree of pro	otect	ion		IEC, IP67							
Connector Approx. 30 g Approx. 20 g	Connection n	neth	od		Pre-wired cable (standard length: 2 m and 0.5 m), Connector (M8)							
Case PBT (polybutylene terephthalate) Methacrylic resin Modified polyarylate Methacrylic resin Modified polyarylate	•		Pre-w	rired cable (2 m)	Approx. 120 g			Approx. 65 g				
Lens Modified polyarylate Methacrylic resin Modified polyarylate	(packedstate))	Conn	ector	Approx. 30 g			Approx. 20 g				
Sensing method Retro-reflective for clear, plastic bottles (without MSR function) NPN output E3Z-B61 E3Z-B66 E3Z-B62 E3Z-B67 PNP output E3Z-B81 E3Z-B86 E3Z-B82 E3Z-B87 Sensing distance 500 mm (80 mm) *1 (using E39-R1S) 2 m (500 mm) *1 *2 (using E39-R1S) Standard sensing object 500-ml (65-mm dia.) transparent round plastic bottles Light source (wavelength) Red LED (660 nm) Current consumption 30 mA max. Protection circuits Reversed power supply polarity protection, Output short-circuit protection, Mutual interference previous circuits.	Material		Case		PBT (polybutylene terephthalate)			T				
NPN output E3Z-B61 E3Z-B66 E3Z-B62 E3Z-B67 PNP output E3Z-B81 E3Z-B86 E3Z-B82 E3Z-B87 Sensing distance 500 mm (80 mm) *1 (using E39-R1S) 2 m (500 mm) *1 *2 (using E39-R1S) Standard sensing object 500-ml (65-mm dia.) transparent round plastic bottles Light source (wavelength) Red LED (660 nm) Current consumption 30 mA max. Protection circuits Reversed power supply polarity protection, Output short-circuit protection, Mutual interference previous			Lens		Modified polyarylate		Methacrylic resin Modified polyarylate					
Item Model PNP output E3Z-B81 E3Z-B86 E3Z-B82 E3Z-B87			Se	ensing method	Retro-reflective for clea			r clear, plastic bottles (without MSR function)				
Item PNP output E3Z-B81 E3Z-B86 E3Z-B82 E3Z-B87 Sensing distance 500 mm (80 mm) *1 (using E39-R1S) 2 m (500 mm) *1 *2 (using E39-R1S) Standard sensing object 500-ml (65-mm dia.) transparent round plastic bottles Light source (wavelength) Red LED (660 nm) Current consumption 30 mA max. Protection circuits Reversed power supply polarity protection, Output short-circuit protection, Mutual interference previous				NPN output	E3Z	-B61	E32	Z-B66		E3Z-B62	E	3Z-B67
Standard sensing object 500-ml (65-mm dia.) transparent round plastic bottles Light source (wavelength) Red LED (660 nm) Current consumption 30 mA max. Protection circuits Reversed power supply polarity protection, Output short-circuit protection, Mutual interference previous		IVIOC	ıeı	PNP output	E3Z	-B81	E32	Z-B86		E3Z-B82 E		3Z-B87
Standard sensing object 500-ml (65-mm dia.) transparent round plastic bottles Light source (wavelength) Red LED (660 nm) Current consumption 30 mA max. Protection circuits Reversed power supply polarity protection, Output short-circuit protection, Mutual interference previous	Sensing distance			500 mm (80	mm) *1 (usir	ng E39-R1S)	2 m (500 mm) *1 *2 (using E39-R1S))	
Light source (wavelength) Red LED (660 nm) Current consumption 30 mA max. Protection circuits Reversed power supply polarity protection, Output short-circuit protection, Mutual interference previous	Standard sensing object											
Current consumption 30 mA max. Reversed power supply polarity protection, Output short-circuit protection, Mutual interference previous circuits.	Light sourc	e (w	avel	ength)								
Protection circuits Reversed power supply polarity protection, Output short-circuit protection, Mutual interference previous	Current cor	nsur	nptic	n .	30 mA max.							
I am a contract and an income in the	Protection circuits			Reversed power supply polarity protection, Output short-circuit protection, Mutual interference prevention, and Reversed output polarity protection								
Response time Operate or reset: 1 ms max.	Response t	ime										
·	Degree of protection		1	<u> </u>								
Connection method Pre-wired cable (standard length: 2 m and 0.5 m) Pre-wired cable (standard length: 2 m and 0.5 m) Pre-wired cable (standard length: 2 m and 0.5 m) Connector (M8, 4 pins) Pre-wired cable (standard length: 2 m and 0.5 m)			Pre-wired cal		Connector				Connecto	r (M8, 4 pins)		
Weight Pre-wired cable (2 m) Approx. 65 g												
(packed state) Standard Connector Approx. 20 g	state) Standard Connector			Connector	Approx. 20 g							
Material Case PBT (polybutylene terephthalate)					PBT (polybutylene terephthalate)							
Material Lens Modified polyarylate		ens	;		Modified pol	yarylate						

^{*1.} Values in parentheses indicate the minimum required distances between the Sensors and Reflectors. *2. Plastic bottles must pass with the minimum clearance of 500 mm.

The E3Z-T \square 2-G0 is equipped with an emission stop function. Ratings and specifications of this function are given in the following table.

Item Sensing method Output and Modes		Through-beam models, NPN output: E3Z-T62/T67-G0, PNP output: E3Z-T82/T87-G0
Emission stop function	Input	<npn models=""> Emission OFF: Short-circuit to 0 V or 1.5 V max. (Outflow current 1 mA max.), Emission ON: Disconnected (Leakage current 0.1 mA max.) <pnp models=""> Emission OFF: Short-circuit to +DC (Power supply plus side) or +DC-1.5 V max. (Inlet current 3 mA max.), Emission ON: Disconnected (Leakage current 0.1 mA max.)</pnp></npn>
	Response time	Operate or reset: 0.5 ms max.

Visible spot models are available for through-beam NPN output models. The different items from E3Z-T62 are listed below.

Model	E3Z-T62-SOSDW-P2		
Light source (wavelength)	Orange LED (615 nm)		
Response time	Operate or reset: 1 ms max.		
Connection method	Pre-wired lable (Standard length: 2 m)		

Sensing method		Transparent glass Limited-reflective (for transparent object detection)				
Model	NPN output	E3Z-L63	E3Z-L68			
Item	PNP output	E3Z-L83	E3Z-L88			
Sensing distance	e	30±20 mm (transparent glasses 100 × 100 mm)	·			
Spot diameter		2-mm dia. min. (at sensing distance of 30 mm)				
Minimum detect	able object (typical)	0.1 mm dia. (copper wire)				
Light source (wa	avelength)	Red LED (660 nm)				
Current consum	ption	30 mA max.				
Protection circu	its	Power supply reverse polarity protection, Output short-circuit protection, Mutual interference prevention, Reverse output polarity protection				
Response time		Operate or reset: 1 ms max.				
Degree of prote	ction	IEC, IP67				
Connection method		Pre-wired (standard length: 2 m)	M8 connector			
Weight (packed state)	Pre-wired cable (2 m)	Approx. 65 g				
	Standard Connector	Approx. 20 g				
Material	Case	PBT (polybutylene terephthalate)				
	Lens	Modified polyarylate				

Oil-resistant

Sensing method			Sensing method	Through-beam	Retro-reflective	Diffuse	reflective	
	•	NPN	Pre-wired Models	E3Z-T61K	E3Z-R61K	E3Z-D61K	E3Z-D62K	
	Model	out- put	M8 Pre-wired connector	E3Z-T61K-M3J	E3Z-R61K-M3J	E3Z-D61K-M3J	E3Z-D62K-M3J	
	wodei	PNP	Pre-wired Models	E3Z-T81K	E3Z-R81K	E3Z-D81K	E3Z-D82K	
Item		out- put	M8 Pre-wired connector	E3Z-T81K-M3J	E3Z-R81K-M3J	E3Z-D81K-M3J	E3Z-D82K-M3J	
Sensing distance		15 m	3 m (150 mm) * (when using E39-R1S) 2 m (100 mm) * (when using E39-R1)	100 mm (white paper: 100 × 100 mm)	1 m (white paper: 300 × 300 mm)			
Standard	l sensin	ıg obje	ect	Opaque: 12-mm dia. min.	Opaque: 75-mm dia. min.			
Differenti	ial trave	el		-		20% max. of setting dista	nce	
Directional angle				Both emitter and receiver: 3 to 15°	2 to 10°			
Light sou	urce (wa	avelen	gth)	Infrared LED (870 nm)	Red LED (660 nm)	Infrared LED (860 nm)		
Current o	consum	ption		35 mA max. (Emitter: 15 mA max., Receiver: 20 mA max.)	30 mA max.			
Protection circuits				Reversed power supply polarity protection, Output short-circuit protection, and Reversed output po- larity protection	Reversed power supply polarity protection, Output short-circuit protection, Mutual terference prevention, and Reversed output polarity protection			
Response time				Operate or reset: 1 ms max.				
Degree of protection				IP67 (IEC), Oil resistant models: IP67 (IEC) (in-house standards: oilproof), excluding cables and connectors				
Connection method				Pre-wired cable (standard length: 2 m), M8 Pre-wired Connector				
Weight (packed Pre-wired cable (2 m)		Approx. 120 g	Approx. 65 g					
state)	Connector (M8, 4 pins)		M8, 4 pins)	Approx. 50 g	Approx. 30 g			
Material	Case			PBT (polybutylene terephth	nalate)			
waterial	Lens			Modified polyarylate	Methacrylic resin			

^{*} Values in parentheses indicate the minimum required distance between the Sensor and Reflector.

Common

Power supply voltage	12 to 24 VDC±10%, ripple (p-p): 10% max.		
Control output	Load power supply voltage: 26.4 VDC max., Load current: 100 mA max. Residual voltage: Load current of less than 10 mA: 1 V max. Load current of 10 to 100 mA: 2 V max. Open collector output (NPN/PNP depending on model) Light-ON/Dark-ON selectable		
Sensitivity adjustment	One-turn adjuster		
Ambient illumination (Receiver side)	Incandescent lamp: 3,000 lx max. Sunlight: 10,000 lx max.		
Ambient temperature range	Operating: -25 to 55°C, Some connector models: -40°C to 55°C * (with no icing or condensation) Storage: -40 to 70°C (with no icing or condensation)		
Ambient humidity range	Operating: 35% to 85%, Storage: 35% to 95% (with no condensation)		
Insulation resistance	20 MΩ min. at 500 VDC		
Dielectric strength	1,000 VAC, 50/60 Hz for 1 min		
Vibration resistance	Destruction: 10 to 55 Hz, 1.5 mm double amplitude for 2 hours each in X, Y, and Z directions		
Shock resistance	Destruction: 500 m/s ² 3 times each in X, Y, and Z directions		
Indicator	Operation indicator (orange) Stability indicator (green) Through-beam Emitter has power indicator (orange) only.		
Accessories Instruction manual (Neither Reflectors nor Mounting Brackets are provided with any of the all			

^{*} The ambient temperature range during operation for connector models depends on the model. For the E3Z-T66/T86/R66/R86, the range is -40°C to 55°C. For the E3Z-D66/D86/D87/D87, the range is -30°C to 55°C. For other connector models, the range is -25°C to -55°C.

The sensing distance for Retro-reflective Models (E3Z-R66/R86) between -40°C to -25°C, however, will be as follows (not the values in the table): With E39-R1S: 3 m (100 mm), With E39-R1: 2 m (100 mm).

Also, use the XS3F-M42-4--L Sensor I/O Connector (PUR cable) for applications between -25°C to -40°C. (Refer to page 6.)

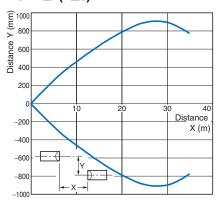


Engineering Data (Typical)

Parallel Operating Range

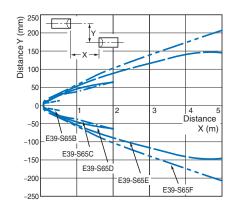
Through-beam Models

E3Z-T□1(T□6)

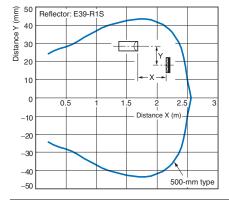


Through-beam Models

E3Z-T□1(T□6) and Slit (A Slit is mounted to the Emitter and Receiver.)

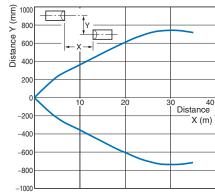


E3Z-B□1/B□6 + E39-R1S Reflector (Order Separately)



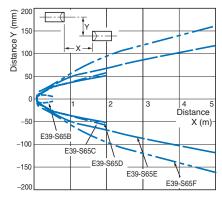
Through-beam Models

E3Z-T□A

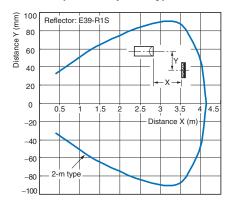


Through-beam Models

E3Z-T□A and Slit (A Slit is mounted to the Emitter and Receiver.)

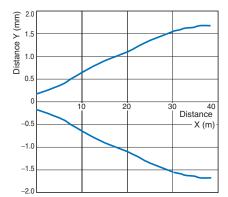


E3Z-B 2/B 7 + E39-R1S Reflector (Order Separately)



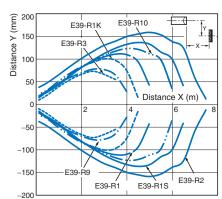
Through-beam Models

E3Z-T□2(T□7)



Retro-reflective Models

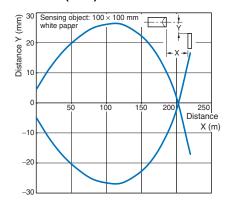
E3Z-R□1(R□6) and Reflector



Operating Range

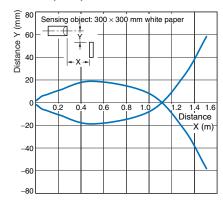
Diffuse-reflective Models

E3Z-D□1(D□6)



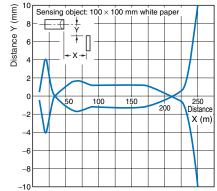
Diffuse-reflective Models

E3Z-D□2(D□7)



Narrow-beam Reflective Models

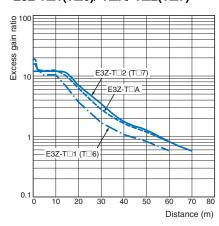
E3Z-L□1(L□6)



Excess Gain vs. Set Distance

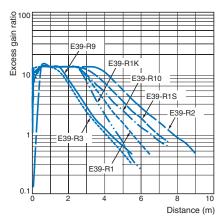
Through-beam Models

E3Z-T \square 1(T \square 6)/-T \square A/-T \square 2(T \square 7)



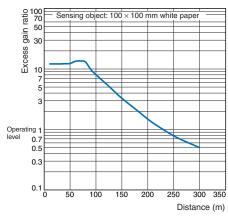
Retro-reflective Models

E3Z-R□1(R□6) and Reflector



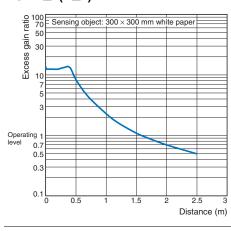
Diffuse-reflective Models

E3Z-D□1(D□6)



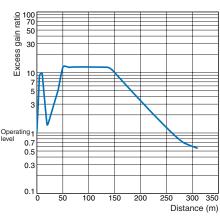
Diffuse-reflective Models

E3Z-D□2(D□7)



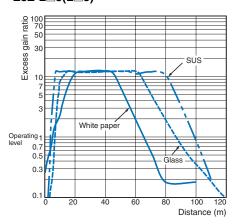
Narrow-beam Reflective Models

E3Z-L□1(L□6)



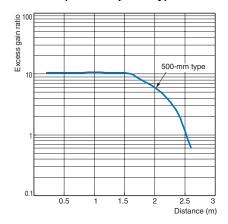
Limited reflective Models

E3Z-L□3(L□8)

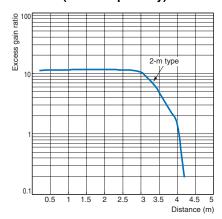


Excess Gain vs. Set Distance

E3Z-B□1/B□6 + E39-R1S Reflector (Order Separately)



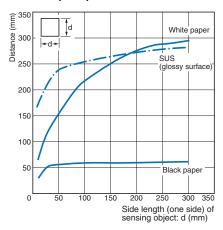
E3Z-B 2/B 7 + E39-R1S Reflector (Order Separately)



Sensing Object Size vs. Sensing Distance

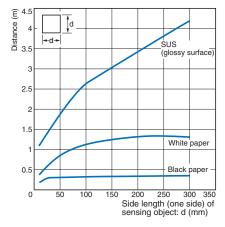
Diffuse-reflective Models

E3Z-D□1(D□6)



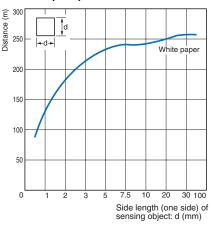
Diffuse-reflective Models

E3Z-D□2(D□7)



Narrow-beam Reflective Models

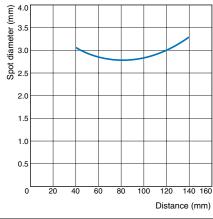
E3Z-L□1(L□6)



Spot Diameter vs. Sensing Distance

Narrow-beam Reflective Models

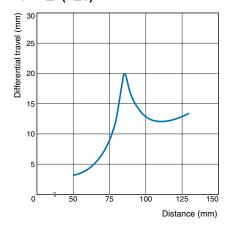




Differential Travel vs. Sensing Distance

Narrow-beam Reflective Models

E3Z-L□1(L□6)

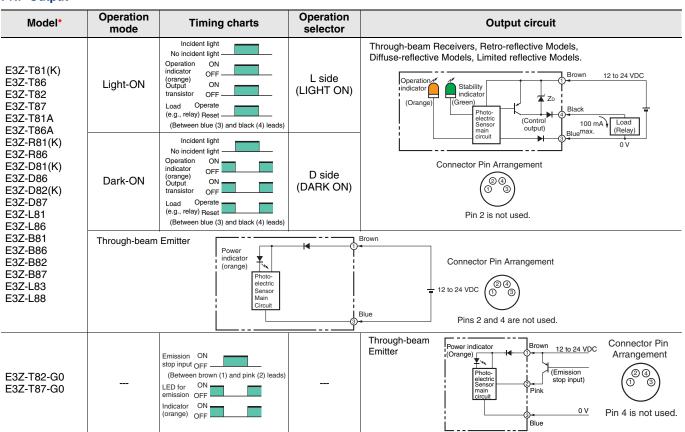


I/O Circuit Diagrams

NPN Output

Model*	Operation mode	Timing charts	Operation selector	Output circuit
E3Z-T61(K) E3Z-T66 E3Z-T62 E3Z-T67 E3Z-T61A E3Z-T66A	Light-ON	Incident light No incident light Operation ON Indicator OFF Output ON transistor OFF Load Operate (e.g., relay) Reset (Between brown (1) and black (4) leads)	L side (LIGHT ON)	Through-beam Receivers, Retro-reflective Models, Diffuse-reflective Models, Limited reflective Models. Operation Indicator (Orange) Stability Indicator (Control output) Black Relay) Blue
E3Z-R61(K) E3Z-R66 E3Z-D61(K) E3Z-D66 E3Z-D62(K) E3Z-D67 E3Z-L61 E3Z-L66	Dark-ON	Incident light No incident light Operation Operation On indicator (orange) Output On Undicator (orange) OPE	D side (DARK ON)	Connector Pin Arrangement e-CON Connector Pin Arrangement 1 Press fit 2 Press fit 3 4 Press fit 3 4 Press fit 4 Press fit 4 Press fit 4 Press fit 5 Press fit 4 Press fit 4 Press fit 4 Press fit 4 Press fit 5 Press fit 4
E3Z-B61 E3Z-B66 E3Z-B62 E3Z-B67 E3Z-L63 E3Z-L68	Through-beam	Power indicator (orange) Photo-electric Sensor main circuit	Br → □	Connector Pin Arrangement Press fit 1 Clamp type 24 VDC Pins 2 and 4 are not used.
E3Z-T62-G0 E3Z-T67-G0		Emission ON stop input OFF (Between blue (3) and pink (2) leads) LED for ON emission OFF Indicator (orange)		Through-beam Emitter Power indicator

PNP Output

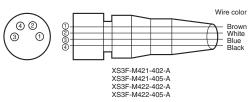


^{*} Models numbers for Through-beam Sensors (E3Z-T \(\) are for sets that include both the Emitter and Receiver.

The model number of the Emitter is expressed by adding "-L" to the set model number (example: E3Z-T61-L 2M), the model number of the Receiver, by adding "-D" (example: E3Z-T61-D 2M.) Refer to Ordering Information to confirm model numbers for Emitter and Receivers.

Plugs (Sensor I/O Connectors)

M8 connector



e-CON connector E39-ECONOM E39-ECONWOM

Pin arrangement

Classifi- cation	Wire color	Connector pin No.	Application
	Brown	1	Power supply (+V)
DC	White	2	(Emission stop input)
БС	Blue	3	Power supply (0 V)
	Black	4	Output

Note: Pin 2 is not used.

Nomenclature

Through-beam Models
E3Z-T□□ (Emitter)
E3Z-T□□A (Receiver)

Retro-reflective Models

E3Z-R□□ E3Z-B□□

Diffuse-reflective Models

E3Z-D□□

Narrow-beam Reflective Models

E3Z-L□□

Limited reflective Models

E3Z-L□□



Safety Precautions

Refer to Warranty and Limitations of Liability.



This product is not designed or rated for ensuring safety of persons either directly or indirectly. Do not use it for such purposes.



Precautions for Correct Use

Do not use the product in atmospheres or environments that exceed product ratings.

Wiring

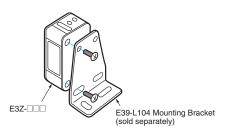
M8 Metal Connector

- Be sure to connect or disconnect the metal connector after turning OFF the Sensor.
- Hold the connector cover to connect or disconnect the metal connector.
- Secure the connector cover by hand. Do not use any pliers, otherwise the connector may be damaged.
- The proper tightening torque range is between 0.3 and 0.4 N·m. Be sure to tighten the connector securely, otherwise the specified degree of protection may not be maintained or the connector may be disconnected due to vibration.

Mounting

Sensor Mounting

Use M3 screws to mount the sensor and tighten each screw to a maximum torque of 0.53 N·m.



Oil-resistant Models

Oil Resistance

- Although the E3Z-\(\subseteq\) K Sensors have oil-resistant specifications, performance may be affected by certain types of oil. Refer to the following table.
- E3Z- Sensors are tested for resistance to the oils given in the following table. Refer to the information in the table when deciding which type of oil to use.

	Test oil clas- sification	Product name	Kinematic viscosity (mm²/s) at 40°C	рН
	Lubricant	Velocity No.3	2.02	
-	Water insolu- ble machining oil	Yushiron Oil No.2 ac	Less than 10	
		Yushiroken EC50T-3		7 to 9.5
	Watersoluble	Yushiron Lubic HWC68		7 to 9.9
	machining oil	Gryton 1700D		7 to 9.2
		Yushironken S50N		7 to 9.8

- Note: 1. The E3Z maintained a minimum insulation resistance of 100 $\text{M}\Omega$ after it was dipped in all the above oils for 240 hours.
 - When using the Sensors in environments subject to oils other than those listed above, use the figures for kinematic viscosity and pH from the table as general guidelines. Additives and other substances contained in oils may affect the E3Z. Be sure to consider this before use.

(Unit: mm)

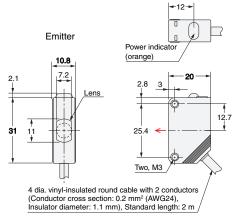
Dimensions

Sensors

Through-beam* **Pre-wired Models** E3Z-T61(K) E3Z-T81(K) E3Z-T61A

E3Z-T81A E3Z-T62(-G0) E3Z-T82(-G0)



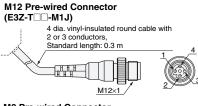


(Excludin	ig -G0)
Terminal No.	Specifi- cations
1	+V
2	
3	0V
4	

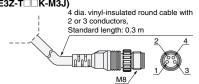
Pins 2 and 4 are not used.

(-G0)							
Terminal No.	Specifi- cations						
1	+V Input						
2							
3	0V						
4							

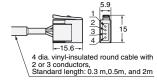
Pin 4 is not used.



M8 Pre-wired Connector (E3Z-T□□K-M3J)



Press-fit e-CON Pre-wired Connector



Clamp-type e-CON Pre-wired Connector (E3Z-T61-ECON-C)



The Emitter cable has two conductors and the Receiver cable has three conductors.

11.2 Operation Indicator (orange) 7.5 Receiver Operation selector Stability indicator (green) Sensitivity adjuster 10.8 12.7 31 25.4 Two, M3 4 dia. vinyl-insulated round cable with 3 conductors (Conductor cross section: 0.2 mm² (AWG24), Insulator diameter:1.1 mm), Standard length: 2 m

3 4 Output Pin 2 is not used.

Terminal

No.

2

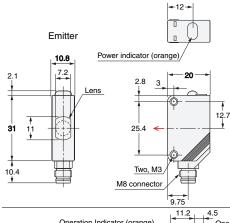
Through-beam*

Connector Models E3Z-T66 E3Z-T86

E3Z-T66A E3Z-T86A E3Z-T67(-G0)

E3Z-T87(-G0)





(Excluding -G0)						
Terminal No.	Specifi- cations					
1	+V 0V					
2						
3						
4						
Ding 2 and 4 are not used						

Specifi-

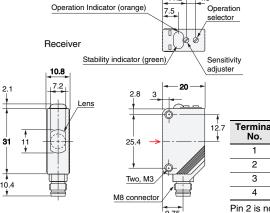
cations

+V

0V

Pins 2 and 4 are not used. (CO)

(-G0)							
Terminal No.	Specifi- cations						
1	+V						
2	Input						
3	٥V						
4							
Pin 4 is not used.							



Terminal No.	Specifi- cations			
1	+V			
2				
3	0V			
4	Output			

^{*} Models numbers for Through-beam Sensors (E3Z-T□□) are for sets that include both the Emitter and Receiver.

The model number of the Emitter is expressed by adding "-L" to the set model number (example: E3Z-T61-L 2M), the model number of the Receiver, by adding "-D" (example: E3Z-T61-D 2M.) Refer to *Ordering Information* to confirm model numbers for Emitter and Receivers.

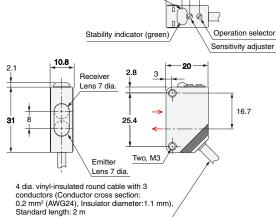
Retro-reflective Models

Pre-wired Models

E3Z-R61(K) E3Z-B61 E3Z-R81(K) E3Z-B81 E3Z-D61(K) E3Z-B62 E3Z-D81(K) E3Z-B82 E3Z-D62(K) E3Z-L63 E3Z-D82(K) E3Z-L83

E3Z-L61 E3Z-L81





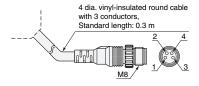
Operation Indicator (orange)

Terminal No.	Specifica- tions					
1	+V					
2						
3	0V					
4	Output					

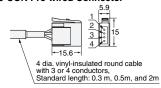
M12 Pre-wired Connector (E3Z-□□□-M1J)



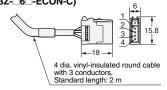
M12×1 / E M8 Pre-wired Connector (E3Z-T□□K-M3J)



Press-fit e-CON Pre-wired Connector



Clamp-type e-CON pre-wired connectors (E3Z-□6□-ECON-C)



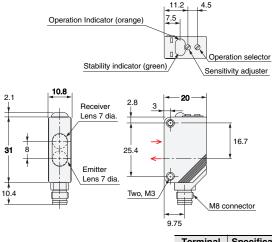
Retro-reflective Models

Connector Models

E3Z-R66 E3Z-B66 E3Z-R86 E3Z-B86 E3Z-D66 E3Z-B67 E3Z-D86 E3Z-B87 E3Z-D67 E3Z-L68 E3Z-D87 E3Z-L88

E3Z-L66 E3Z-L86





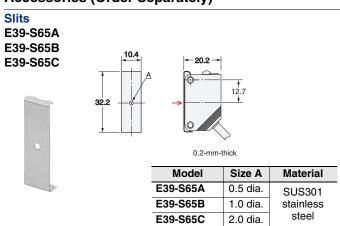
Terminal No.	Specifica- tions				
1	+V				
2					
3	0V				
4	Output				

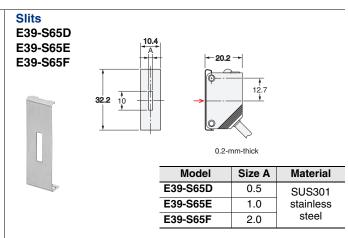
Note: The lens for the E3Z-D_1/D_6/L__/B__ is red. The lens for the E3Z-D_2/D_7 is black.

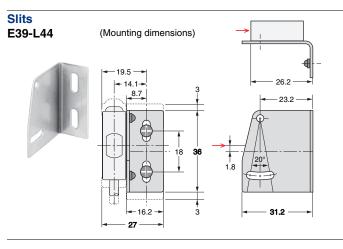
e-CON Connector Configurations

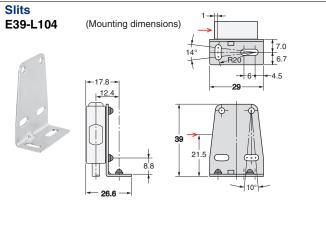
Wiring method	Sensor connectors							
Press-fit	37104-3122-000FL (made by Sumitomo 3M)							
Clamp	XN2A-1430 (made by OMRON)							

Accessories (Order Separately)









Mounting Brackets

Refer to E39-R for details.

Sensor I/O Connectors

Refer to XS2 ☐ and XS3 ☐ for details.

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- Systems, machines, and equipment that could present a risk to life or property.

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2010.12

In the interest of product improvement, specifications are subject to change without notice.





DIGITAL MARK SENSOR

New LX-100 SERIES



Introducing the ultimate mark sensor





Can detect any mark!



R•G•B light emitting elements all in one

To detect any marking, this unit is equipped with red, green and blue LED light emitting elements all in one.

High precision coaxial reflective optical system

SUNX's unique coaxial reflective optics technology ensures very accurate sensing. The unit is made with a scratchproof glass lens.

Total reflection mirror

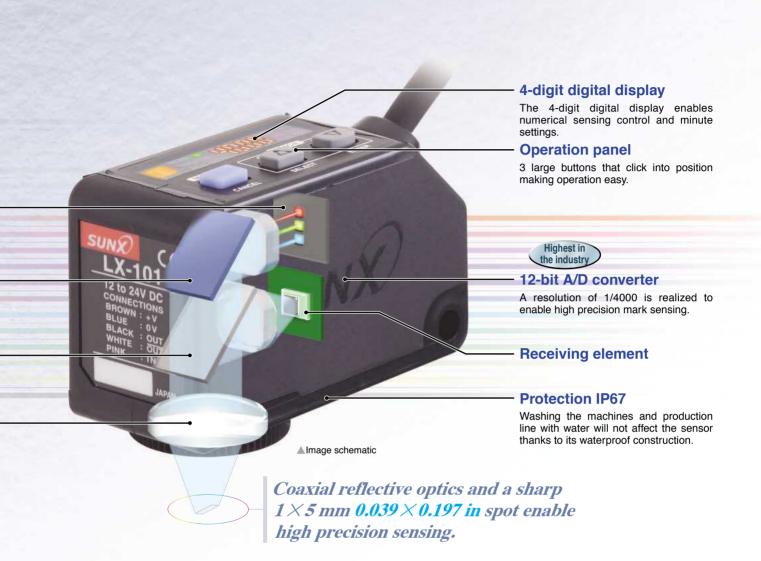
Half mirror

Glass lens

MODE NAVI

The sensor's basic operations are represented by 6 indicator lamps (MODE NAVI). The user can check what mode the sensor is presently in with a quick glance rendering operation simple.





Mark mode



R (red) LED lit



G (green) LED lit



B (blue) LED lit

Color mode



All 3 R•G•B LEDs lit

2 selectable sensing modes for any application

Mark mode

The sensor automatically selects the most suitable light source color from the 3 R·G·B LEDs offering the largest contrast between the mark and base (non-mark area). The sensor effectuates ultra quick mark detection with a 45 μ s response time.

Color mode

The sensor utilizes all 3 $R \cdot G \cdot B$ LEDs to convert the reflective light into an $R \cdot G \cdot B$ ratio. Only the color of the mark indicated by teaching is accurately detected.

Various functions to ensure the best mark sensing. Sensing modes can be selected depending on the application.

Has a built-in 'Mark mode' that realizes a ultra quick 45 μ s response time as well as a 'Color mode' offering the best mark color discrimination capacity. Use either of these modes as per the application.

Mark mode This sensing mode automatically selects a single color from the 3 R·G·B LEDs to realize an ultra

BLUE

color from the 3 R•G•B LEDs to realize an ultra quick 45 μ s response time. The automatic optimal LED selection function automatically selects the LED that is most suitable for the sensing. This function is perfect for ultra quick sensing.

GREEN

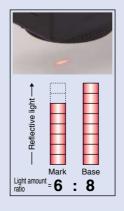


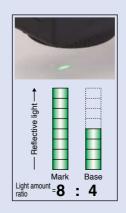
Automatic optimal LED selection function

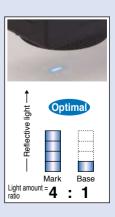
The 3 colors of the R•G•B LEDs are optimally selected according to the color combination. With the **LX-100**'s Mark mode, the built-in 'Automatic optimal LED selection function' automatically selects the LED for the largest contrast (S / N ratio) between the mark and base (non-mark area) to ensure optimal sensing. For more stable detection, the sensor makes selection according to the contrast and not according to the reflected light variation between the mark and base (non-mark area).

With mark sensing, the larger the received light variation is, the easier sensing becomes. Also, the higher the received light ratio (contrast) is, the more sensing is stabilized. The example on the right deals with reflected light on packing film. Great figures are indicated for the blue LED's light amount ratio and, for even more stable sensing, the blue LED effectuates this mark sensing.

The LX-100 series sensors automatically selects the optimal LED that will ensure the most stable sensing results.

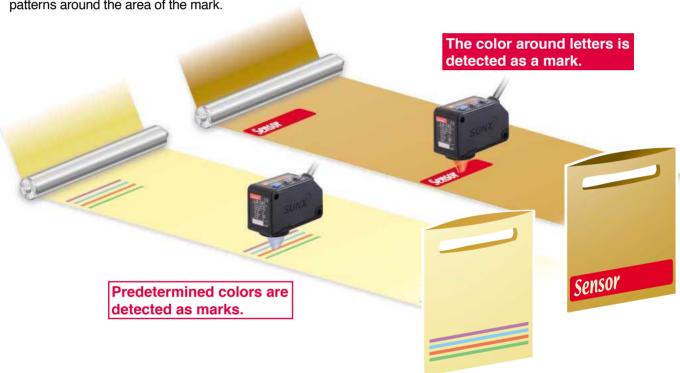






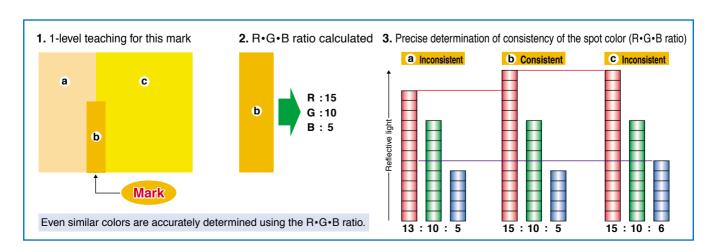
Color mode

All 3 R•G•B LEDs light up and high precision mark color discrimination occurs using the R•G•B reflective light ratio. This function enables effective detection of films with patterns around the area of the mark.



High precision mark color discrimination

The color mode on the **LX-100** series utilizes all 3 R•G•B LEDs to determine the R•G•B ratio of the mark color. The built-in 12-bit A/D converter enables high precision 1/4000-resolution judgments. The figure below is a graphic description of this process.



Its digital display makes for easy settings! Numerical control of the settings possible

The 4-digit digital display enables easy verification of received light from marks and base (non-mark area). Also, the threshold value can be controlled numerically enabling setting indication easily. Displaying the direct code enables settings verification. This function is handy for remote maintenance.



Even beginners can quickly master MODE NAVI operation

The sensor's basic operations are represented by 6 indicator lamps (MODE NAVI). The user can check what mode the sensor is presently in with a quick glance rendering operation simple.



Sensing status digitally controllable

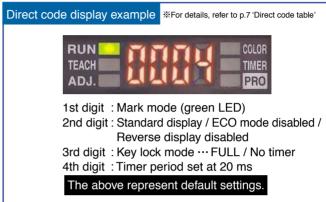
The sensing status, displayed numerically, can be verified at a glance. Also, the sensor settings for each type of packing film can be digitally indicated.

• Example of sensor setting indication | April | Apri

Direct codes enable settings verification at a glance

The settings for the **LX-100** series sensors are displayed using a 4-digit direct code. Direct codes enable easy settings verification and maintenance by phone.

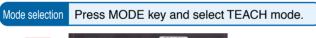




Super simple teaching

Press the ON button at the targeted mark.

We provided an example of the most basic setting method '2-level teaching'.





Teaching

1 Align the spot on the mark and press the ON key.
2 Align the spot onto the base (non-mark area) and press the OFF key.

**The 1 2 order can be reversed.





Sensing

Teaching complete. The optimal LED is automatically selected and the sensor automatically returns to RUN mode.

Other teaching methods

- Full-auto teaching: In Mark mode, teaching is effectuated without stopping the sensing object.
- 1-level teaching: In Color mode, the color detected is aligned by the spot and teaching is effectuated.

External teaching possible

Teaching is possible by external input using the operation panel or touch panel even for color mark sensors whose position within the equipment is out of reach. Models can be easily interchanged.

Mark mode

2-level teaching and full-auto teaching possible

Color mode

1-level teaching possible

The LEDs light up in order and each LED's reflected light is checked instantaneously.



2 The LEDs light up in order and each LED's reflected light is checked instantaneously.





Other features and handy functions

Compact design for significant space savings

High precision sensing and multiple functions provided all in a compact $W57\times D24\times H38\,$ mm $W2.244\times D0.945\times H1.496\,$ in body. Cable and plug-in connector types are available depending on the equipment used. These sensors can be easily introduced to already existing facilities.



Cable type

- Built-in output 1 (OUT) and output 2 (OUT)
- · Built-in teaching input
- NPN and PNP output types available
- With 5-core cable

Plug-in connector type



Key lock function

The key lock function enables input operation control that prevents mistaken changes in the sensor settings. Also possible are minute settings such as 'RUN adjust', allowing threshold value adjustment only, and 'RUN teaching', allowing teaching operation only. If setting the sensor to 'RUN adjust' or 'RUN teaching', adjustments and teaching is possible with the sensor left in RUN mode.

%The key lock function is enabled by pressing the MODE key and OFF key simultaneously for at least 2 sec. after having effectuated settings. Press the MODE and OFF keys again simultaneously for at least 2 sec. to release.



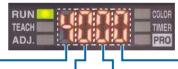
Timer function

The built-in timer function cancels signals not needed for mark sensing and lengthens the width of signals to control devices.

- ON-delay and OFF-delay timers built-in
- 9 timer levels available: 1 ms / 2 ms / 5 ms / 10 ms / 20 ms / 50 ms / 100 ms / 200 ms / 500 ms

Direct code table (D-Code)

The sensor setting modes can be verified by a 4-digit code (D-Code). The table below shows a list of all available codes.



• When in RUN mode, press the MODE key for at least 2 sec. to display the direct code. (Remove your finger from the MODE key and the direct code will disappear.)

1st digit					2nd digit			3rd digit			4th digit	
Display Sensing mode (light source color) Operation mode (Note 1) Sensing (Note 2)		Display	Display mode	ECO mode (Note 4)	Turn mode (Note 5)	Display Key lock Tim		Timer mode	Displa	Timer period		
	Mark mode (green)	L-ON	FINE COARSE		Standard	OFF	OFF ON		Full lock	non OFF-delay	<u> </u>	1 ms 2 ms
7		D-ON	FINE COARSE			ON	OFF ON	3	(All operations disabled) RUN teaching	ON-delay non	3	5 ms 10 ms
4		L-ON	FINE COARSE	7	Percent display	OFF	OFF ON	4	(Teaching only enabled)	OFF-delay ON-delay	4	20 ms 50 ms
5		D-ON	FINE COARSE	- B	(Note 3)	ON	OFF ON	5	RUN adjust /Threshold value \	non OFF-delay	5	100 ms 200 ms
Ü		L-ON	FINE COARSE	D D			8	\adjustment only enabled	ON-delay	8	500 ms	
Ř	Mark mode (red)	D-ON	FINE COARSE	Ä				Ř				
c d	Color mode	Consistent-ON	FINE COARSE	<u> </u>	_			d			<u>ь</u> с	
Color mode	Inconsistent-ON	FINE COARSE	F	_			F			F		

Notes: 1) In Mark mode, L-ON / D-ON is automatically set in the sensor. For example, with 2-level teaching, press the ON key at the targeted mark and press the OFF key at the base (non-mark area). When doing so, the operator does not have to consider L-ON / D-ON.

- 2) Sensing accuracy can be set to either FINE (standard) or COARSE.
- 3) The percent display is only enabled in mark mode.
- 4) ECO mode is a function that reduces power consumption by turning off the digital display in the event no button operations are made for a predetermined time (approx. 10 sec. or more) in RUN mode. Press any button to turn the digital display on again.
- 5) The turn mode is a function that reverses the digital display making it easily viewed in the event the sensor installation renders the display up-side-down.

*Default setting: D-code 'CCCY'.

ORDER GUIDE

Sensors Mating cable is not supplied with the plug-in connector type. Please order it separately.

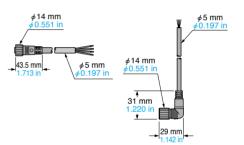
Туре	Appearance	Model No.	Output	Sensing range
onnector Cable type		LX-101	NPN open-collector transistor	
		LX-101-P	PNP open-collector transistor	10 ± 3 mm
		LX-101-Z	NPN open-collector transistor	0.394 ± 0.118 in
Plug-in connector type		LP-101-P-Z	PNP open-collector transistor	

Mating cables for plug-in connector type sensor Mating cable is not supplied with the plug-in connector type sensor. Please order it separately.

	Туре	Model No.	Description		
_	Straight	CN-24B-C2	Length: 2 m 6.562 ft		
	Straight	CN-24B-C5	Length: 5 m 16.404 ft	0.34 mm ² 4-core cabtyre cable,	
	Elbow	CN-24BL-C2	Length: 2 m 6.562 ft	Cable outer diameter: ϕ 5 mm ϕ 0.197 in	
		CN-24BL-C5	Length: 5 m 16.404 ft		

Mating cables for plug-in connector type sensor

- CN-24B-C2 C
 - CN-24BL-C2
- CN-24B-C5 CN-24BL-C5



OPTIONS

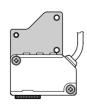
Туре	Model No.	Description		
Sensor mounting	MS-LX-1	Mounting bracket made for		
bracket	MS-LX-2	LX-100 series applicable for various kinds of installations		

Sensor mounting brackets

• MS-LX-1

Two M4 (length 28 mm 1.102 in) screws with washers are attached.





· MS-LX-2

Two M4 (length 30 mm 1.181 in) screws with washers are attached.



SPECIFICATIONS

		Туре	Cable type	Plug-in connector type				
	Š	NPN output	LX-101	LX-101-Z				
Item	Model No.	PNP output	LX-101-P	LX-101-P-Z				
Sensing range			10 ±3 mm 0.394 ± 0.118 in					
Spot size			$1 \times 5 \text{ mm } 0.039 \times 0.197 \text{ in (at 10 mm } 0.394 \text{ in setting distance)}$					
Supp	oly voltage		12 to 24 V DC ± 10 % Ripple P-P 10 % or less					
Current consumption		ption	Normal mode: 750 mW or less (Current consumption 30 mA or less at 24 V supply voltage) ECO mode: 600 mW or less (Current consumption 25 mA or less at 24 V supply voltage)					
Output 1 (OUT)			<npn output="" type=""> NPN open-collector transistor Maximum sink current: 50 mA Applied voltage: 30 V DC or less (between output and 0 V) Residual voltage: 1.5 V or less (at 50 mA sink current) <pnp output="" type=""> PNP open-collector transistor Maximum source current: 50 mA Applied voltage: 30 V DC or less (between output and +V) Residual voltage: 1.5 V or less (at 50 mA source current) </pnp></npn>	<npn output="" type=""> NPN open-collector transistor Maximum sink current: 100 mA Applied voltage: 30 V DC or less (between output and 0 V) Residual voltage: 1.5 V or less (at 100 mA sink current) <pnp output="" type=""> PNP open-collector transistor Maximum source current: 100 mA Applied voltage: 30 V DC or less (between output and + V) Residual voltage: 1.5 V or less (at 100 mA source current) </pnp></npn>				
:	Short-circui	t protection	Incorp	porated				
	Output oper	ration	Mark mode: Light-ON / Dark-ON (Auto-setting on teaching), Col	lor mode: Consistent-ON / Inconsistent-ON (Setting on teaching)				
Output 2 (OUT)			<npn output="" type=""> NPN open-collector transistor • Maximum sink current: 50 mA • Applied voltage: 30 V DC or less (between output and 0 V) • Residual voltage: 1.5 V or less (at 50 mA sink current) PNP output type> PNP open-collector transistor • Maximum source current: 50 mA • Applied voltage: 30 V DC or less (between output and + V) • Residual voltage: 1.5 V or less (at 50 mA source current)</npn>					
Short-circuit protection		t protection	Incorporated					
Output operation			Inverted operation of the output 1					
Resp	onse time		Mark mode: 45 μ s or less,	Color mode: 150 μ s or less				
Teac	ching input			<pnp output="" type=""> PNP non-contact input • Signal condition: High + 4 V to + V (sink current: 3 mA or less) Low 0 V to + 0.6 V, or open • Input impedance: 10 kΩ approx.</pnp>				
Digita	al display		4-digit red	LED display				
Sens	sitivity settin	g	Mark mode: 2-level teaching / Full-autc	teaching, Color mode: 1-level teaching				
Fine s	sensitivity adj	ustment function	Incorporated					
Time	er function		Incorporated with variable ON-delay / OFF-delay timer, switchable eith	her effective or ineffective (Timer period: 1 to 500 ms, 9 levels variable)				
	Protection		IP67	(IEC)				
Environmental resistance	Ambient ter	nperature	- 10 to +55 °C + 14 to +131 °F (No dew condensation of	or icing allowed), Storage: -20 to +70 °C -4 to +158 °F				
esist	Ambient hu	midity	35 to 85 % RH, Storage: 35 to 85 % RH					
ıtalı	Ambient illu	minance	Incandescent light: 3,000 ℓx at the light-receiving face					
ıme ,	Voltage with	nstandability	1,000 V AC for one min. between all supply terminals connected together and enclosure					
viror	Vibration re	sistance	10 to 500 Hz frequency, 3.0 mm 0.118 in double amplitude (max. 20 G) in X, Y and Z directions for two hours each					
Shock resistance			500 m/s² acceleration (50 G approx.) in X, Y and Z directions for three times each					
Emitting element			Combined Red / Green / Blue LEDs (Peak emission wave length: 640 nm 0.025 mil / 525 nm 0.021 mil / 470 nm 0.019 mil)					
Mate			,	ons: Silicone rubber, Lens: Glass, Lens holder: Aluminum				
Cable			0.34 mm ² 5-core cabtyre cable, 2 m 6.562 ft long	(Note)				
	e extension		, , ,	s possible with 0.3 mm ² , or more, cable.				
Weig			Net weight: 120 g approx., Gross weight: 180 g approx.	Net weight: 55 g approx., Gross weight: 120 g approx.				
	essory) screw with washers: 2 pcs.				
	•		d with the plug-in connector type. Please order it separately	,				

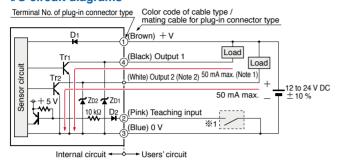
Note: Mating cable is not supplied with the plug-in connector type. Please order it separately.



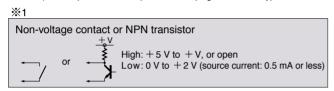
I/O CIRCUIT AND WIRING DIAGRAMS

NPN output type

I/O circuit diagrams



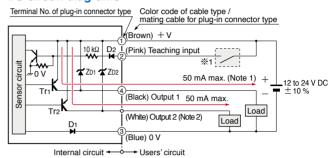
Notes: 1) The current of the plug-in connector type LX-101 -Z is 100 mA max.
2) The output 2 is not incorporated to the plug-in connector type LX-101 -Z.



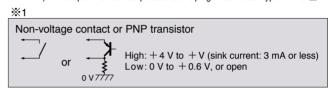
Symbols... D_1 , D_2 : Reverse supply polarity protection diode Z_{D1} , Z_{D2} : Surge absorption zener diode T_{r1} , T_{r2} : NPN output transistor

PNP output type

I/O circuit diagrams

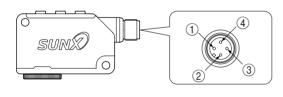


Notes: 1) The current of the plug-in connector type LX-101□-Z is 100 mA max.
2) The output 2 is not incorporated to the plug-in connector type LX-101□-Z.



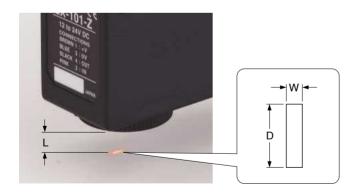
Symbols... D₁, D₂ : Reverse supply polarity protection diode Z_{D1}, Z_{D2}: Surge absorption zener diode Tr₁, Tr₂ : PNP output transistor

Layout of connector pin of plug-in connector type



Connector pin No.	Description		
1	+ V		
2	Teaching input		
3	0 V		
4	Output		

SPOT SIZE CHARACTERISTICS (TYPICAL)



(Unit: mm ir				
Setting distance L	Spot size (Note 2)			
(Note 1)	Width (W)	Length (D)		
7 0.276	2 0.079	5.5 0.217		
8 0.315	1.7 0.067	5.5 0.217		
9 0.354	1.2 0.047	5.3 0.209		
10 0.394	1.0 0.039	5.0 0.197		
11 0.433	1.3 0.051	5.0 0.197		
12 0.472	1.5 0.059	5.0 0.197		
13 0.512	2.0 0.079	5.0 0.197		

Notes: 1) Setting distance 'L' represents the distance from the lens surface to the sensing object.

Examples only meant for use as a guideline.

PRECAUTIONS FOR PROPER USE

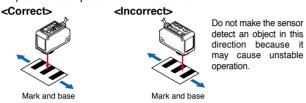
• This catalog is a guide to select a suitable product. Be sure to read the instruction manual attached to the product prior to its use.



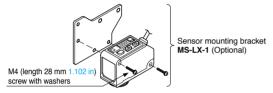
This product is not a safety sensor. Its use is not intended or designed to protect life and prevent body injury or property damage from dangerous parts of machinery. It is a normal object detection sensor.

Mounting

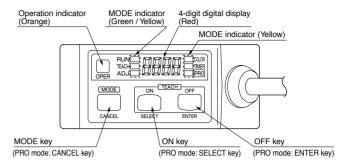
 Care must be taken regarding the sensor mounting direction with respect to the object's direction of movement.



• The tightening torque should be 0.8 N·m or less.



Part description



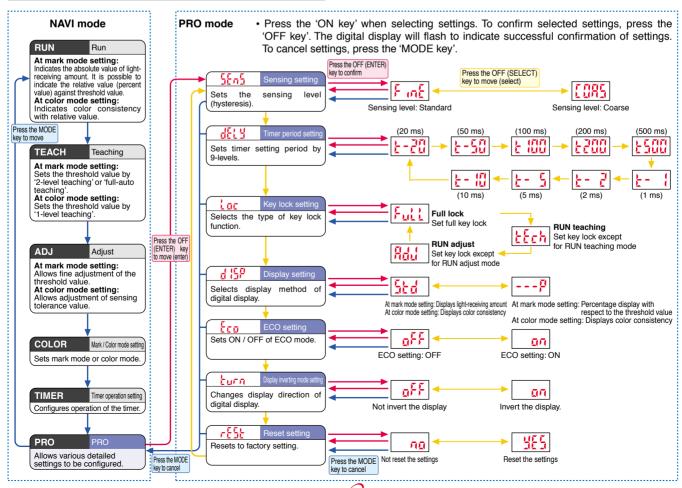
Sensing glossy object

- Objects with a glossy surface have a large amount of specular reflection particles that may destabilize sensing. In such a case, by slightly tilting the sensor's beam axis, this specular reflection can be reduced rendering sensing more stable.
- If the surface of the sensing object has a shine, mount the sensor inclining approx. 10 to 15 degrees against the sensing object.

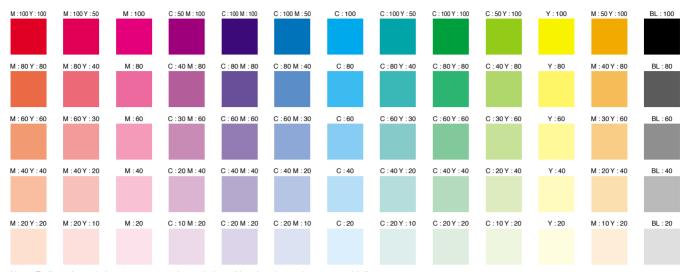


TABLE FOR PRO MODE SETTINGS

 Before performing teaching or each detail setting, perform the setting of either mark mode or color mode with mark / color mode setting of NAVI mode.

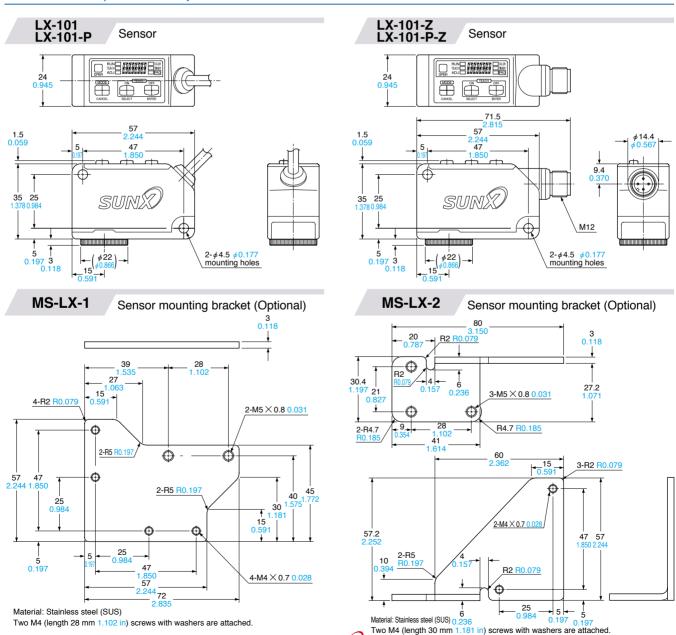


COLOR CHART [The color notations are based on the C (cyan) / M (magenta) / Y (yellow) / BL (black) format used for printing.]



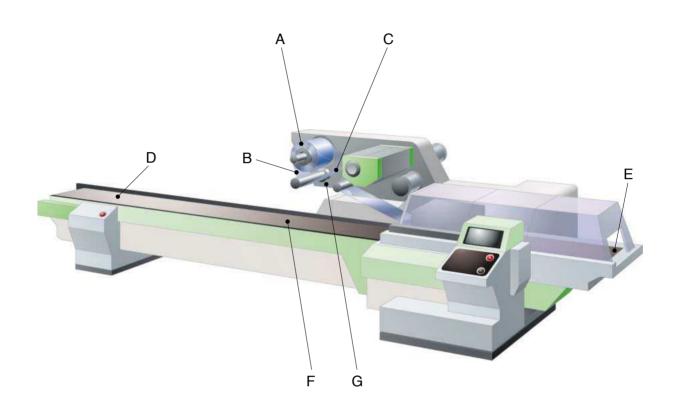
Note: Fading after printing may cause color variations. Use the above chart as a guideline.

DIMENSIONS (Unit: mm in)



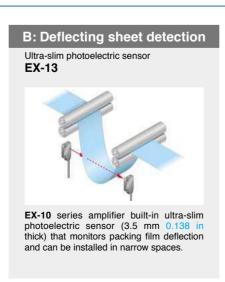
Various mark sensing applications and sensor applications to suit any job are available.

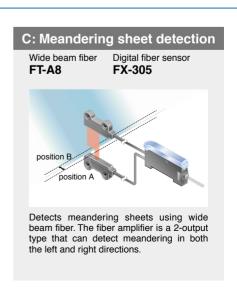
We at SUNX provide every type of sensor for food or drug packaging machines such as the LX-100 series digital mark sensor made for sensing various types of marks.



EACH SENSOR TYPE







DIGITAL MARK SENSOR LX-100 SERIES



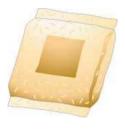
Tube positioning



Detects printed marks to align tubes.

Can be used for various kinds of packing film

Paper bags



• Transparent film



· Aluminum evaporation film

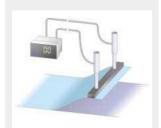


Carrier bags



D: Air pressure detection

Digital pressure sensor DP2 / DP4 series



Detects air pressure and displays it digitally. Its semi-conductor transducer ensures high precision and long life. Optimal for controlling the pressure of pneumatic machinery.

E: Packing and content detection

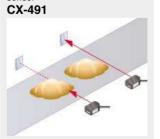
Adjustable range reflective photoelectric sensor CX-440 series



Adjustable range reflective photoelectric sensor not effected by the color of the object. Can be used for checking packaged goods or counting contents.

F: Content detection

Retroreflective photoelectric sensor



Ideal for sensing objects moving on a conveyor belt.

G: Cut tape verification

Digital laser sensor

LS series



High precision red laser sensor. Its minute spot can effectively detect the presence of narrow cut

Introducing SUNX food or drug packaging machine sensors

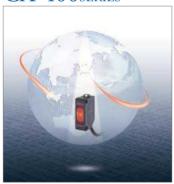


Digital Fiber Sensor FX-300 SERIES



- Red / Green / Blue / Infrared LED amplifiers available.
- · Various fibers available for any application.

Compact Photoelectric Sensor CX-400 SERIES



- · World standard size.
- · Wide variation 116 models.

Digital Pressure Sensor DP2 / DP4series



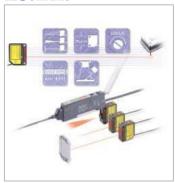
- · Bright, easy to view dual-color digital display (DP4).
- Improved functions and wide variations (DP2).

Adjustable Range Reflective Photoelectric Sensor X-440_{SERIES}



- · Can difference as small as 0.4 mm 0.016 in.
- · Not affect by color. The difference in sensing range between black and white is 1 % or less.

Digital Laser Sensor LSSERIES



- · 3 types of laser sensor heads available.
- · General purpose photoelectric sensor CX-400 series installation compatibility.

Ultra-slim Photoelectric Sensor EX-10series



- · Smallest in the industry with 3.5 mm 0.138 in thickness.
- 1 m 3.281 ft long-distance sensing (thru-beam type: EX-19).
- **EX-20** made for installation with M3 screws
- In addition, micro-size inductive proximity sensors and photoelectric sensors with amplifier-separated available. Refer to SUNX homepage (http://www.sunx.co.jp/).

All information is subject to change without prior notice.



SUNX Limited

2431-1 Ushiyama-cho, Kasugai-shi, Aichi, 486-0901, Japan Phone: +81-(0)568-33-7211 FAX: +81-(0)568-33-2631

Overseas Sales Dept.

Phone: +81-(0)568-33-7861 FAX: +81-(0)568-33-8591



VFD-M

High Performance / Low-Noise Micro-Type AC Motor Drives



Power Range:

1-phase 115V series:0.2~0 75kW

1-phase 230V series:0.4~5.5kW

3-phase 460V series:0.75~ 1.5kW 3-phase 575V series:0.75~7.5kW (0.25~1HP)

(0.5~7.5HP) (1.0~10HP)

(1.0~10HP) (1.0~10HP)



Delta Electronics, Inc.

Delta Electronics (Jiang Su) Ltd.

Delta Electronics (Japan), Inc.

Tokyo Office Delta Shibadaimon Building, 2-1-14 Shibadaimon

Delta Electronics (Korea), Inc.

Delta Electronics (Singapore) Pte. Ltd. 8 Kaki Bukit Road 2, #04-18 Ruby Warehouse Complex,

Singapore 417841

TEL: 65-6747-5155 / FAX: 65-6744-9228

Delta Energy Systems (India) Pvt. Ltd. Plot No. 27 & 31, Sector-34, EHTP,

Gurgaon-122001 Haryana, India

TEL: 91-124-4169040 / FAX: 91-124-4036045

AMERICA

Delta Products Corporation (USA)

Raleigh Office

P.O. Box 12173,5101 Davis Drive, Research Triangle Park, NC 27709, U.S.A.

TEL: 1-919-767-3813 / FAX: 1-919-767-3969

EUROPE

Deltronics (Netherlands) B.V.

Eindhoven Öffic

De Witbogt 15, 5652 AG Eindhoven, The Netherlands TEL: 31-40-259-28-50/ FAX: 31-40-259-28-51



5011201814 200805-19



NEUTA

M-G-M

User Manual

High Performance / Low-Noise Micro-Type AC Motor Drives

Thank you for choosing DELTA's high-performance VFD-M Series. The VFD-M Series is manufactured with high-quality components and materials and incorporate the latest microprocessor technology available.

This manual is to be used for the installation, parameter setting, troubleshooting, and daily maintenance of the AC motor drive. To guarantee safe operation of the equipment, read the following safety guidelines before connecting power to the AC motor drive. Keep this operating manual at hand and distribute to all users for reference.

To ensure the safety of operators and equipment, only qualified personnel familiar with AC motor drive are to do installation, start-up and maintenance. Always read this manual thoroughly before using VFD-M series AC Motor Drive, especially the WARNING, DANGER and CAUTION notes. Failure to comply may result in personal injury and equipment damage. If you have any questions, please contact your dealer.

PLEASE READ PRIOR TO INSTALLATION FOR SAFETY.



- 1. AC input power must be disconnected before any wiring to the AC motor drive is made.
- A charge may still remain in the DC-link capacitors with hazardous voltages, even if the power
 has been turned off. To prevent personal injury, please ensure that power has turned off before
 opening the AC motor drive and wait ten minutes for the capacitors to discharge to safe voltage
 levels.
- 3. Never reassemble internal components or wiring.
- 4. The AC motor drive may be destroyed beyond repair if incorrect cables are connected to the input/output terminals. Never connect the AC motor drive output terminals U/T1, V/T2, and W/T3 directly to the AC mains circuit power supply.
- Ground the VFD-M using the ground terminal. The grounding method must comply with the laws of the country where the AC motor drive is to be installed. Refer to the Basic Wiring Diagram.
- VFD-M series is used only to control variable speed of 3-phase induction motors, NOT for 1phase motors or other purpose.
- 7. VFD-M series shall NOT be used for life support equipment or any life safety situation.



- DO NOT use Hi-pot test for internal components. The semi-conductor used in AC motor drive easily damage by high-voltage.
- There are highly sensitive MOS components on the printed circuit boards. These components are especially sensitive to static electricity. To prevent damage to these components, do not touch these components or the circuit boards with metal objects or your bare hands.
- 3. Only qualified persons are allowed to install, wire and maintain AC motor drives.



- 1. Some parameters settings can cause the motor to run immediately after applying power.
- DO NOT install the AC motor drive in a place subjected to high temperature, direct sunlight, high humidity, excessive vibration, corrosive gases or liquids, or airborne dust or metallic particles.
- Only use AC motor drives within specification. Failure to comply may result in fire, explosion or electric shock.
- To prevent personal injury, please keep children and unqualified people away from the equipment.
- 5. When the motor cable between AC motor drive and motor is too long, the layer insulation of the motor may be damaged. Please use a frequency inverter duty motor or add an AC output reactor to prevent damage to the motor. Refer to appendix B Reactor for details.
- The rated voltage for AC motor drive must be ≤ 240V for 230V models (≤ 120V for 115V models; ≤ 480V for 460V models; ≤ 600V for 575V models) and the mains supply current capacity must be < 5000A RMS.

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C.3 How to Choose a Suitable Motor	

Chapter 1 Introduction

The AC motor drive should be kept in the shipping carton or crate before installation. In order to retain the warranty coverage, the AC motor drive should be stored properly when it is not to be used for an extended period of time. Storage conditions are:



- 1. Store in a clean and dry location free from direct sunlight or corrosive fumes.
- 2. Store within an ambient temperature range of -20 °C to +60 °C.
- 3. Store within a relative humidity range of 0% to 90% and non-condensing environment.
- 4. Store within an air pressure range of 86 kPA to 106kPA.
- DO NOT place on the ground directly. It should be stored properly. Moreover, if the surrounding environment is humid, you should put exsiccator in the package.
- DO NOT store in an area with rapid changes in temperature. It may cause condensation and frost.
- If the AC motor drive is stored for more than 3 months, the temperature should not be higher than 30 °C. Storage longer than one year is not recommended, it could result in the degradation of the electrolytic capacitors.
- When the AC motor drive is not used for longer time after installation on building sites or places with humidity and dust, it's best to move the AC motor drive to an environment as stated above.

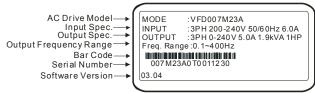
1.1 Receiving and Inspection

This VFD-M AC motor drive has gone through rigorous quality control tests at the factory before shipment. After receiving the AC motor drive, please check for the following:

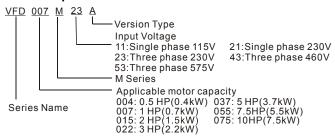
- Check to make sure that the package includes an AC motor drive, the User Manual/Quick Start and CD, and rubber bushings.
- Inspect the unit to assure it was not damaged during shipment.
- Make sure that the part number indicated on the nameplate corresponds with the part number of your order.

1.1.1 Nameplate Information

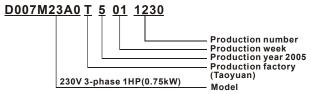
Example of 1HP 230V AC motor drive



1.1.2 Model Explanation

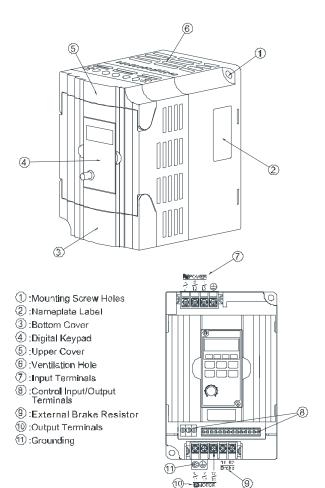


1.1.3 Series Number Explanation



If the nameplate information does not correspond to your purchase order or if there are any problems, please contact your distributor.

1.1.4 External Parts and Labels



1.1.5 Remove Instructions

Remove Keypad



Remove Front Cover

RST Side

UVW Side







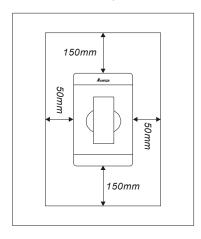
1.2 Preparation for Installation and Wiring

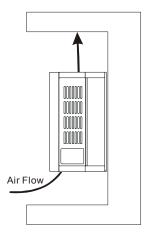
1.2.1 Ambient Conditions

Install the AC motor drive in an environment with the following conditions:

	Air Temperature:	-10 ~ +50°C (14 ~ 122°F) for UL & cUL -10 ~ +40°C (14 ~ 104°F) for 5.5kw models and above	
	Relative Humidity:	<90%, no condensation allowed	
Operation	Atmosphere pressure:	86 ~ 106 kPa	
	Installation Site Altitude:	<1000m	
	Vibration:	<20Hz: 9.80 m/s² (1G) max 20 ~ 50Hz: 5.88 m/s² (0.6G) max	
	Temperature:	-20°C ~ +60°C (-4°F ~ 140°F)	
Storage	Relative Humidity:	<90%, no condensation allowed	
Transportation	Atmosphere pressure:	86 ~ 106 kPa	
	Vibration:	<20Hz: 9.80 m/s ² (1G) max 20 ~ 50Hz: 5.88 m/s ² (0.6G) max	
Pollution Degree	2: good for a factory type environment.		

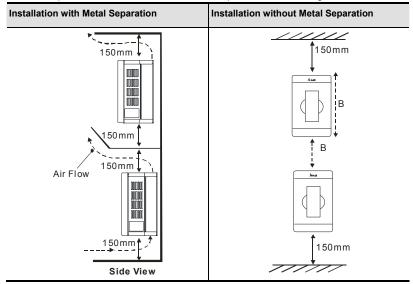
1.2.2 Minimum Mounting Clearances





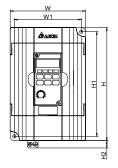


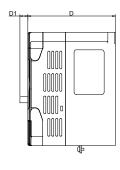
- Operating, storing or transporting the AC motor drive outside these conditions may cause damage to the AC motor drive.
- 2. Failure to observe these precautions may void the warranty!
- Mount the AC motor drive vertically on a flat vertical surface object by screws. Other directions are not allowed.
- The AC motor drive will generate heat during operation. Allow sufficient space around the unit for heat dissipation.
- The heat sink temperature may rise to 90°C when running. The material on which the AC motor drive is mounted must be noncombustible and be able to withstand this high temperature.
- When AC motor drive is installed in a confined space (e.g. cabinet), the surrounding temperature must be within 10 ~ 40°C with good ventilation. DO NOT install the AC motor drive in a space with bad ventilation.
- Prevent fiber particles, scraps of paper, saw dust, metal particles, etc. from adhering to the heatsink.
- 8. When installing multiple AC more drives in the same cabinet, they should be adjacent in a row with enough space in-between. When installing one AC motor drive below another one, use a metal separation between the AC motor drives to prevent mutual heating.





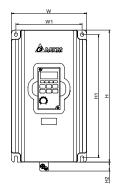
1.3 Dimensions

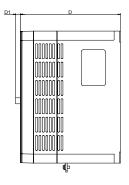




Unit: mm [inch]

Model Name	W	W1	Н	H1	H2	D	D1
VFD004M21A/23A, VFD007M21A/23A, VFD015M21A/23A	85.0 [3.35]	74.0 [2.91]	141.5 [5.57]	130.5 [5.14]	10.0 [0.39]	113.0 [4.45]	10.0 [0.39]
VFD002M11A, VFD004M11A/21B, VFD007M11A/21B/43B/53A, VFD015M21B/43B/53A, VFD022M23B/43B/53A	100.0 [3.94]	89.0 [3.50]	151.0 [5.94]	140.0 [5.51]	10.0 [0.39]	116.5 [4.59]	10.5 [0.41]





Unit: mm [inch]

Model Name	W	W1	Н	H1	H2	D	D1
VFD022M21A,							
VFD037M23A/43A/53A,	125.0	110.0	220.0	205.0	15.0	166.3	8.2
VFD055M23A/43A/53A,	[4.92]	[4.33]	[8.66]	[8.07]	[0.59]	[6.55]	[0.32]
VFD075M43A/53A							



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Chapter 2 Installation and Wiring

After removing the front cover, check if the power and control terminals are clear. Be sure to observe the following precautions when wiring.

General Wiring Information

Applicable Codes

All VFD-M series are Underwriters Laboratories, Inc. (UL) and Canadian Underwriters Laboratories (cUL) listed, and therefore comply with the requirements of the National Electrical Code (NEC) and the Canadian Electrical Code (CEC).

Installation intended to meet the UL and cUL requirements must follow the instructions provided in "Wiring Notes" as a minimum standard. Follow all local codes that exceed UL and cUL requirements. Refer to the technical data label affixed to the AC motor drive and the motor nameplate for electrical data.

The "Line Fuse Specification" in Appendix B, lists the recommended fuse part number for each VFD-M Series part number. These fuses (or equivalent) must be used on all installations where compliance with U.L. standards is a required.



- Make sure that power is only applied to the R/L1, S/L2, T/L3 terminals. Failure to comply may result in damage to the equipment. The voltage and current should lie within the range as indicated on the nameplate.
- All the units must be grounded directly to a common ground terminal to prevent lightning strike or electric shock.
- Please make sure to fasten the screw of the main circuit terminals to prevent sparks which is made by the loose screws due to vibration.
- 4. Check following items after finishing the wiring:
 - A. Are all connections correct?
 - B No loose wires?
 - C. No short-circuits between terminals or to ground?

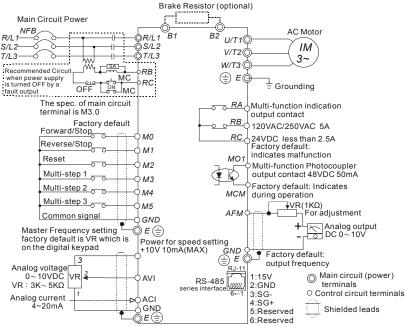




- 1. A charge may still remain in the DC bus capacitors with hazardous voltages even if the power has been turned off. To prevent personal injury, please ensure that the power is turned off and wait ten minutes for the capacitors to discharge to safe voltage levels before opening the AC motor drive.
- 2. Only qualified personnel familiar with AC motor drives is allowed to perform installation, wiring and commissioning.
- 3. Make sure that the power is off before doing any wiring to prevent electric shock.

2.1 Basic Wiring Diagram

Users must connect wires according to the following circuit diagram shown below.



NOTE: Do not plug a Modem or telephone line to the RS-485 communication port, permanent damage may result. Terminal 1& 2 are the power sources for the optional copy keypad and should not be used while using RS-485 communication.

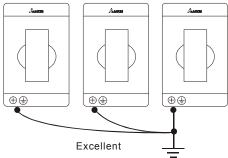
^{*} If it is single phase model, please select any of the two input power terminals in main circuit power.

^{*} Single phase model can be input 3-phase power.

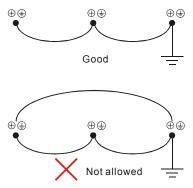




- The wiring of main circuit and control circuit should be separated to prevent erroneous actions. 1.
- 2. Please use shield wire for the control wiring and not to expose the peeled-off net in front of the terminal.
- 3. Please use the shield wire or tube for the power wiring and ground the two ends of the shield wire or tube.
- 4. Damaged insulation of wiring may cause personal injury or damage to circuits/equipment if it comes in contact with high voltage.
- 5. The AC motor drive, motor and wiring may cause interference. To prevent the equipment damage, please take care of the erroneous actions of the surrounding sensors and the equipment.
- 6. When the AC drive output terminals U/T1, V/T2, and W/T3 are connected to the motor terminals U/T1, V/T2, and W/T3, respectively. To permanently reverse the direction of motor rotation, switch over any of the two motor leads.
- 7. With long motor cables, high capacitive switching current peaks can cause over-current, high leakage current or lower current readout accuracy. To prevent this, the motor cable should be less than 20m for 3.7kW models and below. And the cable should be less than 50m for 5.5kW models and above. For longer motor cables use an AC output reactor.
- 8. The AC motor drive, electric welding machine and the greater horsepower motor should be grounded separately.
- 9. Use ground leads that comply with local regulations and keep them as short as possible.
- No brake resistor is built in the VFD-M series, it can install brake resistor for those occasions that use higher load inertia or frequent start/stop. Refer to Appendix B for details.
- 11. Multiple VFD-M units can be installed in one location. All the units should be grounded directly to a common ground terminal, as shown in the figure below. Ensure there are no ground loops.

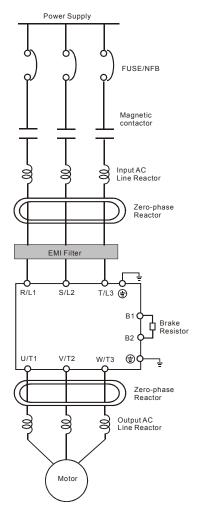


Chapter 2 Installation and Wiring | V





2.2 External Wiring

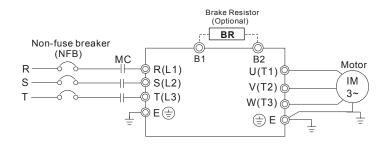


Items	Explanations
Power supply	Please follow the specific power supply requirement shown in APPENDIX A.
Fuse/NFB (Optional)	There may be inrush current during power up. Please check the chart of APPENDIX B and select the correct fuse with rated current. NFB is optional.
Magnetic contactor (Optional)	Please do not use a Magnetic contactor as the I/O switch of the AC drive, this will reduce the operating life cycle of the AC drive.
Input AC Line Reactor (Optional)	Used to improve the input power factor, to reduce harmonics and provide protection from AC line disturbances. (Surge, switching spike, power flick, etc.) AC line reactor should be installed when the power supply capacity is ≥500kVA or phase lead reactor will be switched. And the wiring distance should not exceed 10m. Please refer to Appendix B for detail.
Zero-phase Reactor (Ferrite Core Common Choke) (Optional)	Zero phase reactors are used to reduce radio noise especially when audio equipment installed near the inverter. Effective for noise reduction on both the input and output sides. Attenuation quality is good for a wide range from AM band to 10Mhz. Appendix B specifies zero phase reactors. (RF220X00A)
EMI filter (Optional)	To reduce electromagnetic interference. Please refer to Appendix B for detail.
Brake Resistor (Optional)	Used to reduce stopping time of the motor. Please refer to the chart on Appendix B for specific brake resistors.
Output AC Line Reactor (Optional)	Motor surge voltage amplitudes depending on motor cable length. For long motor cable applications (>20m), it is necessary to install on the inverter output side.



2.3 Main Circuit

2.3.1 Main Circuit Connection



Terminal Symbol	Explanation of Terminal Function	
R/L1, S/L2, T/L3	AC line input terminals (three phase)	
U/T1, V/T2, W/T3	Motor connections	
B1 – B2	Connections for brake resistor (optional)	
+	Earth Ground	



Mains power terminals (R/L1, S/L2, T/L3)

- Connect these terminals (R/L1, S/L2, T/L3) via a non-fuse breaker or earth leakage breaker to 3-phase AC power (some models to 1-phase AC power) for circuit protection. It is unnecessary to consider phase-sequence.
- It is recommended to add a magnetic contactor (MC) in the power input wiring to cut off power quickly and reduce malfunction when activating the protection function of AC motor drives. Both ends of the MC should have an R-C surge absorber.
- Please make sure to fasten the screw of the main circuit terminals to prevent sparks which is made by the loose screws due to vibration.



- Please use voltage and current within the regulation shown in Appendix A.
- When using a GFCI (Ground Fault Circuit Interrupter), select a current sensor with sensitivity of 200mA, and not less than 0.1-second detection time to avoid nuisance tripping.
- Do NOT run/stop AC motor drives by turning the power ON/OFF. Run/stop AC motor drives by RUN/STOP command via control terminals or keypad. If you still need to run/stop AC drives by turning power ON/OFF, it is recommended to do so only ONCE per hour.
- Do NOT connect 3-phase models to a 1-phase power source.

Output terminals for main circuit (U, V, W)

- When it needs to install the filter at the output side of terminals U/T1, V/T2, W/T3 on the AC motor drive. Please use inductance filter. Do not use phase-compensation capacitors or L-C (Inductance-Capacitance) or R-C (Resistance-Capacitance), unless approved by Delta.
- DO NOT connect phase-compensation capacitors or surge absorbers at the output terminals of AC motor drives.
- Use well-insulated motor, suitable for inverter operation.

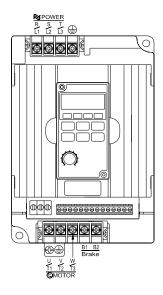
Terminals [B1, B2] for connecting external brake unit

Brake Resistor(optional) Refer to Appendix B for the use of special brake resistor



- Connect a brake resistor or brake unit in applications with frequent deceleration ramps, short deceleration time, too low braking torque or requiring increased braking torque.
- The AC motor drive has a built-in brake chopper, you can connect the external brake resistor to the terminals [B1, B2] when needed.
- When not used, please leave the terminals [B1, B2] open.

2.3.2 Main Circuit Terminals



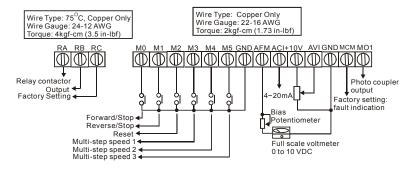
Wire Type: 75 °C Copper Only

31 11			
	Max.	Wire	Torque
Model Name	Current	Gauge	kgf-cm
	(input /	AWG	(in-lbf)
\/ED000M444	output)	(mm²)	(
VFD002M11A	6A/1.6A	12-14	
VFD004M11A	9A/2.5A	(3.3-2.1)	
VFD007M11A	16A/4.2A	12 (3.3)	
VFD004M21A/21B	6.3A/2.5A		
VFD004M23A	3.2A/2.5A	12-14	14
VFD007M21A/21B	11.5A/5.0A	(3.3-2.1)	(12)
VFD007M23A	6.3A/5.0A		
VFD015M21A/21B	15.7A/7.0A	12 (3.3)	
VFD015M23A	9.0A/7.0A	12-14	
		(3.3-2.1)	
VFD022M21A	27A/10A	8 (8.4)	
VFD022M23B	15A/10A	8-12	
	10/11/0/1	(8.4-3.3)	15
VFD037M23A	19.6A/17A	8-10	(13)
\/ED05514004	004/054	(8.4-5.3)	
VFD055M23A	28A/25A	8 (8.4)	
VFD007M43B	4.2A/3.0A	12-14	
		(3.3-2.1)	
VFD007M53A	2.4A/1.7A	(3.3-2.1)	
		12-14	
VFD015M43B	5.7A/4.0A	(3.3-2.1)	14
		12-14	(12)
VFD015M53A	4.2A/3.0A	(3.3-2.1)	(12)
\/FD0001110D	0.04/5.04	12-14	
VFD022M43B	6.0A/5.0A	(3.3-2.1)	
VFD022M53A	5.9A/4.2A	12-14	
VFDUZZIVIOSA	5.9A/4.2A	(3.3-2.1)	
VFD037M43A	8.5A/8.2A	8-14	
VI DOSTIVI T SA	0.5A/0.2A	(8.4-2.1)	
VFD037M53A	7.0A/6.6A	8-14	
	1.07 10.07 1	(8.4-2.1)	
VFD055M43A	14A/13A	8-12	
		(8.4-3.3)	15
VFD055M53A	10.5A/9.9A	8-12	(13)
		(8.4-3.3)	
VFD075M43A	23A/18A	8-10 (8.4-5.3)	
		8-12	
VFD075M53A	12.9A/12.2A	(8.4-3.3)	
		(0.4-0.3)	

Note: It needs to use the Recognized Ring Terminal to conduct a proper wiring.

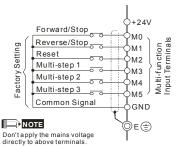


2.4 Control Terminal Wiring (Factory Settings)

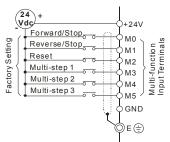


NPN Mode





NPN mode with external power



Terminal symbols and functions

erminal symbols and functions				
Terminal Symbol	Terminal Function	Factory Settings (NPN mode)		
RA	Multi-Function Relay Output (N.O.) a	RA-RC Resistive Load 5A(N.O.)/3A(N.C.) 277Vac; 5A(N.O.)/3A(N.C.) 30Vdc Refer to P45 for programming.		
RB	Multi-Function Relay Output (N.C.) b	RB-RC Resistive Load 5A(N.O.)/3A(N.C.) 277Vac; 5A(N.O.)/3A(N.C.) 30Vdc		

Terminal Symbol	Terminal Function	Factory Settings (NPN mode)		
RC	Multi-function Relay Common	5A(N.O.)/3A(N.C.) 277Vac; 5A(N.O.)/3A(N.C.) 30Vdc		
MO	Multi-function auxiliary input			
M1	Multi-function input 1	M0~M5-GND Refer to P38~P42 for programming the multi- function inputs.		
M2	Multi-function input 2			
M3	Multi-function input 3	ON: the activation current is 10 mA.		
M4	Multi-function input 4	OFF: leakage current tolerance is 10µA.		
M5	Multi-function input 5			
GND	Common Signal			
+10V	+10 Vdc Output	+10V-GND It can supply +10 VDC power.		
AVI	Analog Voltage Input AVI Circuit AVI ACM Internal Circuit	Impedance: 20kΩ Resolution: 10 bits Range: 0~10Vdc = 0~Max.Output Frequency		
ACI	Analog Current Input ACI ACI Circuit ACI ACI Circuit	Impedance: 250Ω Resolution: 10 bits Range: 4~20mA = 0~Max.Output Frequency		
AFM	Analog Output Meter ACM Circuit AFM AFM No.100 Now. 2mM No.100 Now. 2mM ACM Internal Circuit ACM	0 to 10V, 2mA Impedance: 100kΩ Output Current: 2mA max Resolution: 8 bits Range: 0 ~ 10Vdc		

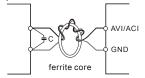


Terminal Symbol	Terminal Function	Factory Settings (NPN mode)			
MO1	Multi-function Output Terminal (Photocoupler)	Maximum: 48Vdc, 50mA Refer to P45 for programming. MO1-DCM MO1 MO1 MO1 MO1 MON MON MON MO			
МСМ	Multi-function Output Common (Photocoupler)	Common for Multi-function Outputs			

Note: Use twisted-shielded, twisted-pair or shielded-lead wires for the control signal wiring. It is recommended to run all signal wiring in a separate steel conduit. The shield wire should only be connected at the drive. Do not connect shield wire on both ends.

Analog inputs (AVI, ACI)

- Analog input signals are easily affected by external noise. Use shielded wiring and keep it as short as possible (<20m) with proper grounding. If the noise is inductive, connecting the shield to terminal GND can bring improvement.
- If the analog input signals are affected by noise from the AC motor drive, please connect a capacitor (0.1 μ F and above) and ferrite core as indicated in the following diagrams:



wind each wires 3 times or more around the core

Digital inputs (M0~M5)

When using contacts or switches to control the digital inputs, please use high quality components to avoid contact bounce.

Digital outputs (MO1)

- Make sure to connect the digital outputs to the right polarity, see wiring diagrams.
- When connecting a relay to the digital outputs, connect a surge absorber or fly-back diode across the coil and check the polarity.

Chapter 2 Installation and Wiring | Variable

General

- Keep control wiring as far away as possible from the power wiring and in separate conduits to avoid interference. If necessary let them cross only at 90° angle.
- The AC motor drive control wiring should be properly installed and not touch any live power wiring or terminals.



If a filter is required for reducing EMI (Electro Magnetic Interference), install it as close as possible to AC drive. EMI can also be reduced by lowering the Carrier Frequency.



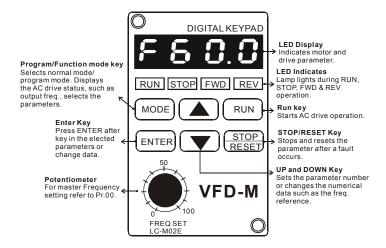
Damaged insulation of wiring may cause personal injury or damage to circuits/equipment if it comes in contact with high voltage.

Chapter 3 Keypad and Start Up

3.1 Keypad

3.1.1 Description of the Digital Keypad

The digital keypad includes two parts: Display panel and keypad. The display panel provides the parameter display and shows the operation status of the AC drive and the keypad provides programming and control interface.

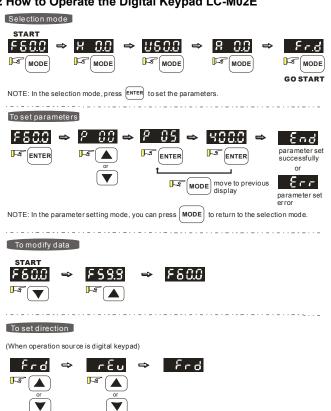


Displayed Message	Descriptions
<i>F</i> 60.0	The AC drives Master Frequency.
H50.0	The Actual Operation Frequency present at terminals U, V, and W.
₀ 800.	The custom unit (v), where v = H x Pr.65.
c 999	The counter value (c).
8 5.0	The output current present at terminals U, V, and W
: 50	The internal PLC process step currently being performed.
<u> </u>	The specified parameter.

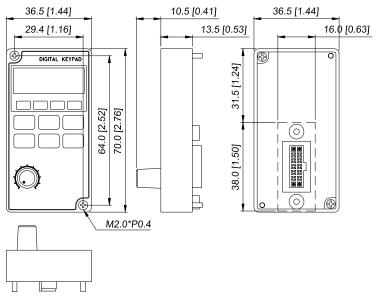
Chapter 3 Keypad and Start Up | Variable

Displayed Message	Descriptions
8 1	The actual value stored within the specified parameter.
Frd	The AC drive forward run status.
-50	The AC drive reverse run status.
End	"End" displays for approximately 1 second if input has been accepted. After a parameter value has been set, the new value is automatically stored in memory. To modify an entry, use the and keys.
Ecc	"Err" displays, if the input is invalid.

3.1.2 How to Operate the Digital Keypad LC-M02E



3.1.3 LC-M02E



Unit: mm [inch]

Reference Tal	ole for the 7-segmen	nt LED Display c	of the Digital Keypad

Digit	0	1	2	3	4	5	6	7	8	9
LED Display	0	- ;	2	3	4	5	8	7	8	9

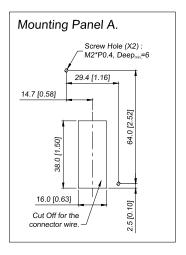
English alphabet	А	b	Сс	d	Е	F	G	Hh	ı	Jj
LED Display	R	Ь	Ec	ď	ε	F	5	XH	1.	JJ

English alphabet	К	L	n	Oo	Р	q	r	S	Tt	U
LED Display	۲	L	n	Co	P	9	_	5	75	U

English alphabet	v	Y	Z				
LED Display	U	3	111				

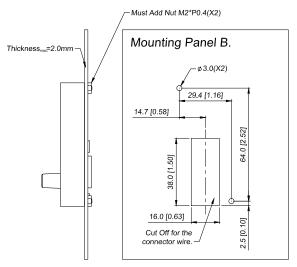
Digital Keypad – Mounting Panel A

Unit: mm [inch]



Digital Keypad – Mounting Panel B

Unit: mm [inch]





3.2 Operation Method

The operation method can be set via control terminals and LC-M02E keypad. Please choose a suitable method depending on application and operation rule.

Operation Method	Frequency Source	Operation Command Source
Operate from external signal	Factory default Sequence of the control of the con	M0 M1 M2 M3 M4 M5 GND © E ⊕
	External terminals input (multi-step speed function) M2~M5 (Pr.39~Pr.42)	M0-GND: FWD/Stop M1~GND: REV/Stop (Pr.01=01/02)
LC-M02E keypad		RUN STOP RESET (Pr.00=00)

3.3 Trial Run

The factory setting of the operation source is from the digital keypad (Pr.01=00). You can perform a trial run by using the digital keypad with the following steps:

- 1. After applying power, verify that the display shows F60.0Hz. When AC motor drive is in standby situation. STOP LED and FWD LED will light up.
- key to set frequency to 5Hz.
- kev. RUN LED and FWD LED will light up, which indicates operation command is forward running. And if you want to change to reverse running, you should And if you want to decelerate to stop, please press

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- 4. Check following items:
 - Check if the motor direction of rotation is correct.
 - Check if the motor runs steadily without abnormal noise and vibration.
 - Check if acceleration and deceleration are smooth.

If the results of trial run are normal, please start the formal run.



- Stop running immediately if any fault occurs and refer to the troubleshooting guide for solving the problem.
- Do NOT touch output terminals U, V, W when power is still applied to L1/R, L2/S, L3/T even when the AC motor drive has stopped. The DC-link capacitors may still be charged to hazardous voltage levels, even if the power has been turned off.
- To avoid damage to components, do not touch them or the circuit boards with metal objects or your bare hands.

Chapter 4 Parameters

This VFD-M AC motor drive has 157 parameters for easy setting. In most applications, the user can finish all parameter settings before start-up without the need for re-adjustment during operation.

4.1 Summary of Parameter Settings

★: The parameter can be set during operation.

Parameter	Explanation	Settings	Factory Setting	Customer
⊮ Pr.00	Source of Frequency Command	00: Master frequency determined by digital keypad (LC-M02E)	00	
		01: Master frequency determined by 0 to +10 V input on AVI terminal with jumpers		
		02: Master frequency determined by 4 to 20mA input on ACI terminal with jumpers		
		03: Master frequency determined by RS-485 Communication port		
		04: Master frequency determined by potentiometer on digital keypad		
⊮ Pr.01	Source of Operation	00: Operation determined by digital keypad	00	
	command	01: Operation determined by external control terminals, keypad STOP is effective		
		02: Operation determined by external control terminals, keypad STOP is ineffective		
		03: Operation determined by RS-485 communication port, keypad STOP is effective		
		04: Operation determined by RS-485 communication port, keypad STOP is ineffective		
Pr.02	Stop Method	00: Ramp stop 01: Coast Stop	00	
Pr.03	Maximum Output Frequency	50.00 to 400.0 Hz	60.00	
Pr.04	Maximum Voltage Frequency (Base Frequency)	10.00 to 400.0Hz	60.00	
		115V/230V: 0.1 to 255.0V	220.0	
Pr.05	Maximum Output Voltage (Vmax)	460V: 0.1 to 510.0V	440.0	1
	voltago (villax)	575V: 0.1 to 637.0V	575.0	
Pr.06	Mid-point Frequency	0.10 to 400.0Hz	1.50	
		115V/230V: 0.1 to 255.0V	10.0	
Pr.07	Mid-point Voltage	460V: 0.1 to 510.0V	20.0	1
		575V: 0.1 to 637.0V	26.1	1

		Chapter 4	Parameters	/FD - M
Parameter	Explanation	Settings	Factory Setting	
Pr.08	Minimum Output Freq	0.10 to 20.00Hz	1.50	
		115V/230V: 0.1 to 255.0V	10.0	
Pr.09	Minimum Output Voltage	460V: 0.1 to 510.0V	20.0	
		575V: 0.1 to 637.0V	26.1	
⊮ Pr.10	Acceleration Time 1	0.1 to 600.0 sec or 0.01 to 600.0 sec	10.0	
⊮ Pr.11	Deceleration Time 1	0.1 to 600.0 sec or 0.01 to 600.0 sec	10.0	
⊮ Pr.12	Acceleration Time 2	0.1 to 600.0 sec or 0.01 to 600.0 sec	10.0	
⊮ Pr.13	Deceleration Time 2	0.1 to 600.0 sec or 0.01 to 600.0 sec	10.0	
Pr.14	Accel S-curve	00 to 07	00	
⊮ Pr.15	Jog Accel/Decel Time	0.1 to 600.0 sec or 0.01 to 600.0 sec	1.0	
⊮ Pr.16	Jog Frequency	0.00 to 400.0 Hz	6.00	
⊮ Pr.17	1st Step Speed Freq.	0.00 to 400.0Hz	0.00	
⊮ Pr.18	2nd Step Speed Freq.	0.00 to 400.0Hz	0.00	
⊮ Pr.19	3rd Step Speed Freq.	0.00 to 400.0Hz	0.00	
⊮ Pr.20	4th Step Speed Freq.	0.00 to 400.0Hz	0.00	
⊮ Pr.21	5th Step Speed Freq.	0.00 to 400.0Hz	0.00	
⊮ Pr.22	6th Step Speed Freq.	0.00 to 400.0Hz	0.00	
⊮ Pr.23	7th Step Speed Freq.	0.00 to 400.0Hz	0.00	
Pr.24	Reverse Operation Inhibition	00: Enable REV operation 01: Disable REV operation	00	
		00: Disable		
D- 05	Over-Voltage Stall	115V/230V: 330 to 450 Vdc	390	
Pr.25	Prevention	460V: 660 to 900 Vdc	780	
		575V: 825 to 1025 Vdc	975	
Pr.26	Over-current Stall Prevention during Acceleration	00: Disable 20% to 200%	150	
Pr.27	Over-current Stall Prevention during Operation	00: Disable 20% to 200%	150	
Pr.28	DC Braking Current Level	00 to 100 %	00	

Pr.29

DC Braking during Start-up

0.0 to 5.0 sec

0.0

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Parameter		Settings	Factory Setting	Customer
Pr.30	DC Braking during Stopping	0.0 to 25.0 sec	0.0	
Pr.31	Start-point for DC Braking	0.00 to 60.00 Hz	0.00	
Pr.32	Momentary Power Loss Operation Selection	Stop operation after momentary power loss Continues after momentary power loss, speed search starts with Master Frequency Continues after momentary power loss, speed search starts with Minimum output Frequency	00	
Pr.33	Maximum Allowable Power Loss Time	0.3 to 5.0 sec	2.0	
Pr.34	Base-Block Time for Speed Search	0.3 to 5.0 sec	0.5	
Pr.35	Maximum Current Level for Speed Search	30 to 200 %	150	
Pr.36	Upper Bound of Output Frequency	0.10 Hz to 400.0 Hz	400.0	
Pr.37	Lower Bound of Output Frequency	0.00 Hz to 400.0 Hz	0.00	
Pr.38	Multi-function Input Terminal (M0,M1)	00: M0: FWD/STOP, M1: REV/STOP 01: M0: RUN/STOP, M1: REV/FWD 02: M0, M1, M2: 3-wire operation control mode	00	
Pr.39	Multi-function Input Terminal (M2)	00: No Function 01: Output OFF (N.O.) (enabled when	05	
Pr.40	Multi-function Input Terminal (M3)	running) 02: Output OFF (N.C.) (enabled when running)	06	
Pr.41	Multi-function Input Terminal (M4)	03: External Fault (normally open) N.O. 04: External Fault (normally close) N.C 05: RESET	07	
Pr.42	Multi-function Input Terminal (M5)	06: Multi-Step Speed Command 1 07: Multi-Step Speed Command 2 08: Multi-Step Speed Command 3 09: Jog Operation 10: Accel/Decel Speed Inhibit 11: First or Second Accel/Decel Time 12: Base-block (B.B.) (N.O)	08	

Parameter	Explanation	Settings	Factory Setting	Customer
		13: Base-block (B.B.) (N.C)		
		14: Increase Master Frequency		
		15: Decrease Master Frequency		
		16: Run PLC Program		
		17: Pause PLC		
		18: Counter Trigger Signal		
		19: Counter Reset		
		20: No function		
		21: RESET command (N.C)		
		22: Control source: External Terminal		
		23: Control source: Keypad		
		24: Control source: Communication		
		25: Parameter Lock (Write disable, Read is always 0)		
		26: PID Disable (N.O.)		
		27: PID Disable (N.C.)		
		28: Second Source for Frequency Command		
		29: Forward (contact is open) / Reverse (contact is close)		
		30: One-Shot PLC Run		
		31: Index input signal		
		32: Counter Incremented by Drive Output Frequency		
		00: Analog Frequency Meter (0 to Maximum Output Frequency)		
⊮ Pr.43	Analog Output Signal	01: Analog Current Meter (0 to 250% of the rated AC drive current)	00	
		02: Feedback signal (0 - 100%)		
		03: Output power (0 - 100%)		
⊮ Pr.44	Analog Output Gain	00 to 200 %	100	
	Multi-Function Output	00: AC Drive Operational		
Pr.45	Terminal 1 (Photocoupler output)	01: Maximum Output Frequency Attained	00	
		02: Zero Speed		
-		03: Over-Torque Detection		
		04: Base-Block (B.B) Indication		
	Multi-function Output	05: Low Voltage Indication		
Pr.46	Terminal 2	06: AC Drive Operation Mode	07	
	(Relay Output)	07: Fault Indication		
		08: Desired Frequency Attained		
	l	1 * *	l	L

Parameter	Explanation	Settings	Factory Setting	Customer
		09: PLC Program Running		
		10: PLC Program Step Completed		
		11: PLC Program Completed		
		12: PLC Operation Paused		
		13: Top Count Value Attained		
		14: Preliminary Counter Value Attained		
		15: Warning (PID feedback loss, communication error)		
		16: Below the Desired Frequency		
		17: PID supervision		
		18: Over Voltage supervision		
		19: Over Heat supervision		
		20: Over Current stall supervision		
		21: Over Voltage stall supervision		
		22: Forward command		
		23: Reverse command		
		24: Zero Speed (Includes Drive Stop)		
⊮ Pr.47	Desired Frequency Attained	0.00 to 400.0 Hz	0.00	
⊮ Pr.48	Adjust Bias of External Input Frequency	0.00 to 200.0%	0.00	
⊮ Pr.49	Potentiometer Bias	00: Positive Bias	00	
# F1. 4 3	Polarity	01: Negative Bias	00	
⊮ Pr.50	Potentiometer Frequency Gain	0.10 to 200.0%	100.0	
	Potentiometer	00: Reverse Motion Disabled in negative		
Pr.51	Reverse Motion Enable	bias	00	
	Enable	01: Reverse Motion Enabled in negative bias		
⊮ Pr.52	Motor Rated Current	30.0% FLA to 120.0% FLA	FLA	
⊮ Pr.53	Motor No-Load Current	00%FLA to 99%FLA	0.4*FLA	
⊮ Pr.54	Torque Compensation	00 to 10	00	
⊮ Pr.55	Slip Compensation	0.00 to 10.00	0.00	
Pr.56	Reserved			
Pr.57	AC Drive Rated Curren	t Display (unit: 0.1A)	##.#	
		00: Standard Motor (self cool motor)		
Pr.58	Electronic Thermal Overload Relay	01: Inverter Motor (auxiliary cool fan on motor)	02	
		02: Inactive		l

		meters	Zacsacki	
Parameter	Explanation	Settings	Factory Setting	Customer
⊮ Pr.59	Electronic Thermal Motor Overload	30 to 300 sec	60	
Pr.60	Over-Torque Detection Mode	O0: Over-Torque Detection Disable O1: Enabled during constant speed operation until the allowable time for detection (Pr.62) elapses. C2: Enabled during constant speed operation and halted after detection. C3: Enabled during acceleration until the allowable time for detection (Pr.62) elapses.		
Pr.61	Over-Torque	04: Enabled during acceleration and halted after detection. 30 to 200 %	150	
Pr.62	Over-Torque Detection Time	0.0 to 10.0 seconds	0.1	
Pr.63	Loss of ACI (4-20mA)	00: Decelerate to 0 Hz 01: Stop immediately and display "EF" 02: Continue operation by last frequency command	00	
№ Pr.64	User Defined Function for Display	00: Display AC drive output Frequency (Hz) 01: Display User-defined output Frequency (H*Pr.65) 02: Output Voltage (E) 03: DC Bus Voltage (u) 04: PV (i) 05: Display the value of internal counter (c) 06: Display the setting frequency (F or o=%) 07: Display the parameter setting (Pr.00) 08: Reserved 09: Output Current (A) 10: Display program operation (0.xxx), Fwd, or Rev	06	
⊮ Pr.65	Coefficient K	0.01 to 160.0	1.00	
✓ Pr.66	Communication Frequency	0.00 to 400.0 Hz	0.00	
Pr.67	Skip Frequency 1	0.00 to 400.0 Hz	0.00	
Pr.68	Skip Frequency 2	0.00 to 400.0 Hz	0.00	
Pr.69	Skip Frequency 3	0.00 to 400.0 Hz	0.00	
Pr.70	Skip Frequency Band	0.00 to 20.00 Hz	0.00	
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Parameter	Explanation	Settings	Factory Setting	Customer
Pr.71	PWM Carrier	115V/230V/460V series: 01 to 15 (The factory setting of VFD075M43A is 10)	15	
	Frequency	575V series: 01 to 10	6	
Pr.72	Auto Restart Attempts after Fault	00 to 10	00	
		00: No fault occurred		
		01: Over-current (oc)		
Pr.73	Present Fault Record	02: Over-voltage (ov)	00	
	T TOSCITET AUTO TOCOTA	03: Overheat (oH)		
		04: Overload (oL)		
		05: Overload 1 (oL1)		
		06: External Fault (EF)		
	Second Most Recent	07: CPU failure 1 (CF1)		
		08: CPU failure 3 (CF3)		
Pr.74		09: Hardware Protection Failure (HPF)	00	
	Fault Record	10: Over-current during acceleration (oca)	00	
		11: Over-current during deceleration (ocd)		
		12: Over-current during steady state operation (ocn)		
		13: Ground fault or fuse failure(GFF)		
Pr.75	Third Most Recent Fault Record	14: Low Voltage (not record)		
		15: 3 Phase Input Power Loss		
		16: EPROM failure (CF2)		
		17: External interrupt allowance(bb)	00	
		18: Overload (oL2)		
		19: Auto Adjustable accel/decel failure (CFA)		
		20: CPU self detection failure (codE)		
		00: All parameters can be set/read		
		01: All parameters are read-only		
	Parameter Lock and	02-08: Reserved		
Pr.76	Configuration	09: Resets all parameters to 50Hz factory	00	

defaults

defaults

0.1 to 6000.0 sec

Time for Auto Reset

the Restart Times in

Abnormality

10: Resets all parameters to 60Hz factory

Pr.77

60.0

Parameter	Explanation	Settings	Factory Setting	
Pr.78	PLC Operation Mode	00: Disable PLC operation 01: Execute one program cycle 02: Continuously execute program cycles 03: Execute one program cycle step by step 04: Continuously execute one program cycle	00	
Pr.79	PLC FWD/REV Motion	step by step 00 to 127	00	
Pr.80	Identity Code of the AC Motor Drive	Read only	##	
Pr.81	Time Duration of 1st Step Speed	00 to 9999 sec	00	
Pr.82	Time Duration of 2nd Step Speed	00 to 9999 sec	00	
Pr.83	Time Duration of 3rd Step Speed	00 to 9999 sec	00	
Pr.84	Time Duration of 4th Step Speed	00 to 9999 sec	00	
Pr.85	Time Duration of 5th Step Speed	00 to 9999 sec	00	
Pr.86	Time Duration of 6th Step Speed	00 to 9999 sec	00	
Pr.87	Time Duration of 7th Step Speed	00 to 9999 sec	00	
Pr.88	Communication Address	01 to 254	01	
Pr.89	Transmission Speed	00: 4800 bps 01: 9600 bps 02: 19200 bps 03: 38400 bps	01	
Pr.90	Transmission Fault Treatment	00: Warn and Continue Operating 01: Warn and RAMP to Stop 02: Warn and COAST to Stop 03: Keep Operation without Warning	03	
Pr.91	Time Out Detection	0.0: Disable 0.1 to 120.0 sec	0.0	
Pr.92	Communication Protocol	00: MODBUS ASCII mode, <7,N,2> 01: MODBUS ASCII mode, <7,E,1> 02: MODBUS ASCII mode, <7,O,1> 03: MODBUS RTU mode, <8,N,2> 04: MODBUS RTU mode, <8,E,1> 05: MODBUS RTU mode, <8,O,1>	00	

Parameter	Explanation	Settings	Factory Setting	Customer
Pr.93	Accel 1 to Accel 2 Frequency Transition	0.01 to 400.0 0.00: Disable	0.00	
Pr.94	Decel 1 to Decel 2 Frequency Transition	0.01 to 400.0 0.00: Disable	0.00	
Pr.95	Auto Energy Saving	00: Disable auto energy saving 01: Enable auto energy saving	00	
Pr.96	Counter Countdown Complete	00 to 9999	00	
Pr.97	Preset counter countdown	00 to 9999	00	
Pr.98	Total Time Count from Power On (Days)	00 to 65535 days	Read Only	
Pr.99	Total Time Count from Power On (Minutes)	00 to 1440 minutes	Read Only	
Pr.100	Software Version		##	
Pr.101	Auto Adjustable Accel/Decel	 00: Linear Accel/Decel 01: Auto Accel, Linear Decel 02: Linear Accel, Auto Decel 03: Auto Accel/Decel 04: Linear Accel/Decel Stall Prevention during Deceleration 	00	
Pr.102	Auto Voltage Regulation (AVR)	00: AVR function enabled 01: AVR function disabled 02: AVR function disabled when stops 03: AVR function disabled when decel	00	
Pr.103	Auto tune Motor Parameters	00: Disable 01: Auto tune for R1 02: Auto tune for R1 + No Load testing	00	
Pr.104	R1 value	00 to 65535 mΩ	00	
Pr.105	Control Mode	00: V/F Control 01: Sensor-less Control	00	
Pr.106	Rated Slip	0.00 to 10.00 Hz	3.00	
Pr.107	Vector Voltage Filter	5 to 9999 (per 2ms)	10	
Pr.108	Vector Slip Compensation Filter	25 to 9999 (per 2ms)	50	
Pr.109	Selection for Zero Speed Control	00: No output 01: Control by DC voltage	00	

1/22/21			
1/27201			
1/2/2/			

Parameter	Explanation	Settings	Factory Setting	Customer
Pr.110	Voltage of Zero Speed Control	0.0 to 20.0 % of Max. output voltage (Pr.05)	5.0	
Pr.111	Decel S-curve	00 to 07	00	
Pr.112	External Terminal Scanning Time	01 to 20	01	
Pr.113	Restart Method after Fault (oc, ov, BB)	None speed search Standard Search Search from speed reference Continue operation after fault speed search from Minimum speed	01	
Pr.114	Cooling Fan Control	00: Fan Off when the drive stop after 1 Min. 01: AC Drive Runs and Fan On, AC Drive Stops and Fan Off 02: Always Run 03: Reserved	02	
Pr.115	PID Set Point Selection	00: Disable 01: Keypad (based on Pr.00 setting) 02: AVI (external 0-10V) 03: ACI (external 4-20mA) 04: PID set point (Pr.125)	00	
Pr.116	PID Feedback Terminal Selection	00: Input positive PID feedback, PV from AVI (0 to 10V) 01: Input negative PID feedback, PV from AVI (0 to 10V) 02: Input positive PID feedback, PV from ACI (4 to 20mA) 03: Input negative PID feedback, PV from ACI (4 to 20mA)	00	
Pr.117	Proportional Gain (P)	0.0 to 10.0	1.0	
Pr.118	Integral Time (I)	0.00: Disable 0.01 to 100.0 sec	1.00	
Pr.119	Differential Time (D)	0.00 to 1.00 sec	0.00	
Pr.120	Integration's Upper Bound Frequency	00 to 100 %	100 %	
Pr.121	One-Time Delay	0.0 to 2.5 sec	0.0	
Pr.122	PID Frequency Output Command Limit	00 to 110 %	100	
Pr.123	Feedback Signal Detection Time	0.0: Disable 0.1 to 3600 sec	60.0	
Pr.124	Feedback Signal Fault Treatment	00: Warning and RAMP to stop 01: Warning and keep operating	00	

Parameter	• • • • • •	Settings	Factory Setting	Customer
Pr.125	Source of PID Set Point	0.00 to 400.0Hz	0.00	
Pr.126	PID Offset Level	1.0 to 50.0 %	10.0	
Pr.127	Detection Time of PID Offset	0.1 to 300.0 sec	5.0	
Pr.128	Minimum Reference Value	0.0 to 10.0 V	0.0	
Pr.129	Maximum Reference Value	0.0 to 10.0 V	10.0	
Pr.130	Invert Reference Signal AVI (0-10V)	00: Not inverted 01: Inverted	00	
Pr.131	Minimum Reference Value (4-20mA)	0.0 to 20.0mA	4.0	
Pr.132	Maximum Reference Value (4-20mA)	0.0 to 20.0mA	20.0	
Pr.133	Invert Reference Signal (4-20mA)	00: Not inverted 01: Inverted	00	
Pr.134	Analog Input Delay Filter for Set Point	00 to 9999 (per 2ms)	50	
Pr.135	Analog Input Delay Filter for Feedback Signal	00 to 9999 (per 2ms)	5	
Pr.136	Sleep Period	0.0 to 6550.0 sec	0.0	
Pr.137	Sleep Frequency	0.00 to 400.0 Hz	0.00	
Pr.138	Wake Up Frequency	0.00 to 400.0 Hz	0.00	
Pr.139	Treatment for Counter Attained	00: Continue operation 01: Stop Immediately and display E.F.	00	
Pr.140	External Up/Down Selection	00: Fixed Mode (keypad) 01: By Accel or Decel Time 02: Reserved	00	
Pr.141	Save Frequency Set Point	00: Not Save 01: Save	01	
Pr.142	Second Source of Frequency Command	00: Keypad Up/Down 01: AVI (0-10V) 02: ACI (4-20mA) 03: Communication 04: Keypad potentiometer	00	
		115V/230V: 370-450 Vdc	380.0	
Pr.143	Software Braking Level	460V: 740-900 Vdc	760.0	
		575V: 925-1075 Vdc	950.0	
Pr.144	Total operation time (Day)	Read Only	•	

Parameter	Explanation	Settings	Factory Setting	Customer
Pr.145	Total operation time (Minutes)	Read Only		
Pr.146	Line start Lockout	00: Disable	00	
P1.140	Line start Lockout	01: Enable	00	
Pr.147	Decimal Number of	00: One decimal	00	
11.147	Accel / Decel Time	01: Two decimals	00	
Pr.148	Number of Motor Poles	02 to 20	04	
Pr.149	Gear Ratio for Simple Index Function	4 to 1000	200	
Pr.150	Index Angle for Simple Index Function	00.0 to 360.0	180.0	
Pr.151	Deceleration Time for Simple Index Function	0.00 to 100.00 sec	0.00	
Pr.152	Skip Frequency Width	0.00 to 400.0Hz	0.00	
Pr.153	Bias Frequency Width	0.00 to 400.0Hz	0.00	
Pr.154	Reserved			
	Compensation	0.0: Disable		
⊮ Pr.155	Coefficient for Motor Instability	0.1 to 5.0 (recommended setting d2.0)	0.0	
⊮ Pr.156	Communication Response Delay Time	0 to 200 (x500us)	0	
⊮ Pr.157	Communication Mode	0: Delta ASCII	1	
# Pf.157	Selection	1: Modbus	l l	

4.2 Parameter Settings for Applications

Speed Search

Applications	Purpose	Functions	Related Parameters
Windmill, winding machine, fan and all inertia loads	Restart free- running motor	Before the free-running motor is completely stopped, it can be restarted without detection of motor speed. The AC motor drive will auto search motor speed and will accelerate when its speed is the same as the motor speed.	Pr.32~Pr.35

DC Braking before Running

Applications	Purpose	Functions	Related Parameters
When e.g. windmills, fans and pumps rotate freely by wind or flow without applying power	standstill.	If the running direction of the free- running motor is not steady, please execute DC braking before start-up.	Pr.28 Pr.29

Energy Saving

Applications	Purpose	Functions	Related Parameters
Punching machines fans, pumps and precision machinery	Energy saving and less vibrations	Energy saving when the AC motor drive runs at constant speed, yet full power acceleration and deceleration For precision machinery it also helps to lower vibrations.	Pr.95

Multi-step Operation

Applications	Purpose	Functions	Related Parameters
Conveying machinery		To control 7-step speeds and duration by simple contact signals.	Pr.17~Pr.23 Pr.78~Pr.79 Pr.81~Pr.87



Switching acceleration and deceleration time

Applications	Purpose	Functions	Related Parameters
Auto turntable for conveying machinery	Switching acceleration and deceleration time by external signal	When an AC motor drive drives two or more motors, it can reach high-speed but still start and stop smoothly.	Pr.10~Pr.13 Pr.39~Pr.42

Overheat Warning

Applications	Purpose	Functions	Related Parameters
Air conditioner	Safety measure	When AC motor drive overheats, it uses a thermal sensor to have overheat warning.	Pr.45~Pr.46 Pr.39~Pr.42

Two-wire/three-wire

Applications	Purpose	Functions	Related Parameters
General application	To run, stop, forward and reverse by external terminals	RUN/STOP TO M0 "Open": Stop, "Close": RWD Run M1 "Open": Stop, "Close": REV Run GND VFD-M RUN/STOP M0 "Open": Stop, "Close": REV GND VFD-M 3-wire STOP RUN M0 Run command, Runs when "close" M2 Stop command, stops when "Open" TWD/REV Open": FWD Run GND VFD-M GND VFD-M GND VFD-M GND VFD-M GND VFD-M	Pr.01 Pr.38

Operation Command

Applications	Purpose	Functions	Related Parameters
General application	Selecting the source of control signal	Selection of AC motor drive control by external terminals or digital keypad.	Pr.01 Pr.39~Pr.42

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Frequency Hold

Applications	Purpose	Functions	Related Parameters
General application	Acceleration/ deceleration pause	Hold output frequency during Acceleration/deceleration	Pr.39~Pr.42

Auto Restart after Fault

Applications	Purpose	Functions	Related Parameters
Air conditioners, remote pumps	For continuous and reliable operation without operator intervention	The AC motor drive can be restarted/reset automatically up to 10 times after a fault occurs.	Pr.72 Pr.113

Emergency Stop by DC Braking

Applications	Purpose	Functions	Related Parameters
High-speed rotors	Emergency stop without brake resistor	AC motor drive can use DC braking for emergency stop when quick stop is needed without brake resistor. When used often, take motor cooling into consideration.	Pr.28 Pr.30 Pr.31

Over-torque Setting

Applications	Purpose	Functions	Related Parameters
Pumps, fans and extruders	To protect machines and to have continuous/ reliable operation	The over-torque detection level can be set. Once OC stall, OV stall and over-torque occurs, the output frequency will be adjusted automatically. It is suitable for machines like fans and pumps that require continuous operation.	Pr.60~Pr.62

Upper/Lower Limit Frequency

Applications	Purpose	Functions	Related Parameters
Pump and fan	Control the motor speed within upper/lower limit	When user cannot provide upper/lower limit, gain or bias from external signal, it can be set individually in AC motor drive.	Pr.36 Pr.37



Skip Frequency Setting

Applications	Purpose	Functions	Related Parameters
Pumps and fans	To prevent machine vibrations	The AC motor drive cannot run at constant speed in the skip frequency range. Three skip frequency ranges can be set.	Pr.67~Pr.70

Carrier Frequency Setting

Applications	Purpose	Functions	Related Parameters
General application	Low noise	The carrier frequency can be increased when required to reduce motor noise.	Pr.71

Keep Running when Frequency Command is Lost

Applications	Purpose	Functions	Related Parameters
Air conditioners	For continuous operation	When the frequency command is lost by system malfunction, the AC motor drive can still run. Suitable for intelligent air conditioners.	Pr.63

Output Signal in Zero Speed

Applications	Purpose	Functions	Related Parameters
General application	Provide a signal for running status	When the output frequency is lower than the min. output frequency, a signal is given for external system or control wiring.	Pr.45 Pr.46

Output Signal at Master Frequency

Applications	Purpose	Functions	Related Parameters
General application	Provide a signal for running status	When the output frequency is at the master frequency (by frequency command), a signal is given for external system or control wiring (frequency attained).	Pr.45 Pr.46

Chapter 4 Parameters | V SV M

Output signal for Over-torque

Applications	Purpose	Functions	Related Parameters
Pumps, fans and extruders	To protect machines and to have continuous/ reliable operation	When over-torque is detected, a signal is given to prevent machines from damage.	Pr.45 Pr.46 Pr.61 Pr.62

Output Signal for Low Voltage

Applications	Purpose	Functions	Related Parameters
General application	Provide a signal for running status	When low voltage is detected, a signal is given for external system or control wiring.	Pr.45 Pr.46

Output Signal at Desired Frequency

Applications	Purpose	Functions	Related Parameters
General application	Provide a signal for running status	When the output frequency is at the desired frequency (by frequency command), a signal is given for external system or control wiring (frequency attained).	Pr.45~Pr.46 Pr.47

Output Signal for Base Block

Applications	Purpose	Functions	Related Parameters
General application	Provide a signal for running status	When executing Base Block, a signal is given for external system or control wiring.	Pr.45 Pr.46

Overheat Warning for Heat Sink

Applications	Purpose	Functions	Related Parameters
General application	For safety	When heat sink is overheated, it will send a signal for external system or control wiring.	Pr.45 Pr.46



Multi-function Analog Output

Applications	Purpose	Functions	Related Parameters
General application	Display running status	The value of frequency, output current/voltage can be read by connecting a frequency meter or voltage/current meter.	Pr.43 Pr.44

4.3 Description of Parameter Settings

Pr.00	✓ Sour	ce of	Frequency Command
			Factory Setting: 00
	Settings	00	Master Frequency determined by digital keypad. (LC-M02E)
		01	Master frequency determined by 0 to +10 V input
		02	Master frequency determined by 4 to 20mA input
		03	Master frequency determined by RS-485 Communication port
		04	Master frequency determined by potentiometer on digital keypad.
			(LC-M02E)

Pr.01 ✓ Source of Operation Command

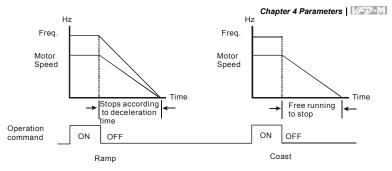
Factory Setting: 00

- Settings 00 Operation instructions determined by the Digital Keypad.
 - 01 Operation instructions determined by the External Control Terminals. Keypad STOP key is effective.
 - 02 Operation instructions determined by the External Control Terminals. Keypad STOP key is not effective.
 - 03 Operation instructions determined by the RS-485 communication port. Keypad STOP key is effective.
 - 04 Operation instructions determined by the RS-485 communication port. Keypad STOP key is not effective.
- Refer to Pr.38 to Pr.42 for more details.

Pr.02 Stop Method

Factory Setting: 00

- Settings 00 Ramp to stop
 - 01 Coast to stop
- This parameter determines how the motor is stopped when the AC drive receives a valid stop command.
 - Ramp: The AC drive decelerates the motor to Minimum Output Frequency (Pr.08) and then stops according to the deceleration time set in Pr.11 or Pr.13.
 - 2. Coast: The AC drive will stop the output instantly, and the motor will coast to stop.



Note: The motor stop method is usually determined by the application or system requirements.

Pr.03	Maximum Output Frequency	Unit: 0.1Hz
	Settings 50.00 to 400.0 Hz	Factory Setting: 60.00

This parameter determines the AC drive's Maximum Output Frequency. All the AC drive analog inputs (0 to +10V, 4 to 20mA) are scaled to correspond to the output frequency range.

Pr.04	Maximum Voltage Frequency (Base Frequency)	Unit: 0.1Hz
	Settings 10.00 to 400.0Hz	Factory Setting: 60.00

This parameter should be set according to the rated frequency as indicated in the motor nameplate. Pr.04 and Pr.03 determine the volts per hertz ratio.

For example: if the drive is rated for 460 VAC output and the Maximum Voltage Frequency is set to 60Hz, the drive will maintain a constant ratio of 7.66 v/Hz. **Setting of Pr.04 must be equal to or greater than setting of Mid-Point Frequency (Pr.06).**

Pr.05	Maximum Output Voltage (Vmax)			
	Settings	115V/230V series	0.1 to 255.0V	Factory Setting: 220.0
		460V series	0.1 to 510.0V	Factory Setting: 440.0
		575V series	0.1 to 637.0V	Factory Setting: 575.0

This parameter determines the Maximum Output Voltage of the AC drive. The Maximum Output Voltage setting must be smaller than or equal to the rated voltage of the motor as indicated on the motor nameplate. Setting of Pr.05 must be equal to or greater than setting of Mid-Point Voltage (Pr.07).

Onapi	ter 41 drumeters	
Pr.	Mid-Point Frequency	Unit: 0.1Hz
	Settings 0.10 to 400.0Hz	Factory Setting: 1.50

The parameter sets the Mid-Point Frequency of V/F curve. With this setting, the V/F ratio between Minimum Frequency and Mid-Point frequency can be determined. Setting of this parameter must be equal to or greater than Minimum Output Frequency (Pr.08) and equal to or less than Maximum Voltage Frequency (Pr.04).

Pr.07	Mid-Point Voltage			
	Settings	115V/230V series	0.1 to 255.0V	Factory Setting: 10.0
		460V series	0.1 to 510.0V	Factory Setting: 20.0
		575V series	0.1 to 637.0V	Factory Setting: 26.1

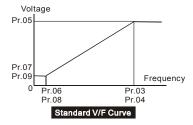
The parameter sets the Mid-Point Voltage of any V/F curve. With this setting, the V/F ratio between Minimum Frequency and Mid-Point Frequency can be determined. Setting of this parameter must be equal to or greater than Minimum Output Voltage (Pr.09) and equal to or less than Maximum Output Voltage (Pr.05).

Pr.08	Minimum Output Frequency	Unit: 0.1Hz
	Settings 0.10 to 20.00Hz	Factory Setting: 1.50

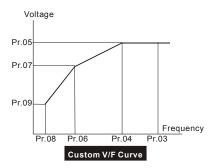
The parameter sets the Minimum Output Frequency of the AC drive. Setting of this parameter must be equal to or less than Mid-Point Frequency (Pr.06).

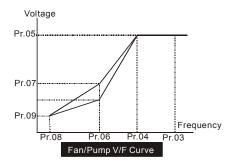
Pr.09	09 Minimum Output Voltage			
	Settings	115V/230V series	0.1 to 255.0V	Factory Setting: 10.0
		460V series	0.1 to 510.0V	Factory Setting: 20.0
		575V series	0.1 to 637.0V	Factory Setting: 26.1

This parameter sets the Minimum Output Voltage of the AC drive. Setting of this parameter must be equal to or less than Mid-Point Voltage (Pr.07).



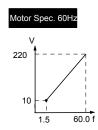






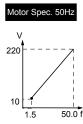
Commonly used V/F Setting

(1) General Purpose



Factory Settings

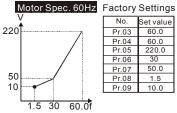
No.	Set value
Pr.03	60.0
Pr.04	60.0
Pr.05	220.0
Pr.06	1.5
Pr.07	10.0
Pr.08	1.5
Pr.09	10.0



No.	Set value
Pr.03	50.0
Pr.04	50.0
Pr.05	220.0
Pr.06	1.3
Pr.07	12.0
Pr.08	1.3
Pr.09	12.0

Chapter 4 Parameters | V

(2) Fans and Pumps



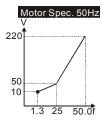
No. Set value 60.0 Pr.03 Pr.04 60.0 220.0 Pr.05 30 Pr.06 50.0 Pr.07

1.5

10.0

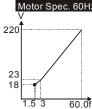
Pr.08

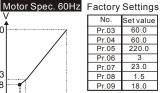
Pr.09

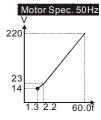


No.	Set value
Pr.03	50.0
Pr.04	50.0
Pr.05	220.0
Pr.06	25
Pr.07	50.0
Pr.08	1.3
Pr.09	10.0

(3) High Starting Torque







No.	Set value
Pr.03	50.0
Pr.04	50.0
Pr.05	220.0
Pr.06	2.2
Pr.07	23.0
Pr.08	1.3
Pr.09	14.0

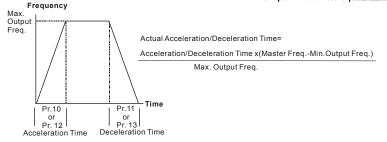
Pr.10	✓ Acceleration Time 1	Unit: 0.1 or 0.01 sec
Pr.11	✓ Deceleration Time 1	Unit: 0.1 or 0.01 sec
Pr.12		Unit: 0.1 or 0.01 sec
Pr.13	✓ Deceleration Time 2	Unit: 0.1 or 0.01 sec

Settings 0.1 to 600.0 sec or 0.01 to 600.0 sec

Factory Setting: 10.0

- Pr.10. This parameter is used to determine the time required for the AC drive to ramp from 0 Hz to its Maximum Output Frequency (Pr.03). The rate is linear unless the S-Curve (Pr.14) is "Fnabled"
- Pr.11. This parameter is used to determine the time required for the AC drive to decelerate from the Maximum Output Frequency (Pr.03) down to 0 Hz. The rate is linear unless the S-Curve (Pr.14) is "Enabled".
- \square Pr.12 and Pr.13: Provide an additional Accel/Decel time although Time 1 is the default. A Multi-Function input terminal must be programmed to select Accel/ or Decel/ Time 2 and the terminal must be closed to select Accel/Decel Time 2 (See Pr.38 to Pr.42).
- In the below diagram, suppose the Maximum Output Frequency is 60 Hz (Master Freq), Minimum Output Frequency (start-up) is 1.0 Hz, and accel/decel time 1 is 10 seconds. The actual time for the AC drive to accelerate from start-up to 60 Hz is 9.83 seconds (deceleration time is also 9.83 seconds), can be determined by the formula.

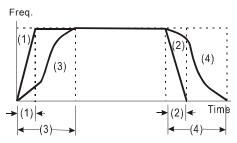




Pr.14 Acceleration S-Curve Settings 00 to 07

Factory Setting: 00

This parameter is used whenever the motor load needs to be accelerated or decelerated smoothly. The desired accel/decel effect is selectable from 0 to 7, in which the larger the number, the greater the effect achieved. If the default value of Pr.111 Deceleration S Curve is unchanged ("0"), then Pr.14 sets both acceleration and deceleration S-Curves. If Pr.111 is set to any value other than "0", then Pr.14 will set the acceleration S-Curve and Pr.111 will set the deceleration S-Curve.



Acceleration/Deceleration characteristics

(1), (2) Disabling S curve

(3), (4) Enabling S curve

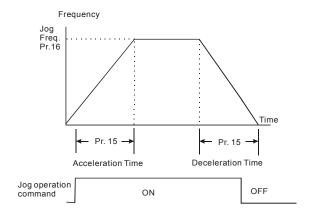
Pr.15	✓ Jog Accel / Decel Time	Unit: 0.1 or 0.01 sec
	Settings 0.1 to 600.0 sec or 0.01 to 600.0 sec	Factory Setting: 1.0 sec

Ω. This parameter sets the acceleration or deceleration time for Jog operation.

Pr.16	✓ Jog Frequency	Unit: 0.1 Hz
	Settings 0.00 to 400.0 Hz	Factory Setting: 6.00 Hz

Chapter 4 Parameters | Variable

When the JOG function is activated, the AC drive will accelerate from Minimum Output
Frequency (Pr.08) to Jog Frequency (Pr.16). Drive must be in "stop" status for the operator to
activate the JOG function. Likewise, during Jog operation, other commands cannot be
accepted through the keypad but FORWARD, REVERSE and STOP. The JOG function can
be remotely activated when the Jog terminal is closed, and if the Jog terminal opens, the AC
drive will decelerate from Jog Frequency to zero. The accel / decel time is entered as Jog
Accel / Decel Time (Pr.15). Multi-function Input terminals (M1-M5) can also be used to initiate
the JOG operation if so programmed.



Pr.17		Unit: 0.1 Hz
Pr.18		Unit: 0.1 Hz
Pr.19		Unit: 0.1 Hz
Pr.20		Unit: 0.1 Hz
Pr.21		Unit: 0.1 Hz
Pr.22		Unit: 0.1 Hz
Pr.23		Unit: 0.1 Hz
	Settings 0.00 to 400.0Hz	Factory Setting: 0.00 Hz

- Multi-Function Input Terminals (refer to Pr.38 to Pr.42) are used to select Multi-Step speeds.

 The desired speed frequencies are entered in Pr.17 to Pr.23. When the associated multifunction input terminal is closed, drive will run at one of these specific frequencies.
- Multi-step speeds (Pr.17 to Pr.23), Pr.78, Pr.79, and Pr.81 to Pr.87; are used for multi-step motion control, which is executed in an orderly manner, similar to a PLC program.



Pr.24 Reverse Operation Inhibition

Factory Setting: 00

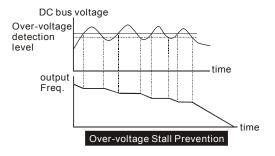
Settings 00 Enable REV operation 01 Disable REV operation

 \Box This parameter is used to disable motor rotation in reverse.

Pr.25	Over–V	oltage Stall Preventic	n	
	Settings	115V/230V series	330-450Vdc	Factory Setting: 390
		460V series	660-900Vdc	Factory Setting: 780
		575V series	825-1025Vdc	Factory Setting: 975
		00 disable		

Ω. During deceleration, the DC bus voltage may exceed its maximum allowable value due to motor regeneration. When this function is enabled, the AC drive will stop decelerating, and maintain a constant output frequency to prevent from over-voltage tripping. Drive will resume deceleration when the voltage drops below the setting for Pr.25.

Note: In applications where inertia is low, over-voltage during deceleration would not occur. When inertia is high, the AC drive will automatically extend the deceleration period. If a faster stop is needed, then a dynamic brake resistor should be used.



Pr.26 Unit: 1% Over-Current Stall Prevention during Acceleration

Factory Setting: 150%

Settings 20 to 200% 00 disable

 \Box A setting of 100% is equal to the Rated Output Current of the drive.

Chapter 4 Parameters | V

Under certain conditions, the AC drive output current may increase abruptly, and exceed the value specified by Pr.26. This is commonly caused by rapid acceleration or excessive load on the motor. When this function is enabled, the AC drive will stop accelerating and maintain a constant output frequency. Drive will resume accelerating only after the current drops below the setting for Pr.26.

Pr.27

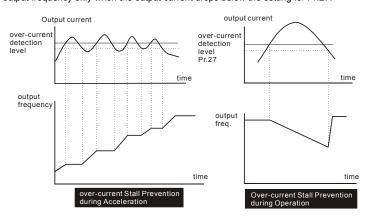
Over-Current Stall Prevention during Operation

Unit: 1%

Factory Setting: 150%

Settings 20 to 200% 00: disable

During a steady-state operation with the motor load rapidly increasing, the AC drive output current may exceed the limit specified in Pr.27. When this occurs, the output frequency will decrease to maintain a constant motor speed. The drive will accelerate to the steady-state output frequency only when the output current drops below the setting for Pr.27.



Pr.28	DC Braking Current Level	Unit: 1%
	Settings 00 to 100%	Factory Setting: 00

This parameter determines the amount of DC Braking Current applied to the motor during starting and stopping. When setting the DC Braking Current, please note that 100% corresponds to the rated current of the AC drive. It is recommended to start with a low DC Braking Current level and then increase it until proper holding torque has been attained.

	Chapter 4 Parameters Va	
Pr.29	DC Braking Time during Start-up	Unit: 0.1sec
	Settings 0.0 to 5.0 sec	Factory Setting: 0.0

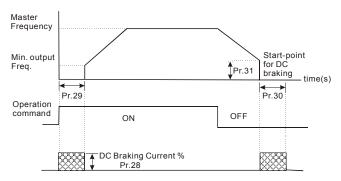
This parameter determines the duration for the DC Braking Current applied during starting. DC Braking is applied until the Minimum Frequency is reached.

Pr.30 DC Braking Time during Stopping		Unit: 0.1sec
	Settings 0.0 to 25.0 sec	Factory Setting: 0.0

This parameter determines the duration for the DC Braking voltage to be applied during stopping. If stopping with DC Braking is desired, then Pr.02 must be set to Ramp to Stop (0.0).

Pr.31	Start-Point for DC Braking	Unit: 0.1sec
	Settings 0.00 to 60.00Hz	Factory Setting: 0.00

This parameter sets the frequency at which the DC Braking will begin during deceleration.



Notes:

- DC Braking during starting is used for loads that may move before the AC drive starts, such
 as hoists and cranes. These loads may also be moving in the wrong direction. Under such
 circumstances, the DC Braking can be used to hold the load in position before applying a
 forward motion.
- DC Braking during stopping is used to stop faster than the ramp-to-stop or to hold a stopped load in position. A dynamic brake resistor may be needed in order to stop loads of high inertia.

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Momentary Power Loss Operation Selection

Factory Setting: 00

- Settings 00 Operation stops after momentary power loss
 - 01 Operation continues after momentary power loss Speed search starts with the Master Frequency reference value
 - 02 Operation continues after momentary power loss Speed search starts with the min frequency

Pr.33 Maximum Allowable Power Loss Time

Unit: 0.1sec

Settings 0.3 to 5.0 sec

Factory Setting: 2.0 sec

After a power loss, the AC drive will resume operation only if the power loss duration is shorter than the time defined by Pr.33. If the Maximum Allowable Power Loss Time is exceeded, the AC drive output is then turned off.

Pr.34 Base-Block Time for Speed Search

Unit: 0.1sec

Settings 0.3 to 5.0 sec

Factory Setting: 0.5 sec

- When a momentary power loss is detected, the AC drive will stop its output and will wait during a specified time interval called Base Block (entered in Pr.34) before resuming operation.

 Setting of this parameter should make the residual output voltage due to regeneration almost zero, before the drive resumes operation.
- This parameter also determines the search time when performing external Base-Block and Fault Reset (Pr.72).

Pr.35 Maximum Current Level for Speed Search

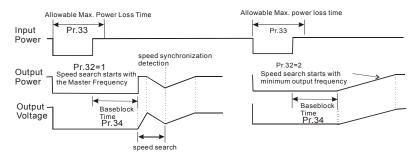
Unit: 1%

Settings 30 to 200%

Factory Setting: 150

Following a power failure, the AC drive will start its speed search operation only if the output current is greater than the value determined by Pr.35. When the output current is less than that of Pr.35, the AC drive output frequency is at a "speed synchronization point" and will accelerate or decelerate back to the operating frequency at which it was running prior to the power failure.



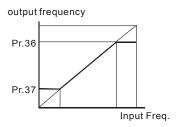


Pr.36	Upper Bound of Output Frequency	Unit: 0.1Hz
	Settings 0.10 Hz to 400.0 Hz	Factory Setting: 400

- \Box The Upper/Lower Bounds help prevent operation error and machine damage.
- If the Upper Bound of Output Frequency is 50Hz and the Maximum Output Frequency is 60Hz, the Maximum Output Frequency will be limited to 50Hz.
- Ш Setting of this parameter must be equal to or greater than the Lower Bound of Output Frequency (Pr.37).

Pr.37	Lower Bound of Output Frequency	Unit: 0.1Hz
	Settings 0.00 Hz to 400.0 Hz	Factory Setting: 0 Hz

- \Box Setting of this parameter must be equal to or less than the Upper Bound of Output Frequency
- \Box If the Lower Bound of Output Frequency is 10Hz, and the Minimum Output Frequency (Pr.08) is set at 1.0Hz, then any command frequency between 1-10Hz will generate a 10Hz output from the drive.



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Multi-function Input Terminal (M0, M1)

Factory Setting: 00

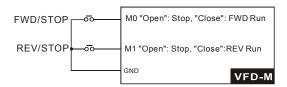
Settings 00 M0: FWD/STOP, M1: REV/STOP

01 M0: RUN/STOP, M1: REV/FWD

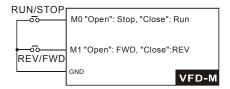
02 M0, M1, M2: 3-wire operation control mode

Explanations:

00: Two wire operation: Only Pr.38 can be set to "0".

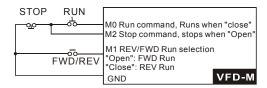


01: Two wire operation: Only Pr.38 can be set to "1".



Note: Multi-function Input Terminal M0 does not have its own parameter designation. M0 must be used in conjunction with M1 to operate two and three wire control.

02 Three Wire Control: Only Pr.38 can be set to "2".



Note: When the "2" setting is selected for Pr.38, the value in Pr.39 will be ignored.

Settings 00 to 32

Cattings	Function	Description
Settings	FullCuon	Description
00	No Function	
01	Output OFF (N.O.) (enabled when running)	When it is set to 01 or 02, AC drive output will stop
02	Output OFF (N.C.) (enabled when running)	immediately. If there is start signal after stopping, the output will start from the minimum frequency.
03	External Fault (N.O.)	Parameter values 3 and 4 program Multi-Function Input
04	External Fault (N.C.)	Terminals: M1 (Pr.38), M2 (Pr.39), M3 (Pr.40), M4 (Pr.41) or M5 (Pr.42) to be External Fault (E.F.) inputs. E.F.(N.O.) Setting by 3 E.F.(N.C.) Setting by 4 Mx "Close": Operation available. Mx "Open": Operation available. VFD-M Note: When an External Fault input signal is received, the AC drive output will turn off, drive will display "E.F." on Digital Keypad, and the motor will coast. Normal operation can resume after the External Fault is cleared and the AC drive is reset.

Factory Setting: 08

Settings	Function	Description
05	External Reset	Parameter value 5 programs Multi-Function Input Terminals: M1 (Pr.38), M2 (Pr.39), M3 (Pr.40), M4 (Pr.41) or M5 (Pr.42) to be an External Reset. RESET Setting by 5 Mx *Close*: Operation available GND VFD-M Note: The External Reset has the same function as the Reset key on the Digital keypad. It will reset the drive after a fault.
06	Multi-Step Speed Command 1	Parameter values 06, 07,and 08 program any three of the following Multi-Function Input Terminals: M1 (Pr.38), M2
07	Multi-Step Speed Command 2	(Pr.39), M3 (Pr.40), M4 (Pr.41) or M5 (Pr.42) for Multi-step Speed Command function.
08	Multi-Step Speed Command 3	Mx "Close": Operation available Mx "Close": Operation available Mx "Close": Operation available Mx "Close": Operation available GND VFD-M Note: These three inputs select up to seven multi-step speeds defined by Pr.17 to Pr.23 as shown in the following diagram. Pr.78 to Pr.87 can also control output speed by programming the AC drive's internal PLC function. Freq. Pr.17 Step 1 Pr.18 Pr.20 Step 5 Pr.20 Step 5 Pr.21 Step 5 Pr.22 Step 7 Mx1-GND ON ON ON ON ON ON ON ON ON

Settings	Function	Description	
		Parameter value 09 programs Multi-Function Input Terminal: M1 (Pr.38), M2 (Pr.39), M3 (Pr.40), M4 (Pr.41) or M5 (Pr.42) for Jog control.	
09	09 Jog Operation	Mx "Close": Operation available GND VFD-M Note: Jog operation programmed by 9 can only be initiated	
10	Accel/Decel Speed Inhibit	while the motor is stop. (Refer to Pr.15, Pr.16.) Parameter value 10 programs Multi-Function Input Terminal: M1 (Pr.38), M2 (Pr.39), M3 (Pr.40), M4 (Pr.41) or M5 (Pr.42) for Accel/Decel Inhibit. After receiving this command, the AC Drive stops accelerating or decelerating and maintains a constant speed. Frequency Master Frequency Accel inhibit Accel inhibit Accel inhibit Decel inhibit Decel inhibit Accel inhibit Operation Operation On Operation On Operation	

Settings	Function	Description
	First or Second	Parameter value 11 programs a Multi-Function Input Terminal: M1 (Pr.38), M2 (Pr.39), M3 (Pr.40), M4 (Pr.41) or M5 (Pr.42) for selecting the First or Second Accel/Decel time. (Refer to Pr.10 to Pr.13.) Mx*Close*: 2nd Accel/Decel "Open*: 1st Accel/Decel GND
11	Accel/Decel Time Selection	Frequency Master Frequency Pr.10 Pr.11 Pr.12 Pr.13 Pr.10 Pr.13 Accell Accell Accell Decel Mx-GND ON ON ON ON ON OFF
12	External Base Block (N.O.) (Normally Open Contact	Parameter values 12, 13 program Multi-Function Input Terminals: M1 (Pr.38), M2 (Pr.39), M3 (Pr.40), M4 (Pr.41) or M5 (Pr.42) for external Base Block control. Value 12 is for
13	External Base Block (N.C.) (Normally Close Contact Input)	Note: When a Base-Block signal is received, the AC drive will stop all output and the motor will coast. When base block control is deactivated, the AC drive will start its speed search function and synchronize with the motor speed, and then accelerate to the Master Frequency. Allowable max. power loss time base-block signal pr.33 Pr.32=1 Output Speed synchronization detection Speed synchronization detection Speed synchronization detection Mx *Close*: Operation available. Mx *Open*: Operation available. Mx *Open*: Operation available. Mx *Open*: Operation available. Starting by 13 VFD-M Note: When a Base-Block signal is received, the AC drive will start its speed search function and synchronize with the motor speed, and then accelerate to the Master Frequency. Allowable max. power loss time External base-block signal is received, the AC drive will start its speed search synchronize with the motor speed, and then accelerate to the Master Frequency. Allowable max. power loss time External base-block signal is received, the AC drive will start its speed search synchronize with the motor speed, and then accelerate to the Master Frequency. Allowable max. power loss time External base-block signal is received, the AC drive will start its speed search starts with the motor speed, and then accelerate to the Master Frequency. Allowable max. power loss time External base-block signal is received, the AC drive will start its speed search starts with the motor speed synchronization detection. Allowable max. power loss time External base-block signal is received, the AC drive will start its speed synchronization detection.

Settings	Function	Description Description
14	Increase Master Frequency	Parameter values 14, 15 program the Multi-Function Input Terminals: M1 (Pr.38), M2 (Pr.39), M3 (Pr.40), M4 (Pr.41) or
15	Decrease Master Frequency	M5 (Pr.42) to incrementally increase/ decrease the Master Frequency each time an input is received. UP Setting by 14 DOWN Setting by 15 Mx "Close": Freq. will increase by one unit. Mx "Open": Freq. will decrease by one unit. GND VFD-M
16	Run PLC Program	Parameter value 16 programs Multi-Function Input Terminal:
17	Pause PLC Program	M1 (Pr.38), M2 (Pr.39), M3 (Pr.40), M4 (Pr.41) or M5 (Pr.42) to enable the AC drive internal PLC program. Parameter value 17 programs an input terminal to pause the PLC program. PLC operation

Settings	Function	Description
Jettings	runction	Description
		Parameter value 18 programs Multi-Function Input Terminal:
		M1 (Pr.38), M2 (Pr.39), M3 (Pr.40), M4 (Pr.41) or M5 (Pr.42)
		to increase the AC drive's internal counter. When an input is
		received, the counter is increased by 1.
		Trigger Output 18 counter trigger signal input. Mx counter value increase by 1 when closed.
		GND VFD-M
		Note: The Counter Trigger input can be connected to an
18	Counter Trigger Signal	external Pulse Signal Generator when counting a
		process step or unit of material. See the diagram
		below.
		Indication value 10 2 2 3 2 2 2 2 2 2 2 2 3 2 2 2 3 2 2 2 3 2 2 2 3 2 2 3 2 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 3 2 3 3 2 3 3 2 3 3 2 3 3 2 3 3 2 3 3 2 3 3 2 3 3 2 3 3 2 3 3 2 3 3 2 3 3 2 3 3 2 3 3 2 3 3 2 3 3 3 2 3
		Signal output with Pr.97 (Pr.97=3) counter value is attained. (Pr.45/46=13) can't be less than 2ms. (<250Hz)
		Signal output with Pr.96 (Pr.96=5) counter value is attained (Pr.45/46=14)
		Parameter value 19 programs Multi-Function Input Terminal:
		M1 (Pr.38), M2 (Pr.39), M3 (Pr.40), M4 (Pr.41) or M5 (Pr.42)
		to reset the counter.
19	Counter Reset	Reset counter Mx "close": reset counter. 19 reset the
		counter value.
		GND VFD-M
		Enter value (20) to disable any Multi-Function Input Terminal:
		M1 (Pr.38), M2 (Pr.39), M3 (Pr.40), M4 (Pr.41) or M5 (Pr.42)
20	No Function	Note: Purpose of this function is to isolate unused Multi-
		Function Input Terminals. Any unused terminals should
		be programmed to 20 to insure they have no effect on
		drive operation.



Settings	Function	Description	
21	RESET Command (N.C)		
22	Control source: External Terminal	Enter values 22, 23, or 24 to set the control source to be the external terminals, keypad or communication respectively.	
23	Control source: Keypad	This setting is used to create functions for manual/auto, and remote/near-end control. When these three functions are	
24	Control source: Communication	used at the same time, the priority is 22-I/O > 23-Keypad > 24-Communication.	
25	Parameter Lock (Write disable, Read is always 0)	This function will disable the write function and all the content of read are 0. The application is for customer having a key to control the operator to modify parameters or modify the parameter by improper use.	
26	PID Disable (N.O.)	This function pause the PID control. It is commonly used for	
27	PID Disable (N.C.)	manual operation or function testing, and to recover the PID function when the system is normal.	
28	Second Source for Frequency Command	This function is used with Pr. 142 to select a different frequency source for control.	
29	Forward (contact is open) / Reverse (contact is close)	This function has top priority to set the direction for running (If "Pr. 24 inhibit REV function" is not set). No mater what the present direction of run is, the contact N.O. is forward and the contact N.C. is reverse, once this function is set.	
		The requirement for setting direction is Pr. 24 > setting 29 of Pr. 39-Pr. 42 > Pr. 38.	
30	One-Shot PLC Run		
31	Index Input Signal	This function is used with parameters 149 to 151. The position where AC drive stops will be regarded as the zero position and it will move to the angle that Pr. 150 sets.	
32	Virtual Timer Input	This function is for counting at the speed of the output frequency.	

Note: The settings 00~32 in Pr. 39 to Pr.42 can be used to set multi-function terminals (M2-M5) but the settings cannot be used repeatedly at the same time (besides settings 20).

п.		И	9
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✓ Analog Output Signal

Factory Setting: 00

Settings 00 Analog Frequency Meter (0 to Maximum Output Frequency)

01 Analog Current Meter (0 to 250% of the rated AC drive current)

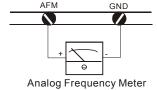
02 Feedback Signal (0 - 100%)

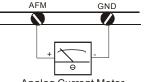
03 Output Power (0 - 100%)

This parameter selects if the Output Frequency, Current, PID feedback or Output Power will be the output signal on the AFM terminal (0 to 10V).

Pr.44		Unit: 1%
	Settings 00 to 200%	Factory Setting: 100

This parameter sets the voltage range of the analog output signal on output terminal AFM.





Analog Current Meter

The analog output voltage is directly proportional to the output frequency of the AC drive. A setting of 100% on Pr.44 makes the Maximum Output Frequency (Pr.03) of the AC drive to correspond to the +10VDC analog voltage output. (The actual voltage is about +10VDC, and can be adjusted by Pr.44)

The analog output voltage is also directly proportional to the output current of the AC drive. A setting of 100% on Pr.44 makes the 2.5 times rated current of the AC drive to correspond to the +10 VDC analog voltage output. (The actual voltage is about +10 VDC, and can be adjusted by Pr.44)

Note: Any type of voltmeter can be used. If the meter reads full scale at a voltage less than 10 volts,

then Pr.44 should be set by the following formula:

Pr.44 = ((meter full scale voltage)/10)×100%

For Example: When using a meter with a full scale of 5 volts, adjust Pr.44 to 50%



Pr.45 Multi-function Output Terminal 1 (Photocoupler output)

Factory Setting: 00

Pr.46

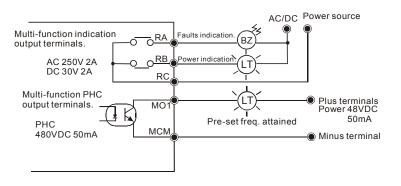
Multi-function Output Terminal 2 (Relay output)

Factory Setting: 07

Settings 00 to 24

Settings	Function	Description
	AC Drive Operational	Terminal output is activated when there is power output
00	AC Drive Operational	from drive.
01	Maximum Output	Terminal output is activated when the AC drive attains
01	Frequency Attained	Maximum Output Frequency.
02	Zero speed	Terminal output is activated when Command Frequency is
	Zero speed	lower than the Minimum Output Frequency.
		Terminal output is activated when over-torque is detected.
03	Over-Torque detection	Parameter Pr.61 determines the Over-Torque detection
		level.
04	Base-Block (B.B.)	Terminal output is activated when the AC drive output is
	Indication	shut-off by the external Base-Block.
05	Low-Voltage Indication	Terminal output is activated when low voltage is detected.
06	AC Drive Operation Mode	Terminal output is activated when the operation of AC Drive
		is controlled by External Control Terminals.
07	Fault Indication	Terminal output is activated when certain faults occur (oc,
	Fault Indication	ov, oH, oL, oL1, EF, cF3, HPF, ocA, ocd, ocn, GF).
08	Desired Frequency	Terminal output is activated when the desired frequency
	attained	(Pr.47) is attained.
09	PLC Program Running	Terminal output is activated when the PLC program is
		running.
10	PLC Program Step	Terminal output is activated for 0.5 sec. when each multi-
	Completed	step speed is attained.
11	DLC Brogram Completed	Terminal output is activated for 0.5 sec. when the PLC
	PLC Program Completed	program cycle has completed.
12	PLC Operation Paused	Terminal output is activated when PLC operation is paused.
10	Ton Count Value Attained	Terminal output is activated when counter reaches the Top
13	Top Count Value Attained	Count Value. See diagram for Pr.38 to Pr.42=18.

Settings	Function	Description	
14	Preliminary Counter Value Attained	Terminal output is activated when counter reaches the Preliminary Count Value. See diagram for Pr.38 to Pr.42=18.	
15	Warning (PID feedback loss, communication error)	The contact will be "close" when PID feedback loss or communication is error.	
16	Below the Desired Frequency	The contact will be "close" when output frequency is less than desired frequency.	
17	PID supervision	The contact will be "close" when PID offset exceeds the setting of P126 and P127.	
18	Over Voltage supervision	The contact will be "close" before over voltage. It will be activated at 370Vdc in 230V series and at 740Vdc in 460 series.	
19	Over Heat supervision	The contact will be "close" before 90°C.	
20	Over Current stall supervision	The contact will be "close" before exceeding the setting of P26/P27.	
21	Over Voltage stall supervision	The contact will be "close" before exceeding the setting of P25.	
22	Forward command	The contact will be "close" with forward command.	
23	Reverse command	The contact will be "close" with reverse command.	
24	Zero Speed (Includes Drive Stop)	The contact will be "close" when the setting frequency is less than min. frequency or drive stop.	



Multi-function Terminals Wiring Example

Pr.47

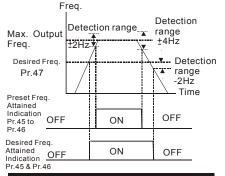
✓ Desired Frequency Attained

Unit: 0.1Hz

Settings 0.00 to 400.0 Hz

Factory Setting: 0.00

This parameter allows monitoring a certain frequency and then activates one of the Multifunction output terminals (Pr.45 or Pr.46 set to 8) when that frequency is achieved.



Desired Freq. Attained & Preset Freq. Attained

Pr.48		Unit: 0.1Hz
	Settings 0.00 to 200.0%	Factory Setting: 0.00 Hz

This parameter provides a frequency offset when the source of frequency command is the analog input.

Pr.49 ✓ Potentiometer Bias Polarity

Factory Setting: 00

Settings 00 Positive Bias
01 Negative Bias

This parameter sets the potentiometer Bias Frequency to be positive or negative.

Pr.50		Unit: 1%
	Settings 0.10 to 200.0%	Factory Setting: 100.0

This parameter sets the ratio of analog input vs frequency output.

Pr.51	Potentiometer Reverse Motion Enable	
		Factory Setting: 00

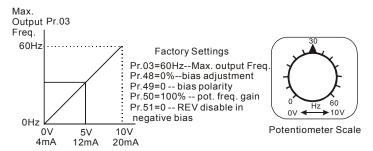
Settings 00 Reverse Motion Disabled in negative bias 01 Reverse Motion Enabled in negative bias

Chapter 4 Parameters | Value

Pr.48 to Pr.51 are used when the source of frequency command is the analog signal (0 to +10V DC or 4 to 20mA DC). Refer to the following examples.

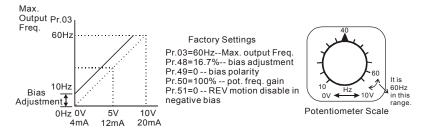
Example 1:

Set Pr.00=1 to command frequency with the potentiometer on keypad or Pr.00=2 (4 to 20mA current signal) potentiometer/current signal of external terminal.



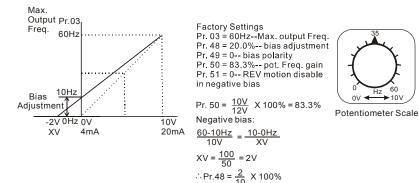
Example 2:

A Bias Adjustment (16.7% of 60Hz) determines the Output Frequency to be 10 Hz with the potentiometer set at 0V as shown. Notice that the entire V/F is transposed accordingly. An analog input voltage 0-8.33V (or current 4-13.33mA) would set frequency as 0-60Hz. Once the Maximum Output Frequency is reached any further increase on the potentiometer will not increase output frequency (If you want to use the range of 60Hz, please refer to the example 3).



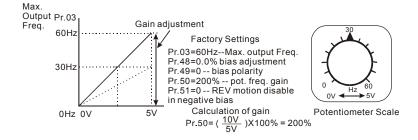
Example 3:

The whole scale of the potentiometer may be used as desired. In addition to the signals 0 to 10V and 4 to 20mA, other popular voltage signals include 0 to 5V, 20 to 4mA or that under 10V.



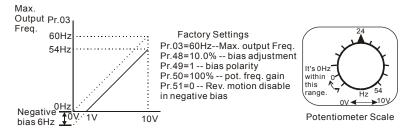
Example 4:

This example shows how to use Gain to set a potentiometer range of 0 to 5 Volts for 0-60 Hz. As an option, you also could set Pr. 03 =120Hz.



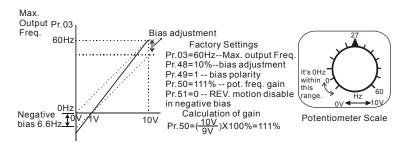
Chapter 4 Parameters | Variable |

In this example, a 6 Hz (10% of 60 Hz) negative bias is used. This setting is used to provide a noise margin (1V in this example) in noisy environments. Note that the top frequency is reduced to 54 Hz.



Example 6:

This example also uses negative bias and includes a potentiometer frequency gain to allow the AC drive to reach the Maximum Output Frequency.



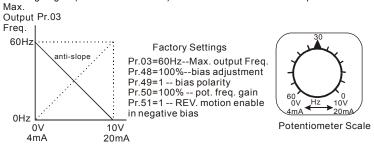
Example 7:

In this example, the potentiometer is programmed to run a motor in forward or reverse direction. The motor will idle when the potentiometer is set at the scale mid-point. Please note that this adjustment will disable the external FWD and REV controls.



Example 8:

This example shows how to set up the "anti-slope", which is an inversely proportional variation of frequency to the input analog signal, required for some applications in process control. A sensor will generate a large signal (such as 20mA or 10V) and the AC Drive will slow or stop.



Pr.52	Motor Rated Current	Unit: 0.1A
	Settings 30.0% FLA to 120.0% FLA	Factory Setting: FLA

- Ш Factory setting is the AC drive rated current. When setting this parameter, just input the motor rated current value without any calculation.
- \Box Use the following criteria to determine the setting of this parameter: no-load current < rated current of motor < rated current of AC drive. You can use this parameter to limit the output current to the motor as to prevent overheat.

Pr.53 / Motor No-Load Current	Unit: 0.1A
Settings 00%FLA to 99%FLA	Factory Setting: 0.4*FLA

The rated current of the AC drive means 100%. Setting of this parameter affects the slip compensation. The setting value must be smaller than the motor rated current setting in Pr.52. (this parameter displays the value of actual current.)

Pr.54	✓ Torque Compensation	
	Settings 00 to 10	Factory Setting: 00

Ш This parameter forces the AC drive to increase its voltage output during start-up in order to obtain a higher initial starting torque.

Pr.55	lip Compensation	
Setti	ngs 0.00 to 10.00	Factory Setting: 0.00

Chapter 4 Parameters | Variable

This parameter can be used to compensate motor slip. Although no linear, it typically adds 6Hz for a setting of 10 if Pr.03=60 Hz. When the output current of the AC drive is greater than the motor no-load current (Pr.53), the AC drive will adjust its output frequency according to this parameter.

Pr.56	Reserved

Pr.57 Rated Current Display of the AC motor drive

Settings Read Only Factory Setting: ###

Pr.57 displays the rated current of the AC motor drive. By reading this parameter the user can check if the AC motor drive is correct. See Pr.80 for details.

Pr.58 Electronic Thermal Overload Relay Selection

Factory Setting: 02

Settings 00 Standard Motor (self cool motor)

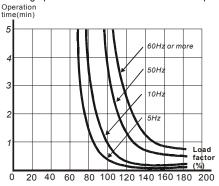
01 Inverter Motor (auxiliary cool fan on motor)

02 Inactive

This function is used to limit the output power of the AC drive when powering a "self-cooled motor" at low speed.

Pr.59	Electronic Thermal Motor Overload	Unit: 1 second
	Settings 30 to 300sec	Factory Setting: 60

The parameter determines the time required to activate the I²t electronic thermal motor overload protection. The graph below shows I²t curves at 150% output power for 1 minute.





Pr.60 Over-Torque Detection Mode

Factory Setting: 00

- Settings 00 Over-Torque detection disabled.
 - 01 Enabled during constant speed operation until the allowable time for detection (Pr.62) elapses.
 - 02 Enabled during constant speed operation and halted after detection.
 - 03 Enabled during acceleration until the allowable time for detection (Pr.62) elapses.
 - 04 Enabled during acceleration and halted after detection.

Pr.61 Over-Torque Detection Level

Unit: 1%

Settings 30 to 200%

Factory Setting: 150

- Ω A setting of 100% is proportional to the Rated Output Current of the drive.
- This parameter sets the Over-Torque Detection level in 1% increments. (The AC drive rated current is equal to 100%.)

Pr.62 Over-Torque Detection Time

Unit: 0.1 sec

Settings 0.0 to 10.0sec

Factory Setting: 0.1sec

This is the duration for over-torque detection. When the output current is larger than the overtorque detection level (Pr.61), an over-torque condition exists and the detection time (Pr.62) is timed-out. Any of the multi-function output terminals set to indicate over-torque, will then close. (Please refer to Pr. 45 and Pr.46)

Pr.63

Loss of ACI (4-20mA)

Factory Setting: 00

- Settings 00 Decelerate to 0 Hz
 - 01 Stop immediately and display "EF"
 - 02 Continue operation by last frequency command

Pr.64

User Defined Function for Display

Factory Setting: 06

- Settings 00 Displays AC drive output frequency (Hz)
 - 01 Display User-defined output Frequency (H*Pr.65)
 - 02 Output Voltage (E)
 - 03 DC Bus Voltage (u)
 - 04 PV (i)

Chapter 4 Parameters | Value

- 05 Displays the value of the internal counter (c)
- 06 Displays the setting Frequency (F)
- 07 Displays the parameter setting (P)
- 08 Reserved
- 09 Output Current (A)
- 10 Display program operation (0. xxx), Fwd, or Rev
- The parameter can be set to display the user-defined value. (where $v = H \times Pr.65$)

Pr.65		Unit: 0.01
	Settings 0.01 to 160.0	Factory Setting: 1.00

- The coefficient K determines the multiplying factor for the user-defined unit.
- The display value is calculated as follows:

Display value = output frequency x K

The display window is only capable of showing four digits, yet you could use Pr.65 to create larger numbers. The display windows uses decimal points to signify numbers up to three digits as illustrated in next page:

Display	Number Represented	
9999	The absence of a decimal point indicates a four-digit integer.	
999.9	A signal decimal point between the middle and the right-most numbers is a true decimal point. For example, the number 123.4 would be displayed as "123.4".	
9999.	A single decimal point after the right-most number is not a true decimal point; instead it indicates that a zero follows the right-most number. For example, the number 12340 would be displayed as "1234."	
999.9.	Two decimal points (one between the middle and the right-most numbers, and one after the right-most number) are not true decimal points; instead they indicate that two zeros follow the right-most number. For example, the number 345600 would be displayed as "345.6.".	

Pr.66 Communication Frequency		Unit: 0.1 Hz
	Settings 0.00 to 400.0 Hz	Factory Setting: 0.00

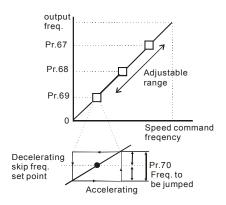
This parameter defines the Master Frequency when the AC drive is controlled by the communication interface.

		Chapter 4 Parameters
Pr.67	Skip Frequency 1	Unit: 0.1 Hz
Pr.68	Skip Frequency 2	Unit: 0.1 Hz
Pr.69	Skip Frequency 3	Unit: 0.1 Hz
	Settings 0.00 to 400.0 Hz	Factory Setting: 0.00

These three parameters determine the three Skip Frequencies that in conjunction with Pr.70, Skip Frequency Band, will cause the AC drive to skip operating in each frequency band. Note: Pr.67 > Pr.68 > Pr.69.

Pr.70 Skip Frequency Band Unit: 0.		Unit: 0.1 Hz
	Settings 0.00 to 20.00 Hz	Factory Setting: 0.00

This parameter determines the frequency band for a given Skip Frequency. Half of the Skip Frequency Band is above the Skip Frequency and the other half is below. Programming this parameter to 0.1 disables all skip frequencies.



Pr.71	PWM C	arrier Frequer	псу	
	Settings	115V series		Franks Outline 45
		230V series	01 to 15 (1KHz to 15KHz)	Factory Setting: 15 VFD075M43A is 10
		460V series		VI DOI SIVIASA IS TO
		575V series	01 to 10 (1KHz to 10KHz)	Factory Setting: 6
	Note: 1-9	kHz in senso	rless vector control mode	

The parameter defines the carrier frequency of the PWM (Pulse-Width Modulated) output.

Chapter 4 Parameters | V

Carrier Frequency	Acoustic Noise	Electromagnetic Noise, Leakage Current	Heat Dissipation
1KHz	Significant	Minimal	Minimal
1	†	1	1
15KHz	Minimal	Significant	Significant

From the above table, we see that the carrier frequency of PWM output has a significant influence on the electromagnetic noise, heat dissipation of the AC drive, and the acoustic noise to the motor.

Pr.72 Auto Restart Attempts After Fault		
	Settings 00 to 10	Factory Setting: 00

When this parameter is enabled (set different to zero), the AC Drive will restart/reset automatically up to 10 times after the occurrence of certain type of faults (over-current OC, over-voltage OV). If enabled, the AC drive will restart on "speed search", which begins at Master Frequency. Setting this parameter to 0 will disable this operation. To set the fault recovery time after a fault, please see base-block time for speed search (Pr.34).

Pr.73	Present Fault Record	
Pr.74	Second Most Recent Fault Record	
Pr.75	Third Most Recent Fault Record	

Factory Setting: 00

Settings 00 (no fault occurred)

01 Over-current (oc)

02 Over-voltage (ov)

03 Overheat (oH)

04 Overload (oL)

05 Overload 1 (oL1)

06 External Fault (EF)

07 CPU failure 1 (CF1)

08 CPU failure 3 (CF3)

09 Hardware Protection Failure (HPF)

10 Over-current during acceleration (OCA)

11 Over-current during deceleration (OCd)

12 Over-current during steady state operation (OCn)

- 13 Ground fault or fuse failure (GFF)
- 14 Low voltage (not record)
- 15 3 Phase Input Power Loss
- 16 CPU Failure (CF2)
- 17 External Base-Block (bb)
- 18 Overload 2 (oL2)
- 19 Auto Adjustable accel/decel failure (cFA)
- 20 Software protection code (codE)

Pr.76 Parameter Lock and Configuration

Factory Setting: 00

Settings 00 All parameters can be set/read

01 All parameters are read-only

02-08 Reserved

Resets all parameters to 50Hz factory defaults
 Resets all parameters to 60Hz factory defaults

This parameter allows the user to reset the drive to factory settings.

Pr.77 Time for Auto Reset the Restart Times after Fault

Unit: 0.1 second

Settings 0.1 to 6000.0 sec

Factory Setting: 60.0

If there is no fault in the period of this setting, it will reset the rest restart times that used after fault to the setting of restart times.

Pr.78 PLC Operation Mode

Factory Setting: 00

- Settings 00 Disable PLC operation
 - 01 Execute one program cycle
 - 02 Continuously execute program cycles
 - 03 Execute one program cycle step by step (separated by "STOP")
 - 04 Continuously execute program cycles step by step (separated by "STOP")

This M drive can be programmed to execute a sequence of operations named "PLC mode".

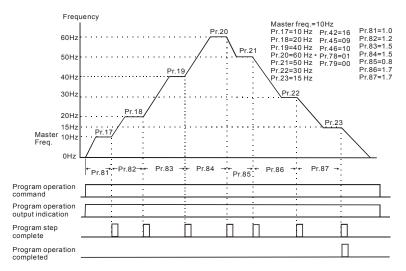
The PLC program can be used in lieu of any external controls, relays or switches. The AC drive will change speeds and directions according to the user's desired programming. This parameter selects the PLC operation mode for the drive. Please review the following examples:

Chapter 4 Parameters | Variable

Example 1 (Pr.78 =01): Execute one cycle of the PLC program. Its relative parameter settings are:

- 1 Pr.17 to Pr.23: 1st to 7th step speed (sets the frequency for each step speed)
- 2 Pr.38 to Pr.42: Multi-Function Input Terminals (program one multi-function terminal for PLC auto-operation (16)).
- 3 Pr.45 to Pr.46: Multi-Function Output Terminals: program a Multi-Function Output Terminal for PLC operation indication (09), one cycle in PLC auto mode (10) or PLC operation fulfillment attainment (11).
- 4 Pr.78: PLC mode.
- **5 Pr.79:** Direction of operation for Master Frequency and 1st to 7th step speeds.
- **6 Pr.81 to Pr.87:** operation time setting of Master Frequency and 1st to 7th step speeds.

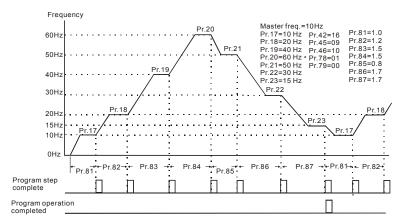
Example 1 (Pr.78 = 01) Execute one cycle through the PLC program:



Note: The above diagram shows one complete PLC cycle. To restart the cycle, turn the PLC Program input off and then back on.

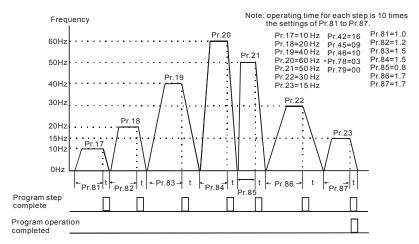
Example 2 (Pr.78 = 02) Continuously executes program cycles:

The diagram below shows the PLC program stepping through each speed and then automatically starting again. To stop the PLC program, either pause or stop the program. (Refer to Pr.38 to Pr.42 value 17 and 18)



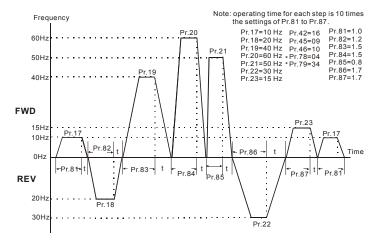
Example 3 (Pr.78 = 03) Execute one cycle step by step:

This example shows how the PLC function can perform one cycle at a time, within a complete cycle. Each step will use the accel/decel times in Pr.10 to Pr.13. It should be noted that the time interval for each step may be shorter than expected due to the time required for acceleration and deceleration.



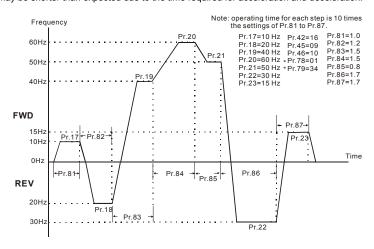
Example 4 (Pr.78 = 04) Continuously executes program cycles step by step:

In this explanation, the PLC program runs continuously step by step. Also shown are examples of steps in the reserve direction.



Example 5 (Pr.78 = 01) Execute one cycle through the PLC program:

In this example, the PLC program runs continuously. It should be noted that the time interval for each step may be shorter than expected due to the time required for acceleration and deceleration.





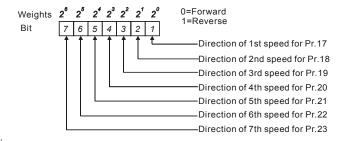
Application Note:

PLC program execution will be interrupted when values for JOG parameters 15 and 16 are changed.

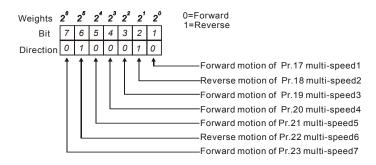
Pr.79 PLC Forward/Reverse Motion	
Settings 00 to	127 Factory Setting: 00

 \Box This parameter determines the direction of motion for the multi-speed Pr.17 to Pr.23 and Master Frequency. The original direction of Master Frequency will become invalid.

Note: A 7-bit binary number is used to program the forward/reverse motion for each of the 8 speed steps (including Master Frequency). The binary notation for the 7-bit number must be translated into decimal notation and then entered in Pr.79.



Example:



The setting value=bit7 x
$$2^6$$
+bit6 x 2^5 +bit5 x 2^4 +bit4 x 2^3 +bit3 x 2^2 +bit2 x 2^1 +bit1 x 2^0
= 0 x 2^6 +1 x 2^5 +0 x 2^4 +0 x 2^3 +0 x 2^2 +1 x 2^1 +0 x 2^0
= 0+32+0+0+0+2+0+0
= 34

Pr.80	Identity Code of the AC Motor Drive	
	Settings Read Only	Factory Setting: #

This parameter displays the identity code of the AC motor drive. The capacity, rated current, rated voltage and the max. carrier frequency relate to the identity code. Users can use the following table to check how the rated current, rated voltage and max. carrier frequency of the AC motor drive correspond to the identity code.

	115V series			230V series						
kW	0.2	0.4	0.75	0.4	0.75	1.5	2.2	3.7	5.5	
HP	0.25	0.5	1.0	0.5	1	2	3	5	7.5	
Model Number (Pr.80)	20	22	24	00	02	04	06	08	10	
Rated Output Current (A)	1.6	2.5	4.2	2.5	5.0	7.0	10	17	25	
Max. Carrier Frequency (kHz)					15kHz					

	460V series						575V series					
kW	0.75	1.5	2.2	3.7	5.5	7.5	0.75	1.5	2.2	3.7	5.5	7.5
HP	1	2	3	5	7.5	10	1	2	3	5	7.5	10
Model Number (Pr.80)	03	05	07	09	11	13	50	51	52	53	54	55
Rated Output Current (A)	3.0	4.0	5.0	8.2	13	18	1.7	3.0	4.2	6.6	9.9	12.2
Max. Carrier Frequency (kHz)	15kHz						10k	кНz				

Pr.81	Time Duration of 1st Step Speed (correspond to Pr.17)	Unit: 1 sec
Pr.82	Time Duration of 2nd Step Speed (correspond to Pr.18)	Unit: 1 sec
Pr.83	Time Duration of 3rd Step Speed (correspond to Pr.19)	Unit: 1 sec
Pr.84	Time Duration of 4th Step Speed (correspond to Pr.20)	Unit: 1 sec
Pr.85	Time Duration of 5th Step Speed (correspond to Pr.21)	Unit: 1 sec
Pr.86	Time Duration of 6th Step Speed (correspond to Pr.22)	Unit: 1 sec
Pr.87	Time Duration of 7th Step Speed (correspond to Pr.23)	Unit: 1 sec
	Settings 00 to 9999 second	Factory Setting: 00

Pr.81 to Pr.87 input the duration of each Multi-step speed operation defined by Pr.17 to Pr.23.

Note: If any duration is set to "0" (sec), the corresponding step operation will be skipped. This is commonly used to reduce the number of program steps.

Pr.88	Communication Address	
	Settings 01 to 254	Factory Setting: 01



Ш This parameter sets the Ac drive address identification when using the RS-485 serial port for communication.

Pr.89 Transmission Speed (Baud rate)

4800 bps

Settings 00

01 9600 bps

02 19200 bps

03 38400 bps

 \Box This parameter sets the transmission speed for communication on the RS-485 serial port

Pr.90 Transmission Fault Treatment

Factory Setting: 03

Factory Setting: 01

Warn and Continue Operating Settings 00

> 01 Warn and RAMP to Stop

02 Warn and COAST to Stop

03 Keep Operation without Warning

Pr.91 Time Out Detection

Factory Setting: 0.0

Settings 0.1 to 120.0 sec

0.0 disable

 \Box This parameter is used for ASCII mode. When the over-time detection is enabled, the separation between characters cannot exceed 500 ms.

Pr.92 Communication Protocol

Factory Setting: 00

Settings 00 Modbus ASCII mode, <7,N,2>

> 01 Modbus ASCII mode, <7,E,1>

> 02 Modbus ASCII mode, <7,0,1>

03 Modbus RTU mode. <8.N.2>

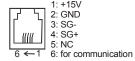
04 Modbus RTU mode. <8.E.1>

05 Modbus RTU mode. <8.O.1>

\Box 1. Computer Control

Chapter 4 Parameters | Variable

Each drive has a built-in RS-485 serial interface, marked (RJ-11 Jack) on the control terminal block, whose pins are defined as shown:



- ★ Either ASCII or RTU Modbus protocols are used for communication. Users can select the desired mode along through parameters Pr.92 and Pr.113.
- ★ Each VFD-M AC drive has a pre-assigned communication address specified by Pr.88. The master controller communicates with each AC drive according to its particular address.
- ★ Code Meaning:

ASCII mode:

Each 8-bit data is the combination of two ASCII characters. For example, a 1-byte data: 64 Hex, shown as '64' in ASCII, consists of '6' (36Hex) and '4' (34Hex).

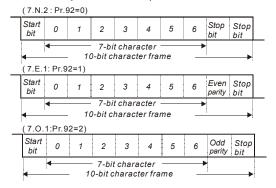
Character	'0'	'1'	'2'	'3'	'4'	' 5'	'6'	'7'
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H
Character	'8'	'9'	'A'	'B'	,C,	'D'	'E'	'F'
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

RTU mode:

Each 8-bit data is the combination of two 4-bit hexadecimal characters. For example, 64 Hex.

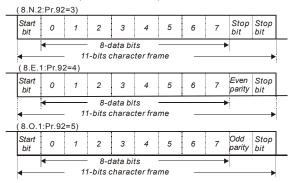
2. Data Format

2.1 10-bit character frame (For 7-bit character):





2.2 11-bit character frame (For 8-bit character):



3. Communication Protocol

3.1 Communication Data Frame:

STX	ADR1	ADR0	CMD1	CMD0	0	1		N-1	Z	ETX	CHK1	CHK0
02H	Add	ress	CMD			ata	char	acters	3	03H	Check	Sum

3.2 ASCII mode:

	1
STX	Start character: (3AH)
ADR 1	
ADR 0	Communication address:
CMD 1	8-bit address consists of 2 ASCII codes
CMD 0	
DATA (n-1)	Contents of data:
	n x 8-bit data consist of 2n ASCII codes.
DATA 0	n≦25 maximum of 50 ASCII codes
LRC CHK 1	LRC check sum:
LRC CHK 0	8-bit check sum consists of 2 ASCII codes
END 1	END characters:
END 0	END 1 = CR (0DH), END 0 = LF (0AH)

Chapter 4 Parameters | Value

RTU mode:

START	A silent interval of more than 10 ms			
ADR	Communication address: 8-bit address			
CMD	Command code: 8-bit command			
DATA (n-1)				
	Contents of data: n×8-bit data, n<=25			
DATA 0				
CRC CHK Low	CRC check sum:			
CRC CHK High	16-bit check sum consists of 2 8-bit characters			
END	A silent interval of more than 10 ms			

3.3 ADR (Communication Address)

Valid communication addresses are in the range of 0 to 254. An address equals to 0 means a broadcast to all AC drives (AMD) in the network. In this case, the AMD will not reply to the master device.

For example, communication to AMD with address 16 decimal:

ASCII mode: (ADR 1, ADR 0)='1','0' => '1'=31H, '0'=30H

RTU mode: (ADR)=10H

3.4 Function (Function code) and DATA (data characters)

The format of data characters depends on the function code. The available function codes are described as follows:

03H: read data from register

06H: write single data to register

10H: write multiple data to registers



Command code: 03H, read N words. The maximum value of N is 12. For example, reading continuous 2 words from starting address 2102H of AMD with address 01H.

ASCII mode:

Command message:

STX	·.'
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'3'
	'2'
Starting data address	'1'
Starting data address	'0'
	'2'
	'0'
Number of data	'0'
(count by word)	'0'
	'2'
LRC CHK 1	'D'
LRC CHK 0	'7'
END 1	CR
END 0	LF

Response message:

STX	'.'
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'3'
Number of data	'0'
(count by byte)	'4'
Content of starting	'1'
data address	'7'
2102H	'7'
	'0'
	'0'
Content of data address	'0'
2103H	·0'
	'0'
LRC CHK 1	'7'
LRC CHK 0	'1'
END 1	CR
END 0	LF

RTU mode:

Command message:

ADR	01H
CMD	03H
Starting data address	21H
	02H
Number of data	00H
(count by word)	02H
CRC CHK Low	6FH
CRC CHK High	F7H

Response message:

ADR	01H
CMD	03H
Number of data (count by byte)	04H
Content of data address 2102H	17H
	70H
Content of data address	00H
2103H	00H
CRC CHK Low	FEH
CRC CHK High	5CH

Command code: 06H, write 1 word

For example, writing 6000(1770H) to address 0100H of AMD with address 01H.

ASCII mode:

Command message:

STX	٠.,٠
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'6'
Data address	'0'
	'1'
	'0'
	'0'
Data content	'1'
	'7'
	'7'
	'0'
LRC CHK 1	'7'
LRC CHK 0	'1'
END 1	CR
END 0	LF

Response message:

Response message.	
STX	·.·
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'6'
Data address	·0'
	'1'
	'0'
	'0'
Data content	'1'
	'7'
	'7'
	'0'
LRC CHK 1	'7'
LRC CHK 0	'1'
END 1	CR
END 0	LF

RTU mode:

Command message:

ADR	01H
CMD	06H
Data address	01H
	00H
Data content	17H
	70H
CRC CHK Low	86H
CRC CHK High	22H

Response message:

	ADR	01H
	CMD	06H
	Data address	01H
	Data address	00H
Ī	Data content	17H
		70H
	CRC CHK Low	86H
	CRC CHK High	22H



Command code: 10H, write multiple data to registers

For example, set the multi-step speed,

Pr.17=50.00 (1388H), Pr.18=40.00 (0FA0H). AC drive address is 01H.

ASCII Mode:

Command message:

•	
STX	'.'
ADR 1 ADR 0	'0'
	'1'
CMD 1	'1'
CMD 0	'0'
Starting data address	'0'
	'0'
	'1'
	'1'
	'0'
Number of data	'0'
(count by word)	'0'
	'2'
Number of data	'0'
(count by byte)	'4'
	'1'
The first data content	'3'
	'8'
	'8'
	'0'
The second data content	'F'
The second data content	'A'
	'0'
LRC Check	'8'
	'E'
END	CR
	LF

Response message:

. tooponee meedage.	
STX	٠.,
ADR 1 ADR 0	'0'
	'1'
CMD 1	'1'
CMD 0	'0'
Starting data address	'0'
	'0'
	'1'
	'1'
Number of data (count by word)	'0'
	'0'
	'0'
	'2'
LRC Check	'D'
	'C'
END	CR
	LF

RTU Mode:

Command message:

oonmana moodage.	
ADR	01H
CMD	10H
Starting data	00H
address	11H
Number of data	00H
(count by word)	02H
Number of data (count by byte)	04H
The first data	13H
content	88H
The second data	0FH
content	A0H
CRC Check Low	B2H
CRC Check High	49H

Response message:

ADR	01H
CMD	10H
Starting data	00H
address	11H
Number of data	00H
(count by word)	02H
CRC Check Low	11H
CRC Check High	CDH

3.5 CHK (check sum)

ASCII mode:

LRC (Longitudinal Redundancy Check) is calculated by summing up, module 256, the values of the bytes from ADR1 to last data character then calculating the hexadecimal representation of the 2's-complement negation of the sum.

For example, reading 1 word from address 0401H of the AC drive with address 01H.

STX	٠.,
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'3'
Starting data address	'0'
	'4'
	'0'
	'1'
	'0'
Number of data	'0'
Number of data	'0'
	'1'
LRC CHK 1	'F'
LRC CHK 0	'6'
END 1	CR
END 0	LF

01H+03H+04H+01H+00H+01H=0AH, the 2's-complement negation of 0AH is <u>F6</u>H.

RTU mode:

ADR	01H
CMD	03H
Starting address	21H
	02H
Number of data	00H
(count by word)	02H
CRC CHK Low	6FH
CRC CHK High	F7H

CRC (Cyclical Redundancy Check) is calculated by the following steps:

- Step 1: Load a 16-bit register (called CRC register) with FFFFH.
- Step 2: Exclusive OR the first 8-bit byte of the command message with the low order byte of the 16bit CRC register, putting the result in the CRC register.
- Step 3: Shift the CRC register one bit to the right with MSB zero filling. Extract and examine the LSB.
- Step 4: If the LSB of CRC register is 0, repeat step 3, else Exclusive or the CRC register with the polynomial value A001H.
- Step 5: Repeat step 3 and 4 until eight shifts have been performed. When this is done, a complete 8-bit byte will have been processed.
- Step 6: Repeat steps 2 to 5 for the next 8-bit byte of the command message.

Continue doing this until all bytes have been processed. The final contents of the CRC register is the CRC value. When transmitting the CRC value in the message, the upper and lower bytes of the CRC value must be swapped, i.e. the lower order byte will be transmitted first.

The following is an example of CRC generation using C language. The function takes two arguments:

Unsigned char* data ← a pointer to the message buffer

Unsigned char length ← the quantity of bytes in the message buffer

The function returns the CRC value as a type of unsigned integer.

Unsigned int crc_chk(unsigned char* data, unsigned char length){

int i;

unsigned int reg crc=0xFFFF;

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```
while(length--){
    reg_crc ^= *data++;
    for(j=0;j<8;j++){
        if(reg_crc & 0x01){ /* LSB(b0)=1 */
            reg_crc=(reg_crc>>1) ^ 0xA001;
        }else{
            reg_crc=reg_crc >>1;
        }
    }
    return reg_crc;
}
```

3.6 Address list:

The contents of available addresses are shown as below:

Content	Address		Functions	
AC drive Parameters	00nnH	00 means parameter group, nn means parameter number, for example, the address of Pr.100 is 0064H. Referencing to chapter 5 for the function of each parameter. When reading parameter by command code 03H, only one parameter can be read at one time.		
		Bit 0-1	00: No function 01: Stop 10: Run 11: Jog + Run	
	2000H	Bit 2-3	Reserved	
Command Read/Write	200011	Bit 4-5	00: No function 01: FWD 10: REV 11: Change direction	
		Bit 6-15	Reserved	
	2001H	Freq. comn	nand	
		Bit 0	1: EF (external fault) on	
	2002H	Bit 1	1: Reset	
		Bit 2-15	Reserved	

		1	Chapter 4 Parameters	
Content	Address		Functions	
Status monitor Read only	2100Н	Error code: 00: No errors occurred 01: Over-current (oc) 03: Overheat (oH) 04: Drive overload (oL) 05: Motor overload1 (oL1) 06: External fault (EF) 07: CPU failure (cF1) 08: CPU or analog circuit failure (cF3) 09: Hardware protection failure (HPF) 10: Current exceeds 2 times rated current during accel (ocA) 11: Current exceeds 2 times rated current during decel (ocd) 12: Current exceeds 2 times rated current during steady state operation (ocn) 13: Ground Fault (GF) 14: Low voltage (Lv) 15: Reserved 16: CPU failure 1 (cF2) 17: Base block 18: Overload (oL2) 19: Auto accel/decel failure (cFA) 20: Software protection enable (codE)		
	2101H	Bit 0-1 Bit 2 Bit 3-4	Status of AC Drive 00: RUN LED light off, STOP LED light up 01: RUN LED blink, STOP LED light up 10: RUN LED light up, STOP LED blink 11: RUN LED light up, STOP LED light off 01: Jog active 00: REV LED light off, FWD LED light up 01: REV LED blink, FWD LED light up 10: REV LED light up, FWD LED blink 11: REV LED light up, FWD LED light off	
		Bit 5-7	Reserved	
		Bit 8	1: Main freq. Controlled by communication	
		Bit 9	1: Main freq. Controlled by external terminal	
		Bit 10	Operation command controlled by communication	
		Bit 11	1: Parameters have been locked	
		Bit 12	0: Stop 1: Run	
		Bit 13	1: Jog command	
		Bit 14-15	Reserved	
	2102H		y command F (XXX.XX)	
	2103H	-	equency H (XXX.XX)	
	2104H		urrent A (XXX.X)	
	2105H	DC-BOS /	Voltage U (XXX.X)	

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Content	Address	Functions
	2106H	Output Voltage E (XXX.X)
	2107H	Step number of Multi-Step Speed Operation (step)
	2108H	Time of PLC Operation (sec)
	2109H	Value of External Trigger (count)
210AH		The Correspondent Value of Power Factor (XXX.X)
210BH		Pr.65 X Low word of H (XXX.XX)
	210CH	Pr.65 X High word of H (XXX.XX)
	210DH	AC Drive Temperature (XXX.X)
	210EH	PID Feedback Signal (XXX.XX)
210FH		PID Target Value (XXX.XX)
	2110H	AC Drive Mode Type Information

3.7 Communication program of PC:

The following is a simple example of how to write a communication program for Modbus ASCII mode on a PC by C language.

#include<stdio h> #include<dos h> #include<conio h> #include<process.h> #define PORT 0x03F8 /* the address of COM1 */ /* the address offset value relative to COM1 */ #define THR 0x0000 #define RDR 0x0000 #define BRDL 0x0000 #define IFR 0x0001 #define BRDH 0x0001 #define LCR 0x0003 #define MCR 0x0004 #define LSR 0x0005 #define MSR 0x0006 unsigned char rdat[60];

/* read 2 data from address 2102H of AC drive with address 1 */

unsigned char tdat[60]={':','0','1','0','3','2','1','0','2', '0','0','2','D','7','\r','\n'};

```
void main(){
               int i;
               outportb(PORT+MCR,0x08);
                                              /* interrupt enable */
               outportb(PORT+IER,0x01);
                                              /* interrupt as data in */
               outportb(PORT+LCR,(inportb(PORT+LCR) | 0x80));
                /* the BRDL/BRDH can be access as LCR.b7==1 */
               outportb(PORT+BRDL,12);
                                              /* set baudrate=9600, 12=115200/9600*/
               outportb(PORT+BRDH,0x00);
                                              /* set protocol, <7,N,2>=06H
               outportb(PORT+LCR,0x06);
              <7,E,1>=1AH, <7,O,1>=0AH
              <8,N,2>=07H, <8,E,1>=1BH
              <8,O,1>=0BH */
               for(i=0;i<=16;i++)
                while(!(inportb(PORT+LSR) & 0x20)); /* wait until THR empty */
                outportb(PORT+THR,tdat[i]); /* send data to THR */
               }
               i=0;
               while(!kbhit()){
                if(inportb(PORT+LSR) & 0x01){ /* b0==1, read data ready */
                 rdat[i++]=inportb(PORT+RDR); /* read data form RDR */
} } }
```

Pr.93	Accel 1 to Accel 2 Frequency Transition	Unit: 0.10 Hz
Pr.94	Decel 1 to Decel 2 Frequency Transition	Unit: 0.10 Hz

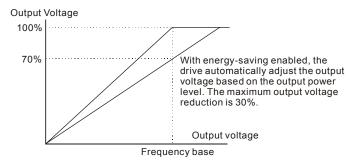
Factory Setting: 0.00

Settings 0.01 to 400.0 Hz 0.00 disable

These functions are used to change acceleration or deceleration depending on attained frequency and not by closing contacts on the external terminals. The priority of this parameter is higher than the time of Accel/Decel 1 and Accel/Decel 2.

Pr.95	Auto energy-saving			
				Factory Setting: 00
	Settings	00	Disable auto energy-saving operation	
		01	Enable auto energy-saving operation	

When this function is enabled, the AC drive operates at full voltage during speed changes. At the constant speed periods, drive calculates the optimal output voltage value for the load and may get it reduced up to 30% below the Maximum Output Voltage.



Pr.96	Count Down Completion	
	Settings 00 to 9999	Factory Setting: 00

This parameter defines the top count value for the VFD-M internal counter. Please also see Pr.45 and Pr.46 (setting 13). Counting is incremented when the Multi-Function Input Terminal M1 or M2, makes a low-to-high transition. Upon completion of the count, either Multi-Function Output Terminal (MO1) or the Multi-Function Relay Contact (RA, RB) will close.



Pr.97 Preset Count Down Completion

Settings 00 to 9999

Factory Setting: 00

Ш This parameter sets a preliminary count value for the internal counter. Counter is incremented by a low-to-high transition on one of the programmed Multi-Function Input Terminals: M1 or M2 (see Pr.44 or Pr.45, setting 14). Count starts at 01. Upon completion the selected Multi-Function Output Terminal will close. Preliminary Count could be used to initiate an external event before the "terminal count" is reached. (See Pr.38, 39, 40, 41, 42, 45, and 46 for further details.)

Pr.98 Total Time Count from Power On (Days)

Settings 00 to 65535 days

Read Only

Pr.99 Total Time Count from Power On (Minutes)

Settings 00 to 1440 minutes

Read Only

Pr.100 Software Version

Read Only

This parameter shows the software version for the AC motor drive.

Pr.101

Auto Acceleration/Deceleration

Factory Setting: 00

Settings 00 Linear acceleration/deceleration

- 01 Auto acceleration, linear deceleration
- 02 Linear acceleration, auto deceleration
- 03 Auto acceleration/deceleration
- 04 Linear Accel/Decel Stall Prevention during Deceleration (Please refer to Accel/Decel time setting at parameter Pr.10-Pr.13)
- \Box When this parameter is set to 03, the AC drive will accel/decel in the fastest and smoothest possible way by automatically adjusting the accel /decel time.
- Ш This parameter provides five modes to choose:
 - 00 Linear acceleration and deceleration (operation by Pr.10, Pr.11, or Pr.12, Pr.13 acceleration/deceleration time)
 - 01 Automatic acceleration, linear deceleration (Operation by automatic acceleration, Pr.11 or Pr.13 deceleration time).

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- 02 Linear acceleration and automatic deceleration (Operation by automatic deceleration time, Pr.10 or Pr.12 acceleration time).
- O3 Automatic acceleration, deceleration (Operation by AC drive auto adjustable control)
- 04 If this parameter is set to 04, Accel/Decel time will be equal to or more than parameter Pr.10 ~Pr.13.
- This parameter should not be used when a brake unit is installed.

Pr.102 Auto Voltage Regulation (AVR)

Factory Setting: 00

- Settings 00 AVR function enabled
 - 01 AVR function disabled
 - 02 AVR function disabled when stop
 - 03 AVR function disabled for deceleration
- AVR function automatically regulates the AC drive output voltage to the Maximum Output Voltage (Pr.03). For instance, if Pr.03 is set at 200 VAC and the input voltage varies from 200V to 264VAC, then the Maximum Output Voltage will automatically be regulated to 200VAC.
- When the AVR function is disabled, the Maximum Output Voltage follows the variations of the input voltage (180V to 264VAC).
- Selecting program value 2 enables the AVR function and also disables the AVR function during deceleration. This offers a quicker deceleration.

Pr.103 Auto Tune Motor parameters

Factory Setting: 00

- Settings 00 Disable
 - 01 Auto tune for R1
 - 02 Auto tune for R1 + No Load testing
- For Auto Tune, set Pr.103 to 01 or 02 and press the RUN key. When it is set to 02, motor should have no load.

Pr.104

R1 Value

Settings 00 to $65535m\Omega$

Factory Setting: 00

As an option to Auto Tune, this parameter inputs the motor resistance.

Pr.105 Control Mode

Factory Setting: 00

V/F Control Settings 00

> 01 Sensor-less Control

Pr.106 Unit: 0.01Hz Rated Slip Settings 0.00 to 10.00 Hz Factory Setting: 3.0

 \Box Example of Slip calculation: The rated speed of 4 poles/3 of 60Hz/ 220V on the nameplate is 1710RPM. The rated slip is then: 60-(1710/(120/P))=3Hz. (being P the number of poles)

Unit: 2ms Pr.107 Vector Voltage Filter Settings 5 to 9999 Factory Setting: 10 Pr.108 Unit: 2ms Vector Slip Compensation Filter Settings 25 to 9999 Factory Setting: 50

- Ш This parameter sets the low-pass filter in vector control.
- Ш Example: Pr. 107 = 10 X 2ms = 20ms, Pr. 108 = 50 X 2 ms = 100ms.

Pr.109 Selection for Zero Speed Control

Factory Setting: 00

Settings 00 No output

Control by DC voltage

This parameter is used to select the control method at zero speed. If set to 01, the voltage in Pr.110 is used for holding torque.

Pr.110 Voltage of Zero Speed Control Unit: 0.1% Settings 0.0 to 20.0 % of Max. output voltage (Pr.05) Factory Setting: 5.0

- \Box This parameter should be used in conjunction with Pr.109.
- Example: if Pr.05 = 100 and this parameter is set to 20.0, the level of output voltage is 100X20.0% = 20.

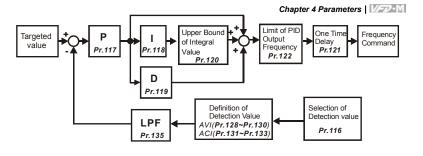
Pr.111	Deceleration S Curve	
	Settings 00 to 07	Factory Setting: 00

When this parameter is set differently to zero, it selects a deceleration S-curve and overrides Pr.14. Otherwise, Pr.14 sets the deceleration S-curve.

Chapter 4 Parameters | Value

Note: From the diagram shown below, the original setting accel/decel time will be for reference when the function of the S-curve is enabled. The actual accel/decel time will be determined based on the S-curve selected (1 to 7).

Pr.112 Ext	ternal	Terr	ninal Scanning Time	Unit: 2msec
Sett	tings	01 t	20	Factory Setting: 01
This fu	This function screens the signal on I/O terminals for CPU malfunctions due to external			
transie	nts. A	A set	ing of 02, makes the scanning time to be 2 x 2 = 4 ms	ec.
☐ Set Pr.	.77 to	02 b	efore changing settings in Pr.112.	
Pr.113 Res	start N	Meth	od after Fault (oc, ov, BB)	
				Factory Setting: 01
Sett	tings	00	None speed search	
		01	Continue operation after fault speed search from spe	ed reference
		02	Continue operation after fault speed search from Min	imum speed
This pa	arame	ter is	used to select the restart method after certain faults.	
Pr. 114 Co	oling	Fan	Control	
				Factory Setting: 02
Sett	tings	00	Fan Off when the drive stop after 1 Min	
		01	AC Drive Runs and Fan On, AC Drive Stops and Far	n Off
		02	Always Run	
		03	Reserved	
Pr. 115 PIE) Set	Poin	Selection	
				Factory Setting: 00
Sett	tings	00	Disable	
		01	Keypad (based on Pr.00 setting)	
		02	AVI (external 0-10V)	
		03	ACI (external 4-20mA)	
		04	PID set point (Pr.125)	



Pr. 116 PID Feedback Terminal Selection

Factory Setting: 00

- Settings 00 Input positive PID feedback, PV from AVI (0 to 10V)
 - 01 Input negative PID feedback, PV from AVI (0 to 10V)
 - 02 Input positive PID feedback, PV from ACI (4 to 20mA)
 - 03 Input negative PID feedback, PV from ACI (4 to 20mA)
- Select an input terminal to be the PID feedback. Please verify the PID feedback position is different from the Frequency Set Point position.
- Negative feedback = positive targeted value detective value. Positive feedback = negative targeted value + detective value.

Pr. 117 Proportional Gain (P)

Settings 0.0 to 10.0

Factory Setting: 1.0

- This parameter determines the feedback loop Gain. If the gain is large, the response will be strong and immediate (If the gain is too large, vibration may occur). If the gain is small, the response will be weak and slow.
- When I=0.0 and D=0.0, it is only used for proportional control.

Pr. 118 Integral Time (I)

Unit: 0.01sec

Factory Setting: 1.00

Settings 0.01 to 100.00 sec

0.00 disable

This parameter determines the speed of response for the PID feedback loop. If the integral time is long, the response will be slow. If the integral time is short, the response will be quick.

Be careful not to set (I) too small, since a rapid response may cause oscillation in the PID loop.

Pr. 11	Differential Time (D)	Unit: 0.01sec
	Settings 0.00 to 1.00 sec	Factory Setting: 0.00

This parameter determines the damping effect for the PID feedback loop. If the differential time is long, any oscillation will quickly subside. If the differential time is short, the oscillation will subside slowly.

Pr. 120 Integration's Upper Bound Frequency Settings 00 to 100 % Factory Setting: 100 %

This parameter determines the integration's upper frequency limit while operating in the PID feedback loop. (Limit = Pr.03xPr.120). During a fast Integration response, it is possible for the frequency to surpass a reasonable point. This parameter will help limit this frequency spike.

Pr. 121 One-Time Delay Unit: 0.1sec

Factory Setting: 0.0

Settings 0.0 to 2.5 sec 0.0 disable

- PI Control: When controlled by P action only, deviations cannot be eliminated entirely. To eliminate residual deviations, the P + I control is generally utilized. If PI is used, it could eliminate the deviation caused by set-point changes and external interferences. However, if the I-action is excessively powerful, it will delay the response to the variation. The P-action could solely be used on a loading system that possesses integral components.
- PD Control: when a deviation occurs, the system immediately generates some operational load that is greater than the single load generated by the D-action in order to restrain the increment of the deviation. If the deviation is small, the effectiveness of the P-action decreases as well. In some cases, control systems include integral component loads, which are controlled by the P action only, and sometimes, if the integral component is functioning, the whole system will be vibrating. In such cases, a PD control could be used to lower the P-action's vibration and to stabilize the system. In other words, this control is good for use if the loads have no braking functions over the process.
- PID Control: Uses the I-action to eliminate the deviation and the D-action to restrain the vibration, and combine with the P action to construct the PID control. The PID control method normally determines a control process with no deviations, high accuracy and very stable.



Pr. 122 PID Frequency Output Command limit

Settings 00 to 110 %

Factory Setting: 100

Ш This parameter sets a limit of the PID Command frequency. If this parameter is set to 20%, then the maximum output frequency for the PID operation will be (20% x Pr.03).

Pr. 123 Feedback Signal Detection Time

Unit: 0.1sec

Factory Setting: 60.0

Settings 0.1 to 3600 sec

0.0 disable

This parameter defines the detection time for the loss of a feedback analog signal. The drive will follow the operating procedure programmed in Pr.124 if the feedback signal is lost for more than the time set in Pr 123

Pr. 124 Feedback Signal Fault Treatment

Factory Setting: 00

Settings 00 Warning and RAMP to stop

Warning and keep operating

Ш This parameter selects the operation of the drive upon a loss of the PID feedback signal.

Pr. 125 Source of PID Set point

Settings 0.00 to 400.0Hz

Factory Setting: 0.00

This parameter is used in conjunction with Pr.115 (04) to input a set point in Hz.

Pr. 126 PID Offset Level

Settings 1.0 to 50.0 %

Factory Setting: 10.0

This parameter is used to set the offset between set point and feedback.

Pr. 127 Detection Time of PID Offset

Settings 0.1 to 300.0 sec

Factory Setting: 5.0

This parameter is used to set the detection time of PID offset.

Pr. 128 Minimum Reference Value

Unit: 0.1V

Settings 0.0 to 10.0 V Factory Setting: 0.0

 \Box This parameter is used to set the AVI input voltage that corresponds to minimum frequency.

Settings 00 to 9999

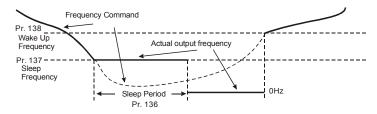
Factory Setting: 5



Ш These two parameters are used to set the analog input delay filter in set point or feedback signal.

Pr. 136 Sleep Period	Unit: 0.1sec
Settings 0.0 to 6550.0 sec	Factory Setting: 0.0
Pr. 137 Sleep Frequency	Unit: 0.10Hz
Settings 0.00 to 400.0 Hz	Factory Setting: 0.0
Pr. 138 Wake Up Frequency	Unit: 0.10Hz
Settings 0.00 to 400.0 Hz	Factory Setting: 0.0

 \Box These parameters determine the sleep functions of the AC drive. If the command frequency falls below the sleep frequency, for the specified time in Pr.136, then drive output is turned off until the command frequency rises above Pr.138. Please see the below diagram.



Pr. 139 Treatment for Counter Attained

Factory Setting: 00

Settings 00 Continue Operation

> 01 Stop Immediately and display E.F.

 \Box This parameter sets the procedure for the AC drive to follow once the internal counter attains the setting value in Pr.96.

Pr. 140 External Up/Down Selection

Factory Setting: 00

Settings 00 Fixed Mode (keypad)

> 01 By Accel or Decel Time

02 Reserved

 \square This parameter is used to change the Master Frequency externally with the Multifuction Input Terminals. If any two parameters in the group Pr.39-Pr.42 are set to 14 and 15, and Pr.140 is set to 01, the up/down frequency operation is initiated as the contact closes and according to the time of acceleration/deceleration.

Ш	This parameter sets the level for the dynamic braking to operate. The setting value must be
	higher than the steady-state DC BUS Voltage to prevent the braking transistor from having a
	100%-duty. At 100% duty the transistor and resistor will most likely fail.

Pr. 144	Accumulative Motor Operation Day	
	Settings 00-65535 Days	Read Only
Pr. 145	Accumulative Motor Operation Time (Min.)	
	Settings 00-1440 Minutes	Read Only

 \square These parameters display accumulative time of motor operation. They will not reset to zero due to parameter reset to factory and will not re-calculate if the 65535 days limit is exceeded.

Pr. 146 Line Start L	_ockout	
		Factory Setting: 00
Settings 00	Disable	
0.	1 Enable	



Factory Setting: 00

Ш When Line Start Lockout is disabled (also known as Auto-Start), the drive will start when powered-up with run commands applied. To start in Line Start Lockout mode, the AC drive must see the run command go from stop to run after power up. When enabled, the AC drive will not start when powered up if run commands were applied.

Settings 00 One Decimal

> 01 Two Decimals

 \Box It sets the number of decimals in the accel/decel time. It can be used for Acceleration / Deceleration Time 1, Acceleration / Deceleration Time 2 and JOG Acceleration / Deceleration Time.

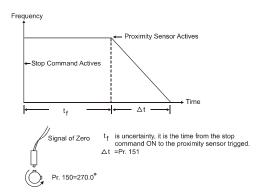
Pr. 148 Number of Motor Poles	
Settings 02 to 20	Factory Setting: 04
Pr. 149 Gear Ratio for Simple Index Function	
Settings 4 to 1000	Factory Setting: 200
Pr. 150 Index Angle for Simple Index Function	
Settings 00.0 to 360.0	Factory Setting: 180.0
Pr. 151 Deceleration Time for Simple Index Function	
	Factory Setting: 0.00

Settings 0.00 to 100.00 sec

0.00 Disable

 \Box This parameter should be used with Pr. 39-Pr.42 (setting 31).

Example:



Pr. 152 Skip Frequency Width

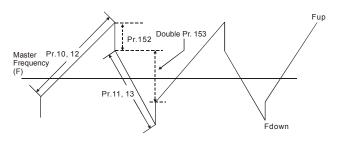
Settings 0.00 to 400.00Hz

Factory Setting: 0.00

Pr. 153 Bias Frequency Width

0.00 to 400.00Hz Factory Setting: 0.00 Settings

- M Frequency of Δ top point Fup= master frequency F + Pr.152 + Pr.153.
- Frequency of ∆ down point Fdown= master frequency F Pr.152 Pr.153.



Pr. 154 Reserved

Pr.155 Compensation Coefficient for Motor Instability

Factory Setting: 0.0

Settings 0.1 to 5.0 (recommended setting 2.0)

0.0 Disable

 \Box This parameter is used to improve a condition of unstable current in any specific area. For higher frequencies, you can adjust this parameter to 0.0, and increase the setting value in Pr.155 for 30HP and above (a setting of 2.0 is recommended).

Pr.156

Settings 0 to 200 (x500µs)

Factory Setting: 0

 \square This parameter is used to set communication response delay time. If you set Pr. 156 to 1 the communication response delay time will be 1 X 500µs=500µs, set Pr. 156 to 2 the communication response delay time will be 2 X 500µs=1000µs.

Pr.157 Communication Mode Selection

Factory Setting: 1

Settings 0 Delta ASCII

> MODBUS 1

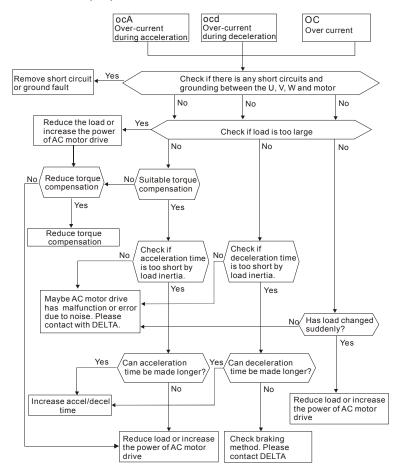


This parameter is to select the communication mode, 0 is the existed Delta ASCII communication mode, whereas 1 is to select MODBUS mode.

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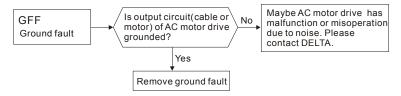
Chapter 5 Troubleshooting

5.1 Over Current (OC)

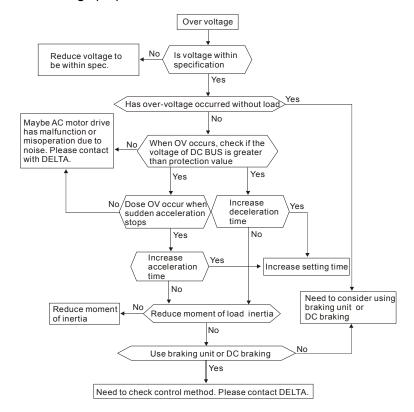




5.2 Ground Fault

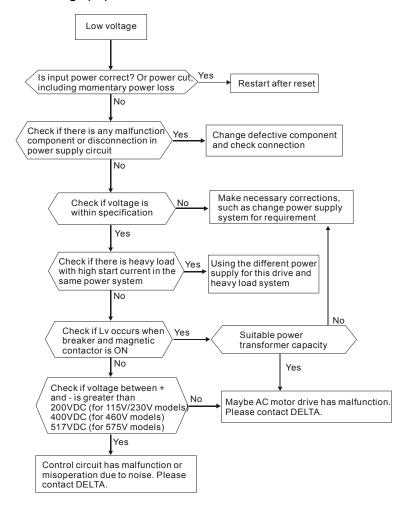


5.3 Over Voltage (OV)



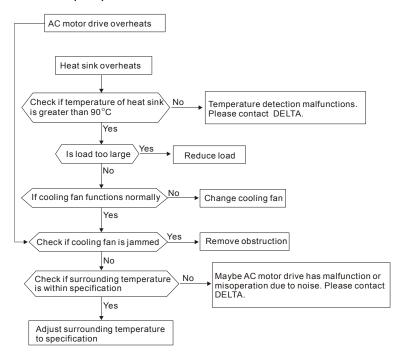


5.4 Low Voltage (Lv)

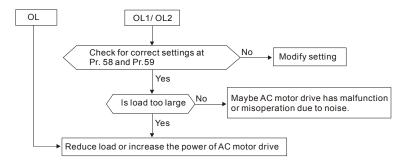




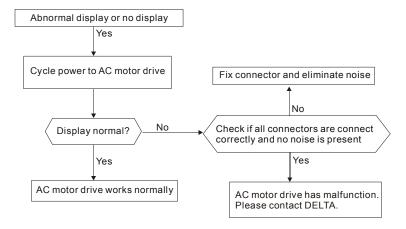
5.5 Over Heat (OH1)



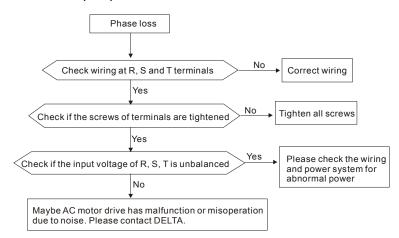
5.6 Overload



5.7 Keypad Display is Abnormal

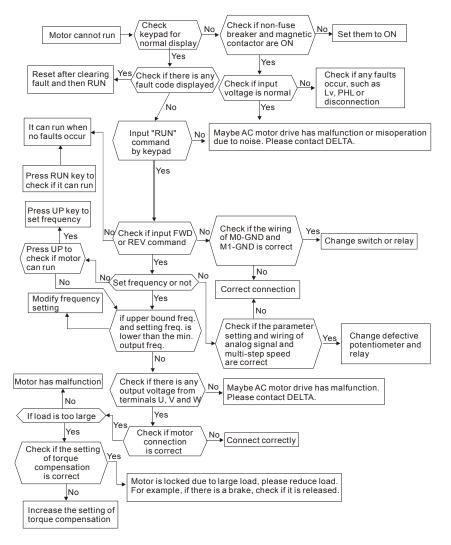


5.8 Phase Loss (PHL)



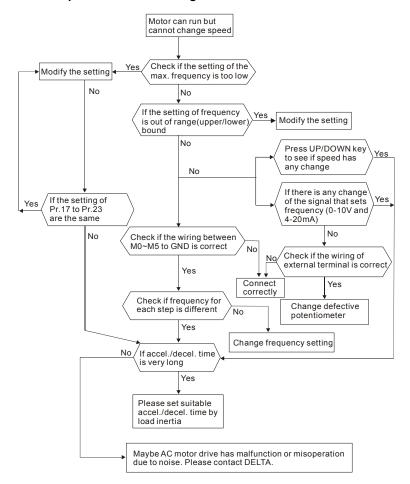


5.9 Motor cannot Run



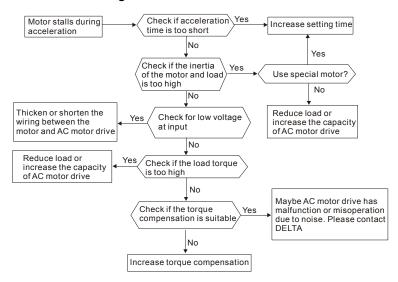


5.10 Motor Speed cannot be Changed

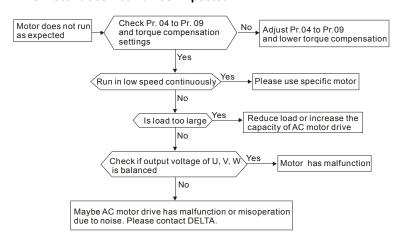




5.11 Motor Stalls during Acceleration



5.12 The Motor does not Run as Expected





5.13 Electromagnetic/Induction Noise

Many sources of noise surround AC motor drives and penetrate it by radiation or conduction. It may cause malfunctioning of the control circuits and even damage the AC motor drive. Of course, there are solutions to increase the noise tolerance of an AC motor drive. But this has its limits. Therefore, solving it from the outside as follows will be the best.

- Add surge suppressor on the relays and contacts to suppress switching surges.
- 2 Shorten the wiring length of the control circuit or serial communication and keep them separated from the power circuit wiring.
- 3 Comply with the wiring regulations by using shielded wires and isolation amplifiers for long length.
- 4 The grounding terminal should comply with the local regulations and be grounded independently, i.e. not to have common ground with electric welding machines and other power equipment.
- 5 Connect a noise filter at the mains input terminal of the AC motor drive to filter noise from the power circuit. VFD-M can have a filter as option.

In short, solutions for electromagnetic noise exist of "no product" (disconnect disturbing equipment), "no spread"(limit emission for disturbing equipment) and "no receive" (enhance immunity).

5.14 Environmental Condition

Since the AC motor drive is an electronic device, you should comply with the environmental conditions. Here are some remedial measures if necessary.

- 1 To prevent vibration, the use of anti-vibration dampers is the last choice. Vibrations must be within the specification. Vibration causes mechanical stress and it should not occur frequently, continuously or repeatedly to prevent damage to the AC motor drive.
- 2 Store the AC motor drive in a clean and dry location, free from corrosive fumes/dust to prevent corrosion and poor contacts. Poor insulation in a humid location can cause shortcircuits. If necessary, install the AC motor drive in a dust-proof and painted enclosure and in particular situations, use a completely sealed enclosure.
- 3 The ambient temperature should be within the specification. Too high or too low temperature will affect the lifetime and reliability. For semiconductor components, damage will occur once any specification is out of range. Therefore, it is necessary to periodically check air quality and the cooling fan and provide extra cooling of necessary. In addition, the microcomputer may not work in extremely low temperatures, making cabinet heating necessary.

Chapter 5 Troubleshooting | Warranti

Store within a relative humidity range of 0% to 90% and non-condensing environment.
 Use an air conditioner and/or exsiccator.

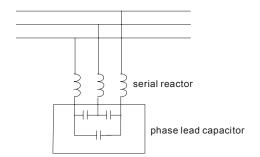
5.15 Affecting Other Machines

An AC motor drive may affect the operation of other machines due to many reasons. Some solutions are:

■ High Harmonics at Power Side

High harmonics at power side during running can be improved by:

- 1. Separate the power system: use a transformer for AC motor drive.
- 2. Use a reactor at the power input terminal of the AC motor drive.
- If phase lead capacitors are used (never on the AC motor drive output!!), use serial reactors to prevent damage to the capacitors damage from high harmonics.



Motor Temperature Rises

When the motor is a standard induction motor with fan, the cooling will be bad at low speeds, causing the motor to overheat. Besides, high harmonics at the output increases copper and core losses. The following measures should be used depending on load and operation range.

- Use a motor with independent ventilation (forced external cooling) or increase the motor rated power.
- 2. Use a special inverter duty motor.
- 3. Do NOT run at low speeds for long time.

Chapter 6 Fault Code Information and Maintenance

6.1 Fault Code Information

The AC motor drive has a comprehensive fault diagnostic system that includes several different alarms and fault messages. Once a fault is detected, the corresponding protective functions will be activated. The following faults are displayed as shown on the AC motor drive digital keypad display. The three most recent faults can be read from the digital keypad by viewing Pr.73 to Pr.75.



Wait 5 seconds after a fault has been cleared before performing reset via keypad or input terminal.

6.1.1 Common Problems and Solutions

Fault Name	Fault Descriptions	Corrective Actions
		Check whether the motors horsepower corresponds to the AC drive output power.
		Check the wiring connections between the AC drive and motor for possible short circuits.
oc	The AC drive detects an abnormal increase in current.	3. Increase the Acceleration time (Pr.10, Pr.12).
		Check for possible excessive loading conditions at the motor.
		If there are any abnormal conditions when operating the AC drive after short-circuit being removed, it should be sent back to manufacturer.
		Check whether the input voltage falls within the rated AC drive input voltage.
		2. Check for possible voltage transients.
00	The AC drive detects that the DC bus voltage has exceeded its maximum allowable value.	Bus over-voltage may also be caused by motor regeneration. Either increase the decel time or add an optional brake resistor.
		Check whether the required braking power is within the specified limits.

Fault Name	Fault Descriptions	Corrective Actions
οН	The AC drive temperature sensor detects excessive heat.	Ensure that the ambient temperature falls within the specified temperature range. Make sure that the ventilation holes are not obstructed. Remove any foreign objects on the heat sinks and check for possible dirty heat sink fins. Provide enough spacing for adequate ventilation.
Lu	The AC drive detects that the DC bus voltage has fallen below its minimum value.	Check whether the input voltage falls within the rated AC drive's input voltage.
οĹ	The AC drive detects excessive drive output current. Note: The AC drive can withstand up to 150% of the rated current for a maximum of 60 seconds.	Check whether the motor is overloaded. Reduce torque compensation setting as set in Pr.54. Increase the AC drive's output capacity.
oL I	Internal electronic overload trip	 Check for possible motor overload. Check electronic thermal overload setting. Increase motor capacity. Reduce the current level so that the drive output current does not exceed the value set by the Motor Rated Current Pr.52.
015	Motor overload. Check the parameter settings (Pr.60 to Pr.62)	Reduce the motor load. Adjust the over-torque detection setting to an appropriate setting.
ocA	Over-current during acceleration: 1. Short-circuit at motor output. 2. Torque boost too high. 3. Acceleration time too short. 4. AC drive output capacity is too small.	Check for possible poor insulation at the output line. Decrease the torque boost setting in Pr.54. Increase the acceleration time. Replace with the AC drive with one that has a higher output capacity (next HP size).
ocd	Over-current during deceleration: 1. Short-circuit at motor output. 2. Deceleration time too short. 3. AC drive output capacity is too small.	Check for possible poor insulation at the output line. Increase the deceleration time. Replace with the AC drive with one that has a higher output capacity (next HP size).

	Chapter 6	Fault Code Information and Maintenance 1
Fault Name	Fault Descriptions	Corrective Actions
ocn	Over-current during steady state operation: 1. Short-circuit at motor output. 2. Sudden increase in motor loading. 3. AC drive output capacity is too small.	Check for possible poor insulation at the output line. Check for possible motor stall. Replace with the AC drive with one that has a higher output capacity (next HP size).
cF4	Internal memory IC can not be programmed.	Switch off power supply. Check whether the input voltage falls within the rated AC drive input voltage. Switch the AC drive back on.
cF2	Internal memory IC can not be read.	Check the connections between the main control board and the power board. Reset drive to factory defaults.
EF	The external terminal EF-GND goes from OFF to ON.	When external terminal EF-GND is closed, the output will be turned off (under N.O. E.F.).
cFR	Auto accel/decel failure	Don't use the function of auto acceleration/ deceleration.
GFF	Ground fault: The AC drive output is abnormal. When the output terminal is grounded (short circuit current is 50% more than the AC drive rated current), the AC drive power module may be damaged. The short circuit protection is provided for AC drive protection, not user protection.	Ground fault : 1. Check whether the IGBT power module is damaged. 2. Check for possible poor insulation at the output line.
cE !	Communication Error Please refer to Pr.92.	Check the connection between the AC drive and computer for loose wires. Check if the communication protocol is properly set.
66	External Base Block. AC drive output is turned off.	When the external input terminal (base-block) is active, the AC drive output will be turned off. Disable this connection and the AC drive will begin to work again.

Fault Name	Fault Descriptions	Corrective Actions
HPF	OC hardware error	
HPF.	CC (current clamp)	
HPF	OV hardware error	Return to the factory.
HPF	GFF hardware error	
cF3	OV or LV	
cF3.	Current sensor error	
cF.3	U-phase error	Return to the factory.
c.F3	W-phase error	
PHL	Phase Loss	Check input phase wiring for loose contacts.
codE	Software protection failure	Return to the factory.
595	PID feedback signal error	Check parameter settings (Pr.116) and AVI/ACI wiring. Check for possible fault between system response time and the PID feedback signal detection time (Pr.123)



6.1.2 Reset

There are three methods to reset the AC motor drive after solving the fault:

- Press key on keypad.
- 2 Set external terminal to "RESET" (set one of Pr.39~Pr.42 to 05) and then set to be ON.
- 3 Send "RESET" command by communication.



Make sure that RUN command or signal is OFF before executing RESET to prevent damage or personal injury due to immediate operation.

6.2 Maintenance and Inspections

Modern AC motor drives are based on solid-state electronics technology. Preventive maintenance is required to keep the AC motor drive in its optimal condition, and to ensure a long life. It is recommended to have a qualified technician perform a check-up of the AC motor drive regularly.

Daily Inspection:

Basic check-up items to detect if there were any abnormalities during operation are:

- 1. Whether the motors are operating as expected.
- 2 Whether the installation environment is abnormal.
- 3. Whether the cooling system is operating as expected.
- 4. Whether any irregular vibration or sound occurred during operation.
- 5 Whether the motors are overheating during operation.
- 6 Always check the input voltage of the AC drive with a Voltmeter.

Periodic Inspection:

Before the check-up, always turn off the AC input power and remove the cover. Wait at least 10 minutes after all display lamps have gone out, and then confirm that the capacitors have fully discharged. It should be less than 25VDC.





- 1. Disconnect AC power before processing!
- 2. Only qualified personnel can install, wire and maintain AC motor drives. Please take off any metal objects, such as watches and rings, before operation. And only insulated tools are allowed.
- Never reassemble internal components or wiring. 3.
- 4. Prevent static electricity.

Periodical Maintenance

Ambient environment

Check Items	Methods and Criterion	Maintena Period		
CHECK REITS	Methous and Officeron	Daily	One Year	
Check the ambient temperature, humidity, vibration and see if there are any dust, gas, oil or water drops	Visual inspection and measurement with equipment with standard specification	0		
Check if there are any dangerous objects in the environment	Visual inspection	0		

Voltage

Object Nove		Maintena Perio		
Check Items	Methods and Criterion	Daily	Half Year	One Year
Check if the voltage of main circuit and control circuit is correct	Measure with multimeter with standard specification	0		



Keypad

Charle Harris	Mathada and Oritarian	Maintena Perio		
Check Items	Methods and Criterion	Daily	One Year	
Is the display clear for reading?	Visual inspection	0		
Any missing characters?	Visual inspection	0		

Mechanical parts

Check Items	Methods and Criterion	Mai	nce	
Check items	methods and Criterion	Daily	One Year	
If there is any abnormal sound or vibration	Visual and aural inspection		0	
If there are any loose screws	Tighten the screws		0	
If any part is deformed or damaged	Visual inspection		0	
If there is any color change by overheating	Visual inspection		0	
If there is any dust or dirt	Visual inspection		0	

Main circuit

Check Items	Methods and Criterion	Maintenan Period		
Check items	Methods and Chterion	Daily	Half Year	One Year
If there are any loose or missing screws	Tighten or replace the screw	0		
If machine or insulator is deformed, cracked, damaged or with changed color change due to overheating or ageing	Visual inspection NOTE: Please ignore the color change of copper plate		0	
If there is any dust or dirt	Visual inspection		0	



Terminals and wiring of main circuit

Check Items	Methods and Criterion	Maintenar Period		
	Methods and Chterion	Daily		One Year
If the wiring shows change of color change or deformation due to overheat	Visual inspection		0	
If the insulation of wiring is damaged or the color has changed	Visual inspection		0	
If there is any damage	Visual inspection		0	

DC capacity of main circuit

Check Items	Methods and Criterion		intenar Period		
Check items	methods and Criterion	Daily	Half Year	One Year	
If there is any leakage of liquid, change of color, cracks or deformation	Visual inspection	0			
Measure static capacity when required	Static capacity ≥ initial value X 0.85		0		

Resistor of main circuit

Check Items	Mash ada and Criterian	Maintena Period			
Check items	Methods and Criterion	Daily	Half Year	One Year	
If there is any peculiar smell or insulator cracks due to overheating	Visual inspection, smell		0		
If there is any disconnection	Visual inspection or measure with multimeter after removing wiring between B1 ~ B2		0		
	Resistor value should be within \pm 10%				



Transformer and reactor of main circuit

Check Items	Mathada and Criterian	Mai		
	Methods and Criterion	Daily	One Year	
If there is any abnormal vibration or peculiar smell	Visual, aural inspection and smell	0		

Magnetic contactor and relay of main circuit

Check Items		Maintenar Period Daily Half Year		
	Methods and Criterion			One Year
If there are any loose screws	Visual and aural inspection. Tighten screw if necessary.	0		
If the contact works correctly	Visual inspection	0		

Printed circuit board and connector of main circuit

Chack Itama		Mai	nce	
Check Items	Methods and Criterion	Daily	Half Year	One Year
If there are any loose screws and connectors	Tighten the screws and press the connectors firmly in place.		0	
If there is any peculiar smell and color change	Visual inspection and smell		0	
If there is any crack, damage, deformation or corrosion	Visual inspection		0	
If there is any leaked liquid or deformation in capacitors	Visual inspection		0	



Cooling fan of cooling system

Check Items	M. W. J. J. J. O. W. J. J.	Maintenar Period		
	Methods and Criterion	Daily	Half Year	One Year
If there is any abnormal sound or vibration	Visual, aural inspection and turn the fan with hand (turn off the power before operation) to see if it rotates smoothly			0
If there is any loose screw	Tighten the screw			0
If there is any change of color due to overheating	Change fan			0

Ventilation channel of cooling system

Object to the	M. W. J. J. J. O. W. J. J.	-	intenar Period	
Check Items	Methods and Criterion	Daily	Half Year	One Year
If there is any obstruction in the heat sink, air intake or air outlet	Visual inspection		0	

Appendix A Specifications

There are 115V, 230V, 460V and 575V models in the VFD-M series. For 115V models, it is 1-phase models. For 0.5 to 3HP of the 230V models, there are 1-phase/3-phase models. Refer to following specifications for details.

	Voltage Class	115V Class					
Model Number VFD-XXXM		002 004		007			
Max	. Applicable Motor Output (kW)	0.2	0.4	0.75			
Max	. Applicable Motor Output (hp)	0.25	0.5	1.0			
ng	Rated Output Capacity (kVA)	0.6	1.0	1.6			
Rating	Rated Output Current (A)	1.6	2.5	4.2			
#	Maximum Output Voltage (V)	3-Phase pro	portion to twice the i	nput voltage			
Output	Output Frequency (Hz)		0.1~400 Hz				
õ	Carrier Frequency (kHz)	1-15					
g	Rated Input Current (A)	Single phase					
Rating	Rated Input Current (A)	6	9	16			
മ്	Rated Voltage, Frequency	Single phase, 100-120 VAC, 50/60Hz					
Input	Voltage Tolerance	± 10% (90-132VAC)					
Frequency Tolerance		± 5% (47~63Hz)					
Coo	ling Method		Fan Cooled				
Weight (kg)		1.5	1.5	1.5			

	Voltage Class			230V	Class				
	Model Number VFD-XXXM	004	007	015	022	037	055		
Max	. Applicable Motor Output (kW)	0.4	0.75	1.5	2.2	3.7	5.5		
Max	. Applicable Motor Output (hp)	0.5	1.0	2.0	3.0	5.0	7.5		
ng	Rated Output Capacity (kVA)	1.0	1.9	2.7	3.8	6.5	9.5		
a E	Rated Output Current (A)	2.5	5.0	7.0	10	17	25		
± ₩	Maximum Output Voltage (V)		3-Phase	proportion	nal to inpu	t voltage			
Output Rating	Output Frequency (Hz)			0.1~4	00 Hz				
_ರ	Carrier Frequency (kHz)	1-15							
			hase	3-phase					
	Rated Input Current (A)	6.3/2.9	11.5/7.6	15.7/8.8	27/12.5	19.6	28		
nput Rating	Input Current for 1-phase Models when Using 3-phase Power	3.2	6.3	9.0	12.5				
Input	Rated Voltage, Frequency		Single/3-phase 3-phase 200-240 VAC, 50/60Hz 50/60Hz						
	Voltage Tolerance		± 10% (180~264 VAC)						
	Frequency Tolerance	± 5% (47~63 Hz)							
Coo	ling Method	Fan Cooled							
Wei	ght (kg)	2.2/1.5	2.2/1.5	2.2/1.5	3.2/2.2	3.2	3.2		



	Voltage Class	460V Class							
	Model Number VFD-XXXM	007	015	022	037	055	075		
Max	. Applicable Motor Output (kW)	0.75	1.5	2.2	3.7	5.5	7.5		
	. Applicable Motor Output (hp)	1.0	2.0	3.0	5.0	7.5	10		
Rating	Rated Output Capacity (kVA)	2.3	3.1	3.8	6.2	9.9	13.7		
Şati	Rated Output Current (A)	3.0	4.0	5.0	8.2	13	18		
#	Maximum Output Voltage (V)		3-phase	Proportion	nal to Input	Voltage	<u>.</u>		
Output	Output Frequency (Hz)			0.1~4	00 Hz				
õ	Carrier Frequency (kHz)	1-15							
	Rated Input Current (A)	3-phase							
Rating	Rated Input Current (A)	4.2	5.7	6.0	8.5	14	23		
20	Rated Voltage, Frequency	3-phase 380-480 VAC, 50/60Hz							
Input	Voltage Tolerance	± 10% (342~528 VAC)							
		± 5% (47~63 Hz)							
Coo	ling Method	Fan Cooled							
Wei	ght (kg)	1.5	1.5	2.0	3.2	3.2	3.3		

	Voltage Class	575V Class						
	Model Number VFD-XXXM	007	015	022	037	055	075	
Max.	Applicable Motor Output (kW)	0.75	1.5	2.2	3.7	5.5	7.5	
	Applicable Motor Output (hp)	1.0	2.0	3.0	5.0	7.5	10	
ng	Rated Output Capacity (kVA)	1.7	3.0	4.2	6.6	9.9	12.2	
Rating	Rated Output Current (A)	1.7	3.0	4.2	6.6	9.9	12.2	
Ħ.	Maximum Output Voltage (V)		3-phase	Proportion	nal to Input	Voltage		
Output	Output Frequency (Hz)			0.1~4	00 Hz			
õ	Carrier Frequency (kHz)	1-10						
	Rated Input Current (A)			3-ph	ase			
Rating	Rated input Current (A)	2.4	4.2	5.9	7.0	10.5	12.9	
ř	Rated Voltage, Frequency	3-phase 500-600 VAC, 50/60Hz						
Input	Voltage Tolerance	-15% ~ +10% (425~660 V)						
Frequency Tolerance		± 5% (47~63 Hz)						
Cooli	ing Method			Fan C	ooled			
Weig	ht (kg)	1.5	1.5	2.0	3.2	3.2	3.3	

_		General Specifications			
	Control System SPWM (Sinusoidal Pulse Width Modulation) control (V/F of sensorless vector control)				
	Freq. Setting Resolution	0.1Hz			
	Output Frequency Resolution	0.1Hz			
cteristics	Torque Characteristics	Including the auto-torque, auto-slip compensation; starting torque can be 150% at 5.0Hz			
cte	Overload Endurance 150% of rated current for 1 minute				
ara	Skip Frequency	Three zones, settings range 0.1-400Hz			
Ë	Accel/Decel Time	0.1 to 600 seconds (4 Independent settings for Accel/Decel Time)			
ontrol (Stall Prevention Level Frequency Setting	20 to 200%, Setting of Rated Current			
Ö	DC Injection Braking	Operation frequency 0-60Hz, output 0-100% rated current Start time 0-5 seconds, stop time 0-25 seconds			
	Braking Torque	Approx. 20% (up to 125% possible with option brake resistor or brake unit externally mounted, 1-15HP braking transistor built-in)			
	V/F Pattern	Adjustable V/F pattern			

			General Specifications					
Frequency Keypad		Keypad	Setting by					
	Setting	External Signal	Potentiometer-5KΩ/0.5W, 0 to +10VDC, 4 to 20mA RS-485 interface; Multi-Function Inputs 0 to 5 (7 steps, Jog, up/down)					
tics	Operation	Keypad	Set by RUN, STOP					
acteris	Setting Signal	External Signal	M0 to M5 can be combined to offer various modes of operation, RS-485 serial interface (MODBUS).					
Operating Characteristics	Multi-Function	on Input Signal	Multi-step selection 0 to 7, Jog, accel/decel inhibit, first to forth accel/decel switches, counter, PLC operation, external Base Block (NC, NO), auxiliary motor control is invalid, selections, driver reset, UP/DOWN key settings, sink/source selection					
Ope	Multi-Function Output Indication		AC drive operating, frequency attained, non-zero, base block, fault indication, local/remote indication, PLC operation indication, auxiliary motor output, driver is ready, overheat alarm, emergency stop					
	Analog Outp	out Signal	Analog frequency/current signal output.					
	Alarm Outpu	it Contact	1 Form C contact or open collector output					
	Operation Functions		AVR, S-Curve, over-voltage, over-current stall prevention, fault records, adjustable carrier frequency, DC braking, momentary power loss restart, auto tuning, frequency limits, parameter Lock/Reset, vector control, counter, PID Control, PLC, MODBUS communication, reverse Inhibition, abnormal reset, abnormal restart, digital frequency output, sleep/revival function, 1st/2nd frequency source selections					
	Protection F	unctions	Self-testing, over voltage, over current, under voltage, overload, overheating, external fault, electronic thermal, ground fault.					
	Display K	eypads	6-key, 4-digit, 7-segment LED, 4 status LEDs, master frequency, output frequency, output current, custom units, parameter values for setup, review and faults, RUN, STOP, RESET, FWD/REV					
	Built-in Brake	e Chopper	Built-in for all models					
	Protection L	evel	IP20					
SI	Pollution De	gree	2					
onditio	Installation I	_ocation	Altitude 1,000 m or lower, keep from corrosive gasses, liquid and dust					
Enviromental Conditions	Ambient Tei	mperature	-10°C to 40°C (-10°C to 50°C without blind plate) Non-Condensing and not frozen					
virome	Storage/ Tra Temperature		-20°C to 60°C					
띱	Ambient Hu	midity	Below 90% RH (non-condensing)					
	Vibration		9.80665m/s ² (1G) less than 20Hz, 5.88m/s ² (0.6G) at 20 to 50Hz					
Арр	rovals		(E c U) us C					

Note: Do not attempt to connect a single-phase power source to a three-phase models drive. However it is acceptable to connect two wires of a three-phase power source to a singlephase drive.

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Appendix B Accessories

B.1 All Brake Resistors & Brake Units Used in AC Motor Drives

Note: Please only use DELTA resistors and recommended values. Other resistors and values will void Delta's warranty. Please contact your nearest Delta representative for use of special resistors.

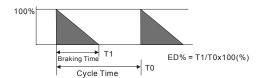
The brake unit should be at least 10 cm away from AC motor drive to avoid possible interference.

Voltage	Appli Mc	cable otor	Full Load Torque	Specification Resistors	Brake Resistors Model No of Units Used		Brake Torque 10%ED%	Minimum Resistance
	HP	kW	kgf-m	1100101010	140 01 011110 00	140 of Office Occu		Rates
ries	1/4	0.2	0.110	80W 200 Ω	BR080W200	1	400	80Ω
115V Series	1/2	0.4	0.216	80W 200 Ω	BR080W200	1	220	80Ω
115	1	0.75	0.427	80W 200 Ω	BR080W200	1	125	80Ω
	1/2	0.4	0.216	80W 200 Ω	BR080W200	1	220	200Ω
Ω	1	0.75	0.427	80W 200 Ω	BR080W200	1	125	80Ω
230V Series	2	1.5	0.849	300W 100 Ω	BR300W100	1	125	55Ω
>0 2	3	2.2	1.262	300W 70 Ω	BR300W070	1	125	35 Ω
23	5	3.7	2.080	400W 40 Ω	BR400W040	1	125	25 Ω
	7.5	5.5	3.111	500W 30 Ω	BR500W030	1	125	16 Ω
	1	0.75	0.427	80W 750 Ω	BR080W750	1	125	260 Ω
Ω	2	1.5	0.849	300W 400 Ω	BR300W400	1	125	190Ω
460V Series	3	2.2	1.262	300W 250 Ω	BR300W250	1	125	145 Ω
8	5	3.7	2.080	400W 150 Ω	BR400W150	1	125	95Ω
46	7.5	5.5	3.111	500W 100 Ω	BR500W100	1	125	60Ω
	10	7.5	4.148	1000W 75 Ω	BR1K0W075	1	125	45 Ω
	1	0.75	0.427	300W 400 Ω	BR300W400	1	125	200Ω
õ	2	1.5	0.849	300W 400 Ω	BR300W400	1	125	200Ω
Serie	3	2.2	1.262	600W 200 Ω	BR300W400	2	125	150Ω
575V Series	5	3.7	2.080	600W 200 Ω	BR300W400	2	125	150Ω
27	7.5	5.5	3.111	600W 200 Ω	BR300W400	2	125	150Ω
	10	7.5	4.148	2000W 100 Ω	BR1000W50	2	125	82 Ω

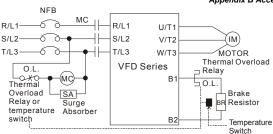
Note: Brake Torque 10%ED%: brake torque at 10% duty cycle in (%).



- Please select the brake unit and/or brake resistor according to the table. "-" means no Delta product. Please use the brake unit according to the Equivalent Resistor Value.
- If damage to the drive or other equipment is due to the fact that the brake resistors and the brake modules in use are not provided by Delta, the warranty will be void.
- 3. Take into consideration the safety of the environment when installing the brake resistors.
- If the minimum resistance value is to be utilized, consult local dealers for the calculation of the power in Watt.
- Please select thermal relay trip contact to prevent resistor over load. Use the contact to switch power off to the AC motor drive!
- When using more than 2 brake units, equivalent resistor value of parallel brake unit can't
 be less than the value in the column "Minimum Equivalent Resistor Value for Each AC
 Drive" (the right-most column in the table).
- Please read the wiring information in the user manual of the brake unit thoroughly prior to installation and operation.
- In applications with brake resistor or brake unit, Pr.25 (Over-voltage stall prevention) must be disabled. And Pr.102 (AVR function) shall not be used.
- 9. Definition for Braking Usage ED% Explanation: The definition of the barking usage ED(%) is for assurance of enough time for the brake unit and brake resistor to dissipate away heat generated by braking. When the brake resistor heats up, the resistance would increase with temperature, and braking torque would decrease accordingly. Suggest cycle time is one minute

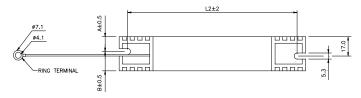


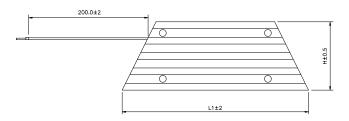
10. For safety reasons, install a thermal overload relay between brake unit and brake resistor. Together with the magnetic contactor (MC) in the mains supply circuit to the drive it offers protection in case of any malfunctioning. The purpose of installing the thermal overload relay is to protect the brake resistor against damage due to frequent braking or in case the brake unit is continuously on due to unusual high input voltage. Under these circumstances the thermal overload relay switches off the power to the drive. Never let the thermal overload relay switch off only the brake resistor as this will cause serious damage to the AC Motor Drive.



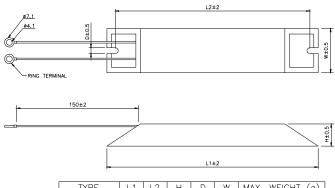
B.1.1 Dimensions and Weights for Brake Resistors& Brake Units

(Dimensions are in millimeter)

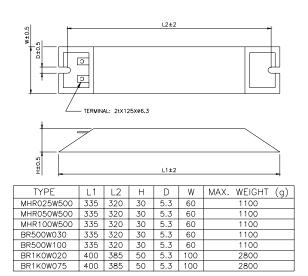




TYPE	L1	L2	Н	Α	В	MAX. WEIGHT (g)
MVR050W120	165	150	40	8.0	12.0	240
MVR080W120	165	150	40	8.0	12.0	240
MVR200W120	165	150	40	8.0	12.0	240
MVR050W200	165	150	40	15.0	15.0	460
MVR080W200	165	150	40	15.0	15.0	460
MVR200W200	165	150	40	15.0	15.0	460
BR200W040	165	150	40	13.0	17.0	460
BR200W070	165	150	40	13.0	17.0	460
BR200W150	165	150	40	13.0	17.0	460
BR200W250	165	150	40	13.0	17.0	460



TYPE	L1	L2	Н	D	W	MAX. WEIGHT (g)
MHR200W120	165	150	20	5.3	40	240
MHR400W120	165	150	20	5.3	40	240
BR080W200	140	125	20	5.3	60	160
BR080W750	140	125	20	5.3	60	160
BR300W070	215	200	30	5.3	60	750
BR300W100	215	200	30	5.3	60	750
BR300W250	215	200	30	5.3	60	750
BR300W400	215	200	30	5.3	60	750
BR400W150	265	250	30	5.3	60	930
BR400W040	265	250	30	5.3	60	930



B.2 Non-fuse Circuit Breaker Chart

The fuse should comply with UL248 and the breaker should comply with UL489.

(Note: Please select enough current capacity of NFB.)

1-phase						
Model Name	Recommended non-fuse breaker (A)					
VFD002M11A	15					
VFD004M11A	20					
VFD007M11A	30					
VFD004M21A	15					
VFD007M21A	20					
VFD015M21A	30					
VFD004M21B	15					
VFD007M21B	20					
VFD015M21B	30					
VFD022M21A	50					

3-phase			
Model Name	Recommended non-fuse breaker (A)		
VFD004M23A	5		
VFD007M23A	10		
VFD015M23A	20		
VFD007M43B	5		
VFD007M53A	5		
VFD015M43B	10		
VFD015M53A	5		
VFD022M23B	30		
VFD022M43B	15		
VFD022M53A	10		
VFD037M23A	40		
VFD037M43A	20		
VFD037M53A	20		
VFD055M23A	50		
VFD055M43A	30		
VFD055M53A	20		
VFD075M43A	40		
VFD075M53A	30		

B.3 Fuse Specification Chart

Smaller fuses than those shown in the table are permitted.

Model	Input Current (A)	Output Current (A)	Line Fuse	
Model	input Current (A)	Output Current (A)	I (A)	Bussmann P/N
VFD002M11A	6	1.6	15	JJN-15
VFD004M11A	9	2.5	20	JJN-20
VFD007M11A	16	4.2	30	JJN-30
VFD004M21A	6.3	2.5	15	JJN-15
VFD004M21B	6.3	2.5	15	JJN-15
VFD007M21A	11.5	5.0	20	JJN-20
VFD007M21B	11.5	5.0	20	JJN-20
VFD015M21A	15.7	7.0	30	JJN-30
VFD015M21B	15.7	7.0	30	JJN-30
VFD022M21A	27	10	50	JJN-50
VFD004M23A	2.9	2.5	5	JJN-6
VFD007M23A	7.6	5.0	15	JJN-15
VFD015M23A	8.8	7.0	20	JJN-20
VFD022M23B	12.5	10.0	30	JJN-30
VFD037M23A	19.6	17	40	JJN-40
VFD055M23A	28	25	50	JJN-50
VFD007M43B	4.2	3.0	5	JJS-6
VFD015M43B	5.7	4.0	10	JJS-10
VFD022M43B	6.0	5.0	15	JJS-15
VFD037M43A	8.5	8.2	20	JJS-20
VFD055M43A	14	13	30	JJS-30
VFD075M43A	23	18	50	JJS-50
VFD007M53A	2.4	1.7	5	JJS-6
VFD015M53A	4.2	3.0	10	JJS-10
VFD022M53A	5.9	4.2	15	JJS-15
VFD037M53A	7.0	6.6	15	JJS-15
VFD055M53A	10.5	9.9	20	JJS-20
VFD075M53A	12.9	12.2	30	JJS-50

B.4 AC Reactor

B.4.1 AC Input Reactor Recommended Value

230V, 50/60Hz, single-phase

kW	HP	Fundamental	Max. continuous Amps	Inductance (mh)
KVV	Amps Amps	Amps		3~5% Impedance
0.2	0.25	4	6	6.5
0.4	0.5	5	7.5	3
0.75	1	8	12	1.5
1.5	2	12	18	1.25
2.2	3	18	27	0.8

460V. 50/60Hz. 3-phase

130/0		Fundamental	Max. continuous	Inductance (mh)	
kW	HP	Amps	Amps	3% Impedance	5% Impedance
0.75	1	4	6	9	12
1.5	2	4	6	6.5	9
2.2	3	8	12	5	7.5
3.7	5	8	12	3	5
5.5	7.5	12	18	2.5	4.2
7.5	10	18	27	1.5	2.5
11	15	25	37.5	1.2	2

B.4.2 AC Output Reactor Recommended Value

115V/230V, 50/60Hz, 3-phase

kW	HP	Fundamental	Max. continuous	Inductance (mh)	
KVV	111	Amps	Amps	3% Impedance	5% Impedance
0.2	0.25	4	6	9	12
0.4	0.5	4	6	6.5	9
0.75	1	8	12	3	5
1.5	2	8	12	1.5	3
2.2	3	12	18	1.25	2.5
3.7	5	18	27	0.8	1.5
5.5	7.5	25	37.5	0.5	1.2



460V, 50/60Hz, 3-phase

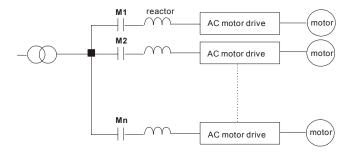
kW	HP	Fundamental	Max. continuous	Inductance (mh)	
KVV		Amps	Amps	3% Impedance	5% Impedance
0.75	1	4	6	9	12
1.5	2	4	6	6.5	9
2.2	3	8	12	5	7.5
3.7	5	12	18	2.5	4.2
5.5	7.5	18	27	1.5	2.5
7.5	10	18	27	1.5	2.5

B.4.3 Applications

Connected in input circuit

Application 1	Question
When more than one AC motor drive is connected to the same mains power, and one of them is ON during operation.	When applying power to one of the AC motor drive, the charge current of the capacitors may cause voltage dip. The AC motor drive may be damaged when over current occurs during operation.

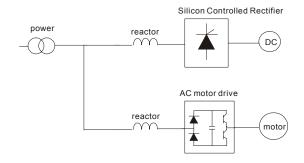
Correct wiring





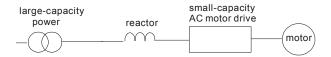
Application 2	Question
Silicon rectifier and AC motor drive are connected to the same power.	Switching spikes will be generated when the silicon rectifier switches on/off. These spikes may damage the mains circuit.

Correct wiring



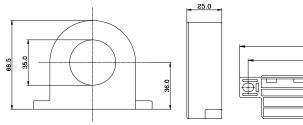
Application 3	Question
Used to improve the input power factor, to reduce harmonics and provide protection from AC line disturbances (surges, switching spikes, short interruptions, etc.). The AC line reactor should be installed when the power supply capacity is 500kVA or more and exceeds 6 times the inverter capacity, or the mains wiring distance ≤10m.	When the mains power capacity is too large, line impedance will be small and the charge current will be too high. This may damage AC motor drive due to higher rectifier temperature.

Correct wiring



B.5 Zero Phase Reactor (RF220X00A)

Dimensions are in millimeter.



Cable	Recommended Wire Size			Otri	Wiring
type (Note)	AWG	mm²	Nominal (mm²)	Qty.	Method
Single-	≦10	≦5.3	≦5.5	1	Diagram A
core	≦2	≦33.6	≦38	4	Diagram B
Three-	≦12	≦3.3	≦3.5	1	Diagram A
core	≦1	≦42.4	≦50	4	Diagram B

Note: 600V Insulated Unshielded Cable.

Diagram A

Please wind each wire **4 times** around the core. The reactor must be put at inverter side as close as possible.

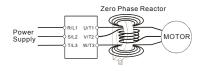
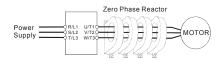


Diagram B

Please put all wires through **4 cores** in series without winding.

90.0 80.0



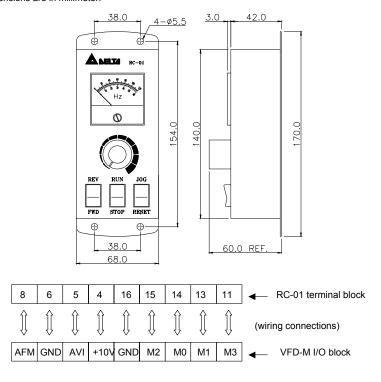
Note 1: The table above gives approximate wire size for the zero phase reactors but the selection is ultimately governed by the type and diameter of cable fitted i.e. the cable must fit through the center hole of zero phase reactors.

Note 2: Only the phase conductors should pass through, not the earth core or screen.

Note 3: When long motor output cables are used, an output zero phase reactor may be required to reduce radiated emissions from the cable.

B.6 Remote Controller RC-01

Dimensions are in millimeter.



VFD-M Programming

Pr.00 set to 01

Pr.01 set to 01 (external controls)

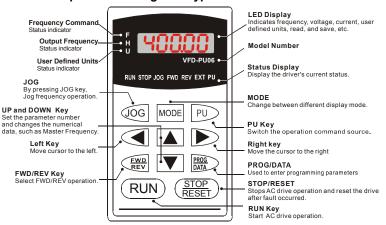
Pr.38 set to 01 (M0, M1 set as run/stop and fwd/rev)

Pr.39 set to 05 (M2 set for reset)

Pr.40 set to 09 (M3 set for jog select)

B.7 PU06

B.7.1 Description of the Digital Keypad VFD-PU06



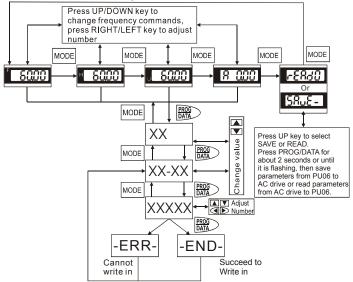
B.7.2 Explanation of Display Message

Display Message	Descriptions
[8000]	The AC motor drive Master Frequency Command.
* 50.00	The Actual Operation Frequency present at terminals U, V, and W.
u 18000	The custom unit (u)
A 5.0	The output current present at terminals U, V, and W.
-E8d0	Press to change the mode to READ. Press PROG/DATA for about 2 sec or until it's flashing, read the parameters of AC drive to the digital keypad PU06. It can read 4 groups of parameters to PU06. (read 0 – read 3)
58 ₀ E-	Press to change the mode to SAVE. Press PROG/DATA for about 2 sec or until it's flashing, then write the parameters from the digital keypad PU06 to AC drive. If it has saved, it will show the type of AC motor drive.

	Appendix B Accessories
Display Message	Descriptions
08-00	The specified parameter setting.
10	The actual value stored in the specified parameter.
E.F.	External Fault
-End-	"End" displays for approximately 1 second if the entered input data have been accepted. After a parameter value has been set, the new value is automatically stored in memory. To modify an entry, use the or keys.
-8	"Err" displays if the input is invalid.
[81-33]	Communication Error. Please check the AC motor drive user manual for more details.

B.7.3 Operation Flow Chart

VFD-PU06 Operation Flow Chart



B.8 AMD - EMI Filter Cross Reference

Model of AC Drive	EMI Filter	
VFD002M11A, VFD004M11A, VFD007M11A, VFD004M21B, VFD007M21B, VFD015M21B	RF015M21AA	
VFD007M43B, VFD015M43B, VFD022M43B	RF022M43AA	
VFD022M21A	RF022M21BA	
VFD037M43A, VFD055M43A, VFD075M43A	RF075M43BA	
VFD037M23A, VFD055M23A	40TDS4W4B	
VFD022M23B, VFD004M23A, VFD007M23A, VFD015M23A	16TDT1W4S	

If users are to operate the AC motor drive in coordination with the EMI filters manufactured by DELTA, consult the above chart for the appropriate I/O terminals' of the applicable filters.



The filter will cause high leakage current. We recommend the grounding is required.

Installation

All electrical equipment, including AC motor drives, will generate high-frequency/low-frequency noise and will interfere with peripheral equipment by radiation or conduction when in operation. By using an EMI filter with correct installation, much interference can be eliminated. It is recommended to use DELTA EMI filter to have the best interference elimination performance.

We assure that it can comply with following rules when AC motor drive and EMI filter are installed and wired according to user manual:

EN61000-6-4

EN61800-3: 1996 + A11: 2000

EN55011 (1991) Class A Group 1 (1st Environment, restricted distribution)

General precaution

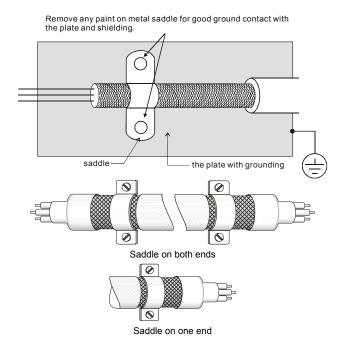
- 1. EMI filter and AC motor drive should be installed on the same metal plate.
- Please install AC motor drive on footprint EMI filter or install EMI filter as close as possible to the AC motor drive.
- 3. Please wire as short as possible.
- 4. Metal plate should be grounded.
- The cover of EMI filter and AC motor drive or grounding should be fixed on the metal plate and the contact area should be as large as possible.



Choose suitable motor cable and precautions

Improper installation and choice of motor cable will affect the performance of EMI filter. Be sure to observe the following precautions when selecting motor cable.

- 1. Use the cable with shielding (double shielding is the best).
- 2. The shielding on both ends of the motor cable should be grounded with the minimum length and maximum contact area.
- 3. Remove any paint on metal saddle for good ground contact with the plate and shielding.



Revision May 2008, ME14, SW V3.04

Appendix B Accessories | Variable

The length of motor cable

When motor is driven by an AC motor drive of PWM type, the motor terminals will experience surge voltages easily due to components conversion of AC motor drive and cable capacitance. When the motor cable is very long (especially for the 460V series), surge voltages may reduce insulation quality. To prevent this situation, please follow the rules below:

- Use a motor with enhanced insulation.
- Connect an output reactor (optional) to the output terminals of the AC motor drive
- The length of the cable between AC motor drive and motor should be as short as possible (10 to 20 m or less)
- For models 7.5hp/5.5kW and above:

Insulation level of motor	1000V	1300V	1600V	
460VAC input voltage	66 ft (20m)	328 ft (100m)	1312 ft (400m)	
230VAC input voltage	1312 ft (400m)	1312 ft (400m)	1312 ft (400m)	

For models 5hp/3.7kW and less:

Insulation level of motor	1000V	1300V	1600V	
460VAC input voltage	66 ft (20m)	165 ft (50m)	165 ft (50m)	
230VAC input voltage	328 ft (100m)	328 ft (100m)	328 ft (100m)	

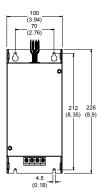


- When a thermal O/L relay protected by motor is used between AC motor drive and motor, it may malfunction (especially for 460V series), even if the length of motor cable is only 165 ft (50m) or less. To prevent it, please use AC reactor and/or lower the carrier frequency (Pr. 71 PWM carrier frequency).
- Never connect phase lead capacitors or surge absorbers to the output terminals of the AC motor drive.
- If the length is too long, the stray capacitance between cables will increase and may cause leakage current. It will activate the protection of over current, increase leakage current or not insure the correction of current display. The worst case is that AC motor drive may damage.
- If more than one motor is connected to the AC motor drive, the total wiring length is the sum of the wiring length from AC motor drive to each motor.

B.8.1 Dimensions

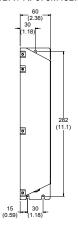
EMI Filter (RF015M21AA / RF022M43AA)

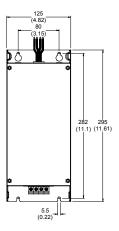






EMI Filter (RF022M21BA / RF075M43BA)

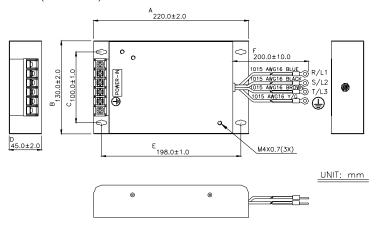




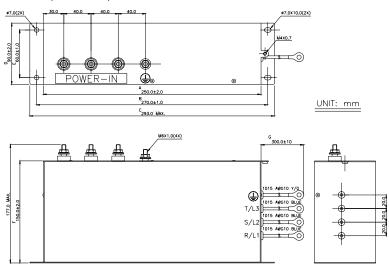


Appendix B Accessories | V

EMI Filter (16TDT1W4S) Used on 0.5-3 HP/230V Three Phase Models.



EMI Filter (40TDS4W4B) Used on 5-7.5 HP/230V Three Phase Models.





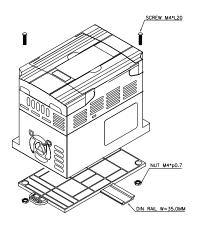
B.9 Din Rail

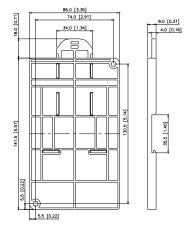
B.9.1 Din Rail-DR01 Adapter

Units: mm (inch)

Models
VFD004M21A/23A, VFD007M21A/23A, VFD015M21A/23A

To mount the drive on a Din Rail adapter, place the drive and mounting plate on the rail and push the lever toward the rail.





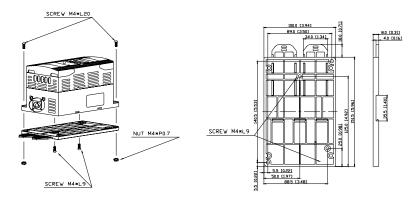
B.9.2 Din Rail-DR02 Adapter

Units: mm (inch)

Models

VFD002M11A, VFD004M11A/21B, VFD007M11A/21B/43B/53A, VFD015M21B/43B/53A, VFD022M23B/43B/53A

To mount the drive on a Din Rail adapter, place the drive and mounting plate on the rail and push the lever toward the rail.



Appendix C How to Select the Right AC Motor Drive

The choice of the right AC motor drive for the application is very important and has great influence on its lifetime. If the capacity of AC motor drive is too large, it cannot offer complete protection to the motor and motor maybe damaged. If the capacity of AC motor drive is too small, it cannot offer the required performance and the AC motor drive maybe damaged due to overloading.

But by simply selecting the AC motor drive of the same capacity as the motor, user application requirements cannot be met completely. Therefore, a designer should consider all the conditions, including load type, load speed, load characteristic, operation method, rated output, rated speed, power and the change of load capacity. The following table lists the factors you need to consider, depending on your requirements.

Item		Related Specification				
		Speed and torque characteristics	Time ratings	Overload capacity	Starting torque	
Load type	Friction load and weight load Liquid (viscous) load Inertia load Load with power transmission	•			•	
Load speed and torque characteristics	Constant torque Constant output Decreasing torque Decreasing output	•	•			
Load characteristics	Constant load Shock load Repetitive load High starting torque Low starting torque	•	•	•	•	
Continuous operation, Short-time operation Long-time operation at medium/low speeds			•	•		
Maximum output current (instantaneous) Constant output current (continuous)		•		•		
Maximum frequer	Maximum frequency, Base frequency					
Power supply transformer capacity or percentage impedance Voltage fluctuations and unbalance Number of phases, single phase protection Frequency				•	•	
Mechanical friction	Mechanical friction, losses in wiring			•	•	
Duty cycle modification			•			



C.1 Capacity Formulas

1. When one AC motor drive operates one motor

The starting capacity should be less than 1.5x rated capacity of AC motor drive The starting capacity=

$$\frac{k \times N}{973 \times n \times \cos \varphi} \left(T_L + \frac{GD^2}{375} \times \frac{N}{t_+} \right) \le 1.5 \times the_capacity_of_AC_motor_drive(kVA)$$

- 2. When one AC motor drive operates more than one motor
 - 2.1 The starting capacity should be less than the rated capacity of AC motor drive
 - Acceleration time ≤60 seconds

The starting capacity=

$$\frac{k \times N}{\eta \times \cos \varphi} \left[n_r + n_s(k_{s-1}) \right] = P_{C1} \left[1 + \frac{n_s}{n_r} \left(k_{s-1} \right) \right] \le 1.5 \times the _capacity_of_AC_motor_drive(kVA)$$

Acceleration time ≥60 seconds

The starting capacity=

$$\frac{k \times N}{\eta \times \cos \varphi} \left[n_r + n_s(k_{s-1}) \right] = Pc_1 \left[1 + \frac{n_s}{n_r} (k_{s-1}) \right] \le the_capacity_of_AC_motor_drive(kVA)$$

- 2.2 The current should be less than the rated current of AC motor drive(A)
 - Acceleration time ≤60 seconds

$$n_T + I_M \left[1 + \frac{n_S}{n_T} (k_S - 1) \right] \le 1.5 \times the_rated_current_of_AC_motor_drive(A)$$

Acceleration time \geq 60 seconds

$$n_T + I_M \Big[1 + \frac{n_S}{n_T} (k_S - 1) \Big] \le the_rated_current_of_AC_motor_drive(A)$$



2.3 When it is running continuously

The requirement of load capacity should be less than the capacity of AC motor drive(kVA)

The requirement of load capacity=

$$\frac{k \times P_M}{\eta \times \cos \varphi} \le the_capacity_of_AC_motor_drive(kVA)$$

The motor capacity should be less than the capacity of AC motor drive

$$k \times \sqrt{3} \times V_M \times I_M \times 10^{-3} \le the_capacity_of_AC_motor_drive(kVA)$$

The current should be less than the rated current of AC motor drive(A)

$$k \times I_M \le the \ rated \ current \ of \ AC \ motor \ drive(A)$$

Symbol explanation

: Motor shaft output for load (kW) P_{M}

: Motor efficiency (normally, approx. 0.85) η

 $\cos \varphi$: Motor power factor (normally, approx. 0.75)

 V_M : Motor rated voltage(V)

: Motor rated current(A), for commercial power I_M

: Correction factor calculated from current distortion factor (1.05-1.1, depending on k

PWM method)

: Continuous motor capacity (kVA) P_{C1}

: Starting current/rated current of motor ks

: Number of motors in parallel n_T

 n_s : Number of simultaneously started motors

: Total inertia (GD²) calculated back to motor shaft (kg m²) GD^2

 T_I : Load torque

: Motor acceleration time t_A

Ν : Motor speed



C.2 General Precaution

Selection Note

- When the AC Motor Drive is connected directly to a large-capacity power transformer (600kVA or above) or when a phase lead capacitor is switched, excess peak currents may occur in the power input circuit and the converter section may be damaged. To avoid this, use an AC input reactor (optional) before AC Motor Drive mains input to reduce the current and improve the input power efficiency.
- 2、 When a special motor is used or more than one motor is driven in parallel with a single AC Motor Drive, select the AC Motor Drive current ≥1.25x(Sum of the motor rated currents).
- 3、 The starting and accel./decel. characteristics of a motor are limited by the rated current and the overload protection of the AC Motor Drive. Compared to running the motor D.O.L. (Direct On-Line), a lower starting torque output with AC Motor Drive can be expected. If higher starting torque is required (such as for elevators, mixers, tooling machines, etc.) use an AC Motor Drive of higher capacity or increase the capacities for both the motor and the AC Motor Drive.
- 4、 When an error occurs on the drive, a protective circuit will be activated and the AC Motor Drive output is turned off. Then the motor will coast to stop. For an emergency stop, an external mechanical brake is needed to quickly stop the motor.

Parameter Settings Note

- 1、 The AC Motor Drive can be driven at an output frequency up to 400Hz (less for some models) with the digital keypad. Setting errors may create a dangerous situation. For safety, the use of the upper limit frequency function is strongly recommended.
- 2、 High DC braking operating voltages and long operation time (at low frequencies) may cause overheating of the motor. In that case, forced external motor cooling is recommended.
- 3、 Motor accel./decel. time is determined by motor rated torque, load torque, and load inertia
- 4、 If the stall prevention function is activated, the accel./decel. time is automatically extended to a length that the AC Motor Drive can handle. If the motor needs to



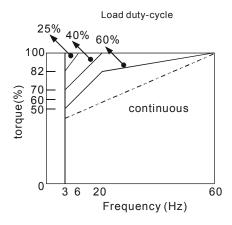
decelerate within a certain time with high load inertia that can't be handled by the AC Motor Drive in the required time, either use an external brake resistor and/or brake unit, depending on the model, (to shorten deceleration time only) or increase the capacity for both the motor and the AC Motor Drive.

C.3 How to Choose a Suitable Motor

Standard motor

When using the AC Motor Drive to operate a standard 3-phase induction motor, take the following precautions:

- 1、 The energy loss is greater than for an inverter duty motor.
- 2、 Avoid running motor at low speed for a long time. Under this condition, the motor temperature may rise above the motor rating due to limited airflow produced by the motor's fan. Consider external forced motor cooling.
- 3、 When the standard motor operates at low speed for long time, the output load must be decreased
- The load tolerance of a standard motor is as follows: 4、



- 5、 If 100% continuous torque is required at low speed, it may be necessary to use a special inverter duty motor.
- 6、 Motor dynamic balance and rotor endurance should be considered once the operating speed exceeds the rated speed (60Hz) of a standard motor.

Appendix CHow to Select the Right AC Motor Drive

- 7 Motor torque characteristics vary when an AC Motor Drive instead of commercial power supply drives the motor. Check the load torque characteristics of the machine to be connected.
- 8 Because of the high carrier frequency PWM control of the VFD series, pay attention to the following motor vibration problems:
 - Resonant mechanical vibration: anti-vibration (damping) rubbers should be used to mount equipment that runs at varying speed.
 - Motor imbalance: special care is required for operation at 50 or 60 Hz and higher frequency.
 - To avoid resonances, use the Skip frequencies.
- 9 The motor fan will be very noisy when the motor speed exceeds 50 or 60Hz.

Special motors:

1 Pole-changing (Dahlander) motor:

The rated current is differs from that of a standard motor. Please check before operation and select the capacity of the AC motor drive carefully. When changing the pole number the motor needs to be stopped first. If over current occurs during operation or regenerative voltage is too high, please let the motor free run to stop (coast).

2 . Submersible motor:

The rated current is higher than that of a standard motor. Please check before operation and choose the capacity of the AC motor drive carefully. With long motor cable between AC motor drive and motor, available motor torque is reduced.

3 · Explosion-proof (Ex) motor:

Needs to be installed in a safe place and the wiring should comply with the (Ex) requirements. Delta AC Motor Drives are not suitable for (Ex) areas with special precautions.

4 . Gear reduction motor:

The lubricating method of reduction gearbox and speed range for continuous operation will be different and depending on brand. The lubricating function for operating long time at low speed and for high-speed operation needs to be considered carefully.

5 \ Synchronous motor:

The rated current and starting current are higher than for standard motors. Please check before operation and choose the capacity of the AC motor drive carefully. When



the AC motor drive operates more than one motor, please pay attention to starting and changing the motor.

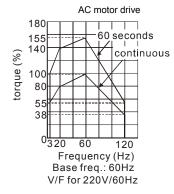
Power Transmission Mechanism

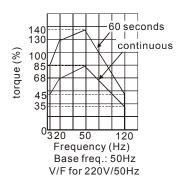
Pay attention to reduced lubrication when operating gear reduction motors, gearboxes, belts and chains, etc. over longer periods at low speeds. At high speeds of 50/60Hz and above. lifetime reducing noises and vibrations may occur.

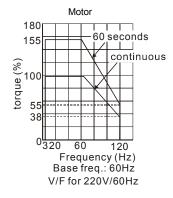
Motor torque

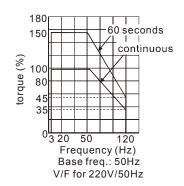
The torque characteristics of a motor operated by an AC motor drive and commercial mains power are different.

Below you'll find the torque-speed characteristics of a standard motor (4-pole, 15kW):









Appendix CHow to Select the Right AC Motor Drive

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