Introduction

Thank you for choosing the CT-2000ES inverter unit, this inverter unit is suitable for operating squirrel cage induction motors. Please read this instruction manual carefully before actual usage in order to ensure proper operation and suit your needs.

Table of Contents

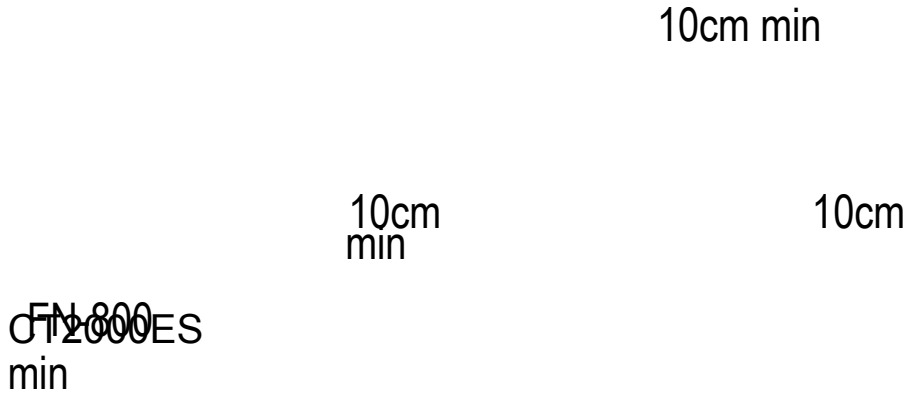
1. Inspection upon receiving

A. Check that the model, the capacity and power voltage specifications are as ordered.
B. Check that no damage has occurred during transportation.
C. Check that none of the internal parts have been damaged or have fallen off.
D. Check that none of the connectors have been damaged or have fallen off.
E. Check that there is no loosening of the terminals or screws of each of the parts.

2. Installation and Storage

A. Storage:
If the equipment is not to be installed immediately, it should be stored in a clean and dry location at ambient temperatures from 20℃to 55℃. The surrounding air must be free of corrosive contaminants.

B. Installation place:
Places where the peripheral temperature is from -10℃to 40℃, and where the relative humidity is 90% or less. Avoid installing at places where there is dust, iron particles, corrosive gas, water spray, direct sunlight or too much vibration. And places where has good ventilation.



10cm min

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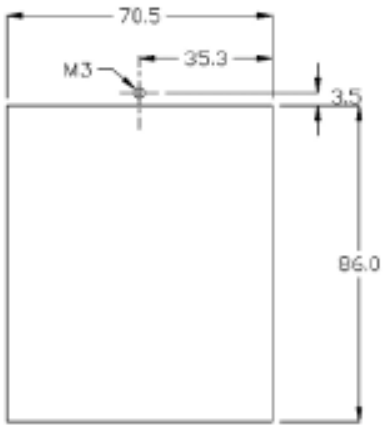
C. Outline Dimension:

CT2002ES-A75、CT2002ES-1A5、CT2004ES-A75、CT2004ES-1A5

CT2002ES-2A2、CT2002ES-3A7、CT2004ES-2A2、CT2004ES-3A7



KEYBAD screw position

3. Application notes

A. Concerning the inverter unit:
   (1) Do not fit capacitors to the output side of the inverter in order to improve the power ratio.
   (2) In case of fitting MC between inverter and motor to control motor operation, then the capacity of inverter must be 6 times the capacity of motor.
   (3) Run a motor that is within the capacity of the inverter unit, light load current and no-load current will cause the motor to develop ripple current.
   (4) This unit is provided with a current limiting function. The starting torque is assumed to be from 80% to 100%.

B. Concerning the AC motor
   (1) When general-purpose motors are operated at low speeds, there is a reduced cooling effect, please apply the special purpose motor.
   (2) Operation at frequencies exceeding 60 Hz requires caution, as there is the danger of the mechanical strength failure of the motor.
   (3) When motors with brakes are being operated, the power for the brake and inverter should be taken from the same power supply and the brake operation must be in phase when the unit is started and stopped.

4. Block diagram, wring

A. Wiring of main and control circuit
Wire according to the standard connection diagram. On using the external sequence control, please use small signal relay or double terminal relay to avoid relay terminal malfunction.

B. Signal circuit
The signal circuit uses either shielded pairs or twisted pairs, should be wired either using a wiring duct separated from that for the power circuit, or with the wiring conduit isolated as much as possible.

C. Connecting the power supply and the AC motor
Connect the main circuit, by wiring according to the main circuit terminal connection diagram. Care is required not to make a mistake when connecting the input and output terminals, lest it will cause inverter damage. Specifications of main circuit path and NFB are as follow:

Voltage (V)	Model	NFB (A)	Wire size for circuit (mm^2)
	CT2002ES-A75	10	2.0
	CT2002ES-1A5	15	2.0
220			
CT2002ES-2A2	20	2.0	
CT2002ES-3A7	30	3.5	
380 / 460			
CT2004ES-1A5	10	2.0	
CT2004ES-2A2	10	2.0	
CT2004ES-3A7	15	3.5	

D. Instantaneous current and to improve power ratio, it should be fitted the A.C.L. to R.S.T. input side under the following circumstance:

a. Where power supply capacity is larger than 500 KVA.
b. Using thyrister, phase advance capacitor etc. from the same power supply.

A.C.L. Specifications table:

Voltage (V)	Model	Current (Ar.m.s)
Induction		

Value

	220	
CT2002ES-A75	6A	1.8mH
CT2002ES-1A5	10A	1.1mH
CT2002ES-2A2	15A	0.71mH
CT2002ES-3A7	20A	0.53mH

	380 / 460	
CT2004ES-1A5	5A	4.2mH
CT2004ES-2A2	7.5A	3.6mH
CT2004ES-3A7	10A	2.2mH

Notes: The A.C.L. for 220V and 380V/460V have different induction values, please does not mix up.

E. Brake resistor standard of usage

CT2000ES series inverter contain brake resistor，P、PR terminal can connect external brake resistor. The sizes of brake resistors take the table for reference.
If inertia is too large or cycle of discharge is higher, user can increase wattage of resistor.

Voltage (V)	Type	Brake resistor standard
	CT2002ES-A75	120Ω 80W
	CT2002ES-1A5	80Ω 160W

Mark

	220	
CT2002ES-2A2	60Ω	250W
CT2002ES-3A7	36Ω	400W

	380 / 460	
CT2004ES-1A5	360Ω	300W
CT2004ES-2A2	250Ω	500W
CT2004ES-3A7	150Ω	800W

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F. Standard external connection diagram

(Note: While external is required for DBR, disconnect inter DBR first)

TM

3-phase power
200V/50Hz
200~230V/50,60Hz
400V/50Hz
400~460V/50,60Hz

ACL

Adapt**or**

R S T

E

Voltage detect
Current detect

DBR

P PR N

Transformer

U

V

IM

W

External Operation
controller

5K Ω 1/2W

External signal 4~20mA

Terminal

Terminal Terminal Terminal

Reverse operation
Forward operation

10V

IN2

CC

IN1

0V

DI1

DI2

DI3

DI4

RR

FR

COM

Braking control

Intreface

CPU Power Control

Operational panel

VOUT CC

D/A output terminal

C1

Multi-function

NO Relay

Output terminal

NC

Twisted or shield wires

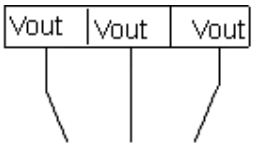
RJ45

REMOTE

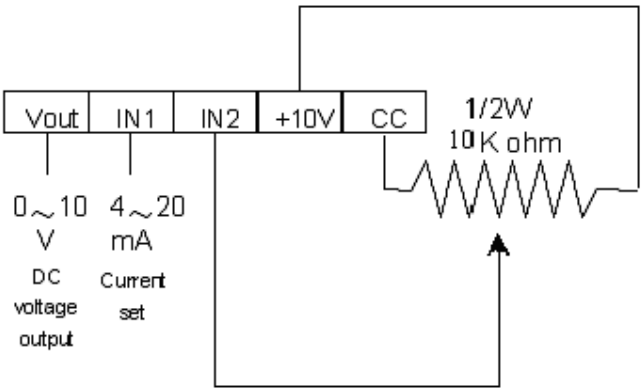
A+ A- B+ B-

RS422/485 Series communication interface terminal

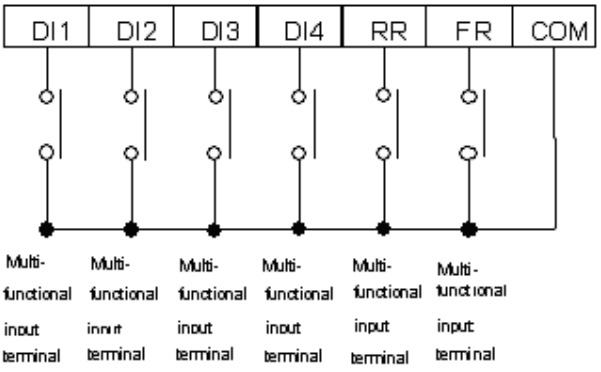
G. Control circuit



Multifunctional RELAY output terminal



Main voltage set



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H. Terminal Specifications

Main Circuit		
R.S.T	AC power input terminal	Connect 3 § AC with Single § 200-230V/50,60Hz with 3 § 380-460V/50,60Hz
U.V.W	Inverter output terminal	3-phase induction motor
E	Ground terminal	Ground terminal of inverter chassis
P.PR	Brake resistor connecting terminal	Connected proper brake resistor according to rated ampere
Control Terminal (1)		
VC	Power speed output setting	DC +10V
IN1	Current speed input setting	DC 4~20mA, CD01=2 or 4
IN2	Voltage speed input setting	DC 0~10V/ 5KΩVR, CD01=1,3
VOUT	Operation (Frequency /Current) output indication	Analog Output 0~10V DC, Frequency/Current set by CD54
CC	Common input control terminal	Ground terminal for speed setting
Control Terminal		
COM	Sequence control common terminal	Ground terminal for sequence control
(2)		
FR	Forward operation input terminal	Forward operation by FR-COM shorted
RR	Reverse operation input terminal	Reverse operation by RR-COM shorted
DI1	2nd acceleration input terminal (AC2)	Select 2nd acceleration time mode by shorting 1- COM, set CD10
DI2	2nd deceleration input terminal (DC2)	Select 2nd deceleration time mode by shorting 2- COM, set CD11
DI3	JOG	Shorting 3-COM
DI4	RST	Shorting 4-COM
C1, NC1, NO1	Control output terminal	Multifunctional relay output terminal
NO		Connector capacity AC 220V, 0.1A

NC C	While normal C□closed and NC□Closed While operating C□open and NO□closed Functions of C1, NC1, NO1 are set by CD47
	A+, A- B+, B- SG
Serial communication terminal	Refer to Serial Communications User Manual. SG is 0 volt terminal of the digital signal.

5. Operational Test

A. Check before test

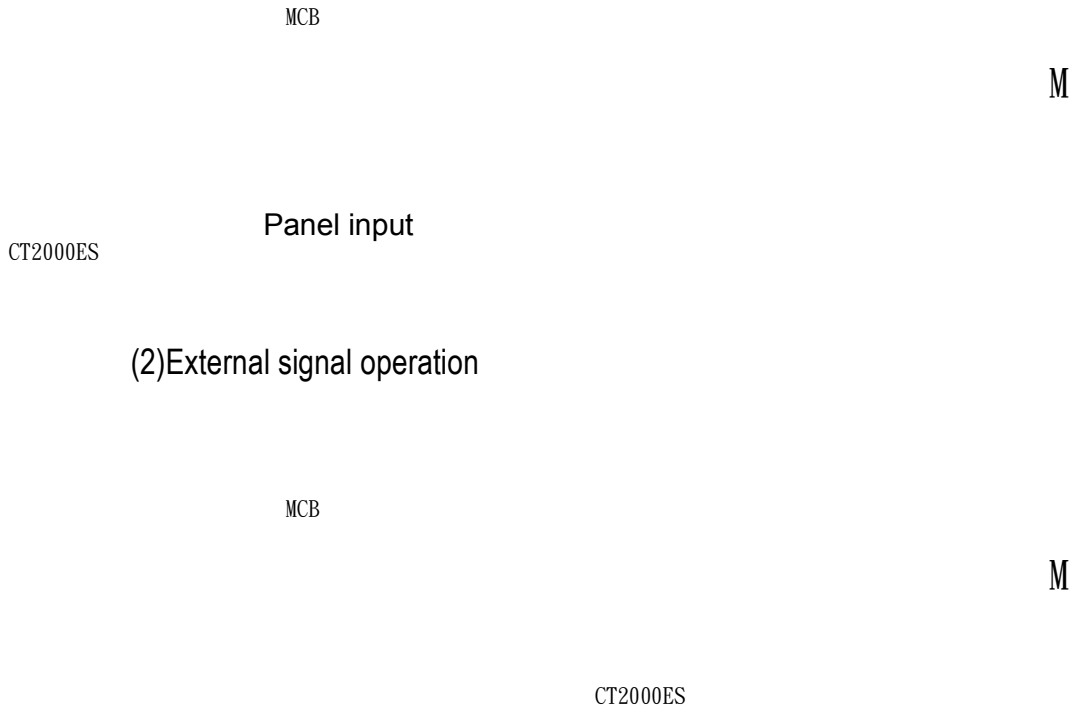
Please check the following:

(1) Is wiring correct? Check especially the input and output terminals.
(2) Is there a short-circuit or ground connection on external wiring?
(3) Make sure there is no loosening of screws.
(4) Check external sequence control circuit.
(5) Check voltage of power supply.

B. Operation Method

CT-2000 series inverter unit has both operator panel and external operation methods.

(1) Operator panel



(2)External signal operation

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C. Operational test

Test according to the following procedure and be aware of indications.

(1) Basic operational test

-Operational procedure

I. Connect power supply
II. Monitor glittering indicates frequency
III. Press either FWD or REV key, motor starts running. It will stop accelerating after reaching set frequency
IV. After pressing STOP key, motor stops and indicating frequency steps down. The set frequency starts glittering after the motor stops.
V. Repeat procedures III and IV to test forward and reverse operations.

-Operation monitor display

I. With reciprocal glittering indicated HZ LED and factory setting (set VR on the panel)
II. Hz display, with FWD (or REV) LED lighted up steadily; indication goes up according to frequency until reaching value 10.00 Hz
III. Indication goes down according to operation frequency, and returns to situation ” I ” after stop

(2) Frequency change test

- Operational procedure

I. Exercise the above operation test procedures I, II, III
II. Adjust VR on the panel to change frequency command
III. Repeat procedures II to increase or decrease frequency

-Operation monitor display

I. The same as the above basic test of I, II
II. Monitor display indicates the current new setting value

Note:

1. Is motor operation direction correct? (Changing any two of U.V.W output terminals to change motor operation direction)
2. Is there any noise or vibration on motor?
3. Is it run smoothly during acceleration and deceleration?
4. Is there any power failure?

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6. Adjust and Function Specification

A. Keypad operation

V

Hz I

FWD REV

Display

FWD

PROG
SET

REV

READ ▲

STOP ▼

(2) Display specification：

1.Hz、I LED : Hz LED means of recent revolution frequency.
I LED means of recent revolution current.
Hz and I LED mean of recent revolution voltage on the display.
2.FWD、REV ： FWD means motor operate at forward direction.
REV means motor operate at reverse direction.

(3) Keyboard specification：

1. FWD and REV: Push keypad to control reverse of motor, and screen display main display content (Cd02 setting).
Push keypad to control reverse of motor, and screen display main display content (Cd02 setting).

2.STOP：STOP function: Stop motor revolution when push STOP key, and on the mean time screen flashing with commanding instruction.
RESET function：While failure occurred, press STOP key to re-start inverter and save failure in failure memory.

3.PROG/SET：FUNC switch: In display mode，PROG/SET key and screen shows Cd00 (General parameter input area).，Press PROG key again and screen shows CE-00 (failure and engineering mode). If pressed PROG key now, screen would return to display mode.
SAVE function: In parameter input mode, press PROG/SET key will save new parameter just input.

4.READ：READ function：When display shows Cd-?? (General parameter Input mode) or CE-?? (Failure display and engineering mode), Press READ to parameter input mode. Screen showing previously parameter setting. Change of parameter can be proceeding.
Back to display function：Press READ at parameter input mode can escape from parameter input mode and not save new parameter.

5. Key (＜ as shown): SHIFT function：press ＜ key to swich position of nonius，when the nonius is at left，press ＜key nonius will be back to right，when accommodate to press ▼、▲key to modify parameter in this mode.

6.▼、▲ key: Item of display changing：Press▲, ▼ key at display mode, select required item.
Parameter selection：Press ▲,▼ key to change value when screen shows Cd- (General parameter input area) or CE- (Failure display and engineering mode). Press and hold ▲,▼ key can progressively increase or decrease value.
Parameter modification：Press ▲,▼ key at parameter input mode can

change parameter. Using with SET key to modify parameter.

D. Function Code

§ Cd00 Set frequency (Settable range 0.5~240 HZ)

There are 5 methods to change set frequency. Items A~C are methods of panel key operation, items D-E are methods of external terminal input.

A. At display function, press READ and setting (Cd01=0)
B. Use PROG key to input data (Cd01=0)
C. Set VR on faceplate (Cd01=5)
D. Set external voltage (Cd01=1 or 3)
E. Set external voltage (Cd01=2 or 4)

Note:

1. Set value should be in accordance with V/F slope (Cd05) and upper limit frequency (Cd17).

Set by function key

A. At display function, press READ and setting (Cd01=0)

1 0. 0 0

READ 1 0. 0 0

1 0. 0 0

1 0. 0 0

▲ 1 1. 0 0

Meanwhile the operation speed (Cd00) has been changed but not saved yet (power cut off and supply again Cd00 still be10.00)，press PROG/SET and save data.

READ 1 1. 0 0

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B. Use PROG key to input procedure (Cd01=0)

1 0. 0 0

PROG/
SET
C d 0 0

READ 1 0. 0 0

1 0. 0 0

▲	1	0.	1	0
SET	1	0.	1	0
	C	d	0	0
	1	0.	1	0
READ	C	d	0	0

Notice: Indicate 7- segment LED flash.

§ Cd01 Setting procedure of frequency (Selective range 0~6)

The function cannot be modified during revolution.

Setting procedure of frequency is to select either panel key or external analog signal.

Cd01=0 Set frequency on operation panel, as the above items A-C.
Cd01=1 Set frequency by terminal In2 DC 0~10V/5KΩVR
Cd01=2 Set frequency by terminal In1 DC 4~20mA
Cd01=3 Set frequency by terminal In2 DC 0~10V/5KΩVR hysteresis
Cd01=4 Setting from terminal In1, input DC4~20mA hysteresis
Cd01=5 Setting value input by VR of keypad
Cd01=6 Set frequency by Multi-step function mode

§ Cd02 Select Main monitor display (Selective range 0~10）

The monitor is consisted of four 7-segment LEDs, displays frequency, current and various data by digital number and character.

Cd02=0 Display the frequency, LED HZ active
Cd02=1 Display the current, LED A active
Cd02=2 Display Ultimate speed, Hz and A LED de-active.

Cd02=3 Display DC voltage of DC BUS, showing d in front of value
Cd02=4 Display rms value of U.V.W. AC output，LED HZ, A active
Cd02=5 Display external control terminal status, showing E in front of value
Cd02=6 Display temperature rising of PIM module, showing b in front of value
Cd02=7 Display speed feedback. Check if MCK circuit working properly, then the restart and free run start function (Cd28) will working normally.
Cd02=8 Display current step of multi-step function (step)
Cd02=9 Display current time of multi-step function (minutes)
Cd02=10 Display motor vibration

§ Cd03 Torque mode (Selective range 0~1)

The function cannot be modified during revolution.

Cd03=0 Automatic torque compensation de-active, set compensation by Cd07
Cd03=1 Initial Torque boost active，set compensation by Cd52
Set compensation by Cd63

§ Cd04 Operation command mode (Selective range 0~2）

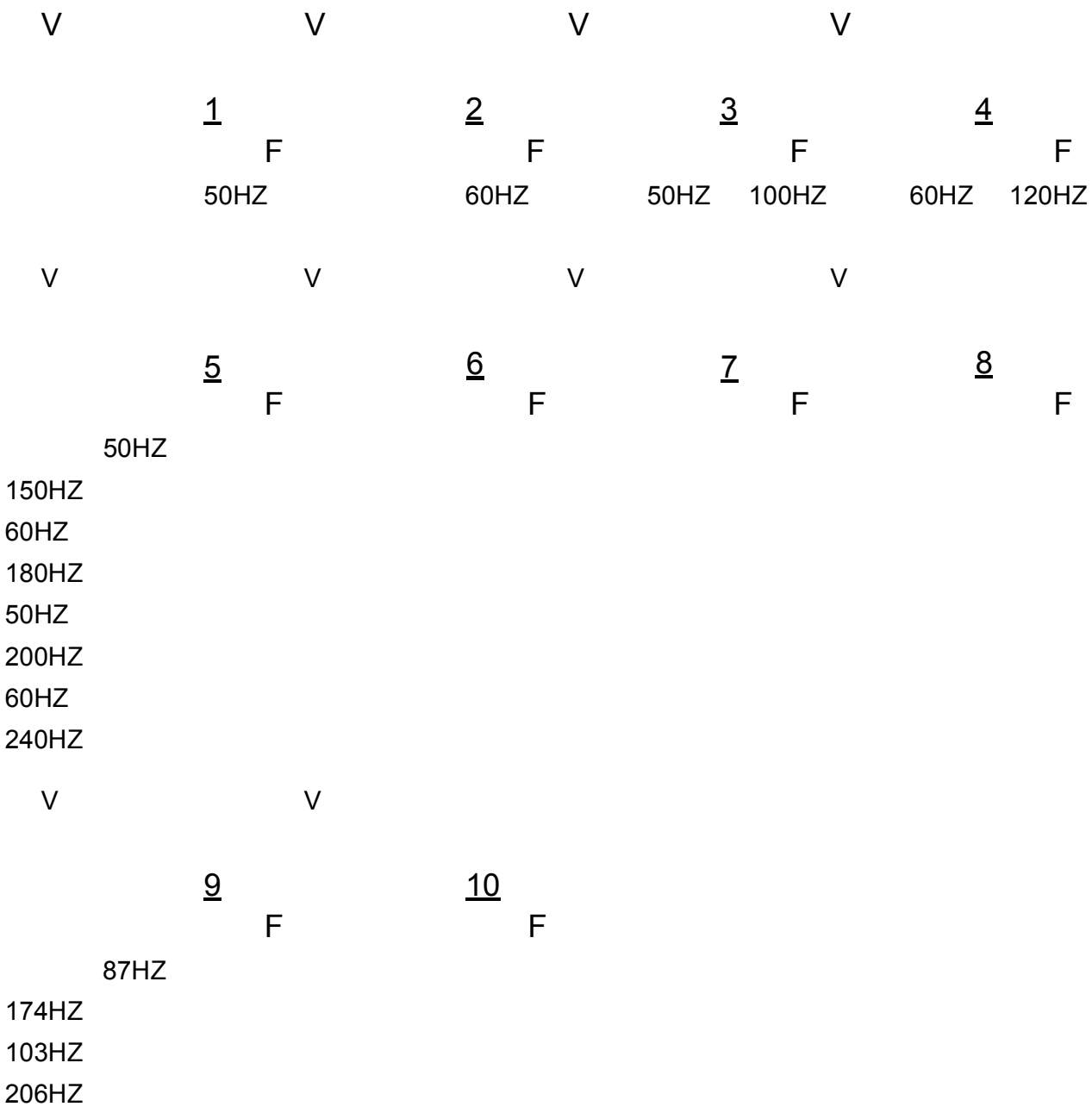
The function cannot be modified during revolution

Cd04=0 Operation on operation panel 1 ▲▼key no active
Cd04=1 Operation by external terminal, including FR, RR, terminal (1, 2, 3, 4)
Cd04=2 Operation on operation panel 2 ▲▼key fine tuning frequency

§ Cd05 Set V/F pattern (Selective range 1~14)

The function cannot be modified during revolution

There are 11 patterns of V/F slope, as follow：



When Cd05=11, V/F slope is determined by Cd57, Cd58

Cd05=12 1.5 power curve

Cd05=13 1.7 power curve
Cd05=14 square curve

V

F

60HZ

16

§ Cd06 Motor current rate (Settable range 25~100)

Set motor overload protective current, in order to avoid motor failure because of overload. Set value=100, please calculate the following formula:

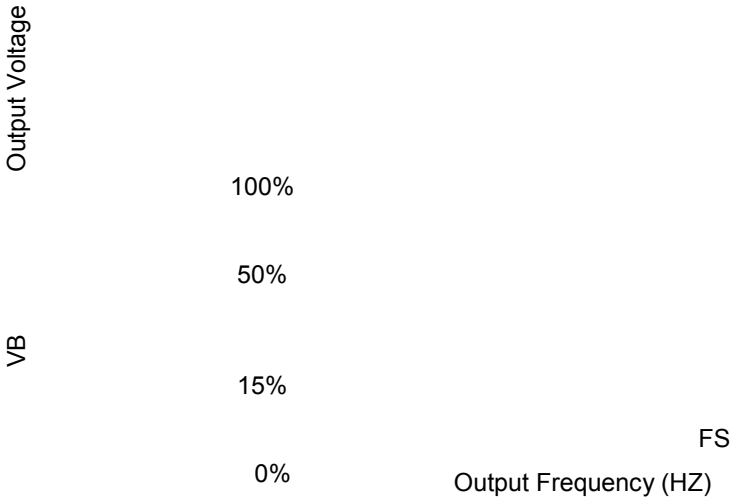
Set Value = Motor rated current / Inverter rated current ×100

Ex. Use inverter with 3.7KW(5HP) to drive motor with 2.2KW(3HP)
Inverter rated current = 17.4A
Motor rated current = 8A

Set Value = 8 / 17.4 ×100 = 46%

§ Cd07 Torque compensation Vb (Settable range 0~150)
The function cannot be modified during revolution.

This function is to raise output voltage to increase torque of motor.
It can also be used to increase load slope of low voltage produced by long wiring between inverter and motor, as well as fluid, fan and pump.



§ Cd08, 09, 10, 11 Acceleration / deceleration time (Settable range 0.1~6000)

The time needed for set frequency from 0Hz to 50Hz.

There are 2 selections for each of acceleration time and deceleration time.

To set acceleration/deceleration time

Set Value (T) = (50 - 0) / △F ×T1

T1: time needed for accelerate / decelerate

△F: frequency changed

Ex.: Frequency from 50Hz down to 30Hz, needed time 1 sec. Then:

Set Value (T) = 50 / 50 - 30 ×1 = 2.5

Cd08 = Acceleration time

Cd09 = Deceleration time

Cd10 = 2nd Acceleration time

Cd11 = 2nd Deceleration time

Note: The 2nd acceleration/ deceleration time only available on external operation mode. (E.g. Cd04=1)

§ Cd12, 13, 14 Speed setting (Settable range 0.5~240)

This function has 4 kinds of speed setting

The 2nd, 3rd, 4th speeds are set from external terminal FR (or RR) which accommodate terminal 3, 5, the setting value cannot exceed the allowed range.

Cd12 = 2nd speed setting

Cd13 = 3rd speed setting

Cd14 = 4th speed setting

Note: When apply to multi-speed setting, use external control (e.g. Cd04=1) to start and use panel to pre-input to set frequency.

§ Cd15 Jogging frequency (Settable range 0.5~30)

To control jogging, use external terminal DI3 accommodate FR or RR with COM shorted. Set running direction

Set running direction

FR or RR

DI3

Running mode

Jogging

Forward(reverse)

Note: Jogging operation is valid only when operation command selects the external operation signal mode (e.g. Cd04=1) and Cd59=0 or 1.

Jogging operation procedures:

1. First put in DI3, and then FR(or RR).
2. Put in DI3and FR (or RR) simultaneously.

Be sure always to put in DI3before FR(or RR).

§ Cd16 Start frequency (Settable range 0.5~60)

Set motor start frequency

Settable range of frequency from 0.5Hz to 30Hz, accuracy is 0.01Hz.

Frequency

Start Frequency

Time

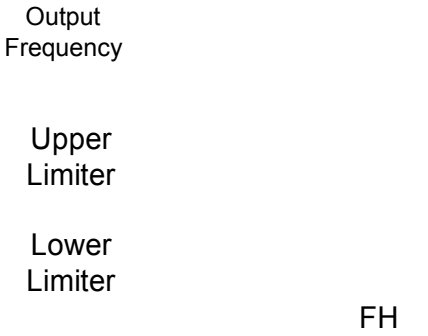
Note: The most appropriate range for start frequency is 0.5Hz to 10Hz.

§ Cd17 Upper limiter of frequency (Selective range 10~240)

This limiter is used to operate within upper limit frequency of motor
Avoid input errors caused by the panel keys and result in mechanical damage.

§ Cd18 Lower limiter of frequency (Settable range 0.5~100)

This limiter is used to operate within lower limit frequency of motor



Set Frequency Operation

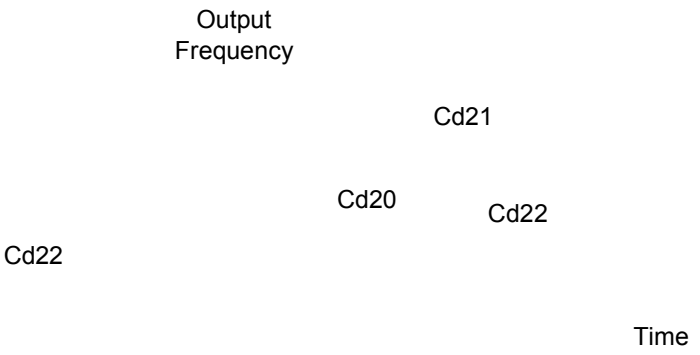
§ Cd19 Acceleration / deceleration time of jogging (Settable range 0.10~30.00)

Time needed for set frequency from 0Hz to 50Hz.
Set Value (T) = (50 - 0) / △F ×T1
T1: Time needed for acceleration/deceleration
△F: Frequency changed

§ Cd20, 21 Jump frequency (Settable range 0~240)

This function is to avoid mechanical resonance frequency
Frequency operation automatically jumps to point ＋/－ jump width (set by Cd22)

This function is only available on constant speed operation, not influence during acceleration/deceleration, it is settable at 2 points.



§ Cd22 Jump frequency width (Settable range 0-6)

This function must accommodate Cd20 and Cd21

§ Cd23 Braking mode (Settable range 0-3)

This function must accommodate Cd24, Cd25, and Cd26.
Cd23=0 No DC braking
Cd23=1 Stop mode
Cd23=2 Start mode
Cd23=3 Stop and start mode

§ Cd24 DC braking frequency (Settable range 1~60)

This function must accommodate Cd23, Cd25, and Cd26.
Set frequency of DC brake starts at the time of inverter deceleration stops, the DC brake is active when operates below the starting frequency.

§ Cd25 DC braking voltage (Settable range 1~15)

This function must accommodate Cd23, CD24, and Cd26.
DC braking torque setting
Cd25=1-15, the higher value the higher output brake torque

Note: When DC brake voltage is high, be aware of over current.

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§ Cd26 DC braking time (Settable range 1~60)

Adjust DC braking time

Start
Frequency

Braking
Rate
Braking
Frequency

Braking Time

Time

Time

Note:

1. DC braking time too long or too many times is possible to cause motor damage because of overheating.
2. Set Cd23=0 when DC braking is not required.

§ Cd27 Motor running direction (Settable range 0~2)

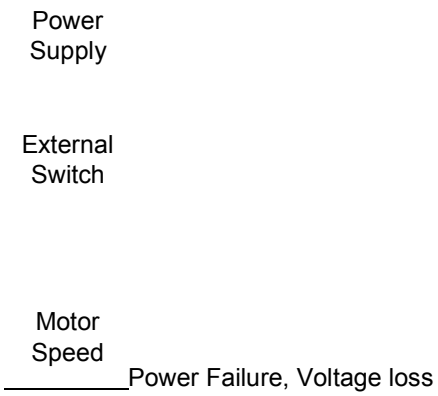
Fix motor running direction to prevent mechanical damage.

Cd27=0	both forward, reverse directions available, stop before changing direction.
Cd27=1	both forward and revise directions available, No stop required.
Cd27=2	only forward operation is available.
Cd27=3	only reverse operation is available.

§ Cd28 Restart / Free run start (Settable range 0~3)

Cd28	Restart	Free run start
0	No function	No function
1	With function	No function
2	No function	With function
3	With function	With function

1. Free run restart function:
   When power supply failure occurs or voltage loss, there may be a malfunction on PCB control circuit, this function is to return to the original setting of speed and frequency after power recovery.



speed

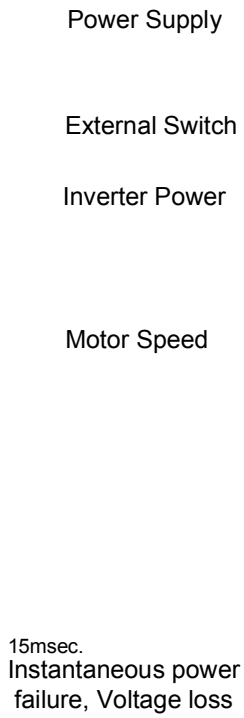
Note:
2 sec.
2 sec.

(1) Free run direction must be the same as setting direction.
(2) After power recovery, there is about 2 sec. delay time (motor frequency detect) for start.
Restart after power recovery, the inverter will output a frequency signal first to detect if it conforms the frequency of free run, if the two frequencies are equal, the inverter output rated voltage then. The purpose is to prevent over current to happen.

2. Restart after instantaneous power failure
This function if different from free run restart, the inverter control power is maintained above 5V.

Restart after instantaneous power failure: no function

Restart after instantaneous power failure: with function
When it detects low voltage “PLU”, it activates “STOP”,
“PLU”. After recovery of voltage, “PLU” are de-active, “STOP” remains the same, and it will have to switch “ON” again to restart if you select external control, if you select panel control, just press “FWD” or “REW” key to restart.
Restart motor under free run.



Note: The inverter will be de-active when control voltage is less than 5V.
Apply with free run restart function when it is required.

§ Cd29 Time (Settable range 0~9000)

This function must accommodate Cd47=0 setting.
When motor starts operation, the time counter is active.

§ Cd30 Stop by panel key (Settable range 0~1)

Cd30=0 No function
Cd30=1 with function

Stop function: This function enables the inverter to be stopped by panel key while the inverter is operated by external sequence.

§ Cd31 Initial factory setting (Settable range 0,1)
The function cannot be modified during revolution.

Set data to original factory setting.
Cd31=0 No change
Cd31=1 Initial factory setting, refer to function code table.

Note: After this function is active, content value returns to “0”, readable value is always “0”.

§ Cd32、33、34、35 DI1~DI4 external terminal function setting（Settable range 0~7)

Setting external terminal by operator request, after external terminal put in, according to Cd32 is DI1 function setting、Cd33 is DI2 function setting、Cd34 is DI3 function setting、Cd35 is DI4 function setting.

0: No motion
1: Two kinds of speed order〔2DF〕
2: Three kinds of speed order〔3DF〕
3: Five kinds of speed order〔5DF〕
4: Two kinds of acceleration time〔2AC〕
5: Two kinds of deceleration time〔2DC〕
6: JOG
7: Inertia stop operation〔MBS〕
8: Failure clear and Programable Logic Controller〔PLC〕time reset〔RST〕

Notice: When setting is 7〔MBS〕or 8〔RST〕，directly set the external terminal short to act without assume external operation pattern.

§ Cd36 Failure record clear (Settable range 0, 1)

Clear the failure record content of Code 32, 33, 34, and 35.
Cd36=0 No change
Cd36=1 All of the contents of data will be “nOnE”, display of “LoAd” after setting
Note: After this function is active, content value automatically returns to “0”, thus readable value is always “0”.

24

§ Cd37 Frequency gain setting (Settable range 20~200)

Select ratio of frequency gain
Gain setting for external input signals are available using this function.
Output Frequency = Set Value ×Frequency Gain ×MAX. Frequency

Ex. Under the mode of external voltage (0-10V) frequency setting, frequency gain = 100%, set voltage to 2V,MAX. Frequency (FH) is 120Hz:
Output Frequency = (2V/10V) ×120Hz ×100% = 24Hz
If change frequency gain to 150%, then
Output Frequency = (2V/10V) ×120Hz ×150% = 36Hz

200%

100%

200 100

20%
0V

4mA
20

10V
20mA
Analog Setting Signal

Note: If the maximum frequency (FH) exceeds more than 120Hz, gain setting of larger than 100% is ignored and fixed at 100% and input data of Cd37 will not be changed.

§ Cd38 Analog output calibration (Settable range 90~110)

Set the ratio of frequency graduation calibration then
Cd38=99: 99% of initial factory
Cd38=101: 101% of initial factory
Set Cd54 to select analog output

25

§ Cd39 Frequency command bias (Settable range 0~250)

External analog frequency command bias setting

Output Frequency %

250

Setting range

125 0V

0

10V

Frequency
directive

§ Cd40, 41, 42, 43 Multi-speed setting (Settable range 0.5~240)

This function has 8 kinds of speed operation
Use external terminal FR (or RR) accommodate DI1, DI2, DI3, DI4 to select different speeds. Refer to the following table:

Cd40= 5th step speed setting
Cd41= 6th step speed setting
Cd42= 7th step speed setting
Cd43= 8th step speed setting
Example：DI1 set to be 2DF、DI2 set to be 3DF、DI3 set to be 5DF(DI1～DI4 any three of them, could be set to be 2DF、3DF、5DF)
◯ : Stands for external terminal to put in.

External Terminal Name /Setting Function	Selective speed					
	2	3	4	5	6	7	8
DI1 2DF	◯		◯		◯		◯
DI2 3DF		◯	◯			◯	◯
DI3 5DF				◯	◯	◯	◯

◯ : Stands for external terminal to put in.

Note: Apply to multi-speed setting external control is required for operation control mode (e.g. Cd04=1).

26

§ Cd44 Stop mode (Settable range 0~2)

Cd44=0 Deceleration stop
Cd44=1 Free run stop
Cd44=2 Free run stop, but restart after the deceleration time is reached, deceleration time is set by Cd11.

§ Cd45 Frequency detect level (Settable range 0.5~240)

This function is only available when RELAY output terminal Cd47=6 or Cd48=6, and Cd45 is assigned.

§ Cd46 Speed multiplier (Settable range 0.01~500)

The function shows revolution speed multiplied by a scaling factor on the Display.

Note: 1. HZ and A LED de-active.
2. RPM = Frequency ×Cd46
3. If the value overflow, it will show “9999”.

§ Cd47 Relay 1 output select (Settable range 0~6)

The function sets the mode of relay1 to activate.

Cd47	Specification	Remark
0	Time counter	Time reached to the content of Cd29
1	Fault	
2	Stop	
3	Acceleration	
4	Speed reached	
5	Deceleration	
6	Speed pass over	Revolution frequency ＞content of Cd45
7	Current pass over	Current percentage＞content of Cd48

27

§ Cd48 Detect current level（Settable range 40~150）

The function is RELAY output terminal function selection Cd47=7, Cd48 allocate motion calibration, Cd59 set reset.

I OUTPUT

CD48

Time

No-Nc

OPEN

CLOSE

Time

§ Cd49 Function to lock data (Settable range 0, 1)

To lock data, prevent errors by none operator.
Cd49=0 Data change capable
Cd49=1 Data change not capable

§ Cd50 Software version (Read only)

This function is to record software version, read only.

28

§ Cd51 Motor rated voltage setting Vr (Settable range 10~450)

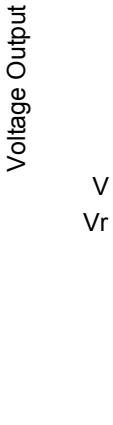
This function cannot be modified during revolution.

RMS Setting

A. 220V Series: Value of Cd51 = Motor rated voltage / 1
A. 380V Series: Value of Cd51 = Motor rated voltage / 1.73
B. 460V Series: Value of Cd51 = Motor rated voltage / 2

Ex.

a. If the motor rated voltage 220Vrms. Power supply voltage 220Vrms, then setting Cd51=220/1=220, then the inverter output Vrate=220Vrms.
b. If the motor rated voltage 380Vrms. Power supply voltage 380Vrms, then setting Cd51=380/1.73=220, then the inverter output Vrate=380Vrms.
c. If the motor rated voltage 460Vrms. Power supply voltage 460Vrms, then setting Cd51=460/2=230, then the inverter output Vrate=460Vrms.



1. Vin ＞Vrate when Fr ＜Fb Vout = Fr / Fb ×Vrate
   when Fr ＞Fb Vout = Vrate
2. Vin ＜Vrate when Vout ＜Vin Vout = Fr / Fb ×Vrate
   when Vout ＞Vin Vout = Vin

Vin: Power supply voltage
Vout: Inverter output voltage
Vrate: Motor rated voltage
Fr: Inverter revolution frequency
Fb: base frequency

§ Cd52 Auto voltage compensation (settable range 0.5%~15.0%）
The function cannot be modified during revolution.

The function is to compensate torque of motor in low r.p.m. Auto voltage compensation

parameter is to increase torque to increase output voltage
This function must accommodate the content of Cd03、Cd63

§ Cd53 Motor slip differential compensation (Settable range 0~100)

This function is to compensate speed variation produced by load variation.
This function must accommodate the content of Cd52.
Setting value 0-100 in relative slip differential 0.0-10.0%
Ex. 60HZ, 4-pole 1700 rpm
Synchronous speed = 1800 rpm
Full-load speed = 1700 rpm
Slip differential speed = 1800-1700=100 rpm
Slip differential % = Slip differential speed / Synchronous speed ×100%
= 100 / 1800 ×100%
= 5.5%, Setting Cd52=55

Slip differential compensation

Load
variation

Time

Motor speed

Motor speed

Output frequency
Without slip
differential compensation

With slip differential compensation

With slip differential compensation

§ Cd54 External analog output selection (Settable range 0~1)

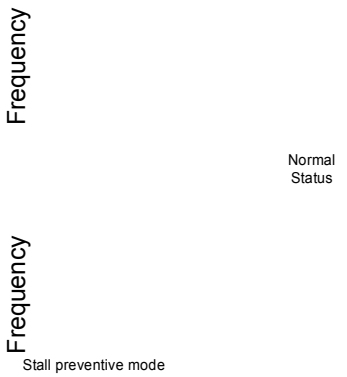
Indicate analog output Vout terminal（0～10V）Physical definition of output single.
Cd54=0 Indicate output frequency.
Cd54=1 Indicate output current

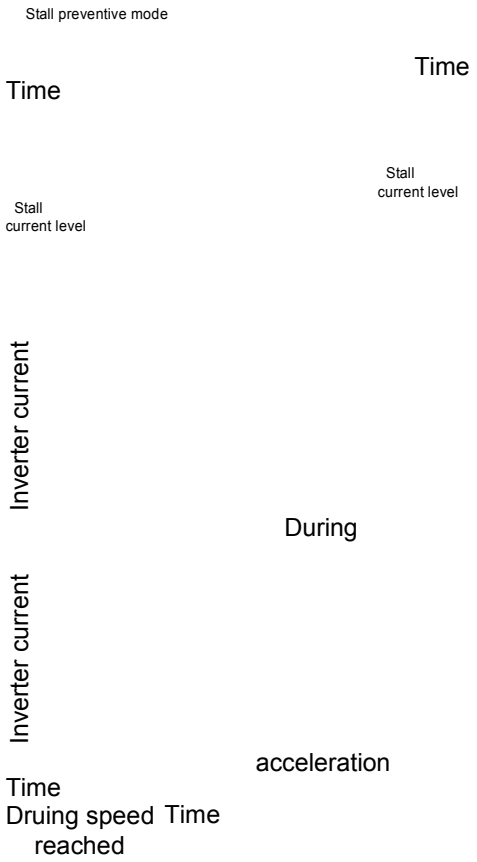
§ Cd55 External analog input selection (Settable range 0~1）

Setting value IN1、IN2	
0	0V indicate 0HZ，10V indicate operation highest frequency。
1	0V indicate operation highest frequency，10V indicate 0HZ。

§ Cd56 Over current stall preventive mode (Settable range 10~200%)

This function is to prevent when motor current exceeds stall current from stall. There are 2 kinds of acceleration time slopes when motor acceleration current exceeding stall current occurs:
Instantaneous load increase during steady operation and current exceeding over current stall, revolution frequency will drop till current dropped to within stall current level.





§ Cd57 Maximum frequency setting FH (Settable range 10~240)

This function cannot be modified during revolution.

When Cd05=11, the maximum frequency V/F slope FH
Settable range 10Hz-240Hz
Please refer to function code table Cd60.

§ Cd58 Base frequency setting Fb (Settable range 10~240)
This function cannot be modified during revolution.

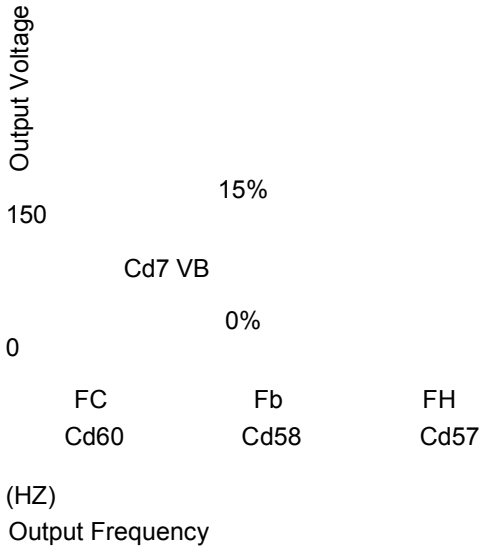
When Cd05=11, the base frequency V/F slope Fb
Settable range 10Hz-240Hz (Fb ≦FH). Please refer to function code table Cd60.

§ Cd59 Stagnancy of current detected (2~10%)

This function accommodate the content of Cd47、Cd48
When Cd47=7，Detect current level over Cd48，input RELAY，but current must be decreased to equal to the value of C48 minus the value of Cd59，RELAY will be opened.

§ Cd60 V / F frequency FC (Settable range 0.5~240)
This function cannot be modified during revolution.

To set V/F slope frequency FC when Cd05=11.
Settable range 10Hz-240Hz (FC ≦Fb)



§ Cd61 PWN frequency (Settable range 0~7)
This function cannot be modified during revolution.

This function is to set PWM frequency.

Cd61	PWM Frequency
0	Setting by Cd62 (1.5-4.0Hz)
1	4 KHZ
2	5 KHZ
3	6 KHZ
4	7 KHZ
5	8 KHZ
6	9 KHZ
7	10 KHZ

Note: When exceed 10kHz, please set=0, maxima 16khz by Cd62

§ Cd62 PWM Frequency (Settable range 15~160)
This function cannot be adjusted during operation.

This function is to set PWM frequency. Frequency (KHZ)= settable value/ 10

Ex: Cd62 = 15, PWM Frequency = 1.5KHz
Ex: Cd62 = 30, PWM Frequency = 3.0KHz

§ Cd63 Start frenquency of auto voltage compensation（Settable range 3.0～20.0HZ）
The function cannot be modified during revolution.

This function is the point of motion to assume auto compensation voltage start

frenquency.
This function accommodate the content of Cd03、Cd52

§ Cd64 Dynamic braking range (Settable range 0-1)
This function cannot be adjusted during revolution.

Cd64 = 0 Dynamic braking can be active during acceleration, deceleration and constant speed.
Cd64 = 1 Dynamic braking can be active during acceleration and deceleration, but not active during constant speed operation.

§ Cd65 Instant initial field time (Settable range 1-7)
This function cannot be adjusted during revolution

This function is to adjust instant initial field current of motor. Shorter of the time is higher of the field current.

Cd65	Instant initial field time
1	64mS
2	128mS
3	256mS
4	512mS
5	1024mS
6	2048mS
7	4096mS

Output Frequency

Set frequency
DC braking frequency in stopping Cd24

§ Cd66 Digital filter function (Settable range 1-6)
This function is adjustable during revolution

This is function is active as digital filter while invert with external analogue input. Increasing the figure to stabilized frequency while noise of external analogue input is higher. Decrease the figure when inverter required to response faster.

Cd 66	Digital filter time
1	4 ms
2	8 ms
3	16 ms

4	32 ms
5	64 ms
6	128 ms

§ Cd67 Power source positioning accuracy calibration (Settable range 0-20)
This function is adjustable during revolution

This function is to adjust the calibration of voltage positioning on DC BUS between detected and actual position. The display value of Cd02=3 will be lower when Cd67 set at bigger figure. Cd02=3 display will be higher when Cd67 setting at smaller figure.

§ Cd68 Motor vibration compensation (Settable range100～500)
The function cannot be modified during revolution.

This function is being modified vibration when the motor spin out, set Cd03=0
When the motor vibrates and know the value of vibration by Cd02=10
E.g.: cause Cd02=10 indicate 160 ～ 210，assume Cd68 = 200

§ Cd69 Motor speed search time
The function cannot be modified during revolution.

Adding Function

§ Cd70 Dynamic Braking active level (Settable range 120~140)
This function cannot be modified during revolution

This function is to adjust active point of dynamic braking.

Note:
220V series: protection point voltage (VDC)= Cd70 ×200V ×% ×√2
400V series: protection point voltage (VDC)= Cd70 ×400V ×% ×√2

§ Cd71 Over Voltage prevention function active point (Settable range 130~150)
This function cannot be modified during revolution

This is to adjust the over voltage protection active point when over voltage occurred.

Note：
220Vseries：active voltage (VDC)= setting value ×200V ×% ×√2
400Vseries：active voltage (VDC)= setting value ×400V ×% ×√2

§ Cd79 Auto saving function setting (setting range 0~1)
This function can't be modified during revolution.

Whether select to use memory function of power failure or not.
Cd79=0 Disable auto saving
Cd79=1 Enable auto saving. When power off and current step PLC will be recorded automatically.

§ Cd80 Modbus Protocol and communication mode setting (settable range 0-6)
This function can't be modified during revolution.

Selection of operation method on RS485 communication port. Supporting Modbus Protocol.
Cd80=0 RS485 shut down communication interface.
Cd80=1 Active RTU Mode(8,n,1). Parameter change is not allowed.
Cd80=2 Active RTU Mode(8,n,1). Allow changes on general parameter.
Cd80=3 Active RTU Mode(8,n,1). Allow changes on operation instruction and general parameter.

§ Cd81 RS485 communication address setting (settable range 1-240)
This function cannot be modified during revolution

Corresponding communication address should be set in advance when active RS485 communication function. Inverter is at slave side.
Note: Communication function refers to manuals of interface.

§ Cd82 Series communication baud rate setting (settable range 0-3）
This function can't be modified during revolution.

Setting of Baud rate during communication
Cd82=0 2400 bps
Cd82=1 4800 bps
Cd82=2 9600 bps
Cd82=3 19200 bps
Note: Re-start inverter after setting Baud rate.

§ Cd83 Series communication response time setting（settable range 0-15）
This function can't be modified during revolution.

Setting waiting time for response when inverter receive correction data.
MODBUS RESPONE TIME=4ms * CD83

§ Cd90 Series communication parameter store eeprom（settable range 0～1）

Cd90=0 unstore
Cd90=1 store one data and reset 0

§ CE00,01,02,03 Failure record

Record cause of failure, in order to solve failure.

Note: 1. Cannot record failure Err, Ero, Erc.
2. Only memorize 4 records.
3. Cannot record inverter stopped by low voltage.
4. Read only Cd00,01,02,03 or delete all (Code 36), cannot put in failure record by operator.

§ CE05 ~ CE20 Multi-step function control frequency setting（settable range 0.5~240HZ）

Maximum 16 steps.

CE05 1st step speed setting
CE06 2nd step speed setting
CE07 3rd step speed setting
CE08 4th step speed setting
CE09 5th step speed setting
CE10 6th step speed setting
CE11 7th step speed setting
CE12 8th step speed setting
CE13 9th step speed setting
CE14 10th step speed setting
CE15 11th step speed setting
CE16 12th step speed setting
CE17 13th step speed setting
CE18 14th step speed setting
CE19 15th step speed setting
CE20 16th step speed setting

§ CE21 ~ CE36 Multi-step process control time setting（settable range 0 - 100Min）

Maximum 16 steps. End of entire procedure if time setting = 0.

CE21 1st step time setting
CE22 2nd step time setting
CE23 3rd step time setting
CE24 4th step time setting
CE25 5th step time setting
CE26 6th step time setting
CE27 7th step time setting
CE28 8th step time setting
CE29 9th step time setting
CE30 10th step time setting
CE31 11th step time setting
CE32 12th step time setting
CE33 13th step time setting
CE34 14th step time setting
CE35 15th step time setting
CE36 16th step time setting

§ CE47 Multi steps function modes selection（settable range0~1）
The function cannot be modified during revolution

Select operation modes on speed variation when process control switch from previous step to next step.

CE47=0 Liner operation

CE47=1 Gradually operation. (Perform time can set to zero, when perform time set to 0, perform time will according to CD08, CD09 increase or decrease. If the step frequency set to 0, the step will be ended.)

Liner operation

Gragually operation

§ CE48 Multi steps function operation reset (settable range0~1)
The function cannot be modified during revolution

Memorized of current operation step and time (in sec) while shut down or power failure.
Step and time reset to 0 when set CE48=1.
Note: External terminal 6 set to RST function, when RST connect with COM, it will reset the records and steps time to 0.

§ CE49 Multi steps process control continuous operation (settable range0~1)
The function cannot be modified during revolution

Selection of shut down or start from 1st step while entire operation procedure finished.
CE49=0 Not continuous operation.
CE49=1 Continuous operation. From 1st steps' speed continuous operation.

CE49=2 Continuous operation, perform speed as the last speed in the step, till the RST or CE48 set to1, then change to first step's speed.

Not continuous operation

Frequency

last step
First step

Continuous operation

frequency
t

From 1st step speedcontinuous operation.

last step
First step

Continuous operation, perform speed as the last speed in the step, till the RST or CE48 set to1

frequency

Last step
First step
t

Perform speed as the last speed in the step, till the RST or CE48 set to 1, then change to first step's speed to continuous operation

t

§ CE52 Choice of multi-speed record file (settable range 1~6)
The function cannot be modified during revolution

The setting cannot be changed while the machine is working.
According to the needs of the user, choose different file for the current step, the data CE05~CE36 are stored in the files.

§ CE53 Multi-steps all files set to default (settable range 0~1)
The function cannot be modified during revolution

The setting cannot be changed while the machine is working.
CE53=0 Data remain unchanged.
CE53=1 Reset data in files 1-2 to default.

§ CE54 Multi-steps memory duplicate function (settable range 1~6)
The function cannot be modified during revolution

The setting cannot be changed while the machine is working.
Duplicate current using file (CE05~CE36) to CE54 .

§ CE61 Input terminal for Set Point and PI feedback (settable range 0~7)
The function cannot be modified during revolution

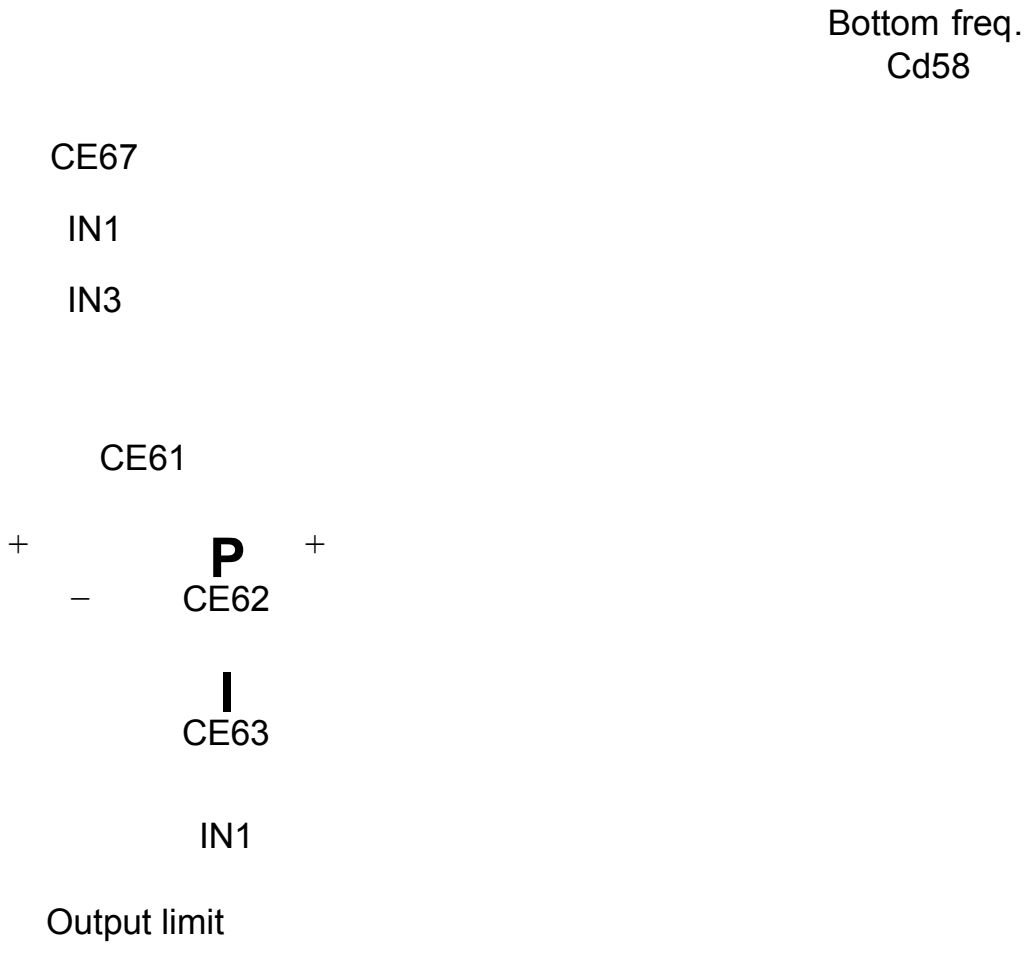
CE61	Target value	PI feedback terminal
0	De-active PI control	
1	CE67	IN1
2	CE67	IN2
3	KEYPAD	IN1
4	KEYPAD	IN2
5	IN1	IN2

Note:

1. IN1(4~20mA) scale to 0~100.0 %， IN2、IN3(0~10V) scale to 0~100.0 %
2. Output frequency = PI output frequency + set frequency
3. Make sure this parameter setting does not conflict with the setting for Cd01 (Set frequency source).
   Ex: If Cd01=1 then the parameter CE61 cann't be modify to 2, 4 or 7.

§ CE62 Proportion gain (settable range 0~10.0)

This parameter specifies proportional control and associated gain (P).



+ CE65

PI Output freq.

IN2

§ CE63 Integral gain (settable range 0.2~1000.0 sec)

This parameter specifies integral control (continual sum of the deviation) and associated gain (I).

§ CE65 PI output limit setting (settable 0~100 %)

This parameter defines the percentage of output limit during the PID control.

§ CE67 PI control target value 1 (settable 0~100.0 %)

This parameter defines the percentage of target value.

7. Description of alarm display indications

Error indication	Description of fault operation	Item for inspection	Processing
Err	Operation error	Was the unit operated as indicated in the manual	Use the correct procedure
ErO	Operation error of internal ROM, RAM	Switch off the power and then apply again	Replace the unit

ErC Error of internal CPU Is there a large amount of external noise
Check the contact absorber. Install a noise filter
OCPA Over current (180% rated current)
OCPd Over current (180% rated current)
OCPn Over current (180% rated current)
Was there rapid acceleration Lengthen the acceleration time

Was there rapid deceleration Lengthen the deceleration time

Was there any variation in the load Lengthen the time for the load variations
OC Over current (200% rated current)
Was there rapid acceleration / deceleration and variation in the load
Lengthen the acceleration and deceleration time and reduce the load
OCS Output short circuit or ground detected Is there a short circuit for the output or grounding for the motor Perform a megger check for the motor
OU DC link over voltage Was there fast deceleration, or fast voltage
Lengthen the deceleration time. Investigate the use of the optional DBR
LU Insufficient voltage detected due to power failure or instantaneous power loss.
LU A Insufficient voltage detected due to power failure or instantaneous power loss. And the auto save function is working
OH Overheating of the cooling fan detected
Is there a low voltage at power, or internal inverter wiring error

Is there a low voltage at power, or internal inverter wiring error

1. Cooling fan stops
2. Ambient temperature too hot
3. Motor being overload

Improve the voltage condition and confirm inverter model

Improve the voltage condition and confirm inverter model

1. Exchange the cooling fan
2. Lower the ambient temperature
3. Check the load conditions

OL Overload detected for more than one Is the motor being overloaded Increase the capacity of the

minute

OL A	Overload warning, the motor is nearly 1min, 150% overload.
bUOH	DBR overheat detected
PLU	Power voltage too low

inverter and motor

Is the motor being overloaded	Increase the capacity of the inverter and motor
Is the braking ratio appropriate	Reduce GD^2 of load or lengthen deceleration time
Is power voltage too low	Improve power supply condition

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8. Troubleshooting

Description of trouble Possible cause Solution

The motor does not run at all

"OCPA" is indicated

1. Wiring error Refer to the wiring diagram
   1. Check the power input wiring
   2. Is there a voltage for U.V.W output
2. Wrong settings at operator panel The function code No.04 is as follows
   0: Panel key operation
   1: External signals
3. Inverter displays fault indication Refer to "Protect Function"
4. Motor cannot start due to overload Exchange a higher capacity one
5. Motor breaks down Repair motor
6. Inverter breaks down Please contact us

1. Motor wiring error Refer to the wiring diagram

as soon as the motor 2. Terminals of inverter and motor

Banish circuit shorted or ground connection

is started.

(Overcurrent protects operation during acceleration.)

(U.V.W.) circuit shorted or ground connection

3. Overload Reduce the load or increase inverter capacity

4. Is V/F slope appropriate — Check Code 05 V/F slope is appropriate with motor specification
5. Is start torque appropriate — Adjust Code 07 torque boost to over come steady friction but not over current trip.
6. Is the acceleration time too short when compared to load GD^2

7. The inverter is starting during motor free-run

Lengthen acceleration time by apply Code
08 and Code 10 or increase inverter capacity
Refers to Code 28, change the value from 0
to 1

"OCPd" is indicated

1. Deceleration time too short, unable — Apply Code 09 and Code 11 to lengthen
as the motor is decelerating. (Over current protects operation during deceleration).

"OC" or "OCS" is indicated during operation. (Over current)
to be loaded

1. Short circuit on U.V.W or grounding for motor
2. Instantaneously mechanical load on motor

deceleration time or increase inverter capacity

Exclude short circuit or grounding

Reduce load or increase inverter capacity

3. Motor breaks down — Repair motor
4. Inverter breaks down — Please contact us

"OU" is displayed during inverter

1. Is power voltage with the specification

Improve power voltage condition
operation

2. Braking resistor not applied — Apply braking resistor, increase braking ratio
3. Deceleration time too short, unable — Apply Code 09 and Code 11 to lengthen

"PLU" is displayed during inverter operation
to be loaded

1. Is power voltage with the specification
2. Instantaneous power voltage failure
3. Power dropped and the protector function has operated

deceleration time
Improve power voltage condition

Check the capacity of the power facilities

Check the capacity of the power facilities

"OL" is displayed

1. Overload — Reduce load or increase inverter capacity
during inverter operation

"OH" is displayed during inverter

2. Is inverter over current limiter appropriate
1. Check if the cooling fan is still working

Apply Code 06 to re-set motor rated current

Change cooling fan and clean dirt
operation 2. Is ambient temperature too hot Improve ambient temperature condition
No any indication,
1. Power failure Check the capacity of the power facilities
the output frequency displayed “0”
2. Is there loosen part on external control terminal
Check external control terminal

9. Maintenance and Inspection

Maintenance and inspection must be taken under power off.

Cautions on maintenance and inspection:

(1) Capacitor is charged at high voltage for a while after turning off the power. (Accordingly, start the inspection work at least 5 minutes after turning off the power)

(2) Do the work with operator.

Inspection items:

(1) Please check the following items
   A. Motor runs as expected.
   B. Avoid installing on circumstances like acid, alkaloid.
   C. No trouble is recognized in the cooling system and irregular vibration or noise.
   D. No parts is overheated or burned.

(2) Periodic inspection

Interval	**Inspection item**
Every 6 months	1. Terminal plates and mounting bolts. 2. Corrosion and breaks in the terminal clips for the wiring. 3. Condition for the connector fixing.
Once a year	1. Use clean, dry air to remove dust buildup from the guards, the stack and the cooling fan. 2. Check for parts burns or damage and make any exchanges necessary.

10. STANDARD SPECIFICATION

A. 200Vseries 1 phase

Motor rating (KW)	0.375＊	0.75	0.75＊	1.5	1.5＊
Model CT2001	ES-A37	ES-A75	ESe-A75	ES-1A5	ESe-1A5
Rated current (A)	2.4	4.2	4.2	6.2	6.2
Rated capacity (KVA)	0.96	1.8	1.8	2.9	2.9
Power supply	1 ϕ 200~230V ±10% 50HZ±5% or 1 ϕ 200~230V ±10% 60HZ±5%				
Output voltage	3 § 200V、220V、230V				

Control method	Sine P.W.M. Control
Frequency accuracy	Digital setting: ±0.1% Analog setting: ±0.5% (35℃)
Frequency resolution	Digital setting: 0.5～100Hz→0.01Hz 100Hz～240Hz→0.1Hz Analog setting: (setting value/ 1000) Hz
Frequency range	0.5～240HZ（Initial frequency 0.5～30Hz）
V/F ratio	10 patterns, or any V/F patterns
Torque compensation	0～15.0％ voltage compensation, automatic voltage compensation
Acceleration/ Deceleration time	0.1～6000 sec（linear, two-step setting）
Motor Braking	No DB Transistor
DC Braking	DC Injection Braking（Setting mode, torque, time, active frequency）
Standard feature	Free run restart, jogging speed, upper/lower frequency limit setting, jump frequency setting, 8-step speed setting, frequency indicated output (DC0～10V), operation direction setting, forward/reverse prohibit, voltage/current limit, data lock, EMI (with CT2000ESe only)
Relay Output	Arrival with timer, failure, stop, acceleration, frequency equal, deceleration, over frequency
Frequency setting	Digital setting by keypad, or external analog signal（DC0～10V，DC4～20mA）

Display	7-segment LED display: Frequency, current, voltage, setting value, function, failure status, Temperature of PIM module				
Protection	Low voltage, over voltage, instantaneous power failure, over voltage stall, overload, over current stall, instantaneous over current, acceleration over current, deceleration over current, over heat.				
Overload capacity	150% for 1 min, anti-time limit function, adjustable (25～100%)				
Altitude	Altitude 1,000m or lower, keep from corrosive gasses, liquid and dust				
Ambient Temperature	-10℃～50℃ (Non-condensing and not frozen)				
Storage Temperature	-20℃～60℃				
Humidity	Relative between 45% to 90% (No condensing)				
Cooling system	Forced air-cooling				
Weight (Kgs)	1.6＊	1.6	1.6＊	2.5	2.5＊

Note 1: Braking resistor specification refer to page 6
＊: Under development

B. 200Vseries 3 phase

Motor rating (KW)	0.375＊	0.75	0.75＊	1.5	1.5＊	2.2	2.2＊	3.7	3.7＊
Model CT2002	ES-A37	ES-A75	ESe-A75	ES-1A5	ESe-1A5	ES-2A2	ESe-2A2	ES-3A7	ESe-3A7
Rated current (A)	2.4	4.2	4.2	7.4	7.4	11.1	11.1	18	18
Rated capacity (KVA)	0.96	1.8	1.8	2.9	2.9	4.4	4.4	7.1	7.1
Power supply	3φ200~230V ±10% 50HZ±5% or 3φ200~230V ±10% 60HZ±5%								
Output voltage	3φ 200V、220V、230V								
Control method	Sine P.W.M. Control								
Frequency accuracy	Digital setting: ±0.1% Analog setting: ±0.5% (35℃)								
Frequency resolution	Digital setting: 0.5～100Hz→0.01Hz 100Hz～240Hz→0.1Hz Analog setting: (setting value/1000)Hz								
Frequency range	0.5～240HZ（Initial frequency 0.5～30Hz）								
V/F ratio	10 patterns, or any V/F patterns								
Torque compensation	0～15.0% voltage compensation, automatic voltage compensation								
Acceleration/ Deceleration time	0.1～6000 sec（linear, two-step setting）								
Motor Braking	DB Transistor built-in, connect braking resistor to reach 100% regeneration braking (Note 2)								
DC Braking	DC Injection Braking（Setting mode, torque, time, active frequency）								
Standard feature	Free run restart, jogging speed, upper/lower frequency limit setting, jump frequency setting, 8-step speed setting, frequency indicated output (DC0～10V), operation direction setting,								

	forward/reverse prohibit, voltage/current limit, data lock, EMI (with CT2000ESe only)								
Relay Output	Arrival with timer, failure, stop, acceleration, frequency equal, deceleration, over frequency								
Frequency setting	Digital setting by keypad, or external analog signal（DC0～10V，DC4～20mA）								
Display	7-segment LED display: Frequency, current, voltage, setting value, function, failure status, Temperature of PIM module								
Protection	Low voltage, over voltage, instantaneous power failure, over voltage stall, overload, over current stall, instantaneous over current, acceleration over current, deceleration over current, over heat.								
Overload capacity	150% for 1 min, anti-time limit function, adjustable (25～100％)								
Altitude	Altitude 1,000m or lower, keep from corrosive gasses, liquid and dust								
Ambient Temperature	-10℃～50℃ (Non-condensing and not frozen)								
Storage Temperature	-20℃～60℃								
Humidity	Relative between 45％ to 90% (No condensing)								
Cooling system	Forced air-cooling								
Weight (Kg)	1.6	1.6	1.6	1.6	1.6	2.5	2.5	2.5	2.5

Note 2: Braking resistor specification refer to page 6
＊: Under development

C. 400Vseries 3 phase

Motor rating (KW)	0.75	0.75	1.5	1.5	2.2	2.2	3.7	3.7＊
Model CT2004	ES-A75	ESe-A75	ES-1A5	ESe-1A5	ES-2A2	ESe-2A2	ES-3A7	ESe-3A7
Rated current (A)	2.2	2.2	4.0	4.0	6.2	6.2	9	9
Rated capacity (KVA)	1.7	1.7	3.2	3.2	4.9	4.9	7.1	7.1
Power supply	3φ380~460V±10% 50HZ±5% or 3φ380V-460V±10% 60HZ±5%							
Output voltage	3§ 380V、400V、415V、440V、460V							
Control method	Sine P.W.M. Control							
Frequency accuracy	Digital setting: ±0.1% Analog setting: ±0.5% (35℃)							
Frequency resolution	Digital setting: 0.5～100Hz→0.01Hz 100Hz～240Hz→0.1Hz Analog setting: (setting value/1000)Hz							
Frequency range	0.5～240HZ（Initial frequency 0.5～30Hz）							
V/F ratio	10 pattern, or any V/F pattern							

Torque compensation	0～15.0％ voltage compensation, automatic voltage compensation
Acceleration/ Deceleration time	0.1～6000 sec（linear, two-step setting）
Motor Braking	DB built-in, connect extra braking resistor to reach 100% braking (Note 3)
DC Braking	DC Injection Braking（Setting mode, torque, time, active frequency）
Standard feature	Free run restart, jogging speed, upper/lower frequency limit setting, jump frequency setting, 8-step speed setting, frequency indicated output (DC0～10V), operation direction setting, forward/reverse prohibit, voltage/current limit, data lock, EMI (with CT2000ESe only)
Relay Output	Arrival with timer, failure, stop, acceleration, frequency equal, deceleration, over frequency
Frequency setting	Digital setting by keypad, or external analog signal（DC0～10V，DC4～20mA）, frequency setting knob
Display	7-segment LED display: Frequency, current, voltage, setting value, function, failure status, Temperature of PIM module
Protection	Low voltage, over voltage, instantaneous power failure, over voltage stall, overload, over current stall, instantaneous over current, acceleration over current, deceleration over current, over heat.
Overload capacity	150% for 1 min, anti-time limit function, adjustable (25～100％)
Altitude	Altitude 1,000m or lower, keep from corrosive gasses, liquid and dust
Ambient Temperature	-10℃～50℃ (Non-condensing and not frozen)
Storage Temperature	-20℃～60℃
Humidity	Relative between 45％ to 90% (No condensing)
Cooling system	Forced air-cooling

Weight (Kg)	1.6	1.6	1.6	1.6	2.5	2.5	2.5	2.5

Note 3: Braking resistor specification refer to page 5

＊: Under development

11. Function Code Table

NO	Function	Detail of Data	Initial factory setting	
MODBUS Address				
0	Set frequency	0~240Hz	10	128
1	Frequency setting procedure			

	2	Select monitor display data	
0: Operation panel Cd00 1: External IN2 (0-10V) 2: External IN1 (4-20mA) 3: External IN2 (0-10V) hysteresis 4: External IN1 (4-20mA) hysteresis 5: Keypad VR 6: Multi-steps control 0: Frequency (HZ) 1: Current (I) 2: RPM 3: DC Voltage (d) 4: Output AC Voltage (V) 5: External I/O status (E) 6: Temperature of PIM module (b) 7: MCK operation frequency feedback 8: Current step of multi-step function 9: Current time of multi-step function (min) 10: Motor vibration			
5		129	
0		130	
	3	Torque mode	0: Without auto boost 1: Auto boost
	4	Operation command	0: Operation panel 1 1: External signal 2: Operation panel 2
	5	V/F pattern	1-10 fixed Modes 11: Set by Cd57, Cd58 12: V/F 1.5 power curve 13: V/F 1.7 power curve 14: V/F square curve
0		131	
2		132	
2		133	
	6	Motor rated current	25~100% 100
	7	Torque boost	0.0~15.0% 2
	8	1st acceleration time	0.1~6000 (S/50HZ) 5
	9	1st deceleration time	0.1~6000 (S/50HZ) 5
	10	2nd acceleration time	0.1~6000 (S/50HZ) 10
	11	2nd deceleration time	0.1~6000 (S/50HZ) 10

12	No.2 frequency	HZ	20
13	No.3 frequency	HZ	30
14	No.4 frequency	HZ	40
15	Jogging frequency	0.5HZ~30HZ	5
16	Start frequency	0.5HZ~60HZ	1
17	Upper limit frequency	10~240HZ	60
18	Lower limit frequency	0.5~100HZ	0
19	Jogging acceleration / deceleration time	0.1~10 (S/50HZ)	1
20	Jump frequency 1	HZ	0
21	Jump frequency 2	HZ	0
22	Jump frequency width	0~6HZ	0
23	Braking mode	0: de-active 1: Active when stop 2: Active when start 3: Active both stop and start	0
24	DC braking frequency	1~60HZ	1
25	DC braking voltage	0~15	5

	Function	Detail of Data	Initial factory setting
26	DC braking time	1~60S	1
MODBUS Address			
27	Operation direction setting	0: Both forward and reverse, stop before changing direction 1: Both forward and reverse, no stop required 2:Forward only 3: Reverse only	0
28	Restart in instantaneous power failure / Free run start		
0: Without / Without 1: With / Without 2: Without / With 3: With / With			0
29	Time	1~9000(sec)	5
30	“Stop” function at panel key under the operation of external sequence	0: Impossible 1: Possible	1
31	Initialize data	0: No change 1: Data at the time of shipment	0
32	DI1 External terminal setting		
33	DI2 External terminal setting		
34	DI31 External terminal setting		
35	DI4 External terminal setting		
0: No motion 1: 2DF 5：2DC 2: 3DF 6：JOG 3: 5DF 7：MBS 4: 2AC 8：RST		4 5 6 8	
36	Memory clear for fault annunciation		

1: Memory clear		0	
37	Frequency gain setting	20~200%	100
38	Analog output calibrate	90~110%	100
39	Frequency command bias	0~250	125
40	No.5 Frequency	HZ	45
41	No.6 Frequency	HZ	50
42	No.7 Frequency	HZ	55
43	No.8 Frequency	HZ	60
44	Stop mode	0: Decelerate stop 1: Free run stop 2: Free run stop after deceleration time is reached	0
45	Detect frequency level	0.5~240HZ	0.5
46	Speed multiplier	0.01~500	1
47	Relay 1 output select	0-7	1
48	Detec current level	40~150%	100
49	Lock data	0: Data change capable 1: Data change not capable	0
50	Software version	Read only	X
51	Motor rated voltage	10-450 200V Series = 1 380V Series = 1.73 400V Series = 2	
220			
52	Auto voltage compensation	0.5%~15.0%	50
53	Motor slip differential boost	0.0~10.0%	0
54	External analog output select		
0: Display output frequency		0	
1: Display output current			
55	External analog input select	0: 0~10V normal pattern 1: 10~0V reverse pattern	0
56	Current stall preventive	10~200%	150
57	Max. Frequency FH setting	10~240HZ (FH)	60

NO	Function	Detail of Data	Initial factory setting
MODBUS Address			
58	Motor rated frequency Fb	10~240HZ (Fb) FH≧Fb	60
59	Stagnancy of current detected		
2~10%		2	
60	V/F Frequency FC	0.5~240HZ	20
61	P.W.M. Frequency 1	0: P.W.M. Frequency set by Cd62 1: 4KHZ 2: 5KHZ 3: 6KHZ 4: 7KHZ 5: 8KHZ 6: 9KHZ 7: 10KHZ	2
62	P.W.M. Frequency 2	15~160	30
63	Start frequency of auto voltage compensation		
3.0~20.0HZ		10	
64	Dynamic braking mode	0~1	1

65	Instant initial field time	1~7	1
66	Digital filter function	1~6	5
67	Power source positioning accuracy calibration		
68	Motor vibration compensation		
69	Motor speed search time		
70	Dynamic braking active level		
71	Over Voltage prevention function active point		

0~30 0

100~500 200

120~140% 130

130~150% 140

79	Auto record when power off		
80	Modbus protocol data frame and Communications mode setting		

0: unuse 1

1: use 0

81	RS485 Communication ID Setting		

1~240 240

82	RS485 Baud rate	0：2400 bps 1：4800 bps 2：9600 bps 3：19200 bps	2
83	Series communication response time.	5~15	5
90	Series communication Parameter store eeprom		

Cd90=0 unstore

Cd90=1 store one data and reset 0

NO	Function	Detail of Data	Initial factory setting	
MODBUS Address				
CE00	Fault annunciation (The last)		None	228
CE01	Fault annunciation (Before the last)		None	229
CE02	Fault annunciation (The 2nd before the			

	last)		None	230
CE03	Fault annunciation (The 3rd before the last)		None	231
CE04	Input code		0	232
CE05	1st step speed setting	0~240Hz	0	233
CE06	2nd step speed setting	0~240Hz	0	234
CE07	3rd step speed setting	0~240Hz	0	235
CE08	4th step speed setting	0~240Hz	0	236
CE09	5th step speed setting	0~240Hz	0	237
CE10	6th step speed setting	0~240Hz	0	238
CE11	7th step speed setting	0~240Hz	0	239
CE12	8th step speed setting	0~240Hz	0	240
CE13	9th step speed setting	0~240Hz	0	241
CE14	10th step speed setting	0~240Hz	0	242
CE15	11th step speed setting	0~240Hz	0	243
CE16	12th step speed setting	0~240Hz	0	244
CE17	13th step speed setting	0~240Hz	0	245
CE18	14th step speed setting	0~240Hz	0	246
CE19	15th step speed setting	0~240Hz	0	247
CE20	16th step speed setting	0~240Hz	0	248
CE21	1st step time setting	0~100Min	0	249
CE22	2nd step time setting	0~100Min	0	250
CE23	3rd step time setting	0~100Min	0	251
CE24	4th step time setting	0~100Min	0	252
CE25	5th step time setting	0~100Min	0	253
CE26	6th step time setting	0~100Min	0	254
CE27	7th step time setting	0~100Min	0	255
CE28	8th step time setting	0~100Min	0	256
CE29	9th step time setting	0~100Min	0	257
CE30	10th step time setting	0~100Min	0	258
CE31	11th step time etting	0~100Min	0	259
CE32	12th step time setting	0~100Min	0	260
CE33	13th step time setting	0~100Min	0	261
CE34	14th step time setting	0~100Min	0	262
CE35	15th step time setting	0~100Min	0	263
CE36	16th step time setting	0~100Min	0	264
CE47	Multi-step function mode selection	0~1	0	275
CE49				
CE48	Multi-step function reset	0~1	0	
	Multi-step function continuous operation selection	0~2	0	277
CE52	Multi-step function time error adjust	1~2	1	
CE53	All Files Restore	0~1	0	
CE54	File copy	0~2	0	

	Set	Target	Feedback
	0	De-active	
	1	CE67	IN1
	2	CE67	IN2
	3	KEYPAD	IN1
	4	KEYPAD	IN2

CE61	PI control Target value/feedback terminal select		0

5	IN1 IN2		
CE62	P gain	0~10.0	0
CE63	I gain	0.2~1000.0 sec.	1
CE64	Reserved		
CE65	Output limit	0~100.0 %	100
CE67	Target value Setting	0~100.0 %	100

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12. Modbus Address of Display Data

Description	Notes	Range	Unit	
MODBUS Address				
Operation frequency		0～24000	0.01HZ	328
Current feedback		0～9999	0.1A	329
Operation command		0～24000	0.01HZ	330
DC voltage		0～9999	0.1V	331
Output voltage	Vac=Output voltage / 2	0～9999	0.1	332
External terminal mode		0～255		333
Module Temperature		112～1130	0.1℃	334
Operation status	Bit2: 0=Stop, 1=RUN Bit14: 0=FR, 1=RR			
Operation command	MASTER changes: Bit0: FWD command Bit1: REV command Clear Bit0 Bit1: Stop command Bit2: Reset after failure command			
Failure	Bit4, 3, 2, 1, 0= 0:None 4:OCPA 5:OCPd 6:OCPn 8:OV 10:OH 12:OL 14:OC 15:PLU 16:OL2 17:BuOH			
335				
336				
337				
IN 1(0~20mA)		0~1023		369
IN 2(0~10V)		0~1023		370
KEYPAD (0~10V)		0~1023		
Automatic procedure control operation time				
0~999	1min	342		

13. Serial Communications User Manual

This product built in with standard RS422/RS485 communicate port, support international standard MODBUS protocol, user can monitor single or many inverters by using PLC, PC, industrial computer or other equipment which support MODBUS protocol

A. The physical link

The wiring of this product can use either RS422 (4 wires) or RS485 (2wires), by jumper.

	JP4	Figure
Single RS422	Pin 1-2 short	13-1
Single RS485	Pin 2-3 short	13-2

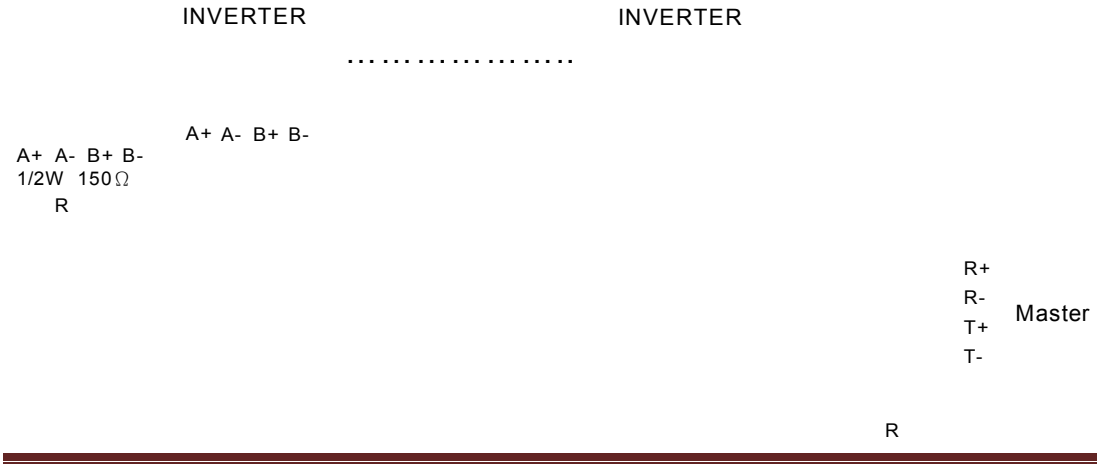

Fig.13-1

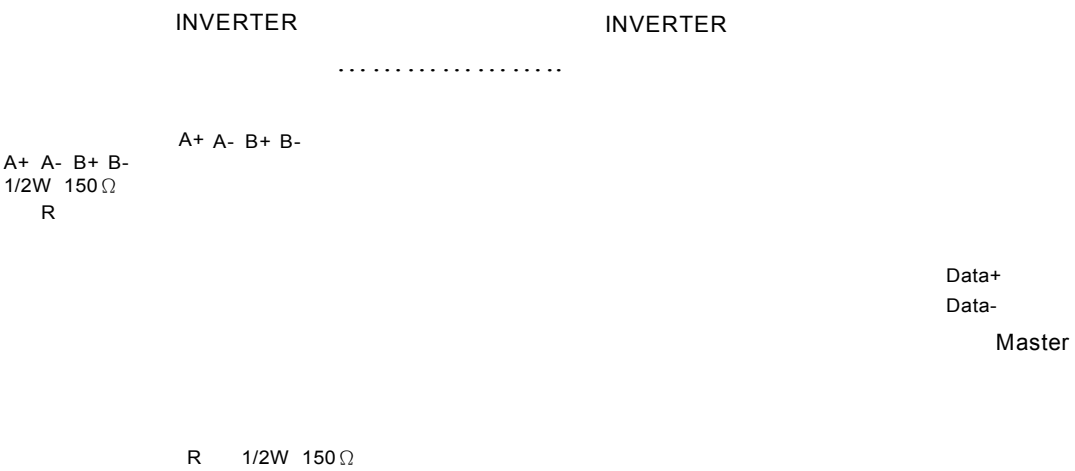

Fig.13-2

Note：a. When use RS422 (4wires), The ‘REMOTE’ socket cannot connect to any device.
b. Single transaction can read up to 10 continuous data from slave device.
c. It can connect up to 32 devices in single net.
d. The R in wiring diagram is terminal resister, only used on the device in the end of communication line.

B. Data structure in communication

This product support MODBUS RTU and MODBUS ASCII protocol.
In ASCII mode, every byte of the data will transfer to two ASCII code.
Ex. If byte data is 63H, it will be 36H, 33H in ASCII code.

(1) Hex to ASCII code transfer table

Char	‘ 0 ’	‘ 1 ’	‘ 2 ’	‘ 3 ’	‘ 4 ’	‘ 5 ’	‘ 6 ’	‘ 7 ’
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H
Char	‘ 8 ’	‘ 9 ’	‘ A ’	‘ B ’	‘ C ’	‘ D ’	‘ E ’	‘ F ’
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H
Char	‘ : ‘	CR	LF					

ASCII code 3AH 0DH 0AH

(2) The data frame format explain

Field Name	Explain
Header	Data frame initial character
Slave Address	Inverter communication address
Function	Function code
Start Address	Enquiry feedback data initial address
No. of Register	Enquiry feedback data (word)
Byte Count	Feedback data(byte)
Data	Feedback data
Register Address	Enquiry modified data address
Preset Data	Modified data
Error Check	Checksum
Trailer	Data frame stop character

C. Function code in Modbus

This product supports Function code 03H and 06H in MODBUS protocol.

(1) Function 03H：Read holding register

Read the binary contents of holding registers (4 x references) in the slave. Broadcast is not supported. The maximum parameters supported by various controller models are listed on page.

Ex: Read data from 3 continuous addresses in register. The beginning address is 0080H, the data frame are listed as follow.

Query

Field Name	Example (hex)	ASCII code	RTU 8-Bit Field
Header		‘ : ’ (Colon)	None
Slave Address	F0	F 0	1111 0110
Function	03	0 3	0000 0011
Start Address Hi	00	0 0	0000 0000
Start Address Lo	80	8 0	1000 0000
No. of Register Hi	00	0 0	0000 0000
No. of Register Lo	03	0 3	0000 0011
Error Check		LRC (2 chars)	CRC (16 bits)
Trailer		CR LF	None
Total Bytes		17	8

Response

Field Name	Example (hex)	ASCII code	RTU 8-Bit Field
Header		‘ : ’ (colon)	None
Slave Address	F0	F 0	1111 0000
Function	03	0 3	0000 0011
Byte Count	06	0 6	0000 0110
1st Data Hi	03	0 3	0000 0011
1st Data Lo	E8	E 8	1110 1000
2nd Data Hi	00	0 0	0000 0000
2nd Data Lo	07	0 7	0000 0111
3rd Data Hi	00	0 0	0000 0000
3rd Data Lo	00	0 0	0000 0000
Error Check		LRC (2 chars)	CRC (16 bits)
Trailer		CR LF	None
Total Bytes		23	11

(2)Function 06H：preset signal register

Presets a value into a single holding register (4 x reference). When broadcast, the function

presets the same register reference in all attached slaves. The maximum parameters supported by various controller models are listed on page.

Ex. To inverter in F0H address protocol, pre set data 6000(1770H) into 0080H register, the protocol frame will listed as below.

Query

Field Name	Example (hex)	ASCII code	RTU 8-Bit Field
Header		‘ : ’ (colon)	None
Slave Address	F0	F 0	1111 0110
Function	06	0 6	0000 0110
Register Address Hi	00	0 0	0000 0000
Register Address Lo	80	8 0	1000 0000
Preset Data Hi	17	1 7	0001 0111
Preset Data Lo	70	7 0	0777 0000
Error Check		LRC (2 chars)	CRC (16 bits)
Trailer		CR LF	None
Total Bytes		17	8

Response

Field Name	Example (hex)	ASCII code	RTU 8-Bit Field
Header		‘ : ’ (colon)	None
Slave Address	F0	F 0	1111 0110
Function	06	0 6	0000 0110
Register Address Hi	00	0 0	0000 0000
Register Address Lo	80	8 0	1000 0000
Preset Data Hi	17	1 7	0001 0111
Preset Data Lo	70	7 0	0777 0000
Error Check		LRC (2 chars)	CRC (16 bits)
Trailer		CR LF	None
Total Bytes		17	8

D. Error check Generation

(1) LRC Generation

Add all bytes in the message, excluding the starting colon and ending CRLF. Add them into an eight-bit field, so that carries will be discarded.
Subtract the final field value from FF hex (all 1's), to produce the ones complement.
Add 1 to produce the two's-complement. Ex. The query data is F0H + 06H + 00H + 80H + 17H + 70H = FDH, the two's complement is 03H. The '0' & '3' will be the LRC.

(2) CRC Generation

Generating a CRC

Step 1 Load a 16-bit register with FFFF hex (all 1's). Call this the CRC register.

Step 2 Exclusive OR the first eight-bit byte of the message with the low order byte of the 16-bit CRC register, putting the result in the CRC register.

Step 3 Shift the CRC register one bit to the right (toward the LSB), zero filling the MSB. Extract and examine the LSB.

Step 4 If the LSB is 0, repeat Step 3 (another shift). If the LSB is 1, Exclusive OR the CRC register with the polynomial value A001 hex (1010 0000 0000 0001).

Step 5 Repeat Steps 3 and 4 until eight shifts have been performed. When this is done, a complete eight-bit byte will have been processed.

Step 6 Repeat Steps 2 ... 5 for the next eight-bit byte of the message. Continue doing this until all bytes have been processed.
The final contents of the CRC register is the CRC value.

Step 7 When the CRC is placed into the message, its upper and lower bytes must be swapped as described below.

Pseudo code for generating a CRC-16：

```
CONST ARRAY BUFFER                  /* data, ex: F0h, 06h, 00h, 80h, 17h, 70h */
CONST WORD POLYNOMIAL = 0A001h                  /* X16 = X15 + X2 + X1 */
/* SUBROTINUE OF CRC CACULATE START */
CRC_CAL(LENGTH)
VAR INTEGER LENGTH;
{     VAR WORD CRC16 = 0FFFFH;                          /* CRC16 initial */
      VAR INTEGER = i,j;                              /* LOOP COUNTER */
      VAR BYTE DATA;                                    /* DATA BUFFER */
      FOR (i=1;i=LENGTH;i++)                          /* BYTE LOOP */
      {     DATA == BUFFER[i];
            CRC16 == CRC16 XOR DATA
            FOR (j=1;j=8;J++)             /* BIT LOOP */
            {     IF (CRC16 AND 0001H) = 1 THEN
                        CRC16 == (CRC16 SHR 1) XOR POLYNOMIAL;
                  ELSE
                        CRC16 == CRC16 SHR 1;
```

```
                DATA == DATA SHR 1;
            };
        };
        RETURN(CRC16);
    };
```

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E. Group and Global Broadcast

(1) Group Broadcast
User can use this function to control certain group of inverter at the same time. When master send out group address data, the slave inverters will react when receive order, but will not send any signal back to master.

(2) Global Broadcast
User can use this function to control all inverters at the same time. When master global broadcast, all slaves inverters will react after receive order, but will not send any signal back to master.

Group and Global broadcast address should be recognized refer to table as below, when the group and global broadcast address is in use.
There are 240 addresses in total for inverter setting, which means it can connect up to 240 inverters at the same time, and provide 1 Global Broadcast address 15-group address. Each group address can control up to 16 inverters, and user can set it.

Group

	Individual Address	Group address	Global address
Group 1	1…16	241	0
Group 2	17…32	242	0
Group 3	33…48	243	0
Group 4	49...64	244	0
Group 5	65...80	245	0
Group 6	81…96	246	0
Group 7	97…112	247	0
Group 8	113...128	248	0
Group 9	129...144	249	0
Group 10	145...160	250	0
Group 11	161...176	251	0
Group 12	177...192	252	0
Group 13	193...208	253	0

Group 14	209...224	254	0
Group 15	225...240	255	0