Instruction Manual

Commander™ ES Series AC Drives

rev. 01-04-01
es-man.p65

Table of Contents

1. Foreward

To fully employ all functions of the inverter, and to ensure the safety of users, please read through this operating manual in detail. Should you have any further inquiry, please feel free to contact your local distributor or Drivecon Corporation at 1-800-374-8266 toll free or 847-855-9150. Our staff will be glad to serve whatever your need.

Precaution

The inverter is a power electronic device. For safety reason, please note paragraphs with **"WARNING"** or **"CAUTION"** heading.

WARNING!: Personal injury may result with improper operation.
CAUTION!: The inverter or mechanical system may be damaged by improper operation.

WARNING!

- Do not touch the PCB or components on the PCB while power is on or immediately after turning off the power.
  Wait for the charging indicator light to extinguish.

- Do not attempt to wire circuitry while power is on. Do not attempt to examine the components and signals on the PCB while the inverter is running.

- Do not attempt to disassemble or modify internal circuitry, wiring, or components of the inverter.

- The grounding terminal of the inverter must be grounded properly according to local codes or NEC standards.

CAUTION!

- Do not attempt to conduct dielectric strength test to internal components of the inverter. There are sensitive semiconductor devices vulnerable to high voltage in the inverter.

- Do not connect the output terminals T1(U), T2(V), T3(W) to AC line power.

- The CMOS IC on the primary PCB of the inverter is vulnerable to static discharge. Do not touch the primary PCB of the inverter. If removal is required, follow recommended guidelines for static discharge control.

2. Examination before installation and purchase history

Every Drivecon inverter has been fully tested and examined before shipment. Please carry out the following examination procedure after unpacking your inverter.

- Verify that the inverter model number is the same as the one you ordered.
- Check to see if there is any damage that may have occured during transit. Do not connect the inverter to the power supply if there is any sign of damage.

Report to regional sales representative or Drivecon Corporation if you find any abnormal conditions as mentioned above.

Caution! Failure to inspect the inverter may lead to damage of the system and avoidable down time. Should you find any reason to suspect the unit itself or any aspects of the system to be faulty please contact Drivecon Corporation toll free at 800-374-8266 or 847-855-9150.
Be prepared to provide model number of your controller and any other pertinant information relative to the system.

Purchase history

Please take a moment and record the following information for future reference:

Model: _____

Serial number: _____

Date purchased: _____

Date installed: _____

Installed by: _____

Dealer: _____

Chapter 1: Safety Precautions

1.1 Precautions of operation

Before turning ON power

CAUTION!

- Choose appropriate power source with correct voltage setting as the input voltage specification of the inverter. Check line voltage phase to phase and phase to ground for compliance.

WARNING!

- Special care must be taken while wiring the power circuit. The L1, L2 (and L3) terminal must be connected to input power source and must not be connected to T1, T2, or T3 terminal by mistake. This will damage the inverter when the power is turned on.

CAUTION!

- Do not attempt to transport the inverter by the front cover. Securely hold the inverter by the chassis to prevent the inverter from falling.

- Install the inverter onto firm metal base or other nonflammable material. Do not install the inverter nearby any flammable material to avoid fire.

- Additional ventilation fan should be installed if several inverters are installed into one control panel to lower the temperature inside to below 40°C to avoid overheating.

- Turn off power supply before proceeding with removal or installation of operating panel. Carry out installation procedure according to instructions given to avoid poor-contact resulting in operating panel malfunction or display malfunction.

- The inverter can be easily operated over a wide speed range. Please reconfirm the operating range of motor and machinery with respective manufacturers.

- Do not examine the signals on the PCB of the inverter when it is under operation.

- All inverters have been adjusted properly at the factory. If adjustment is required consult manual and do not exceed normal operating values.

- Do not disassemble or examine before ensuring that the power is off and the charge indicator (LED2) has been extinguished.

- Insure that all fail safe equipment on machine is operating correctly such as: limit switches, brakes, etc.

When power is turned ON

WARNING!

- Do not attempt to install or remove the control panel connector to or from the inverter when the power supply is turned on. Otherwise, the control panel may be damaged due to surge peak caused by the insertion or removal.

Under Operation

WARNING!

- Do not switch motor ON with output side contactor while inverter is operating, otherwise the inverter may be damaged.

- Do not remove the front cover of the inverter while the power is ON to avoid personal injury caused by electrical shock.

- When the automatic restart function is enabled, the motor machinery will be restarted automatically. Keep a safe distance to avoid personal injury. It is not advisable to enable this function on any manually operated system.

- Do not use input contactor to cycle inverter ON and OFF. Repeated cycling may cause inverter damage.

CAUTION!

- Do not touch the heatsink base.

- The inverter can be easily operated from a low-speed to high-speed range. Please reconfirm the operating range of the motor and the machinery you are controlling with their respective manufacturers.

- Do not examine the signals of the PCB of the inverter when it is under operation.

- All inverters are properly adjusted and set by the factory prior to delivery. However, every system may require minor adjustments to be complete at time of installation. Do not exceed the specified limits of the equipment or inverter.

- Do not proceed with disassembly or examination procedure before ensuring that the power is off and the Power LED extinguished.

- Dangerous voltages are stored within the inverter for up to 2 minutes after removal of line power.

- Use caution when operating from the direct keypad mode as safety travel limits will not function.

- Do not suspend or handle loads directly over people. Refer to ANSI B30.16 as to safe crane operating procedures.

During examination and maintenance

CAUTION!

- Inverter environment should be within -10°C and +40°C, humidity should be under 95% RH non-condensing.

CAUTION!

- If operating without enclosure (chassis mount), the environment temperature should be within -10°C and +50°C and the humidity should be under 95% RH non-condensing. Also, the surrounding environment should be free from moisture or metal dust.

Typically the inverter requires no special maintenance. However, Drivecon suggests inspection of the inverter with special attention to loose wiring connections. Excessive accumulation of dust or dirt will also shorten the expected life of the inverter. Periodic cleaning of the inverter with dry compressed air may be required.

WARNING!

- Insure power supply is switched OFF and the LED charge indicator has extinguished prior to inspection or maintenance of inverter. Lock out all equipment under repair or inspection.

1.2 Precautions of operation environment

Avoid direct sunlight

Keep away from corrosive gas or liquid

Keep away from oil, grease, and petroleum products

Avoid exposure to rain or dripping water

Avoid metal dust and dusty environments

Avoid areas of high vibration

Avoid extreme heat

Keep away from high electrical-magnetic wave or ultra-high wave. (such as electro-soldering machine or other similar machinery)

Keep away from radioactive matter or environments

Keep away from flammable material

Keep surrounding area between -10 ~ +40°C for enclosed units or -10 ~ +50°C for chassis type units

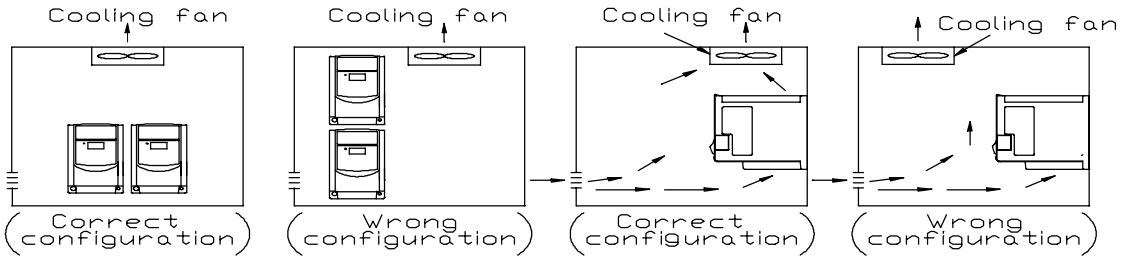
The choice of environments will directly influence the service life of the inverter. Please provide a suitable location.

Chapter 2: Hardware Instructions and Installation

2.1 Operating Environment

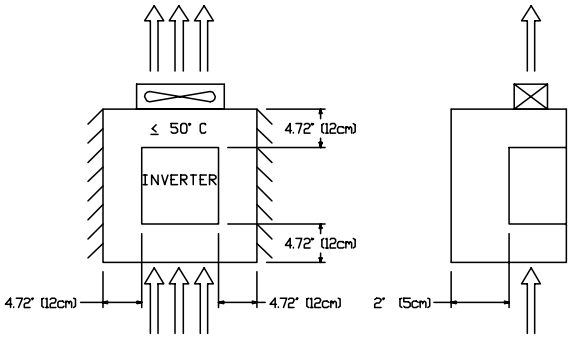
The installation site of the inverter poses direct impact to the full functionality and life expectancy of your inverter. Please carefully choose an appropriate installation site based on the following criteria:

- Environment temperature: -10°C to +40°C enclosed
  without external casing: -10°C to +50°C chassis mount
- Avoid water dripping or humid environment
- Avoid direct sunlight
- Avoid oil atmospheres
- Avoid corrosive liquid or gas
- Prevent foreign dusts or metal scraps from entering interior
- Keep away from radioactive matter or flammable material
- Avoid electromagnetic interference (soldering or power machinery)
- Avoid vibration. If vibration can not be avoided, shock absorber should be installed to reduce vibration.
- If there are several inverters installed in the same control panel, additional cooling fans should be installed to lower the environment below 40°C for enclosed units. 50°C for chassis mount units.

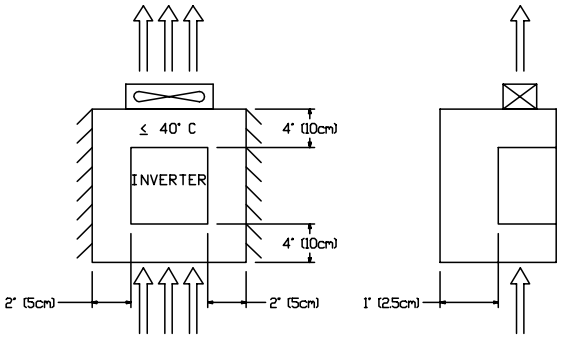


- Inverter should be installed facing forward and upright.
- Inverter must be installed as to leave room on all sides for proper heat dissipation. If installed in an enclosure, the dust cover may be removed for better heat dissipation. See diagram above.

Correct spacing of inverter relative to surroundings.



Ventilation and Installation Direction
Front View



Ventilation and Installation Direction
Front View

2.2 Sample Model No. Identification

Inverter model: **CES-207-xxx**
Input power rating: AC, 1 ph 200~240V, 50/60 Hz
Output rating: AC, 3 ph 0~240V, 1HP, 4.2 Amps

CES- 2 - 07 - x - x - x

Series	**Voltage**	**HP**	**Power Supply**	**Filter**	**Enclosure**
	1: 110V	02: .25HP	1: 1 phase	F: filter	N4S: IP65/NEMA4 with switch
	2: 220V	04: 1/2HP	3: 3 phase	Blank: no filter	N4: IP65/NEMA4
	4: 440V	07: 1 HP	Blank: 1 or 3 phase		without switch
		15: 2 HP			Blank: IP20-NEMA1
		22: 3 HP			

2.3 Specifications of CES models

Inverter model		CES-102	CES-104	CES-202	CES-204	CES-207	CES-215	CES-222	CES-407	CES-415	CES-422
Applicable Motor Output (KW)		0.2	0.4	0.2	0.4	0.75	1.5	2.2	0.75	1.5	2.2
Rated Horsepower (HP)		1/4	1/2	1/4	1/2	1	2	3	1	2	3
Rated Current (A)		1.4	2.3	1.4	2.3	4.2	7.5	10.5	2.3	3.8	5.2
Rated Capacity (KVA)		0.53	0.88	0.53	0.88	1.6	2.9	4	1.7	2.9	4
Weight (Lbs.)		1.5	1.5	1.7	1.7	1.7	3.7	3.9	3.5	3.5	3.6
Input Max. Voltage		Single phase 100~120V (+10%, -15%, 50/60 Hz (+/-5%))		Single phase 200~240V * (+10%, -15%, 50/60 Hz (+/-5%))			Single or three phase 200~240V * (+10%, -15%, 50/60 Hz (+/-5%))		3 phase 380~480V (+10%, -15%), 50/60 Hz (+/-5%)		
Output Max. Voltage		3 phase 200~240V in accordance with 2x (times) input		3 phase 200~240V in accordance with input					3 phase 380~480V in accordance with input		
Input signal state		PNP type (source) input 12VDC provided; 120VAC with D61538 isolator; 24VAC with D61539 isolator optional.									
Control Method		Sinusoidal wave PWM contol									
Frequency control	Frequency control range	1~200Hz									
	Frequency setting resolution	Digital: 0.01Hz (0~99.9Hz); 1Hz (100~200Hz) Analog: .1Hz / 60 Hz									
	Keypad setting method	Directly via up and down arrow keys for adjustment.									
	Frequency setting signal	0~10V, 0~20mA, 4-20mA									
	Frequency limit	Frequency upper / lower limit									
Control characteristics	Accel / Decel time	0.1~999 Seconds. Carrier frequency 1~16kHz									
	V/F pattern	6 patterns for 50 or 60 Hz motors with adjustable torque boost.									
	Multifunction inputs	2 programmable input contacts of the following signals: Speed 2 and Speed 3 command, Jog, Emergency Stop, External base block, Reset command.									
	Multifunction outputs	1 NO output contact of the following signals: fault, running output, frequency arrival.									
	DB Braking torque	20% standard. 100% with external unit and resistor.					20% standard, 100% with external resistor				
	Built-in Function	Deceleration or Free run to stop, Auto reset, DC injection frequency / time / level select. Analog 0-10VDC frequency output.									
Digital operator monitor		3-digit 7 segment display frequency / function constants / fault history / CPU version									
Ambient temperature		-10 ~ 40°C with cover. -10~50°C Chassis									
Humidity		0 ~ 95% RH (non-condensing)									
Vibration		Under 1G									
EMC		Unfiltered		Class A (Filter built-in) optional					Class A (3 phases. Filter built-in) optional		
Enclosure		Protected chassis, IP20. Optional IP65, NEMA 4									
UL		UL 508									
Protective Functions	Overload	150% 1 minute. Instantaneous overcurrent approximately 200% rated amps.									
	Overvoltage	DC bus exceeds 410V							DC bus exceeds 800V		
	Undervoltage	DC bus drop below 200V							DC bus drop below 400V		
	Momentary power loss	0~2 seconds, Inverter can be restarted by speed search									
	Stall prevention current limit	During Acceleration / Deceleration / Constant speed									
	Output short circuit	Provided by electronic circuit									
	Ground fault	Provided by electronic circuit									
	Other protection	Heat sink fin overheat.									
Dimension (inches) H x W x D		5.2" x 2.8" x 4.6"		5.2" x 2.8" x 4.6"			5.63" x 4.65" x 6.8"		5.63" x 4.65" x 6.8"		
Mounting Dimension (inches) H x W		4.6" x 2.4"		4.6" x 2.4"			5.01" x 4.25"		5.01" x 4.25"		
Installation		Panel mounted or using DIN rail (Option)									

* Single phase drives may be connected to three phase AC line voltages by connecting terminal L1/L to phase A, L2/N to phase B and leave phase C disconnected and insulated. You may wish to rotate the phases in areas where there are many single phase drives.

2.4 Wiring Inverter

Suitable options and Wiring Specification

Molded-Case Circuit Breaker or fuse selection / Magnetic Contactor
Warranty does not apply to damage caused by the following situations:

(1) Damage to the inverter caused by the lack of appropriate moded-case circuit breaker or fuses or when a circuit breaker or fuse with too large of capacity is installed between the power supply and the inverter. See chart below.

(2) Damage to the inverter caused by the magnetic contactor, phase advancing capacitor, or surge-protector installed between the inverter and the motor.

(3) Connecting line voltage to T1, T2, T3 output.

Model Type	CES102, CES104, CES202, CES204	CES207, CES215	CES222	CES407, CES415, CES422
Molded case circuit breaker or time delay fuse	15A	20A	30A	15A
Primary Circuit Terminal TM1 (T1) (L1) (T2) (L2) (T3) (L3)	Wire dimension (#14 AWG) 2.0mm² Terminal screw M3	Wire dimension (#14 AWG) 2.0mm² Terminal screw M3, M4	Wire dimension (#12 AWG) 3.5mm² Terminal screw M4	Wire dimension (#14 AWG) 2.0mm² Terminal screw M4
Signal Terminal (TM2) 1~11	Wire dimension 1.5mm² (#16 AWG), Terminal screw M3			
D61538 / D61539 (Optional)	Wire dimension 1.8mm² (#14 AWGmax.), captive screw.			

Use copper conductors only. Size field wiring based on 75°C wire only.

CAUTION!

- **Please utilize three-phase squirrel-cage induction motor with appropriate capacity.**
- **If a inverter is used to drive more than one motor, the total capacity must be smaller than the capacity of the inverter. Additional thermal relay must be installed in series with every motor. Set F_18 at 1.0 times of the rated value specified on the motor name plate at 50 Hz, 1.1 times of the rated value specified on the motor nameplate at 60 Hz.**
- **Do not install phase advancing capacitor, LC, or RC component between the inverter and the motor.**
- **Use copper conductors only. Size field wiring based on 75°C wire only.**
- **Wire voltage rating must be a minimum of 300V for 230VAC systems and 600V for 460VAC systems.**
- **Control wire should not run in same conduit as power or motor wiring.**
- **Follow NEC article 610 guidelines for installation of inverter.**

Application and precautions of Peripherals

Connection of single phase drives: You may connect a single phase input drive to 3 phase power by connecting terminal L1/L to phase A, L2/N to phase B and insulate phase C.
From the Power Source: Apply the power source at the correct rated voltage to prevent from damaging the inverter. Branch circuit protection (reference NEC article 610) must be installed between the AC power supply and the inverter.
Molded-case circuit breaker and / or time delay fuses: Utilize an appropriate circuit breaker that's suitable for the rated voltage and current ratings of the inverter to switch ON/ OFF the power supply to the inverter and as additional protection for the inverter.
Leakage circuit breaker: An earth leakage circuit breaker should be added to prevent false operation caused by leakage current and to ensure personnel safety.
Magnetic contactor: To utilize external DB braking resistors the magnetic contactor or main-line must be installed on the primary side of the inverter with DB overload wired in series. The magnetic contactor is only a fault isolation means. Do not use the magnetic contactor to switch power ON or OFF the inverter in a repititious fashion. Constant power cycling to inverter may damage the inverter. If the inverter is installed in a retrofit where existing reversing contactors are still maintained, insure the inverter is connected to a constant source of power.
Load side contactors or conductors: Any type of load side switch is strictly forbidden. The intermittent connection of the load will damage the inverter.
Brake contactor: Select the proper contactor wired to primary of inverter to control motor brake. Drivecon recommends the addition of a 3 phase AC suppressor across all brake contactors.
Power improvement AC Reactor: If large capacity source is applied (over 500KVA) additional AC reactor may be added to improve power factor and reduce likelihood of damage to inverter.
Inverter: Power supply input terminals L1, L2 and (L3) are not differentiated on phase sequence. They can be arbitrarily connected. Their connection may be interchanged.
Output terminal T1, T2, and T3 should be connected to T1, T2, and T3 terminals of motor respectively. If motor turns in opposite direction of the inverter command, simply exchanging two of the three wire connections will correct this problem.
Conductor length between drive and motor:
Excessive wire length between drive and motor can cause premature insulation failure of motor. Substantial voltage spikes can be measured at the motor terminals with as little as 30 feet of distance between the motor and VFD. Drivecon recommends the use of our OLF filter or inverter duty motors with 1600V magnet wire.
CAUTION:

- Output terminal T1, T2, and T3 must not be connected to power source to prevent from damaging the inverter.

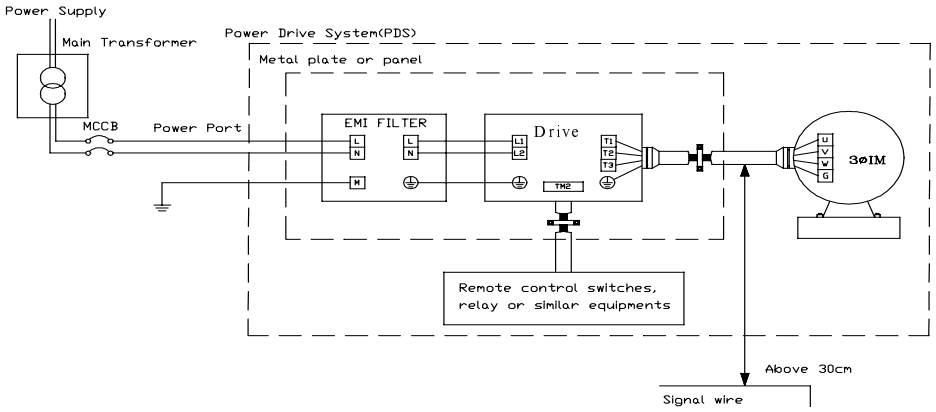
Grounding terminal. Properly ground the grounding terminal in compliance with NEC or local codes. Under most circumstances and extra 4th conductor rail is not required but highly recommended for personal safety.
External wiring should be carried out in accordance with the following requirement. Check and reassure the wiring is correct after the wiring is complete.

EMI connections:

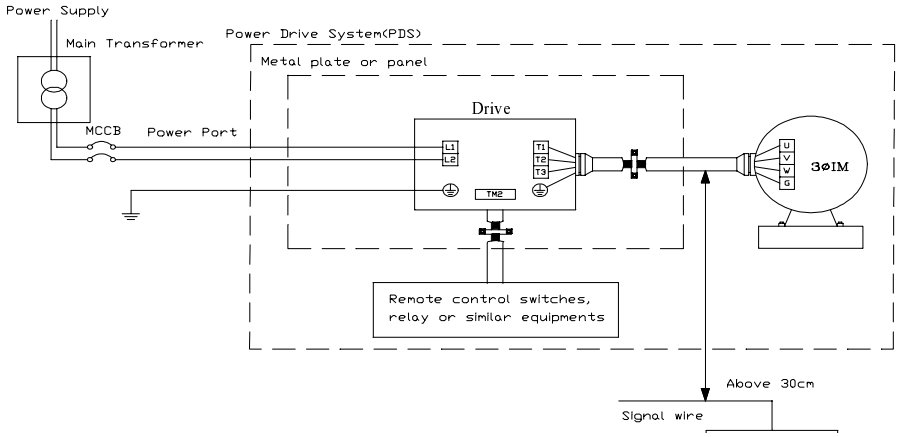
It is very important that the connections between the inverter, the shielded motor cable, and the EMI filters are tested as follows.

Use a metal grounding plate and place the frequency inverter and the EMI filter on the plate.
Use a shielded motor cable with 4 connectors (U, V, W, and Earth). Don't use the shielding as safety earth (shield is high frequency earth)
Remove any paint around the two metal coupling nut holes so that the metal coupling nuts (and the shielding) make contact with the frequency inverter and the motor.
Don't solder a conductor to the shielding.
Use a metal clamp to connect the shielding from the motor cable with the metal grounding plate. Now there is a perfect high frequency earth connection between frequency inverter, grounding plate, and EMI filter.
Keep the distance between the frequency inverter and the EMI filter as short as possible (<30cm). If longer, use a shielded cable with a metal coupling nut and a metal clamp to connect the shielded cable to the frequency inverter and metal grounding plate.
The only earth connection between the line and the test plate should be via the EMI filter. Use a motor which equals the power rating or below of the inverter rating. Install a noise filter for inverter onto the output side of the primary circuitry can suppress conducting noise.

Class B:



Class A:

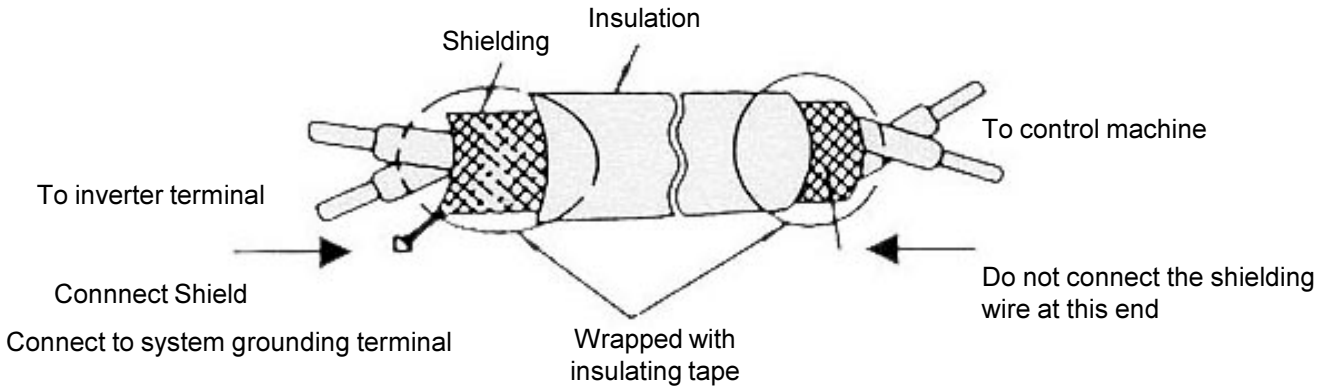


When the distance between the inverter and the motor is longer than 100 meters, cable wires should be carefully chosen to reduce the voltage loss due to wire resistance below 3%. Voltage drop (V) = √3x Wire resistance (ohm/m) x wire length (m) x current.

(B) Control circuitry wiring must be separated, terminated, and away from the primary power circuitry and other high-voltage or large-current power lines to avoid noise interference.

To reduce the noise interference and avoid possible operational problems, shielded twisted pair cable should be used to wire the low voltage DC control circuitry. Please refer to the following diagram. Connect the shielding wire onto the grounding terminal. Only connect one end of the shield to ground.

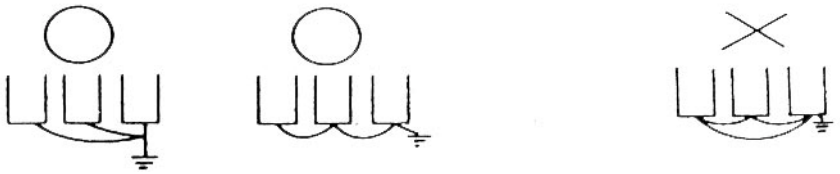
Wiring distance must be under 50m.



(C) The grounding terminal of the inverter must be correctly grounded in compliance with local codes or NEC requirements.

Grounding wire should be wired in accordance to electrical equipment (#14 AWG minimum) with the length of the grounding wire as short as possible.

The grounding wire of the inverter must be grounded together with other large current loads (such as soldering machines or large current motors). They should be grounded separately.

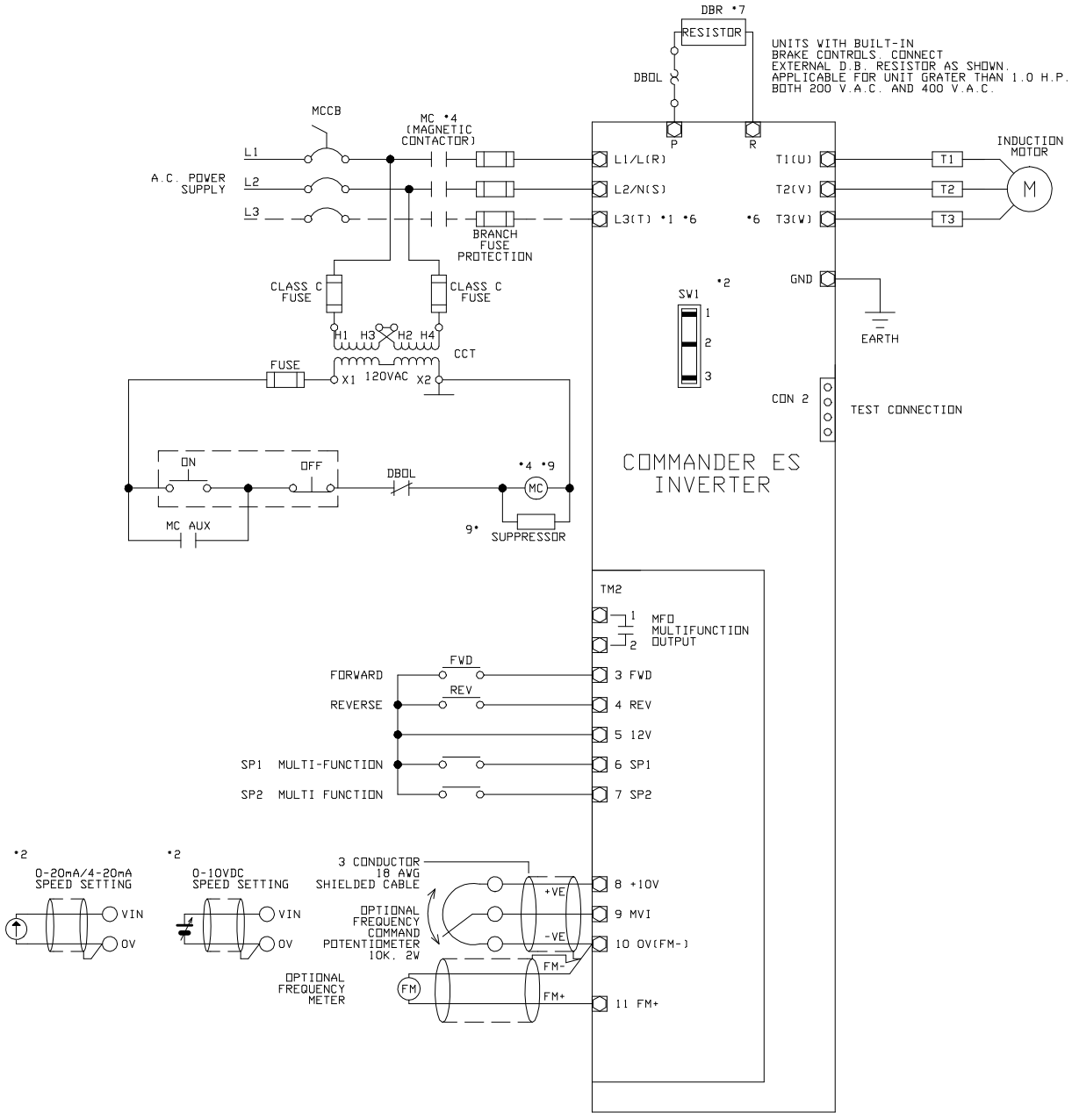


(a) good (b) good (c) not good

(D) Wire specification, apply appropriate wire with correct diameter for primary power circuitry and control circuitry in accordance with electricity regulations.

2.4 Standard Wiring of Commander ES

Interconnection diagram.
(Some devices are optional and may not be required in all cases.)



NOTE:
1. In single phase applications, connect AC power supply to L1/L(R) and L2/N(S) of inverter. For single phase drives connected to three phase supplies just connect L1/L and L2/N to 2 of 3 available line phases. Isolate the 3rd wire.
2. Refer to page 17 for current/voltage speed setting
3. Do not connect wiper of frequency command potentiometer to terminal 8, (+10V), or 10, (0V) of TM2. This will damage the inverter.
4. MC use is optional depending upon application.
5. Built in brake unit not provided on units CES201 or smaller. See separate instructions for DB unit on models CES–201 and smaller.
6. See page 16 for tightening torque values of TM1 and TM2 screw terminals.
7. Use high temperature wire near resistor elements such as SRML.
8. Terminals (SP1) – (SP2) are multi–function terminals which can be defined to user preferences.
9. All coils are to have suppressors.
10. Terminations to inverter must be made with either listed field wiring lug kits or listed crimp type ring terminals.

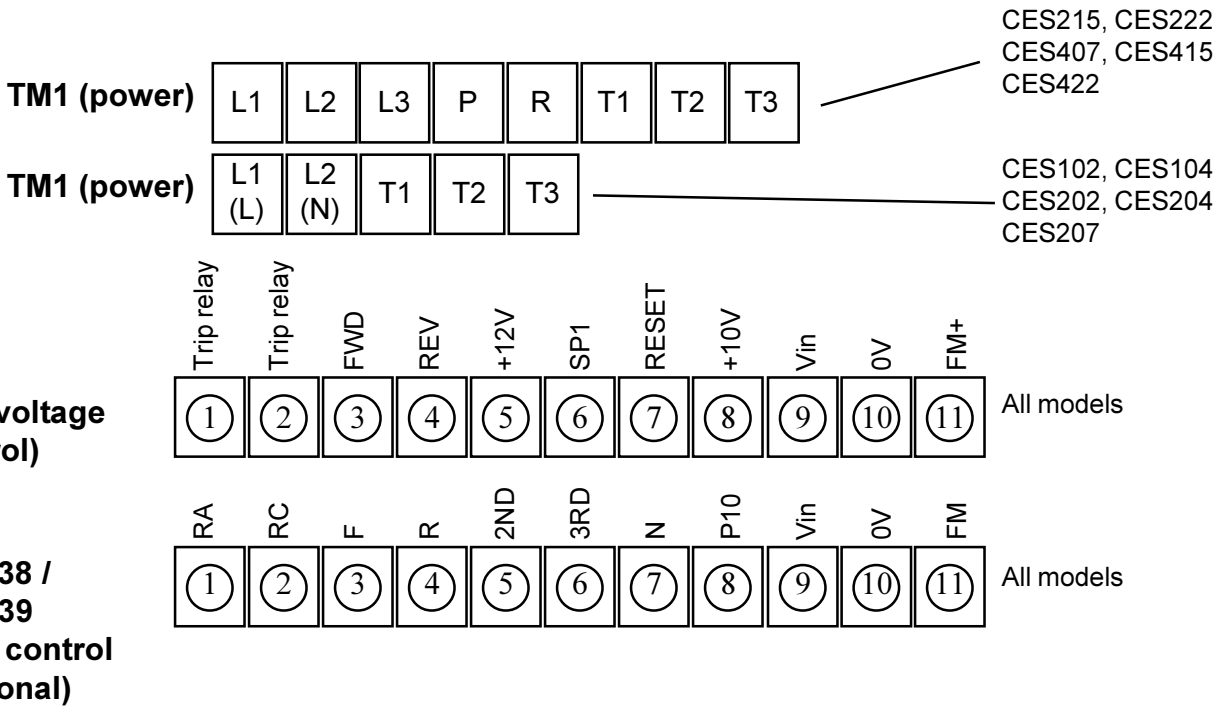
WARNING: Wiring diagrams differ per application.
Please consult system wiring diagrams or Drivecon Corporation.
Insure wiring conforms with all applicable industry and safety standards.

Drivecon Corporation
620 Lakeside Dr.
Gurnee, IL. 60031
Phone: (847) 855–9150
Fax: (847) 855–9650

TITLE: COMMANDER ES INTERCONNECTION DIAGRAM	CLIENT:		VERSION: PRELIMINARY
	LOCATION:		REVISION # / REV. DATE
	PROJECT: ESWIRE		
	STARTUP DATE: XX/XX/XX	DRAWN BY: MTW	DATE: 2/27/01
	SHEET # 001 OF 001	CHECKED BY:ADB	DESIGNER: RMP

Reserved for your notes:

Drive terminal strip layouts



Inverter terminal descriptions:

Primary Circuitry Terminal Block (TM1) descriptions

TM1 Terminal Symbol	Function Description
L1 (L) (R)	Primary power source input to drive. Single phase: L1, L2, or L/N. Three phase: L1, L2, L3
L2 (N) (S)	
L3 (T)	
P	External braking resistor terminal.
R	
T1 (U)	Inverter output to motor.
T2 (V)	
T3 (W)	

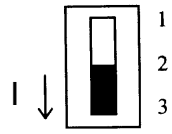
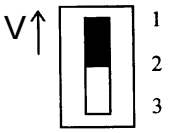
Tightening torque for TM1 is 1 lb.-ft. or 12 lbs.in. (CES-102, 104, 202, 204, 207)
Tightening torque for TM1 is 1.3 lb.-ft. or 16 lbs.in. (CES-215, 222, 407, 415, 422)
* Wire voltage rating must be a minimum of 300V (200V series) / 600V (400V series)

Control Circuitry Terminal Block (TM2) description:

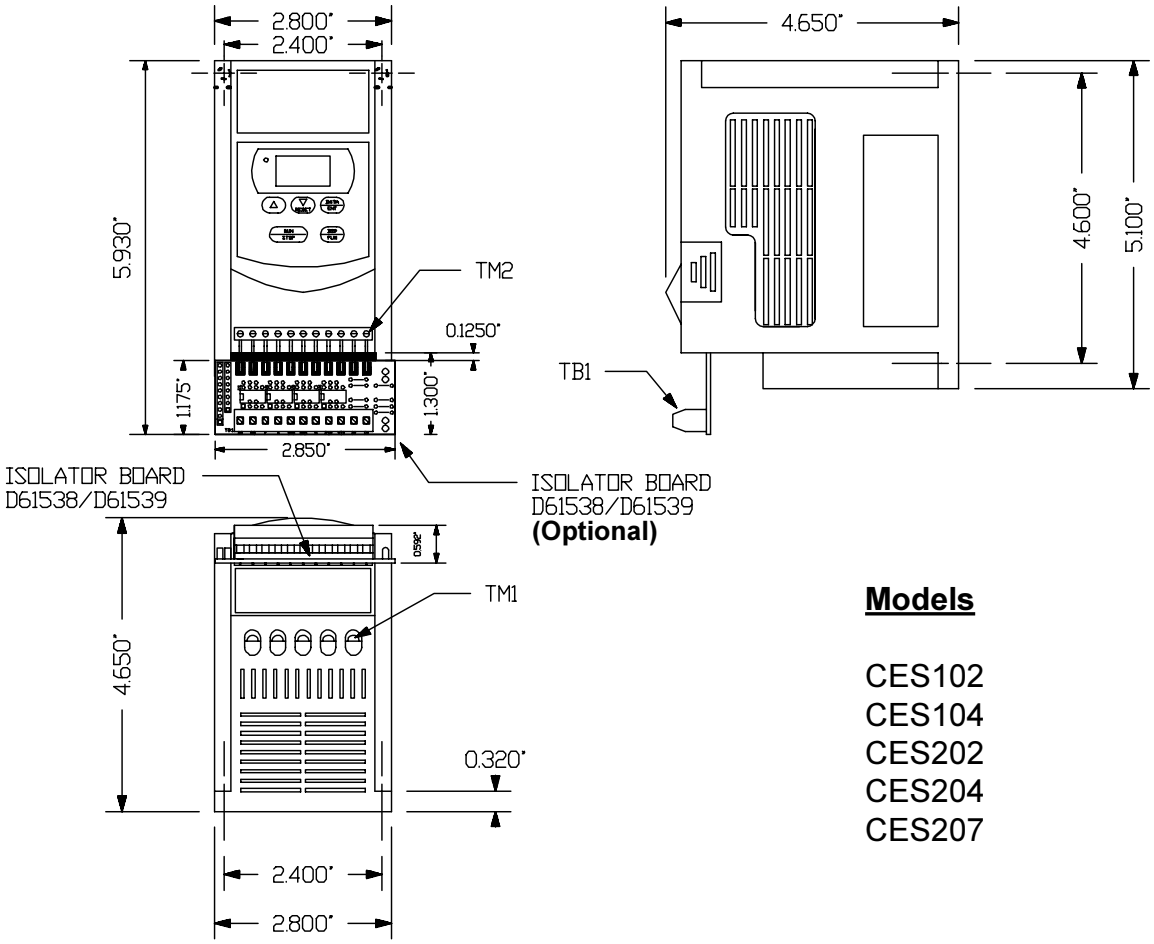
TB1 D61538 / D61539 Terminal Symbol	TM2 Terminal Symbol		Function Description	
1	1	Relay	Relay output terminal. Multifunction output terminal (refer to F_21) Connection point rated capacity 250VAC / 1A (30VDC / 1A)	
2	2			
3	3	FWD (FW)	Operation control terminals	
4	4	REV (RE)		
	5	+12V (12)	Common point of terminal 3, 4, 6, 7	
5	6	SP1 (SP)	Multifunction input terminals (refer to F_19, F_20)	
6	7	RESET (RS)		
7		N	Neutral connection for 120VAC / 24VAC	
8	8	P10 / +10V	+10V	Power terminal for potentiometer (Pin 3)
9	9	Vin	Analog input wire Wiper	Analog fequency signal input terminal (Pin 2 of potentiometer or positive terminal of 0~10V / 4~20mA / 0~20mA)
10	10	0V (FM-)	Analog common point	Analog signal common point (Pin 1 of potentiometer or negative terminal of 0~20mA / 0~20mA)
11	11	FM+	Analog output positive connection point	Analog frequency signal output terminal. Output terminal signal is 0~10 VDC/Fn6.

Tightening torque for TM2 and TB1 is 0.42 lb.-ft. or 5.03 lbs.in.
* Wire voltage rating must be a minimum of 300V.
* Control wiring should not run in the same conduit or raceway with power or motor wiring.
* Single input and Output Terminals (TM2) Ratings are ALL Class 2.

SW1 function description

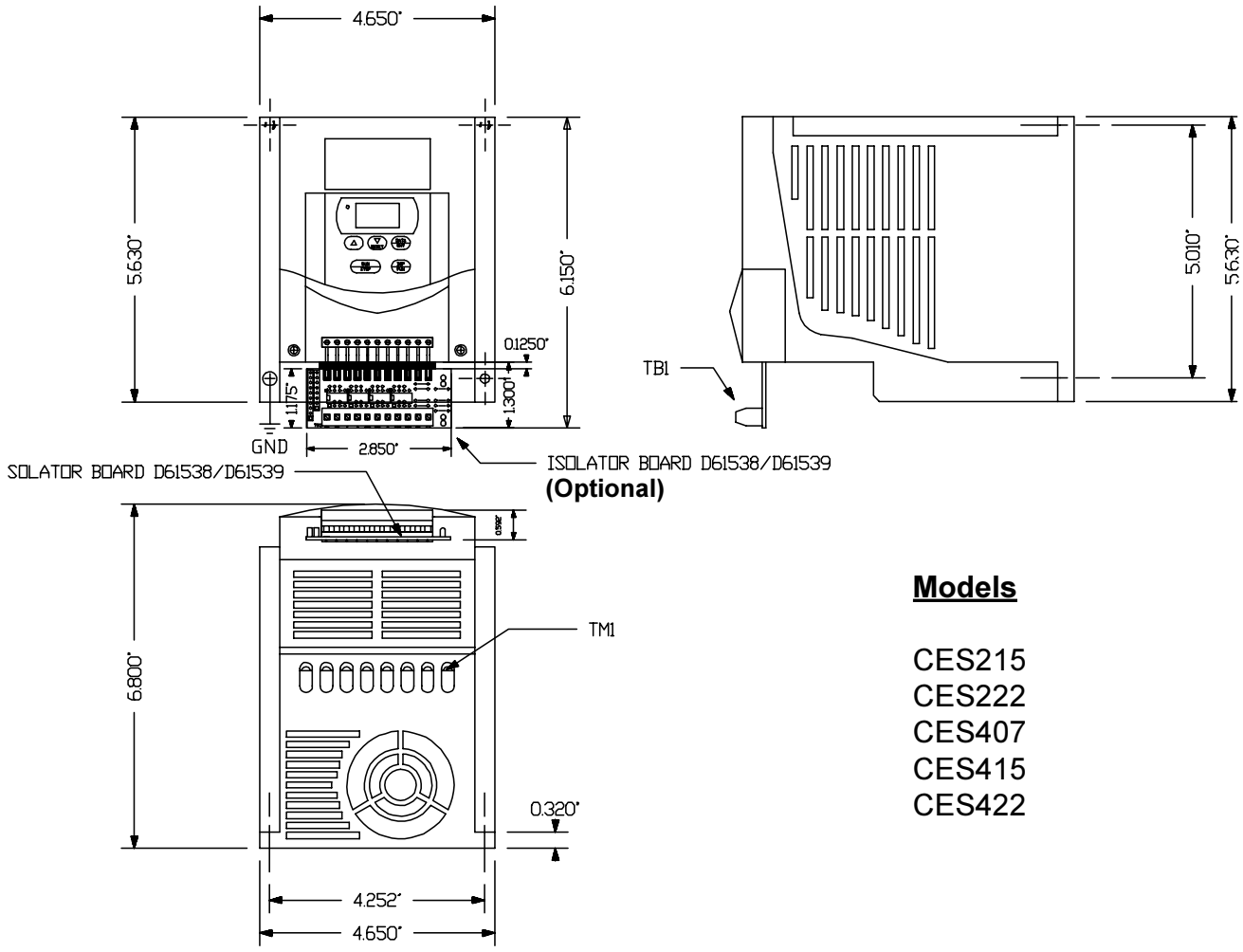
6 wLWK 1	(xWUhDOVlgnDOWSH
	0a20P A DnDORg VlgnDQ(: KHn) B11 LV VHWWR 1) 4a20P A DnDORg VlgnDQ(: KHn) B11 LV VHWWR 2)
	0a10 9' & DnDORg VlgnDQ(: KHn) B11 LV VHWWR 1)

2.5 Dimensions and location of terminal block



Models

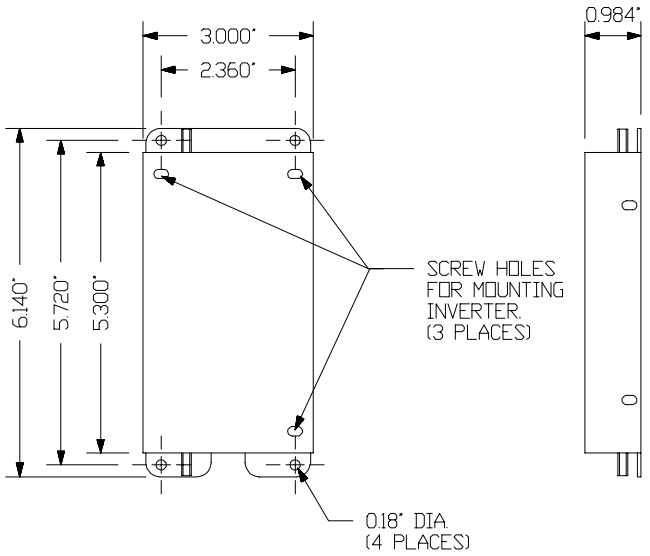
CES102
CES104
CES202
CES204
CES207

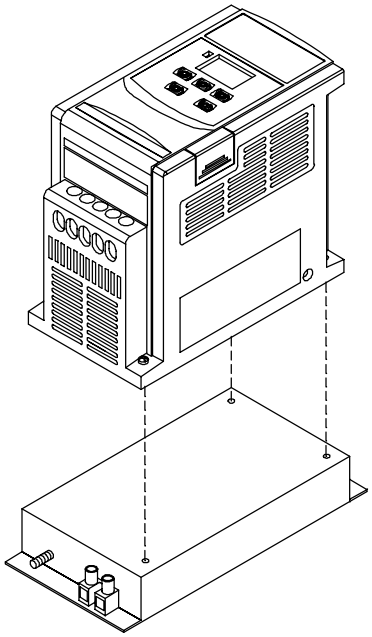


Models

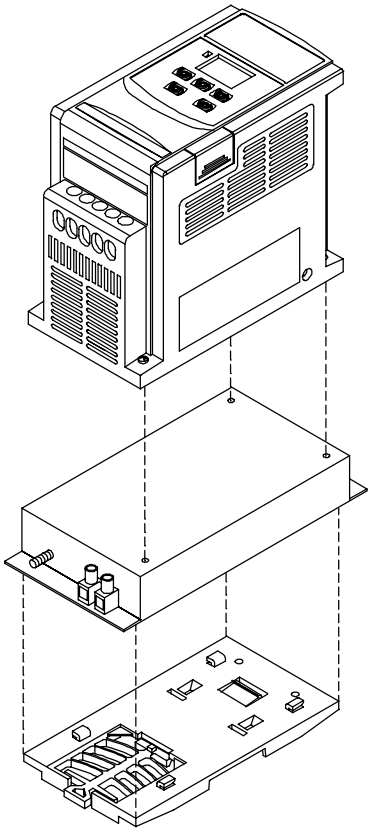
CES215
CES222
CES407
CES415
CES422

Dimensions and installation of class B filter



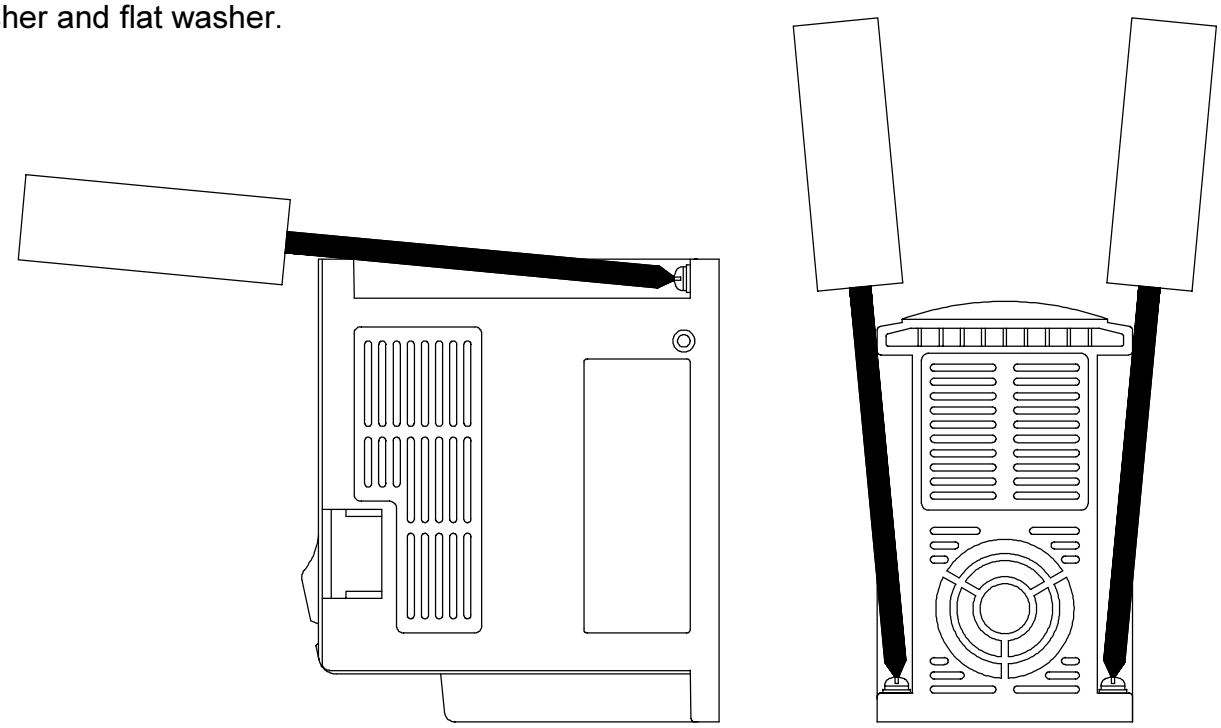


Inverter with class B filter mounted



Inverter with class B filter and DIN rail mounted kit

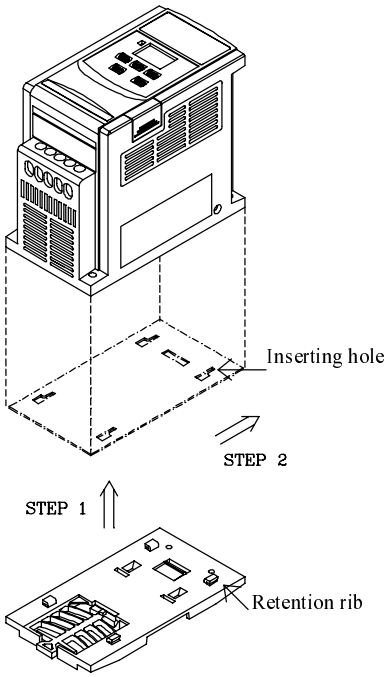
Mounting Instructions:
Secure via 8-32 x 5/8" (minimum). Machine screws to a flat steel plate. Include suitable lock washer and flat washer.

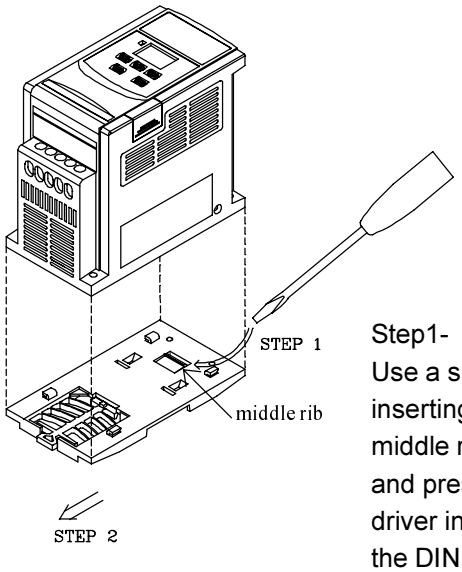


DIN Rail Mounting Diagram

Step1-
Aim and insert the 4 retention ribs of the DIN Rail at the 4 holes in rear panel of inverter

Step2-
Push the DIN Rail forward until the middle rib grips firmly with back panel

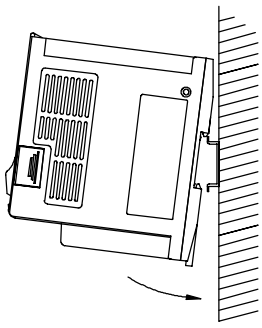


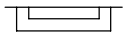


Step1-
Use a small screwdriver inserting it into the middle rib of DIN Rail and press the screw-driver in order to remove the DIN Rail from inverter

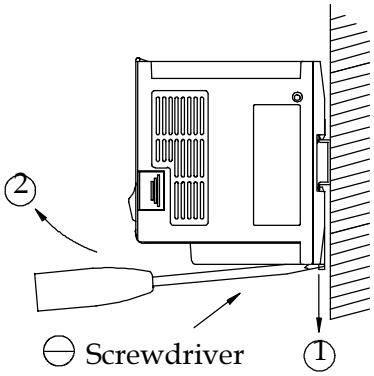
Additional DIN Rail Installation:

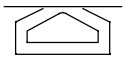
A mounting clamp and a 35mm width rail must be used to install the Drive on the rail.





First place the groove on the back of module on the upper edge of din rail, and then push the module down to lock up position. Finally press the mounting plate upward into module.



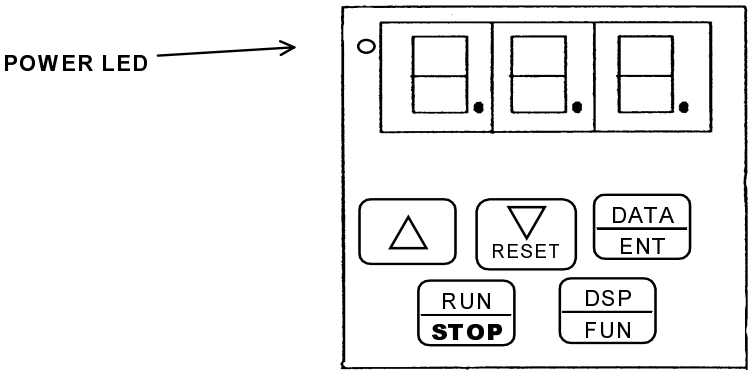


(1) Pull the mounting plate downward.
(2) Rotate the inverter module to dismount it.

Chapter 3 Software Index

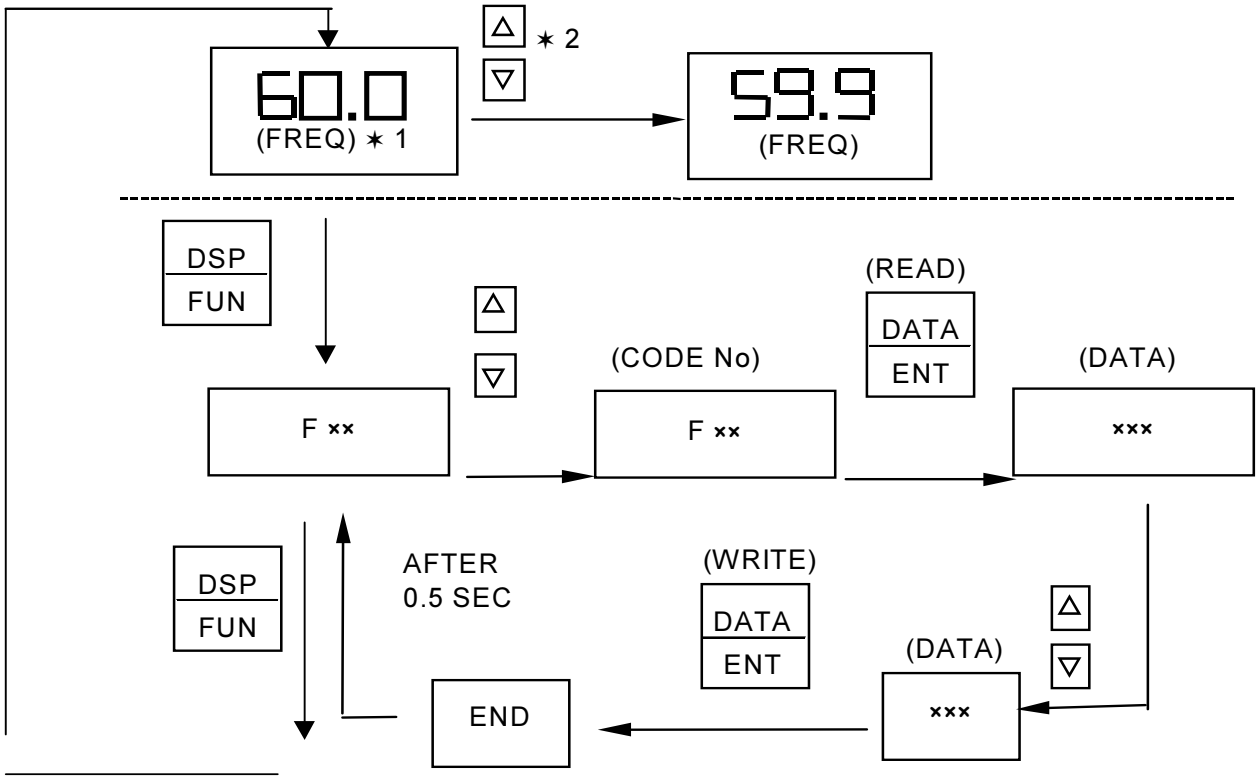
3.1 Keypad operating instructions

Keypad Description



⚠CAUTION
Do not operate keypad by screwdriver or other sharp-ended tool to avoid damaging keypad.

Brief keypad operation flowchart



Note:1 Displayed setting of frequency is flashing when stopped. Display output frequency is constantly on when running.
Note:2 The setting of the frequency can be modified either when stopped or when running.

CES Series AC Drives
Function List

CODE	Function	Function Description	UNIT	RANGE	Factory setting	NOTE	Customer settings
Fn00	Factory adjustment	Factory adjustment			0		
Fn01	Accel time	Accel time	0.1 sec	0.1~999 sec.	5.0	*1	
Fn02	Decel time	Decel time	0.1 sec	0.1~999 sec.	5.0	*1	
Fn03	Operation mode	0: Forward / Stop, Reverse / Stop 1: Run / Stop, Forward / Reverse	1	0~1	0		
Fn04	Motor rotation direction	0: Forward 1: Reverse	1	0~1	0	*1	
Fn05	V/F pattern	V/F pattern setting	1	1~6	1/4	*2	
Fn06	Frequency upper limit	Frequency upper limit	0.1 Hz	1.0~120 Hz	50/60 Hz	*2, *3	
Fn07	Frequency lower limit	Frequency lower limit	0.1 Hz	0.0~120 Hz	0.0 Hz		
Fn08	SPI frequency	SPI frequency	0.1 Hz	1.0~120 Hz	10 Hz	*3	
Fn09	JOG frequency	JOG frequency	0.1 Hz	1.0~10 Hz	6 Hz		
Fn10	Operation control	0: Keypad 1: Terminal (TM2)	1	0~1	0		
Fn11	Frequency control	0: Keypad 1: Terminal (0~10V / 0~20mA) 2: Terminal (4-20mA)	1	0~2	0		
Fn12	Carrier frequency control	Carrier frequency setting	1	1~5 (1~10) *4	5		
Fn13	Torque compensation	Torque compensation gain	0.1%	0.0~10.0%	0.0%	*1	
Fn14	Stop method	0: Decelerate stop 1: Free run stop	1	0~1	0		
Fn15	DC braking setting	DC braking time	0.1 sec	0.0~25.5 S	0.5 S		
Fn16	DC braking setting	DC braking injection frequency	0.1 Hz	1~10 Hz	1.5 Hz		
Fn17	DC braking setting	DC braking level	0.1%	0.0~20.0%	8.0%		
Fn18	Electronic thermal	Protection base on motor rated current.	1%	50~100% (0~200) *4	100%		
Fn19	Multifunction input connection point	Multifunction input terminal (SP1) function	1: Jog 2: SP1 3: Emergency stop 4: External base block 5: Reset 6: SP2 *4		2		
Fn20	Multifunction input connection point	Multifunction input terminal (reset) function			5		
Fn21	Multifunction output	Multifunction output terminal	1: Operating 2: Frequency reached 3: Fault		3		
Fn22	Reverse instruction	0: REV run enabled 1: REV run disabled	1	0~1	0		
Fn23	Momentary power loss	0: enabled 1: disabled	1	0~1	0		
Fn24	Auto restart	Number of Auto-restart times	1	0~5	0		
Fn25	Factory setting	010: Constants initialization to 50 Hz system 020: Constants initialization to 60 Hz system				*2	
Fn26	SP2 frequency	SP2 frequency	0.1 Hz	1.0~200 Hz	20	*4	
Fn27	SP3 frequency	SP3 frequency	0.1 Hz	1.0~200 Hz	30	*4	
Fn28		Reserved for future use					
Fn29	Software version	CPU program version					
Fn30	Fault log	Last 3 malfunction memory					

Notes:
*1: Setting can be changed during running mode.
*2: Please refer to Fn25.
*3: If the setting range is above 100, the setting unit becomes 1.
*4: New function for CPU version v1.8 and above.

Rev. 10-20-00

Reserved for your notes:

3.3 Parameter function description

F_00 Factory adjustment parameter. Do not change.

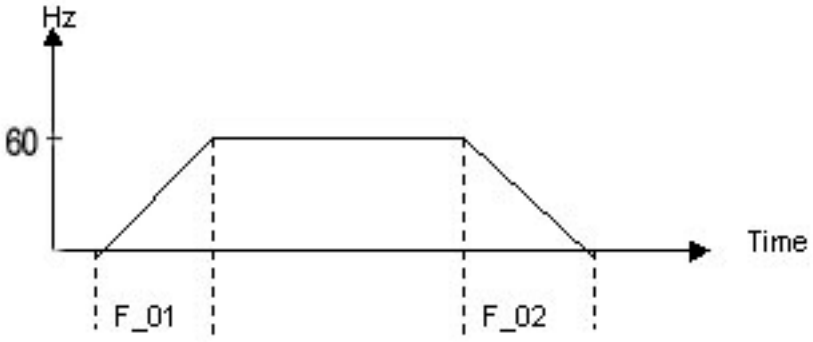
F_01 : Acceleration time. Range= 00.1 ~ 999 sec

F_02 : Deceleration time. Range = 00.1 ~ 999 sec

1. Acceleration / Deceleration time calculation formula: Basis= 60 Hz

Accelerate time = F_01 x $\frac{\text{Setting Frequency}}{\text{60 Hz}}$

Decelerate time = F_02 x $\frac{\text{Setting Frequency}}{\text{60Hz}}$

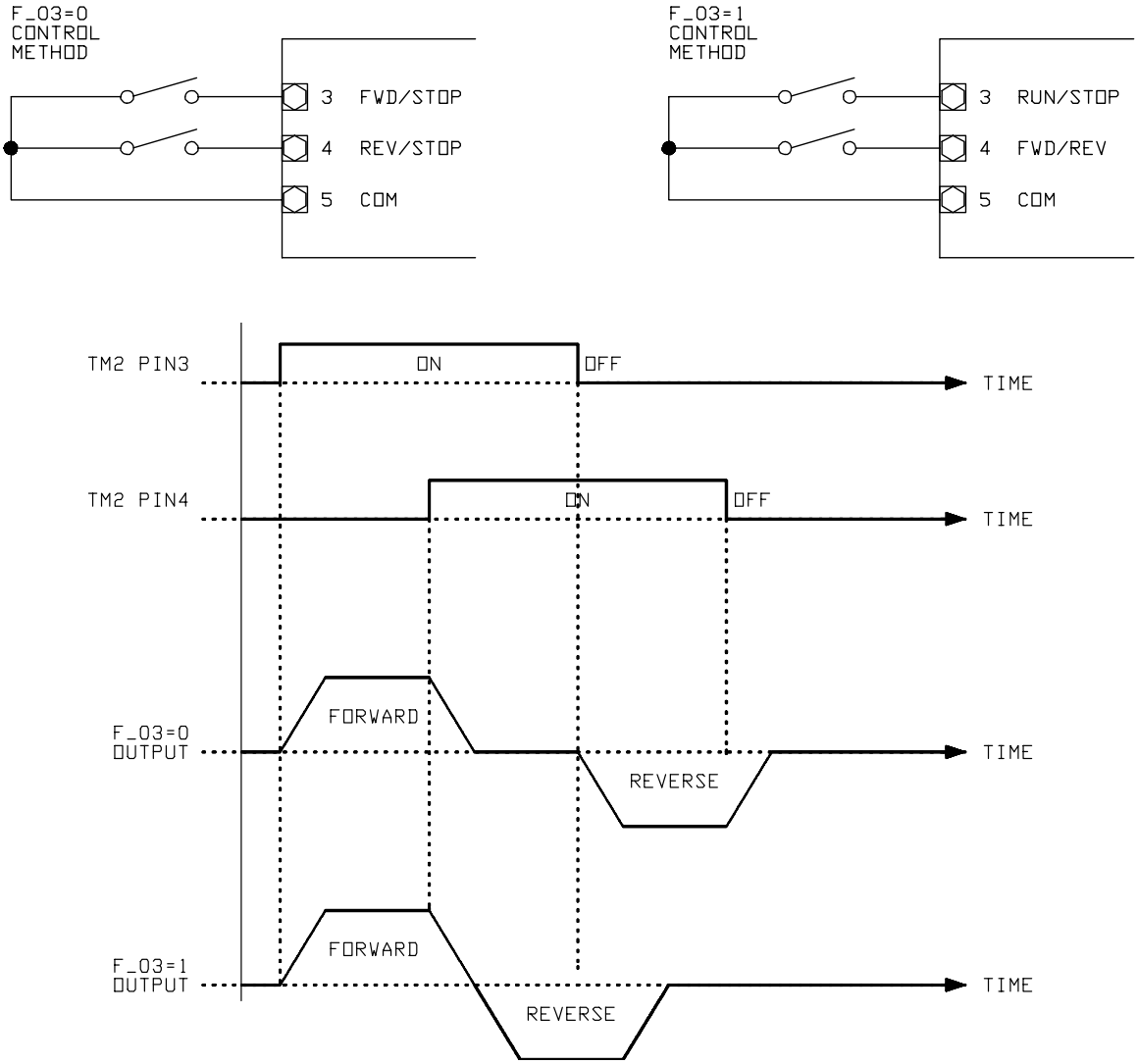


F_03 : Operation mode selection=

0: Forward / Stop, Reverse / Stop

1: Run / Stop, Forward / Reverse

Note 1: F_03 takes effect only when F_10=1 (external operation control)



Note: Reverse command is ignored when F_22=1

F_04 : Motor rotation direction setting.

Range: 000: Forward

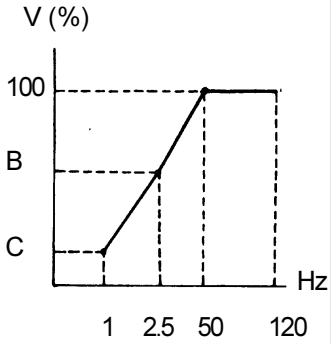
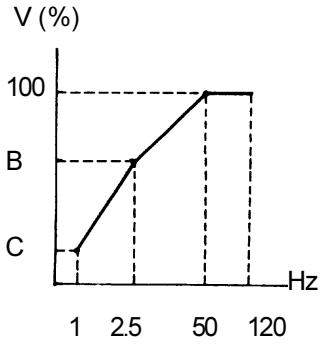
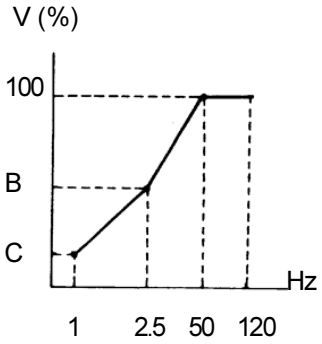
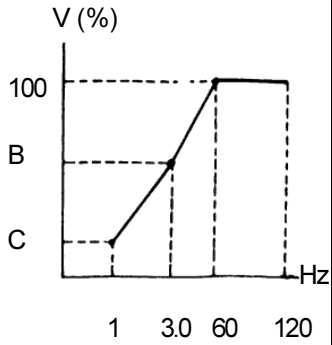
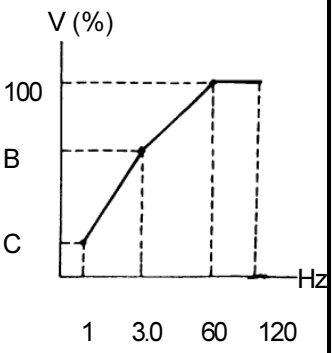
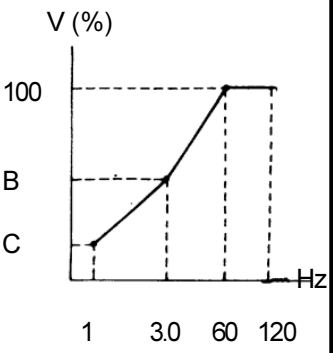
001: Reverse

Although there is no Forward / Reverse push button on the digital control panel, it is possible to adjust forward / reverse function by changing the F_04 setting. This function is only available when F_10=0. (keypad operation)

Note: Keypad operation permits only momentary operation (inverter stops when RUN button is released)

F_05 : V/F pattern setting = 1~6

Setting F_05 range: = 1~6 to select one of the 4 preset V/F patterns. (Refer to the following tables)

Specification	50 Hz System		
Application	General Application	High starting torque	Decreasing torque
F_5	001	002	003
V/F Pattern			
Specification	60 Hz System		
Application	General Application	High starting torque	Decreasing torque
F_5	004	005	006
V/F pattern			

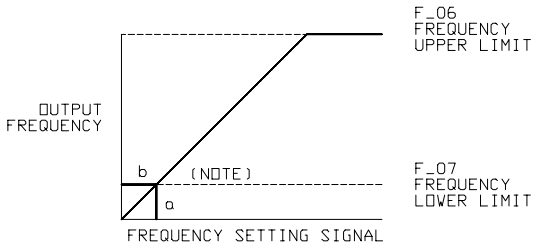
F_5	B	C
1/4	10%	8%
2/5	15%	10.5%
3/6	25%	7.7%

F_06 : frequency upper limit

range=00.0-01.0~200Hz

F_07 : frequency lower limit

range=00.0-01.0~200Hz



F_06 :Factory setting refer to F_25.

NOTE:

a: If F_07 = 0 Hz, The frequency instruction is equal to 0Hz, the inverter will stop at 0 speed and display OSP

b: If F_07 > 1 Hz, The frequency instruction F_07, the inverter will Output a minimum speed according to the setting in F_07

F_08 : SP1 frequency range: 00.0-01.0 ~ 200Hz

F_08 SP1 is active when forward or reverse command is given without SP2 or SP3 command.

The priority of reading frequency setting is :

1. Preset speeds
2. Keypad setting
3. External frequency signal using a speed pot

F_09 : JOG frequency range: 00.0-01.0~200Hz

1. When F_19 or F_20 = 2 and the multifunction input terminal is ON, the inverter operates at SP1 frequency (F_08)

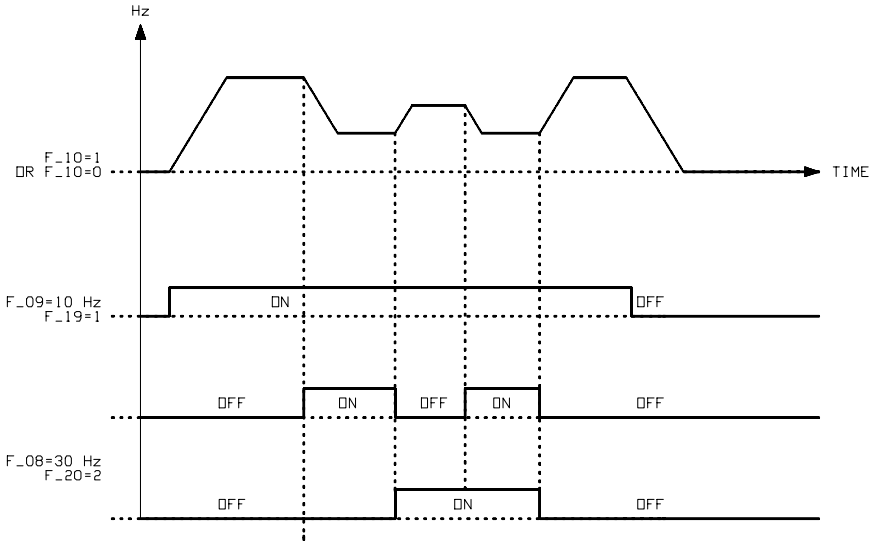
2. When F_19 or F_20 = 1 and the multifunction input terminal is ON, the inverter operates at JOG frequency (F_09)

3. The priority of reading frequency setting is: JOG SP1 Keypad setting or external frequency signal using a speed pot.

F_10 : Start / Stop Control

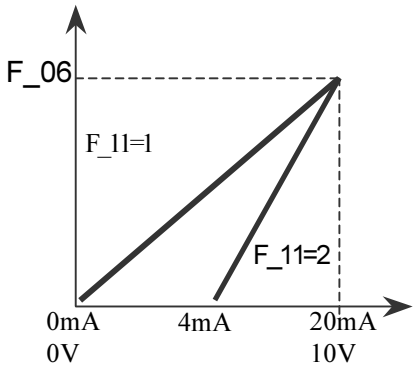
= 000 : Keypad

= 001 : Terminal (TM2) low voltage or D61538 (120V) / D61539 (24V) (TB1)



F_11 : Speed Control range: 000~005

= 000 : Keypad
= 001 : Analog Speed Pot Terminal (TM2 / TB1) (0 ~ 10V / 0-20mA)
= 002 : Analog (TM2 / TB1) (4-20mA)



NOTE 1:
When Sp1 frequency is switched on, the frequency is setup by Sp1 speed, the up/down buttons on the keypad are disabled.
Original setting will be restored after the Sp1 connection is removed.

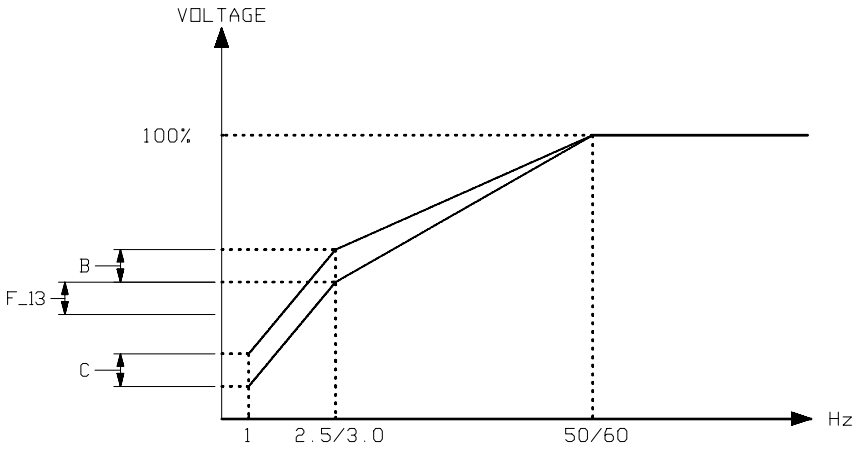
F_12 : Carrier Frequency range: 001 ~ 010

F_12	Carrier frequency	F_12	Carrier frequency	F_12	Carrier frequency
001	4 kHz	005	8 kHz	009	15 kHz
002	5 kHz	006	10 kHz	010	16 kHz
003	6 kHz	007	12 kHz		
004	7.2 kHz	008	14.4 kHz		

NOTE: If F_12=7~10,the inverter must be operated at 75% of full load or less.
Although an IGBT TYPE inverter can provide a low audible noise level during its operation, it is possible that the switching of the high carrier frequency may interfere with external electronic components (or other controllers) or even cause vibration in the motor. Adjusting the carrier frequency can usually correct this problem.

F_13: Torque compensation gain range: 000 ~ 10.0 %

To enhance Inverter output torque response according to the B, C voltage points on the V/F pattern (refer to F_05 description)
F_13 provides a 0-10% increase to voltage points B and C.



F_14 : Stopping method range: = 000: Controlled deceleration stop

= 001: free run to stop

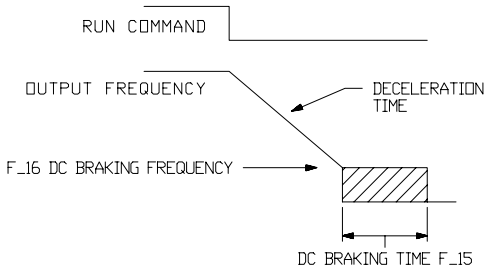
F_15 : DC braking time / free run start range: = 00.0~25.5 sec.

F_16 : DC braking starting frequency = 1~10 Hz

F_17 : DC braking level = 0~20%

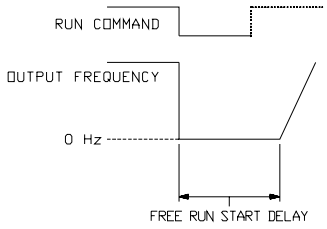
If F_14 = 0

When the inverter receives the stop command, it decelerate to the pre-set frequency setup by F_16 after this the output voltage level that is set in the F_17; will determine the amount of DC voltage that's injected into the motor. The time duration to perform this stopping function is setup in F_15.



If F_14 = 1

The inverter stops output immediately after receiving the stop command. The motor will enter into a free running state until it comes to a complete stop.



DC injection braking is disabled when F_14=1. F_15 becomes free-run start delay to provide sufficient time for the mechanical brake to stop motor rotation before restarting the motor.

Note: Display shows Frd during free run start delay time.

F_18: Motor rated current range: 000-001~200 %

1. The electronic thermal overload protection for motor :

(1) Motor rated current = Inverter rated current x F_18
F_18 = Motor rated current / inverter rated current

(2) When the load is within 100% of the motors rated current, normal operation continues. When the load reaches 150% of the motors rated current the operation is allowed to continue for 1 minute. (refer to curve (1) in Figure 3)

(3) After protecting the motor with the electronic thermal switch activated, the inverter is cut off immediately. The OLI light will flash. To resume operation, push the RESET button or activate an external reset connection wired to TB1 terminal 5 or 6.

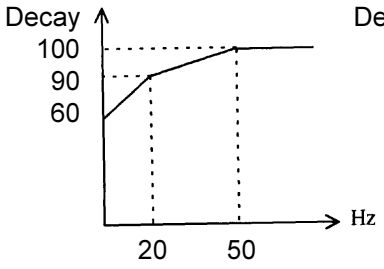
(4) When the motor is operating at low speeds, the heat dissipation efficiency is lower. The electronic thermal activation level is also reduced. (to change from curve (1) to curve (2) in Figure 3. Choose the appropriate F_05 setting according to the applied motor to reach the desired performance.

2. The electronic thermal protecting for inverter :

(1) When the load is within 103% of the inverters rated current, the operation continues. When the load reaches 150% of rated current of the inverter, the operation will continue for 1 minute. (Refer to curve (1) of figure 3)

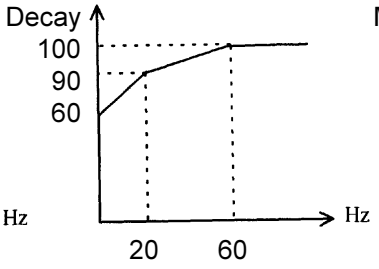
(2) After the activation of the electronic thermal switch, the inverter is shut off immediately. The OL2 light will flash. To resume the operation, push RESET button or activate an external reset contact on TB1 terminal 2.

F_05 = 1, 2
50 Hz standard motors

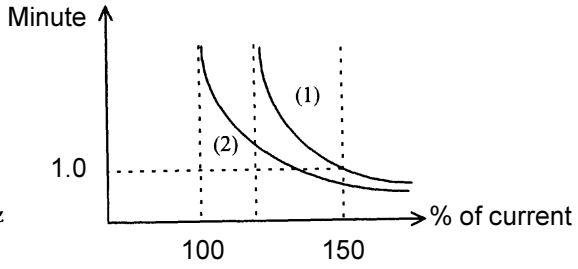


(Figure 1)

F_05 = 3, 4
60 Hz standard motors



(Figure 2)



(Figure 3)

F_19: Multifunctional input terminal 1 function range: 001~ 006

F_20: Multifunctional input terminal 2 function range: 001~006

1. **F_19=001 , F_20 =001** **gOG control: (refer to F_09)**
2. **F_19=002 , F_20=002 or 006** **Multi-speed control:**
   F_19=002 and F_20=006

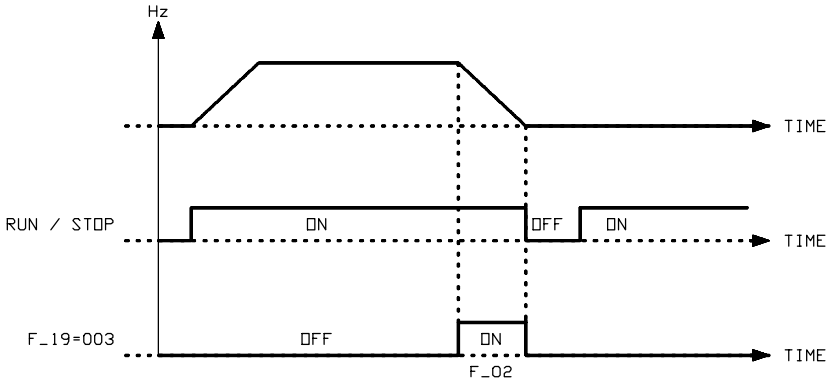
TM2 - SP1 Terminal	TM2 - RESET Terminal	Output frequency
ON	OFF	F_08
OFF	ON	F_26
ON	ON	F_27

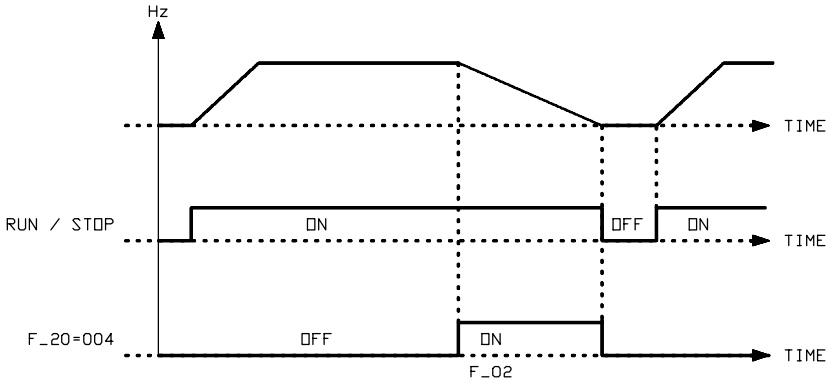
F_19=006 , F_20 =002

TB1 - #5 Terminal	TB1 - #6 Terminal	Output frequency
ON	OFF	F_26
OFF	ON	F_08
ON	ON	F_27

3. F_19, F_20=003: External emergency stop. N/C contact for running.
When the external emergency stop signal is activated, the inverter activates coast to stop, (ignoring the setting of F_14). The inverters display light will flash ES after stopping. After the emergency stop signal is deactivated, turn the RUN switch OFF and then ON again to cycle it. (F_10=1) Or, push the RUN key (F_10=0). The inverter will then resume operation and re-start. If the emergency stop signal is removed before the inverter stops, the inverter will still execute the emergency stop.

4. F_19, F_20=004: External Base Block (Immediate Shut Down) N/O contact for running.
When the external base block signal is activated, the inverter output will be immediately shut off (ignoring the setting of F_14) and flash b.b. light. After the base block signal is deactivated, the inverter will restart from the original starting frequency without the free-run stop time delay.

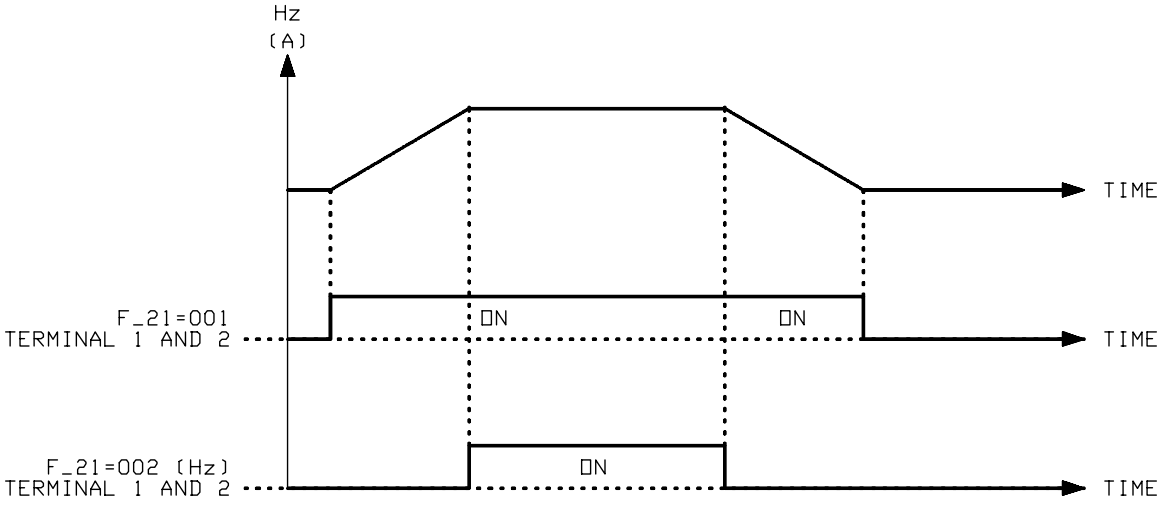




F_21: **Multifunctional output terminal control range: 001~003**

1. F_21=001: Run mode signal operating
2. F_22=002: At frequency speed signal
3. F_21=003: Fault signal

   Terminal 1 and 2 of TM2 / TB1 are activated at the following fault conditions:
   CPF, OL1, OL2, OCS, OCA, OCC, Ocd, Ocb, OVC, LVC, OHC



F_22: Reverse lock-out:

000= REV command; 001= REV command lock-out

Note: When F_04 is set to 1 (reverse), F_22 cannot be set to 1, in order to properly lock-out a motors direction, F_04 must be set at 0 before setting F_22 to 1.

F_23: Restart after momentary power loss

= 000: Restart enabled

= 001: Restart disabled

1. When the AC power supply is temporarily below low voltage protection levels due to power issues or encountering large current loading in the same power supply system, the inverter will stop its output immediately. If the power source resumes within 2 seconds, the inverter can restart by using its speed search program.

2. When F_23 = 0, if the transient power off is less than 2 seconds, the inverter will resume operation via speed search at approximately 0.5 sec. after power up. The restart time is not limited by F_24. If the transient power off duration is longer than 2 seconds, it is up to the setting on the F_24 to decide if the inverter has been programmed to be automatically restarted.

3. When F_23 = 1, the inverter will cease operation and will not automatically restart after a momentary power loss. Starting equipment automatically after a power loss can be dangerous. Use caution when selecting the automatic restart function.

F_24: Number of Auto-restart times range: 000~005

1. When F_24 = 0, the inverter will not try to restart.

2. When F_24 = 0, the inverter will resume operation via SPEED SEARCH at approximately 0.5 second after a function trip. After that, the inverter will accelerate or decelerate to the current frequency setting.

3. When the inverter is set to deceleration or DC braking, the transient restart procedure is not performed.

4. If either of following situations should develop, the auto restart times will be reset:

   (1) No additional malfunction (in operation or stop) occurs within 10 minutes.
   (2) Press RESET button.

WARNING! Do not use when operating a hoist or any other manually operated equipment.

F_25 : Return to Factory Pre-Settings

= 010 : Constants initialization to 50Hz system mode

= 020 : Constants initialization to 60Hz system mode

1. When F_25 is set to 010, all parameters are restored to 50 Hz factory settings. The settings of F_05 =1, F_06 = 50. F_25 is restored back to 000 after the reset process is complete. (50Hz operation)

2. When F_25 is set to 020, all parameters are restored to 60 Hz factory settings. The settings of F_05 =4 and F_06 = 60. F_25 is restored back to 000 after the reset process is complete. (60Hz operation)

F_26: SP2(00.0 - 01.0~200Hz) , Multi-speed2 (Reference to F_19 and F_20)

F_27: SP3(00.0 - 01.0~200Hz) , Multi-speed3 (Reference to F_19 andF_20)

F_28: Reserved

F_29: CPU program version. Displays loaded program version.

F_30: Fault log

1. Last three faults : indicate the sequence of the occurrence of malfunctions by the location of decimal point. **x.xx** indicates a recently happened malfunction. **xx.x** indicates the previous malfunction that happened. **xxx.** Indicates the earliest malfunction in the record.

2. After entering the F_30 function, the **x.xx** trip record will be displayed first. After that, press UP arrow button and you can read activity in a chronological order. **xx.x xx x. x.xx** consecutively.

3. After entering F_30 function, if the RESET button is pressed, the trip record will be cleared. Indication display **-.—**, **—.-**, and **—.**

4. When the content of trip indicates O.CC, it will indicate the trip code is OC.C and so on.

3.4 Malfunction Indications and Countermeasures

1. Manual reset inoperative malfunctions

Fault code	Content	Probable cause	Countermeasure
CPF	Program error	Outside noise interference	Place a RC surge absorber in parallel with the noise generating magnetic contactor coils.
EPR	EEPROM error	EEPROM defective	Replace EEPROM
OV	Voltage too high while not operating	1. Power source voltage too high. 2. Detection circuitry defective.	1. Examine the power supply 2. Return the inverter for repair
LV	Voltage too low while not operating	1. Power source voltage too low. 2. Detection circuitry defective.	1. Examine the power supply. 2. Return the inverter for repair.
OH	Inverter overheat while not operating.	1. Detection circuit defective. 2. Environment overheat or poor ventilation.	1. Return the inverter for repair. 2. Improve the ventilation.

2. Manual reset operative malfunctions (Auto-Reset inoperative)

Fault code	Content	Probable cause	Countermeasure
OC	Overcurrent at stop condition.	Detection circuit malfunction.	Return the inverter for repair.
OL1	Motor overload.	1. Loading too large. 2. Improper V/F model setting. 3. Improper F_18 setting.	1. Increase capacity of motor. 2. Adjust to use a proper V/F curve setting. 3. Adjust F_18 according to instruction.
OL2	Inverter overload.	1. Loading too large. 2. Improper V/F model setting.	1. Increase capacity of inverter. 2. Adjust to use a proper V/F curve setting.

3. Manual Reset and Auto-Reset Operative Malfunction

Fault code	Content	Probable cause	Countermeasure
OCS	Transient overcurrent starting machine.	1. Motor coil short-circuit with external housing. 2. Motor connection wire short-circuited with ground. 3. Transistor module damaged. 4. Driver PCB damaged.	1. Examine motor 2. Examine wiring 3. Replace transistor module. 4. Replace inverter.
OCA	Overcurrent at acceleration.	1. Acceleration time setting too short. 2. Improper V/F feature selection. 3. Applied motor capacity exceeds inverter capacity.	1. Adjust acceleration time to longer setting. 2. Adjust to a proper V/F curve. 3. Replace and install another inverter with appropriate capacity.
OCC	Overcurrent at constant speed.	1. Transient alterations of the load. 2. Transient alteration of the power supply.	1. Examine the loading configuration. 2. Install inductor on the power supply input side.
OCd	Overcurrent at deceleration	Deceleration setting too short.	Adjust to use a longer deceleration time.
OCb	Overcurrent at braking	DC braking frequency, braking voltage, or braking time setting too long.	Adjust to reduce settings of F-15, F_16, or F_17.
OVC	Overvoltage at operation / deceleration	1. Deceleration time setting too short or inertia loading too large. 2. Power supply voltage variation too large. 3. Insufficient dynamic brake or inoperative.	1. Adjust to use a longer deceleration time. 2. Install a inductor on the power supply input side. 3. Increase the capacity of inverter. 4. Replace DB control or resistor.
LVC	Insufficient voltage level at operation	1. Power supply voltage too low. 2. Power supply voltage variation too large.	1. Improve power source quality. 2. Adjust to use a longer acceleration time. 3. Increase capacity of inverter. 4. Install a reactor on the power supply input side.
OHC	Heatsink overheated at operation	1. Loading too heavy. 2. Ambient temperature too high or poor ventilation.	1. Examine the loading. 2. Increase capacity of inverter. 3. Improve ventilation.

Special Conditions Description

Fault code	Content	Probable cause
SP0	Zero speed stopping	When F_11=0, F_7=0 and frequency setting < 1 Hz. When F_11=1, F_7<(F_6 / 100), and frequency setting < (F_6 / 100)
SP2	Keypad emergency stop	The inverter setup to external operation (F_10=1). If the STOP key in the keypad is pressed at the middle of operation, the inverter stops according to the setting in F_14 and flash SP2 after stop. The RUN switch must be turned OFF then ON to restart the machine.
E.S.	External emergency stop	When the external emergency stop signal is activated through the multi-function input terminal, the inverter decelerates and stops. Inverter flashes E.S. after stops. (Refer to instructions for F_19 and F_20 detail)
b.b.	External BASE BLOCK	When the external BASE BLOCKsignal is activated through the multifunction terminal, the inverter stops output immediately and flashes b.b. for indication. (refer to instructions for F_19 and F_20 for detail)
FrE	Forward / Reverse error	Occurs when both Forward and Reverse are simultaneously entered. Clears as soon as problem is corrected.
Ser	Input sequence error	Occurs when input sequence is not in correct order. Reset by correcting sequence and returning both direction inputs to OFF.
Frd	Free run delay	Occurs when Free Run Delay is active set at F_15. Clears once delay expires.

Keypad Operation Error Instruction

Fault code	Content	Probable cause	Countermeasure
LOC	Motor direction locked	1. Attempt to reverse direction when F_22=1 2. Attempt to set F_22 to 1 when F_04=1	1. Adjust F_22 to 0 2. Adjust F_04 to 0
Er1	Keypad operation error	1. Press up or down keys when F_11=1 or under sp1 operation. 2. Attempt to modify F-29 3. Attempt to modify parameter that is not allowed to be modified during operation (refer to parameter list)	1. Use the up or down arrow keys to adjust frequency setting only after F_11=0. 2. Do not modify F_29 3. Modify in stop mode
Er2	Parameter setting error	1. F_6, F_7	1. F_6>F_7

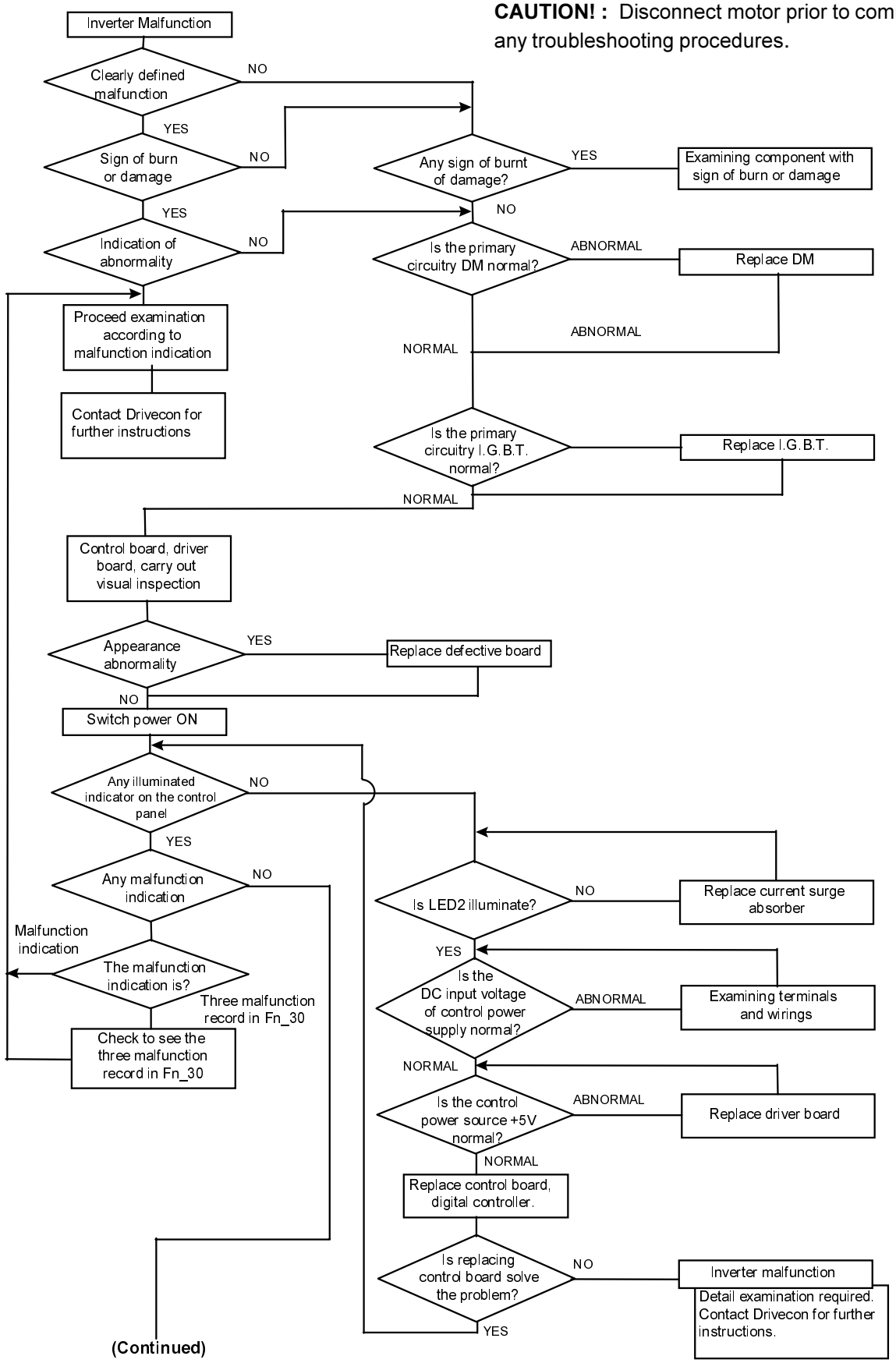
3.5 General Malfunction Examination method

Abnormality	Check Point	Countermeasure
Motor inoperative	Is the power source voltage delivered to L1, L2, (L3) terminal (is the charging indicator illuminated)?	Check if the power source on. Turn power source OFF and then ON again. Reconfirm the power voltage level.
	Is there voltage output from output terminal T1, T2 and T3?	Turn power source OFF and then ON again.
	Is the motor wired correctly?	Check motor wiring.
	Is there any abnormal condition of the inverter? ie: fault display.	Refer to instructions to examine and correct wiring.
	Is the forward or reverse instruction active?	
	Is the analog frequency setting correct?	Check to see if wiring for analog frequency input signal is correct. Check if the frequency input setting voltage is correct.
	Is the operation mode setting correct?	Check program parameters.
Motor operate in opposite direction	Is wiring on the output terminals T1, T2 and T3 correct?	Turn OFF power and swap output phases to motor.
	Is the wiring for the forward and reverse signal scorrect?	Turn OFF power and switch forward and reverse wires.
Motor operation speed fixed	Is the wiring for analog frequency input correct?	Examine the wiring and correct it.
	Is the operation mode setting correct?	Examine parameter settings.
	Is the motor load too large?	Check with amp meter.
Motor operation at speed too high or too low.	Is the specification of motor (poles, voltage) correct?	Reconfirm motor specifications.
	Is the gear ratio correct?	Reconfirm gear ratio.
	Is the highest output frequency setting correct?	Reconfirm output frequency limit setting F_06.
	Is the voltage on motor side reduced?	Reduce loading variation.
Abnormal speed variation at operation	Is the loading too heavy?	Increase inverter and motor capacity.
	Is the input power source steady and stable?	Install AC reactor on the power supply input side.

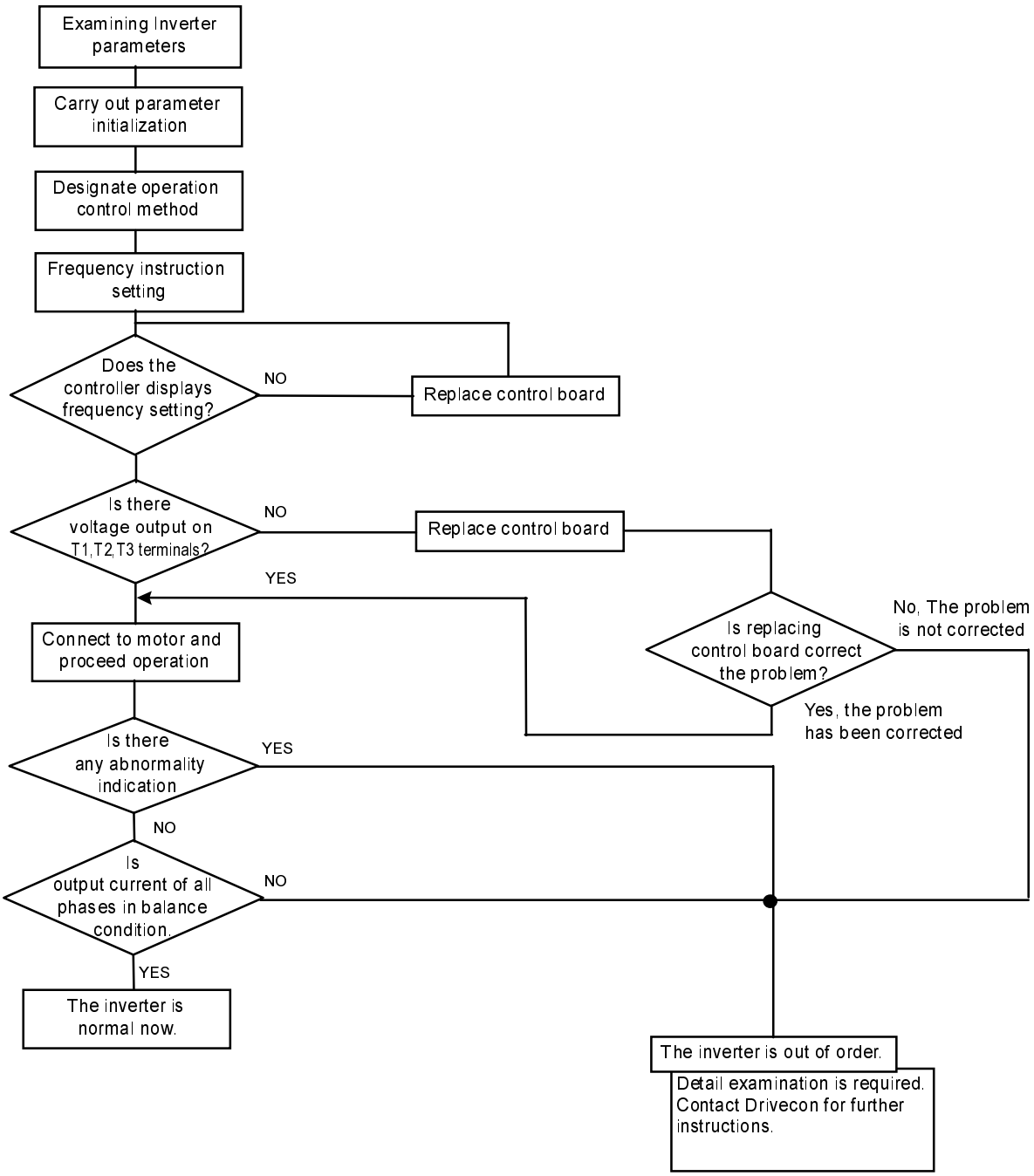
Chapter 4: Troubleshooting Procedures

4.1 Troubleshooting flow charts

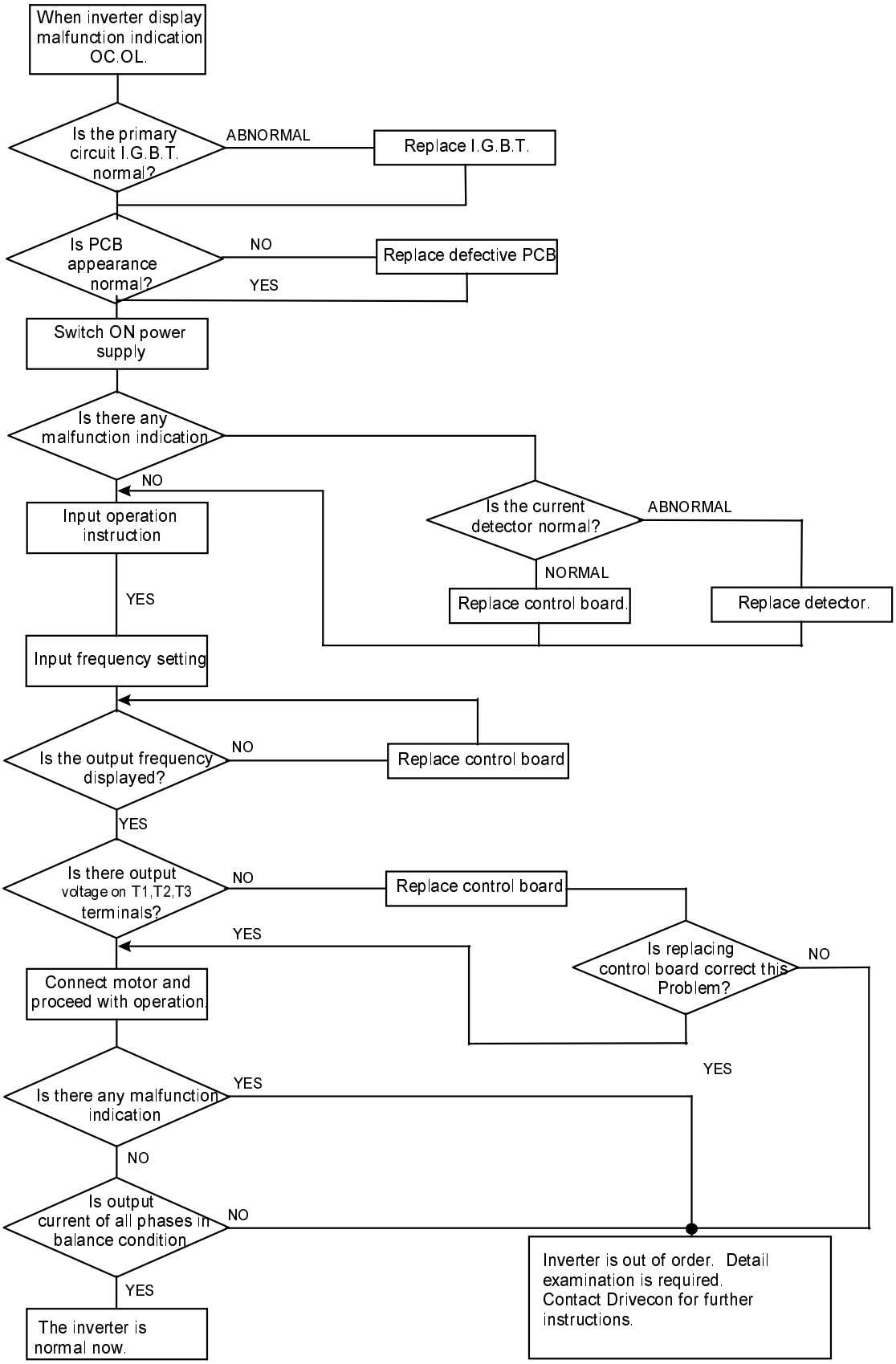
WARNING! : Troubleshooting must be carried out by a qualified service person. Damage or injury can result if proper safety precautions are not observed.
CAUTION! : Disconnect motor prior to commencing any troubleshooting procedures.



4.1 Troubleshooting flow charts (continued)

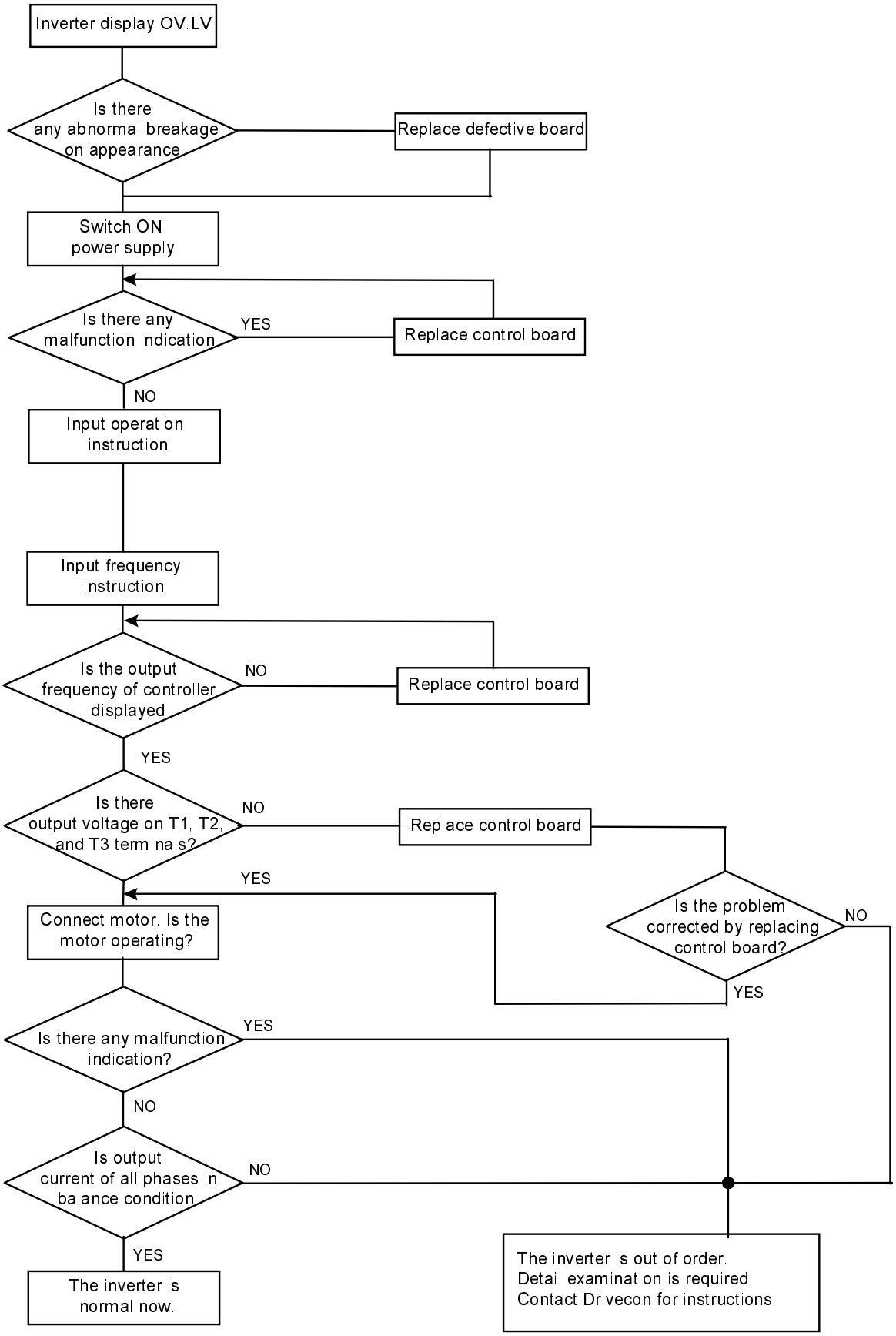


Chapter 4: Troubleshooting Procedures
4.1 Indication of OC.OL

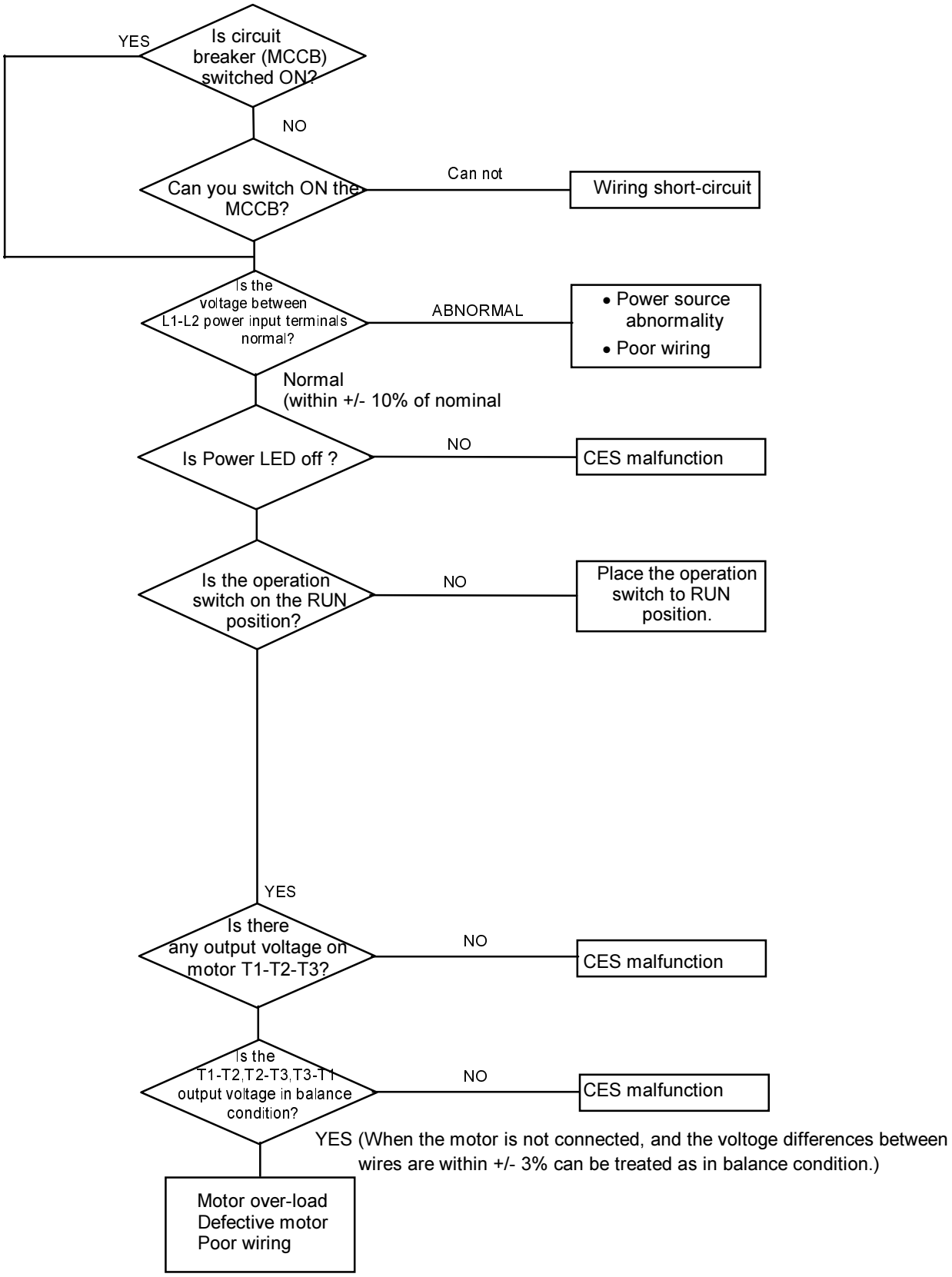


Chapter 4: Troubleshooting Procedures

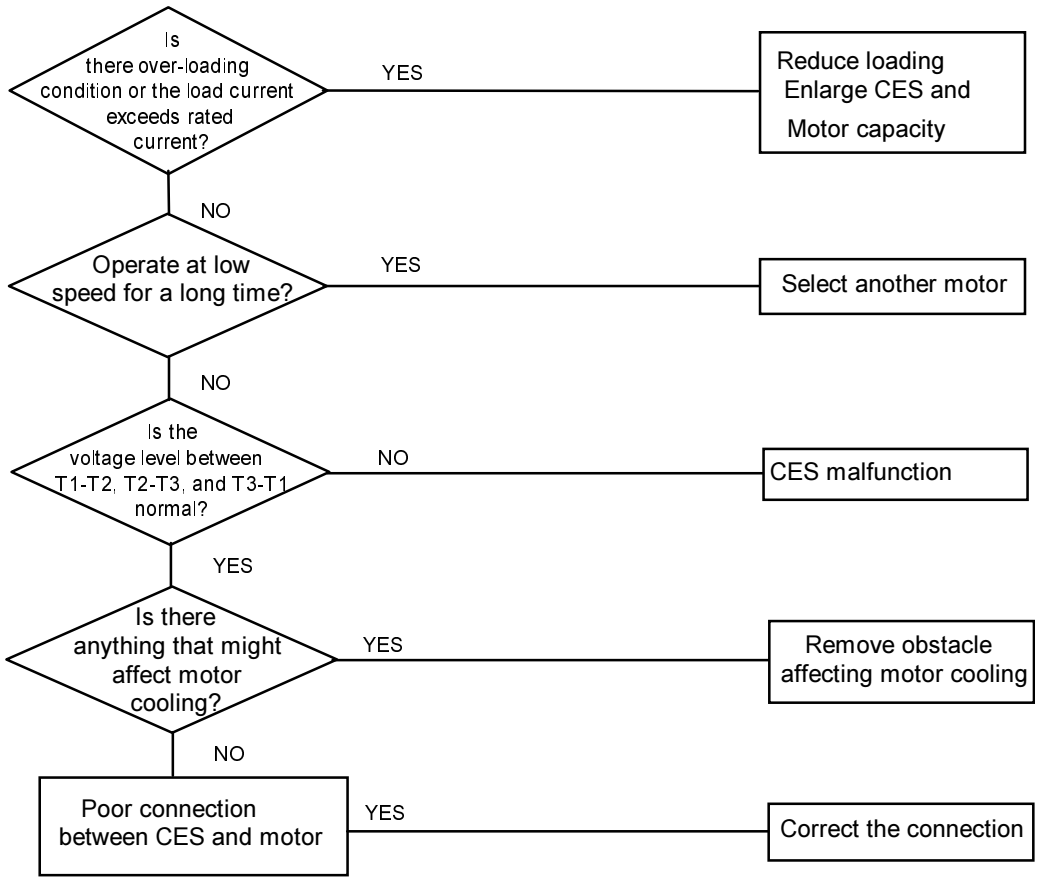
4.1 Indication of OV.LV



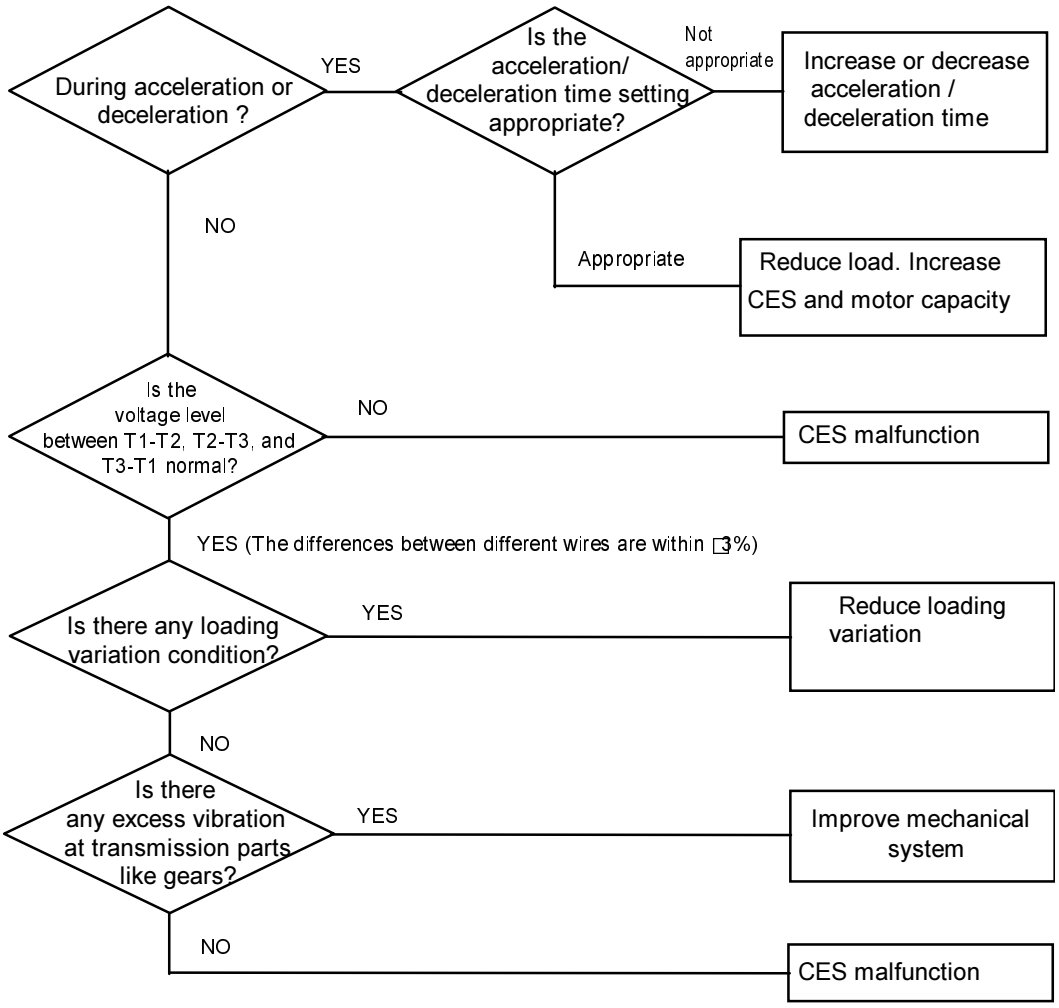
Chapter 4: Troubleshooting Procedures
Motor Inoperative



Motor overheat



Irregular motor operation



Routine examination and periodical examination

Inverter requires routine and periodical examination and maintenance.
Carry out the examination only after the "Power LED" indicator goes off for at least 5 minutes.

Maintenance item	Maintenance description	Examination period		Examination method	Criterion	Countermeasure
		Routine	1 year			
Installation site environment	Reconfirm environment temperature and humidity			Refer to installation instructions and measure with thermometer and hygrometer.	Temperature: -10~40°C Humidity: Under 95% non-condensing	Improve installation site environment
	Check and remove any flammable material nearby			Visual inspection	No foreign object	
Inverter installation and grounding	Is there any abnormal vibration on the installation site?			Visual and audio inspection	Within acceptable range	Tighten loose screw
	Is the grounding resistance within acceptable range?			Measure resistance by multi-meter	200V class under 100 ohm	Improve grounding
Input power source voltage	Is the voltage of the primary circuitry normal?			Measure voltage by multi-meter	Voltage level conforming specification	Improve power source
Inverter external terminal mounting screw	Is the tighten parts secured?			Visual inspection. Use screwdriver to verify screw tightness	No abnormality	Tighten loose screw or return for repair
	Is there any sign of breakage on the terminal panel?					
	Is there any obvious rusty conditions?					
Internal wiring of inverter	Is it deformed or skewed?			Visual inspection	No abnormality	Replace or return for repair
	Is the insulation of wire broken?					
Heatsink	Is it accumulating dust or dirt?			Visual inspection	No abnormality	Clean up dust or dirt
PCB	Is it accumulating conductive metal?			Visual inspection	No abnormality	Clean up or replace PCB
	Is there any overheated or burnt components?					
Cooling fan	Is there any abnormal vibration or noise?			Visual and audio inspection	No abnormality	Replace cooling fan
	Is it accumulating dust or dirt?			Visual inspection		Clean up
Power component	Is it accumulating dust or dirt?			Visual inspection	No abnormality	Clean up
Capacitor	Is there any sign of strange order or leakage?			Visual inspection	No abnormality	Replace capacitor or inverter
	Is there any sign of swelling or bulging?					

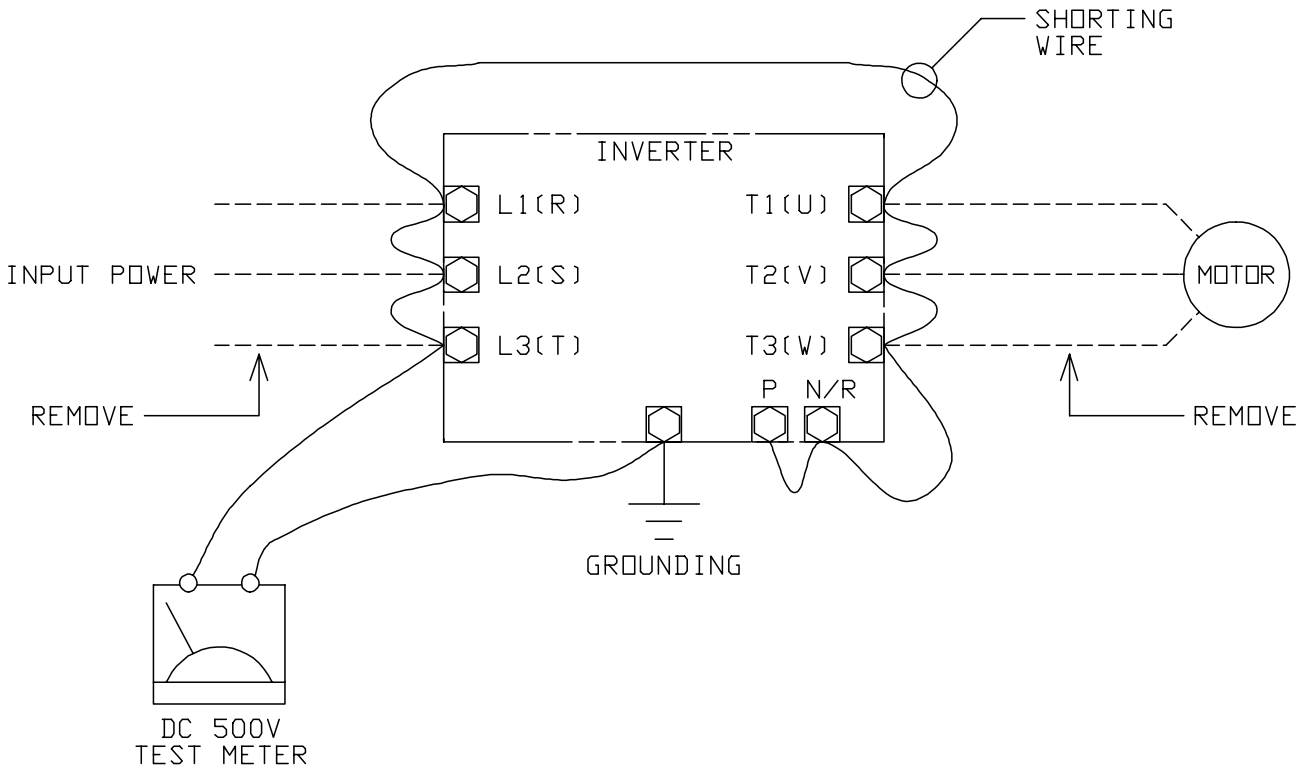
4.2 Maintenance and Examination

Frequent examination and maintenance is not required for the inverter.
To maintain appropriate reliability, please proceed with the following periodical examination. Remember to turn off power supply and wait until the Power LED goes off before proceeding. (Due to the large amount of remaining charge in the internal capacitors.)

(1) Clean out internal dust and dirt.
(2) Check out mounting screws on every terminal and parts. Tighten loose screws.
(3) Dielectric strength test.

(a) Remove all conducting wires between Drive and outside world. Power must be turned OFF.
(b) The dielectric strength test inside Drive should be carried out only for inverter power circuitry. Use DC500V: high resistance meter. Measured resistance should be higher than 100M ohm.
(c) Disconnect and remove control PCB prior to dielectric test.

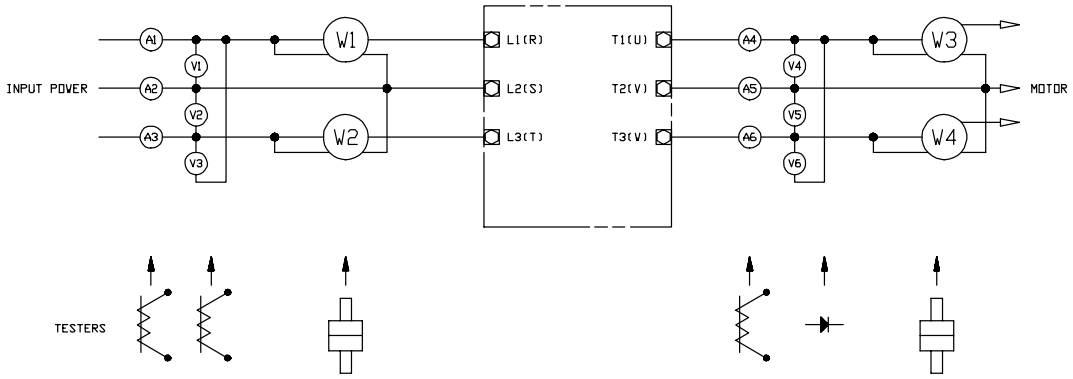
CAUTION! : Do not perform dielectric strength test to the control circuit.



Connection for dielectric strength test

4.3 Voltage and Current Measurement

The result for measuring primary and secondary voltage and current will be somewhat different because of the variety of measuring instruments and harmonics generated by inverter. Refer to the following illustration for measurement.



MEASUREMENT	TESTING POINTS	TESTER	REMARKS
Input voltage Vi	V1 V2 V3	Moving iron type	
Input current Ii	A2 A2 A3	Moving iron type	
Input power Pi	W1 W2	Electrodynamometer	Pi=W1+W2
Input power factor PFi	$PFi = \frac{Pi}{\sqrt{3}Vi \bullet Ii} \times 100\%$		
Output voltage Vo	V4 V5 V6	Rectifier type	+ - 3% of maximum output voltage
Output current Io	A4 A5 A6	Moving iron type	Current should be under inverter rated current
Output power Po	W3 W4	Electrodynamometer	Po=W3+W4
Output power factor PFo	$PFo = \frac{Po}{\sqrt{3}Vo \bullet Io} \times 100\%$		

EMI Filter (Class B) Specifications

Model	Dimensions (inches)	Current value (A)	Inverter model
ESF-2102	6.14 x 3.00 x 0.98	10A	CES102, CES104, CES202, CES204, CES207

Din Rail Specifications
(for use with CES102, CES102, CES204, CES207 inverter models)

Model: DIN ES-201
Dimensions: 5.42" x 2.83" x 0.30"

Specifications of Input Reactor

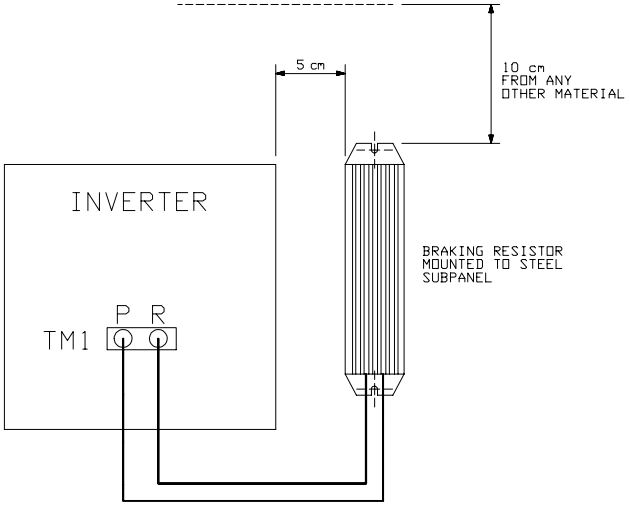
Inverter model	Input AC Reactor		
	Current value (A)	Inductance (mH)	Drivecon reactor part number
CES-102-1xx	6 *1	1.8	KLR6BTB
CES-104-1xx	12 *1	.92	KLR12BTB
CES-202-1xx	3 *1	7.3	KLR3ATB
CES-204-1xx	6 *1	3.6	KLR6ATB
CES207-1xx	8 *1	2.7	KLR8ATB
CES215-1xx	16 *1	1.4	KLR16ATB
CES222-1xx	25 *1	0.88	KLR25ATB
CES407-3xx	2	18	KLR2CTB
CES415-3xx	4	9.2	KLR4CTB
CES422-3xx	6	6.1	KLR6CTB

*1 Single phase input
Open type specified.
Add -1 suffix for NEMA type 1 enclosure.

4.5 Specification of Braking Resistor

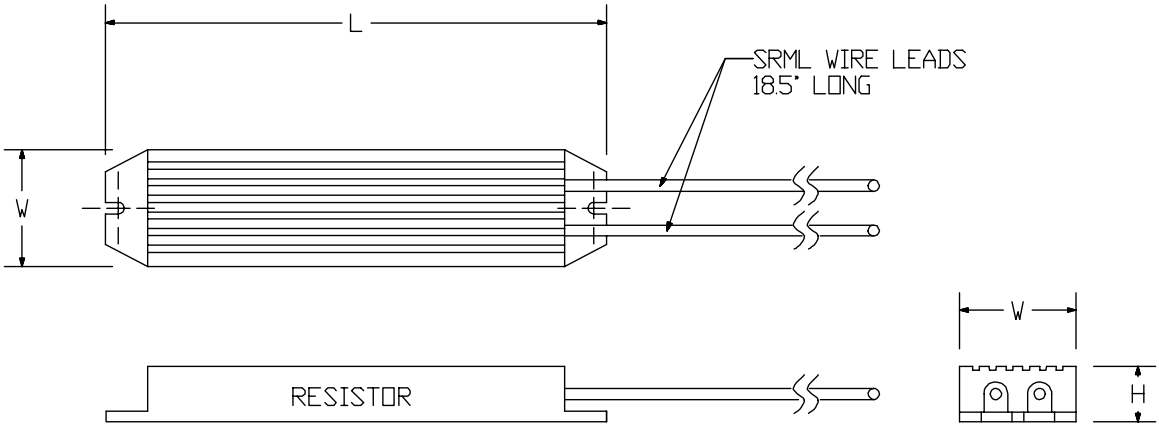
Inverter model	Braking transistor built in	Braking resistor built in	Torque of braking	Braking resistor model (stock #)	Size of Motor (KW)	Model of braking resistor		Braking resistor ED (%)	Torque of Braking (%)	Size of resistor (LxWxH) inches	Weight N.W. (kg)
						Watts	Ohms				
CES102-1xx	O	X	20% (1) / 100% (2)	BRN2-207 (205A1587)	.20	150	150	75%	150	7.25 x 1.625 x .75	1.1
CES104-1xx	O	X	20% (1) / 100% (2)	BRN2-207 (205A1587)	.40	150	150	40%	130	7.25 x 1.625 x .75	1.1
CES202-1xx	O	X	20% (1) / 100% (2)	BRN2-207 (205A1587)	.20	150	150	75%	150	7.25 x 1.625 x .75	1.1
CES204-1xx	O	X	20% (1) / 100% (2)	BRN2-207 (205A1587)	.40	150	150	40%	130	7.25 x 1.625 x .75	1.1
CES207-1xx	O	X	20% (1) / 100% (2)	BRN2-207 (205A1587)	.75	150	150	20%	125	7.25 x 1.625 x .75	1.1
CES215-xxx	O	X	20% (1) / 100% (2)	BRN2-215 (10502526)	1.50	150	91	10%	120	7.25 x 1.625 x .75	1.1
CES222-xxx	O	X	20% (1) / 100% (2)	BRN2-222 (10502526)	2.20	150	91	9%	105	7.25 x 1.625 x .75	1.1
CES407-3xx	O	X	20% (1) / 100% (2)	BRN2-407 (10502209)	0.75	150	390	20%	150	7.25 x 1.625 x .75	1.1
CES415-3xx	O	X	20% (1) / 100% (2)	BRN2-415 (10502209)	1.50	150	390	10%	119	7.25 x 1.625 x .75	1.1
CES422-3xx	O	X	20% (1) / 100% (2)	BRN2-422 (10502525)	2.20	150	220	8%	130	7.25 x 1.625 x .75	1.1

Note: 1. Braking level: 385 / 770 Vdc for CES-200/400 series
2. Braking resistor mounting is demonstrated below.



O: Built in
X: External
Notes:
(1) 20% standard braking torque without DB resistor
(2) 100% with external DB resistor installed (Optional. Purchased separately)

Dimensions



CES Series AC Drives
Function List

CODE	Function	Function Description	UNIT	RANGE	Factory setting	NOTE	Customer settings
Fn00	Factory adjustment	Factory adjustment			0		
Fn01	Accel time	Accel time	0.1 sec	0.1~999 sec.	5.0	*1	
Fn02	Decel time	Decel time	0.1 sec	0.1~999 sec.	5.0	*1	
Fn03	Operation mode	0: Forward / Stop, Reverse / Stop 1: Run / Stop, Forward / Reverse	1	0~1	0		
Fn04	Motor rotation direction	0: Forward 1: Reverse	1	0~1	0	*1	
Fn05	V/F pattern	V/F pattern setting	1	1~6	1/4	*2	
Fn06	Frequency upper limit	Frequency upper limit	0.1 Hz	1.0~120 Hz	50/60 Hz	*2, *3	
Fn07	Frequency lower limit	Frequency lower limit	0.1 Hz	0.0~120 Hz	0.0 Hz		
Fn08	SPI frequency	SPI frequency	0.1 Hz	1.0~120 Hz	10 Hz	*3	
Fn09	JOG frequency	JOG frequency	0.1 Hz	1.0~10 Hz	6 Hz		
Fn10	Operation control	0: Keypad 1: Terminal (TM2)	1	0~1	0		
Fn11	Frequency control	0: Keypad 1: Terminal (0~10V / 0~20mA) 2: Terminal (4-20mA)	1	0~2	0		
Fn12	Carrier frequency control	Carrier frequency setting	1	1~5 (1~10) *4	5		
Fn13	Torque compensation	Torque compensation gain	0.1%	0.0~10.0%	0.0%	*1	
Fn14	Stop method	0: Decelerate stop 1: Free run stop	1	0~1	0		
Fn15	DC braking setting	DC braking time	0.1 sec	0.0~25.5 S	0.5 S		
Fn16	DC braking setting	DC braking injection frequency	0.1 Hz	1~10 Hz	1.5 Hz		
Fn17	DC braking setting	DC braking level	0.1%	0.0~20.0%	8.0%		
Fn18	Electronic thermal	Protection base on motor rated current.	1%	50~100% (0~200) *4	100%		
Fn19	Multifunction input connection point	Multifunction input terminal (SP1) function	1: Jog 2: SP1 3: Emergency stop 4: External base block 5: Reset 6: SP2 *4		2		
Fn20	Multifunction input connection point	Multifunction input terminal (reset) function			5		
Fn21	Multifunction output	Multifunction output terminal	1: Operating 2: Frequency reached 3: Fault		3		
Fn22	Reverse instruction	0: REV run enabled 1: REV run disabled	1	0~1	0		
Fn23	Momentary power loss	0: enabled 1: disabled	1	0~1	0		
Fn24	Auto restart	Number of Auto-restart times	1	0~5	0		
Fn25	Factory setting	010: Constants initialization to 50 Hz system 020: Constants initialization to 60 Hz system				*2	
Fn26	SP2 frequency	SP2 frequency	0.1 Hz	1.0~200 Hz	20	*4	
Fn27	SP3 frequency	SP3 frequency	0.1 Hz	1.0~200 Hz	30	*4	
Fn28		Reserved for future use					
Fn29	Software version	CPU program version					
Fn30	Fault log	Last 3 malfunction memory					

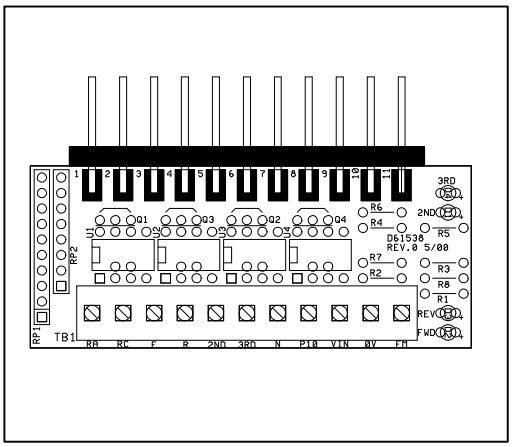
Notes:
*1: Setting can be changed during running mode.
*2: Please refer to Fn25.
*3: If the setting range is above 100, the setting unit becomes 1.
*4: New function for CPU version v1.8 and above.

Reserved for your notes:

D61538 110v Input Isolator Board
D61539 24v Input Isolator Board
Revision 0
September 28, 2000

Instruction Manual

The D61538 / D61539 Input Signal Isolator Boards are for use with Drivecon Crane Commander ES (CCES) and Commander ES (CES) series of variable frequency drives. They are designed to accept external 110vac or 24vac inputs from switch or relay contacts. The D61538 will accept 110-120vac signals and the D61539 will accept 24vac input signals. The D61538 will not function with 24vac input signals and the D61539 will be damaged if used with 110vac input signals.



Either model of input isolator boards will provide direction [run forward / run reverse] and up to 2 additional preset speeds. If the two additional preset speeds are not required, then those inputs can each be assigned a different function from a list of seven available functions. Four red LED indicators are provided for the "Fwd", "Rev" and each of the two programmable inputs to show when the input is activated. A programmable "dry" Form A relay contact is available that can be programmed to one of four available functions. Terminals are provided to connect an external speed reference potentiometer or an external analog speed reference signal. Also available are terminal connections for an analog 0 - 10vdc output representing output frequency.

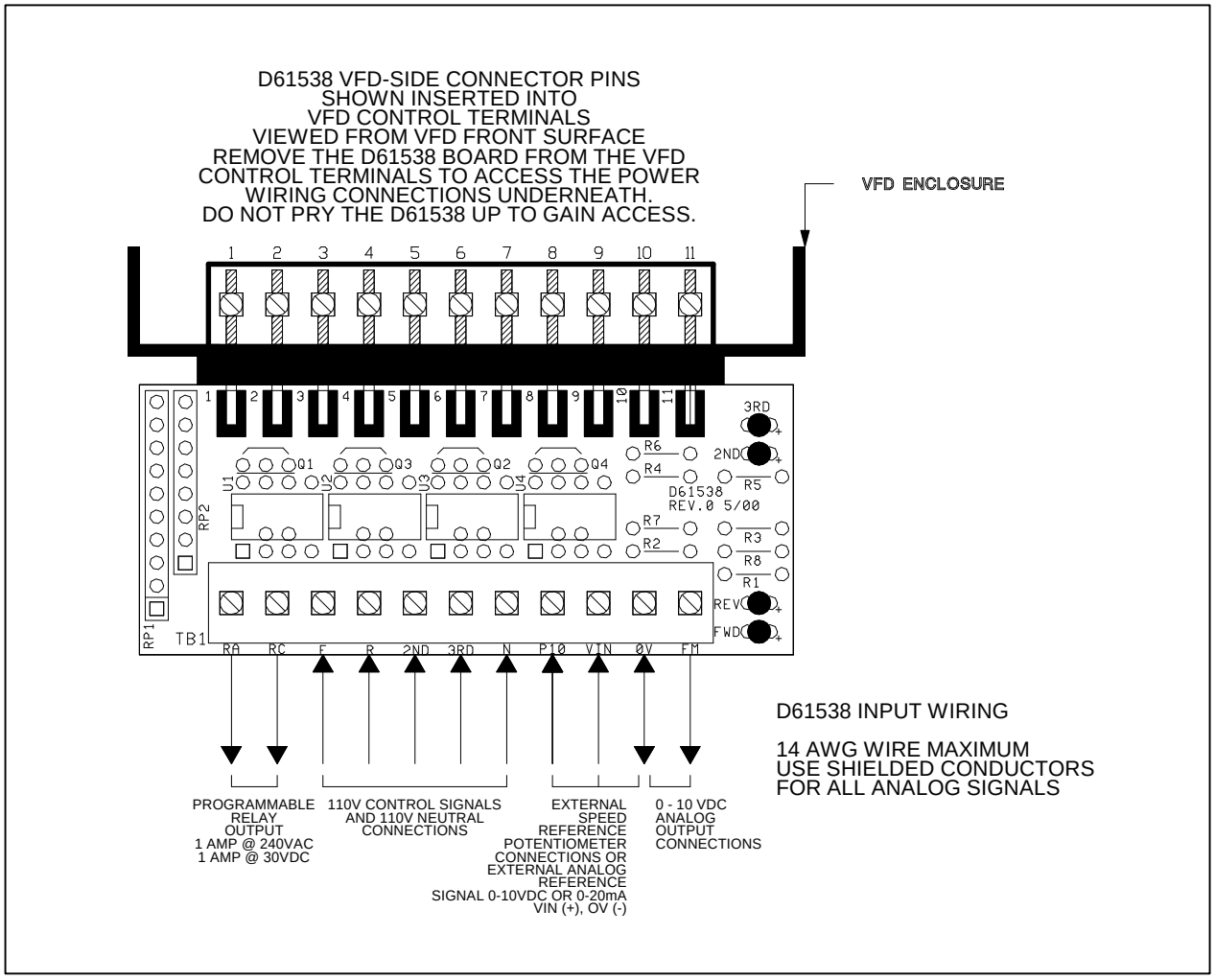
* For use with Commander ES only. Direction frequency should be set up from keypad by scrolling up or down with arrow keys. The priority of reading frequency setting is: JOG, SP1, and keypad setting.

Table 1 Electrical Specification

110v input level	100 VAC minimum	125 VAC maximum	½ watt burden - 5mA per input. Red LED illuminates on input activation
110v input isolation	2000 VRMS	Optically isolated	
Power requirements	15 vdc @ 75 mA from VFD main control board	No external DC power required	
Temperature Range	0 - 50° C		
Humidity	Less than 90 %		
Altitude	Less than 3000 ft		
Storage temperature	-20° C to +70° C		

Instruction Manual

Figure 1 Electrical Connections of D61538 with the Crane Commander ES and Commander ES Series VFD's



Programming Chart for use with Crane Commander ES Series VFD's

CODE	Function	Function Description	UNIT	RANGE	60Hz Traverse factory setting	60Hz Hoist factory setting	NOTE	Customer settings
F00	Factory adjustment	Factory adjustment			000	000		
F01	Accel time	Accel time	0.1 sec	00.1~30.0 sec.	05.0	03.0	*1	
F02	Decel time	Decel time	0.1 sec	00.1~30.0 sec.	05.0	03.0	*1	
F03	Creep / Top Divisor	Ratio of operating speed when enabled	1	001~030	001	001	*1	
F04	Motor rotation direction	Direction selection from keypad.	0= Forward 1= Reverse	000~001	000	000	*1	
F05	V/F pattern	V/F pattern setting	1	001~004	003	003	*2	
F06	Frequency upper limit	Frequency upper limit	0.1 Hz	00.0-01.0~200 Hz	60.0	60.0	*2, *3	
F07	Frequency lower limit	Frequency lower limit	0.1 Hz	00.0-01.0~200 Hz	01.0	03.0	*3	
F08	SP1 frequency	SP1 frequency	0.1 Hz	00.0-01.0~200 Hz	06.0	06.0	*3 SP1 is operating when FOR or REV is active	
F09	Current limit stall level	Current limit level	1	000-020~150%	150	000		
F10	Start / Stop control	0: Keypad 1: Terminal (TM2)	1	000~001	001	001		
F11	Frequency control	0: Keypad 1: Terminal (0~10V / 0~20mA) 2: Terminal (4-20mA) 3: 1~3 preset speeds 4: 2 step infinitely variable 5: 3 step infinitely variable	1	000~005	003	003		
F12	Carrier frequency control	Carrier frequency setting	1	001~010	005	005		
F13	Torque compensation	Torque compensation gain	0.1%	00.0~10.0%	00.0	02.0	*1	
F14	Stop method	0: Decelerate stop 1: Free run stop	1	000~001	000	001		
F15	DC braking setting	DC braking time / coasting start delay	0.1 sec	00.0~25.5 sec	00.5	01.0	*1	
F16	DC braking setting	DC braking injection frequency	0.1 Hz	01.0~10.0 Hz	01.5	0.00	*1	
F17	DC braking setting	DC braking level	0.1%	0.0~20.0%	08.0	0.00		

F18	Electronic thermal overload protection	Protection base on motor rated current.	1%	000-001~200%	100	100	*1	
F19	Multifunction input connection point	Multifunction input terminal (SP1) function TB1 #5	001: SP2 002: Emergency stop. N/C 003: External base block. N/O 004: Reset 005: Creep input 006: Top limit		001	001		
F20	Multifunction input connection point	Multifunction input terminal (reset) function TB1 #6	001: SP3 002: Emergency stop. N/C 003: External base block. N/O 004: Reset 005: Creep input 006: Top limit		001	001		
F21	Multifunction output	Multifunction output terminal TB1 #1 and 2	001: Operating 002: Frequency reached 003: Fault 004: At current detect level 005: At frequency detect level		001	004		
F22	Current detect	Output current detect level. 10% hysteresis.	1%	25~150%	000	025	*1	
F23	Frequency detect level	Output frequency detect level. 1% hysteresis	1	01.0~200	01.0	03.0		
F24	Auto restart	Number of Auto-restart times	1	000~005	000	000		
F25	Factory setting	010: Constants initialization to 50 Hz system Traverse mode 011: Constants initialization to 50 Hz Hoist mode 020: Constants initialization to 60 Hz system Traverse mode 021: Constants initialization to 60 Hz Hoist mode						
F26	SP2 frequency	SP2 frequency	0.1 Hz	00.0-01.0~200 Hz	30.0	30.0	*1	
F27	SP3 frequency	SP3 frequency	0.1 Hz	00.0-01.0~200 Hz	60.0	60.0	*1	
F28	Voltage stall	Voltage stall level control	0=OFF, 1=ON	-	001	000		
F29	Software version	CPU program version			10.0	10.0		
F30	Fault log	Last 3 malfunction memory						

CODE	Function	Function Description	UNIT	RANGE	Factory setting	NOTE	Customer settings
Fn00	Factory adjustment	Factory adjustment			0		
Fn01	Accel time	Accel time	0.1 sec	0.1~999 sec.	5.0	*1	
Fn02	Decel time	Decel time	0.1 sec	0.1~999 sec.	5.0	*1	
Fn03	Operation mode	0: Forward / Stop, Reverse / Stop 1: Run / Stop, Forward / Reverse	1	0~1	0		
Fn04	Motor rotation direction	0: Forward 1: Reverse	1	0~1	0	*1	
Fn05	V/F pattern	V/F pattern setting	1	1~6	1/4	*2	
Fn06	Frequency upper limit	Frequency upper limit	0.1 Hz	1.0~120 Hz	50/60 Hz	*2, *3	
Fn07	Frequency lower limit	Frequency lower limit	0.1 Hz	0.0~120 Hz	0.0 Hz		
Fn08	SPI frequency	SPI frequency	0.1 Hz	1.0~120 Hz	10 Hz	*3	2nd speed
Fn09	JOG frequency	JOG frequency	0.1 Hz	1.0~10 Hz	6 Hz		3rd speed
Fn10	Operation control	0: Keypad 1: Terminal (TM2)	1	0~1	0		1
Fn11	Frequency control	0: Keypad 1: Terminal (0~10V / 0~20mA) 2: Terminal (4-20mA)	1	0~2	0		0
Fn12	Carrier frequency control	Carrier frequency setting	1	1~5 (1~10) *4	5		
Fn13	Torque compensation	Torque compensation gain	0.1%	0.0~10.0%	0.0%	*1	
Fn14	Stop method	0: Decelerate stop 1: Free run stop	1	0~1	0		
Fn15	DC braking setting	DC braking time	0.1 sec	0.0~25.5 S	0.5 S		
Fn16	DC braking setting	DC braking injection frequency	0.1 Hz	1~10 Hz	1.5 Hz		
Fn17	DC braking setting	DC braking level	0.1%	0.0~20.0%	8.0%		
Fn18	Electronic thermal	Protection base on motor rated current.	1%	50~100% (0~200) *4	100%		
Fn19	Multifunction input connection point	Multifunction input terminal (SP1) function	1: Jog 2: SP1 3: Emergency stop 4: External base block 5: Reset 6: SP2 *4		2		2: SP1 2nd speed
Fn20	Multifunction input connection point	Multifunction input terminal (reset) function			5		1: JOG 3rd speed
Fn21	Multifunction output	Multifunction output terminal	1: Operating 2: Frequency reached 3: Fault		3		
Fn22	Reverse instruction	0: REV run enabled 1: REV run disabled	1	0~1	0		
Fn23	Momentary power loss	0: enabled 1: disabled	1	0~1	0		
Fn24	Auto restart	Number of Auto-restart times	1	0~5	0		
Fn25	Factory setting	010: Constants initialization to 50 Hz system 020: Constants initialization to 60 Hz system				*2	
Fn26	SP2 frequency	SP2 frequency	0.1 Hz	1.0~200 Hz	20	*4	
Fn27	SP3 frequency	SP3 frequency	0.1 Hz	1.0~200 Hz	30	*4	
Fn28		Reserved for future use					
Fn29	Software version	CPU program version					
Fn30	Fault log	Last 3 malfunction memory					

Notes:
*1: Setting can be changed during running mode.
*2: Please refer to Fn25.
*3: If the setting range is above 100, the setting unit becomes 1.
*4: New function for CPU version v1.8 and above.

820 Lakeside Drive - Gurnee, IL. 60031
Phone: (847) 855-9150 Fax: (847) 855-9650
1-800-DRIVCON (374-8266)