LOVATO electric

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GB VARIABLE SPEED DRIVES
Instruction manual

VT1…

CE

WARNING!
– Carefully read the manual before the installation or use.
– This equipment is to be installed by qualified personnel, complying to current standards, to avoid damages or safety hazards.
– Before any maintenance operation on the device, remove all the voltages from measuring and supply inputs and short-circuit the CT input terminals.
– The manufacturer cannot be held responsible for electrical safety in case of improper use of the equipment.
– Products illustrated herein are subject to alteration and changes without prior notice. Technical data and descriptions in the documentation are accurate, to the best of our knowledge, but no liabilities for errors, omissions or contingencies arising there from are accepted.
– A circuit breaker must be included in the electrical installation of the building. It must be installed close by the equipment and within easy reach of the operator. It must be marked as the disconnecting device of the equipment: IEC /EN 61010-1 § 6.11.3.1.
– Clean the device with a soft dry cloth; do not use abrasives, liquid detergents or solvents.

ATTENTION !
– Lire attentivement le manuel avant toute utilisation et installation.
– Ces appareils doivent être installés par un personnel qualifié, conformément aux normes en vigueur en matière d'installations, afin d'éviter de causer des dommages à des personnes ou choses.
– Avant toute intervention sur l'instrument, mettre les entrées de mesure et d'alimentation hors tension et court-circuiter les transformateurs de courant.
– Le constructeur n'assume aucune responsabilité quant à la sécurité électrique en cas d'utilisation impropre du dispositif.
– Les produits décrits dans ce document sont susceptibles d'évoluer ou de subir des modifications à n'importe quel moment. Les descriptions et caractéristiques techniques du catalogue ne peuvent donc avoir aucune valeur contractuelle.
– Un interrupteur ou disjoncteur doit être inclus dans l'installation électrique du bâtiment. Celui-ci doit se trouver tout près de l'appareil et l'opérateur doit pouvoir y accéder facilement. Il doit être marqué comme le dispositif d'interruption de l'appareil : IEC/ EN 61010-1 § 6.11.3.1.
– Nettoyer l'appareil avec un chiffon doux, ne pas utiliser de produits abrasifs, détergents liquides ou solvants.

ACHTUNG!
– Dieses Handbuch vor Gebrauch und Installation aufmerksam lesen.
– Zur Vermeidung von Personen- und Sachschäden dürfen diese Geräte nur von qualifiziertem Fachpersonal und unter Befolgung der einschlägigen Vorschriften installiert werden.
– Vor jedem Eingriff am Instrument die Spannungszufuhr zu den Messeingängen trennen und die Stromwandler kurzschließen.
– Bei zweckwidrigem Gebrauch der Vorrichtung übernimmt der Hersteller keine Haftung für die elektrische Sicherheit.
– Die in dieser Broschüre beschriebenen Produkte können jederzeit weiterentwickelt und geändert werden. Die im Katalog enthaltenen Beschreibungen und Daten sind daher unverbindlich und ohne Gewähr.
– In die elektrische Anlage des Gebäudes ist ein Ausschalter oder Trennschalter einzubauen. Dieser muss sich in unmittelbarer Nähe des Geräts befinden und vom Bediener leicht zugänglich sein. Er muss als Trennvorrichtung für das Gerät gekennzeichnet sein: IEC/ EN 61010-1 § 6.11.3.1.
– Das Gerät mit einem weichen Tuch reinigen, keine Scheuermittel, Flüssigreiniger oder Lösungsmittel verwenden.

ADVERTENCIA
– Leer atentamente el manual antes de instalar y utilizar el regulador.
– Este dispositivo debe ser instalado por personal cualificado conforme a la normativa de instalación vigente a fin de evitar daños personales o materiales.
– Antes de realizar cualquier operación en el dispositivo, desconectar la corriente de las entradas de alimentación y medida, y cortocircuitar los transformadores de corriente.
– El fabricante no se responsabilizará de la seguridad eléctrica en caso de que el dispositivo no se utilice de forma adecuada.
– Los productos descritos en este documento se pueden actualizar o modificar en cualquier momento. Por consiguiente, las descripciones y los datos técnicos aquí contenidos no tienen valor contractual.
– La instalación eléctrica del edificio debe disponer de un interruptor o disyuntor. Éste debe encontrarse cerca del dispositivo, en un lugar al que el usuario pueda acceder con facilidad. Además, debe llevar el mismo marcado que el interruptor del dispositivo (IEC/ EN 61010-1 § 6.11.3.1).
– Limpiar el dispositivo con un trapo suave; no utilizar productos abrasivos, detergentes líquidos ni disolventes.

UPOZORNĚNÍ
– Návod se pozorně pročtěte, než začnete regulátor instalovat a používat.
– Tato zařízení smí instalovat kvalifikovaní pracovníci v souladu s platnými předpisy a normami pro předcházení úrazů osob či poškození věcí.
– Před jakýmkoli zásahem do přístroje odpojte měřicí a napájecí vstupy od napětí a zkratujte transformátory proudu.
– Výrobce nenese odpovědnost za elektrickou bezpečnost v případě nevhodného používání regulátoru.
– Výrobky popsané v tomto dokumentu mohou kdykoli projít úpravami či dalším vývojem. Popisy a údaje uvedené v katalogu nemají proto žádnou smluvní hodnotu.
– Spínač či odpojovač je nutno zabudovat do elektrického rozvodu v budově. Musejí být nainstalované v těsné blízkosti přístroje a snadno dostupné pracovníků obsluhy. Je nutno ho označit jako vypínací zařízení přístroje: IEC/ EN 61010-1 § 6.11.3.1.
– Přístroj čistěte měkkou utěrkou, nepoužívejte abrazivní produkty, tekutá čistidla či rozpouštědla.

AVERTIZARE!
– Citiţi cu atenţie manualul înainte de instalare sau utilizare.
– Acest echipament va fi instalat de personal calificat, în conformitate cu standardele actuale, pentru a evita deteriorări sau pericolele.
– Înainte de efectuarea oricărei operaţiuni de întreţinere asupra dispozitivului, îndepărtaţi toate tensiunile de la intrările de măsurare şi de alimentare şi scurtcircuitaţi bornele de intrare CT.
– Producătorul nu poate fi considerat responsabil pentru siguranţa electrică în caz de utilizare incorectă a echipamentului.
– Produsele ilustrate în prezentul sunt supuse modificărilor şi schimbărilor fără notificare anterioară. Datele tehnice şi descrierile din documentaţie sunt precise, în măsura cunoştinţelor noastre, dar nu se acceptă nicio răspundere pentru erorile, omiterile sau evenimentele neprevăzute care apar ca urmare a acestora.
– Trebuie inclus un disjunctor în instalaţia electrică a clădirii. Acesta trebuie instalat aproape de echipament şi într-o zonă uşor accesibilă operatorului. Acesta trebuie marcat ca fiind dispozitivul de deconectare al echipamentului: IEC/EN 61010-1 § 6.11.3.1.
– Curăţaţi instrumentul cu un material textil moale şi uscat; nu utilizaţi substanţe abrazive, detergenţi lichizi sau solvenţi.

ATTENZIONE!
– Leggere attentamente il manuale prima dell'utilizzo e l'installazione.
– Questi apparecchi devono essere installati da personale qualificato, nel rispetto delle vigenti normative impiantistiche, allo scopo di evitare danni a persone o cose.
– Prima di qualsiasi intervento sullo strumento, togliere tensione dagli ingressi di misura e di alimentazione e cortocircuitare i trasformatori di corrente.
– Il costruttore non si assume responsabilità in merito alla sicurezza elettrica in caso di utilizzo improprio del dispositivo.
– I prodotti descritti in questo documento sono suscettibili in qualsiasi momento di evoluzioni o di modifiche. Le descrizioni ed i dati a catalogo non possono pertanto avere alcun valore contrattuale.
– Un interruttore o disgiuntore va compreso nell'impianto elettrico dell'edificio. Esso deve trovarsi in stretta vicinanza dell'apparecchio ed essere facilmente raggiungibile da parte dell'operatore. Deve essere marchiato come il dispositivo di interruzione dell'apparecchio: IEC/ EN 61010-1 § 6.11.3.1.
– Pulire l'apparecchio con panno morbido, non usare prodotti abrasivi, detergenti liquidi o solventi.

UWAGA!
– Przed użyciem i instalacją urządzenia należy uważnie przeczytać niniejszą instrukcję.
– W celu uniknięcia obrażeń osób lub uszkodzenia mienia tego typu urządzenia muszą być instalowane przez wykwalifikowany personel, zgodnie z obowiązującymi przepisami.
– Przed rozpoczęciem jakichkolwiek prac na urządzeniu należy odłączyć napięcie od wejść pomiarowych i zasilania oraz zewrzeć zaciski przekładnika prądowego.
– Producent nie przyjmuje na siebie odpowiedzialności za bezpieczeństwo elektryczne w przypadku niewłaściwego użytkowania urządzenia.
– Produkty opisane w niniejszym dokumencie mogą być w każdej chwili udoskonalone lub zmodyfikowane. Opisy oraz dane katalogowe nie mogą mieć w związku z tym żadnej wartości umownej.
– W instalacji elektrycznej budynku należy uwzględnić przełącznik lub wyłącznik automatyczny. Powinien on znajdować się w bliskim sąsiedztwie urządzenia i być łatwo osiągalny przez operatora. Musi być oznaczony jako urządzenie służące do wyłączania urządzenia: IEC/ EN 61010-1 § 6.11.3.1.
– Urządzenie należy czyścić miękką szmatką, nie stosować środków ściernych, płynnych detergentów lub rozpuszczalników.

警告！
• 安装或使用前，请仔细阅读本手册。
• 本设备只能由合格人员根据现行标准进行安装，以避免造成损坏或安全危害。
• 对设备进行任何维护操作前，请移除测量输入端和电源输入端的所有电压，并短接 CT 输入端。
• 制造商不负责因设备使用不当导致的电气安全问题。
• 此处说明的产品可能会有变更，恕不提前通知。 我们竭力确保本文档中技术数据和说明的准确性，但 对于错误、遗漏或由此产生的意外事件概不负责。
• 建筑电气系统中必须装有断路器。断路器必须安装在靠近设备且方便操作员触及的地方。必须将断路器 标记为设备的断开装置：IEC/EN 61010-1 § 6.11.3.1
• 请使用柔软的干布清洁设备；切勿使用研磨剂、洗涤液或溶剂。

ПРЕДУПРЕЖДЕНИЕ!
– Прежде чем приступать к монтажу или эксплуатации устройства, внимательно ознакомьтесь с содержанием настоящего руководства.
– Во избежание травм или материального ущерба монтаж должен существляться только квалифицированным персоналом в соответствии с действующими нормативами.
– Перед проведением любых работ по техническому обслуживанию устройства необходимо обесточить все измерительные и питающие входные контакты, а также замкнуть накоротко входные контакты трансформатора тока (ТТ).
– Производитель не несет ответственность за обеспечение электробезопасности в случае ненадлежащего использования устройства.
– Изделия, описанные в настоящем документе, в любой момент могут подвергнуться изменениям или усовершенствованиям. Поэтому каталожные данные и описания не могут рассматриваться как действительные с точки зрения контрактов.
– Электрическая сеть здания должна быть оснащена автоматическим выключателем, который должен быть расположен вблизи оборудования в пределах доступа оператора. Автоматический выключатель должен быть промаркирован как отключающее устройство оборудования: IEC /EN 61010-1 § 6.11.3.1.
– Очистку устройства производить с помощью мягкой сухой ткани, без применения абразивных материалов, жидких моющих средств или растворителей.

DİKKAT!
– Montaj ve kullanımdan önce bu el kitabını dikkatlice okuyunuz.
– Bu aparatlar kişilere veya nesnelere zarar verme ihtimaline karşı yürürlükte olan sistem kurma normlarına göre kalifiye personel tarafından monte edilmelidirler
– Aparata (cihaz) herhangi bir müdahalede bulunmadan önce ölçüm girişlerindeki gerilimi kesip akım transformatörlerinede kısa devre yaptırınız.
– Üretici aparatın hatalı kullanımından kaynaklanan elektriksel güvenliğe ait sorumluluk kabul etmez.
– Bu dokümanda tarif edilen ürünler her an evrimlere veya değişimlere açıktır. Bu sebeple katalogdaki tarif ve değerler herhangi bir bağlayıcı değeri haiz değildir.
– Binanın elektrik sisteminde bir anahtar veya şalter bulunmalıdır. Bu anahtar veya şalter operatörün kolaylıkla ulaşabileceği yakın bir yerde olmalıdır. Aparatı (cihaz) devreden çıkartma görevi yapan bu anahtar veya şalterin markası: IEC/ EN 61010-1 § 6.11.3.1.
– Aparatı (cihaz) sıvı deterjan veya solvent kullanarak yumuşak bir bez ile siliniz aşındırıcı temizlik ürünleri kullanmayınız.

CONTENTS

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1 SAFETY PRECAUTIONS

1.1 BEFORE POWER UP

⚠ DANGER!
► Make sure the main circuit connections are correct. Single phase L1(L) and L3(N) are power-input terminals and must not be mistaken for T1,T2 and T3. Otherwise, drive damage can result.

⚠ CAUTION!
► The line voltage applied must comply with the drive's specified input voltage (see the nameplate).
► To avoid the front cover from disengaging, or other damage do not carry the drive by its covers. Support the drive by the heat sink when transporting. Improper handling can damage the drive or injure personnel and should be avoided.
► To avoid the risk of fire, do not install the drive on a flammable object. Install on nonflammable objects such as metal.
► If several drives are placed in the same control panel, provide heat removal means to maintain the temperature below the declared limit to avoid overheat or fire.
► Installation limitation: -10~40°C (without cooling fan inside models, mechanical size 1: 0.2, 0.4, 0.75kW), -10~50°C (cooling fan inside models, mechanical size 2: 1.5, 2.2kW).

WARNING
► This product is sold subject to EN 61800-3 and EN 61800-5-1.
   In a domestic environment this product may cause radio interference in which case the user may be required to apply corrective measures.

⚠ CAUTION!
► Work on the device/system by unqualified personnel or failure to comply with warnings can result in severe personal injury or serious damage to material. Only suitably qualified personnel trained in the setup, installation, commissioning and operation of the product should carry out work on the device/system.
► Only permanently-wired input power connections are allowed.

1.2 DURING POWER UP

⚠ DANGER!
When the momentary power loss is longer than 2 seconds, the drive will not have sufficient stored power for its control circuit. Therefore, when the power is re-applied, the run operation of the drive will be based on the setup of following parameters:
– Run parameters: 00-02 or 00-03.
– Direct run on power up parameter 07-04 and the status of external run switch.
NOTE. The start operation will be regardless of the settings for parameters 07-00 / 07-01 / 07-02.

⚠ DANGER. DIRECT RUN ON POWER UP.
If direct run on power up is enabled and drive is set to external run with the run FWD/REV switch closed then the drive will restart.

⚠ DANGER
► Prior to use, ensure that all risks and safety implications are considered.
► When the momentary power loss ride through is selected and the power loss is short, the drive will have sufficient stored power for its control circuits to function, therefore, when the power is resumed the drive will automatically restart depending on the setup of parameters 07-00 and 07-01.

1.3 BEFORE OPERATION

⚠ CAUTION
► Make sure the model and drive capacity are the same as that set in parameter 13-00.
► Note: On power up the supply voltage set in parameter 01-01 will flash on display for 2 seconds.

1.4 DURING OPERATION

⚠ DANGER
► Do not connect or disconnect the motor during operation. Otherwise, It may cause the drive to trip or damage the unit.

⚠ DANGER
► To avoid electric shock, do not take the front cover off while power is on.
► The motor will restart automatically after stop when auto-restart function is enabled. In this case, care must be taken while working around the drive and associated equipment .
► The operation of the stop switch is different than that of the emergency stop switch. The stop switch has to be activated to be effective. Emergency stop has to be de-activated to become effective.

⚠ CAUTION
► Do not touch heat radiating components such as heat sinks and brake resistors.
► The drive can run the motor from low speed to high speed. Verify the allowable speed ranges of the motor and the associated machinery.
► Risk of electric shock. The DC link capacitors remain charged for five minutes after power has been removed. It is not permissible to open the equipment until 5 minutes after the power has been removed.

⚠ CAUTION
► The drive should be used in environments with temperature range from 14 to 104°F or -10 to 40°C and relative humidity of 95%.
► Note: models without fan (mechanical size 1: 0.2, 0.4, 0.75kW): -10~40°C, models with fan (mechanical size 2: 1.5, 2.2kW): -10~50°C.

⚠ DANGER
► Make sure that the power is switched off before disassembling or checking any components.

1.5 DRIVE DISPOSAL

⚠ CAUTION
Please dispose of this unit with care as an industrial waste and according to your required local regulations.
► The capacitors of drive main circuit and printed circuit board are considered as hazardous waste and must not be burnt.
► The plastic enclosure and parts of the drive such as the cover board will release harmful gases if burnt.

Equipment containing electrical components may not be disposed of together with domestic waste. It must be separately collected with electrical and electronic waste according to local and currently valid legislation.

2 ENVIRONMENT AND INSTALLATION

2.1 ENVIRONMENT

Installation environment has a direct effect on the correct operation and the life expectancy of the drive. Install the drive in an environment complying with the following conditions.

	Protection
Protection class	IP20 Open type
	Suitable environment
Operating temperature	-10~40°C for size 1 (0.2-0.4-0.75kW, models without built-in fan), -10~50°C for size 2 (1.5-2.2kW, models with built-in fan) If several drives are installed in the same control panel, ensure adequate spacing and provide the necessary cooling and ventilation for successful operation.
Storage temperature	-20~60°C
Relative humidity	95% RH below (without condensation)
Altitude	Altitude: below 1000m (3281ft) It is required to reduce 2% of drive rated current at each additional 100m The maximum altitude is 3000m.
Vibration	Frequency: 10Hz - 150Hz - 10Hz Amplitude (0.3mm): 10Hz $\leqq f \leqq$ 57Hz Acceleration (2G): 57Hz $\leqq f \leqq$ 150Hz (According to IEC60068-2-6 standard)
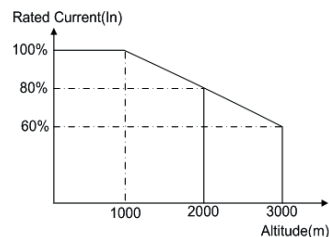
INSTALLATION SITE

Install in an environment that will not have an adverse effect on the operation of the unit and ensure that there is no exposure to areas such as that listed below:
– direct sunlight, rain or moisture
– oil mist and salt
– dust, lint fibres, small metal filings and corrosive liquid and gas
– electromagnetic interference from sources such as welding equipment
– radioactive and flammable materials
– excessive vibration from machines such as stamping, punching machines
– add vibration-proof pads if necessary.

2.2 PRODUCT OVERVIEW AND SPECIFICATIONS

2.2.1 PRODUCT OVERVIEW
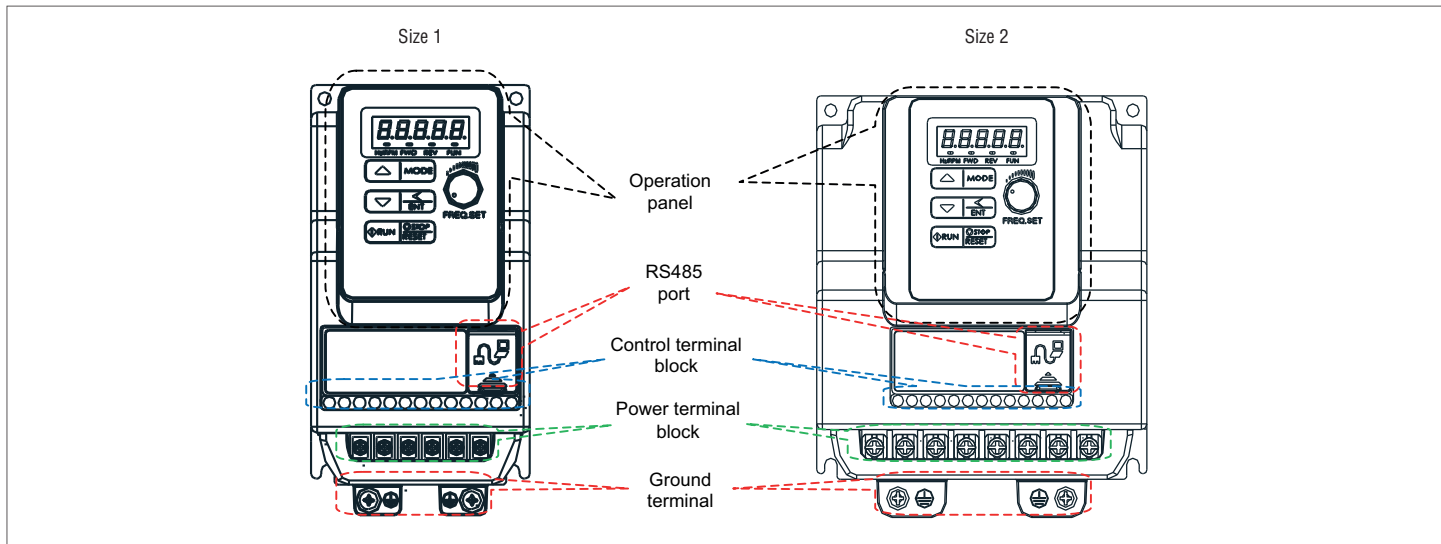
2.2.2 PRODUCT SPECIFICATIONS

Model	VT102A240	VT104A240	VT107A240	VT115A240	VT122A240
Horse power (HP)	0.25	0.5	1	2	3
Suitable motor capacity (kW)	0.2	0.4	0.75	1.5	2.2
Rated output current (A)	1.8	2.6	4.3	7.5	10.5
Rated capacity (kVA)	0.68	1.00	1.65	2.90	4.00
Input voltage range (V)	Single Phase: 200~240V (+10%, -15%), 50/60Hz				
Output voltage range (V)	Three phase 0~240V				
Input current (A)	4.9	7.2	11	15.5	21
Weight (kg)	1.0	1.0	1.0	1.5	1.5
Allowable momentary power loss time (s)	1.0	1.0	1.0	2.0	2.0
Enclosure	IP20				

2.2.3 GENERAL SPECIFICATIONS

|	Item	VT1 drive
	Control Mode	V/F Control + SLV control
Frequency	Range	0.01~599.00Hz
	Speed accuracy (100% torque)	V/F: 3% SLV: 1%
	Starting Torque	V/F: 3Hz / 100% SLV: 3Hz / 150%
	Setting resolution	Digital input : 0.01Hz Analog input : 0.015Hz/60Hz
	Frequency Setting	Keypad : Set directly with ▲ ▼ keys or the potentiometer on the keypad External Input Terminals: AVI(0/2~10V), ACI(0/4~20mA) analog input Multifunction input up/down function (Group3) Setting frequency by communication method. Remote control: Set directly with ▲ ▼ keys of remote keypad
	Frequency limit	Lower and upper frequency limits, 3 -skip frequency settings.
Run	Operation set	Keypad run, stop button External terminals: Multi- operation-mode 2 / 3 wire selection Jog operation Run signal by communication method. Remote control: Set directly with run, stop button of remote keypad
Main Controls	V / F curve setting	6 fixed curve and one customized curve
	Carrier frequency	1~16kHz (default 5kHz)
	Acceleration and deceleration control	2 off Acc / dec time parameters, 4 off S curve parameters.
	Multifunction input	19 functions (refer to description on group3) 5 points, PNP type
	Multifunction output	16 functions (refer to description on group3)
	Multifunction analog output	5 functions (refer to description on group4), 1 point (0~10V)
	Main features	Overload Detection, 8 Preset speeds, Auto-run, Acc/Dec Switch (2 Stages), Main/Alt run Command select, Main/Alt Frequency Command select, PID control, torque boost, V/F start Frequency ,Fault reset. Constant Pressure and Multi-Pump Parallel Connection Function.
Display	LED	Display: parameter/parameter value/frequency/line speed/DC voltage/output voltage/output current/PID feedback/input and output terminal status/Heat sink temperature/Program Version/Fault Log.
	LED Status Indicator	For run/stop/forward and reverse.
Protective Functions	Overload Protection	Integrated motor and drive overload protection. (150% rated current for 60sec, every 10 minutes)
	Over voltage	Over 410V
	Under voltage	Under 190V
	Momentary Power Loss Restart	Drive auto-restart after a momentary power loss.
	Stall Prevention	Stall prevention for Acceleration/ Deceleration/ and continuous Run.
	Short-circuit output terminal	Electronic Circuit Protection
	Grounding Fault	Electronic Circuit Protection
	Additional protective functions	Heatsink over temperature protection, Auto carrier frequency reduction with temperature rise, fault output, reverse prohibit, Number of auto restart attempts, Parameter lock, over voltage protection(OVP), motor PTC over-temperature protection
International Certification		CE, cULus, EAC, RCM
Communication		RS485 (Modbus RTU) built in, with one to one or one to many control. Built-in BacNet communication. Built-in Constant Pressure and Multi-Pump Parallel Connection Function.
Environment	Operating temperature	-10~50°C (models with fan), -10~40°C(models without fan)
	Storage temperature	-20~60°C
	Humidity	Under 95% RH (no condensation)
	Vibration	Frequency: 10Hz - 150Hz - 10Hz Amplitude(0.3mm): 10Hz ≦f ≦57Hz Acceleration(2G): 57Hz ≦f ≦150Hz (According to IEC60068-2-6 standard)
	EMC Compliance	EN61800-3, First Environment (Use of the optional grounding kit is recommended to achieve compliance.).
	LVD Compliance	EN 61800-5-1
	Electrical Safety	UL508C
	Protection level	IP20

2.3 INSTALLATION

2.3.1 MOUNTING ON A FLAT SURFACE

Size 1

Size 2

Screw: M4
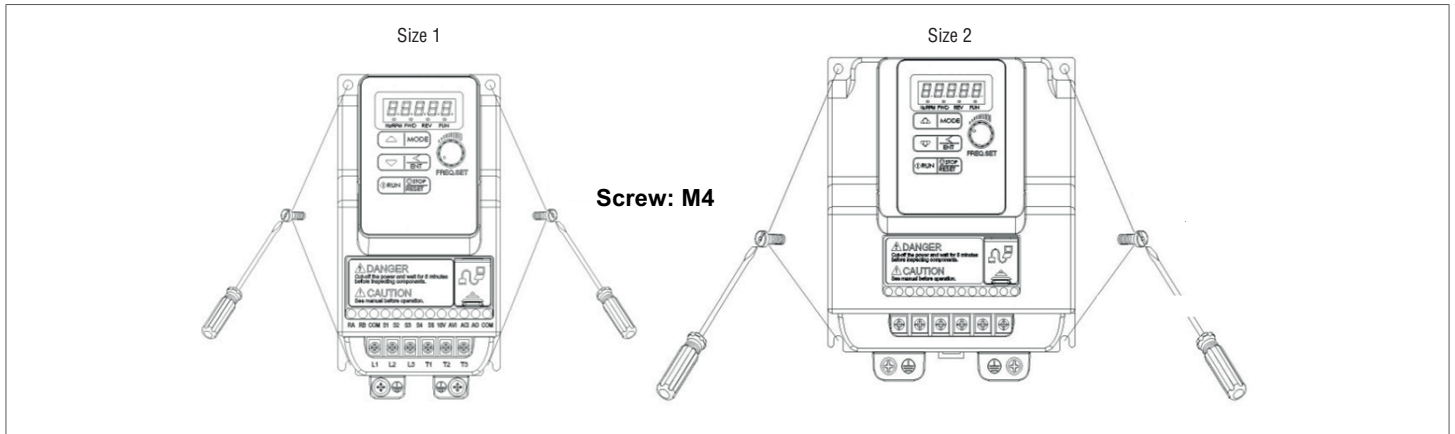
2.3.2 INSTALLATION SPACE

Provide sufficient air circulation space for cooling as shown in examples below. Install the drive on surfaces that provide good heat dissipation.

SINGLE UNIT INSTALLATION
Install the drive verticality to obtain effective cooling

SIDE-BY-SIDE INSTALLATION

Provide the necessary physical space and cooling based on the ambient temperature and the heat loss in the panel.
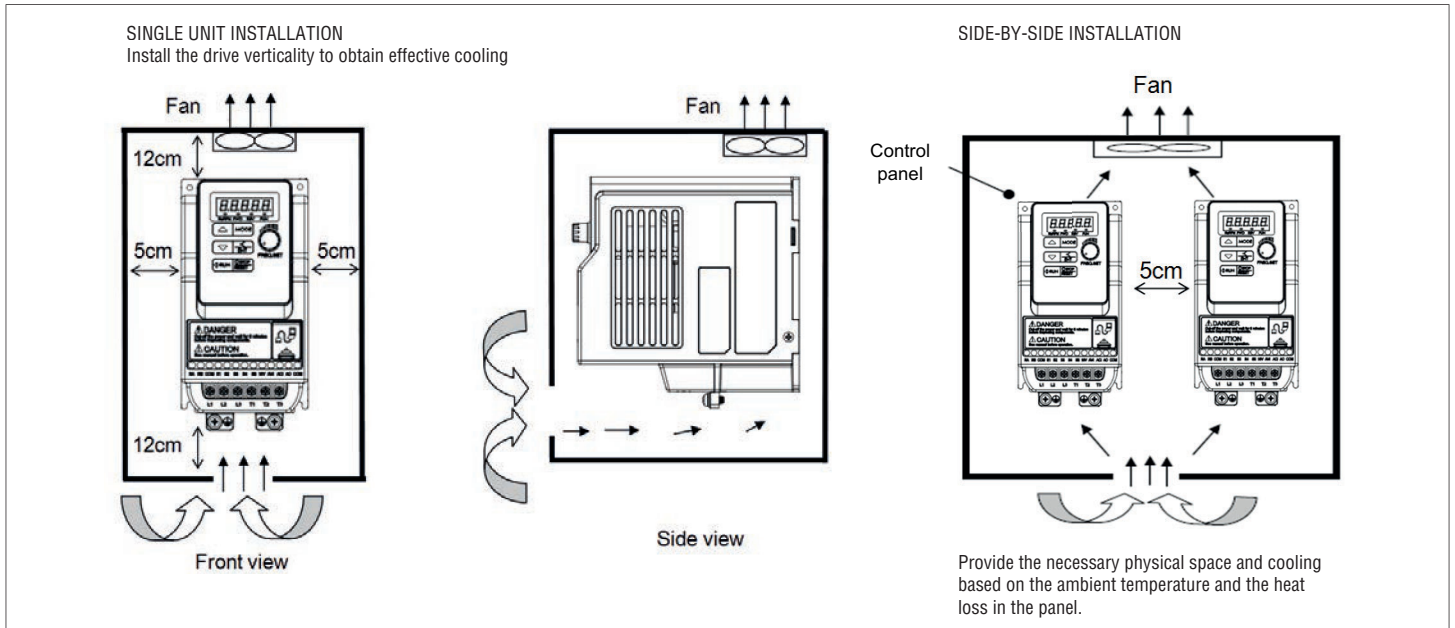
2.3.3 DE-RATING CURVE

Curves below show the applicable output current de-rate due to setting of carrier frequency and the ambient operating temperatures of 40 and 50 degree C.

0.2/0.4/0.75 kW (40°C)

0.2/0.4/0.75 kW (50°C)

1.5/2.2 kW (50°C)

Note. Models without cooling fan design, 50 degrees de-rating curve for 5KHz carrier frequency operation only.

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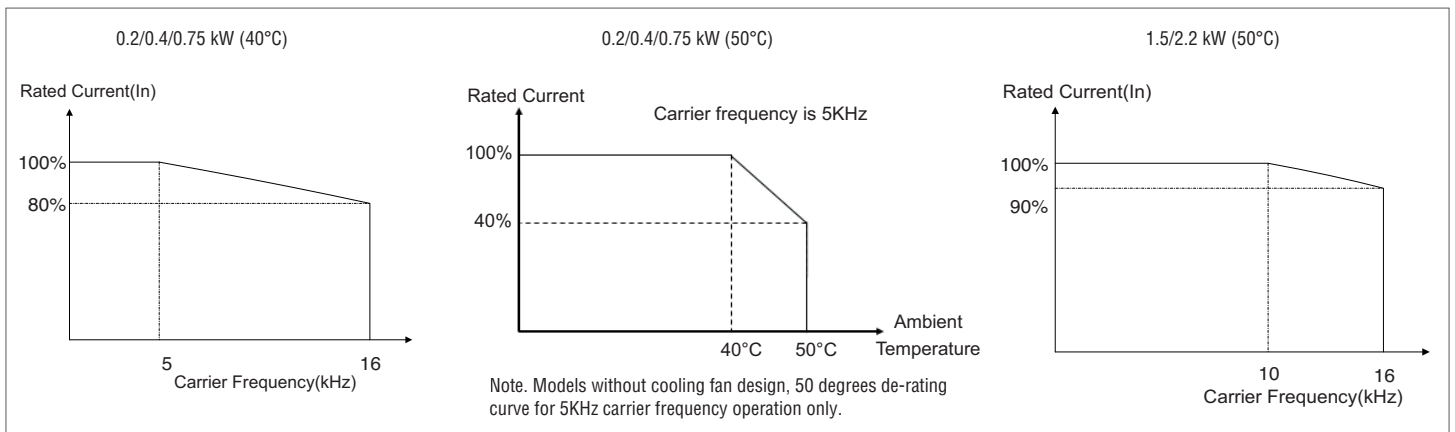
2.4 WIRING GUIDELINES

2.4.1 MAIN CONSIDERATIONS
1 Tightening torque for screw terminals: refer to the table below, when using a screwdriver or any other suitable tools to make connections.
2 Power terminals for single phase supply: L1 (L), L3 (N)
3 For all cabling use copper wires and the cable size shall be according to the table below rated at 105°C.
4 Power and control cable minimum rated voltage: 240V AC system, 300V AC.
5 Control cables should be separated from the power cables. Do not place them in the same cable tray or cable trunking to prevent against electrical interference.

Mechanical size	Power terminal block					Control terminal block				
	Cable Size		Tightening torque			Cable Size		Tightening torque		
	AWG	mm²	kgf.cm	lbf.in	Nm	AWG	mm²	kgf.cm	lbf.in	Nm
Size 1	22~10	0.34~6	14	12.15	1.37	24~12	0.5~2.5	4.08	3.54	0.4
Size 2			12.24	10.62	1.2					

6 The maximum RMS symmetrical current ratings and voltage are listed as below:

Device rating		Short circuit rating	Maximum voltage
Voltage	Power		
220V	0.2-2.2kW	5000A	240V

7 Electrical ratings of terminals:

Power	Voltage specification	Cable voltage	Current
0.2-2.2kW	220~240V	300V	30A

2.4.2 POWER CABLES
Single phase power supply cable must be connected to the terminals L1(L) and L3(N). Motor cable must be connected to terminals T1, T2, T3.
Warning: connection of supply line cable to terminals T1,T2 and T3 will result in serious damage to the drive components.

Example power connections: Drive with dedicated power line.
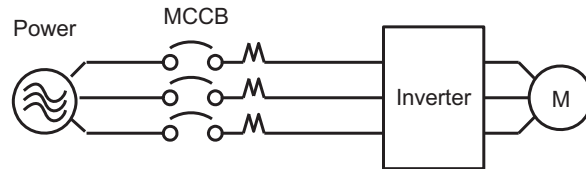
Install a supply RFI filter or isolation transformer when the power source is shared with other high power electrical equipment as shown below.
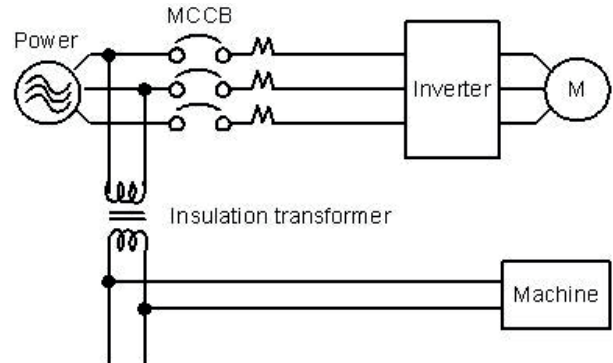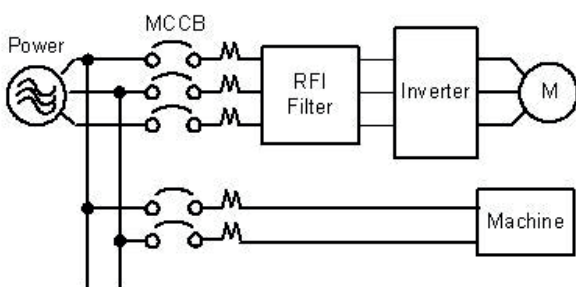
2.4.3 CONTROL CABLE SELECTION AND WIRING
Choose power and control cables according to the following criteria:
– Use copper wires with correct diameter and temperature rating of 60/75°C.
– Minimum cable voltage rating for 200V type drives should be 300VAC.
– Route all cables away from other high voltage or high current power lines to reduce interference effects.
Use a twisted pair shielded cable and connect the shield (screen) wire to the ground terminal at the drive end only. Cable length should not exceed 50 meters.

Shielding sheath   Protective covering

Connect the shield to drive ground terminal

Do not connect this end
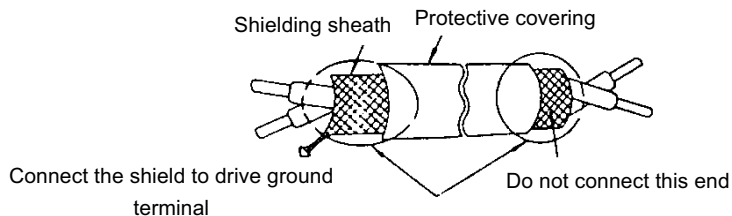
2.4.4 WIRING AND EMC GUIDELINES

For effective interference suppression, do not route power and control cables in the same conduit or trunking.

To prevent radiated noise, motor cable should be put in a metal conduit. Alternatively an armored or shielded type motor cable should be used.

For effective suppression of noise emissions the cable armor or shield must be grounded at both ends to the motor and the drive ground. These connections should be as short as possible.

Motor cable and signal lines of other control equipment should be at the least 30 cm apart.

VT1 has a built in Class "A" EMC filter to first Environment Restricted (Category C2).

For some installations such as residential,(Category C1) an optional external Class "B" type filter will be necessary. Please consult your local supplier.

TYPICAL WIRING

1. Protective earth conductor.
   Conductor size for enclosure and backplate must comply with the local electrical standards. Minimum 10mm².

2. Backplate. Galvanised steel (unpainted).

3. Ferrite core / Output reactor
   Ferrite cores can be used to reduce radiated noise due to long motor cables.
   If ferrite core is used loop motor wires, 3 times round the core. Install core as close to the drive as possible.
   Output reactors provide additional benefit of reducing dv/dt for protection of motor windings.

4. Metal cable clamp. no more than 150mm from the drive.
   Note: If no enclosure and backplate is used then connect the cable shield by a good 360 º termination to the drive output terminal E.

5. Screened (shielded four core cable).

6. Separate protective earth wire, routed outside motor cable separated be at least 100mm.
   Note: this is the preferred method specially for large output cables and long length.
   Multi-core screened (3 core and protective earth) can be used for small power and short length.

7. Connect the cable shield by a good 360º termination and connect to the motor protective earth terminal. This link must be as short as possible.

8. Motor earth terminal (protective earth).

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2.5 CONSIDERATIONS FOR PERIPHERAL EQUIPMENT

Power Supply

POWER SUPPLY

⚠ Make sure the correct voltage is applied to avoid damaging the drive.

Molded Circuit Breaker

MOLDED-CASE CIRCUIT BREAKER (MCCB) AND RCD
Use a molded-case circuit breaker (MCCB) that conforms to the rated voltage and current of the drive.
Do not use the circuit breaker as the run/stop switch for the drive.

Residual Current Circuit Breaker(RCD).
Current setting should be 200mA or above and the operating time at 0.1 second or longer to prevent malfunctions.

Magnetic Contactor

MAGNETIC CONTACTOR
Normally a magnetic contactor is not needed. A contactor can be used to perform functions such as external control and auto restart after power failure.

⚠ Do not use the magnetic contactor as the run/stop switch for the drive.

AC Reactor

AC LINE REACTOR FOR POWER QUALITY
When drives are supplied by a high capacity power source (> 600KVA), an AC reactor can be connected to improve the power factor and reduce harmonics.

Input Noise Filter

INPUT NOISE FILTER
The drive has a built-in filter to Class "A" first Environment. (Category C2).
To satisfy the required EMC regulations for your specific application you may require an additional EMC filter.

Drive

DRIVE
Output terminals T1, T2, and T3 are connected to U, V, and W terminals of the motor. If the motor runs in reverse while the drive is set to run forward, swap any two terminals connections for T1, T2, and T3.

⚠ To avoid damaging the drive, do not connect the output terminals T1, T2, and T3 to AC input power.

Ground

⚠ Connect the ground terminal properly. (Rg <100Ω)

Induction Motor

MOTOR
Three-phase induction motor. Voltage drop on motor due to long cable can be calculated.
Volts drop should be < 10%.
Phase-to-phase voltage drop (V) = 3 ×resistance of wire (Ω/km)×length of line (m)×current×10^{-3}

Ground

2.6 GROUND CONNECTION

Drive ground terminal must be connected to installation ground correctly and according to the required local wiring regulations.
– Ground cable size must be according to the required local wiring regulations. Ground connection should be as short as possible.
– Do not share the ground of the drive with other high current loads (welding machine, high power motors). Ground each unit separately.
– Ensure that all ground terminals and connections are secure
– Do not make ground loops when several drives share a common ground point.
Note: Please leave at least 5 cm while installing the drives side by side in order to provide enough cooling space.

(a) Correct   (b) Correct   (c) Incorrect

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2.7 WIRING DIAGRAMS

2.7.1 STANDARD WIRING

1:Data+
2:Data-
3:Data+
4:Reserved
5:Reserved
6:Data-
7:5V
8:GND
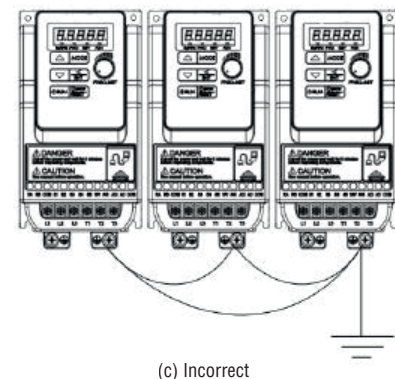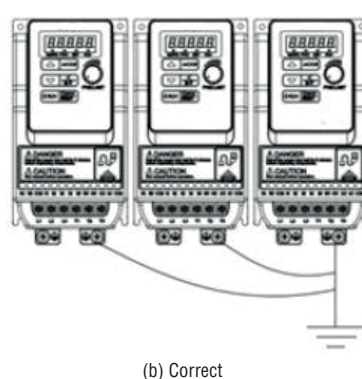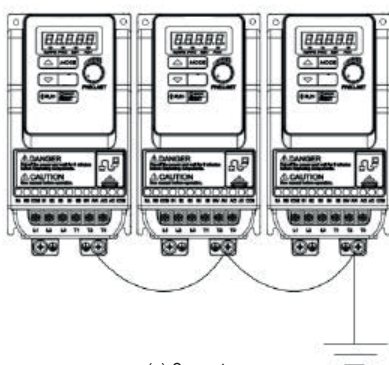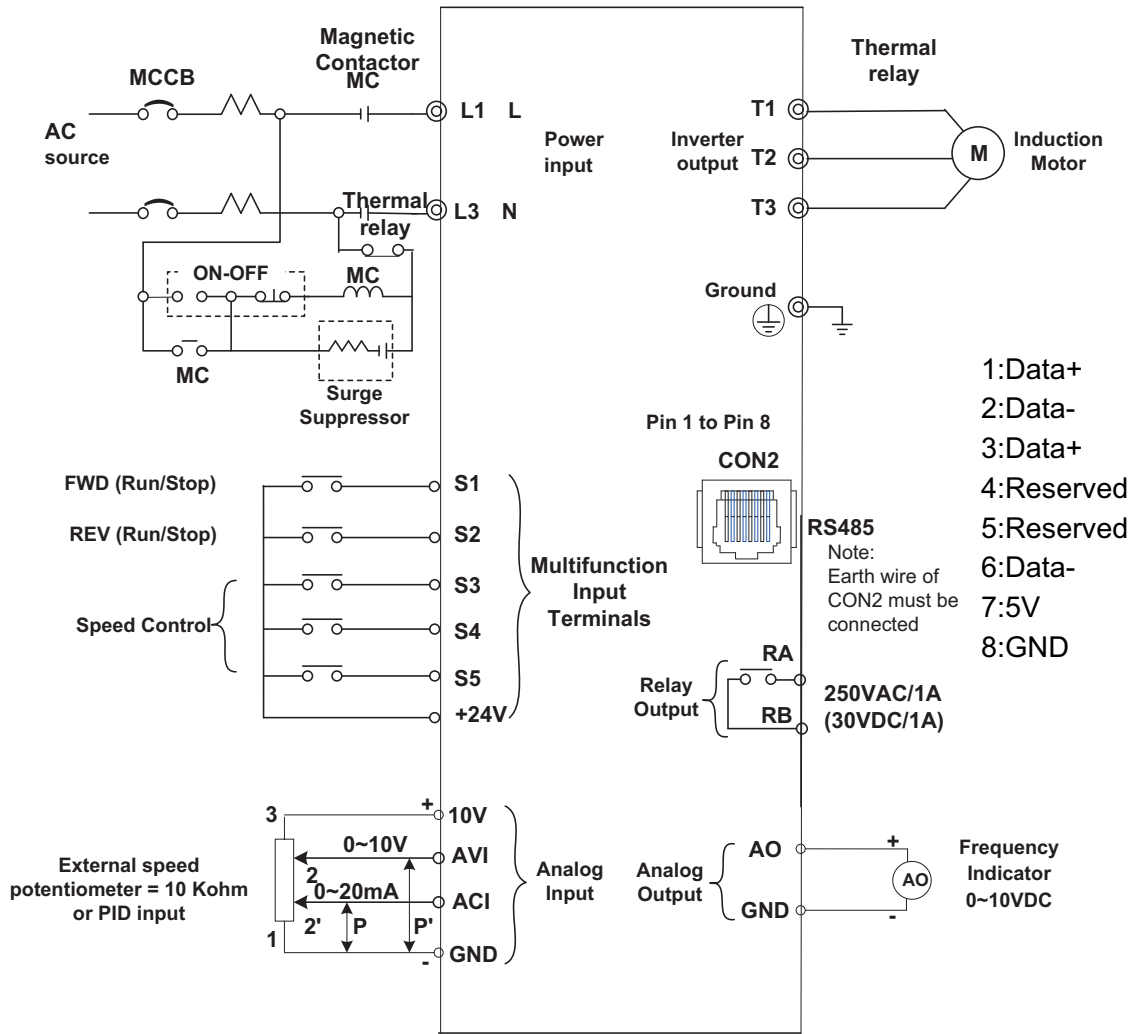
2.7.2 PTC CONNECTION

PTC (positive temperature coefficient) sensors are used in motor windings to provide additional motor protection from overheat. PTC thermistor can be connected to terminals AVI and AGND.
A voltage divider resistor R is necessary to be connected as shown below in figure below.
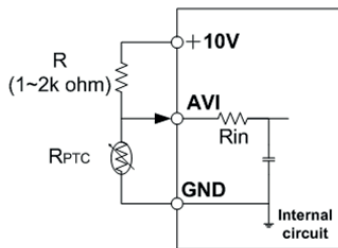
(b) PTC Thermistor Connections

**
Rin=164k ohm

2.7.3 MULTI PUMP WIRING DIAGRAMS

2.7.3.1 PUMP WIRING DIAGRAM FOR PRESSURE SENSOR OF CURRENT TYPE

SINGLE PUMP OPERATION

MULTI-PUMP OPERATION

2.7.3.2 PUMP WIRING DIAGRAM FOR PRESSURE SENSOR OF VOLTAGE TYPE
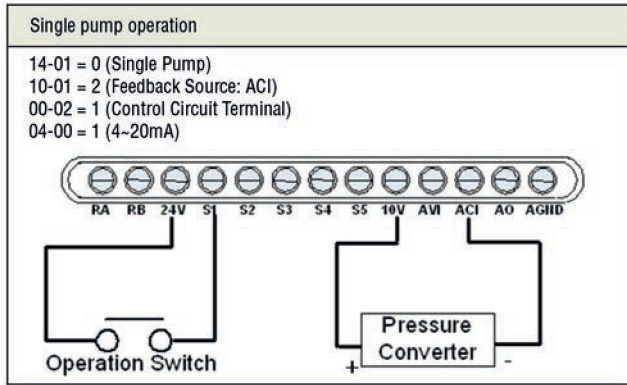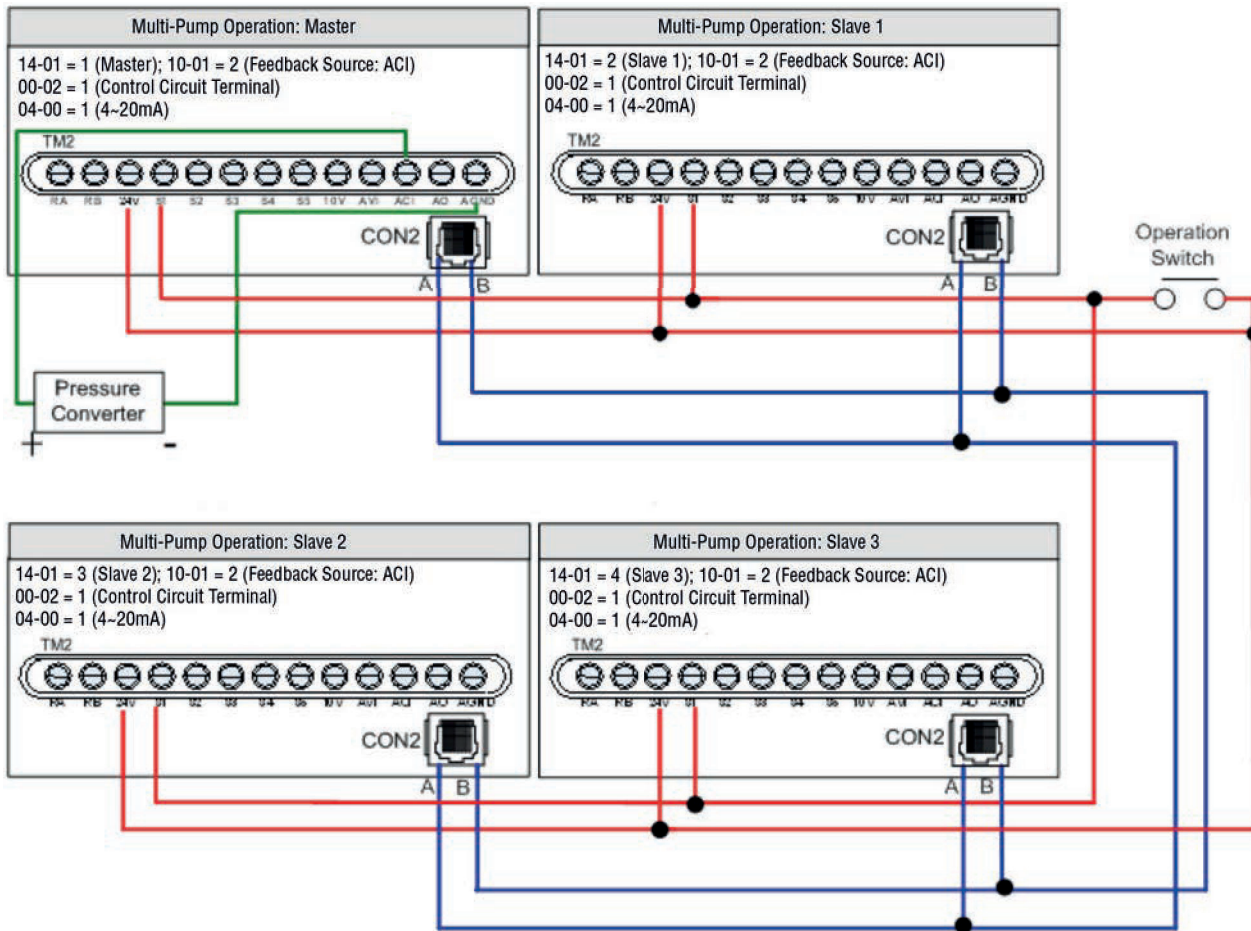
SINGLE PUMP OPERATION
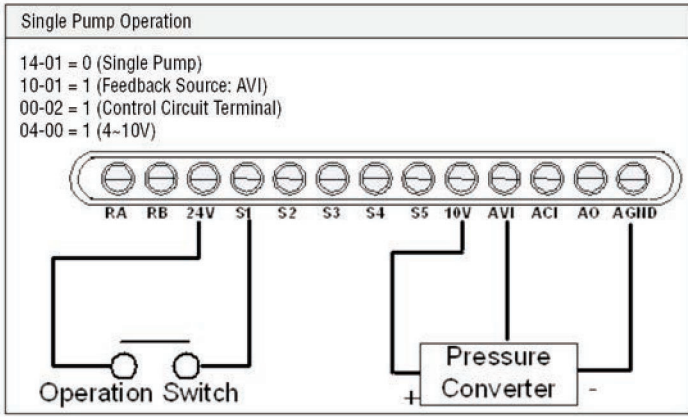
MULTI-PUMP OPERATION
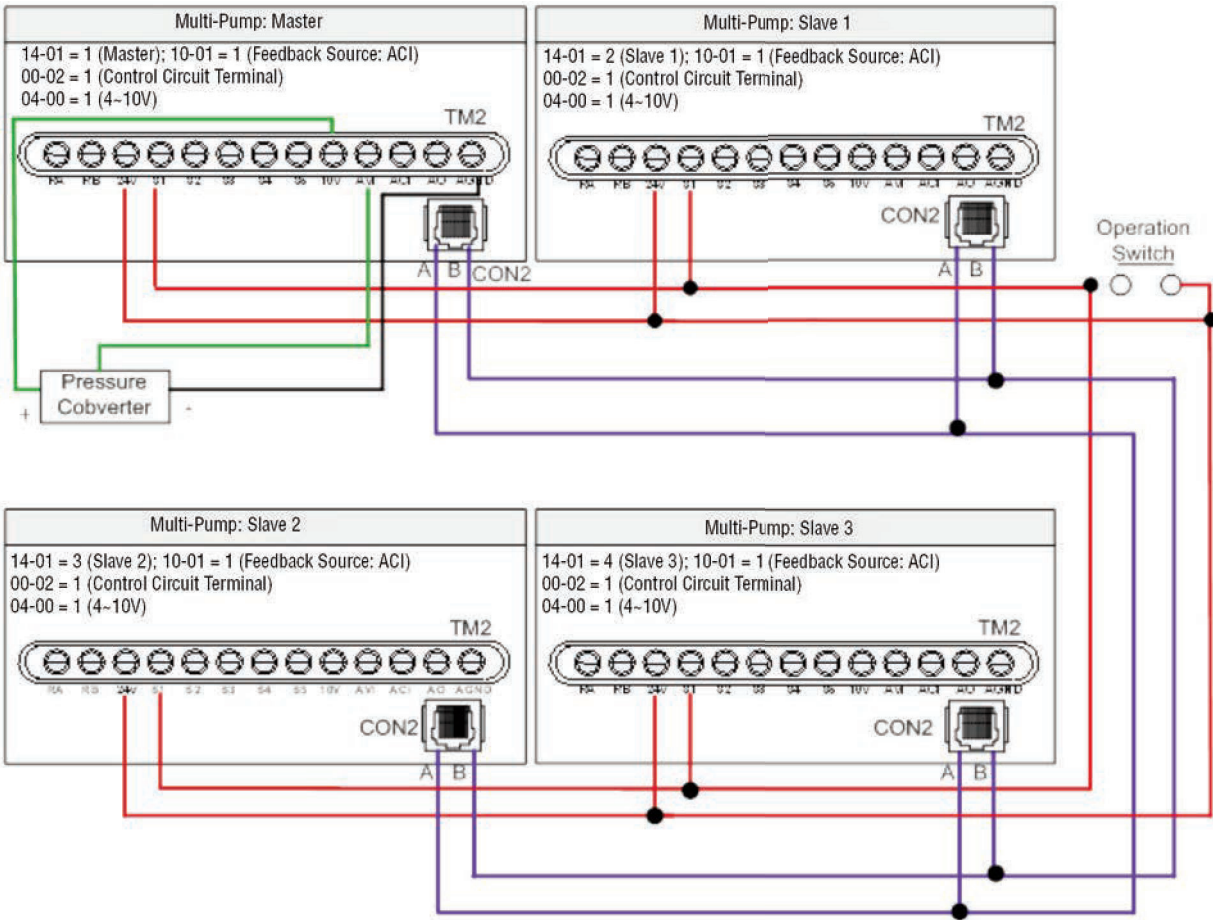
Notes:
1. It is required to reconnect after setting Master and Slave.
2. When the communication modes is selected to be multiple pumps in parallel connection, the baud rate setting 09-02 of Master and Slave are required to be consistent. Refer to parameter 14-31 for the actions in parallel connection modes.

2.8 TERMINAL DESCRIPTION

2.8.1 DESCRIPTION OF MAIN CIRCUIT TERMINALS

L1(L)   L2   L3(N)   T1   T2   T3
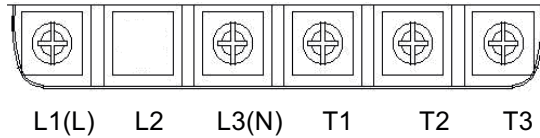
Terminal symbols	Function description
L1(L)	Main power input, single phase: L1(L) / L3(N)
L2	
L3(N)	
T1	Drive output, connect to U, V, W terminals of motor
T2	
T3	
⏚	Ground terminal

2.8.2 DESCRIPTION OF CONTROL CIRCUIT TERMINALS

RA   RB   +24V   S1   S2   S3   S4   S5   10V   AVI   ACI   AO   AGND
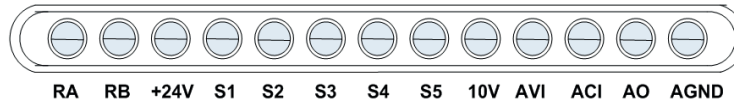
Terminal symbols	Function description	Signal level
RA	Relay output terminal	250VAC/1A (30VDC/1A)
RB		
24V	S1~S5 common (PNP)	±15%, max output current 30mA
S1	Multi-function input terminals (refer to Group 3)	24 VDC, 4.5 mA, optical coupling isolation (max voltage 30VDC, input impedance 6kΩ)
S2		
S3		
S4		
S5		
10V	Built-in power for an external speed potentiometer	10V (max current: 20mA)
AVI	Analog voltage input (selected by parameter 04-00)	0/2~10VDC (input impedance 200kΩ)
ACI	Analog current input (selected by parameter 04-00)	0/4~20mA (input impedance 249Ω)
AO	Multi function analog output terminal	0~10VDC (max current 1mA)
AGND	Analog ground terminal	

2.9 EMC FILTER DISCONNECTION

Drives with built-in EMC filter are not suitable for connection to certain type of supply systems, such as listed below; in these cases the RFI filter can be disabled.
In all such cases consult your local electrical standards requirements.

IT TYPE SUPPLY SYSTEMS (UNGROUNDED) AND CERTAIN SUPPLY SYSTEMS FOR MEDICAL EQUIPMENT.
For ungrounded supply systems, if the filter is not disconnected the supply system becomes connected to Earth through the Y capacitors on the filter circuit. This could result in danger and damage to the drive.

DISCONNECTION STEPS:
1. Remove EMC filter protection cover by screwdriver.
2. Remove EMC Filter link by pliers.
Note: Disconnecting the EMC filter link will disables the filter function, please consult your local EMC standards requirement.

① ②
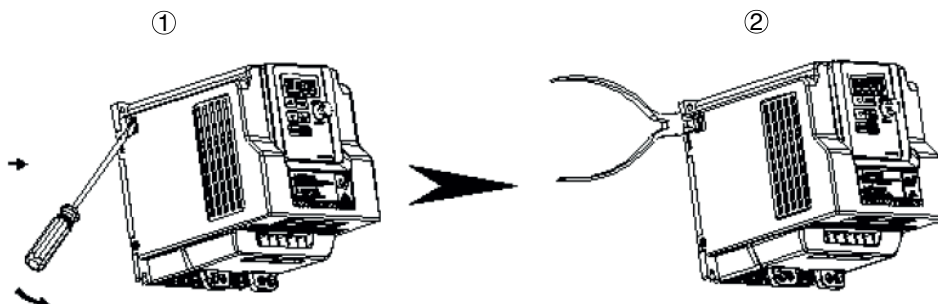
3 PROGRAMMING

3.1 KEYPAD DESCRIPTION

3.1.1 OPERATOR PANEL FUNCTIONS

Type	Item	Function
Digital display and LEDs	Main digital displays	Frequency, parameters, voltage, current, temperature, fault messages.
	LED Status	– Hz/RPM: ON when the frequency or line speed is displayed.OFF when the parameters are displayed. – FWD: ON while the drive is running forward. Flashes while stopped. – REV: ON while the drive is running reverse. Flashes while stopped. – FUN: ON when the parameters are displayed. OFF when the frequency is displayed.
Potentiometer	FREQUENCY	Used to set the frequency
Keys On Keypad	RUN	RUN: Run at the set frequency.
	STOP/RESET (Dual function keys)	– STOP: Decelerate or coast to stop. – RESET: Use to reset alarms or resettable faults.
	▲	Increment parameter number and preset values.
	▼	Decrement parameter number and preset values.
	MODE	Switch between available displays
	✔ (Dual function keys, a short press for left shift function, a long press for ENTER function)	– Left Shift: used while changing the parameters or parameter values – ENTER: used to display the preset value of parameters and for saving the changed parameter values.

3.1.2 DIGITAL DISPLAY DESCRIPTION

Alpha numerical display format

Digit	LED	Letter	LED	Letter	LED	Symbol	LED
0	0	A	A	n	n	-	--
1	1	b	b	O	O	°	0
2	2	C	C	P	P	_	--
3	3	d	d	q	q	.	♦
4	4	E	E	r	r		
5	5	F	F	S	S		
6	6	G	G	t	t		
7	7	H	H	u	u		
8	8	J	J	V	U		
9	9	L	L	y	y		

Digital display indication formats

Actual output frequency	Set frequency	
Digits are lit Continually	Preset digits flashing	Selected digit flashing

I625 GB 01 22

LED display examples

Display	Description
5.00	In stop mode shows the set frequency In run mode shows the actual output frequency
00-01	Selected parameter
0	Parameter value
220u	Output voltage
1.1A	Output current in Amps
310u	DC Bus voltage
24°C	Temperature
000--	PID feedback value
Err1	Error display
00000	Analogue Current / Voltage ACID / AVI . Range (0~1000)

LED Status description

	LED Indicator light Status			
Frequency / line speed indicator	Hz/RPM	On		
Menu mode indicator	Fun	On while not displaying frequency or line speed		
FWD indicator	FWD	On while running forward	FWD	Flashing while stopped in Forward mode.
REV indicator light	REV	On while running reverse	REV	Flashing while stopped in Reverse mode.

3.1.3 DIGITAL DISPLAY SETUP

On power up digital display screens will be as shown below.

Power supply → 2sec later → **Frequency** → MODE → **Parameter**
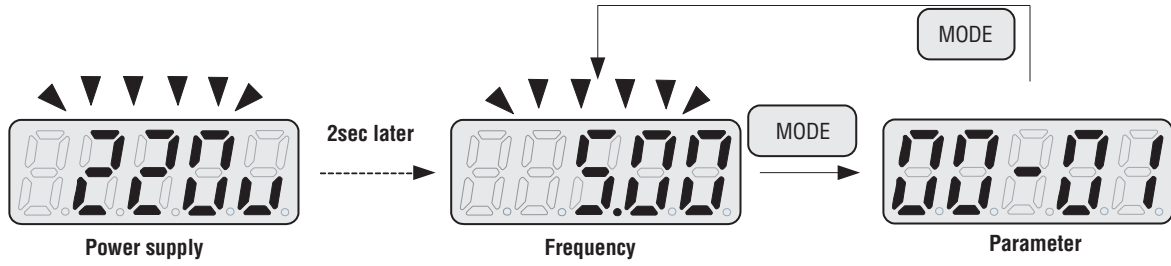
MODE

User selectable display formats:

12- 00	Display Mode
Range	0 0 0 0 High Low Each of the above 5 digits can be set to any of the selections below from 0 to 7 [0] :Disable display [1] :Output Current [2] :Output Voltage [3] :DC voltage [4] :Temperature [5] :PID feedback [6] :AVI [7] :ACI

The highest bit of 12-00 sets the power on the display, other bits set the selected display from range 0-7.as Listed above.

Example1: Set parameter 12- 00= [10000] to obtain display format shown below.

MODE

Display: Power supply → 2sec later → **Output Current** → **Parameter**

MODE

Set frequency

MODE — MODE
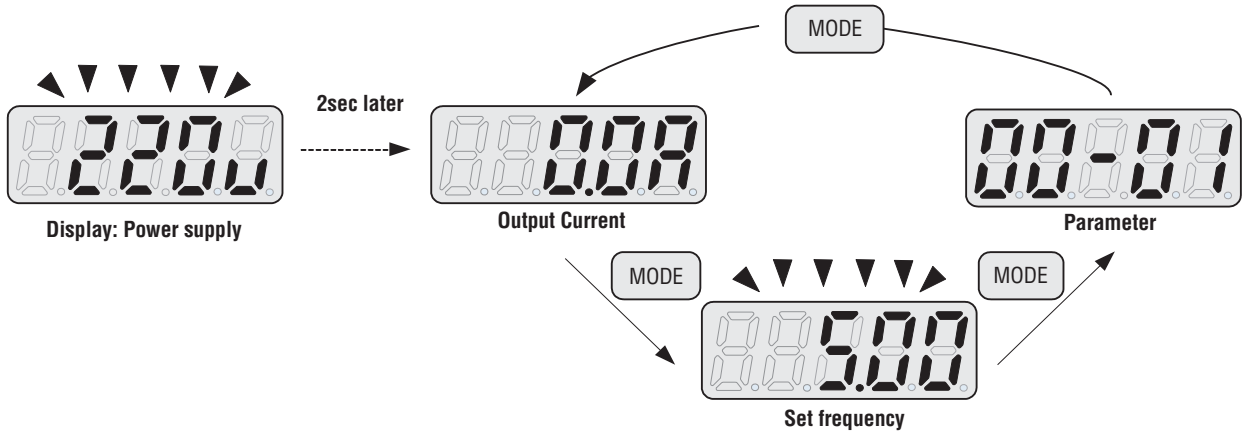
Example 2. Set parameter 2: 12- 00= [12345] to obtain the display format shown below.

MODE

Temperature <4> ← **DC Voltage <3>**

MODE

PIDfeedback <5>

MODE

Output Voltage <2>

Display: Power supply → 2sec later → **Output Current <1>** → **Parameter**

MODE

Set frequency

MODE — MODE

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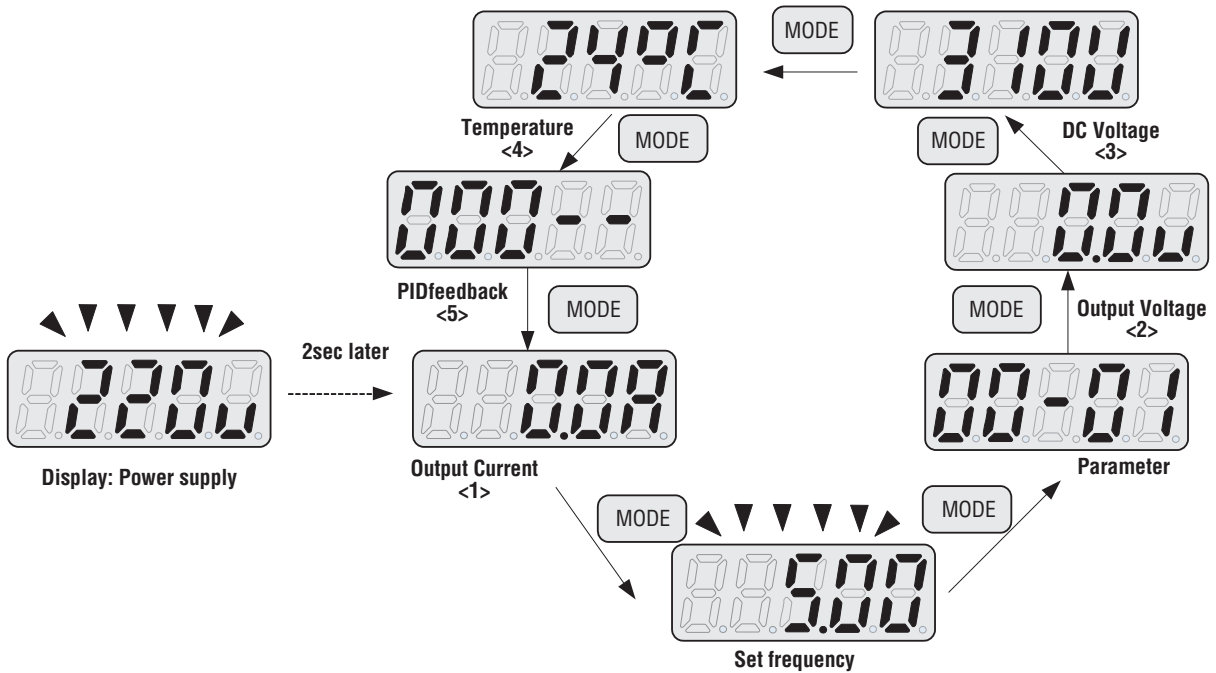
Increment/ Decrement key functions:

1. "▲"/ "▼" :

Short time press

Long time press
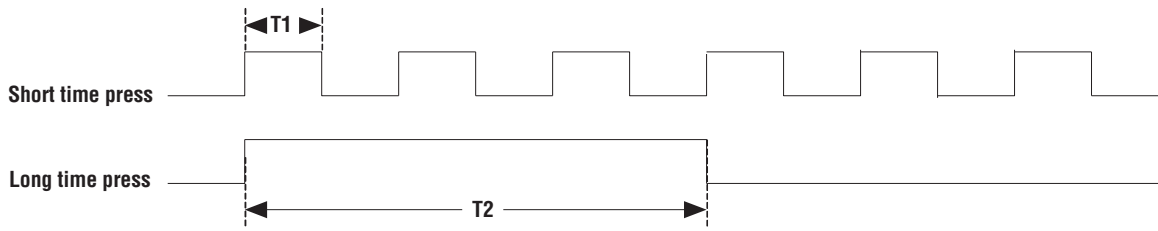
Quick pressing of these keys will increment or decrement the selected digit by one.
Extended pressing will increment or decrement the selected digit continuously.

2. "</ENT" Key functions :

"</ENT"
short press for left shift function

"</ENT"
long press for ENT function
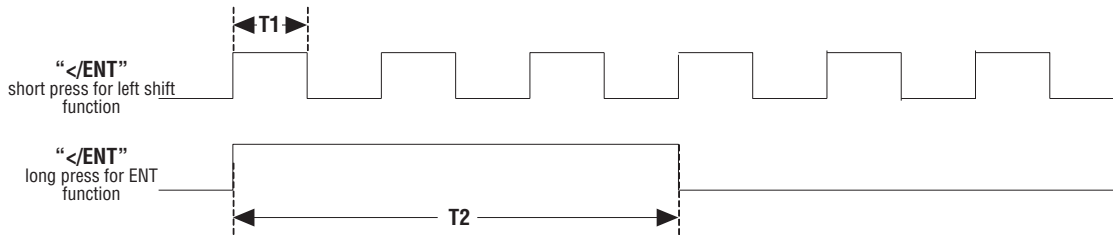
Quick pressing of this key will display the preset value of the parameter selected.
Extended pressing of this key will save the altered value of the selected parameter.

3.1.4 EXAMPLE OF KEYPAD OPERATION

Example1: Modifying Parameters
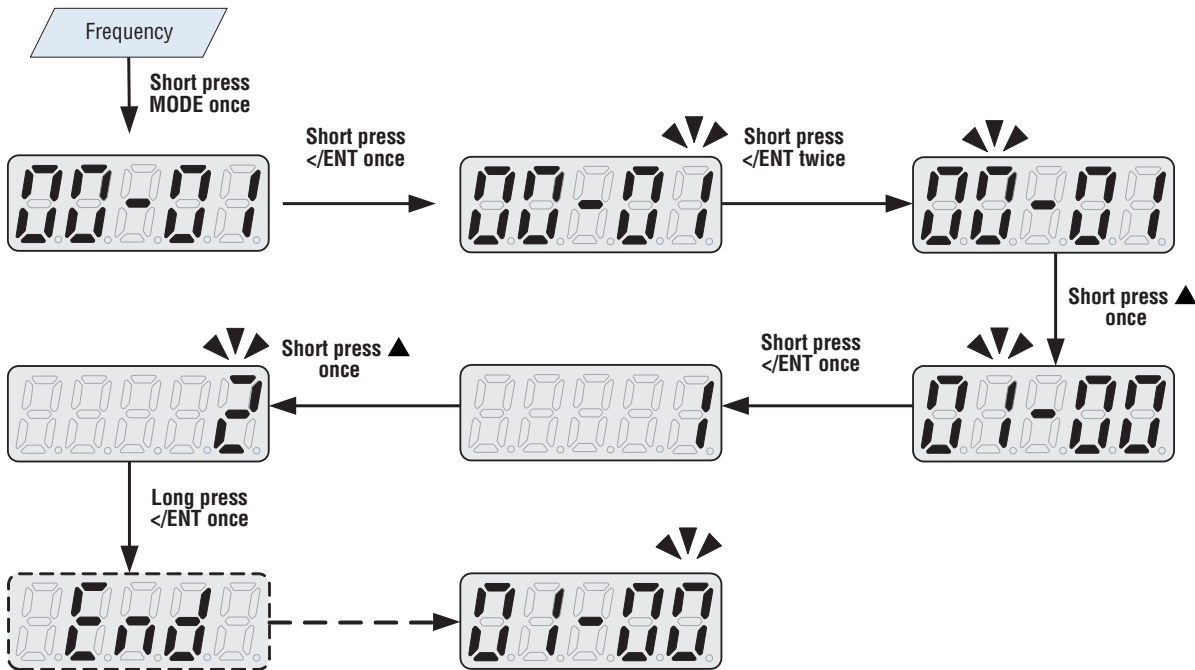
Example2: Modifying the frequency from keypad in run and stop modes.

Modify frequency is stopping

2 2 0 u

Power supply

2sec later

5.00

Set frequency display

Short press </ENT once

0 0 5.0 0

Modify bit <unit>

Short press </ENT once

0 0 5.0 0

Modify bit <ten>

Short press </ENT once

0 0 5.0 0

Modify bit <hundred>

Short press ▲ once

0 0 6.0 0

Modify bit <hundred+1>

5sec later or long press </ENT once

6.00

Modify frequency is stopping

2 2 0 u

Power supply

2sec later

5.00

Set frequency display

Press run

5.00

Actual display

Short press </ENT once

0 0 5.0 0

Modify bit <unit>

Short press </ENT once

0 0 5.0 0

Modify bit <ten>

Short press </ENT once

0 0 5.0 0

Modify bit <hundred>

Short press ▲ once

0 0 6.0 0

Modify bit <hundred+1>

Long press </ENT once

6.00

Actual display

Without pressing the button </ENT, After 5 seconds to return

Note: frequency command setting will be limited to the range set by parameters for lower and upper frequency.

3.1.5 OPERATION CONTROL
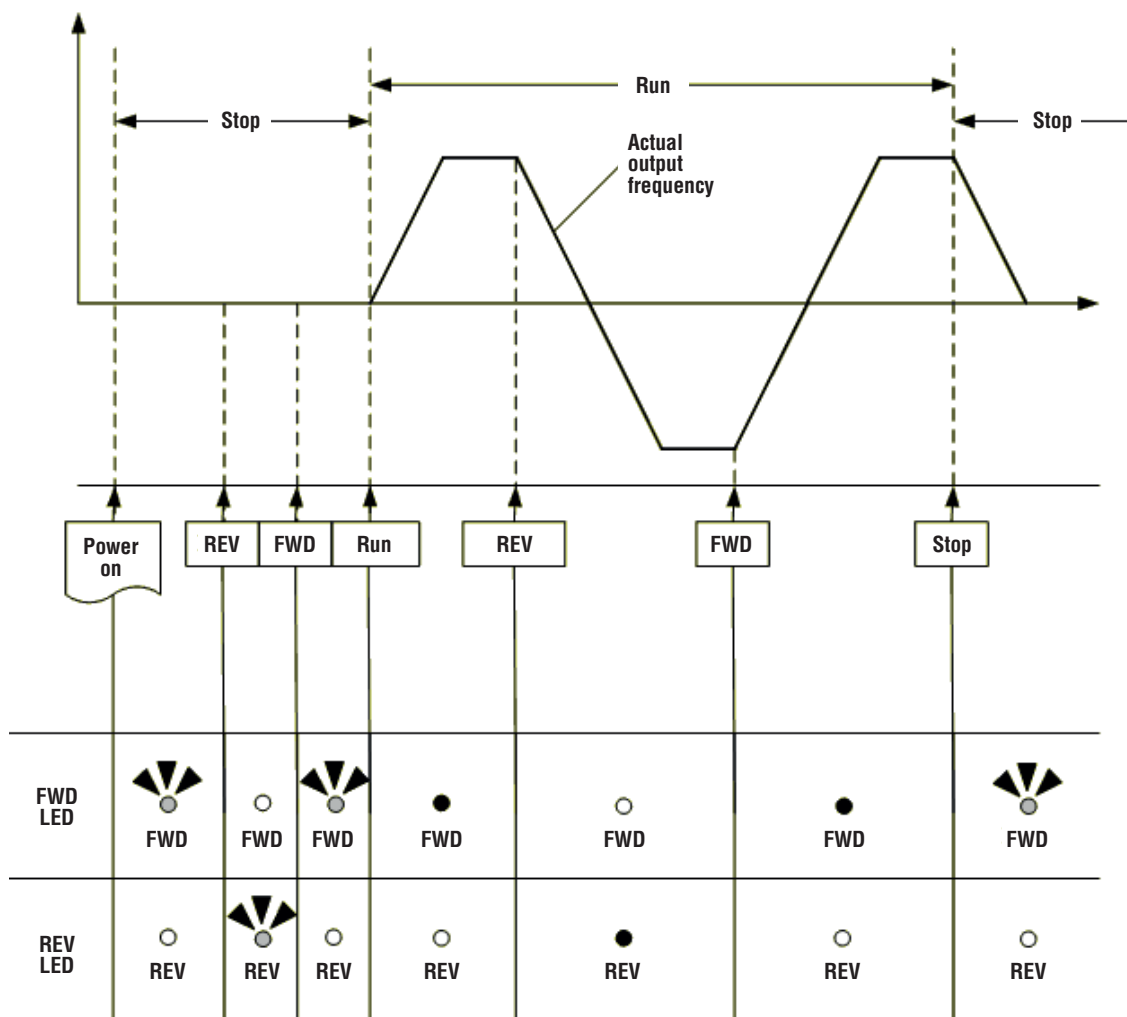
3.2 PARAMETER GROUPS

Parameter group No.	Description
Group 00	Basic parameters
Group 01	V/F pattern selections and setup
Group 02	Motor parameters
Group 03	Multi function digital Inputs/Outputs
Group 04	Analog inputs/ Analog output functions
Group 05	Preset frequency Selections
Group 06	Auto run (Sequencer) function
Group 07	Start/Stop command setup
Group 08	Drive and motor protection functions
Group 09	Communication function setup
Group 10	PID function setup
Group 11	Performance control functions
Group 12	Display and monitor functions
Group 13	Inspection and maintenance function
Group 14	Pump application function

Notes for parameters	
*1	Parameter can be adjusted during running mode
*2	Parameter cannot be modified in communication mode
*3	Parameter does not change with factory reset
*4	Read only parameter

Group 00 - Basic parameters				
No.	Description	Range	Factory Setting	Note
00-00	Control mode	0: V/F mode 1: SLV mode (sensorless vector)	0	
00-01	Motor rotation	0: Forward 1: Reverse	0	*1
00-02	Main run source selection	0: Keypad 1: External run/stop control 2: Communication	1	
00-03	Alternative run source selection	0: Keypad 1: External run/stop control 2: Communication	0	
00-04	Operation modes for external terminals	0: Forward/stop - Reverse/stop 1: Run/stop - Reverse/forward 2: 3-wire control mode-run/stop 3: 2-wire self-holding run/stop	0	
00-05	Main frequency source selection	0: Keypad 1: Potentiometer on keypad 2: AVI analog signal input 3: ACI analog signal input 4: External up/down frequency control 5: Communication setting frequency 6: PID output frequency	2	
00-06	Alternative frequency source selection	0: Keypad 1: Potentiometer on keypad 2: AVI analog signal input 3: ACI analog signal input 4: External up/down frequency control 5: Communication setting frequency 6: PID output frequency.	0	
00-07	Main and alternative Frequency command modes	0: Main or alternative frequency 1: Main frequency + alternative frequency	0	
00-08	Communication frequency command	0.00~599.00 Hz		*4
00-09	Frequency command save mode (communication mode)	0: disabled (keypad frequency is saved) power down 1: enabled (frequency set by communication is saved).	0	
00-10	Initial frequency selection (keypad mode)	0: by current frequency command 1: by 0 frequency command 2: by 00-11	0	
00-11	Initial frequency keypad mode	0.00~599.00 Hz	50.00/60.00	
00-12	Frequency upper limit	0.01~599.00 Hz	50.00/60.00	
00-13	Frequency lower limit	0.00~598.99 Hz	0.00	
00-14	Acceleration time 1	0.1~3600.0 sec	10.0	*1
00-15	Deceleration time 1	0.1~3600.0 sec	10.0	*1
00-16	Acceleration time 2	0.1~3600.0 sec	10.0	*1
00-17	Deceleration time 2	0.1~3600.0 sec	10.0	*1
00-18	Jog frequency	1.00~25.00 Hz	2.00	*1
00-19	Jog acceleration time	0.1~25.5 sec	0.5	*1
00-20	Jog deceleration time	0.1~25.5 sec	0.5	*1
00-21	Application field selection	0: Disable 1: Constant pressure application	1	

Group 01 - V/F pattern selection and setup				
No.	Description	Range	Factory Setting	Note
01-00	Volts/Hz patterns	1~7	1/4	
01-01	V/F max voltage	170.0～264.0 V	Based on 13-08	
01-02	Max frequency	0.2 ~ 599.00 Hz	50.00/60.00	
01-03	Max frequency voltage ratio	0.0 ~ 100.0 %	100.0	
01-04	Mid frequency 2	0.1 ~ 599.00 Hz	2.50/3.00	
01-05	Mid frequency voltage ratio 2	0.0 ~ 100.0 %	7.5/6.8	
01-06	Mid frequency 1	0.1 ~ 599.00 Hz	2.50/3.00	
01-07	Mid frequency voltage ratio 1	0.0 ~ 100.0 %	7.5/6.8	
01-08	Min frequency	0.1 ~ 599.00 Hz	1.30/1.50	
01-09	Min frequency voltage ratio	0.0 ~ 100.0 %	4.5/3.4	
01-10	Volts/Hz curve modification (torque boost)	0 ~ 10.0 %	0.0	*1
01-11	V/F start frequency	0.00~10.00 Hz	0.00	
01-12	No-load oscillation suppression gain	0.0~200.0 %	0	
01-13	Motor hunting prevention coefficient	1~8192	800	
01-14	Motor hunting prevention gain	0~100 %	0	
01-15	Motor hunting prevention limit	0~100.0 %	5.0	
01-16	Auto-torque compensation filter coefficient	0.1~1000.0 ms	0.1	
01-17	Auto-torque compensation gain	0~100 %	0	
01-18	Auto-torque compensation frequency	1.30~5.00 Hz	2	

Group 02 - Motor parameters				
No.	Description	Range	Factory Setting	Note
02-00	Motor no load current	---- A	by motor nameplate	
02-01	Motor rated current (OL1)	---- A	by motor nameplate	
02-02	V/F slip compensation	0.0 ~ 100.0 %	0.0	*1
02-03	Motor rated speed	---- rpm	by motor nameplate	
02-04	Motor rated voltage	---- V	by motor nameplate	
02-05	Motor rated power	---- kW	by motor nameplate	
02-06	Motor rated frequency	0~599.0 Hz	by motor nameplate	
02-07	Motor auto tuning	0: Disable 1: Static auto tuning	0	
02-08	Stator resistor gain	0~600	by series	
02-09	Rotor resistor gain	0~600	by series	
02-10 ~ 02-12	Reserved			
02-13	SLV slip compensation gain	0~200 %	by series	
02-14	SLV torque compensation gain	0~200 %	100	
02-15	Low frequency torque gain	0~100 %	50	
02-16	SLV without load slip compensation gain	0~200 %	by series	
02-17	SLV with load slip compensation gain	0~200 %	150	
02-18	SLV with load torque compensation gain	0~200 %	100	
02-19	SLV slip compensation select	0: Slip compensation 1 2: Slip compensation 2	0	

Group 03- Multi function digital Inputs/Outputs				
No.	Description	Range	Factory Setting	Note
03-00	Multifunction input S1	0: Forward/stop command or run/stop	0	
03-01	Multifunction input S2	1: Reverse/stop command or reverse/forward	1	
03-02	Multifunction input S3	2: Preset speed 1 (05-02) 3: Preset speed 2 (05-03)	2	
03-03	Multifunction input S4	4: Preset speed 4 (05-05)	3	
03-04	Multifunction input S5	6: Jog forward	17	
		7: Jog reverse 8: Up command 9: Down command 10: Acc/Dec 2 11: Acc/Dec disabled 12: Main/alternative run command select 13: Main/alternative frequency command 14: Rapid stop 15: Base block 16: Disable PID function 17: Reset 18: Auto run mode enable 19: Forced Frequency Run 20: Switch to constant pressure 2			
03-05	Reserved			
03-06	Up/down frequency band	0.00~5.00 Hz	0.00	
03-07	Up/Down Frequency modes	0: Preset frequency is held as the drive stops, and the up/down function is disabled. 1: Preset frequency is reset to 0 Hz as the drive stops. 2: Preset frequency is held as the drive stops, and the up/down is available.	0	
03-08	S1~S5 scan confirmation	1~200 ms. Number of scan cycles	10	
03-09	S1~ S5 switch type select	xxxx0:S1 NO xxxx1:S1 NC xxx0x:S2 NO xxx1x:S2 NC xx0xx:S3 NO xx1xx:S3 NC x0xxx:S4 NO x1xxx:S4 NC 0xxxx:S5 NO 1xxxx:S5 NC	00000	
03-10	Reserved			
03-11	Output relay(RY1)	0: Run 1: Fault 2: Setting frequency reached 3: Frequency reached (03-13 ± 03-14) 4: Output frequency detection 1(> 03-13) 5: Output frequency detection 2 (< 03-13) 6: Auto-restart 7: Momentary AC power loss 8: Rapid stop 9: Base block 10: Motor overload protection (OL1) 11: Drive overload protection (OL2) 12: Reserved 13: Output current reached 14: Brake control 15: PID feedback disconnection detection 16: High pressure detection 17: Low pressure detection 18: Pressure loss detection	1	
03-12	Reserved			

Group 03- Multi function digital Inputs/Outputs				
No.	Description	Range	Factory Setting	Note
03-13	Output frequency detection level	0.00~599.00 Hz	0.00	*1
03-14	Frequency detection band	0.00~30.00 Hz	2.00	*1
03-15	Output current detection level	0.1~999.9 A	0.1	
03-16	Output current detection period	0.1~10.0 sec	0.1	
03-17	External brake release level	0.00~20.00 Hz	0.00	
03-18	External brake engage level	0.00~20.00 Hz	0.00	
03-19	Relay output function type	0: normally open 1: normally closed	0	
03-20	Braking transistor On level	240.0~400.0 VDC	380	No function on VT1
03-21	Brake transistor Off level	240.0~400.0 VDC	360	No function on VT1

Group 04 - Analog inputs/Analog output functions						
No.	Description	Range			Factory Setting	Note
04-00	AVI/ACI analog input signal type select		AVI	ACI	0	
		0 :	0~10V	0~20mA		
		1 :	0~10V	4~20mA		
		2 :	2~10V	0~20mA		
		3 :	2~10V	4~20mA		
04-01	AVI signal verification scan rate	1~200 ms			50	
04-02	AVI gain	0 ~ 1000 %			100	*1
04-03	AVI bias	0 ~ 100 %			0	*1
04-04	AVI bias selection	0: Positive 1: Negative			0	*1
04-05	AVI slope	0: Positive 1: Negative			0	*1
04-06	ACI signal verification scan rate	1~200 ms			50	
04-07	ACI gain	0 ~ 1000 %			100	*1
04-08	ACI bias	0 ~ 100 %			0	*1
04-09	ACI bias selection	0: Positive 1: Negative			0	*1
04-10	ACI slope	0: Positive 1: Negative			0	*1
04-11	Analog output (AO) mode	0: Output frequency 1: Frequency setpoint 2: Output voltage 3: DC bus voltage 4: Motor current			0	*1
04-12	Analog output AO gain (%)	0 ~ 1000 %			100	*1
04-13	Analog output AO bias (%)	0 ~ 100 %			0	*1
04-14	AO bias selection	0: Positive 1: Negative			0	*1
04-15	AO slope	0: Positive 1: Negative			0	*1
04-16	Potentiometer gain on keypad	0~1000 %			100	*1
04-17	Potentiometer bias on keypad	0~100 %			0	*1
04-18	Potentiometer bias selection on keypad	0: Positive 1: Negative			0	*1
04-19	Potentiometer slope on keypad	0: Positive 1: Negative			0	*1

Group 05- Preset frequency selections				
No.	Description	Range	Factory Setting	Note
05-00	Preset speed control mode selection	0: Common: acceleration/deceleration 1 or 2 apply to all preset speeds 1: Individual: acceleration/deceleration 0-7 apply to the selected preset speeds (Acc0 / Dec0 ~ Acc7 / Dec7)	0	
05-01	Preset speed 0 (keypad freq)	0.00 ~ 599.00 Hz	5.00	*1
05-02	Preset speed 1		5.00	*1
05-03	Preset speed 2		10.00	*1
05-04	Preset speed 3		20.00	*1
05-05	Preset speed 4		30.00	*1
05-06	Preset speed 5		40.00	*1
05-07	Preset speed 6		50.00	*1
05-08	Preset speed 7		50.00	*1
05-09 ~ 05-16	Reserved			

Group 05- Preset frequency selections				
No.	Description	Range	Factory Setting	Note
05-17	Preset speed 0 – Acc time	0.1 ~ 3600.0 sec	10.0	*1
05-18	Preset speed 0 – Dec time		10.0	*1
05-19	Preset speed 1 – Acc time		10.0	*1
05-20	Preset speed 1 – Dec time		10.0	*1
05-21	Preset speed 2 – Acc time		10.0	*1
05-22	Preset speed 2 – Dec time		10.0	*1
05-23	Preset speed 3 – Acc time		10.0	*1
05-24	Preset speed 3 – Dec time		10.0	*1
05-25	Preset speed 4 – Acc time		10.0	*1
05-26	Preset speed 4 – Dec time		10.0	*1
05-27	Preset speed 5 – Acc time		10.0	*1
05-28	Preset Speed 5 – Dec time		10.0	*1
05-29	Preset speed 6 – Acc time		10.0	*1
05-30	Preset speed 6 – Dec time		10.0	*1
05-31	Preset speed 7 – Acc time		10.0	*1
05-32	Preset speed 7 – Dec time		10.0	*1

Group 06- Auto run (sequencer) function				
No.	Description	Range	Factory Setting	Note
06-00	Auto run (sequencer) mode selection	0: Disabled. 1: Single cycle (continues to run from the unfinished step if restarted). 2: Periodic cycle (continues to run from the unfinished step if restarted). 3: Single cycle, then holds the speed of final step to run (continues to run from the unfinished step if restarted). 4: Single cycle (starts a new cycle if restarted). 5: Periodic cycle (starts a new cycle if restarted). 6: Single cycle, then hold the speed of final step to run (starts a new cycle if restarted).	0	
06-01	Auto run mode frequency command 1	0.00~599.00 Hz	0.00	*1
06-02	Auto run mode frequency command 2		0.00	*1
06-03	Auto run mode frequency command 3		0.00	*1
06-04	Auto run mode frequency command 4		0.00	*1
06-05	Auto run mode frequency command 5		0.00	*1
06-06	Auto run mode frequency command 6		0.00	*1
06-07	Auto run mode frequency command 7		0.00	*1
06-08 ~ 06-15	Reserved			
06-16	Auto run mode running time setting 0	0.0 ~ 3600.0 sec	0.0	*1
06-17	Auto run mode running time setting 1		0.0	*1
06-18	Auto run mode running time setting 2		0.0	*1
06-19	Auto run mode running time setting 3		0.0	*1
06-20	Auto run mode running time setting 4		0.0	*1
06-21	Auto run mode running time setting 5		0.0	*1
06-22	Auto run mode running time setting 6		0.0	*1
06-23	Auto run mode running time setting 7		0.0	*1
06-24 ~ 06-31	Reserved			
06-32	Auto run mode running direction 0	0: Stop 1: Forward 2: Reverse	0	
06-33	Auto run mode running direction 1		0	
06-34	Auto run mode running direction 2		0	
06-35	Auto run mode running direction 3		0	
06-36	Auto run mode running direction 4		0	
06-37	Auto run mode running direction 5		0	
06-38	Auto run mode running direction 6		0	
06-39	Auto run mode running direction 7		0	

Group 07- Start/Stop command setup				
No.	Description	Range	Factory Setting	Note
07-00	Restart after momentary power loss	0: Disabled 1: Enabled	0	
07-01	Auto restart delay time	0.0~6000.0 sec	0.0	
07-02	Number of auto restart attempts	0~10	0	
07-03	Reset mode setting	0: Enable reset only when run command is Off 1: Enable reset when run command is On or Off	0	
07-04	Direct running after power up	0: Enable direct run on power up 1: Disable direct run on power up	1	
07-05	Delay-ON timer	1.0~300.0 sec	1.0	
07-06	DC injection brake start frequency in stop mode	0.10 ~ 10.00 Hz	1.5	
07-07	DC injection brake level in stop mode	0 ~ 20 %. Based on the 20% of maximum output voltage	5	
07-08	DC injection brake time in stop mode	0.0 ~ 25.5 sec	0.5	
07-09	Stopping method	0: Deceleration to stop 1: Coast to stop	0	
07-10	DC braking level at start	0~20% Based on the 20% of maximum output voltage	0	
07-11	DC braking time at start	0.0~25.5 sec	0.0	
07-12	Run command retention	0: Run command retention during power loss 1: Run command not retained during power loss	0	

Group 08- Drive and motor protection functions				
No.	Description	Range	Factory Setting	Note
08-00	Trip prevention selection	xxxx0: Enable trip prevention during acceleration xxxx1: Disable trip prevention during acceleration xxx0x: Enable trip prevention during deceleration xxx1x: Disable trip prevention during deceleration xx0xx: Enable trip prevention in run mode xx1xx: Disable trip prevention in run mode x0xxx: Enable over voltage prevention in run mode x1xxx: Disable over voltage prevention in run mode	00000	
08-01	Trip prevention level during acceleration	50 ~ 200 % (100% = drive rated current)	by series	
08-02	Trip prevention level during deceleration	50 ~ 200 % (100% = drive rated current)	by series	
08-03	Trip prevention level in run mode	50 ~ 200 % (100% = drive rated current)	by series	
08-04	Over voltage prevention level in run mode	350.0~390.0 VDC	380.0	*1
08-05	Electronic motor overload protection operation mode	xxxx0: Disable electronic motor overload protection xxxx1: Enable electronic motor overload protection xxx0x: Motor overload cold start xxx1x: Motor overload hot start xx0xx: Standard motor xx1xx: Invertor duty motor	00001	
08-06	Operation after overload protection is activated	0: Coast-to-stop after overload protection is activated 1: Drive will not trip when overload protection is activated (OL1)	0	
08-07	Over heat protection (cooling fan control) For models size 2 only	0: Auto (depends on temperature) 1: Operate while in run mode 2: Always run 3: Disabled	1	
08-08	AVR function (Auto Voltage Regulation)	0: AVR function enable 1: AVR function disable 2: AVR function disable for stop 3: AVR function disable for deceleration 4: AVR function disable for stop and deceleration 5: When VDC>360V, AVR function disable for stop and deceleration	4	
08-09	Input phase lost protection	0: Disabled 1: Enabled	0	
08-10	PTC overheat function	0: Disable 1: Decelerate to stop 2: Coast to stop 3: Continue running, when warning level is reached. Coast to stop, when protection level is reached.	0	
08-11	PTC signal smoothing time	0.01~10.00 sec	0.2	
08-12	PTC detection time delay	1~300 sec	60	
08-13	PTC protection level	0.1~10.0 V	0.7	
08-14	PTC detection level reset	0.1~10.0 V	0.3	
08-15	PTC warning level	0.1~10.0 V	0.5	
08-16	Fan control temperature level	10.0~50.0 °C	50.0	
08-17	Over current protection level	0.0 ~ 60.0 A	0.0	
08-18	Over current protection time	0.0 ~ 1500.0 sec	1.0	
08-19	Motor overload protection level	0: Motor overload protection level 0 1: Motor overload protection level 1 2: Motor overload protection level 2	0	

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Group 09- Communication function setup				
No.	Description	Range	Factory Setting	Note
09-00	Assigned communication station number	1 ~ 32	1	*2*3
09-01	Communication protocol	0: Modbus RTU 1: Modbus ASCII 2: BACnet	0	*2*3
09-02	Baud rate setting (bps)	0 :4800 1: 9600 2: 19200 3: 38400 4: Remote control is enabled	2	*2*3
09-03	Stop bit selection	0: 1 Stop bit 1: 2 Stop bits	0	*2*3
09-04	Parity selection	0: Without parity 1: With even parity 2: With odd parity	0	*2*3
09-05	Data format selection	0: 8-Bits data 1: 7-Bits data	0	*2*3
09-06	Communication time-out detection time	0.0 ~ 25.5 sec	0.0	
09-07	Communication time-out operation selection	0: Deceleration to stop (set by 00-15) 1: Coast to stop 2: Deceleration to stop (set by 00-17) 3: continue operating	0	
09-08	Error 6 verification time.	0 ~ 20 sec	3	
09-09	Drive transmit delay time	5 ~ 65 ms	5	
09-10	BACnet stations	1~254	1	*2*3
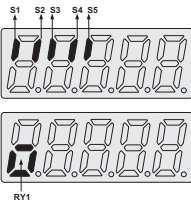
Group 10 - PID function setup				
No.	Description	Range	Factory Setting	Note
10-00	PID target value selection (when 00-05 \ 00-06=6, this function is enabled)	0: Potentiometer on keypad 1: AVI analog signal input 2: ACI analog signal input 3: Frequency set by communication 4: KeyPad frequency parameter 10-02 5: Preset frequency	1	*1
10-01	PID feedback value selection	0: Potentiometer on keypad 1: AVI analog signal input 2: ACI analog signal input 3: Communication setting frequency	2	*1
10-02	PID target (keypad input)	0.0~100.0 %	50.0	*1
10-03	PID mode selection	0: Disabled 1: Deviation D control. Forward characteristic. 2: Feedback D control. Forward characteristic. 3: Deviation D control reverse characteristic. 4: Feedback D control. Reverse characteristic. 5: Frequency command + deviation D control. Forward characteristic. 6: Frequency command + feedback D control. Forward characteristic. 7: Frequency command + deviation D control. Reverse characteristic. 8: Frequency command + feedback D control. Reverse characteristic.	0	
10-04	Feedback gain coefficient	0.00 ~ 10.00 %	1.00	*1
10-05	Proportional gain	0.0 ~ 10.0 %	3.0	*1
10-06	Integral time	0.0 ~ 100.0 sec	0.5	*1
10-07	Derivative time	0.00 ~ 10.00 sec	0.00	*1
10-08	PID offset	0: Positive 1: Negative	0	*1
10-09	PID offset adjust	0 ~ 109 %	0	*1
10-10	PID output lag filter time	0.0 ~ 2.5 sec	0.0	*1
10-11	Feedback loss detection mode	0: Disabled 1: Drive keeps running after feedback loss 2: Drive stops after feedback loss	0	
10-12	Feedback loss detection level	0 ~ 100 %	0	
10-13	Feedback loss detection delay time	0.0 ~25.5 sec	1.0	
10-14	Integration limit value	0 ~ 109 %	100	*1
10-15	Integral value resets to zero when feedback signal equals the target value	0: Disabled 1~30: 1~30 sec	0	
10-16	Allowable integration error margin	0 ~ 100 units (1 unit = 1/8192)	0	
10-17	PID sleep frequency level	0.00~599.00 Hz	0.00	
10-18	PID sleep function delay time	0.0 ~25.5 sec	0.0	
10-19	PID wake up frequency level	0.00 ~ 599.00 Hz	0.00	
10-20	PID wake up function delay time	0.0 ~ 25.5 sec	0.0	
10-21	Max PID feedback setting	0 ~999	100	*1
10-22	Min PID feedback setting	0 ~999	0	*1

Group 11- Performance control functions				
No.	Description	Range	Factory Setting	Note
11-00	Reverse operation control	0: Reverse command is enabled 1: Reverse command is disabled	0	
11-01	Carrier frequency	1~16 kHz	5	
11-02	Carrier mode selection	0: Mode 0, 3phase PWM modulation 1: Mode 1, 2phase PWM modulation 2: Mode 2, 2phase soft PWM modulation	1	
11-03	Carrier frequency reduction by temperature rise	0: Disabled 1: Enabled	0	
11-04	S-curve Acc 1	0.0 ~ 4.0 sec	0.00	
11-05	S-curve Acc 2	0.0 ~ 4.0 sec	0.00	
11-06	S-curve Dec 3	0.0 ~ 4.0 sec	0.00	
11-07	S-curve Dec 4	0.0 ~ 4.0 sec	0.00	
11-08	Skip frequency 1	0.00 ~ 599.00 Hz	0.00	*1
11-09	Skip frequency 2	0.00 ~ 599.00 Hz	0.00	*1
11-10	Skip frequency 3	0.00 ~ 599.00 Hz	0.00	*1
11-11	Skip frequency bandwidth (±)	0.00 ~ 30.00 Hz	0.00	*1
11-12	Reserved			
11-13	Regeneration prevention function	0: Disable 1: Enable 2: Enable (during constant speed only)	0	
11-14	Regeneration prevention voltage level	300.0~400.0 V	380	
11-15	Regeneration prevention frequency limit	0.00～15.00 Hz	3.00	
11-16	Regeneration prevention voltage gain	0~200 %	100	
11-17	Regeneration prevention frequency gain	0~200 %	100	
11-18	Speed loop proportion gain	0~65535	10000	
11-19	Speed loop integration gain	0 ~65535	800	
11-20	Speed loop differential gain	0 ~65535	0	
11-21	Stop key selection	0: Enable stop key when run command not from keypad 1: Disable stop key when run command not from keypad	0	

Group12 – Display and monitor functions				
No.	Description	Range	Factory Setting	Note
12-00	Extended display mode	00000 ~77777. Each digit can be set to 0 to 7 0: Default display (frequency and parameters) 1: Output current 2: Output voltage 3: DC voltage 4: Heat sink temperature 5: PID feedback 6: AVI analog signal input 7: ACI analog signal input	00321	*1
12-01	PID feedback display format	0: Integer (xxx) 1: One decimal place (xx.x) 2: Two decimal places (x.xx)	0	*1
12-02	PID feedback display unit setting	0: xxx-- 1: xxxpb (pressure) 2: xxxfl (flow)	0	*1
12-03	Custom units (line speed) value	0~65535 rpm	1500/1800	*1
12-04	Custom units (line speed) display mode	0: Drive output frequency is displayed 1: Line speed. Integer (xxxxx) 2: Line speed. One decimal place (xxxx.x) 3: Line speed. Two decimal places (xxx.xx) 4: Line speed. Three decimal places (xx.xxx)	0	*1
12-05	Inputs and output logic status display (S1 to S5 and RY1)		-----	*4
12-06	Output power	---- kW	0.0	
12-07	Motor current percentage	---- %	0	

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Group 13 - Inspection and maintenance functions				
No.	Description	Range	Factory Setting	Note
13-00	Drive horse power code	----	-	*3
13-01	Software version	----	-	*3*4
13-02	Fault log (last 3 faults)	----	-	*3*4
13-03	Accumulated operation time 1	0~23 hours	-	*3
13-04	Accumulated operation Time 2	0~65535 days	----	*3
13-05	Accumulated operation time mode	0: Time under power 1: Run mode time only	0	*3
13-06	Parameter lock	0: Enable all functions 1: Preset speeds (05-01~05-08) cannot be changed 2: All functions cannot be changed except for preset speeds (05-01~05-08) 3: Disable all functions	0	
13-07	Parameter lock code	00000~65535	00000	
13-08	Reset drive to factory settings	1150: Initialization (50Hz,220V/380V) 1160: Initialization (60Hz,220V/380V) 1250: Initialization (50Hz,230V/400V) 1260: Initialization (60Hz,230V/460V) 1350: Initialization (50Hz,220V/415V) 1360: Initialization (60Hz,230V/400V)	1250	

Group 14- Pump application function				
No.	Description	Range	Factory Setting	Note
14-00	Function selection	0: Disable 1: Pump	0	
14-01	Setting of single and multiple pumps and master and slave machines	0: Single pump 1: Master 2: Slave 1 3: Slave 2 4: Slave 3	0	
14-02	Operation pressure setting	0.1~(the value of 14-03) PSI	4.00	
14-03	Maximum pressure setting of pressure transmitter	0.10 ~ 650.00 PSI	10.00	
14-04	Pump pressure command source	0: Set by 14-02 1: Set by AI	0	
14-05	Display mode selection	0: Display of target and pressure feedback (14-03<99) 1: Target pressure only 2: Feedback pressure only	0	
14-06	Proportion gain (P)	0.00~10.00	3.00	
14-07	Integral time (I)	0.0~100.0 sec	0.5	
14-08	Differential time (D)	0.00~10.00 sec	0.00	
14-09	Tolerance range of constant pressure	When 14-20=0, range is 0.00~650.00 PSI When 14-20=1, range is 0~100%	5	
14-10	Sleep frequency of constant pressure	0.00~599.00 Hz	30.00	
14-11	Sleep time of constant pressure	0.0~255.5 sec	0.0	
14-12	Maximun pressure limit	When 14-20=0, range is 0.00~650.00 PSI When 14-20=1, range is 0~100%	50	
14-13	Warning time of high pressure	0.0~600.0 sec	10	
14-14	Stop time of high pressure	0.0~600.0 sec	20	
14-15	Minimum pressure limit	When 14-20=0, range is 0.00~650.00 PSI When 14-20=1, range is 0~100%	5	
14-16	Warning time of low pressure	0.0~600.0 sec	0.0	
14-17	Fault stop time of low pressure	0.0~600.0 sec	0.0	
14-18	Time of loss pressure detection	0.0~600.0 sec	0.0	
14-19	Proportion of loss pressure detection	0~100 %	0	
14-20	Switching of pressure and percentage	0: Pressure 1: Percentage	1	
14-22	Slave trip frequency	0.00 ~ 599.00 Hz	45.00	
14-23	Direction of water pressure detection	0: Upward detection 1: Downward detection	1	
14-24	Range of water pressure detection	When 14-20=0, range is 0.00~650.00 PSI When 14-20=1, range is 0~100%	1	
14-25	Period of water pressure detection	0.0~200.0 sec	30.0	
14-26	Acceleration time of water pressure detection	0.1~3600.0 sec	12.0	
14-27	Deceleration time of water pressure detection	0.1~3600.0 sec	35.0	
14-28	Forced run command	0.00 ~ (value of 00-12) Hz	0.00	
14-29	Switching time of water pressure detection	0~240 hours	3	
14-30	Detection time of multiple pumps in parallel running start	0~30.0 sec	0.0	
14-31	Synchronous selection of multiple pumps in parallel	0: Disable 1: Pressure setting run/stop 2: Pressure setting 3: Run/stop	1	
14-34	Tolerance range of constant pressure 2	When 14-20=0, range is 0.00~650.00PSI When 14-20=1, range is 0~100%	5	

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Group 14- Pump application function				
No.	Description	Range	Factory Setting	Note
14-35	Selection of multiple pumps shift operation	0: No function 1: Timer alternately selection 2: Sleep stop alternately selection 3: Timer and sleep stop alternately selection 4: Multiple pumps test mode	1	
14-37	Leakage detection time	0.0~100.0	0.0	
14-38	Pressure variation of leakage detection restart	When 14-20=0, range is 0.00~65.00 PSI When 14-20=1, range is 0~100%	1	
14-39	Pressure tolerance range of leakage detection restart	When 14-20=0, range is 0.00~650.00 PSI When 14-20=1, range is 0~100%	5	
14-71	Maximum pressure setting	0.10~650.00 PSI	10	
14-72	Switching time of alternation in parallel	0: Hour 1: Minute	0	
14-73	Slave Wake-Up Selection	0: Disable 1: Enable	0	
14-74	Proportion time 2 (P)	0.00~10.00	3.00	
14-75	Integral time 2 (I)	0.0~100.0	0.5	
14-76	Differential time 2 (D)	0.00~10.00	0.00	
14-77	Value of water pressure detection	0~100	1	

3.3   PARAMETER FUNCTION DESCRIPTION

GROUP 00 - BASIC PARAMETERS

00-00	Control mode
Range	[0]: V/F mode [1]: SLV mode

Select the relevant control mode for the application, using parameter 00-00 Control mode.
Default control mode is V/F.
– **V/F mode** can be used for most applications specifically multi-motor or applications where auto tune is not successful or when a customized V/F pattern may be required.
   Several V/f patterns are available selectable by parameter 01-00.
   Select the appropriate V/f pattern based on the application load type and the motor base frequency of 50 or 60 Hz.
   For selections of the V/f patterns. Refer to description of parameter 01-00
– **SLV (Sensorless vector)** is used for obtaining best performance from a motor. Especially at low speeds or for applications with dynamic speed change.

00-01	Motor Direction Control
Range	[0]: Forward [1]: Reverse

– 00-01 Is valid in keypad mode only.
Note: When Reverse function is disabled by parameter 11-00=1 setting 00-01 to 1 ." LOC" will be displayed

00-02	Main Run Command Source selection
00-03	Alternative Run Command Source selection
Range	[0]: Keypad [1]: External Run/Stop Control [2]: Communication

– Parameter 00-02/00-03 sets the drive operation command source. For switching between 00-02 and 00-03, use any of the external inputs S1 to S5 and set the relevant parameters (03-00~03-04) to [12]. Refer to parameter Group 3.

00-04	Operation modes for external terminals
Range	[0]: Forward/stop-reverse/stop [1]: Run/stop-forward/reverse [2]: 3-wire control mode run/stop [3]: 2-wire self-holding run/stop

– Parameter 00-04 sets the function of the External Run/Stop and it is used in conjunction with Parameters.

00-02 (Main Run Source) = 1 or 00-03 (Alternative Run source) = 1
(When 00-02 / 00-03=1, the command comes from External Run /Stop)

Parameters 03-00 to 03-04, which are used to set the required function for the digital inputs S1 to S5 (multi-function inputs).

Note1: Parameters 03-00 to 03-04 are only required for External Run/stop
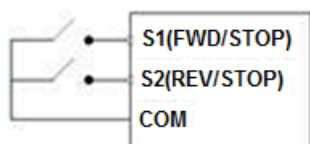(Two wire control mode).
Note2: For External Run/Stop control set parameters in the following order:
1. 00-02 or 00-03
2. 00-04
3. 03-00 to 03-04 as required. Not required for three wire control mode.

When 00-04=0

Two external switches are required, one for forward direction and the other for reverse.
Switch type: two position, maintained type. (This is two wire mode).

1. Forward (Run/Stop) Switch
   Select one of the multifunction inputs [S1 to S5] and set the relevant parameter 03-00 to 03-04 = 0 (Forward run /Stop mode.)
2. Reverse (Run/Stop) Switch
   Select one of the multifunction inputs [S1 to S5] and set the relevant parameter 03-00 to 03-04 = 1 (Reverse run /Stop mode.)

00-04 = 1

```
  o  o----•--- S1(RUN/STOP)
  o  o----•--- S2(REV/FWD)
           --- COM
```
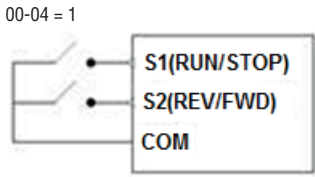
Two external switches are required.
Switch type: two position, maintained type. (This is two wire mode).

1. Run/Stop switch
   Select one of the multifunction inputs [S1 to S5] and set the relevant parameter 03-00 to 03-04 = 0 (Run/Stop mode.)
2. Forward/Reverse Switch
   Select one of the multifunction inputs [S1 to S5] and set the relevant parameter 03-00 to 03-04 = 1 (Forward/ Reverse direction selection.)
Switch in OFF position = Forward direction
Switch in ON position = Reverse direction

00-04= 2. Three Wire Control mode Run/Stop

```
 o o  o o ---- S1(RUN)
          ---- S2(STOP)
  o  o  •----- S3(FWD/REV)
          ---- COM
```
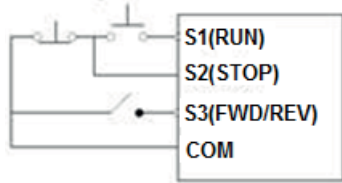
In this mode, two separated momentary push buttons are used for start and stop functions.
In this mode, parameter Group 3 for S1 to S5 are not effective.
S1, S2 and S3 are allocated automatically.
Note: For S1 to initiate the Run command. Push button connected to S2 must be connected by a normally closed type contact (NC).

00-04 = 3, Two wire self-holding RUN/STOP
Please see the wiring diagram and timing chart below.

Wiring diagram

```
  o  o----•--- S1(RUN/STOP)
           (self-holding)
  o  o----•--- S2(REV/FWD)
           (self-holding)
  o  o----•--- S3(STOP)
           (self-holding)
           --- 24VG
```

Timing chart

FWD command — ON — OFF — ON — time

REV command — OFF — ON — OFF — time

STOP command — OFF (inverter operation) — ON — time

Motor speed — time

STOP | FWD | REV | STOP | FWD

00-05	Main Frequency Command Source Selection
00-06	Alternative Frequency Command Source Selection
Range	[0]:UP/DOWN of Keypad [1]:Potentiometer on Keypad [2]:External AVI Analog Signal Input [3]:External ACI Analog Signal Input [4]:External Up/Down Frequency Control [5]:Communication setting Frequency [6]:PID Output frequency

– When 00-06 =[6], frequency command source is output of the PID.

00-07	Main and Alternative Frequency Command Modes
Range	[0]:Main Or Alternative Frequency. [1]:Main frequency + Alternative Frequency

– When 00-07=[0], the frequency source is set by the Main frequency parameter 00-05 (default) or by the Alternative frequency parameter 00-06. Use any of the external terminals S1 to S5 and set the relevant parameter 03-00 to 03-04 =[13]to switch from main to alternative source.
– When 00-07 =[1]The frequency command will be the result of setting of main and alternative frequencies.

00-08	Communication Frequency Command
Range	[0.00~599.00]Hz

– This parameter can be used to read the set frequency in communication mode
– This parameter is only effective in the communication mode.

00-09	Frequency Command save on power down (Communication mode)
Range	[0]:Disable [1]:Enable

– 00-09=[0] Keypad frequency is saved.
– 00-09=[1] Frequency set by communication is saved.

00-10	Initial Frequency Selection
Range	[0]:By Current Frequency Command [1]:By Zero Frequency Command [2]:By 00-11
00-11	Initial Frequency Setpoint
Range	[0.00~599.00]Hz

– This parameter is only effective in keypad mode.
– When 00-10=[0]the initial frequency will be current frequency.
– When 00-10=[1]the initial frequency will be 0.
– When 00-10=[2]the initial frequency will be as set by parameter 00-11.

00-12	Frequency Upper limit
Range	[0.01~599.00]Hz
00-13	Frequency Lower limit
Range	[0.00~598.99]Hz

– When 00-13 and the command frequency are both set to 0.00, if RUN is pressed "Stop" is displayed.
– When Frequency command is > than preset in 00-13 drive output will ramp up from 0.00 to the command frequency.
– When 00-13> 0, and the frequency command value ≤ 00-13, drive output will ramp up from preset in lower limit to the command frequency.
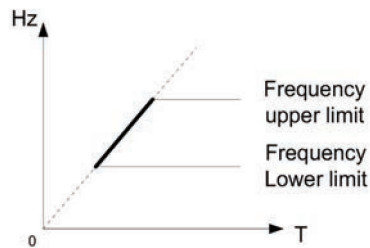
00-14	Acceleration time 1
Range	[0.1~3600.0]s
00-15	Deceleration time 1
Range	[0.1~3600.0]s
00-16	Acceleration time 2
Range	[0.1~3600.0]s
00-17	Deceleration time 2
Range	[0.1~3600.0]s

– Preset Acceleration and Deceleration times by above parameters are the time taken for the output frequency to ramp up or ramp down between the upper and the lower V/F frequency limits.
– Actual acceleration and deceleration time is calculated as follows:

V/F mode:

$$\text{Actual acceleration time} = \frac{(00\text{-}14)\text{x(set frequency-the minimum starting frequency)}}{\text{V/F Maximum output frequency}}$$

$$\text{Actual deceleration time} = \frac{(00\text{-}15)\text{x(set frequency-the minimum starting frequency)}}{\text{V/F Maximum output frequency}}$$

SLV mode:

$$\text{Actual acceleration time} = \frac{(00\text{-}14)\text{x(set frequency-the minimum starting frequency)}}{\text{Motor rated frequency}}$$

$$\text{Actual deceleration time} = \frac{(00\text{-}15)\text{x(set frequency-the minimum starting frequency)}}{\text{Motor rated frequency}}$$
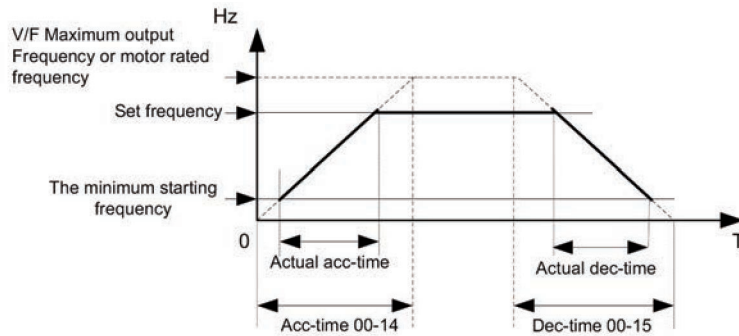
V/F Maximum output frequency is for V/F curve, which can be checked from table when V/F curve is fixed. Maximum output frequency is 01-02 when V/F curve is customized, or motor rated frequency 02-06.

00-18	Jog Frequency
Range	[1.00~25.00]Hz
00-19	Jog Acceleration Time
Range	[0.1~25.5]sec
00-20	Jog Deceleration Time
Range	[0.1~25.5]sec

– The JOG function is operational by using the multi-function input terminals S1 to S5 and setting the relevant parameters 03-00~03-04 to[6]JOG FWD or[7]JOG REV. Refer to parameter Group 3.

00-21	Application Field Selection
Range	[0]:Disable [1]:Constant Pressure Application

– When 00-21=1, these parameters will change the default setting suitable for PUMP application. (00-14~00-15 / 01-00 / 01-04~01-07 / 04-00 / 14-00 / 14-24~14-27 / 14-74~14-77).

GROUP 01 - V/F PATTERN SELECTIONS AND SETUP

01-00	Volts/Hz Patterns (V/F)
Range	[1~7]

– Set 01-00 to one of the following preset V/f selections[1~6]according to the required application.
– Parameters 01-02~01-09 can not be modified (read only).
– Six fixed V/f patterns are shown below.[1~3]for 50 Hz systems and[4~6]for 60 Hz.

– (V) 100% is the maximum output voltage. B, C point preset % settings will be as table below:

01-00	B(Xb)	C(Xc)
1/4	10%	8%
2/5	12%	9.5%
3/6	25%	7.7%

– Setting 01-00=[7] provides a flexible V/F curve which can be selected by experienced users by setting parameters (01-02~01-09).

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01-01	V/f Maximum voltage
Range	[170.0~264.0] V
01-02	Maximum Frequency (base frequency)
Range	[0.2~ 599.00] Hz
01-03	Maximum Frequency Voltage Ratio
Range	[0.0 ~ 100.0] %
01-04	Medium Frequency 2
Range	[0.1~599.00] Hz
01-05	Medium Frequency Voltage Ratio 2
Range	[0.0 ~ 100.0] %
01-06	Medium Frequency 1
Range	[0.1~599.00] Hz
01-07	Medium Frequency Voltage Ratio 1
Range	[0.0 ~ 100.0] %
01-08	Minimum Frequency
Range	[0.1~599.00] Hz
01-09	Minimum Frequency Voltage Ratio
Range	[0.0 ~ 100.0] %

– Max output frequency depends on parameter 01-00, for 01-00=7, it can be set by parameter 01-02.
– For 01-00 ≠ 7, the maximum output frequency depends on parameter 00-12
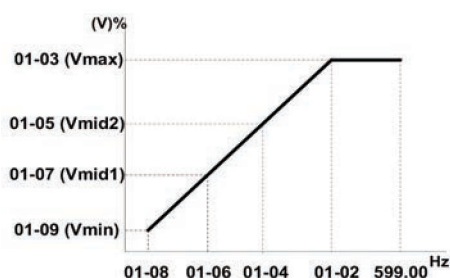
01-10	Volts/Hz Curve Modification (Torque Boost)
Range	[0 ~ 10.0] %

– Drive output V/F curve settings for points B, C can be adjusted by parameter 01-10 to improve the output torque.
– Calculation of B, C point voltage:
  B point voltage = Xb × maximum output voltage
  C point voltage = Xc × maximum output voltage (Xb, Xc see description of 01-00).
  When 01-10 = 0, the torque improvement is disabled.
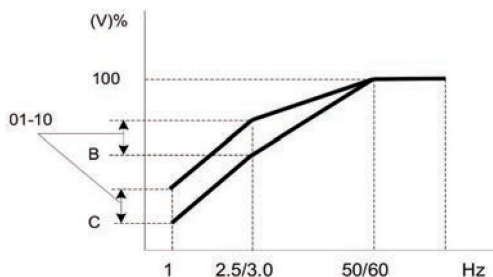
01-11	V/F start Frequency
Range	[0.00 ~10.00] Hz

– VF Start Frequency is for occasion where Start Frequency higher than zero Hz is needed.

01-12	No-load oscillation suppression gain
Range	[0.0~200.0] %

– In the situation of no power and no-load that damping is low, active and reactive energy fluctuations will greatly stimulate the drive output current oscillations. Appropriately adjusting 01-12 can suppress oscillation by frequency gain. Compensation is based on the percentage of the load current corresponds to the motor rated current. The adjustment for 01-14 can be increased or decreased every time about 5% to 10%.

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01-13	Motor Hunting Prevention Coefficient
Range	[1~8192]
01-14	Motor Hunting Prevention Gain
Range	[0~100]%
01-15	Motor Hunting Prevention Limit
Range	[0.0~100.0]%

– In the situation of no power and no-load that damping is low, active and reactive energy fluctuations will greatly stimulate the drive output current oscillations. Appropriately adjusting 01-12 can suppress oscillation by compensating V/F voltage command. Compensation is based on high-pass filtering and the load current value, then it is multiplied by the gain limiting, finally, it is added by the V/F output voltage. The adjustment for 01-14 can be increased or decreased every time about 5% to 10%.
– 01-13 filter coefficients corresponding filter time = 2048 / set point ms, such as 01-13 = 800, then filtering time = 2048/800 = 2.56ms.
– 01-15 of 100% corresponds to 150V.
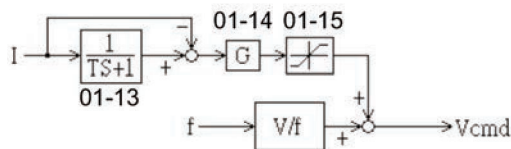
01-16	Auto-Torque Compensation Filter Coefficient
Range	[0.1 ~ 1000.0]ms
01-17	Auto-torque Compensation Gain
Range	[0~ 100]%
01-18	Auto-torque Compensation Frequency
Range	[1.30 ~ 5.00]Hz

– Auto-torque Compensation function must be in SLV mode to auto tune so that drive can get the value of stator resistor. Drive without Auto-Torque Compensation If 01-17=0. 01-17 compensation is based on V/F maximum output voltage and the load current, The adjustment for 01-14 can be increased or decreased every time about 5% to 10%.
– Parameter 01-16~01-18 is for V/F mode only. SLV mode doesn't need to adjust these parameter because auto-tune in SLV mode will get the value of motor parameter.
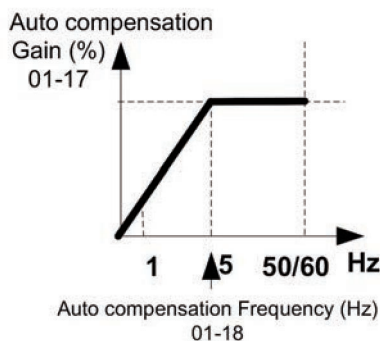
GROUP 02 - MOTOR PARAMETER GROUP

02-00	Motor no load current (for slip compensation calculation)
Range	----
02-01	Motor Rated Current
Range	----
02-02	Slip Compensation Gain (V/f mode only)
Range	[0.0 ~ 100.0](%)

– When the load causes the actual motor speed to be reduced below the speed set by drive output frequency (Slip), parameter 02-02 Slip compensation can be used to correct the speed.

Slip compensation calculation in V/F mode:

$$\text{Slip compensation boost} = \frac{\text{Output Current-/02-00)}}{(02\text{-}01)\text{-}(02\text{-}00)} \times (02\text{-}02) \times \text{Rate motor slip}$$

Motor slip = Motor synchronous speed-Motor Rated Speed

$$(02\text{-}02)\ \text{appropriate Value} = \frac{\text{Motor synchronization speed-Rated speed}}{\text{Motor synchronization speed}}$$

Example: 4 poles, 60Hz induction motor synchronization speed = $\dfrac{120}{4} \times 60 = 1800\ \text{(RPM)}$

Note: Parameters 02-00/02-01 have to be set according to the specific motor data and in relation to the Drive rating model parameter (13-00).

02-03	Motor Rated Speed
Range	----

– Slide compensation limit, drive will calculate the motor slide according to 02-03. V/F slide compensation will not be higher than 02-03.

Note: Please set the value according to motor's nameplate.

02-04	Motor Rated Voltage
Range	----

– In order to prevent the output voltage of drive is too high. The output voltage value will not be higher than 02-04. 02-04 can be changed during operation.

Note: Please set the value according to motor's nameplate.

02-05	Motor Rated Power
Range	[0~22.0]kW
02-06	Motor Rated Frequency
Range	[0~599.0]Hz
02-07	Motor Auto Tuning
Range	[0]: Disable [1]: Static auto tuning

– When drive executes auto tuning function, Fmax value sets by 02-06.
When drive does not execute auto tuning function, Fmax value sets by 01-02.

02-08	Stator Resistor Gain
Range	----
02-09	Rotor Resistor Gain
Range	----

– Auto tune function in SLV mode. 00-00=[1], set motor parameters 02-01 and 02-03~02-06, then set 02-07=1 to start the auto tune function. During the Auto tune function the display will show AT and show END briefly when auto tune is completed then the display will return to the frequency display. Following an auto tune the motor test data are stored in parameters 02-08 and 02-09 then the setting in 02-07 will automatically reset to 0.
– Carry out Auto tune again whenever replacing the motor. If the motor parameter already knew, please enter the parameter 02-01, 02-03~02-06 directly.
– Parameters 02-00 ~ 02-06 are available both for V/F and SLV mode (Except parameter 02-02 which is for V/F).
– Auto tune can be used on motors of equivalent size to the drive or one size smaller (or one size bigger). Just need to set the motor parameter and set 02-07 to be 1.

02-13	SLV Slip Compensation Gain
Range	[0~200]%

– When the load causes the actual motor speed to be reduced below the speed set by drive output frequency (Slip), parameter 02-13 SLV Slip compensation can be used to correct the speed.

02-14	SLV Torque Compensation Gain
Range	[0~200]%

– When torque is reduced due to load conditions, parameter 02-14 can be used to correct the torque. Torque producing current adjusted to compensate for the reduced torque. Parameter 02-13, 02-14 compensation is based on the load current. The unit of 02-13 is based on rated slip frequency; the unit of 02-14 is based on rated torque difference. The adjustment can be increased or decreased 5% to 10%.

02-15	Low Frequency Torque Gain
Range	[0~100]%

– Drive of dead zone (IGBT on short) will lower the torque of output in the system, leading to lower motor efficiency. Setting 02-15 can not only reduce this situation but also increase torque of output in low frequency. Default setting is 50, means 50% voltage compensation.
100% of 02-15 according to output voltage that is less affected by dead zone.

02-16	SLV Without Load Slip Compensation Gain
Range	[0~200]%
02-17	SLV With Load Slip Compensation Gain
Range	[0~200]%

– When output current <= 02-00 (Motor current without load), slip compensation gain :
= [SLV slip compensation gain (02-13)]* [Normal Duty slip compensation gain (02-16)]
– When output current > 02-00 (Motor current with load), slip compensation gain:
= [SLV slip compensation gain (02-13)] * Slip compensation gain 1(as bellowed figure)
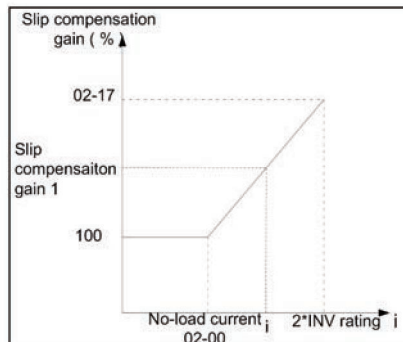
02-18	SLV With Load Torque Compensation Gain
Range	[0~200]%

– Please refer the contents as parameter 02-13 / 02-14.

02-19	SLV Slip Compensation Select
Range	0: Slip Compensation Select 1
	1: Slip Compensation Select 2

– When output current lower or equal to 02-00(no load), the value of slip compensation will be equal to (02-13)*(02-16)(slip compensation select 1)
– When output current higher than 02-00(with load), the value of slip compensation will be equal to (02-13)*(02-17)(slip compensation select 2)
Note: If drive worked at lower speed with load, please use slip compensation select 2.

GROUP 03 - MULTI FUNCTION DIGITAL INPUTS/OUTPUTS

03-00	Multifunction Input Terminal S1
03-01	Multifunction Input Terminal S2
03-02	Multifunction Input Terminal S3
03-03	Multifunction Input Terminal S4
03-04	Multifunction Input Terminal S5
Range	[0]:Forward/Stop Command------------(Parameters 00-02/00-03=1 and 00-04)
	[1]:Reverse/Stop Command------------(Parameters 00-02/00-03=1 and 00-04)
	[2]:Preset Speed 1 (5-02)----------------(Parameter Group5)
	[3]:Preset Speed 2 (5-03)----------------(Parameter Group5)
	[4]:Preset Speed 4 (5-05)---------------(Parameter Group5)
	[6]:JOG Forward Command-------------(Parameters 00-18~00-20)
	[7]:JOG Reverse Command-------------(Parameters 00-18~00-20)
	[8]:Up Command---------------------------(Parameters 00-05/00-06=4 and 03-06/03-07)
	[9]:Down Command----------------------(Parameters 00-05/00-06=4 and 03-06/03-07)
	[10]: 2nd Acc/Dec times
	[11]: Disable Acc/Dec
	[12]: Main/ Alternative run source Select------------------(Parameters 00-02/00-03)
	[13]: Main/Alternative Frequency Command Select----(Parameters 00-05/00-06)
	[14]: Rapid Stop (controlled deceleration stop)
	[15]: Base Block (Coast to stop)
	[16]: Disable PID Function.------------------(Parameter Goup10)
	[17]: Reset
	[18]: Enable Auto Run Mode----------------(Parameter Group 6)
	[19]: Forced Frequency Run----------------(Parameter Group 14)
	[20]: Switch to Constant Pressure 2----------------(Parameter Group 14)

1) For setting parameters 03-00~03-04 to[0, 1]External Run/Stop Control, refer to 00-04.

A.2-wire method. Mode 1.
Example: FWD/STOP and REV/STOP from two inputs (S1&S2)
Set 00-04=[0], S1: 03-00=[0](FWD/STOP) , S2: 03-01=[1](REV/STOP);
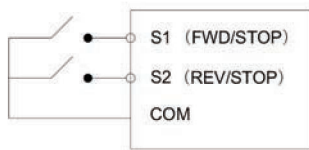
Note: If both forward and reverse commands are ON, it will be treated as a STOP signal.

B. 2-wire method. Mode 2.
Example: RUN/STOP and REV/FWD from two inputs (S1 and S2)
Set 00-04=[1]; S1: 03-00=[0](RUN/STOP); S2:03-01=[1](REV/FWD);
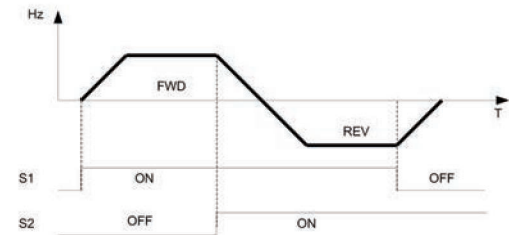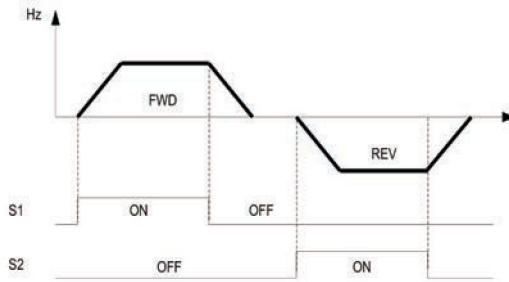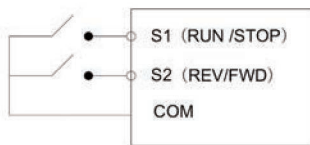
C. 3-wire method.
Example: Two separate push buttons for RUN and STOP and a two position switch for FWD/REV
Set 00-04=2 (3 wire control mode), then terminals S1, S2 and S3 are dedicated to this function and
preset selections for parameters 03-00, 03-01 and 03-02.are not relevant.
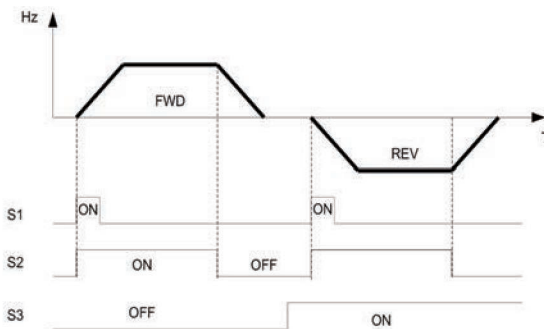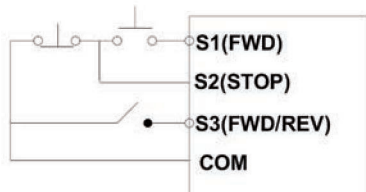
2) Parameters 03-00~03-04=[4, 3, 2]Preset speed selections.
Combination of any three terminals from S1~ S5 can be used to select preset speeds 0 to 7 according to the table below, for example timing diagram refer to Group 5 description.

Preset speed	Function setting and state of any three (A,B,C) of terminal S1~S5			Frequency	Acc-time	Dec-time
	terminal A=4	terminal B =3	terminal C =2			
speed 0	OFF	OFF	OFF	05-01	05-17	05-18
speed 1	OFF	OFF	ON	05-02	05-19	05-20
speed 2	OFF	ON	OFF	05-03	05-21	05-22
speed 3	OFF	ON	ON	05-04	05-23	05-24
speed 4	ON	OFF	OFF	05-05	05-25	05-26
speed 5	ON	OFF	ON	05-06	05-27	05-28
speed 6	ON	ON	OFF	05-07	05-29	05-30
speed 7	ON	ON	ON	05-08	05-31	05-32

3) 03-00~03-04=[6 ,7]Forward/ Reverse JOG
When an input terminal is set to function[6]and is turned on, drive will work in jog forward mode.
When an input terminal is set to function[7]and is turned on, drive will work in jog reverse mode.
Note: If jog forward and jog reverse function is enabled at the same time, drive will enter stop mode.

4) 03-00~03-04=[8, 9]UP/DOWN
When an input terminal is set to function[8]and is turned on, frequency command is increased according to the UP/DOWN increment/decrement step set in parameter 03-06.
If the input is kept on continuously, the frequency command increases accordingly until the upper frequency limit is reached.

When an input terminal is set to function[9]and is turned on , frequency command decreases according to the UP/DOWN increment/decrement step set in parameter 03-06.
If the input is kept on continuously, the frequency command decreases accordingly and in relation to settings for parameter 03-06 and 3-07 until Zero speed is reached.
Refer to Group 3 parameter description.

5) 03-00~03-04=[10] 2nd Acc/Dec time
When an input terminal is set to function[10]and is turned on, the actual acceleration and deceleration time will be according to the time for 2nd Acceleration/Deceleration set in parameters 00-16 and 00-17.
If the input is turned off, the acceleration and deceleration times will be according to the default acceleration /deceleration 1 set in parameters 00-14 and 00-15.

6) 03-00~03-04=[11] Disable Acc/Dec function
When an input terminal is set to function[11]and is turned on, acceleration and deceleration function will be disabled and the frequency at the time is maintained. (constant speed mode)
If the input is turned off, acceleration and deceleration function is enabled again.

For an example see the following diagram.

Acceleration/Deceleration and Enable/Disable timing diagram using terminal S1 and parameter 03-00 = 11.
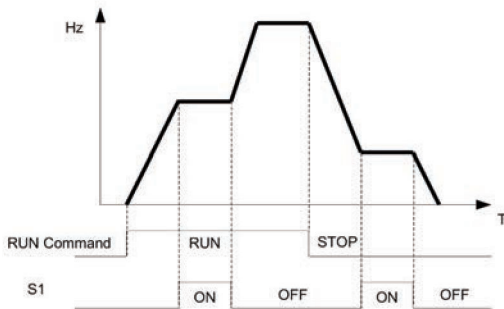
7) 03-00~03-04=[12]Main/ Alternative run source select.
When an input terminal is set to function[12]and is turned on, the run command source is according to parameter 00-03 (Alternative Run source). If the Input is off it will be according to 00-02 (Main run source).

8) 03-00~03-04=[13]Main/ Alternative Frequency source Select
When an input terminal is set to function[13]and is turned on, the frequency source is according to parameter 00-06 (Alternative Frequency source). If the Input is off it will be according to 00-05 (Main Frequency source).

9) 03-00~03-04=[14]Rapid Stop (controlled deceleration stop)
When DI is on, keypad shows "E.S", motor decelerates to stop according to the setting value of 00-17. When turning off DI (remove ES), VT1 stays in "stop" status. VT1 runs again after giving Run command.

10) 03-00~03-04=[15]Base Block (Coast to stop)
When DI is on, keypad shows "b.b", motor free runs to stop. When turning off DI (remove b.b), VT1 starts running from 5Hz below the set frequency to 5Hz above the set frequency, then setting in set frequency.

11) 03-00~03-04=[16]Disable PID Function.
When an input terminal is set to function[16]and is turned on, PID functions is disabled, if it is turned off, PID function is enabled again.

12) 03-00~03-04=[17]Reset
When a failure that can be manually reset occurs, turn on a terminal with function[17], the failure will be reset. (Same function as the Reset button on keypad).

13) 03-00~03-04=[18]Auto Run Mode
When an input terminal is set to function[18], the programmable auto-sequencer function is enabled, Refer to description of parameter Group 6.

14) 03-00~03-04=[19]Forced Frequency Run
This function enables with the corresponding of parameter 14-28 and the source of frequency command of parameter 00-05 set to the value of 5 (PID given, namely the parameter of 10-03 needs to be active).
When any one of the multi-function digital input terminal (S1~S6) is set to the value of 16 (the interdiction of PID function), pump will not depend on feedback to do any PID output adjustment; simultaneously another one is set to the value of 19 (forced frequency run) and drive will have the frequency run setting depending on the parameter of 14-28. Drive will stop output when digital input terminals (S1~S6) are removed.
This function is applied to drive output being controlled by external pressure sensor (e.g. differential pressure switch) when pressure sensor disconnects.

15) 03-00~03-04=[20]Switch to Constant Pressure 2
When using in PUMP mode (14-00=1), the tolerance range of constant pressure (14-09) will be used for walking up the drive. When digital input terminal enables, the tolerance range of constant pressure 2 (14-24) will be used.

03-06	Up/Down frequency step
Range	[0.00~5.00]Hz

Example: S1: 03-00 =[8]Up frequency command, S2: 03-01=[9]Down frequency command,
      03-06=[△]Hz
Mode1: If UP or DOWN input terminals are turned on for less than 2 seconds, for every On operation frequency changes by △ Hz.
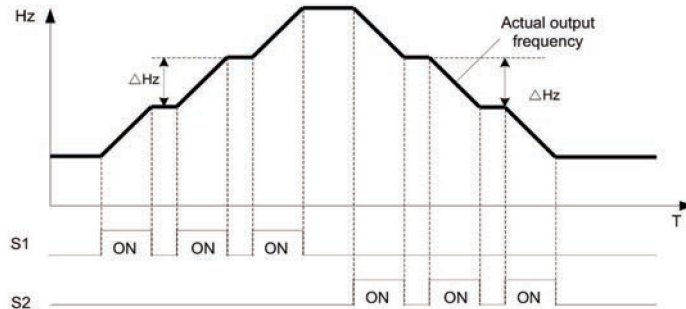
Mode 2: If UP or DOWN input terminals are turned on for more than 2 seconds, the original UP/DOWN mode is restored output frequency ramps up or down as long as the input is kept ON.
      As shown in the diagram below.
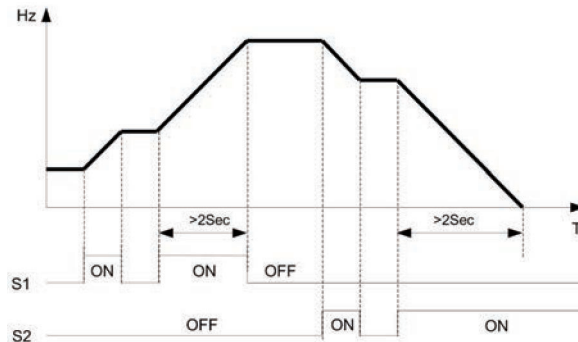
03-07	Up/Down keep Frequency status after a stop command
Range	After a stop command in Up/Down mode: [0]: The preset frequency is held as the drive stops. [1]: The preset frequency is reset to 0 Hz as the drive stops. [2]: The preset frequency is held as the drive stops, the function remains enabled.

– 03-07=0, when run signal is removed (Stop Command), the output frequency is stored in parameter 05-01. In stop mode since frequency cannot be increased or decreased from Up/Down terminals then keypad can be used to change the frequency by modifying parameter 05-01.
– 03-07=1, in Up/down frequency mode drive will ramp up from 0Hz on Run command and Ramp down to 0 Hz on stop command.
– 03-07=2, when drive stopped, Up/down key is still valid.

03-08	Multifunction terminals S1~S5 scan time
Range	[1~200] 2ms

– Multifunction input terminal On/Off periods will be scanned for the number of cycles according to the set value in parameter 03-08. If the signal status for on or off period is less than the set period it will be treated as noise.
– Scan period unit is 1ms.
– Use this parameter if unstable input signal is expected, however setting long scan time periods results in slower response times.

03-09	S1~S5 Input type selection NO and NC
Range	[xxxx0]:S1 NO [xxxx1]:S1 NC [xxx0x]:S2 NO [xxx1x]:S2 NC [xx0xx]:S3 NO [xx1xx]:S3 NC [x0xxx]:S4 NO [x1xxx]:S4 NC [0xxxx]:S5 NO [1xxxx]:S5 NC

– (NO) Normally Open, (NC) Normally Closed.
– For selecting Normally Open (NO) or Normally Closed (NC) set the relevant digit in parameter 03-09 to 0 or 1 as required.
– Set Parameter 03-09 first before you use the Parameters 00-02 / 00-03=1 to set the drive run mode to External multifunction inputs.

03-11	Multifunction Output Relay RY1 functions (terminals RB, RA)
Range	[0]:Run [1]:Fault [2]:Setting Frequency Reached---------------------------(refer to 03-14) [3]:Frequency Reached (3-13±3-14)----------------------(refer to 03-13/03-14) [4]:Output Frequency Detection 1 (> 03-13)-------------(refer to 03-13) [5]:Output Frequency Detection 2 (< 03-13)-------------(refer to 03-13) [6]:Auto-Restart [7]:Momentary AC Power Loss----------------------------(refer to 07-00) [8]:Rapid Stop (Decelerate to Stop) [9]:Base Block [10]:Motor Overload Protection (OL1) [11]:Drive Overload Protection (OL2) [12]:Reserved [13]:Output Current Reached-----------------------------(refer to 03-15/03-16) [14]:Brake Control---(refer to 03-17/03-18) [15]:PID Feedback Disconnection Detection------------(refer to 10-11/10-13) [16]:High Pressure Detection [17]:Low Pressure Detection [18]:Pressure Loss Detection
03-13	Frequency Detection Level
Range	[0.00~599.00] Hz
03-14	Frequency Detection Width
Range	[0.00~30.00] Hz

Output relay RY1. function descriptions:
1) 03-11 =[0]. RY1 will be ON with run signal.
2) 03-11 =[1]. RY1 will be ON with drive faults.
3) 03-11 =[2]. RY1 will be ON when output frequency reached setting frequency.

<div align="center">When Output Freq. = Setting Frequnecy - Frequency Detection Width (03-14).
Relay Output will be ON.</div>
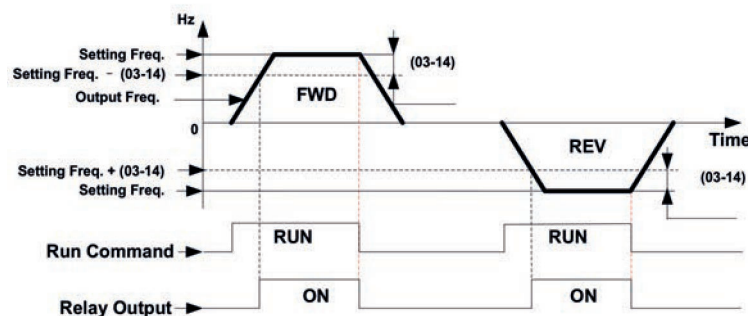
Example:
Setting Freq. =30, and Frequency Detection Width (03-14) =5, relay will be ON when output frequency reached 25Hz to 30Hz and Run Command is on (Allowable tolerance ±0.01).

4) 03-11=[3]RY1 will be ON when Setting Freq. and Output Frequency reached (03-13 ± 03-14).

When Frequency Detection Range Lower Limit <Setting Freq. <Frequency Detection Range Upper Limit
And, Frequency Detection Range Lower Limit <Output Freq. <Frequency Detection Range Upper Limit,
Relay output will be ON (Allowable tolerance ±0.01)
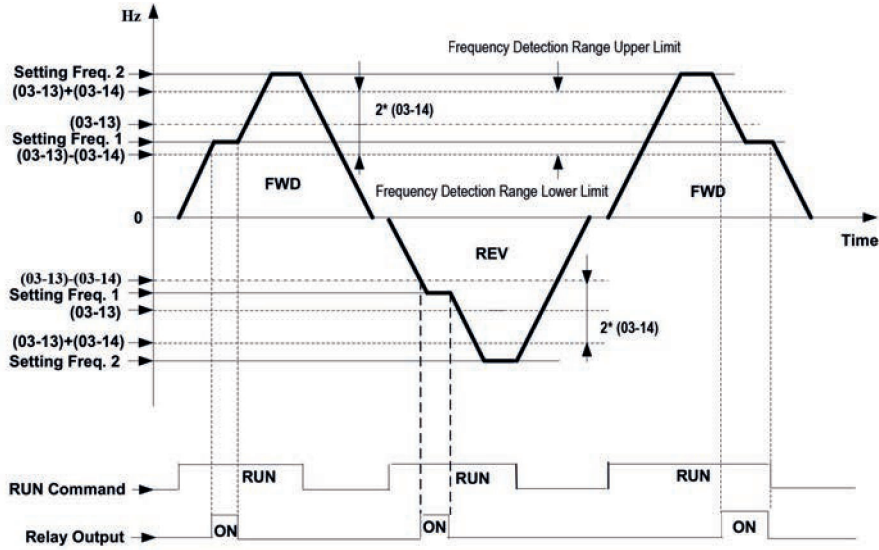
Example:
Frequency Detection Level (03-13) =30, and Frequency Detection Width (03-14) =5 cause frequency detection range upper limit = 35, and Frequency Detection Range lower limit = 25. So RY1 will be on when Setting Freq. and Output Freq. are both under these limits; on the other hand, RY1 will be off when Setting Freq. and Output Freq. are not under these limits either.

5) 03-11=[4], RY1 will be on while Output Freq. > Frequency Detection Level (03-13).

When Output Freq. > (03-13). Relay output will be ON.

03-11=[5]. RY1 will be on while Output Freq. < Frequency Detection Level (03-13).

When Output Freq. < (03-13). Relay output will be ON.
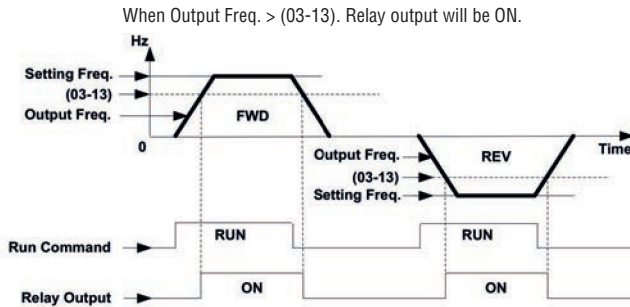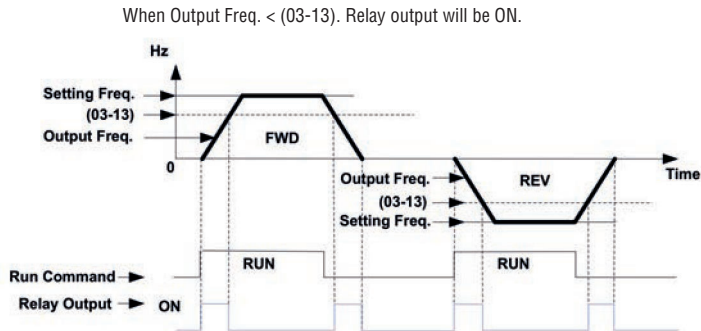
7) 03-11=[16], High Pressure Detection, please refer parameter setting of 14-12~14-14

8) 03-11=[17], Low Pressure Detection, please refer parameter setting of 14-15~14-17

9) 03-11=[18], Pressure Loss Detection, please refer parameter setting of 14-18~14-19

03-15	Output Current Detection Level
Range	[0.1~999.9] A
03-16	Output Current Detection Period
Range	[0.1~10.0]Sec

– 03-11=[13], RY1 will be on as soon as the output current value > output current detection level (03-15).
– 03-15: Setting range (0.1~15.0 Amps) as required according to the rated motor current.
– 03-16: Setting range (0.1~10.0) unit: seconds.
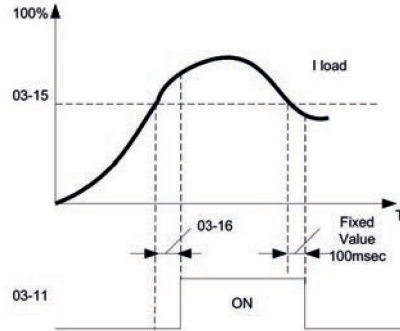
03-17	Brake Release Level
Range	[0.00~20.00] Hz
03-18	Brake Engage Level
Range	[0.00~20.00] Hz

– If 03-11 =[14]
    (a) In accelerating mode. RY1 will be ON as soon as the actual output frequency reaches the external Brake release level set in parameter 03-17.
    (b) In decelerating mode, RY1 will be OFF as soon as the actual output frequency reaches the external Brake engage level set in parameter 03-18.

Timing diagram for 03-17 < 03-18 is shown below:
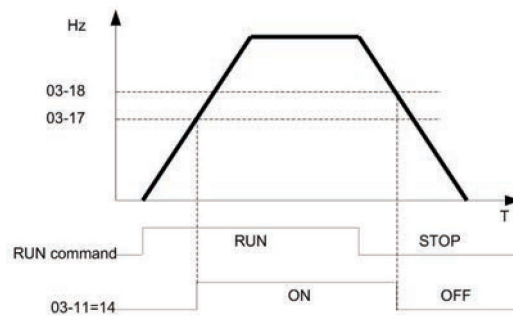
Timing diagram for 03-17 > 03-18 is shown below:
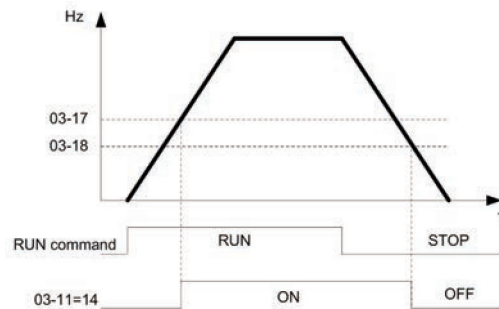
03-19	Relay Output Status type
Range	[0]:A (Normally open) [1]:B (Normally close)
03-20	Brake Transistor ON Level
Range	[240.0~400.0]VDC
03-21	Brake Transistor OFF Level
Range	[240.0~400.0]VDC

– Parameters 03-20 and 03-21 have no function on VT1 drives.

GROUP 04 - ANALOG INPUTS/ ANALOG OUTPUT FUNCTIONS

04-00	Analog Voltage and Current input selections
Range	AVI ACI [0]:0~10V 0~20mA [1]:0~10V 4~20mA [2]:2~10V 0~20mA [3]:2~10V 4~20mA

– Analog Input Scaling formulas:

AVI(0~10V), ACI(0~20mA)

$$\text{AVI(0~10V):F(Hz)} = \frac{V(v)}{10(v)} \times (00\text{-}12)$$

$$\text{ACI(0~20mA):F(Hz)} = \frac{I(mA)}{20(mA)} \times (00\text{-}12)$$

AVI(2~10V), ACI(4~20mA)

$$\text{AVI(2~10V):F(Hz)} = \frac{V\text{-}2(v)}{10\text{-}2(v)} \times (00\text{-}12)$$

$$\text{ACI(4~20mA):F(Hz)} = \frac{I\text{-}4(mA)}{20\text{-}4(mA)} \times (00\text{-}12)$$

04-01	AVI signal verification Scan Time
Range	[1~200]2ms
04-02	AVI Gain
Range	[0 ~ 1000]%
04-03	AVI Bias
Range	[0~ 100]%
04-04	AVI Bias Selection
Range	[0]: Positive [1]: Negative
04-05	AVI Slope
Range	[0]: Positive [1]: Negative
04-06	ACI signal verification Scan Time
Range	[1~200]2ms
04-07	ACIGain
Range	[0 ~ 1000]%
04-08	ACI Bias
Range	[0 ~ 100]%
04-09	ACI Bias Selection
Range	[0]: Positive [1]: Negative
04-10	ACI Slope
Range	[0]: Positive [1]: Negative

– Set 04-01 and 04-06 for Analog signal verification.
Drive reads the average values of A/D signal once per (04-01 / 04-06 x 2ms). Set scan intervals according to the application and with consideration for signal instability or interference effects on the signal by external sources. Long scan times will result in slower response time.

– AVI example (analog voltage input) by adjusting Gain, Bias and Slope parameters (04-02~04-05).
(1) Positive Bias type (04-04= 0) and effects of modifying Bias amount by parameter 04-03 and Slope type with parameter 04-05 are shown in Fig 1 and 2.

Figure 1

	04-02	04-03	04-04	04-05
A	100%	50%	0	0
B	100%	0%	0	0
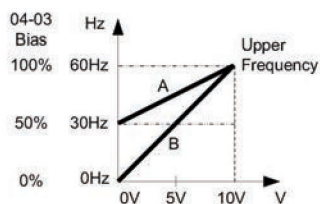
Figure 2

	04-02	04-03	04-04	04-05
C	100%	50%	0	1
D	100%	0%	0	1
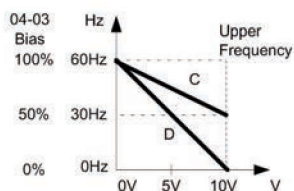
Negative Bias type and effects of modifying Bias amount by parameter 04-03 and Slope type with parameter 04-05 are shown in Fig 3 and 4.

Figure 3

	04-02	04-03	04-04	04-05
E	100%	20%	1	0
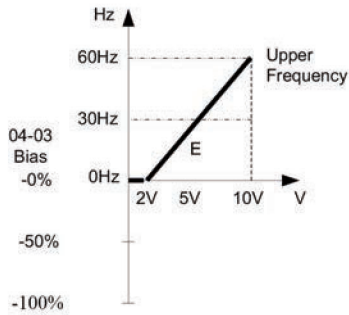
Figure 4

	04-02	04-03	04-04	04-05
F	100%	50%	1	1
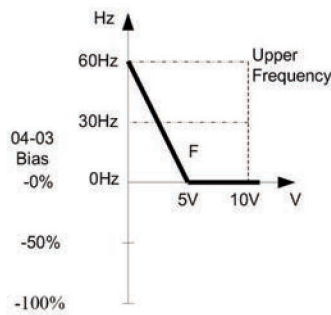
(2)   Offset bias set to 0% (04-03) and effect of modifying Analog Gain (04-02), Bias type (04-04) and slope type(04-05) are shown in shown Fig 5 and 6.

Figure 5

	04-02	04-03	04-04	04-05
A'	50%	0%	0/1	0
B'	200%	0%	0/1	0
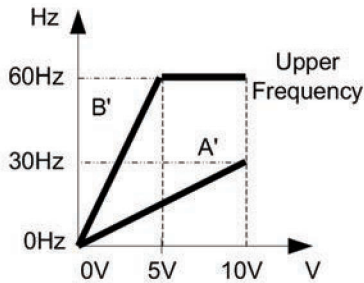
Figure 6

	04-02	04-03	04-04	04-05
C'	50%	0%	0/1	1
D'	200%	0%	0/1	1
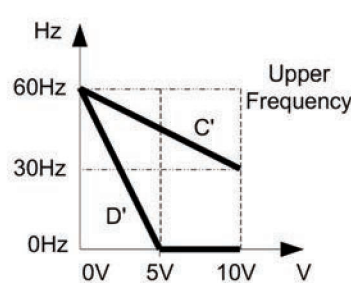
(3)   Various other examples of analog input scaling and modification are shown in following figures 7,8,9 and 10.

Figure 7

	04-02	04-03	04-04	04-05
a	50%	50%	0	0
b	200%	50%	0	0
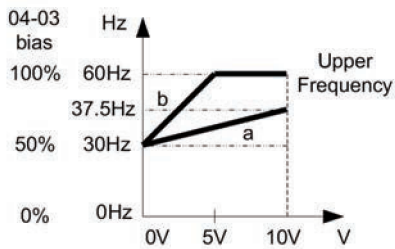
Figure 8

	04-02	04-03	04-04	04-05
c	50%	50%	0	1
d	200%	50%	0	1
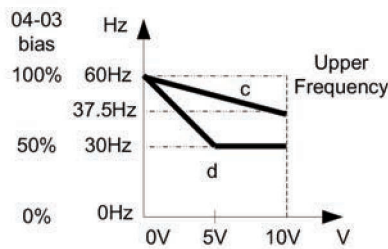
Figure 9

	04-02	04-03	04-04	04-05
e	50%	20%	1	0
f	200%	20%	1	0
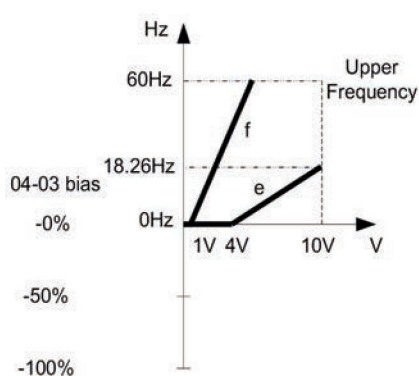
Figure 10

	04-02	04-03	04-04	04-05
g	50%	50%	1	1
h	200%	0%	0	1
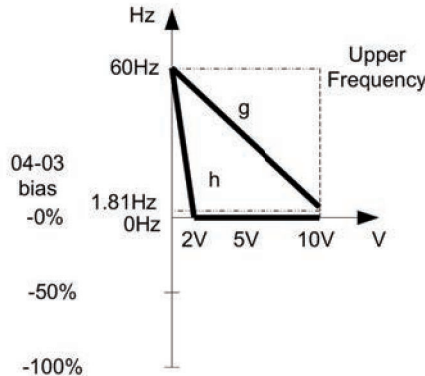
04-11	Analog Output (AO) function selection.
Range	[0]:Output frequency [1]:Frequency Setting [2]:Output voltage [3]:DC Bus Voltage [4]:Output current

Example: Set 04-11 required according to the following table.
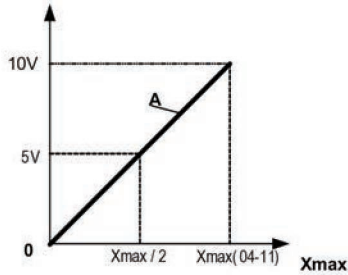
04-11	A	Xmax
【0】	Output frequency	upper frequency limit
【1】	Frequency Setting	upper frequency limit
【2】	Output voltage	Motor Rated Voltage
【3】	DC Bus Voltage	0~400V
【4】	Output current	2 times rated current of drive

04-12	AO Gain
Range	[0 ~ 1000]%
04-13	AO Bias
Range	[0 ~ 100]%
04-14	AO Bias Selection
Range	[0]: Positive [1]: Negative
04-15	AO Slope
Range	[0]: Positive [1]: Negative

– Select the Analog output type for the multifunction analog output on terminal (TM2) as required by parameter 04-11. Output format is 0-10VDC.The output voltage level can be scaled and modified by parameters 04-12 to 04-15 if necessary.
– The modification format will be same as the examples shown previously for Analog Voltage Input (AVI) parameters 4-02 to 4-05.

Note: the max output voltage is 10V due to the hardware of the circuit.
        Use external devices that require a maximum of 10VDC signal.

04-16	Potentiometer Gain on Keypad
Range	[0 ~ 1000]%
04-17	Potentiometer Bias on Keypad
Range	[0 ~ 100]%
04-18	Potentiometer Bias Selection on Keypad
Range	[0]: Positive [1]: Negative
04-19	Potentiometer Slope on Keypad
Range	[0]: Positive [1]: Negative

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GROUP 05 - PRESET FREQUENCIES SELECTION

05-00	Preset Speed Control mode Selection
Range	[0]:Common Acceleration / Deceleration. [1]: Individual Acceleration / Deceleration for each preset speed 0-7.
05-01	Preset Speed 0 (Keypad Frequency)
05-02	Preset Speed 1
05-03	Preset Speed 2
05-04	Preset Speed 3
05-05	Preset Speed 4
05-06	Preset Speed 5
05-07	Preset Speed 6
05-08	Preset Speed 7
Range	[0.00 ~ 599.00] Hz
05-17	Preset Speed 0 Acceleration time
05-18	Preset Speed 0 Deceleration time
05-19	Preset Speed 1 Acceleration time
05-20	Preset Speed 1 Deceleration time
05-21	Preset Speed 2 Acceleration time
05-22	Preset Speed 2 Deceleration time
05-23	Preset Speed 3 Acceleration time
05-24	Preset Speed 3 Deceleration time
05-25	Preset Speed 4 Acceleration time
05-26	Preset Speed 4 Deceleration time
05-27	Preset Speed 5 Acceleration time
05-28	Preset Speed 5 Deceleration time
05-29	Preset Speed 6 Acceleration time
05-30	Preset Speed 6 Deceleration time
05-31	Preset Speed 7 Acceleration time
05-32	Preset Speed 7 Deceleration time
Range	[0.1 ~ 3600.0]s

– When 05-00 =[0]Acceleration /Deceleration 1 or 2 set by parameters 00-14 / 00-15 or 00-16 / 00-17 apply to all speeds.
– When 05-00 =[1]Individual Acceleration /Deceleration apply to each preset speed 0-7. See parameters 05-17 to 05-32.
– Formula for calculating acceleration and deceleration time:

V/F mode:

$$\text{Actual Acc time} = \frac{\text{Time of Accel1 or 2 x Preset Frequency}}{\text{V/F Max Frequency}}$$

$$\text{Actual Dec time} = \frac{\text{Time of Accel1 or 2 x Preset Frequency}}{\text{V/F Max Frequency}}$$

SLV mode:

$$\text{Actual Acc time} = \frac{\text{Time of Accel1 or 2 x Preset Frequency}}{\text{Motor rated output frequency}}$$

$$\text{Actual Dec time} = \frac{\text{Time of Accel1 or 2 x Preset Frequency}}{\text{Motor rated output frequency}}$$

– V/F Maximum output frequency=parameter 01-02 when programmable V/F is selected by 01-00=[7], Motor rated output frequency is set by parameter 02-06.
– V/F Maximum output frequency = 50.00 hz or 60.00 hz when preset V/F patterns are selected. 01-00≠[7].

Bellowing examples is in V/F mode:

Exaxmple: 01-00≠7, 01-02=50Hz, 05-20=10Hz (preset speed1)
        05-19=5s (Accel time), 05-20=20s (Decel time)

$$\text{Preset speed 1 Actual Accel time} = \frac{(05\text{-}19)\text{x}10(\text{Hz})}{01\text{-}02} = 1(s)$$

$$\text{Preset speed 1 Actual Deccel time} = \frac{(05\text{-}20)\text{x}10(\text{Hz})}{01\text{-}02} = 4(s)$$

– Multi speed run/stop cycles with Individual acceleration/deceleration time. 05-00=[1]
– Two modes are shown below:
  • Mode 1 = On/Off run command
  • Mode 2= Continuous run command

Mode 1 Example 00-02=[1](External Run/Stop Control).
00-04=[1](Operation Mode： Run/stop-forward/reverse).
S1: 03-00=[0](RUN/STOP);
S2: 03-01=[1](Forward/Reverse);
S3: 03-02=[2](Preset speed 1);
S4: 03-03=[3](Preset speed 2);
S5: 03-04=[4](Preset speed 4);
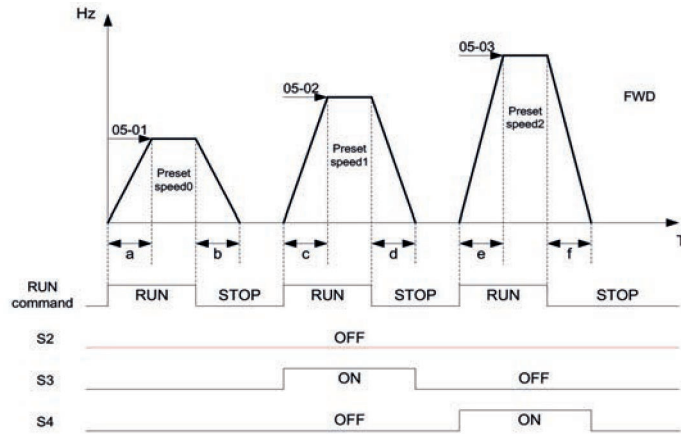
When the run command is On/Off, acceleration and deceleration times for each cycle can be calculated as below: time unit is in seconds.

$$a= \frac{(05-17)\times(05-01)}{01-02}, b = \frac{(05-18)\times(05-01)}{01-02}, c= \frac{(05-19)\times(05-02)}{01-02}, d = \frac{(05-20)\times(05-02)}{01-02} \cdots\cdots$$

Mode 2 Example. Continuous run command.
– Set S1 for Continuous Run
– Set S2 For Forward /Revise direction selection
– Set multi function terminals S3,S4 and S5 for setting three different preset speeds.
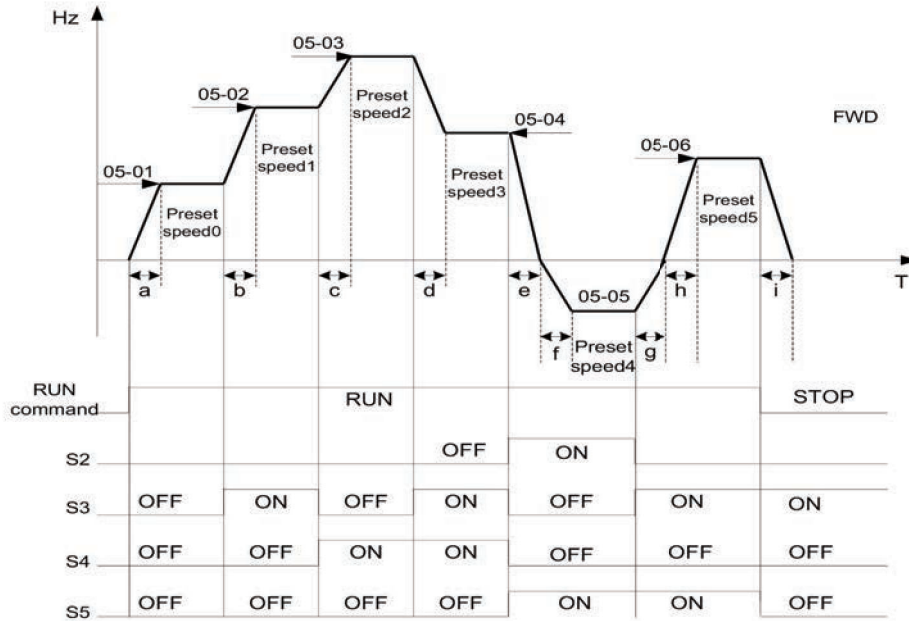
When the run command is continuous, acceleration and deceleration times for each segment can be calculated as below:

$$Ex : a = \frac{(05-17)x(05-01)}{01-02} , b = \frac{(05-19)x[(05-02)-(05-01)]}{01-02}$$

$$C = \frac{(05-21)x[(05-03)-(05-02)]}{01-02} , d = \frac{(05-24)x[(05-03)-(05-04)]}{01-02}$$

$$e = \frac{(05-26)x(05-05)}{01-02} , f = \frac{(05-28)x(05-05)}{01-02} , g = \frac{(05-28)x(05-05)}{01-02}$$

$$h = \frac{(05-29)x(05-05)}{01-02} , i = \frac{(05-28)x(05-05)}{01-02} \ldots..Unit(sec)$$

GROUP 06 - AUTO RUN (SEQUENCER) FUNCTION

06-00	Auto Run (sequencer) mode selection
Range	[0]:Disabled [1]:Single cycle, continues to run from the unfinished step if restarted. [2]:Periodic cycle, continues to run from the unfinished step if restarted. [3]:Single cycle, then holds the speed of final step to run. Continues to run from the unfinished step if restarted. [4]:Single cycle, starts a new cycle if restarted. [5]:Periodic cycle, starts a new cycle if restarted. [6]:Single cycle, then hold the speed of final step to run, starts a new cycle if restarted.

Frequency of the step 0 is set by parameter 05-01 keypad Frequency.	
06-01	Auto Run Mode Frequency Command 1
06-02	Auto Run Mode Frequency Command 2
06-03	Auto Run Mode Frequency Command 3
06-04	Auto Run Mode Frequency Command 4
06-05	Auto Run Mode Frequency Command 5
06-06	Auto Run Mode Frequency Command 6
06-07	Auto Run Mode Frequency Command 7
Range	[0.00 ~ 599.00]Hz

06-16	Auto Run Mode Running Time Setting 0
06-17	Auto Run Mode Running Time Setting 1
06-18	Auto Run Mode Running Time Setting 2
06-19	Auto Run Mode Running Time Setting 3
06-20	Auto Run Mode Running Time Setting 4
06-21	Auto Run Mode Running Time Setting 5
06-22	Auto Run Mode Running Time Setting 6
06-23	Auto Run Mode Running Time Setting 7
Range	[0.00 ~ 3600.0]Sec

06-32	Auto Run Mode Running Direction 0
06-33	Auto Run Mode Running Direction 1
06-34	Auto Run Mode Running Direction 2
06-35	Auto Run Mode Running Direction 3
06-36	Auto Run Mode Running Direction 4
06-37	Auto Run Mode Running Direction 5
06-38	Auto Run Mode Running Direction 6
06-39	Auto Run Mode Running Direction 7
Range	[0]: STOP [1]: Forward [2]: Reverse

– Auto Run sequencer mode has to be enabled by using one of the multifunctional inputs S1 to S5 and setting the relevant parameter 03-00 to 03-04 to selection[18].
– Various Auto Run (sequencer) modes can be selected by parameter (06-00) as listed above.
– 7 Auto Run (sequencer) modes can be selected by parameters (06-01~06-39)
– Auto Run frequency commands1 to 7 are set with Parameters (06-01~06-07),

– Sequence run times are set with parameters (06-17~ 06-23)
– FWD/REV Direction for each sequence can be set with parameters (06-33 ~ 06-39).
– Auto sequence 0, frequency is set from keypad by parameter 05-01, sequence run time and direction are set by parameters 06-16 and 06-32.

Auto RUN (Auto Sequencer) examples are shown in the following pages.

Example 1. Single Cycle (06-00=1,4)
The drive will run for a single full cycle based on the specified number of sequences, then it will stop. In this example 4 sequences are set, three in forward direction and one in Reverse.

Auto Run Mode	06-00=1 or 4
Frequency	05-01=15Hz, 06-01=30Hz, 06-02=50Hz, 06-03=20Hz
Sequence Run Time	06-16=20s, 06-17=25s, 06-18=30s, 06-19=40s
Direction	06-32=1(FWD), 06-33=1(FWD), 06-34=1(FWD), 06-35=2(REV)
Unused Sequence Parameters	06-04~06-07=0Hz, 06-20~06-23=0s, 06-36~06-39=0
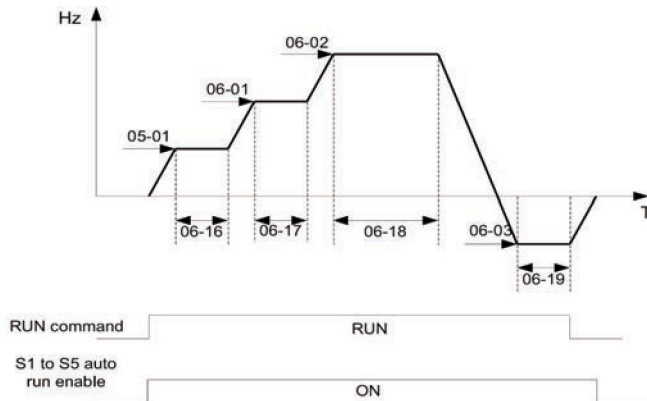
Example 2. Periodic cycle Run.
Mode: 06-00=2 or 5
The drive will repeat the same cycle periodically.
All other Parameters are set same as Example 1. shown above.
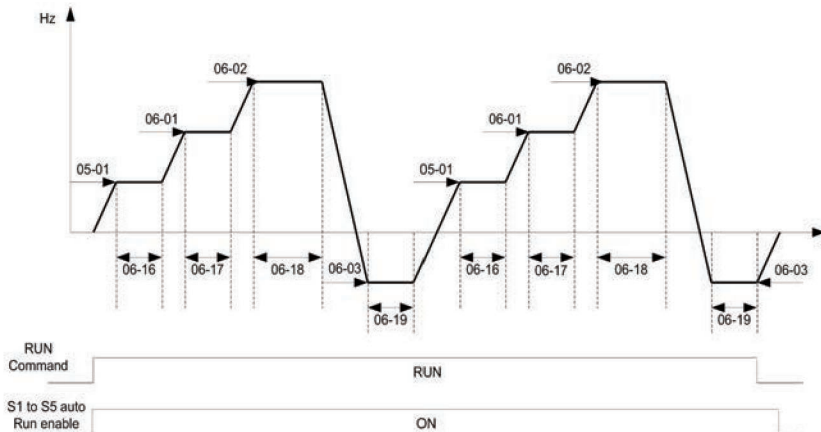
Example 3. Auto Run Mode for Single Cycle 06-00=3 or 6
The speed of final step will be held to run.

Auto Run Mode	06-00=3 or 6
Frequency	05-01=15Hz, 06-01=30Hz, 06-02=50Hz, 06-07=20Hz
Sequence Run Time	06-16=20s, 06-17=25s, 06-18=30s, 06-23=40s
Direction	06-32=1(FWD), 06-33=1, 06-34=1, 06-39=1
Unused Sequence Parameters	06-03~06-06=0Hz, 06-19~06-22=0s, 06-35~06-38=0
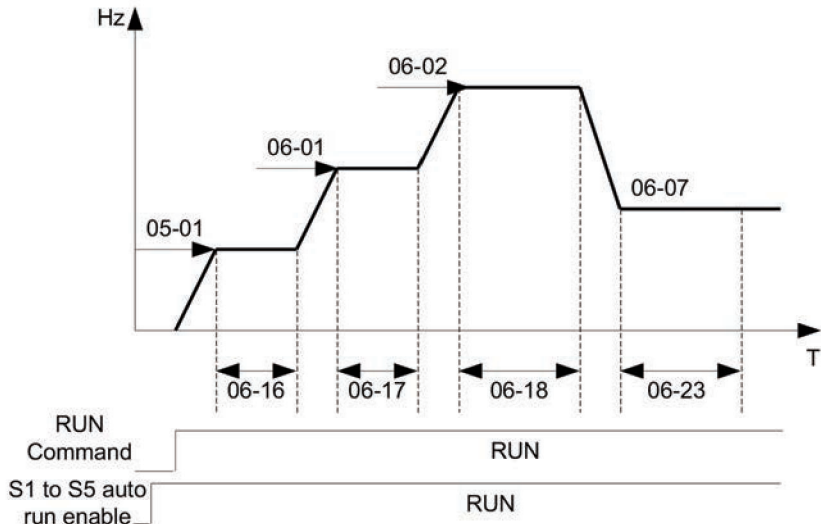
Example 4 and 5 .

Auto Run Mode 06-00=1~3, after a restart continues to run from the unfinished step.

Auto Run Mode 06-00=4~6, after a restart, it will begin a new cycle.
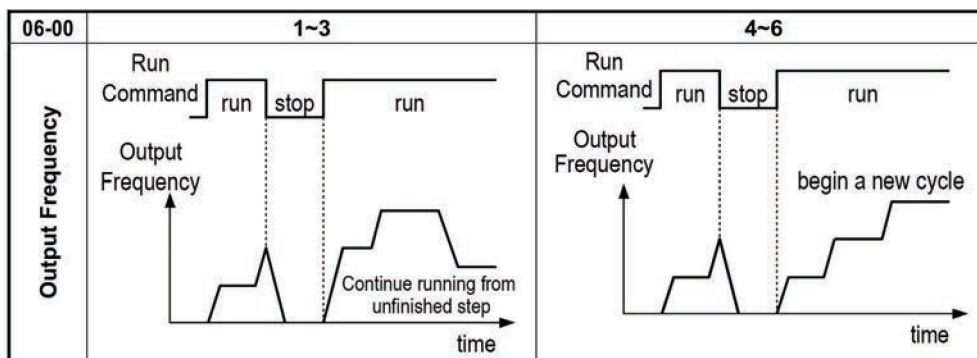
– ACC/DEC time in Auto run mode will be according to the setting of 00-14 / 00-15 or 00-16 / 00-17.
– For Auto sequence 0. The run frequency will be according to keypad frequency set by parameter 05-01. Parameters 06-16 and 06-32 are used to set the sequence Run time and Run direction.

GROUP 07 - START/STOP COMMAND SETUP

07-00	Momentary power loss and restart
Range	[0]:Momentary Power Loss and Restart disable [1]:Momentary power loss and restart enable

– If the input power supply due to sudden increase in supply demand by other equipment results in voltage drops below the under voltage level, the drive will stop its output at once.
– When 07-00=0, on power loss, the drive will not start.
– When 07-00=1, after a momentary power loss, drive will restart with the same frequency before power loss, and there is no limitation on number of restarts.
– On power loss, as long as the drive CPU power is not completely lost, the momentary power loss restart will be effective, restart will be according to setting of parameters 00-02 and 07-04 and status of External run switch.

Caution:

After any power loss if the Run mode is set to External by parameter 00-02=1 and if Direct start on power up is also selected by parameter 07-04=0, please note that the drive will run on resumption of power.

To ensure safety of operators and to avoid any damages to the machinery, all necessary safety measure must be considered, including disconnection of power to the drive.

07-01	Auto Restart Delay Time
Range	[0.0~6000.0]Sec
07-02	Number of Auto Restart Attempts
Range	[0~10]

– 07-02=0 : The drive will not auto restart after trips due to fault.
– 07-02>0, 07-01=0, after a trip due to fault the drive will run with the same frequency before power loss, and restarts after an internal delay of 0.5 seconds.
– 07-02>0, 07-01>0, after a fault trip the drive will run with the same frequency before power loss, and restart with a delay according the preset in parameter 07-01.
– Note: Auto restart after a fault will not function while DC injection braking or decelerating to stop.

07-03	Reset Mode Setting
Range	[0]:Enable Reset Only when Run Command is Off [1]:Enable Reset when Run Command is On or Off

– 07-03=0 Once the drive is detected a fault, please turn Run switch Off and then On again to perform reset, otherwise restarting will not be possible.

07-04	Direct Running on Power Up
Range	[0]:Enable Direct running after power up [1]:Disable Direct running after power up
07-05	Delay-ON Timer
Range	[1.0~300.0]Sec

– When direct run on power up is selected by 07-04=0 and the drive is set to external run by (00-02 / 00-03=1), if the run switch is ON as power is applied, the drive will auto start.
  It is recommend that the power is turned off and the run switch is also off to avoid possibility of injury to operators and damage to machines as the power is reapplied.
Note: If this mode is required all safety measures must be considered including warning labels.
– When direct run on power up is disabled by 07-04=1and if the drive is set to external run by (00-02 / 00-03=1), if the run switch is ON as power is applied, the drive will not auto start and the display will flash with STP1. It will be necessary to turn OFF the run switch and then ON again to start normally.

07-06	DC Injection Brake Start Frequency (Hz)
Range	[0.10 ~ 10.00]Hz

– When DC Injection braking is active DC voltage is applied to the motor, increasing the braking current and resulting in an increase in the strength of the magnetic field trying to lock the motor shaft.
– To enable DC injection braking during a stop operation set the DC injection braking current (07-07) and the DC injection braking time at stop (07-08) to a value greater than 0.
Notes:
- Increasing the DC braking time (07-08) can reduce the motor stop time
- Increasing the DC braking current (07-07) can reduce the motor stop time.
- During stop operation: If the DC braking start frequency < minimum output frequency (01-08), DC braking is activated when the output frequency reaches the minimum output frequency level.

07-07	DC Injection Brake Level (%)
Range	[0~ 20]% Based on the 20% of maximum output voltage

– Please refer the formula below.
  In V/F mode, the value is equal to 0~20% of max output voltage (01-01)
  In SLV mode, the value is equal to 0~20% of max output voltage (02-04).

07-08	DC Injection Brake Time (Sec)
Range	[0.0 ~ 25.5]Sec

– 07-08 / 07-06 set the DC injection brake duration and the brake start frequency as shown below.
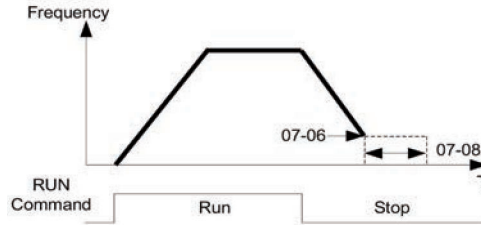
07-09	Stopping Method
Range	[0]:Deceleration to stop. [1]:Coast to stop.

– 07-09 = [0]: after receiving stop command, the motor will decelerate to stop according to setting of 00-15, deceleration time 1.
– 07-09 = [1]: after receiving stop command, the motor will free-run (coast) to stop.

07-10	DC Braking Level at Start
Range	[0~100]%

In V/F mode, the value is equal to 0~20% of max output voltage (01-01)
In SLV mode, the value is equal to 0~20% of max output voltage (02-04).

07-11	DC Braking Time at Start
Range	[0~25.5]s

– When DC braking time reached, ouptut frequency will be based on V/F curve.
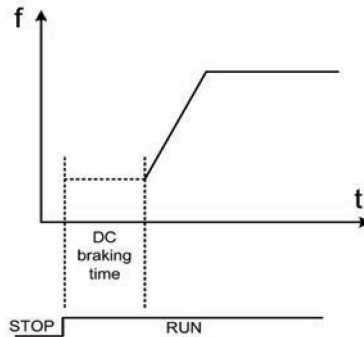
07-12	Run Command Retention
Range	0: Run command retention during power loss 1: Run command not retained during power loss

– When 07-12=0, run command during drive run is retained before power off. After power ceclying, drive start running automatically according to the frequency command which is retained before power off, no need to press "RUN" key again.

08-00	Trip Prevention Selection
Range	[xxxx0]:Enable Trip Prevention during Acceleration [xxxx1]:Disable Trip Prevention during Acceleration [xxx0x]:Enable Trip Prevention during Deceleration [xxx1x]:Disable Trip Prevention during Deceleration [xx0xx]:Enable Trip Prevention in Run Mode [xx1xx]:Disable Trip Prevention in Run Mode [x0xxx]:Enable over voltage Prevention in Run Mode [x1xxx]:Disable over voltage Prevention in Run Mode

08-01	Trip Prevention Level during Acceleration
Range	[50 ~ 200]%

– Trip prevention adjustment level during acceleration to prevent over current (OC-A) trips.
– If trip prevention during acceleration is enabled and an over current occurs due to the load, then the acceleration is interrupted until the over current level is dropped below the setting in 08-01 then the acceleration is resumed.

08-02	Trip Prevention Level during Deceleration
Range	[50 ~ 200]%

– Trip prevention adjustment level during deceleration to prevent over Voltage (OV-C) trips.
– If trip prevention during deceleration is enabled and an over voltage occurs during stopping due to the load, then the deceleration is interrupted until the over voltage level is dropped below the setting in 08-02 then the deceleration is resumed.

08-03	Trip Prevention Level during continuous Run Mode
Range	[50 ~ 200]%

– Trip prevention adjustment level during continuous Run to prevent over current (OC-C) trips.
– If trip prevention during continuous Run is enabled and an over current occurs due the load such as a sudden transient load, then the output frequency is reduced by decelerating to a lower speed until the over current level is dropped below the preset in 08-03, then the output frequency accelerates back to the normal running frequency.

08-04	Over voltage Prevention Level during Run Mode
Range	[350~390]VDC

– Over voltage prevention level can be set by parameter 08-04 when necessary.
  When the DC bus voltage is higher than 08-04, drive will keep running, the output frequency will be decreased once the DC bus voltage reduced. It's the over voltage prevention function, drive will not appear any error message.
  (If the DC bus voltage higher than OV protection level, drive will appear "OV" message).

08-05	Electronic Motor Overload Protection Operation Mode (OL1)
Range	xxxx0: Disable Electronic Motor Overload Protection xxxx1: Enable Electronic Motor Overload Protection xxx0x: Motor Overload Cold Start xxx1x: Motor Overload Hot Start xx0xx: Standard Motor xx1xx: Invertor Duty Motor (Force Vent)

Electronic Motor Overload Protection OL1 (08-05)
– When more than one motor is connected to the drive set the Overload protection level parameter 02-01 to the total current of all motors and provide external overload relay protection for each motor.
– When using normal power supply switch, motor overload protection 08-05=xxx1x (hot start protection curve). Because whenever power is turned off, value of heat will return to default setting.
– 08-05 = xx0xx. (Standard motor Overload protection). For standard motors with integrated cooling fan when running at low speeds the heat dissipation is not very effective, consider Force vent cooling then set parameter 08-05=xx1xx for the correct overload protection.
– 08-05 = xxxx1: Enable electronic overload protection for motor according to setting in parameter 02-01 (motor rated current).
– Refer to the curve below as an example for overload protection for a standard motor. (08-05=xx0xx).
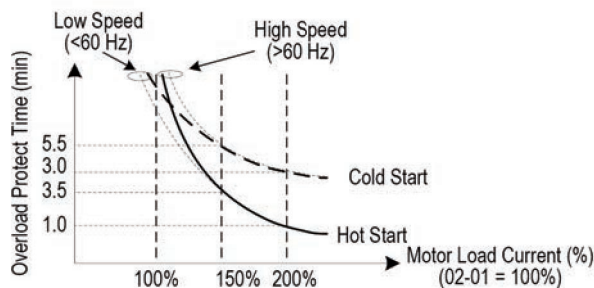
08-06	Operation After Overload Protection is Activated
Range	[0]:Coast-to-Stop After Overload Protection is Activated [1]:Drive Will Not Trip when Overload Protection is Activated (OL1)

– 08-06=0 : On overload condition the drive coast to stop as the thermal relay detects the overload and the display will flash OL1. To reset Press the 'Reset' key or use an external reset to continue to run.
– 08-06=1 : On overload condition the drive continues to run, display flash with OL1, until the current falls below the overload level.

08-07	OH overheat Protection
Range	[0]:Auto (depends on heat sink temperature) [1]:Operate while in RUN mode [2]:Always Run [3]:Disabled

– 08-07=0 : Cooling fan runs as the drive detects temperature rise. Available only on VT1 size 2.
– 08-07=1 : Cooling fan runs while the drive is running. Available only on VT1 size 2.
– 08-07=2 : Cooling fan runs continuously. Available only on VT1 size 2.
– 08-07=3 : Cooling fan is Disabled. Available only on VT1 size 2.

08-08	AVR function
Range	[0]:AVR function enable [1]:AVR function disable [2]:AVR function disable for stop [3]:AVR function disable for deceleration [4]:AVR function disabled for stop and deceleration from one speed to another speed. [5]:when VDC>(360V/740V), AVR function is disabled for stop and deceleration

– Automatic voltage regulator function provides a level of output voltage stability when there is input voltage instability. So when 08-08=0, Input voltage fluctuations will not effect the output voltage.
– 08-08=1, Input voltage fluctuations will cause fluctuations on output voltage.
– 08-08=2, AVR is disabled during stopping to avoid an increase in stopping time.
– 08-08=3, AVR is disabled only during deceleration from one speed to another speed. This will avoid longer than required deceleration time.
– 08-08=4, AVR function disabled for stop and deceleration from one speed to another speed.
– 08-08=5, When VDC>360 AVR function is disabled for stop and deceleration.

08-09	Input phase loss protection
Range	[0]:Disabled [1]:Enabled

– When 08-09=1 : On phase loss warring message PF is displayed.

08-10	PTC Motor Overheat Function
Range	[0]: Disable [1]: Decelerate to stop [2]: Coast to stop [3]: Continue running, when warning level is reached. Coast to stop, when protection level is reached.
08-11	PTC Signal Smoothing Time
Range	[0.00 ~ 10.00]Sec
08-12	PTC Detection Time Delay
Range	[1 ~ 300]Sec
08-13	PTC Protection Level
Range	[0.1 ~ 10.0]V
08-14	PTC Detection Level Reset
Range	[0.1 ~ 10.0]V
08-15	PTC Warning Level
Range	[0.1 ~ 10.0]V

– Selection for motor overheat protection:
PTC (Positive temperature coefficient) sensors are used in motor windings to provide additional motor protection from overheat.
PTC thermistor can be connected to terminals AVI and AGND.
A voltage divider resistor R is necessary to be connected as shown below in figure (b).

1) If 08-10 =1 or 2 (Decelerate or Coast to stop on over temperature detection). When over temperature is detected by signal at terminal AVI increasing above the warning detection limit set in parameter 08-15 and the delay time set in parameter 08-12 is reached, the display will show "OH4" (motor overheat detection), then output frequency will decelerate or coast to stop according to the selection 1 or 2.
2) If 08-10 = 3 Continue running when warning level is reached (08-15). Coast to stop when protection level is reached (08-13).When over temperature is detected by signal at terminal AVI increasing above the warning detection limit set in parameter 08-15, then the display will show "OH3" (motor overheat warning level) and the motor will continue to run.
If temperature detected increases above the set limit in parameter 08-13 and for the delay time set in parameter 08-12 then the display will show "OH4" (motor overheat detection), and the motor will coast to stop.
3) Motor overheat detection "OH4" can be reset when the temperature detection level at terminal AVI becomes lower than the set level in parameter 08-14.
4) External PTC thermistor characteristics
Diagram in figure (a) shows two curves for Class F and Class H temperatures.
Tr = 150°C in class F,
Tr = 180°C in class H.
Tr-5°C: RPTC ≤ 550Ω, put value of RPTC into formula to calculate the value of V to be set in parameter 08-14.
Tr + 5°C: RPTC≥1330Ω, put value of RPTC into formula to calculate, the value of V to be set in parameter 08-13.

5) For different specifications of PTC thermistor, set the values for parameters 08-13 and 08-14 by calculating from the formula shown below.

$$V = \frac{1}{2} \times 10 \times \frac{R_{PTC} // Rin}{R + (R_{PTC} // Rin)}$$
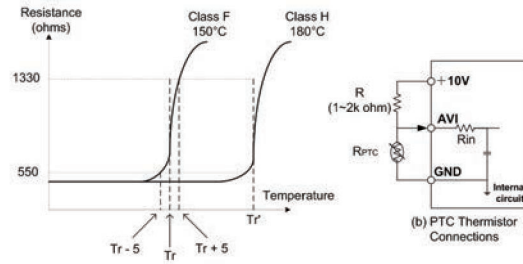
(a) PTC Thermistor Characteristics

08-16	Fan Control Temperature Level
Range	[10.0~50.0]°C

– When 08-07=0 (heat sink temperature detection control for cooling fan). Fan will run when temperature of heat sink is higher than 08-16. When temperature of heat sink decreases below setting value of 08-16 minus 20°C, fan will stop. Available only on VT1 size 2.

08-17	Over current protection level
Range	[0.0~60.0] A
08-18	Over current protection time
Range	[0.0~1500.0] s

– When the output current exceeds the setting value of 08-17 and then keep running exceeds the setting value of 08-18, drive will show "OL3" alarm and then stop running.
  (When the output current lower than the setting value of 08-17, 08-18 will be reset, over current protection function will be closed when 08-17 set to "0".)
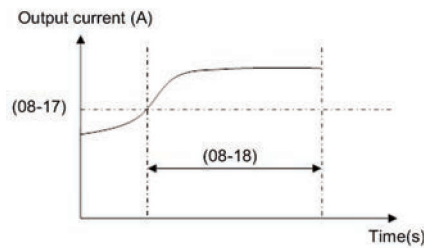
08-19	Motor Overload (OL1) Protection Level
Range	0: Motor Overload Protection Level 0 1: Motor Overload Protection Level 1 2: Motor Overload Protection Level 2

Motor overload protection level (08-05)
– Set motor overload protection level according to current motor nameplate.
– Turn off the motor overload protection when using two or more motors connected to the drive (set 08-05 = xxx0b), and provide external overload protection for each motor (e.g. thermal overload switch).
– When 08-05=xx1xb (Hot start), the value of hot start will be reset once power-off.
– The motors without cooling fan (general standard motor), heat dissipation of lower speed is low, 08-05 can be set to x0xxb.
– The motors with cooling fan (special motor or V/F motor), heat dissipation is not related with output speed, 08-05 can be set to x1xxb.
– To use the built-in motor overload protection function parameter 02-01 (motor rated current) has to match the motor rated current on the motor nameplate.
– Refer to the following examples (08-05=x0xxb) and the overload curves will be based on parameter setting of 08-19.

When 08-19=0:

Low Speed (0 Hz)
Overload Protect Time (min)
7.9
2.9
1.5
Hot Start
100% 150% 200%
Motor Load Current (%)
(02-01 = 100%)

Low Speed (0 Hz)
Overload Protect Time (min)
12.4
4.5
2.4
Cold Start
100% 150% 200%
Motor Load Current (%)
(02-01 = 100%)

High Speed (60Hz)
Overload Protect Time (min)
28.8 ← start activacted point
3.9
1.7
Hot Start
116% 150% 200%
Motor Load Current (%)
(02-01 = 100%)

High Speed (60Hz)
Overload Protect Time (min)
45.2 ← start activacted point
6.1
2.7
Cold Start
116% 150% 200%
Motor Load Current (%)
(02-01 = 100%)

When 08-19=1:

Low Speed (1.5 Hz)
Overload Protect Time (min)
8.9
3.2
1.7
Hot Start
100% 150% 200%
Motor Load Current (%)
(02-01 = 100%)

Low Speed (1.5 Hz)
Overload Protect Time (min)
14.9
5.3
2.8
Cold Start
100% 150% 200%
Motor Load Current (%)
(02-01 = 100%)

High Speed (60Hz)
Overload Protect Time (min)
30.9 ← start activacted point
4.2
1.9
Hot Start
116% 150% 200%
Motor Load Current (%)
(02-01 = 100%)

High Speed (60Hz)
Overload Protect Time (min)
51.6 ← start activacted point
7.1
3.2
Cold Start
116% 150% 200%
Motor Load Current (%)
(02-01 = 100%)

When 08-19=2:

Low Speed (1.5 Hz)
Overload Protect Time (min)
9.9
3.5
1.9
Hot Start
100% 150% 200%
Motor Load Current (%)
(02-01 = 100%)

Low Speed (1.5 Hz)
Overload Protect Time (min)
17.8
6.3
3.4
Cold Start
100% 150% 200%
Motor Load Current (%)
(02-01 = 100%)

High Speed (60Hz)
Overload Protect Time (min)
34.4 ← start activacted point
4.7
2.1
Hot Start
116% 150% 200%
Motor Load Current (%)
(02-01 = 100%)

High Speed (60Hz)
Overload Protect Time (min)
61.9 ← start activacted point
8.5
3.8
Cold Start
116% 150% 200%
Motor Load Current (%)
(02-01 = 100%)

Motor overload curves (for general motor)

GROUP 09 - COMMUNICATION FUNCTION SETUP

09-00	Assigned communication station number
Range	[1 ~ 32]

– 09-00 sets the communication station number when there are more than one unit on the communication network. Up to 32 slave units can be controlled from one master controller such as a PLC.

09-01	Communication Mode Select
Range	[0]:RTU [1]:ASCII [2]:BACnet
09-02	Baud Rate Setting (bps)
Range	[0]:4800 [1]:9600 [2]:19200 [3]:38400 [4]:Remote Keypad is enabled

– When 09-02=4, if remote keypad VT1X C02 is not connected, drive will show "OPErr" message.
– When 09-02 is changed, please re-connect the input power again, the function keys of drive will malfunction (except "Reset" key).
– If "OPErr" occurred, please press "Reset" key of drive to clean the error code and then set 09-02 to 0~3.

09-03	Stop Bit Selection
Range	[0]:1 stop bit [1]:2 stop bit
09-04	Parity Selection
Range	[0]:no parity [1]:even parity [2]:odd parity
09-05	Data Format Selection
Range	[0]:8 bit data [1]:7 bit data
09-06	Communication time-out detection time
Range	[0.0~25.5]Sec

– 09-06 is against communication test messages. When a test message is not responded within the time specified by 09-06, drive will be stopped according to the setting of 09-07, and then appear "COT" on keypad display. Once the 09-06=0, drive will not appear "time-out".

09-07	Communication time-out operation selection
Range	[0]:Stop in deceleration time 1 and show COT after communication timeout [1]:Stop in free run mode and show COT after communication timeout [2]:Stop in deceleration time 2 and show COT after communication timeout [3]:Keep running and show COT after communication timeout

– Time-out detection time: 00.0~25.5 seconds; setting 00.0 seconds: disables time-out function.

09-08	Err6 fault tolerance times
Range	[0~20]

– 09-08 is against real communication messages. When a real message does not pass error check, that message is resent. The number of errors for the same message are counted and accumulated and if it reaches the setting of 09-08, VT1 will show Err6 and stop according to the setting of 07-09.

09-09	Drive Transmit Wait Time
Range	[5~65]2ms

– This parameter is used to set the converter to receive data from the sending date to the beginning of the time.
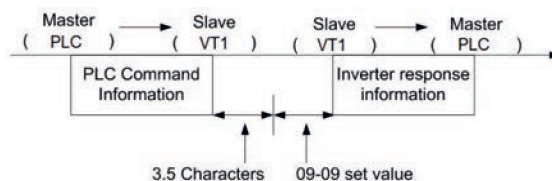
09-10	BACnet stations
Range	[1~254]

GROUP 10 - PID FUNCTION SETUP

PID block diagram

10-00	PID target value selection
Range	[0]:Potentiometer on Keypad [1]:External AVI Analog Signal Input [2]:External ACI Analog Signal Input [3]:Target Frequency set by Communication method [4]:Set from keypad by parameter 10-02 [5]:Set from preset frequency

– 10-00 selections are only effective when frequency source selection is set to PID by parameters 00-05 \ 00-06= 6.
– When 10-00=5, PID target value is set according to Parameter Group 05 "preset frequency".
  Ex : When 00-05=6, 10-00=5, 10-03=1, 03-00=2, 03-01=3, 03-02=4, turn on S1~S3 sequentially (0: OFF, 1: ON), please check the output frequency on display is consistent with the 05-01 ~ 05-08

	S1	S2	S3
	03-00=2	03-01=3	03-02=4
Preset frequency 0 (05-01)	0	0	0
Preset frequency 1(05-02)	1	0	0
Preset frequency 2(05-03)	0	1	0
Preset frequency 3(05-04)	1	1	0
Preset frequency 4(05-05)	0	0	1
Preset frequency 5(05-06)	1	0	1
Preset frequency 6(05-07)	0	1	1
Preset frequency 7(05-08)	1	1	1

10-01	PID feedback value selection
Range	[0]:Potentiometer on Keypad [1]:External AVI Analog Signal Input [2]:External ACI Analog Signal Input [3]:Communication setting Frequency

– Note: 10-00 and 10-01 cannot be set to the same value!

10-02	PID keypad input
Range	[0.0~100.0]%
10-03	PID operation selection
Range	[0]: PID Function disabled [1]: FWD Characteristic (Deviation is D-controlled) [2]: FWD Characteristic (Feedback is D-controlled) [3]: REV Characteristic (Deviation is D-controlled) [4]: REV Characteristic (Feedback is D-controlled) [5]: FWD Characteristic (Frequency Command +Deviation D Control) [6]: FWD Characteristic (Frequency Command + Feedback D Control) [7]: Reverse characteristic (Frequency Command + Deviation D Control) [8]: Reverse characteristic (Frequency Command + Feedback D Control)

– 10-03=1
  D deviation (target-detected value) is derivative controlled in unit time set in parameter 10-07.
– 10-03=2
  Feedback (detected value) is derivative controlled in unit time set in parameter 10-07.
– 10-03=3
  Ddeviation (target value-detected value) is derivative controlled in unit time set in parameter 10-07. If the deviation is positive, the output frequency decreases, vice versa.
– 10-03=4
  Feedback (detected value) is derivative controlled in unit time set in parameter 10-07.
  If the deviation is positive, the output frequency decreases, vice versa.
– 10-03=5~8
  Output frequency= PID output frequency + frequency command (10-03=1~4).

10-04	Feedback Gain coefficient
Range	[0.00 ~ 10.00]

– 10-04 is the calibration gain. Deviation = set point – (feedback signal×10-04).

10-05	Proportional Gain
Range	[0.0 ~ 10.0]

– 10-05: Proportion gain for P control.

10-06	Integral Time
Range	[0.0 ~ 100.0]s

– 10-06: Integration time for I control.

10-07	Derivative Time
Range	[0.00 ~ 10.00]s

– 10-07: Differential time for D control.

10-08	PID Offset
Range	[0]: Positive Direction [1]: Negative Direction
10-09	PID Offset Adjust
Range	[0 ~ 109]%

– 10-08 / 10-09: Calculated PID output is offset by 10-09 (the polarity of offset is according to 10-08).

10-10	PID Output Lag Filter Time
Range	[0.0 ~ 2.5]s

– 10-10: Update time for output frequency.

10-11	Feedback Loss Detection Mode
Range	[0]: Disable [1]: Drive keeps running after feedback loss [2]: Drive stops after feedback loss

– 10-11=1: On feedback loss detection, continue running and display 'PDER'.
– 10-11=2: On feedback loss detection, stop and display 'PDER'.

10-12	Feedback Loss Detection Level
Range	[0 ~ 100]

– 10-12 is the level for signal loss. Error = (Set point – Feedback value). When the error is larger than the loss level setting, the feedback signal is considered lost.

10-13	Feedback Loss Detection Delay Time
Range	[0.0 ~25.5]s

– 10-13: The minimum time delay before feedback signal loss is determined.

10-14	Integration Limit Value
Range	[0 ~ 109]%

– 10-14: The Limiter to prevent the PID from saturating.

10-15	Integration Value Resets to Zero when Feedback Signal Equals the target Value
Range	[0]: Disabled [1]: After 1 Sec [30]: After 30 Sec (Range: 1 ~ 30 Sec)

– 10-15=0, as PID feedback value reaches the set point, the integral value will not be reset.
– 10-15=1~30, as PID feedback value reaches the set point, reset to 0 in 1~30 seconds and drive stops. The drive will run again when the feedback value differs from the set point value.

10-16	Allowable Integration Error Margin (Unit) (1 Unit = 1/8192)
Range	[0 ~ 100]%

– 10-16= 0~100% unit value: Restart the tolerance after the integrator reset to 0.

10-17	PID Sleep Frequency Level
Range	[0.00~599.00]Hz
10-18	PID Sleep Function Delay Time
Range	[0.0 ~25.5]s
10-19	PID Wake up frequency Level
Range	[0.00 ~ 599.00]Hz
10-20	PID Wake up function Delay Time
Range	[0.0 ~ 25.5]s

– When PID output frequency is less than the sleep threshold frequency and exceeds the time of sleep delay, the drive will decelerate to 0 and enters PID sleep mode.
– When PID output frequency is larger than the wake up threshold frequency drive will enter the PID mode again as shown in the timing diagram below.
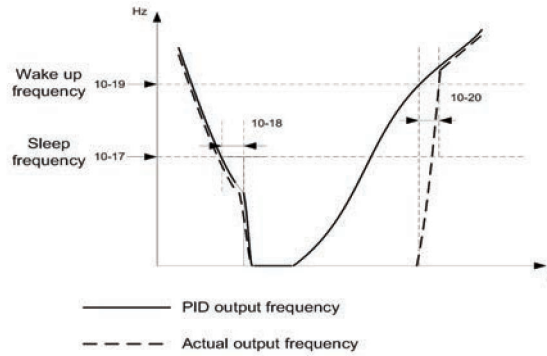
10-21	Max PID Feedback Level.
Range	[0 ~ 999]
10-22	Min PID Feedback Level.
Range	[0 ~ 999]

– Example: If 10-21=100 and 10-22=50 and the unit for the range from 0 to 999 will be defined with the parameters setting of 12-02 , actual feedback value variation range, will be scaled to 50 and 100 only for display, as Shown below.
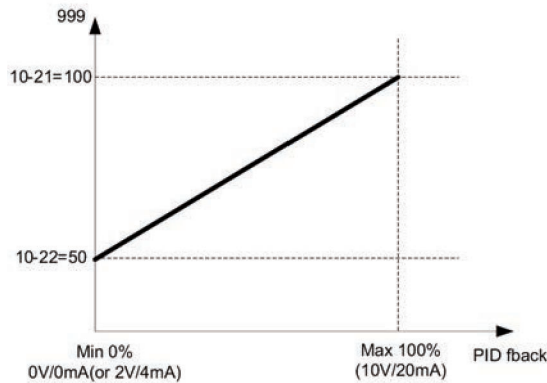
GROUP 11 - PERFORMANCE CONTROL FUNCTIONS

11-00	Prevention of Reverse operation
Range	[0]:Reverse command is valid [1]:Reverse command is invalid

– When 11-00=1, drive did not accept reverse operation command.

11-01	Carrier Frequency
Range	[1~16]KHz

– Setting range from 1 to 16 represents KHz.
– A low carrier frequency decreases RFI, EMI interference and motor leakage current.
– A low carrier frequency increases motor noise, but reduces motor losses and temperature.
– If cable length between the drive and the motor is too long, the high-frequency leakage current will cause an increase in drive output current, which might affect peripheral devices.

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11-02	Carrier mode selection
Range	[0]:Carrier mode0 3-phase PWM modulation [1]:Carrier mode1 2-phase PWM modulation [2]:Carrier mode2 Random PWM modulation

The function can be used for audible noise reduction from a motor. It can be used in cases where the 100% torque from motor is not critical but it is necessary to reduce the audible noise.

– Mode 0 (3-phase PWM Modulation)
  Three Output transistors are ON at the same time (full duty). Carrier frequency is set according to parameter 11-01.
– Mode 1 (2-phase PWM Modulation)
  Two output transistors are ON at the same time (2/3 duty). This mode is suitable for variable torque applications such as fan and pump. It reduces the output transistor switching losses. Carrier frequency will be according to parameter 11-01 with the exception noted below.
– Mode 2 (Random PWM Modulation)
  This modulation method will use 3-phase PWM and 2-phase PWM modulation in a random combination. Carrier frequency will be according to parameter 11-01.

PWM mode selection considerations:

Modes	Name	IGBT duty	Heat losses	Torque performance	Waveform distortion	Motor noise
0	3-Phase PWM	100%	High	High	Low	Low
1	2-Phase PWM	66.6%	Low	Low	High	High
2	2-Phase random PWM	66.6%	Low	Low	High	Mid

11-03	Carrier frequency auto reduction due to temperature rise
Range	[0]:Disable [1]:Enable

– If drive (heat sink) temperature rises above 80°C the carrier frequency is reduced by 4kHz.
– If the temperature falls below less than 70°C, carrier frequency is restore to the value of 11-01.
– Temperature can be displayed by setting parameter 12-00=04000.
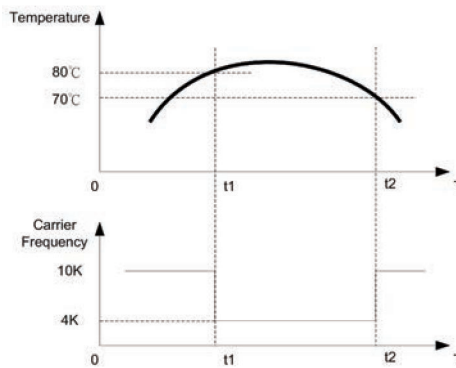
11-04	S-Curve Acceleration 1
11-05	S-Curve Acceleration 2
11-06	S-Curve Deceleration 3
11-07	S-Curve Deceleration 4
Range	[0.0 ~ 4.0]s

– Use S Curve parameters where a smooth acceleration or deceleration action is required, this will prevent possible damage to driven machines by sudden acceleration/deceleration.
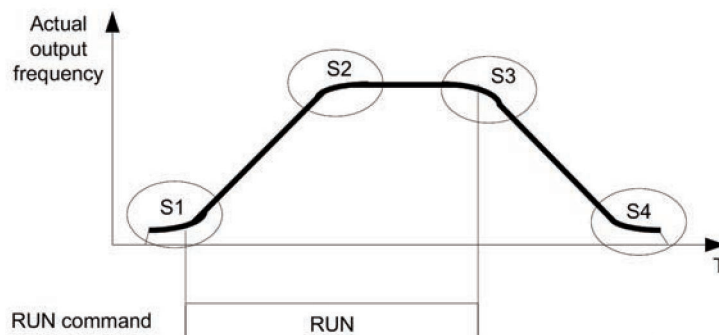
Note:
– Regardless of the stall prevention period, actual acceleration and deceleration time =preset acceleration / deceleration time + S curve time.
– Please set the required individual S curve times in the parameters (11-04~11-07).
– When S curve time (11-04~11-07) is set as 0, the S curve function is disabled.

11-08	Skip frequency 1
11-09	Skip frequency 2
11-10	Skip frequency 3
Range	[0.00 ~ 599.00]Hz
11-11	Skip frequency range. (± frequency band)
Range	[0.00 ~ 30.00]Hz

Skip frequency parameters can be used to avoid mechanical resonance in certain applications.
Example: 11-08=10.00(Hz); 11-09=20.00(Hz); 11-10=30.00(Hz); 11-11=2.00(Hz).
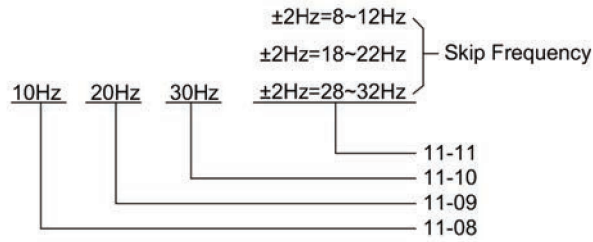
11-13	Regeneration Prevention Function
Range	[0]: The function is disabled [1]: The function is enabled [2]: The function is enabled only during constant speed

– Regeneration Prevention Function:
During excessive energy regeneration, the Vpn (DC bus) voltage will Increase and lead to OV (over voltage), to avoid over voltage due to regeneration the output frequency will be increased.
Regeneration prevention function can be set according to the selections above.

Example: Regeneration prevention during acceleration.
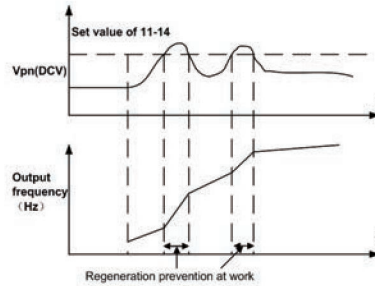
Example: Regeneration prevention during constant speed.
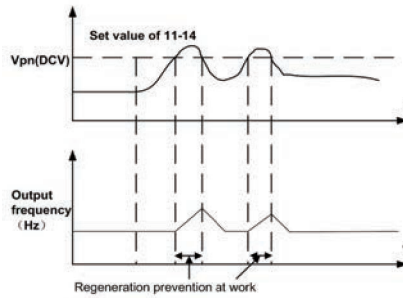
Example: Regeneration prevention during deceleration.
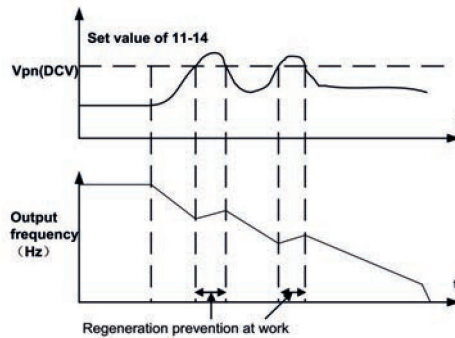
11-14	Regeneration Prevention Voltage Level
Range	300.0~400.0 V

− If the DC bus voltage level is set too low, then over-voltage protection will not be reached, but the actual deceleration time will be extended.

11-15	Regeneration Prevention Frequency Limit
Range	[0.00~15.00]Hz

− Sets the regeneration prevention frequency limit.

11-16	Regeneration Prevention Voltage Gain
Range	[0~200]%
11-17	Regeneration Prevention Frequency Gain
Range	[0~200]%

− 11-16 / 11-17 represent the effect for regeneration prevention. It will enhance the response of DC bus voltage variation by enlarging the setting. However, it will lead to instability of output frequency.
− If setting 11-16 to be smaller still can't suppress the shake, please set 11-17 to be smaller.

11-18	Speed loop proportion gain
Range	[0~65535]
11-19	Speed loop integration gain
Range	[0~65535]
11-20	Speed loop differential gain
Range	[0~65535]

− SLV control mode use an output speed estimator as speed feedback value. Speed control system to adjust the output frequency to follow the value of speed feedback command. The output torque command is by the controller output with a limiter.
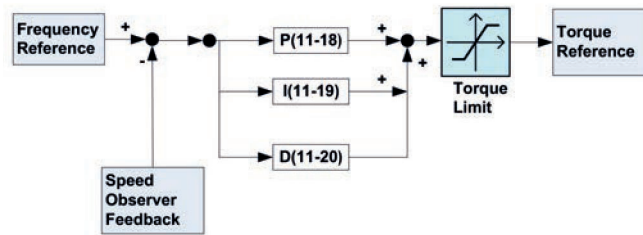
11-21	Stop Key Selection
Range	[0] : Enable Stop Key when Run Command not from Keypad [1] : Disable Stop Key when Run Command not from Keypad

− When run command comes from control terminal (00-02=1) or communication (00-02=2), this parameter can be enabled or disabled the stop key function of operator.

GROUP 12 – DISPLAY AND MONITOR FUNCTION

12-00	Display Mode
Range	0 0 0 0 0 MSD LSD 00000~77777 Each digit can be set from 0 to 7 as listed below. [0]:Disable display [1]:Output Current [2]:Output Voltage [3]:DC voltage [4]:Heat Sink Temperature [5]:PID feedback [6]:AVI [7]:ACI

− MSD= Most significant digit. LSD= Least significant digit.
− Note: MSD of parameter 12-00 sets the power on display, other digits set user selected displays. (refer to P4-4).

12-01	PID Feedback Display Mode
Range	[0]:Displayed in Integer (xxx) [1]:Displayed with One Decimal Place (xx.x) [2]:Displayed with Two Decimal Places (x.xx)
12-02	PID Feedback Display Unit Setting
Range	[0]:----- [1]:xxxpb (pressure) [2]:xxxfl (flow)
12-03	Custom Units (Line Speed) Display Mode
Range	[0~65535]rpm

− Set motor rated RPM in this parameter if required then the display will show this value when drive output frequency reaches the motor name plate frequency. 50Hz or 60 Hz as appropriate.
− The line speed display is linearly proportional to the output frequency 0 to 50Hz or 0-60 Hz as appropriate. Motor synchronous speed = 120 x Rated frequency/Number of poles.

12-04	Custom Units (Line Speed) Display Mode
Range	[0]:Drive Output Frequency is Displayed [1]:Line Speed is Displayed in Integer (xxxxx) [2]:Line Speed is Displayed with One Decimal Place (xxxx.x) [3]:Line Speed is Displayed with Two Decimal Places (xxx.xx) [4]:Line Speed is Displayed with Three Decimal Places (xx.xxx)

– 12-04≠0, line speed is displayed while the drive is running or stopped.

12-05	Input and output terminal status display
Range	Read only (Panel read only)

– When any of S1~S5 is turned on, corresponding segments on the digital display will be on.
– When relay output RY1 is on, the corresponding digit will be on as shown below.
– When no Digital input and no relay output, they will show-----.

Example 1: The following figure shows 12-05 display status,
when S1, S3, S5 Inputs are ON and S2, S4 and RY1 are OFF.
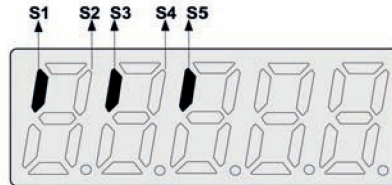
Example 2: The following figure shows 12-05 display status
when S2, S3, S4 inputs are ON and S1, S5 are OFF but RY1 is ON.
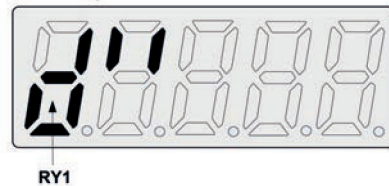
12-06	Output Power
Range	----

– It needs to set motor rated power correctly (parameter 02-05).

12-07	Motor Current Percentage
Range	----

– The ratio of drive output current and motor rated current, it needs to set motor rated current correctly (parameter 02-01).

GROUP 13 - INSPECTION AND MAINTENANCE FUNCTION

13-00	Drive Horsepower Code
Range	----

Drive model	13-00 show
VT1 02 A240	2P2
VT1 04 A240	2P5
VT1 07 A240	201
VT1 15 A240	202
VT1 22 A240	203

13-01	Software version
Range	----
13-02	Fault Log Display (Latest 3 faults)
Range	----

– Last three faults are stored in a stack and whenever there is a new fault the previous faults are pushed down the stack. So the fault stored in 2.xxx will be transferred to 3.xxx, and the one in 1.xxx to 2.xxx. The recent fault will be stored in the empty register 1.xxx.
– Use ▲ and ▼ keys to scroll between the fault registers.
– Pressing reset key when parameter 13-02 is displayed then all three fault registers will be cleared and the display for each register will change to 1.---, 2.---, 3.---.
– E.g. fault log content is '1.OC-C'; this indicates the latest fault is OC-C, etc.

13-03	Accumulated Drive Operation Time 1
Range	[0~23] Hours
13-04	Accumulated Drive Operation Time 2
Range	[0~65535] Days
13-05	Accumulated Drive Operation Time Mode
Range	[0]:Power on time [1]:Operation time

– When the operation time recorded in accumulator 1 (parameter 13-03) reaches 24 hours the recorded value in accumulator 2 parameter 13-04 changes to 1 day and the value in accumulator 1 is reset to 0000.

13-06	Parameter lock
Range	[0]: Enable all Functions [1]: Preset speeds 05-01~05-08 cannot be changed [2]: All Functions cannot be changed except for preset speeds set in 05-01~05-08 [3]: Disable all function except 13-06

– When the 13-07=00000, you can adjust the parameters 05-01~05-08 from 13-06.

13-07	Parameter lock key code
Range	[00000~65535]

– When parameter 13-07 is entered, all the parameters cannot be modified.
  For any modification, the parameter lock key code has to unlock.

Setting Parameter lock key number example:

Step 1:

Step 2:
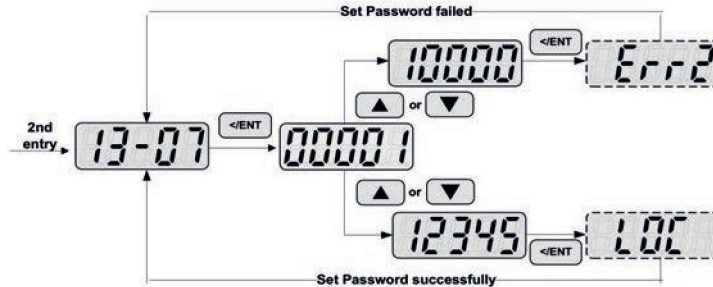
Key code (password) unlock

13-08	Reset drive to factory settings
Range	[1150]: Initialization (50Hz, 220V/380V system) [1160]: Initialization (60Hz, 220V/380V system) [1250]: Initialization (50Hz, 230V/400V system) [1260]: Initialization (60Hz, 230V/460V system) [1350]: Initialization (50Hz, 220V/415V system) [1360]: Initialization (60Hz, 230V/400V system)

– When a parameter lock key number has been entered in parameter 13-07. This key number must be entered first before parameter 13-08 can be used.
– Reset 13-08 to default setting will reset parameter 02 Group.
– The default setting of 13-08 is "1250".

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GROUP 14 – PUMP APPLICATION FUNCTION

14-00	Function selection
Range	0: Disable 1: Pump application

– Select function of pump via parameter 14-00. This function is enabled if PID control mode (10-03) is enabled.
– When 14-00=1 and 10-03=1 (PID function is enabled), pump function will be enabled.

14-01	Setting of single and multiple pumps and master and slave machines
Range	0: Single pump 1: Master 2: Slave 1 3: Slave 2 4: Slave 3

– Set the drive as the Master or Slave 1~3 via parameter 14-01. Refer chapter "2.7.3 Multi pump wiring diagram" for the functional process of dual pump start to enable multiple pumps in parallel. It is required to reconnect to write in the parameter after it is set.

14-02	Operation pressure setting
Range	0.1~(the value of 14-03)

– Set the pressure value depending on the pressure transmitter of pump system after setting 10-00 to 0 (keypad given).

14-03	Maximum pressure setting of pressure transmitter
Range	[0.1~650]PSI

– Set the maximum pressure value depending on the pressure transmitter of pump system. Parameter 14-02 is limited to this maximum value.

14-04	Pump pressure command source
Range	0：Set by 14-02 1：Set by AI

– Pressure command source is given the value set by 14-02 (operation pressure setting) or AI (refer to parameter 10-00 for the setting of AI terminal).

14-05	Display mode selection
Range	0: Display of target and pressure feedback (14-03<99) 1: Target pressure only 2: Feedback pressure only

– This function can have the common display of target & feedback pressure or display separately
(1) When 14-05=0, LED keypad displays pressure setting value and pressure feedback. Two-digit in the left is the pressure value setting and two-digit in the right is the pressure feedback value in the seven-segment monitor.

$$2.0\ 1.8$$

(2) When 14-05=1, keypad only displays the pressure setting value.

$$^-02.0$$

(3) When14-05=2：LED keypad only displays the pressure feedback value.

$$\_01.8$$

Note:
If Pump mode is used LED keypad, parameter 14-03 is required to ≦ 99.0 PSI.

14-06	Proportion gain (P)
Range	[0.00~10.00]
14-07	Integral time (I)
Range	[0.0~100.0]s
14-08	Differential time (D)
Range	[0.00~10.00]s

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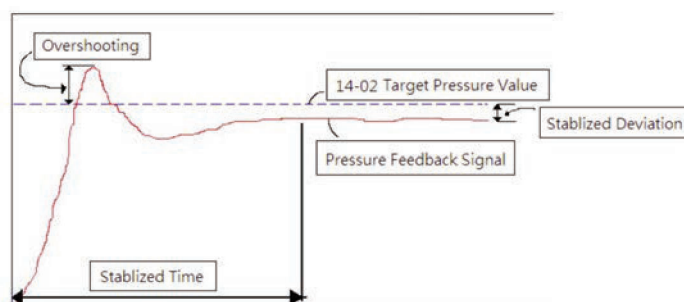
	Increase Setting Value	Decrease Setting Value	Main Feature
Proportional Gain (P)	(Pros) Increase response time (Cons) Might cause pump jittering	(Pros) Reduce jittering (Cons) Slow down response	Increase stabilized time
Integral Time (I)	(Pros) Smooth output frequency (Cons) Slow down response	(Pros) Fast response (Cons) Change rapidly output frequency	For smooth feedback variations
Differential	(Pros) Avoid overshooting (Cons) System instability or motor jittering	(Pros) System stability (Cons) Overshooting easily	Respond to system rapid variations

Guide for PID parameter adjustment
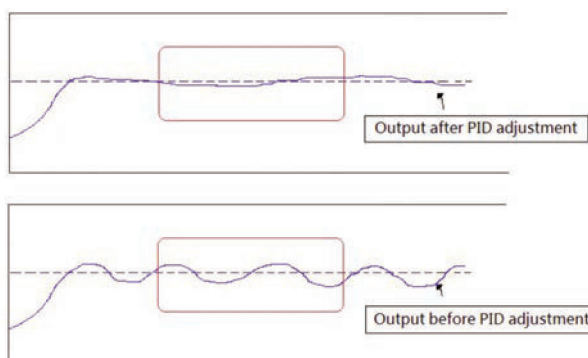
PID Diagram for PID parameter adjustment

* PID parameters can be modified during the drive is running.

14-09	Tolerance range of constant pressure
Range	When 14-20=0, range is 0.00~650.00 When 14-20=1, range is 0~100

– When pressure feedback value is in the range of 14-02+14-09, drive output frequency will decrease downward into sleep status.

14-10	Sleep frequency of constant pressure
Range	[0.00~599.00]Hz

– When drive output frequency falls below 14-10 (sleep frequency of constant pressure), it starts to count the sleep time (14-11).

14-11	Sleep time of constant pressure
Range	[0.00~255.5]s

– When the drive finishes counting the sleep time (14-11), the output frequency falls downward at the deceleration time (00-15) and gets into sleep status. Parameter 14-10 (sleep frequency of constant pressure) is dedicated by the pump and it is not applied to parameter 10-17 (start frequency of PID sleep).
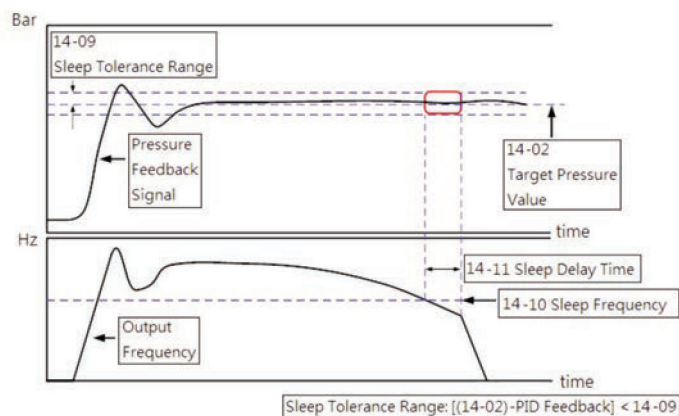
Diagram for stop time of constant pressure

14-12	Maximum pressure limit
Range	When 14-20=0, range is 0.00~650.00 When 14-20=1, range is 0~100

– It is convenient for user to limit maximum pressure. When pressure feedback value is higher than maximum pressure limit, the drive displays warning signal and then stops.

14-13	Warning time of high pressure
Range	[0.0~600.0]s

– When pressure feedback value is higher than maximum pressure limit, warning time of high pressure starts to count. If pressure feedback value is lower than maximum pressure limit during counting time, the warning time will recount and the drive will display the warning signal of HIPb when the warning time ends.

14-14	Stop time of high pressure
Range	[0.0~600.0]s

– When the warning signal of high pressure occurs and pressure feedback value is higher than maximum pressure limit, stop time of high pressure starts to count. If pressure feedback value is lower than maximum pressure limit during counting time, the stop time will recount and the drive will display stop error signal of OPbFt when the stop time ends.
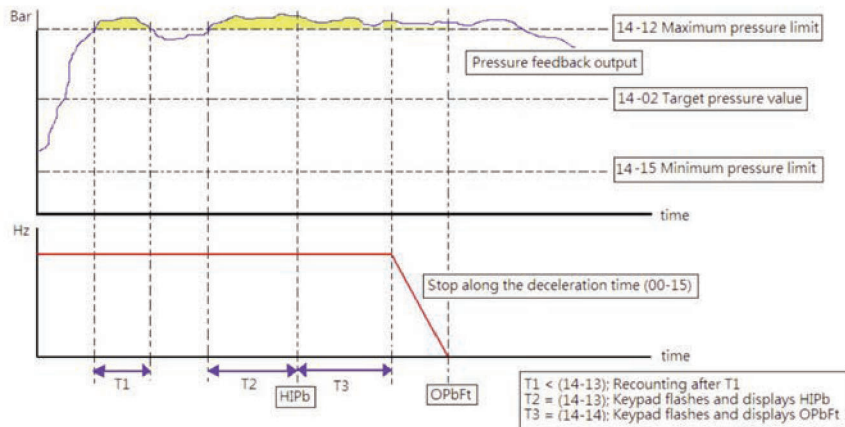
14-15	Minimum pressure limit
Range	When 14-20=0, range is 0.00~650.00 When 14-20=1, range is 0~100

– It is convenient for user to limit minimum pressure. When pressure feedback value is lower than minimum pressure limit, the drive displays warning signal and then stops.

Diagram for pressure feedback limit
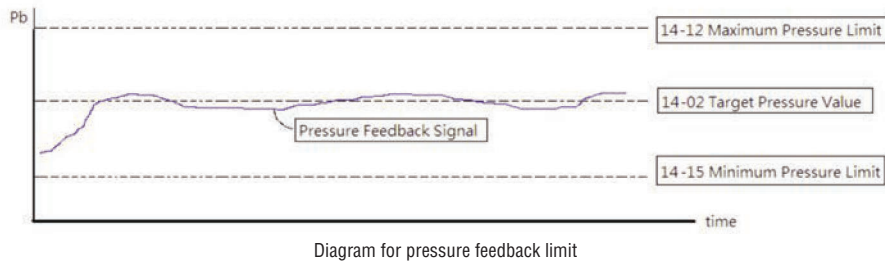
Note:

The pressure under the control of PID is between the maximum pressure limit (14-12) and minimum pressure limit (14-15).

14-16	Warning time of low pressure
Range	[0.0~600.0]s

– When pressure feedback value is lower than minimum pressure limit, warning time of low pressure starts to count. If pressure feedback value is higher than minimum pressure limit during counting time, the warning time will recount and the drive will display the warning signal of LoPb when the warning time ends.

14-17	Fault stop time of low pressure
Range	[0.0~600.0]s

– When the warning signal of low pressure occurs and pressure feedback value is lower than minimum pressure limit, stop time of low pressure starts to count. If pressure feedback value is higher than minimum pressure limit during counting time, the stop time will recount and the drive will display stop error signal of LPbFt when the stop time ends.
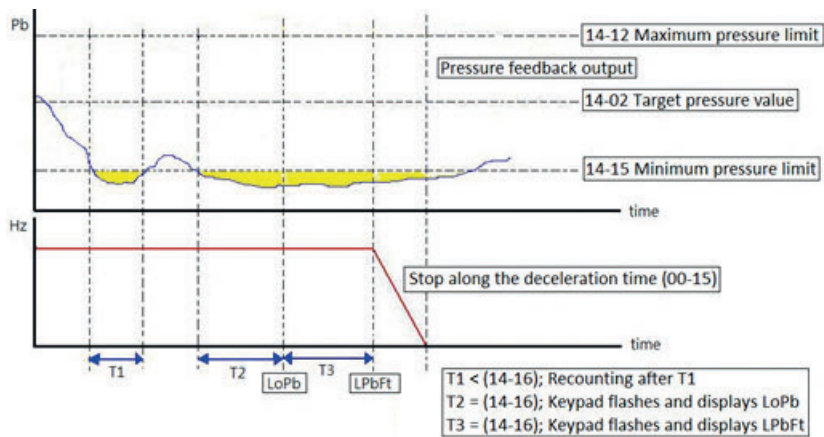
Diagram for warning to stop at low pressure limit

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14-18	Time of loss pressure detection
Range	[0.0~600.0]s
14-19	Proportion of loss pressure detection
Range	[0~100]%

– When 14-19=0, function of loss pressure detection is disabled.
– When 14-19 > 0, If the feedback pressure value is lower than the value of [(14-02) x (14-19)]and the detection time of loss pressure (14-18) passes, the drive jumps to fault signal (FBLSS).

14-20	Switching of pressure and percentage
Range	0: Pressure 1: Percentage

– When 14-20=0, 14-09/14-12/14-15/14-24/14-34/14-38/14-39 is displayed and set via pressure mode.
– When 14-20=1, 14-09/14-24/14-34/14-38/14-39 are proceeding to switch percentage on the basis of parameter 14-02 and parameter 14-12/14-15 are on the basis of parameter 14-03.

For example, 14-02=4.00PSI, 14-03=10.00PSI, 14-09=0.5PSI, 14-12=5.00PSI

When 14-20=0→1,
[(14-09)/(14-02)]x100% → 14-09=13% (rounded to integer)
[(14-15)/(14-03)]x100% → 14-15=50% (rounded to integer)

When 14-20=1→0,
[(14-09)/100]*(14-02) → 14-09=0.52PSI
[(14-15)/100]*(14-03) → 14-15=5.00PSI

14-22	Slave trip frequency
Range	[0.00~599.00]Hz
14-23	Direction of water pressure detection
Range	0: Upward Detection 1: Downward Detection
14-24	Range of water pressure detection
Range	When 14-20=0, range is 0.00~650.00 When 14-20=1, range is 0~100
14-25	Period of water pressure detection
Range	[0.0~200.0]s
14-26	Acceleration time of water pressure detection
Range	[0.1~3600.0]s
14-27	Deceleration time of water pressure detection
Range	[0.1~3600.0]s

– 14-26 and 14-27 are corresponding to 00-16 and 00-17, so the setting of 14-26 changed with the setting of 00-16. Thus, avoid using multi-speed application function while using PUMP function.
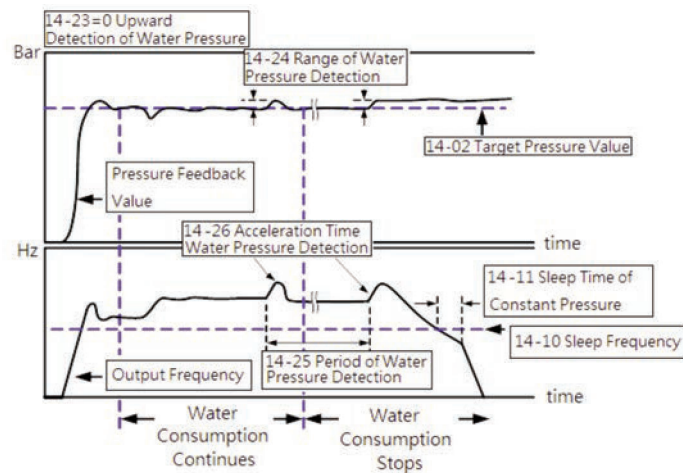
Diagram for upward detection of water pressure

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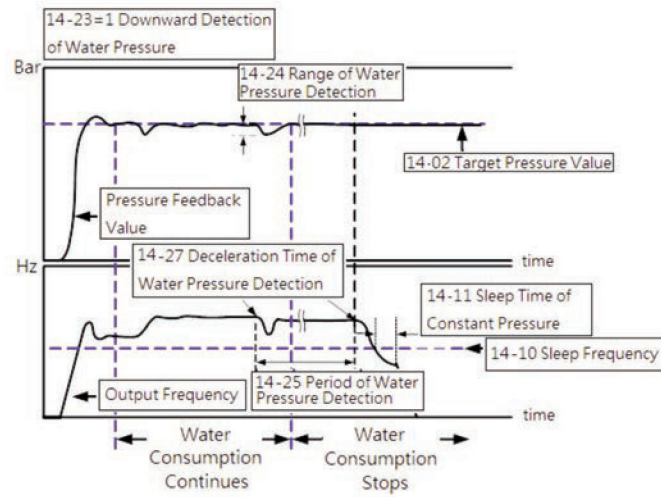
Diagram for download detection of water pressure

−   When 14-25=0.0 (sec) means to disable the function of water pressure detection.
−   When function of water pressure detection is enabled, it can shorten the time of jumping into sleep without water consumption or with mild water consumption.
−   If water consumption frequently continues, it is recommended to extend the cycle of water pressure detection (14-25) so as the detection times can be reduced and the occurrence of fluttering or instability during water pressure detection in constant pressure can be avoided.
−   When upward detection of water pressure starts, water pressure will slightly increase. At this time, it may cause shortly pressure fluttering or instability if water consumption continues. It is recommended to reduce the range of water pressure detection (14-24) but it will extend the time of drive jumping into sleep without water consumption or with mild water consumption.

	Pros	Consequences
Upward detection of water pressure	− Keep the pressure above the target pressure during this process. − For strict and precise applications	− If "Pump lift" is too high, operation frequency is higher without water consumption or with mild water consumption. So this detection effect is too restricted to jump into sleep. − Energy-saving of water flow is not obvious and slave is not easy to sleep under the multiple pumps in parallel.
Downward detection of water pressure	− Jump into sleep status without water consumption or with mild water consumption. For energy-saving purpose, under the multiple pumps in parallel regulate the pumps to the optimum operation state during this process. Startup frequency is by Master, Slave 1, Slave 2, and Slave 3. Sleep frequency is by Slave 1, Slave 2, and Slave 3 and Master. After the switching time is allowable, alternate Master and Slave reach the average of life expectancy.	− Pressure fluctuations may occur during this process if user inappropriately regulates the range of water pressure detection (23-24) and the deceleration time of water pressure detection (23-27).

Guide for comparison of water pressure detection direction

14-28	Forced run command
Range	0.00~(the value of 00-12)

−   This function is enabled when PID mode (10-03) is selected. Pump will not depend on the feedback to make any PID output adjustment and runs the frequency of 00-05 (frequency command) when multi-function digital input (S1~S6) is set to 16 (PID control disable).
−   And when the other digital input is set to 57(forced frequency run), drive sets the frequency to run depending on the parameter 14-28 (forced run command). If PID function disable is removed, the drive is controlled by PID.

14-29	Switching time of water pressure detection
Range	[0~240]Hr

−   If function of multiple pumps in parallel is enabled, the switching way is Master→Slave1→ Slave2→ Slave3 → Master → ... and the switching time is set via parameter 14-72.

14-30	Detection time of multiple pumps in parallel running start
Range	[0~30]s

−   When parameter 14-31 is set to 1 or 3, detection time of multiple pumps in parallel running start is enabled. If water pressure cannot reach the error range of constant pressure and water flow time is over the detection time (14-30), Master will inform Slave of running start.

14-31	Synchronous selection of multiple pumps in parallel
Range	0: Disable 1: Pressure setting Run/Stop 2: Pressure setting 3: Run/Stop

−   When 14-31=0: Disabled
−   When 14-31=1: Set 14-01 to 1, pressure setting and Run/ Stop command are modified by master and Slave follows Master's command. Run/Stop command from Slave can be regarded as the emergency stop command with the highest priority.
−   When 14-31=2: Pressure setting is modified by Master and Slave follows Master's command to update synchronously.
−   When 14-31=3: Run/ Stop command is set by Master and Slave follows Master's command. Run/Stop command from Slave can be regarded as the emergency stop command with the highest priority.

Note:
1. When Master modifies the pressure setting, it requires pressing ENTER key to modify the pressure setting of Slave.
2. When the switching time of multiple pumps in parallel (14-29) changes and reconnection, it will recount the time.
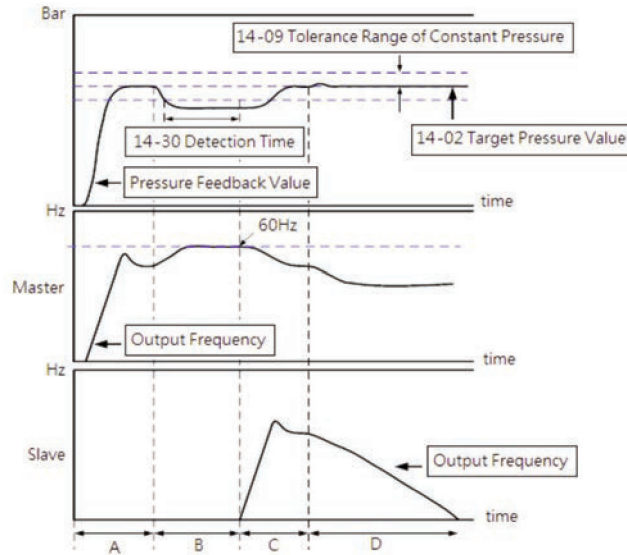
Dual pumps start up process

A. Dual pumps are enabled during this time. Master starts up first and Slave is in standby to enter constant-pressure operation.
B. Large water consumption results in the higher operation frequency of Master. If water pressure is not lower than the tolerance range of constant-pressure and the operation time is not over the detection time (14-30), Slave is still in standby.
C. If it is over the detection time (14-30), and Master runs at 60Hz, Master informs Slave of auxiliary kicking water. After Slave operates, the operation frequency of Master and Slave reduces to the operation of constant-pressure if water consumption is stable.
D. If water consumption is mild, the operation frequency of Master and Slave reduces. Because the water consumption is less than that of the operation of dual pumps, Slave stops to sleep (please refer to parameter 14-22 for dual pump slave sleep requirements) and only Master runs to reach constant-pressure operation.

Note：
– When 14-35=3, If the operation time is over the switching time (14-29) or sleep to stop under the operation of dual pumps, the dominance between Master and Slave will exchange to operate.
– When 14-01≠0, the parameter 14-01 of these two drives cannot be simultaneously set to 1 or 2. That is, the parameter 14-01 of one drive is set to 1 and that of the other drive should be set to 2 and vice versa.
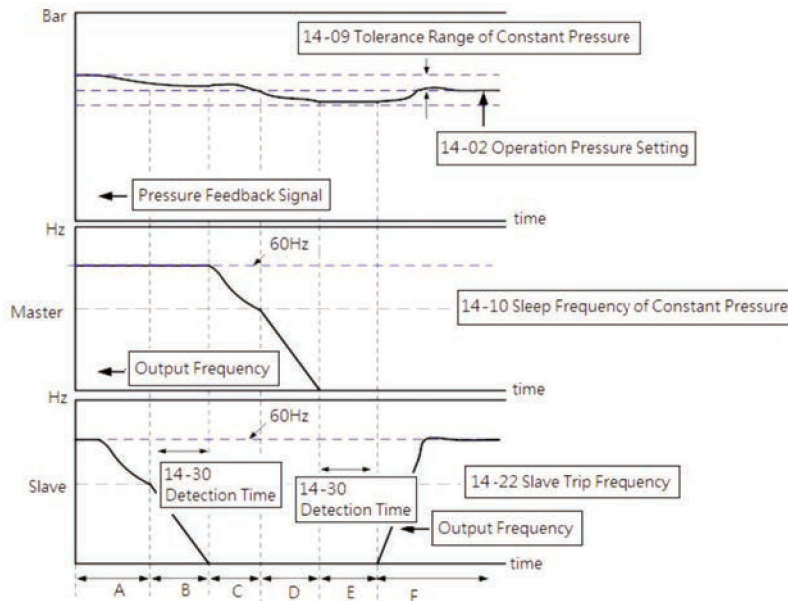
Diagram of sleep stop alternative selection action

A. Dual pumps are enabled during this time. Higher operation pressure occurs, Master keeps operation and Slave output frequency decreases.
B. Master operation frequency maintains 60Hz. If water pressure doesn't decrease to the target constant pressure and Slave continuously decreases to the set trip frequency (14-22), Slave detection time (14-30) starts and Slave decelerates to stop.
C. If milder water consumption and higher water pressure occur and Slave operation command is in sleep status, Master output frequency decreases to let the water pressure be in constant status when the detection time (14-30) is over.
D. When Master operation frequency decreases to the sleep frequency of constant pressure (23-10), Master will decrease to stop, water consumption is continuously mild and water pressure will reduce slowly.
E. When water consumption stops, Master jumps into sleep and the pressure remains the same. and Slave's detection time (14-30) starts.
F. When the detection time (14-30) is over, shift operation stops and virtual Master starts to become Slave. The drive operates in constant pressure under the target pressure value

14-34	Tolerance range of constant pressure 2
Range	When 14-20=0, range is 0.00~650.00 When 14-20=1, range is 0~100
14-35	Selection of multiple pumps shift operation
Range	0: No function 1: Timer alternately selection 2: Sleep stop alternately selection 3: Timer and sleep stop alternately selection 4: Multiple pumps test mode

– 14-35=1, if the operation time is over the switching time (14-29) or sleep to stop under the operation of dual pumps, the dominance between Master and Slave will exchange to operate.
– 14-35=2, when the Master and Slave of multiple pumps in parallel are both in sleep mode, and after the detecting time (14-30), the Master and Slave of multiple pumps in parallel will be exchange. Every time the multiple pumps start, the exchange will be processed. Please refer to the diagram of sleep stop alternative selection action.
– 14-35=3, timer and sleep stop alternately selected will be enabled at the same time.
– 14-35=4, when master stop running and the slave need to run, no exchange between Master and Slave.

14-37	Leakage detection time
Range	[0.0~100.0]s
14-38	Pressure variation of leakage detection restart
Range	When 14-20=0, range is 0.00~65.00 When 14-20=1, range is 0~100
14-39	Pressure tolerance range of leakage detection restart
Range	When 14-20=0, range is 0.00~650.00 When 14-20=1, range is 0~100

Leakage detection case 1: Pressure tolerance higher than 14-38
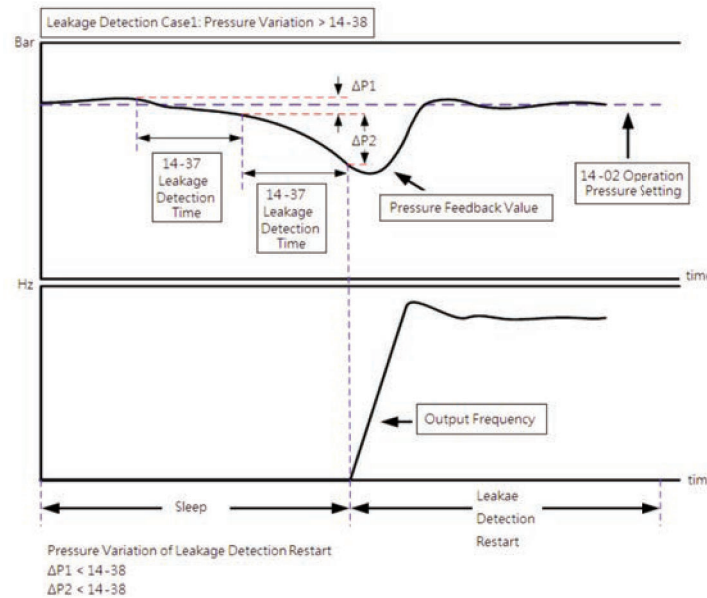
– To limit single drive to use leakage detection.
– When 14-37 = 0.0 (sec), switch off this function.
– When pump is at shutdown state, pressure will drop over time if pipeline leaks. Pump will restart if pressure variation is larger than the value of parameter 14-38 in every detection time (14-37).
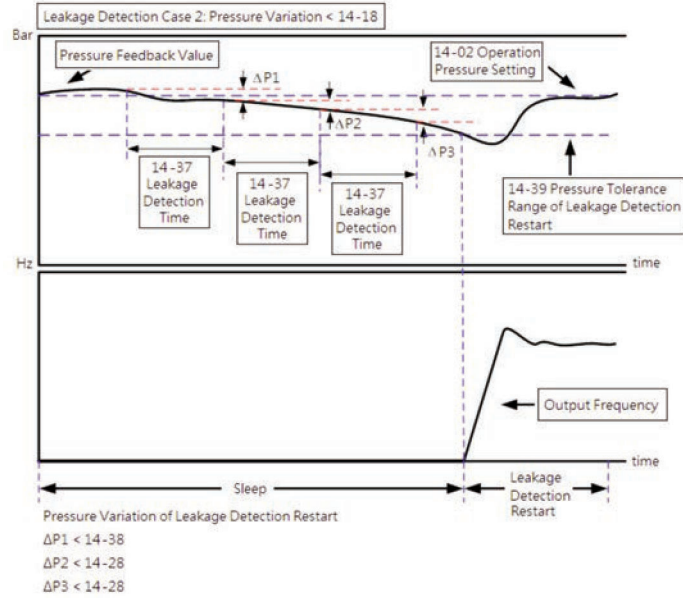
Leakage detection case 2: Pressure tolerance lower than 14-38

- When 14-37=0.0 (sec), switch off this function.
- When pump is at shutdown state, pressure will drop over time if pipeline leaks. Drive will keep sleep state if pressure variation is lower than the value of parameter 14-38 in every detection time (14-37) and pump will restart if pressure variation is larger than that of 14-38 or pressure tolerance range is over the value of parameter 14-39 in the detection time.。
- Properly adjust the relevant leakage detection parameters 14-37, 14-38 and 14-39 to improve the condition of frequently pump start and stop caused from the dropping pressure of water system due to leakage.
- Function of leakage detection is enabled only in the setting of single pump.

14-71	Maximum Pressure Setting
Range	[0.1~650.0]PSI
14-72	Switching Time of Alternation in Parallel
Range	0: Hour 1: Minute

- When 14-72=0, parameter 14-29 will be in the unit of hour.
- When 14-72=1, parameter 14-29 will be in the unit of minute.

14-73	Slave Wake-Up Selection
Range	0: Disable 1: Enable

- When multiple pumps are in parallel and the requirements of slave wake-up can not be achieved in tolerance range, user can set parameter 14-73=1 and refer to the following conditions to wake up Slave.
- Master is in full speed operation (01-02 maximum output frequency) but pressure feedback value cannot achieve the target pressure value.
- Slave is forced to start after 30secs+the value of 14-30, even if the requirement of sleep to wake-up is not achieved and the pressure feedback value is under the tolerance range of constant pressure) and keeps operation to achieve the target pressure value.
- It is required to follow the formula (the set method 1) and refer to the following diagram to set the wake-up requirements.
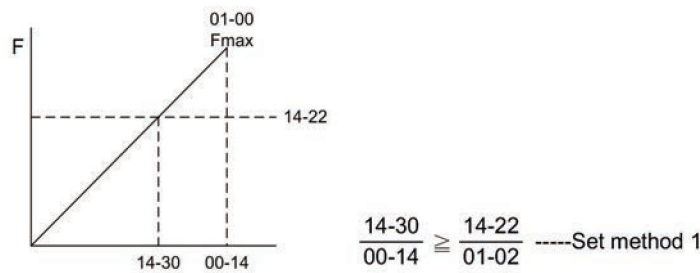
Diagram of requirements for waking up slave

14-74	Proportion Time 2 (P)
Range	0.00~10.00
14-75	Integral Time 2 (I)
Range	0.0~100.0
14-76	Differential Time 2 (D)
Range	0.00~10.00
14-77	The Value of Water Pressure Detection
Range	0~100

4 TROUBLESHOOTING AND MAINTENANCE

4.1 ERROR DISPLAY AND CORRECTIVE ACTION
4.1.1 MANUAL RESET AND AUTO-RESET

Faults which cannot be recovered manually			
Display	Content	Cause	Corrective action
-OV- – OU –	Voltage too high when stopped	Detection circuit malfunction	Consult with the supplier
-LV- – LU –	Voltage too low when stopped	– Power voltage too low – Pre-charge resistor or fuse burnt out. – Detection circuit malfunction	– Check if the power voltage is correct – Failed resistor or fuse – Consult with the supplier
-OH- – OH –	The drive is overheated when stopped	– Detection circuit malfunction – Ambient temperature too high or bad ventilation	Improve the ventilation conditions, if no result then replace the drive
OH-C OH – C	The drive is overheated during running	– IGBT temperature is too high or poor ventilation – Temperature sensor error or circuit malfunctions	– Reduce carrier frequency – Improve the ventilation conditions, if no result then replace the drive
CtEr CtEr	Current Sensor detection error	Current sensor error or circuit malfunction	Consult with the supplier
HPErr HPErr	Drive capacity setting error: Drive capacity setting 13-00 does not match the rated voltage.	The drive capacity setting (13-00) does not match the hardware voltage levels	Check the drive capacity setting (13-00) to meet the hardware voltage levels
Err4 Err4	CPU Unusual interruption	External noise interference	– Remove the interference source then restart by switching power OFF/ON – If not resolved then consult with the supplier
EPr EPr	EEPROM problem	Faulty EEPROM	Consult with the supplier
COt COt	Communication error	Communications disruption	Check the wiring

Faults which can be recovered manually and automatically			
Display	Content	Cause	Corrective action
OC-A OC–A	Over-current at acceleration	– Acceleration time too short – The capacity of the motor exceeds the capacity of the drive – Short circuit between the motor coil and the case – Short circuit between motor wiring and ground – IGBT module damaged	– Set a longer acceleration time – Replace drive with one that has the same rating as that of the motor – Check the motor – Check the wiring – Consult with the supplier
OC-C OC–C	Over-current at fixed speed	– Transient load change – Transient power change	– Increase the capacity of the drive – Install inductor on the power supply input side
OC-d OC–d	Over-current at deceleration	The preset deceleration time is too short	Set a longer deceleration time
OC-S OC–S	Over-current at start	– Short circuit between the motor coil and the case – Short circuit between motor coil and ground – IGBT module damaged	– Inspect the motor – Inspect the wiring – Consult with the supplier
OV-C OU–C	Excessive Voltage during operation/deceleration	– Deceleration time setting too short or excessive load inertia – Power voltage varies widely (fluctuates)	– Set a longer deceleration time – Consider use of a reactor at the power input side
PF PF	Input phase Loss	Abnormal fluctuations in the main circuit voltage	– Check the main circuit power supply wiring – Check the power supply voltage
LPBFT LPbFt	Low pressure fault	Since feedback value of pump pressure is lower than limit of minimum flow	– Check feedback signal is correct and with connection – Check if feedback value of pressure is lower than limit of minimum pressure (14-15)
OPBFT OPbFt	High pressure fault	Since feedback value of pump pressure is lower than limit of maximum flow	– Check feedback signal is correct – Check if feedback value of pressure is lower than limit of maximum pressure (14-12)
FBLSS FbLSS	PID Feedback Signal Loss	Since proportion of loss pressure (14-19) is enabled and over high, the drive trips to fault Thus, feedback sensor cannot operate properly or is not installed correctly	– Check if the proportion of loss pressure (14-19) is set correctly – Make sure the feedback sensor is installed correctly and PID feedback signal operates normally

Faults which can be recovered manually but not automatically			
Display	Content	Cause	Corrective action
OC OC	Over-current during stop	Detection circuit malfunction	Consult with the supplier
OL1 OL 1	Motor overload	Loading too large	Consider increasing the motor capacity
OL2 OL 2	Drive overload	Excessive Load	Consider increasing the drive capacity
CL CL	Drive over current: Wait 1 minute to reset. If it occurs CL or OL2 up to 4 successive times then wait 5 mins to reset	Drive over current warning： drive current reach the level of over current protection	Check load condition and running period time
LV-C LU-C	Voltage too low during operation	1. Power voltage too low 2. Power voltage varies widely (fluctuates)	1. Improve power quality 2. Consider adding a reactor at the power input side
OVSP OUSP	Motor rotation over speed	The actual rotation speed is different to the set speed	1. Check for excessive load 2. Check weather frequency setting signal is right or not
OH4 OH4	Motor over heat error	1. If temperature detected increases above the set limit in parameter 08-13 and for the delay time set in parameter 08-12 then the display will show "OH4" (motor over heat detection), and the motor will coast to stop 2. Motor over heat detection "OH4" can be reset when the temperature detection level is lower than the set level in parameter [08-14 PTC reset level]	1. To improve the ventilation condition 2. Adjust parameter 08-15
OPErr OPErr	Operator setting error	When 09-02 set to 4, remote keypad (VT1X C02) is disconnected	1. Use "RESET" key of drive to remove the error code 2. Set 09-02 to 0~3

4.1.2 KEYPAD OPERATION ERROR INSTRUCTION

Display	Content	Cause	Corrective action
LOC LOC	1. Parameter already Locked 2. Motor direction locked 3. Parameter password (13-07) enabled	1. Attempt to modify frequency parameter while 13-06>0 2. Attempt to reverse direction when 11- 00=1. 3. Parameter (13 - 07) enabled, set the correct password will show LOC	1. Adjust 13-06 2. Adjust 11-00
Err1 Err1	Keypad operation error	1. Press ▲ or ▼while 00-05/00-06 > 0 or running at preset speed 2. Attempt to modify the parameter can not be modified during operation (refer to the parameter list)	1. The ▲ or ▼ is available for modifying the parameter only when 00-05 / 00-06=0 2. Modify the parameter in STOP mode
Err2 Err2	Parameter setting error	1. 00-13 is within the range of (11-08 ±11-11) OR (11-09 ±11-11) OR (11-10 ±11-11) 2. 00-12 ≦ 00-13 3. 00-05/00-06 or 10-00/10-01 set the same value 4. Modifying parameters 01-01 to 01-09 when 01-00≠7 5. If this parameter is parameterized for both functions (AVI/PTC) at the same time ; PTC function is enabled by setting 08-10≠0 6. Parameter password (13-07) set incorrect	1. Modify11-08~11-10 or 11-11 2. Set 00-12>00-13 3. Set 00-05 and 00-06 to be different 4. Set 03-21 <03-20 5. PTC function source can not be set the same source(AVI) with frequency command and PID command 6. Please set correct password
Err5 Err5	Modification of parameter is not available in communication	1. Control command sent during communication 2. Attempt to modify the function 09-02~ 09-05 during communication	1. Issue enable command before communication 2. Set parameters 09-02~ 09-05 function before communication
Err6 Err6	Communication failed	1. Wiring error 2. Communication parameter setting error 3. Incorrect communication protocol 4. Communication ground disconnected 5. External noise	1. Check hardware and wiring 2. Check functions (09-00~09- 05). 3. CON2 needs to connect to the earth 4. Increase the setting value of 09-08
Err7 Err7	Parameter conflict	1. Attempt to modify the function 13-00/13-08. 2. Voltage and current detection circuit is abnormal	If reset is not possible, please consult with the supplier

4.1.3 SPECIAL CONDITIONS

Display	Fault	Description
StP0 **StP0**	Zero speed at stop	In V/f mode, STP0 comes out at less than 1.3Hz (50Hz set) or at less than 1.5Hz (60Hz set) In SLV mode, STP0 comes out at less than 1Hz.
StP1 **StP1**	Fail to start directly On power up	1. If the drive is set for external terminal control mode (00-02/00-03=1) and direct start is disabled (07-04=1) 2. The drive cannot be started and will flash STP1 3. The run input is active at power-up, refer to descriptions of 07-04.
StP2 **StP2**	Keypad Stop Operated when drive in external Control mode.	1. If the stop key is pressed while the drive is set to external control mode (00-02/00-03=1) then 'STP2' flashes after stop. 2. Release and re-activate the run contact to restart the drive.
E.S. **E.S.**	External Rapid stop	When external rapid stop input is activated the drive will decelerate to stop and the display will flash with E.S. message
b.b. **b.b.**	External base block	When external base block input is activated the drive stops immediately and then the display will flash with b.b. message
PdEr **PdEr**	PID feedback loss	PID feedback loss is detected
Alter **AtEr**	Auto tuning error	Other errors show up in the process of auto tuning
OH3 **OH3**	Motor over heat warning	If 08-10 = 3, when over temperature is detected by signal at terminal AVI increasing above the warning detection limit set in parameter 08-15, then the display will show "OH3"(motor over heat warning level) and the motor will continue to run
LOPB **LOPb**	Low pressure error	– The feedback signal is not connected – Due to feedback value of pump pressure is lower than limit of minimum flow
HIPB **HIPb**	High pressure error	Due to feedback value of pump pressure is lower than limit of maximum flow
COPUP **COPuP**	Breaking error of multiple pumps communication	Communication breaking or disconnection of pump cascade control

4.2 GENERAL TROUBLESHOOTING

Status	Checking point	Remedy
Motor runs in wrong direction	Is the wiring for the output terminals correct?	Wiring must match U, V, and W terminals of the motor
	Is the wiring for forward and reverse signals correct?	Check for correct wiring
The motor speed can not be regulated	Is the wiring for the analog frequency inputs correct?	Check for correct wiring
	Is the setting of operation mode correct?	Check the Frequency Source set in parameters 00-05/00-06
	Is the load too excessive?	Reduce the load
Motor running speed too high or too low	Check the motor specifications (poles, voltage...) correct?	Confirm the motor specifications
	Is the gear ratio correct?	Confirm the gear ratio
	Is the setting of the highest output frequency correct?	Confirm the highest output frequency
Motor speed varies unusually	Does the load vary excessively?	1. Minimize the variation of the load 2. Consider increasing the capacities of the drive and the motor
	Is the input power unstable or is there a phase loss?	1. Consider adding an AC reactor at the power input side if using single-phase power 2. Check wiring if using three-phase power
Motor can not run	Is the power connected to the correct L1 and L3 terminals? Is the charging indicator lit ?	1. Is the power applied? 2. Turn the power OFF and then ON again. 3. Make sure the power voltage is correct. 4. Make sure screws are secured firmly.
	Is there voltage across the output terminals T1, T2 and T3?	Turn the power OFF and then ON again.
	Is overload causing the motor to stall?	Reduce the load so the motor will run.
	Are there any abnormalities in the drive?	See error descriptions to check wiring and correct if necessary.
	Is there a forward or reverse run command?	
	Has the analog frequency signal been input?	1. Is analog frequency input signal wiring correct? 2. Is voltage of frequency input correct?
	Is the operation mode setting correct?	Operate through the digital keypad

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```
                        ┌─────────────────┐
                        │    INV Fault    │
                        └────────┬────────┘
                                 │
                          ┌──────┴──────┐
                          │ Is fault    │──── NO ─────────────────┐
                          │ known?      │                         │
                          └──────┬──────┘                         │
                              YES │                               │
        ┌──────────────────┐     │          ┌──────────────────┐ │
        │ Symptoms other   │     │          │ Any Symptoms of  │ │  ┌──────────────────┐
        │ than burn out,   │── NO ─────────▶│ burn out and     │─ YES ─▶│ Check burnt and  │
        │ damage, or fuse  │                │ damage?          │  │  │ damaged parts    │
        │ meltdown in the  │                └────────┬─────────┘     └──────────────────┘
        │ inverter?        │                      NO │
        └────────┬─────────┘                         │
             YES │                          ┌────────┴─────────┐
        ┌────────┴─────────┐                │ Is the main      │        ┌──────────────────┐
        │  Fault signal?   │──── NO ───────▶│ circuit DM       │── NO ─▶│ Consult with the │
        └────────┬─────────┘                │ intact?          │        │ supplier         │
             YES │                          └────────┬─────────┘        └──────────────────┘
        ┌────────┴─────────┐                      YES │
        │ Check according  │                ┌────────┴─────────┐        ┌──────────────────┐
        │ to displayed     │                │ Is the fuse      │── NO ─▶│   Replace fuse   │
        │ fault messages   │                │ intact?          │        └──────────────────┘
        └──────────────────┘                └────────┬─────────┘
                                                  YES │
                                           ┌────────┴─────────┐        ┌──────────────────┐
                                           │ Is the main      │── NO ─▶│ Consult with the │
                                           │ circuit I.G.B.T  │        │ supplier         │
                                           │ intact?          │        └──────────────────┘
                                           └────────┬─────────┘
                                                 YES │
        ┌──────────────────┐               ┌────────┴─────────┐
        │ Consult with the │◀─── YES ──────│ Visually check   │
        │ supplier         │               │ controller and   │
        └──────────────────┘               │ Drive boards     │
                                           └────────┬─────────┘
                                           ┌────────┴─────────┐
                                           │ Any visual       │
                                           │ abnormalities?   │
                                           └────────┬─────────┘
                                                 NO │
        ┌──────────────────┐                       │
        │ Apply the power  │◀──────────────────────┘
        └────────┬─────────┘
        ┌────────┴─────────┐              ┌──────────────┐        ┌──────────────────┐
        │ Are displays and │              │ Is LED lit?  │── NO ─▶│ Replace the      │
        │ indicators of    │── NO ───────▶│              │        │ pre-charge       │
        │ the operating    │              └──────┬───────┘        │ resistor         │
        │ unit working     │                 YES │               └──────────────────┘
        │ normally?        │              ┌──────┴───────┐        ┌──────────────────┐
        └────────┬─────────┘              │ Is the DC    │── NO ─▶│ Check terminals  │
             YES │                        │ input voltage│        │ and wiring       │
        ┌────────┴─────────┐              │ controlling  │        └──────────────────┘
        │ Any fault        │              │ the power    │
        │ display?         │              │ correct      │
        └────────┬─────────┘              └──────┬───────┘
             YES │                           YES │
        ┌────────┴─────────┐              ┌──────┴───────┐        ┌──────────────────┐
        │ What's the       │              │ Is +5V       │── NO ─▶│ Consult with the │
        │ message?         │              │ control      │        │ supplier         │
        └──────────────────┘              │ voltage      │        └──────────────────┘
                     NO                    │ correct?     │
        ┌──────────────────┐              └──────┬───────┘
        │  *to next page   │                 YES │
        └──────────────────┘              ┌──────┴───────┐
                                          │ Replace      │
                                          │ control board│
                                          │ and digital  │
                                          │ operating    │
                                          │ unit         │
                                          └──────┬───────┘
                                          ┌──────┴───────┐        ┌──────────────────┐
                                          │ Is the error │── NO ─▶│ Perform detailed │
                                          │ eliminated   │        │ check and consult│
                                          │ after        │        │ with the supplier│
                                          │ replacing    │        └──────────────────┘
                                          │ control      │
                                          │ board?       │
                                          └──────────────┘
```

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From previous page

Check Inverter parameters

Perform parameter initializations

Specify operation control mode

Does the FWD or REV LED light flash? —NO→ Replace the control board

YES

Set up frequency command

Is the frequency value displayed on the display? —NO→ Replace the control board

YES

Are there voltage outputs at terminals U, V and W —NO→ Replace the control board

YES

Connect the motor to run ←YES— Does the control Board function after replacement

NO

Is there any fault display? —YES→

NO

Are output currents of each phase even? —NO→

YES

The inverter is OK

NO

Perform detailed check and consult with the supplier.

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4.3.2 TROUBLESHOOTING FOR OC, OL ERROR DISPLAYS

```
┌─────────────────────────────────┐
│ The inverter displays OC, OL errors │
└─────────────────────────────────┘
                 │
        ┌────────────────────┐                              ┌──────────────────┐
        │ Is the main circuit I.G.B.T │──────NO──────────────│  Replace I.G.B.T  │
        │        working      │                              └──────────────────┘
        └────────────────────┘
              YES
                 │
        ┌────────────────────┐                              ┌──────────────────┐
        │ Any visual abnormalities? │──────YES──────────────│ Replace faulty circuit │
        └────────────────────┘                              │       board       │
              NO                                             └──────────────────┘
                 │
        ┌────────────────────┐
        │    Apply power      │
        └────────────────────┘
                 │
        ┌────────────────────┐           ┌────────────────────┐          ┌──────────────────┐
        │ Any abnormal indications? │──YES──│ Is the current detector │──YES──│ Replace the current │
        └────────────────────┘           │        OK?         │          │     controller    │
              NO                          └────────────────────┘          └──────────────────┘
                 │                              NO
        ┌────────────────────┐           ┌────────────────────┐
        │ Input operation command │        │ Replace control board │
        └────────────────────┘           └────────────────────┘
                 │
        ┌────────────────────┐           ┌──────────────────┐
        │ Is FWD LED illuminated? │──NO──│ Replace control board │
        └────────────────────┘           └──────────────────┘
              YES
                 │
        ┌────────────────────┐
        │ Input frequency command │
        └────────────────────┘
                 │
        ┌────────────────────┐           ┌──────────────────┐
        │ Is the output frequency of the │──NO──│ Replace control board │
        │ operating unit displayed? │       └──────────────────┘
        └────────────────────┘
              YES
                 │
        ┌────────────────────┐           ┌──────────────────┐
        │ Is there Voltage at U,V and W │──NO──│ Replace control board │
        │    output terminals? │           └──────────────────┘
        └────────────────────┘                        │
                 │                            ┌────────────────────┐
        ┌────────────────────┐               │ Is the inverter operation OK │
        │ Connect the motor to run │◄──YES──│ after board replacement ? │
        └────────────────────┘               └────────────────────┘
                 │                                        │ NO
        ┌────────────────────┐                            │
        │ Any fault values displayed? │──────YES───────────┤
        └────────────────────┘                            │
              NO                                           │
                 │                                         ●
        ┌────────────────────┐                            │
        │ Is the output current of each │──────NO──────────┤
        │       phase even? │                              │
        └────────────────────┘                            │
              YES                             ┌──────────────────────┐
                 │                            │ The inverter is faulted │
        ┌────────────────────┐               │ (Perform detailed check) │
        │ The inverter's output is OK │        └──────────────────────┘
        └────────────────────┘
```

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```
                    ┌─────────────────────────────┐
                    │  The inverter displays OV, LV │
                    └─────────────────────────────┘
                                  │
                    ┌─────────────────────────────┐        NO      ┌──────────────────────────┐
                    │  Is the main circuit fuse intact ? ├──────────►│  Consult with the supplier │
                    └─────────────────────────────┘                └──────────────────────────┘
                                  │ YES
                    ┌─────────────────────────────┐        YES     ┌──────────────────────────┐
                    │   Any visual abnormalities?  ├──────────────►│  Consult with the supplier │
                    └─────────────────────────────┘                └──────────────────────────┘
                                  │ NO
                    ┌─────────────────────────────┐
                    │          Apply power         │
                    └─────────────────────────────┘
                                  │
                    ┌─────────────────────────────┐        YES     ┌──────────────────────────┐
                    │   Any abnormal indications?  ├──────────────►│  Consult with the supplier │
                    └─────────────────────────────┘                └──────────────────────────┘
                                  │
                    ┌─────────────────────────────┐
                    │    Input operation command   │
                    └─────────────────────────────┘
                                  │
                    ┌─────────────────────────────┐        NO      ┌──────────────────────────┐
                    │ Is FWD LED still illuminated after flash ├───►│  Consult with the supplier │
                    └─────────────────────────────┘                └──────────────────────────┘
                                  │ YES
                    ┌─────────────────────────────┐
                    │   Input frequency commands   │
                    └─────────────────────────────┘
                                  │
                    ┌─────────────────────────────┐        NO      ┌──────────────────────────┐
                    │ Is the output frequency of the ├─────────────►│  Replace the control board │
                    │ operating unit displayed?    │                └──────────────────────────┘
                    └─────────────────────────────┘
                                  │ YES
                    ┌─────────────────────────────┐   NO    ┌──────────────────┐
                    │ Is there Voltage at T1,T2,T3 ├────────►│ Replace the control │
                    │ output terminals?            │         │      board        │
                    └─────────────────────────────┘         └──────────────────┘
                                  │ YES                               │
                    ┌─────────────────────────────┐  YES   ┌──────────────────────────┐
                    │    Connect the motor to run  │◄───────┤ Is the inverter operation OK │
                    └─────────────────────────────┘        │ after board replacement?   │
                                  │ NO                      └──────────────────────────┘
                    ┌─────────────────────────────┐   YES            │ NO
                    │      Any abnormal value?     ├──────────────►  ●
                    └─────────────────────────────┘
                                  │ NO
                    ┌─────────────────────────────┐   NO
                    │ Is the current on all phases ├──────────────►  ●
                    │           even?              │
                    └─────────────────────────────┘
                                  │ YES                              │
                    ┌─────────────────────────────┐       ┌──────────────────────────┐
                    │  The inverter's output is OK │       │ Perform detailed check and │
                    └─────────────────────────────┘       │  consult with the supplier │
                                                          └──────────────────────────┘
```

GB

```
                    ┌─────────────────────────┐
                    │   The motor can not run  │
                    └─────────────────────────┘
                                 │
                    ┌─────────────────────────┐
                    │        Is MCCB On?       │─── YES ──┐
                    └─────────────────────────┘           │
                                 │ NO                      │
                    ┌─────────────────────────┐            │
                    │   Can MCCB be turned On? │── NO ──→  Short circuited wiring
                    └─────────────────────────┘            │
                                 │ YES                     │
                    ┌─────────────────────────┐            │
                    │ Are voltages between power│── NO ──→  1.The power is abnormal
                    │   terminals correct?      │           2.Incorrect wiring
                    └─────────────────────────┘
                                 │ YES
                    ┌─────────────────────────┐
                    │        Is LED lit?        │── NO ──→  INVfault
                    └─────────────────────────┘
                                 │ YES
                    ┌─────────────────────────┐
                    │ Is the operation switch   │── NO ──→  The operation switch is set to
                    │     in "RUN' ?            │           "RUN" position
                    └─────────────────────────┘
                                 │ YES
                    ┌─────────────────────────┐
                    │ Are there outputs between │── NO ──→  INVfault
                    │ the U,V, and W terminals  │
                    │      of the motor?        │
                    └─────────────────────────┘
                                 │ YES
                    ┌─────────────────────────┐
                    │ Are outputs between U,V,W │── NO ──→  INVfault
                    │       the same?           │
                    └─────────────────────────┘
                                 │ YES
                    ┌─────────────────────────┐
                    │ 1. Motor                  │
                    │ 2. Motor faults           │
                    │ 3. Incorrect  wiring      │
                    └─────────────────────────┘
```

4.3.5 MOTOR OVERHEATING

```
┌─────────────────────────────┐
│      Motor Overheating       │
└──────────────┬──────────────┘
               ▼
      ┌──────────────────┐                    ╭─────────────────────────────╮
      │ Is load or current│──── YES ────────▶ │ Consider reducing the load   │
      │ exceeding the     │                   │ and increasing the capacities│
      │ specified value?  │                   │ of the inverter and motor    │
      └────────┬─────────┘                    ╰─────────────────────────────╯
              NO
               ▼
      ┌──────────────────┐                    ╭─────────────────────────────╮
      │ Is motor running  │──── YES ────────▶ │   Select the motor again     │
      │ at low speed      │                   ╰─────────────────────────────╯
      │ for a long time?  │
      └────────┬─────────┘
              NO
               ▼
      ┌──────────────────┐                    ╭─────────────────────────────╮
      │ Is motor voltage  │──── NO ─────────▶ │         INV faults           │
      │ between U-V,V-W,   │                   ╰─────────────────────────────╯
      │ W-U correct?      │
      └────────┬─────────┘
              YES
               ▼
      ┌──────────────────┐                    ╭─────────────────────────────╮
      │ Is there any      │──── YES ────────▶ │    Clear the deterrence      │
      │ deterrence        │                   ╰─────────────────────────────╯
      │ preventing cooling│
      │ of the motor      │
      └────────┬─────────┘
              NO
               ▼
      ┌──────────────────┐                    ╭─────────────────────────────╮
      │ Bad connection    │──── YES ────────▶ │  Correct the bad connection  │
      │ between drive and │                   ╰─────────────────────────────╯
      │ the motor         │
      └──────────────────┘
```

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4.3.6 MOTOR RUNS UNBALANCED

```
                    ┌─────────────────────────┐
                    │   Motor runs unevenly   │
                    └─────────────────────────┘
                                │
                    ┌───────────────────┐              ┌───────────────────┐              ┌──────────────────────────┐
                    │ Does it happen    │──YES──────▶  │ Is the acceleration│──NO──────▶   │ Increase the Acc/ Dec time│
                    │ during eceleration?│             │ time correct?     │              └──────────────────────────┘
                    └───────────────────┘              └───────────────────┘
                            │ NO                               │ YES            ┌──────────────────────────────────┐
                            │                                  └──────────────▶│ Reduce the load.Increase         │
                            ▼                                                   │ capacities of INV and the motor. │
                    ┌───────────────────────┐                                  └──────────────────────────────────┘
                    │ Are the output voltages│
                    │ between U-V,V-W,W-U    │──NO──────────────────────────▶  ( INV faults )
                    │ balanced?             │
                    └───────────────────────┘
                            │ YES
                            ▼
                    ┌───────────────────────┐                          ┌──────────────────────────────┐
                    │ Is the load fluctuating?│──YES────────────────▶  │ Reduce the load fluctuation  │
                    └───────────────────────┘                          │ or add a flywheel.           │
                            │ NO                                        └──────────────────────────────┘
                            ▼
                    ┌───────────────────────┐                          ┌──────────────────────────────┐
                    │ Any mechanical vibration│──YES──────────────▶    │ Inspect the mechanical       │
                    │ or gear backlash       │                         │ system                       │
                    └───────────────────────┘                          └──────────────────────────────┘
                            │ NO
                            ▼
                    ( INV faults )
```

4.4 ROUTINE AND PERIODIC INSPECTION

To ensure stable and safe operations, check and maintain the drive at regular intervals.
Use the checklist below to carry out inspection.
Disconnect power after approximately 5 minutes to make sure no voltage is present on the output terminals before any inspection or maintenance.

Items	Details	Checking period		Methods	Criteria	Remedies
		Daily	1Year			
Environment & Ground connection						
Ambient conditions at the installation	Confirm the temperature and humidity at the machine	●		Measure with thermometer and hygrometer	Temperature: -10 ~40°C (14~120°F) Humidity: Below 95%RH	Improve the ambient or relocate the drive to a better area
Installation Grounding	Is the grounding resistance correct?		●	Measure the resistance with a multi-tester	200Vclass: below 100Ω	Improve the grounding if needed
Terminals & Wiring						
Connection terminals	Any loose parts or terminals?		●	Visual check Check with a screwdriver	Correct installation requirement	Secure terminals and remove rust
	Any damage to the base ?		●			
	Any corroded Terminals?		●			
Wiring	Any broken wires?		●	Visual check	Correct wiring requirement	Rectify as necessary
	Any damage to the wire insulation?		●			
Voltage						
Input power voltage	Is the voltage of the main circuit correct?	●		Measure the voltage with a multi-tester	Voltage must conform with the spec.	Improve input voltage if necessary
Circuit boards and components						
Printed circuit board	Any contamination or damage to printed circuit board?		●	Visual check	Correct component condition	Clean or replace the circuit board
Power component	Any dust or debris		●			Clean components
	Check resistance between terminals		●	Measure with a multi-tester	No short circuit or broken circuit in three phase output	Consult with the supplier
Cooling System						
Cooling fan	Unusual vibration and noise?		●	Visual and sound check	Correct cooling	Consult with the supplier
	Excessive dust or debris	●		Visual check		Clean the fan
Heat sink	Excessive dust or debris	●				Clean up debris or dust
Ventilation Path	Is the ventilation path blocked?	●				Clear the path

4.5 MAINTENANCE

To ensure long-term reliability, follow the instructions below to perform regular inspection. Turn the power off and wait for a minimum of 5 minutes before inspection to avoid potential shock hazard from the charge stored in high-capacity capacitors.

Maintenance Check List.

- Ensure that temperature and humidity around the drives is as required in the instruction manual, installed away from any sources of heat and the correct ventilation is provided.
- For replacement of a failed or damaged drive consult with the local supplier.
- Ensure that the installation area is free from dust and any other contamination.
- Check and ensure that the ground connections are secure and correct.
- Terminal screws must be tight, especially on the power input and output of the drive.
- Do not perform any insulation test on the control circuit.

5 PERIPHERALS COMPONENTS

5.1 REACTOR SPECIFICATIONS

Drive model	Specification	
	Current (A)	Inductance (mH) ❶
VT1 02 A240	4.9	4.48
VT1 04 A240	7.2	3.05
VT1 07 A240	11.0	2.00
VT1 15 A240	15.5	1.42
VT1 22 A240	21.0	1.05

❶ Calculated inductance based on 3% reactance.

5.2 FUSE SPECIFICATION

Drive model	HP	kW	Rating
VT1 02 A240	0.25	0.2	10A, 300VAC
VT1 04 A240	0.5	0.4	15A, 300VAC
VT1 07 A240	1	0.75	
VT1 15 A240	2	1.5	30A, 300VAC
VT1 22 A240	3	2.2	

5.3 FUSE SPECIFICATION (UL MODEL RECOMMENDED)

Drive model	Manufacture	Type	Rating
VT1 02 A240	Bussmann	10CT KLM-10	690V 10A 600V 10A
VT1 04 A240	Bussmann	10CT/16CT KLM-10 / KLM-15	690V 10A/690V 16A 600V 10A / 600V 15A
VT1 07 A240	Bussmann	16CT/20CT KLM-20	690V 16A/690V 20A 600V 20A
VT1 15 A240	Bussmann	30FE	690V 30A
VT1 22 A240	Bussmann	50FE	690V 50A

6 DIMENSIONS

Size 1 (0.2, 0.4, 0.75kW)

Size 2 (1.5, 2.2kW)
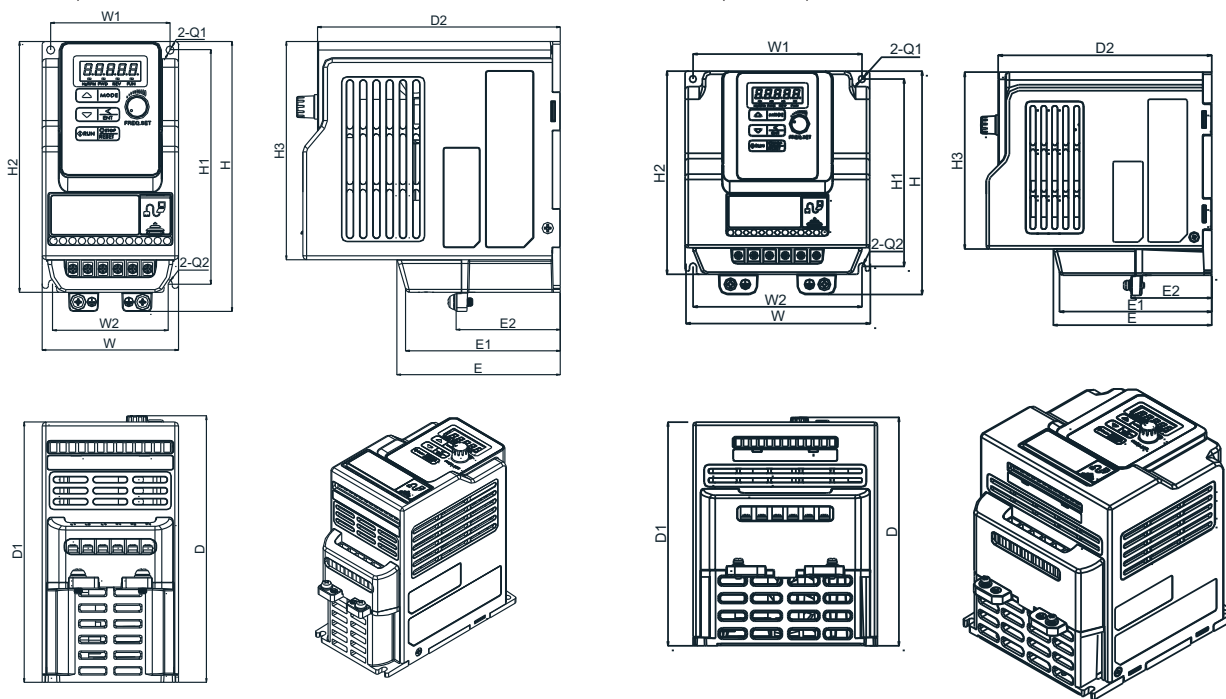
Size	Model	Dimension (mm)														
		W	W1	W2	H	H1	H2	H3	D	D1	D2	E	E1	E2	Q1	Q2
Size 1	VT1 02 A240 VT1 04 A240 VT1 07 A240	72	63	61	141	122	131	114	141	136	128	86	81	55	4.4	2.2
Size 2	VT1 15 A240 VT1 22 A240	118	108	108	144	121	131	114	150	144	136	101	96	51	4.4	2.2

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APPENDIX – INSTRUCTIONS FOR UL

◆ **SAFETY PRECAUTIONS**

⚠ DANGER
ELECTRICAL SHOCK HAZARD

Do not connect or disconnect wiring while the power is on.
Failure to comply will result in death or serious injury.

⚠ WARNING
ELECTRICAL SHOCK HAZARD

Do not operate equipment with covers removed.
Failure to comply could result in death or serious injury.
The diagrams in this section may show drives without covers or safety shields to show details. Be sure to reinstall covers or shields before operating the drives and run the drives according to the instructions described in this manual.

Always ground the motor-side grounding terminal.
Improper equipment grounding could result in death or serious injury by contacting the motor case.

Do not touch any terminals before the capacitors have fully discharged.
Failure to comply could result in death or serious injury.
Before wiring terminals, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

Do not allow unqualified personnel to perform work on the drive.
Failure to comply could result in death or serious injury.
Installation, maintenance, inspection, and servicing must be performed only by authorized personnel familiar with installation, adjustment, and maintenance of AC drives.

Do not perform work on the drive while wearing loose clothing, jewelry, or lack of eye protection.
Failure to comply could result in death or serious injury.
Remove all metal objects such as watches and rings, secure loose clothing, and wear eye protection before beginning work on the drive.

Do not remove covers or touch circuit boards while the power is on.
Failure to comply could result in death or serious injury.

FIRE HAZARD

Tighten all terminal screws to the specified tightening torque.
Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

Do not use an improper voltage source.
Failure to comply could result in death or serious injury by fire.
Verify that the rated voltage of the drive matches the voltage of the incoming power supply before applying power.

Do not use improper combustible materials.
Failure to comply could result in death or serious injury by fire.
Attach the drive to metal or other noncombustible material.

NOTICE

Observe proper electrostatic discharge procedures (ESD) when handling the drive and circuit boards.
Failure to comply may result in ESD damage to the drive circuitry.

Never connect or disconnect the motor from the drive while the drive is outputting voltage.
Improper equipment sequencing could result in damage to the drive.

Do not use unshielded cable for control wiring.
Failure to comply may cause electrical interference resulting in poor system performance. Use shielded twisted-pair wires and ground the shield to the ground terminal of the drive.

NOTICE

Do not modify the drive circuitry.
Failure to comply could result in damage to the drive and will void warranty.
Lovato Electric is not responsible for any modification of the product made by the user. This product must not be modified.

Check all the wiring to ensure that all connections are correct after installing the drive and connecting any other devices.
Failure to comply could result in damage to the drive.

◆ **UL STANDARDS**

The UL/cUL mark applies to products in the United States and Canada and it means that UL has performed product testing and evaluation and determined that their stringent standards for product safety have been met. For a product to receive UL certification, all components inside that product must also receive UL certification.

C ⓤⓁ US
LISTED
UL/cUL Mark

◆ **UL STANDARDS COMPLIANCE**
This drive is tested in accordance with UL standard UL508C and complies with UL requirements. To ensure continued compliance when using this drive in combination with other equipment, meet the following conditions:

INSTALLATION AREA
Do not install the drive to an area greater than pollution severity 2 (UL standard).

MAIN CIRCUIT TERMINAL WIRING
UL approval requires crimp terminals when wiring the drive's main circuit terminals. Use crimping tools as specified by the crimp terminal manufacturer.
The table below matches drives models with crimp terminals.

Closed-loop crimp terminal size

Drive model	Wire gauge mm² (AWG)	Terminal	Crimp terminal
VT102A240	1.3(16)	M3.5	R2-3.5
VT104A240	1.3(16)		
VT107A240	2.1 (14)		
VT115A240	3.3(12)	M4	R3.5-4
VT122A240	5.3(10)	M4	R5.5-4

◆ **TYPE 1**
During installation, all conduit hole plugs shall be removed, and all conduit holes shall be used.

Recommended Input Fuse Selection

Drive model	Fuse type	
	Model	Fuse rating (A)
VT102A240	Bussmann 10CT	690V 10A
VT104A240	Bussmann 10CT/16CT	690V 10A / 690V 16A
VT107A240	Bussmann 16CT/20CT	690V 16A / 690V 20A
VT115A240	Bussmann 30FE	690V 30A
VT122A240	Bussmann 50FE	690V 50A

FIELD WIRING TERMINALS
All input and output field wiring terminals not located within the motor circuit shall be marked to indicate the proper connections that are to be made to each terminal and indicate that copper conductors, rated 80°C are to be used.

DRIVE SHORT-CIRCUIT RATING
This drive has undergone the UL short-circuit test, which certifies that during a short circuit in the power supply the current flow will not rise above value. Please see electrical ratings for maximum voltage and table below for current.
– The MCCB and breaker protection and fuse ratings (refer to the preceding table) shall be equal to or greater than the short-circuit tolerance of the power supply being used.
– Suitable for use on a circuit capable of delivering not more than (A) RMS symmetrical amperes for (Hp) Hp in 240V class drives motor overload protection.

Horse Power (Hp)	Current (A)	Voltage (V)
0 - 50	5,000	240

DRIVE MOTOR OVERLOAD PROTECTION
Set parameter 02-01 (motor rated current) to the appropriate value to enable motor overload protection. The internal motor overload protection is UL listed and in accordance with the NEC and CEC.

02-01 MOTOR RATED CURRENT
Setting range: Model dependent
Factory default: Model dependent
Set 02-01 to the full load amps (FLA) stamped on the nameplate of the motor.
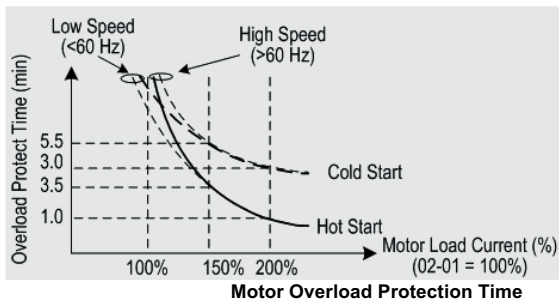
08-05 MOTOR OVERLOAD PROTECTION SELECTION
The drive has an electronic overload protection function (OL1) based on time, output current, and output frequency, which protects the motor from overheating. The electronic thermal overload function is UL-recognized, so it does not require an external thermal overload relay for single motor operation.
This parameter selects the motor overload curve used according to the type of motor applied.

Setting	Description
XXXX0	Disabled
XXXX1	Enabled

Sets the motor overload protection function in 08-05 according to the applicable motor.

Setting 08-05 = XXXX0 disables the motor overload protection function when two or more motors are connected to a single drive. Use an alternative method to provide separate overload protection for each motor such as connecting a thermal overload relay to the power line of each motor.

Motor Overload Protection Time

8-06 MOTOR OVERLOAD OPERATION SELECTION

Setting	Description
0	Free run to stop (default setting)
1	Alarm only

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