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You can read the recommendations in the user guide, the technical guide or the installation guide for HITACHI L300P. You'll find the answers to all your questions on the HITACHI L300P in the user manual (information, specifications, safety advice, size, accessories, etc.). Detailed instructions for use are in the User's Guide.

User manual HITACHI L300P  
User guide HITACHI L300P  
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Instructions for use HITACHI L300P  
Instruction manual HITACHI L300P

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## L300P Series Inverter Instruction Manual

- Three-phase Input 200V Class
- Three-phase Input 400V Class

U.S. Version Models



European Version Models



Manual Number: NB604XJ  
September 2006

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keep it handy for future reference.

Hitachi Industrial Equipment Systems Co., Ltd.



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**Manual abstract:**

Read the message and follow the instructions carefully. This symbol is the "Safety Alert Symbol." It occurs with either of two signal words: CAUTION or WARNING, as described below. WARNING: Indicates a potentially hazardous situation that, if not avoided, can result in serious injury or death. CAUTION: Indicates a potentially hazardous situation that, if not avoided, can result in minor to moderate injury, or serious damage to the product. The situation described in the CAUTION may, if not avoided, lead to serious results. Important safety measures are described in CAUTION (as well as WARNING), so be sure to observe them. STEP: A step is one of a series of action steps required to accomplish a goal. The number of the step will be contained in the step symbol. NOTE: Notes indicate an area or subject of special merit, emphasizing either the product's capabilities or common errors in operation or maintenance.

TIP: Tips give a special instruction that can save time or provide other benefits while installing or using the product. The tip calls attention to an idea that may not be obvious to first-time users of the product. Hazardous High Voltage HIGH VOLTAGE: Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock.

Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case an emergency occurs. Disconnect power before checking controllers or performing maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electronic controllers or rotating machinery.

ii General Precautions - Read These First! WARNING: This equipment should be installed, adjusted, and serviced by qualified electrical maintenance personnel familiar with the construction and operation of the equipment and the hazards involved. Failure to observe this precaution could result in bodily injury. WARNING: The user is responsible for ensuring that all driven machinery, drive train mechanism not supplied by Hitachi Industrial Equipment Systems Co., Ltd., and process line material are capable of safe operation at an applied frequency of 150% of the maximum selected frequency range to the AC motor. Failure to do so can result in destruction of equipment and injury to personnel should a single-point failure occur. WARNING: For equipment protection, install a ground leakage type breaker with a fast response circuit capable of handling large currents. The ground fault protection circuit is not designed to protect against personal injury. HIGH VOLTAGE: HAZARD OF ELECTRICAL SHOCK. DISCONNECT INCOMING POWER BEFORE WORKING ON THIS CONTROL.

WARNING: Wait at least five (5) minutes after turning OFF the input power supply before performing maintenance or an inspection. Otherwise, there is the danger of electric shock. CAUTION: These instructions should be read and clearly understood before working on L300P series equipment. CAUTION: Proper grounds, disconnecting devices and other safety devices and their location are the responsibility of the user and are not provided by Hitachi Industrial Equipment Systems Co., Ltd. CAUTION: Be sure to connect a motor thermal disconnect switch or overload device to the L300P series controller to assure that the inverter will shut down in the event of an overload or an overheated motor. HIGH VOLTAGE: Dangerous voltage exists until power light is OFF. Wait at least 5 minutes after input power is disconnected before performing maintenance. CAUTION: This equipment has high leakage current and must be permanently (fixed) hardwired to ground via two independent cables. WARNING: Rotating shafts and above-ground electrical potentials can be hazardous. Therefore, it is strongly recommended that all electrical work conform to the National Electrical Codes and local regulations. Installation, alignment and maintenance should be performed only by qualified personnel. Factory-recommended test procedures included in the instruction manual should be followed. Always disconnect electrical power before working on the unit. L300P Inverter iii CAUTION: a) Motor must be connected to protective ground via low resistive path (< 0.

1) b) Any motor used must be of a suitable rating. c) Motors may have hazardous moving parts. In this event suitable protection must be provided. CAUTION: Alarm connection may contain hazardous live voltage even when inverter is disconnected. When removing the front cover for maintenance or inspection, confirm that incoming power for alarm connection is completely disconnected.

CAUTION: Hazardous (main) terminals for any interconnection (motor, contact breaker, filter, etc.) must be inaccessible in the final installation. CAUTION: The end application must be in accordance with BS EN60204-1. Refer to the section "Step-by-Step Basic Installation" on page 26. The diagram dimensions are to be suitably amended for your application. CAUTION: Connection to field wiring terminals must be reliably fixed having two independent means of mechanical support. Using a termination with cable support (figure below), or strain relief, cable clamp, etc. Terminal (ring lug) Cable support Cable CAUTION: A three-pole disconnection device must be fitted to the incoming main power supply close to the inverter. Additionally, a protection device meeting IEC947-1/IEC947-3 must be fitted at this point (protection device data shown in "Determining Wire and Fuse Sizes" on page 214). NOTE: The above instructions, together with any other requirements are highlighted in this manual, and must be followed for continued LVD (European Low Voltage Directive) compliance.

iv Index to Warnings and Cautions in This Manual Installation--Cautions for Mounting Procedures CAUTION: Be sure to install the unit on flame-resistant material such as a steel plate. Otherwise, there is the danger of fire. CAUTION: Be sure not to place any flammable materials near the inverter. Otherwise, there is the danger of fire. CAUTION: Be sure not to let the foreign matter enter vent openings in the inverter housing, such as wire clippings, spatter from welding, metal shavings, dust, etc. Otherwise, there is the danger of fire. CAUTION: Be sure to install the inverter in a place that can bear the weight according to the specifications in the text (Chapter 1, Specifications Tables). Otherwise, it may fall and cause injury to personnel. CAUTION: Be sure to install the unit on a perpendicular wall that is not subject to vibration. Otherwise, it may fall and cause injury to personnel.

CAUTION: Be sure not to install or operate an inverter that is damaged or has missing parts. Otherwise, it may cause injury to personnel. CAUTION: Be sure to install the inverter in a well-ventilated room that does not have direct exposure to sunlight, a tendency for high temperature, high humidity or dew condensation, high levels of dust, corrosive gas, explosive gas, inflammable gas, grinding-fluid mist, salt air, etc.



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Otherwise, there is the danger of fire. CAUTION: Be sure to maintain the specified clearance area around the inverter and to provide adequate ventilation. Otherwise, the inverter may overheat and cause equipment damage or fire. ....

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. 27 Wiring--Warnings for Electrical Practices and Wire Specifications WARNING: "Use 60/75°C Cu wire only" or equivalent. ...

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213 WARNING: "Open Type Equipment." .....

.... 213 WARNING: "A Class 2 circuit wired with Class 1 wire" or equivalent.

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..... 213 WARNING: "Suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 240 V maximum." For models with suffix L.

WARNING: "Suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 480 V maximum." For models with suffix H.

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..... 213 L300P Inverter v HIGH VOLTAGE: Be sure to ground the unit. Otherwise, there is a danger of electric shock and/or fire.

HIGH VOLTAGE: Wiring work shall be carried out only by qualified personnel. Otherwise, there is a danger of electric shock and/or fire. HIGH VOLTAGE: Implement wiring after checking that the power supply is OFF. Otherwise, you may incur electric shock and/or fire. HIGH VOLTAGE: Do not connect wiring to an inverter or operate an inverter that is not mounted according the instructions given in this manual. Otherwise, there is a danger of electric shock and/or injury to personnel. ....

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..... 213 Wiring--Cautions for Electrical Practices CAUTION: Be sure that the input voltage matches the inverter specifications: · Three phase 200 to 240V 50/60Hz · Three phase 380 to 480V 50/ 60Hz CAUTION: Be sure not to power a three-phase-only inverter with single phase power. Otherwise, there is the possibility of damage to the inverter and the danger of fire.

CAUTION: Be sure not to connect an AC power supply to the output terminals. Otherwise, there is the possibility of damage to the inverter and the danger of injury and/or fire. ....

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. 219 Power Input L1 R L2 S L3 T Power Output T1 U T2 V T3 W NOTE: L1, L2, L3: Three-phase 200 to 240V 50/60 Hz Three-phase 380 to 480V 50/60 Hz vi CAUTION: Fasten the screws with the specified fastening torque in the table below. Check for any loosening of screws. Otherwise, there is the danger of fire. CAUTION: Remarks for using ground fault interrupter breakers in the main power supply: Adjustable frequency inverters with CE-filters (RFI-filter) and shielded (screened) motor cables have a higher leakage current toward Earth GND.

Especially at the moment of switching ON this can cause an inadvertent trip of ground fault interrupter breakers. Because of the rectifier on the input side of the inverter there is the possibility to stall the switch-off function through small amounts of DC current. Please observe the following: · Use only short time-invariant and pulse current-sensitive ground fault interrupter breakers with higher trigger current. · Other components should be secured with separate ground fault interrupter breakers. · Ground fault interrupter breakers in the power input wiring of an inverter are not an absolute protection against electric shock.

*CAUTION: Be sure to install a fuse in each phase of the main power supply to the inverter. Otherwise, there is the danger of fire. CAUTION: For motor leads, ground fault interrupter breakers and electromagnetic contactors, be sure to size these components properly (each must have the capacity for rated current and voltage). Otherwise, there is the danger of fire. CAUTION: Failure to remove all vent opening covers before electrical operation may result in damage to the inverter. ....*

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*220 Powerup Test Caution Messages CAUTION: The heat sink fins will have a high temperature. Be careful not to touch them. Otherwise, there is the danger of getting burned. CAUTION: The operation of the inverter can be easily changed from low speed to high speed. Be sure to check the capability and limitations of the motor and machine before operating the inverter. Otherwise, there is the danger of injury. CAUTION: If you operate a motor at a frequency higher than the inverter standard default setting (50Hz/60Hz), be sure to check the motor and machine specifications with the respective manufacturer. Only operate the motor at elevated frequencies after getting their approval. Otherwise, there is the danger of equipment damage.*

*CAUTION: It is possible to damage the inverter or other devices if your application exceeds the maximum current or voltage characteristics of a connection point. CAUTION: Be careful not to turn PID Clear ON and reset the integrator sum when the inverter is in Run Mode (output to motor is ON). Otherwise, this could cause the motor to decelerate rapidly, resulting in a trip. CAUTION: When the motor runs at lower speeds, the cooling effect of the motor's internal fan decreases. .*

*Be sure check the capability and limitations of the motor and machine before operating the inverter. Otherwise, it may cause injury to personnel. CAUTION: If you operate a motor at a frequency higher than the inverter standard default setting (50Hz/60Hz), be sure to check the motor and machine specifications with the respective manufacturer. Only operate the motor at elevated frequencies after getting their approval. Otherwise, there is the danger of equipment damage.*

*CAUTION: It is possible to damage the inverter or other devices if your application exceeds the maximum current or voltage characteristics of a connection point. CAUTION: Be careful not to turn PID Clear ON and reset the integrator sum when the inverter is in Run Mode (output to motor is ON). Otherwise, this could cause the motor to decelerate rapidly, resulting in a trip. CAUTION: When the motor runs at lower speeds, the cooling effect of the motor's internal fan decreases. .*

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*447 Warnings and Cautions for Troubleshooting and Maintenance WARNING: Wait at least five (5) minutes after turning OFF the input power supply before performing maintenance or an inspection. Otherwise, there is the danger of electric shock. WARNING: Make sure that only qualified personnel will perform maintenance, inspection, and part replacement. Before starting to work, remove any metallic objects from your person (wristwatch, bracelet, etc.).*

*Be sure to use tools with insulated handles. Otherwise, there is a danger of electric shock and/or injury to personnel. WARNING: Never remove connectors by pulling on its wire leads (wires for cooling fan and logic P.C. board). Otherwise, there is danger of fire due to wire breakage and/or injury to personnel. CAUTION: Do not connect the megger to any control circuit terminals such as intelligent I/O, analog terminals, etc. Doing so could cause damage to the inverter. CAUTION: Never test the withstand voltage (HIPOT) on the inverter. The inverter has a surge protector between the main circuit terminals above and the chassis ground.*

*WARNING: The screws that retain the capacitor bank assembly are part of the electrical circuit of the high-voltage internal DC bus. Be sure that all power has been disconnected from the inverter, and that you have waited at least 5 minutes before accessing the terminals or screws. Be sure the charge lamp is extinguished.*



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Otherwise, there is the danger of electrocution to personnel. ....

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..... 613 L300P Inverter ix CAUTION: Do not operate the inverter unless you have replaced the six screws that connect the capacitor bank assembly to the inverter's circuits. Otherwise, damage to the inverter may occur.

CAUTION: Remove the fan assembly carefully, since it is attached to the unit via connecting wires. HIGH VOLTAGE: Be careful not to touch wiring or connector terminals when working with the inverters and taking measurements. Be sure to place the measurement circuitry above in an insulated housing before using them. ....

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.. 616 General Warnings and Cautions WARNING: Never modify the unit. Otherwise, there is a danger of electric shock and/or injury. CAUTION: Withstand voltage tests and insulation resistance tests (HIPOT) are executed before the units are shipped, so there is no need to conduct these tests before operation.

CAUTION: Do not attach or remove wiring or connectors when power is applied. Also, do not check signals during operation. CAUTION: Do not stop operation by switching OFF electromagnetic contactors on the primary or secondary sides of the inverter. Power Input MCCB Ground fault interrupter Inverter GFI R, S, T L1, L2, L3 U, V, W Motor FW When there has been a sudden power failure while a Run command is active, then the unit may restart operation automatically after the power failure has ended. If there is a possibility that such an occurrence may harm humans, then install an electromagnetic contactor on the power supply side, so that the circuit does not allow automatic restarting after the power supply recovers.

If an optional remote operator is used and the retry function has been selected, this will also allow automatic restarting when a Run command is active. So, please be careful. x CAUTION: Do not insert leading power factor capacitors or surge absorbers between the output terminals of the inverter and motor. Ground fault interrupter Power Input L1, L2, L3 GFI R, S, T GND lug Leading power factor capacitor Inverter U, V, W Motor Surge absorber CAUTION: Be sure to connect the grounding terminal to earth ground. CAUTION: When inspecting the unit, be sure to wait five minutes after tuning OFF the power supply before opening the cover. CAUTION: SUPPRESSION FOR NOISE INTERFERENCE FROM INVERTER The inverter uses many semiconductor switching elements such as transistors and IGBTs. Thus, a radio receiver or measuring instrument located near the inverter is susceptible to noise interference. To protect the instruments from erroneous operation due to noise interference, they should be used well away from the inverter. It is also effective to shield the whole inverter structure. The addition of an EMI filter on the input side of the inverter also reduces the effect of noise from the commercial power line on external devices.

Note that the external dispersion of noise from the power line can be minimized by connecting an EMI filter on the primary side of inverter. EMI filter L1 Power source L2 L3 R1 S1 T1 R2 S2 T2 Inverter R S T U V W T1 T2 T3 Motor noise EMI filter Inverter Motor Grounded frame Completely ground the enclosed panel, metal screen, etc. with as short a wire as possible. Remote operator Conduit or shielded cable-- to be grounded L300P Inverter xi CAUTION: MOTOR TERMINAL VOLTAGE SURGE SUPPRESSION FILTER (For 400 V CLASS Inverters) In a system using an inverter with the voltage control PWM system, a voltage surge caused by the cable constants such as the cable length (especially when the distance between the motor and inverter is 10 m or more) and cabling method may occur at the motor terminals. A dedicated filter of the 400 V class for suppressing this voltage surge is available. Be sure to install a filter in this situation. (See "LCR filter" on page 52, part type HRLxxxC.) CAUTION: EFFECTS OF POWER DISTRIBUTION SYSTEMS ON INVERTERS In the cases below involving a general-purpose inverter, a large peak current can flow on the power supply side, sometimes destroying the converter module: 1.

The unbalance factor of the power supply is 3% or higher. 2.

The power supply capacity is at least 10 times greater than the inverter capacity (or the power supply capacity is 500 kVA or more). 3. Abrupt power supply changes are expected, due to conditions such as: a. Several inverters are interconnected with a short bus. b.

A thyristor converter and an inverter are interconnected with a short bus. c. An installed phase advance capacitor opens and closes. Where these conditions exist or when the connected equipment must be highly reliable, you MUST install an input-side AC reactor of 3% (at a voltage drop at rated current) with respect to the supply voltage on the power supply side. Also, where the effects of an indirect lightning strike are possible, install a lightning conductor.

CAUTION: Do not install inverters in a corner-grounded Delta distribution system. The resulting line imbalance will cause premature line fuse failure and failure of the inverter input bridge rectifier. Install in a balanced Delta or Wye distribution system only. CAUTION: When the EEPROM error E8 occurs, be sure to confirm the setting values again. CAUTION: When using normally closed active state settings (C011 to C019) for externally commanded Forward or Reverse terminals [FW] or [RV], the inverter may start automatically when the external system is powered OFF or disconnected from the inverter! So, do not use normally closed active state settings for Forward or Reverse terminals [FW] or [RV] unless your system design protects against unintended motor operation. CAUTION: Do not discard the inverter with household waste. Contact an industrial waste management company in your area who can treat industrial waste without polluting the environment. General Caution CAUTION: In all the illustrations in this manual, covers and safety devices are occasionally removed to describe the details. While operating the product, make sure that the covers and safety devices are placed as they were specified originally and operate it according to the instruction manual. xii UL® Cautions, Warnings, and Instructions Wiring Warnings for Electrical Practices and Wire Sizes The Cautions, Warnings, and instructions in this section summarize the procedures necessary to ensure an inverter installation complies with Underwriters Laboratories® guidelines.

*WARNING: "Use 60/75°C Cu wire only" or equivalent. WARNING: "Open Type Equipment." For models L300P900H to L300P1320H. WARNING: "Suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 240 V maximum." For models with suffix L. WARNING: "Suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 480 V maximum." For models with suffix H.*



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*Terminal Tighten- The wire size range and tightening torque for field wiring terminals are presented in the table below. ing Torque and Wire Size Input Voltage Motor Output HP 2 3 5 7.5 10 15 200V 20 25 30 40 50 60 75 100 kW 1.*

*5 2.2 3.7 5.5 7.5 11 15 18.*

*5 22 30 37 45 55 75 -015LFU2 -022LFU2 -037LFU2 -055LFU2 -075LFU2 -110LFU2 -150LFU2 -185LFU2 -220LFU2 -300LFU2 -370LFU2 -450LFU2 -550LFU2 -750LFU2 14 14 10 8 6 4 2 1 1/0 1/0 1/0 || 1/0 1/0 || 1/0 2/0 || 2/0 AWG 3/0 || 3/0 AWG Inverter Models, L300P Torque Wire Size Range (AWG) ft-lbs 1.1 1.1 1.1 1.8 1.*

*8 3.6 3.6 3.6 6.5 6.5 6.5 10.1 10.1 10.1 N-m 1.*

*5 1.5 1.5 2.5 2.5 4.9 4.9 4.9 8.8 8.8 8.*

*8 13.7 13.7 13.7 L300P Inverter Input Voltage Motor Output HP 2 3 5 7.5 10 15 20 25 kW 1.*

*5 2.2 4.0 5.5 7.5 11 15 18.*

*5 22 30 37 45 55 75 90 110 132 Inverter Models, L300P -015HFU2, HFE2 -022HFU2, HFE2 -040HFU2, HFE2 -055HFU2, HFE2 -075HFU2, HFE2 -110HFU2, HFE2 -150HFU2, HFE2 -185HFU2, HFE2 -220HFU2, HFE2 -300HFU2, HFE2 -370HFU2, HFE2 -450HFU2, HFE2 -550HFU2, HFE2 -750HFU2, HFE2 -900HFU2, HFE2 -1100HFU2, HFE2 -1320HFU2, HFE2 Torque Wire Size Range (AWG) ft-lbs 20 18 16 14 12 8 6 6 4 3 1 1 1/0 AWG 1/0 || 1/0 AWG 3/0 (1/0 || 1/0 AWG) 2/0 || 2/0 AWG 2/0 || 2/0 AWG 1.1 1.1 1.1 1.1 1.8 3.6 3.6 3.6 3.6 3.*

*6 3.6 6.5 6.5 6.5 10.1 10.1 10.1 N-m 1.5 1.5 1.*

*5 1.5 2.5 4.9 4.9 4.*

*9 4.9 4.9 4.9 8.8 8.*

*8 8.8 13.7 13.7 13.7 400V 30 40 50 60 75 100 125 150 175 xiv Fuse and Circuit Breaker Sizes Input Voltage Motor Output HP 2 3 5 7.5 10 15 20 25 200V 30 40 50 60 75 100 kW 1.5 2.2 3.7 5.5 7.*

*5 11 15 The inverter's input power wiring must include UL Listed, dual-element, 600V fuses, or UL Listed, inverse-time, 600V circuit breakers. Motor Output HP 2 3 5 7.5 10 15 20 25 400V 30 40 50 60 75 100 125 150 175 kW 1.5 2.2 4.0 5.5 7.5 11 15 Ampere Rating 200V Inverter Models, for Fuse or L300P Breaker -015LFU2 -022LFU2 -037LFU2 -055LFU2 -075LFU2 -110LFU2 -150LFU2 10 15 20 30 40 60 70 90 100 150 175 200 250 300 Input Voltage 400V Inverter Models, L300P -015HFU2, HFE2 -022HFU2, HFE2 -040HFU2, HFE2 -055HFU2, HFE2 -075HFU2, HFE2 -110HFU2, HFE2 -150HFU2, HFE2 -185LFU2 22 30 37 45 55 75 -220LFU2 -300LFU2 -370LFU2 -450LFU2 -550LFU2 -750LFU2 18.5 -185HFU2, HFE2 22 30 37 45 55 75 90 110 132 -220HFU2, HFE2 -300HFU2, HFE2 -370HFU2, HFE2 -450HFU2, HFE2 -550HFU2, HFE2 -750HFU2, HFE2 -900HFU2, HFE2 -1100HFU2, HFE2 -1320HFU2, HFE2 Wire Connectors WARNING: Field wiring connections must be made by a UL Listed and CSA Certified ring lug terminal connector sized for the wire gauge being used.*

*The connector must be fixed using the crimping tool specified by the connector manufacturer. Terminal (ring lug) Cable support Cable Motor Overload Protection Hitachi L300P inverters provide solid state motor overload protection, which depends on the proper setting of the following parameters: · B012 "electronic overload protection" · B212 "electronic overload protection, 2nd motor" Set the rated current [Amperes] of the motor(s) with the above parameters. The setting range is 0.2 \* rated current to 1.2 \* rated current.*

*WARNING: When two or more motors are connected to the inverter, they cannot be protected by the electronic overload protection. Install an external thermal relay on each motor. L300P Inverter xv Table of Contents Safety Messages Hazardous High Voltage General Precautions - Read These First! Index to Warnings and Cautions in This Manual General Warnings and Cautions UL® Cautions, Warnings, and Instructions i ii ix xii Table of Contents Revisions Contact Information xvii xviii Chapter 1: Getting Started Introduction L300P Inverter Specifications Introduction to Variable-Frequency Drives Frequently Asked Questions 12 16 116 120 Chapter 2: Inverter Mounting and Installation Orientation to Inverter Features Basic System Description Step-by-Step Basic Installation Powerup Test Using the Front Panel Keypad 22 25 26 221 223 Chapter 3: Configuring Drive Parameters Choosing a Programming Device Using Keypad Devices "D" Group: Monitoring Functions "F" Group: Main Profile Parameters "A" Group: Standard Functions "B" Group: Fine-Tuning Functions "C" Group: Intelligent Terminal Functions "H" Group: Motor Constants Functions "P" Group: Expansion Card Functions "U" Group: User-selectable Menu Functions Programming Error Codes 32 33 36 38 39 328 343 356 357 359 360 Chapter 4: Operations and Monitoring Introduction Optional Alarm Output at Power Loss Connecting to PLCs and Other Devices Using Intelligent Input Terminals Using Intelligent Output Terminals Analog Input Operation Analog Output Operation Setting Motor Constants PID Loop Operation Configuring the Inverter for Multiple Motors 42 44 46 410 435 451 454 457 458 459 xvi Chapter 5: Inverter System Accessories Introduction Component Descriptions Dynamic Braking 52 53 56 Chapter 6: Troubleshooting and Maintenance Troubleshooting Monitoring Trip Events, History, & Conditions Restoring Factory Default Settings Maintenance and Inspection Warranty 62 65 69 610 618 Appendix A: Glossary and Bibliography Glossary Bibliography A2 A6 Appendix B: Serial Communications Introduction Communications Protocol Communications Reference Information B2 B5 B17 Appendix C: Drive Parameter Settings Tables Introduction Parameter Settings for Keypad Entry C2 C2 Appendix D: CEEMC Installation Guidelines CEEMC Installation Guidelines Hitachi EMC Recommendations D2 D4 Index L300P Inverter xvii Revisions Revision History Table No. Revision Comments Initial release of manual NB604X Date of Issue August 2001 December 2001 Operation Manual No. NB604X NB604XA 1 Added default terminal symbols to tables on 343, 348 Updated intelligent I/O wiring examples throughout Chapter 4 to use default terminals or otherwise least-used terminals Corrected alarm relay symbols in multiple pages in Chapter 4 Contents, Revisions, Index, Front cover update Updated company name on cover, contact page, nameplate photo Corrected graphs on pages 328 and 340 Made a few minor edits throughout Added ten new inverter sizes, models 015LFU2 to 075LFU2 and 015HFU2 to 075HFU2.*

*.. included updates to Safety section wire and fuse size tables, Chapter 1 specs tables and derating curves, Chapter 2 dimension drawings, Chapter 2 wire and fuse size tables, Chapter 2 input power diagrams For new xFU2 models, added new intelligent input [ROK] and new intelligent output [RMD] descriptions to Chapter 3 tables, Chapter 4 terminal listing and terminal description pages For new xFU2 models, added new function P050 to Chapter 3 descriptions and Appendix C parameter listing Changed xFU models references to xFU2 throughout Added index entries for new xFU2 functions Expanded derating curve graphs in Chapter 1 Corrected [FM] common terminal to [L] in Chapter 4 Analog Input section Updated wire and fuse sizes for larger horsepower models in Safety section tables and Chapter 2 tables Enhanced Chapter 5 text and diagrams for dynamic braking Other minor corrections / enhancements throughout Contents, Revisions, Index, Cover updates Minor miscellaneous edits Revisions, Cover updates Minor miscellaneous edits Revisions, Cover updates Minor miscellaneous edits Revisions, Cover updates Minor miscellaneous edits Revisions, Cover updates Minor miscellaneous edits Revisions, Cover updates Minor miscellaneous edits Revisions, Cover updates Minor miscellaneous edits Revisions, Cover updates Minor miscellaneous edits Revisions, Cover updates 2 May 2002 NB604XB 3 August 2002 NB604XC 4 5 6 7 8 9 10 November 2002 March 2003 March 2003 July 2003 December 2003 February 2006 September 2006 NB604XD NB604XE NB604XF NB604XG NB604XH NB604XI NB604XJ xviii Contact Information Hitachi America, Ltd.*



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NOTE: To receive technical support for the Hitachi inverter you purchased, contact the Hitachi inverter dealer from whom you purchased the unit, or the sales office or factory contact listed above. Please be prepared to provide the following inverter nameplate information: 1. Model 2. Date of purchase 3. Manufacturing number (MFG No).

4. Symptoms of any inverter problem If any inverter nameplate information is illegible, please provide your Hitachi contact with any other legible nameplate items. To reduce unpredictable downtime, we recommend that you stock a spare inverter. Getting Started 1 page In This Chapter..

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20 12 Introduction Getting Started Introduction Main Features Congratulations on your purchase of an L300P Series Hitachi inverter! This inverter drive features state-of-the-art circuitry and components to provide high performance. The housing footprint is exceptionally small, given the size of the corresponding motor. The Hitachi L300P product line includes more than twenty inverter models to cover motor sizes from 2 horsepower to 175 horsepower, in either 230 VAC or 480 VAC power input versions. The main features are: · 200V Class and 400V Class inverters · U.S. or European version available · Variable frequency control · Optional regenerative braking circuit · Different operator keypads available for RUN/ STOP control and setting parameters · Built-in RS-422 communications interface to allow configuration from a PC and for field bus external modules · Sixteen programmable speed levels · PID control adjusts motor speed automatically to maintain a process variable value The design of Hitachi inverters overcomes many of the traditional trade-offs between speed, torque and efficiency. The performance characteristics are: · Continuous operation at 100% rated torque within a 1:10 speed range (6/60 Hz / 5/50 Hz) without motor derating · Models up to and including 11kW and 15kW (15 and 20hp) have built-in dynamic braking units · Cooling fan has ON/OFF selection to provide longer life Model L300P-110HFE2 (European version) A full line of accessories from Hitachi is available to complete your motor control application. These include: · Digital remote operator keypad · Expansion card for digital inputs · Braking resistors · Radio noise filters · CE compliance filters · Additional factory I/O network interface cards (to be announced) Expansion Card - Digital Inputs Model L300P-110HFU2 (U.S. version) L300P Inverter 13 Digital Operator Interface Components The L300P Series inverters have a detachable keypad (called a digital operator) on the front panel of the housing.

The particular keypad that comes with the inverter depends on the country or continent corresponding to the particular model number. The standard digital operators occupy just part of the keypad recess in the panel. Therefore, the inverter comes with a snap-in panel filler plate that mounts below the keypad as shown. These detachable keypads can be mounted in a NEMA cabinet panel door cut-out, for example. Threaded metal inserts on the rear of the keypads facilitate this external mounting configuration. A short cable then connects the keypad unit to the connector in the inverter keypad recess. See Chapter 3 for information on how to install and use these keypads and cables. Getting Started Digital Operator OPE-SRE standard for -LFU2 and -HFU2 models The digital operator / copy unit is optional, and occupies the entire keypad recess when mounted. It has the additional capability of reading (uploading) the parameter settings in the inverter into its memory. Then you can install the copy unit on another inverter and write (download) the parameter settings into that inverter.

OEMs will find this unit particularly useful, as one can use a single copy unit to transfer parameter settings from one inverter to many. Other digital operator interfaces may be available from your Hitachi distributor for particular industries or international markets. Contact your Hitachi distributor for further details. Digital Operator OPE-SR standard for -HFE2 models Optional Digital Operator / Copy Unit SRW-0EX 14 Introduction Getting Started Removable Components The L300P Series inverters are designed for long life and ease of service. Several components are removable as shown below, aiding installation or parts replacement.

Details on how and when to remove these parts are in the referenced chapters. Fan Unit (See Chapter 6 for servicing) Digital Operator and Panel Filler Plate (See Chapter 3 for instructions) Auxiliary fan (on some models) Control Signal Terminal Block (See Chapter 4 for wiring) Capacitor Bank for DC Link (See Chapter 6 for servicing) Cable entry/exit plate (See Chapter 2 for instructions) L300P Inverter 15 Specifications The Hitachi L300P inverters have product specification and Agency labels located on the front and the right side of the housing, as pictured to the right. Be Approvals sure to verify that the specifications on the labels match your power source, motor, and application safety requirements. Getting Started Product Labels Regulatory agency approvals Specifications Inverter model number Motor capacity for this model Power Input Rating: frequency, voltage, phase, current Output Rating: frequency, voltage, current Manufacturing codes: lot number, date, etc. Model Number Convention The model number for a specific inverter contains useful information about its operating characteristics.

Refer to the model number legend below: L300P 110 H F U 2 Version number (1, 2, 3, ...) Restricted distribution: E=Europe, U=U.S., R=Japan Series name Configuration type F = with digital operator (keypad) Input voltage: H = three-phase 400V class L = three phase only, 200V class Applicable motor capacity in kW 015 = 1.



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5 kW 022 = 2.2 kW 037 = 3.7 kW 055 = 5.5 kW 075 = 7.

5 kW 110 = 11 kW 150 = 15 kW 185 = 18.5 kW 220 = 22 kW 300 = 30 kW 370 = 37 kW 450 = 45 kW 550 = 55 kW 750 = 75 kW 900 = 90 kW 1100 = 110 kW 1320 = 132 kW 16 L300P Inverter Specifications Getting Started L300P Inverter Specifications Tables for 200V class inverters Note that "General Specifications" on page 19 covers all L300P inverters, followed by footnotes for all specifications tables. Seven 200V models in the tables below (2 to 20 hp) have internal dynamic braking units (see "Dynamic Braking" on page 56). Item L300P, 200V models, U.S. version Applicable motor size, 4-pole \*2 HP kW Rated capacity (200/240V) kVA Rated input voltage Rated input current (A) Rated output voltage \*3 Rated output current (A) Efficiency at 100% rated output, % Watt loss, approximate (W) Dynamic braking approx. % torque, short time stop \*7 DC braking Weight kg / lb at 70% output at 100% output without ext. res. with external res. 8.

3 015LFU2 2 1.5 2.5 / 3.1 200V Class Specifications 022LFU2 3 2.2 3.

6 / 4.3 037LFU2 5 3.7 5.7 / 6.8 055LFU2 7.

5 5.5 8.3 / 9.9 075LFU2 10 7.5 11 / 13.3 3-phase: 200 to 240V ±10%, 50/60 Hz ±5% 12 18 26 35 3-phase (3-wire) 200 to 240V (corresponding to input voltage) 7.5 92.3 102 125 50% 200% 160% 100% 10.5 93.2 127 160 16.

5 94.0 179 235 20% 80% 24 94.4 242 325 32 94.6 312 425 Variable operating frequency, time, and braking force 3.5 / 7.7 3.5 / 7.7 3.5 / 7.7 3.

5 / 7.7 5 / 11 Item L300P, 200V models, U.S. version Applicable motor size, 4-pole \*2 HP kW Rated capacity (200/240V) kVA Rated input voltage Rated input current (A) Rated output voltage \*3 Rated output current (A) Efficiency at 100% rated output, % Watt loss, approximate (W) Dynamic braking approx. % torque, short time stop \*7 at 70% output at 100% output without ext.

res. with external res. and braking unit DC braking Weight kg / lb 48 110LFU2 15 11 15.2 / 18.

2 200V Class Specifications 150LFU2 20 15 20.0 / 24.1 185LFU2 25 18.5 25.2 / 30.3 220LFU2 30 22 29.4 / 35.3 300LFU2 40 30 39.1 / 46.9 3-phase: 200 to 240V ±10%, 50/60 Hz ±5% 64 80 94 124 3-phase (3-wire) 200 to 240V (corresponding to input voltage) 44 94.

8 435 600 10% 55% -- 58 94.9 575 800 10% 50% 25170% 73 95 698 975 10% 85 95 820 1150 10% -- 25150% 55110% 113 95 1100 1550 10% Variable operating frequency, time, and braking force 5 / 11 5 / 11 12 / 26.4 12 / 26.4 12 / 26.4 L300P Inverter 17 Item L300P, 200V models, U.S. version Applicable motor size \*2 HP kW Rated capacity (200/240V) kVA Rated input voltage Rated input current (A) Rated output voltage \*3 Rated output current (A) Efficiency at 100% rated output, % Watt loss, approximate (W) Dynamic braking approx. % torque, short time stop \*7 at 70% output at 100% output without external braking unit with external res. and braking unit 154 200V Class Specifications, continued Getting Started 370LFU2 50 37 48.4 / 58.

1 450LFU2 60 45 58.5 / 70.2 550LFU2 75 55 72.7 / 87.2 750LFU2 100 75 93.

5 / 112.2 3-phase: 200 to 240V ±10%, 50/60 Hz ±5% 186 231 297 3-phase (3-wire) 200 to 240V (corresponding to input voltage) 140 95.1 1345 1900 10% 4590% 169 95.1 1625 2300 10% 3575% 210 95.1 1975 2800 10% 3060% 270 95.

1 2675 3800 10% 3060% DC braking Weight kg / lb Variable operating frequency, time, and braking force 20 / 44 30 / 66 30 / 66 50 / 110 Tables for 400V class inverters Note that "General Specifications" on page 19 covers all L300P inverters, followed by footnotes for all specifications tables. Seven 400V models in the tables below (2 to 20 hp) have internal dynamic braking units (see "Dynamic Braking" on page 56). Item 400V Class Specifications U.S. version European ver. HP kW 015HFU2 015HFE2 2 1.5 2.6 / 3.1 022HFU2 022HFE2 3 2.2 3.

6 / 4.4 040HFU2 040HFE2 5 4.0 5.9 / 7.1 055HFU2 055HFE2 7.5 5.5 8.3 / 9.9 075HFU2 075HFE2 10 7.5 11 / 13.

3 L300P inverters, 400V models Applicable motor size \*2 Rated capacity (400 / 480V) kVA Rated input voltage Rated input current (A) Rated output voltage \*3 Rated output current (A) Efficiency at 100% rated output, % Watt loss, approximate (W) Dynamic braking approx. % torque, short time stop \*7 DC braking Weight kg / lb at 70% output at 100% output without ext. res. with external res. 3-phase (3-wire) 380 to 480V ±10%, 50/60 Hz ±5% 4.

2 5.8 9.5 13 18 3-phase (3-wire): 380 to 480V (corresponding to input voltage) 3.8 92.3 102 125 50% 200% 140% 5.

3 93.2 127 160 8.6 94.0 179 235 20% 100% 12 94.4 242 325 16 94.6 312 425 Variable operating frequency, time, and braking force 3.5 / 7.7 3.5 / 7.7 3.

5 / 7.7 3.5 / 7.7 55 / 121 18 L300P Inverter Specifications Item Getting Started L300P inverters, 400V models U.S. version European ver. HP kW Rated capacity (400 / 480V) kVA Rated input voltage Rated input current (A) Rated output voltage \*3 Rated output current (A) Efficiency at 100% rated output, % Watt loss, approximate (W) Dynamic braking approx. % torque, short time stop \*7 at 70% output at 100% output without ext. res. with external res. with external res. and braking unit DC braking Weight kg / lb 5 / 11 24 110HFU2 110HFE2 15 11 400V Class Specifications 150HFU2 150HFE2 20 15 185HFU2 185HFE2 25 18.5 220HFU2 220HFE2 30 22 300HFU2 300HFE2 40 30 370HFU2 370HFE2 50 37 Applicable motor size \*2 15.2 / 18.2 20.

0 / 24.1 25.6 / 30.7 29.7 / 35.

7 39.4 / 47.3 48.4 / 58.1 3-phase (3-wire) 380 to 480V ±10%, 50/60 Hz ±5% 32 41 47 63 77 3-phase (3-wire): 380 to 480V (corresponding to input voltage) 22 94.8 435 600 10% 55% -- 29 94.9 575 800 10% 50% 40200% 35200% 37 95 698 975 10% 43 95 820 1150 10% -- 110170% 90150% 57 95 1100 1550 10% 70 95.1 1345 1900 10% Variable operating frequency, time, and braking force 5 / 11 12 / 26.4 12 / 26.4 12 / 26.

4 20 / 44 Item L300P inverters, 400V models U.S. version European ver. HP kW Rated capacity (400 / 480V) kVA Rated input voltage Rated input current (A) Rated output voltage \*3 Rated output current (A) Efficiency at 100% rated output, % Watt loss, approximate (W) Dynamic braking approx. % torque, short time stop \*7 at 70% output at 100% output without external braking unit with external res. and braking unit 85 95.1 1625 2300 10% 70120% 94 450HFU2 450HFE2 60 45 58.8 / 70.1 550HFU2 550HFE2 75 55 72.7 / 87.

2 400V Class Specifications 750HFU2 750HFE2 100 75 93.5 / 112 900HFU2 900HFE2 125 90 111 / 133 1100HFU2 1100HFE2 150 110 135 / 162 1320HFU2 1320HFE2 175 132 159 / 191 Applicable motor size \*2 3-phase (3-wire) 380 to 480V ±10%, 50/60 Hz ±5% 116 149 176 215 253 3-phase (3-wire): 380 to 480V (corresponding to input voltage) 105 95.1 1975 2800 10% 60100% 135 95.1 2675 3800 10% 4570% 160 95.2 3375 4800 10% 4060% 195 95.

2 3900 5550 10% 3050% 230 95.2 4670 6650 10% 2540% DC braking Weight kg / lb 30 / 66 Variable operating frequency, time, and braking force 30 / 66 30 / 66 60 / 132 60 / 132 80 / 176 L300P Inverter 19 General Specifications Item The following table (continued on next page) applies to all L300P inverter models.



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Getting Started General Specifications Models L300P015xxx to 750xxx: IP20 (NEMA 1) Models L300P900xx to 1320xxx: IP00 Line-to-line sine wave pulse-width modulation (PWM) control 0.1 to 400 Hz Digital command:  $\pm 0.01\%$  of the maximum frequency Analog command:  $\pm 0$ . 2% (25°C  $\pm 10^\circ\text{C}$ ) Digital:  $\pm 0.01$  Hz; Analog: (max. frequency)/4000, [O] terminal: 12-bit, 0 to 10V; [OI] terminal: 12-bit, 4-20mA; 12 bit [O2] terminal: 12 bit 10 to +10V V/F optionally variable (30 to 400Hz base frequency), V/F control (constant torque, reduced torque) 120% for 60 seconds, 150% for 0.5 seconds 0.01 to 3600 sec., (linear curve profiles, accel./decel. selection), two-stage accel./decel. Up and Down keys / Value settings Analog setting via potentiometer on operator keypad Protective enclosure \*1 \*11 Control method Output frequency range \*4 Frequency accuracy Frequency setting resolution Volt.

/Freq. characteristic Overload capacity (output current) Acceleration/deceleration time Input signal Freq. setting Operator keypad Potentiometer External signal \*8 0 to 10 VDC (input impedance 10k Ohms), 4 to 20 mA (input impedance 250 Ohms), Potentiometer (1k to 2k Ohms, 2W) Serial port FW/RV Run Operator panel External signal RS485 interface Run key / Stop key (change FW/RV by function command) FW Run/Stop (NO contact), RV set by terminal assignment (NC/NO), 3-wire input available RV (reverse run/stop), CF1~CF4 (multi-speed select), JG (jogging), DB (external DC braking), SET (set 2nd motor data), 2CH (2-stage accel./decel.), FRS (free-run stop), EXT (external trip), USP (unattended start protection), CS (commercial power source), SFT (software lock), AT (analog input voltage/current select), RS (reset inverter), STA (start, 3-wire interface), STP (stop, 3-wire interface), F/R (FW/RV 3-wire interface), PID (PID ON/OFF), PIDC (PID reset), CAS (control gain setting), UP (remote control Up function, motorized speed pot.), DWN (remote control Down function, motorized speed pot.), UDC (remote control data clearing), OPE (Operator control), SF1-SF7 (Multispeed bits 0-7), OLR (Overload limit change) One terminal (PTC characteristics) RUN (run signal), FA1 (Frequency arrival type 1 constant speed), FA2 (Frequency arrival type 2 over-frequency), OL (overload advance notice signal 1), OD (Output deviation for PID control), AL (alarm signal), FA3 (Frequency arrival type 3 at frequency), IP (Instantaneous power failure signal), UV (Under-voltage signal), RNT (Run time over), ONT (Power-ON time over), THM (thermal alarm) Analog voltage monitor, analog current monitor (8-bit resolution), and PWM output, on terminals [AM], [AMI], and [FM] Output frequency, output current, motor torque, scaled value of output frequency, trip history, I/O terminal condition, input power, output voltage V/F free-setting (up to 7 points), frequency upper/lower limit, frequency jump, accel/ decel curve selection, manual torque boost value and frequency adjustment, analog meter tuning, start frequency, carrier frequency, electronic thermal protection level, external frequency output zero/span reference, external frequency input bias start/end, analog input selection, retry after trip, restart after instantaneous power failure, overload restriction, default value setting (US, Europe, Japan) Models L300P015xxx to 750xxx: 0.5 to 12 kHz Models L300P900Hxx to 1320Hxx: 0.5 to 8 kHz Intelligent Input terminals (assign eight functions to terminals) Thermistor input Output signal Intelligent Output terminals (assign three functions to two relay N.O.

(1 Form A) outputs and one relay N.O.N.C. (1 Form C) contact Intelligent monitor output terminals Display monitor Other user-settable parameters Carrier frequency range 110 L300P Inverter Specifications Getting Started Item Protective functions General Specifications Over-current, overload, braking resistor overload, over-voltage, EEPROM error, undervoltage error, CT (current transformer) error, CPU error, external trip, USP error, ground fault, input over-voltage, instantaneous power failure, inverter thermal trip, phase failure detection, IGBT error, thermistor error, expansion card 1 error, expansion card 2 error, under-voltage waiting error Operating (ambient): -10 to 40°C / Storage: -20 to 65°C 20 to 90% humidity (non-condensing) Models L300P110xxx to 300xxx: 5.

9 m/s<sup>2</sup> (0.6G), 10 to 55 Hz Models L300P370xx to 1320xxx: 2.94 m/s<sup>2</sup> (0.3G), 10 to 55 Hz Altitude 1,000 m or less, indoors (no corrosive gasses or dust) Models L300P110xxx to 750xxx: Blue (D.I C14 version No. 436) Models L300P900xx to 1320xxx: Gray (MUNSELL 8.5YR6.2/0.2) SJ-DG (4-digit BCD / 16-bit binary) EMI filters, input/output reactors, DC reactors, radio noise filters, braking resistors, braking units, LCR filter, communication cables, factory I/O network interface cards OPESRE (4-digit LED with potentiometer) / OPES (4-digit LED w/o potentiometer), Optional: OPE-SR (4-digit LED with potentiometer, Japanese/English overlay), SRW0EX Multilingual operator with copy function (English, French, German, Italian, Spanish, and Portuguese) Environment Temperature \*10 Humidity Vibration \*7 Location \*8 Coating color Accessories Digital input PCB Others Operator input devices \*9 Signal Ratings Detailed ratings are in "Specifications of Control and Logic Connections" on page 48. Ratings 24VDC supply, 100 mA maximum 27VDC maximum, 4.7k input impedance Relay type, normally open contacts (1 Form A) 250 VAC / 30 VDC, 5A (resistive load) maximum 250 VAC / 30 VDC, 1A (inductive load) maximum Minimum 5 VDC, 1mA Minimum thermistor power 100mW 0 to 10VDC, 1.2 mA max., 50% duty cycle 0 to 10VDC, 2 mA max. 4-20 mA, nominal load impedance 250 4 to 19.6 mA range, 20 mA nominal 0 to 9.

6 VDC range, 10VDC nominal, 12VDC max., input impedance 10 k 10VDC nominal, 10 mA maximum Maximum loads: 250VAC, 2A; 30VDC, 8A resistive load 250VAC, 0.2A; 30VDC, 0.6A inductive load Minimum loads: 100 VAC, 10mA; 5VDC, 100mA 250VAC, 1A; 30VDC 1A max. resistive load / 250VAC, 0.2A; 30VDC, 0.2A max. inductive load Min. loads: 100 VAC, 10mA; 5VDC, 100mA Signal / Contact Built-in power for inputs Intelligent (programmable) logic inputs Intelligent (programmable) logic outputs Thermistor input PWM output Voltage analog output Current analog output Analog input, current Analog input, voltage +10V analog reference Alarm relay, normally closed contacts Alarm relay, normally open contacts L300P Inverter 111 Footnotes for the preceding tables: Getting Started Note 1: The protection method conforms to JEM 1030. Note 2: The applicable motor refers to Hitachi standard 3-phase motor (4-pole).

When using other motors, care must be taken to prevent the rated motor current (50/60 Hz) from exceeding the rated output current of the inverter. Note 3: The output voltage decreases as the main supply voltage decreases (except when using the AVR function).



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*In any case, the output voltage cannot exceed the input power supply voltage. Note 4: To operate the motor beyond 50/60 Hz, consult the motor manufacturer for the maximum allowable rotation speed. Note 5: The braking resistor is not installed in the inverter.*

*When your application requires a high regenerative torque, use the optional regenerative braking unit and resistor (see Chapter 5). Note 6: The storage temperature refers to the short-term temperature during transport. Note 7: Conforms to the test method specified in JIS C0911 (1984). For the model types excluded in the standard specifications, contact your Hitachi sales representative. Note 8: When using the inverter in a dust-prone area, we recommend the optional varnish coating specification for the inverter.*

*Note 9: When using a remote operator keypad and cable, be sure to remove the RJ45 modular interconnect from the inverter's keypad port before connecting the cable. Note 10: When using the inverter from 40° to 50°C ambient, the output current of the inverter must be derated (see the next section on derating curves). Note 11: NEMA 1 applies to inverter models up to 30kW (300xxx). An optional wire-entry conduit box is required for inverter models 37kW to 75kW (370 to 750xxx) to meet the NEMA 1 rating. 112 L300P Inverter Specifications Derating Curves Getting Started The maximum available inverter current output is limited by the carrier frequency and ambient temperature. The carrier frequency is the inverter's internal power switching frequency, settable from 0.5 kHz to 12 kHz, or 0.5 kHz to 8 kHz for higher horsepower models. Choosing a higher carrier frequency tends to decrease audible noise, but it also increases the internal heating of the inverter, thus decreasing (derating) the maximum current output capability. Ambient temperature is the temperature just outside the inverter housing--such as inside the control cabinet where the inverter is mounted.*

*A higher ambient temperature decreases (derates) the inverter's maximum current output capacity. Use the following derating curves to help determine the optimal carrier frequency setting for your inverter, and to find the output current derating. Be sure to use the proper curve for your particular L300P inverter model number. Legend: Output current at 40 °C ambient Output current at 50 °C ambient L300P 1.5 to 22 kW 200V class 100% % of Drive's Rated Amps 95% 90% 85% 80% 75% 70% 65% 60% 55% 0.5 2 4 6 8 10 12 220L 150L 110L 015L, 022L, 037L, 055L, 075L, 110L, 150L, 185L 220L 185L Carrier Frequency (kHz) L300P Inverter 113 Derating curves, continued... Getting Started L300P 30 to 37 kW 200V class 100% % of Drive's Rated Amps 95% 90% 85% 80% 75% 70% 65% 60% 55% 0.5 2 4 6 8 10 12 300L 370L 300L 370L Carrier Frequency (kHz) L300P 45 to 75 kW 200V class 100% % of Drive's Rated Amps 95% 90% 85% 80% 75% 70% 65% 60% 55% 0.*

*5 2 4 6 8 10 12 750L 450L 550L 750L 550L 750L 450L Carrier Frequency (kHz) 114 L300P Inverter Specifications Derating curves, continued... Getting Started L300P 1.5 to 22 kW 400V class % of Drive's Rated Amps 95% 90% 85% 80% 75% 70% 65% 60% 55% 0.*

*5 2 4 6 8 10 12 015H, 022H, 030H, 040H, 055H, 075H, 110H, 150H, 185H, 220H 185H, 220H 150H 110H Carrier Frequency (kHz) L300P 30 to 37 kW 400V class % of Drive's Rated Amps 95% 90% 85% 80% 75% 70% 65% 60% 55% 0.5 2 4 6 8 10 12 370H 370H 300H 300H Carrier Frequency (kHz) L300P Inverter 115 Derating curves, continued... Getting Started L300P 45 to 75 kW 400V class % of Drive's Rated Amps 95% 90% 85% 80% 75% 70% 65% 60% 55% 0.*

*5 2 4 6 8 10 450H, 550H 450H 550H 750H 750H 12 Carrier Frequency (kHz) L300P 90 to 132 kW 400V class 100% % of Drive's Rated Amps 95% 90% 85% 80% 75% 70% 65% 60% 55% 0.5 1 2 3 4 5 6 7 8 900H 900H 1100H, 1320H 1100H, 1320H Carrier Frequency (kHz) 116 Introduction to Variable-Frequency Drives Getting Started Introduction to Variable-Frequency Drives The Purpose of Motor Speed Control for Industry Hitachi inverters provide accurate speed control for 3-phase AC induction motors. You connect AC power to the inverter, and connect the inverter to the motor. Many applications can benefit from the use of variable-speed drives in several ways: · Energy savings - HVAC · Need to coordinate speed with an adjacent process - textiles and printing presses · Need to control acceleration and deceleration (torque) · Sensitive loads - elevators, food processing, pharmaceuticals What is an Inverter? The term inverter and variable-frequency drive are related and somewhat interchangeable. An electronic drive for an AC motor controls the motor's speed by varying the frequency of the power sent to the motor. An inverter, in general, is a device that converts DC power to AC power. The figure below shows how the variable-frequency drive employs an internal inverter. The drive first converts incoming AC power to DC through a rectifier bridge, creating an internal DC bus voltage. Then the inverter circuit converts the DC back to AC again to power the motor. The special inverter can vary its output frequency and voltage according to the desired motor speed.*

*Variable-frequency Drive Converter Internal DC Bus + L2/S Rectifier L3/T + U/T1 V/T2 W/T3 Inverter Motor Power Input L1/R The simplified drawing of the inverter shows three double-throw switches. In Hitachi inverters, the switches are actually IGBTs (isolated gate bipolar transistors). Using a commutation algorithm, the microprocessor in the drive switches the IGBTs ON and OFF at a very high speed to create the desired output waveforms. The inductance of the motor windings helps smooth out the pulses. Torque and Constant Volts/ Hertz Operation In the past, AC variable speed drives used an open loop (scalar) technique to control speed. The constant-volts-per-hertz operation maintains a constant ratio between the applied voltage and the applied frequency. With these conditions, AC induction motors inherently delivered constant torque across the operating speed range. For some applications, this scalar technique was adequate. Output voltage V 100% Constant torque f Today, with the advent of sophisticated micro0 processors and digital signal processors 100% Output frequency (DSPs), it is possible to control the speed and torque of AC induction motors with unprecedented accuracy. The L300P utilizes these devices to perform complex mathematical calculations required to achieve superior performance.*

*You can choose various torque curves to fit the needs of your application. Constant torque applies the same torque level across the frequency (speed) range. Variable torque, also called reduced torque, lowers the torque delivered at mid- L300P Inverter 117 level frequencies. A torque boost setting will add additional torque in the lower half of the frequency range for the constant and variable torque curves.*



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With the free-setting torque curve feature, you can specify a series of data points that will define a custom torque curve to fit your application. Getting Started Inverter Input and The Hitachi L300P Series of inverters includes two sub-groups: the 200V class and the 400V class inverters. The drives described in this manual may be used in either the United States or Three-Phase Europe, although the exact voltage level for commercial power may be slightly different from Power country to country. Accordingly, a 200V class inverter requires (nominal) 200 to 240VAC, and a 400V class inverter requires from 380 to 480VAC. All L300P inverters require three-phase input power, whether 200V or 400V class. TIP: If your application only has single phase power available, refer to the Hitachi L100 Series inverters.

L100 inverters of 3HP or less can accept single phase input power. The common terminology for single phase power is Line (L) and Neutral (N). Three-phase power connections are usually labeled Line 1 (L1), Line 2 (L2) and Line 3 (L3). In any case, the power source should include a ground connection. That ground connection will need to connect to the inverter chassis and to the motor frame (see "Wire the Inverter Output to Motor" on page 220). Inverter Output to The AC motor must be connected only to the inverter's output terminals. The output terminals are uniquely the Motor labeled (to differentiate them from the input terminals) with the designations U/T1, V/T2, and W/T3. This corresponds to typical motor lead connection designations T1, T2, and T3. It is often not necessary to connect a particular inverter output to a particular motor lead for a new application. The consequence of swapping any two of the three connections is the reversal of the motor direction.

In applications where reversed rotation could cause equipment damage or personnel injury, be sure to verify direction of rotation before attempting full-speed operation. For safety to personnel, you must connect the motor chassis ground to the ground connection at the bottom of the inverter housing. U/T1 3-Phase

AC Motor V/T2 Earth GND W/T3 Notice the three connections to the motor do not include one marked "Neutral" or "Return." The motor represents a balanced "Y" impedance to the inverter, so there is no need for a separate return. In other words, each of the three "Hot" connections serves also as a return for the other connections, because of their phase relationship. The Hitachi inverter is a rugged and reliable device. The intention is for the inverter to assume the role of controlling power to the motor during all normal operations. Therefore, this manual instructs you not to switch OFF power to the inverter while the motor is running (unless it is an emergency stop). Also, do not install or use disconnect switches in the wiring from the inverter to the motor (except thermal disconnect). Of course, safety-related devices such as fuses must be in the design to break power during a malfunction, as required by NEC and local codes.

118 Introduction to Variable-Frequency Drives Getting Started Intelligent Functions and Parameters Much of this manual is devoted to describing how to use inverter functions and how to configure inverter parameters. The inverter is microprocessor-controlled, and has many independent functions. The microprocessor has an on-board EEPROM for parameter storage. The inverter's front panel keypad provides access to all functions and parameters, which you can access through other devices as well. The general name for all these devices is the digital operator, or digital operator panel.

Chapter 2 will show you how to get a motor running, using a minimal set of function commands or configuring parameters. The optional read/write programmer will let you read and write inverter EEPROM contents from the programmer. This feature is particularly useful for OEMs who need to duplicate a particular inverter's settings in many other inverters in assembly-line fashion. Braking In general, braking is a force that attempts to slow or stop motor rotation. So it is associated with motor deceleration, but may also occur even when the load attempts to drive the motor faster than the desired speed (overhauling).

If you need the motor and load to decelerate quicker than their natural deceleration during coasting, we recommend installing a braking resistor. The dynamic braking unit (built into certain L300P models) sends excess motor energy into a resistor to slow the motor and load (see "Introduction" on page 52 and "Dynamic Braking" on page 56 for more information). For loads that continuously overhaul the motor for extended periods of time, the L300P may not be suitable (contact your Hitachi distributor). The inverter parameters include acceleration and deceleration, which you can set to match the needs of the application. For a particular inverter, motor, and load, there will be a range of practically achievable accelerations and decelerations. Velocity Profiles The L300P inverter is capable of sophisticated speed control. A graphical representation of that capability will help you understand and configure the associated parameters. This manual makes use of the velocity profile graph used in industry (shown at right). In the example, the acceleration is a ramp to a set speed, and the deceleration is a decline to a stop. Speed Fixed speed Accel Decel t Velocity Profile L300P Inverter 119 Acceleration and deceleration settings specify the time required to go from a stop to maximum frequency (or visa versa).

The Speed resulting slope (speed change divided by time) is the acceleration or deceleration. An increase in output frequency uses the acceleration slope, while a decrease uses the deceleration slope. The accel or decel time a particular speed change depends on the starting and ending frequencies. However, 0 the slope is constant, corresponding to the full-scale accel or decel time setting. For example, the full-scale acceleration setting (time) may be 10 seconds--the time required to go from 0 to 60 Hz. The L300P inverter can store up to 16 preset speeds. And, it can apply separate acceleration and deceleration transitions from any preset to any other preset speed. A multispeed profile (shown at right) uses two or more preset speeds, which you can select via intelligent input terminals. This external control can apply any preset speed at any time. Alternatively, the selected speed is infinitely variable across the speed range.

You can use the potentiometer control on the keypad for manual control. The drive accepts analog 0-10V signals and 4-20 mA control signals as well. The inverter can drive the motor in either direction. Separate FW and RV commands select the direction of rotation. The motion profile example shows a forward motion followed by a reverse motion of shorter duration.



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