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You can read the recommendations in the user guide, the technical guide or the installation guide for HITACHI L200-2. You'll find the answers to all your questions on the HITACHI L200-2 in the user manual (information, specifications, safety advice, size, accessories, etc.). Detailed instructions for use are in the User's Guide.

User manual HITACHI L200-2  
User guide HITACHI L200-2  
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Instruction manual HITACHI L200-2

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## L200<sub>2</sub> Series Inverter Instruction Manual

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



Manual Number: NB675X  
Sept. 2006

After reading this manual,  
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. **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. **1 Step 1:** Indicates a step in 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. **WARNING: 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 L2002 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 L2002 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 five (5) minutes after input power is disconnected before performing maintenance. **WARNING:** This equipment has high leakage current and must be permanently (fixed) hard-wired to earth ground via two independent cables. **L2002 Inverter iii 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. **CAUTION:** a) Class I motor must be connected to earth 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:** This equipment should be installed in IP54 or equivalent (see EN60529) enclosure. The end application must be in accordance with BS EN60204-1. Refer to the section "Choosing a Mounting Location" on page 29. 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. Use a termination with cable support (figure below), or strain relief, cable clamp, etc. Terminal (ring lug) Cable support Cable **CAUTION:** A double-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 217). **NOTE:** The above instructions, together with any other requirements highlighted in this manual, must be followed for continued LVD (European Low Voltage Directive) compliance. **iv Index to Warnings and Cautions in This Manual Cautions and Warnings for Orientation and Mounting Procedures CAUTION:** Hazard of electrical shock.

Disconnect incoming power before working on this control. Wait five (5) minutes before removing the front cover. **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.



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**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 damage, etc. 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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.... 210 Wiring - Warnings for Electrical Practices and Wire Specifications **WARNING:** "Use 60/75°C Cu wire only" or equivalent.

..... 216 **WARNING:** "Open Type Equipment." .....

. 216 **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 N or L. .... 216 L2002 Inverter v **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.

**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 to the instructions given in this manual. Otherwise, there is a danger of electric shock and/or injury to personnel. **WARNING:** Make sure the input power to the inverter is OFF. If the drive has been powered, leave it OFF for five minutes before continuing.

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216 .... 222 Wiring - Cautions for Electrical Practices **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:** Be sure that the input voltage matches the inverter specifications: · Single/Three phase 200 to 240 V 50/60 Hz (up to 2.2kW) for NFEF/NFU models · Three phase 200 to 240V 50/60Hz (above 2.2kW) for LFU models · Three phase 380 to 480 V 50/60Hz for HFEF models **CAUTION:** If you power a 3-phase-only inverter with single phase power, you must derate the output current.

Be sure to call your Hitachi distributor for assistance. Otherwise, there is the possibility of damage to the inverter and the danger of fire. .... 218 ....

220 .... 220 L2002 Inverter Power Input Output to Motor vi **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. **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 interrupters. 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 interrupters with higher trigger current.

· Other components should be secured with separate ground fault interrupters. · Ground fault interrupters 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. ....

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**WARNING:** After the Reset command is given and the alarm reset occurs, the motor will restart suddenly if the Run command is already active. Be sure to set the alarm reset after verifying that the Run command is OFF to prevent injury to personnel. ...

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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 sure to turn OFF power to the inverter before changing the SR/SK switch position. Otherwise, damage to the inverter circuitry may occur. 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. .*

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42 ..... 44 ...  
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.... 428 L2002 Inverter ix 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.



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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 a 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. **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 components above in an insulated housing before using them. ....

.. 62 ...  
... 62 ..  
.... 62 .... 610 ..

.. 610 .... 614 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:** 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:** 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.

**CAUTION:** Do not stop operation by switching OFF electromagnetic contactors on the primary or secondary sides of the inverter. Ground fault interrupter Power Input L1, L2, L3 Inverter PCS U, V, W Motor FW When there has been a sudden power failure while an operation instruction 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 (Mgo) on the power supply side, so that the circuit does not allow automatic restarting after the power supply recovers. If the optional remote operator is used and the retry function has been selected, this will also cause automatic restarting when a Run command is active. So, please be careful.

**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 Inverter U, V, W Surge absorber Motor GND lug Leading power factor capacitor **CAUTION: MOTOR TERMINAL SURGE VOLTAGE SUPPRESSION FILTER (For the 400 V CLASS)** 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. L2002 Inverter

**CAUTION: EFFECTS OF POWER DISTRIBUTION SYSTEM ON INVERTER** 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: 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 R1 S1 T1 R2 S2 T2 Inverter L1 L2 L3 U V W Motor noise EMI Filter Inverter Motor Completely ground the enclosed panel, metal screen, etc. with as short a wire as possible.

Remote Operator Grounded frame Conduit or shielded cable--to be grounded xii **CAUTION:** When the EEPROM error E08 occurs, be sure to confirm the setting values again. **CAUTION:** When using normally closed active state settings (C011 to C015) 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:** 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. UL® Cautions, Warnings, and Instructions Wiring Warnings for Electrical Practices and Wire Sizes The 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." **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 N or 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. **WARNING:** "Hot surface--risk of burn." **WARNING:** "Install device in pollution degree 2 environment.



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" WARNING: "Maximum Surrounding Air Temperature 50°C" or equivalent. WARNING: "Risk of electric shock--capacitor discharge time is at least 5 minutes.

" WARNING: "Solid state motor overload protection is provided in each model." WARNING: "Tightening torque and wire range for field wiring terminals are marked adjacent to the terminal or on the wiring diagram." L2002 Inverter xiii Terminal Tightening Torque and Wire Size The wire size range and tightening torque for field wiring terminals are presented in the tables below. Input Voltage Motor Output Inverter Model kW 0.2 0.4 0.55 0.75 200V 1.1 1.5 2.

2 3 7 5.5 7.5 0.4 0.

75 1.5 400V 2.2 3.0 4.0 5.

5 7.5 HP 1/4 1/2 3/4 1 1 1/2 2 3 5 7 1/2 10 1/2 1 2 3 4 5 7 1/2 10 L200-002NFE(F)2/NFU2 L200-004NFE(F)2/NFU2 L200-005NFE(F)2 L200-007NFE(F)2/NFU2 L200-011NFE(F)2 L200-015NFE(F)2/NFU2 L200-022NFE(F)2/NFU2 L200-037LFU2 L200-055LFU2 L200-075LFU2 L200-004HFE(F)2/HFU2 L200-007HFE(F)2/HFU2 L200-015HFE(F)2/HFU2 L200-022HFE(F)2/HFU2 L200-030HFE(F)2 L200-040HFE(F)2/HFU2 L200-055HFE(F)2/HFU2 L200-075HFE(F)2/HFU2 14 16 0.9 1.2 14 12 10 8 1.5 2.0 0.9 1.2 16 0.6 0.8 Power Terminal Wiring Size Range (AWG) Torque ft-lbs (N-m) 12 1.

5 2.0 Terminal Connector Logic/Analog connector Relay connector Wiring Size Range (AWG) 30--16 30--14 Torque ft-lbs (N-m) 0.16--0.19 0.22--0.25 0.37--0.44 0.5--0.6 Wire Connectors WARNING: Field wiring connections must be Terminal (ring lug) 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. Cable support Cable xiv Fuse and Circuit Breaker Sizes The inverter's input power wiring must include UL Listed, dual-element, 600V fuses, or UL Listed, inverse-time, 600V circuit breakers. Input Voltage Motor Output Inverter Model kW 0.2 0.4 0.

55 0.75 1.1 200V 1.5 2.2 3.

7 5.5 7.5 0.4 0.75 1.5 400V 2.2 3.0 4.0 5.5 7.

5 HP 1/4 1/2 3/4 1 1 1/2 2 3 5 7 1/2 10 1/2 1 2 3 4 5 7 1/2 10 L200-002NFE(F)2/NFU2 L200-004NFE(F)2/NFU2 L200-005NFE(F)2 L200-007NFE(F)2/NFU2 L200-011NFE(F)2 L200-015NFE(F)2/NFU2 L200-022NFE(F)2/NFU2 L200-037LFU2 L200-055LFU2 L200-075LFU2 L200-004HFE(F)2/HFU2 L200-007HFE(F)2/HFU2 L200-015HFE(F)2/HFU2 L200-022HFE(F)2/HFU2 L200-030HFE(F)2 L200-040HFE(F)2/HFU2 L200-055HFE(F)2/HFU2 L200-075HFE(F)2/HFU2 Ampere Rating for Fuse or Breaker 10 10 15 15 20 (single ph.) 15 (three ph.) 30 (single ph.) 20 (three ph.) 30 40 50 3 6 10 10 15 15 20 25 Motor Overload Protection Hitachi L2002 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.

L2002 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 iv ix xii Table of Contents Revisions Contact Information xvii xviii Chapter 1: Getting Started Introduction Inverter Specifications Introduction to Variable-Frequency Drives Frequently Asked Questions 12 15 118 123 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 27 28 222 224 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 32 33 36 39 310 333 347 363 364 xvi Chapter 4: Operations and Monitoring Introduction Connecting to PLCs and Other Devices Control Logic Signal Specifications Intelligent Terminal Listing Using Intelligent Input Terminals Using Intelligent Output Terminals Analog Input Operation Analog Output Operation PID Loop Operation Configuring the Inverter for Multiple Motors 42 44 46 47 49 435 453 455 456 458 Chapter 5: Inverter System Accessories Introduction Component Descriptions Dynamic Braking 52 53 55 Chapter 6: Troubleshooting and Maintenance Troubleshooting Monitoring Trip Events, History, & Conditions Restoring Factory Default Settings Maintenance and Inspection Warranty 62 65 68 69 616 Appendix A: Glossary and Bibliography Glossary Bibliography A2 A8 Appendix B: ModBus Network Communications Introduction Connecting the Inverter to ModBus Network Protocol Reference ModBus Data Listing B2 B3 B6 B19 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 D6 Index L2002 Inverter xvii Revisions Revision History Table No. Revision Comments Initial release of manual NB675X Date of Issue Sept. 2006 Operation Manual No. NB675X xviii Contact Information Hitachi America, Ltd. Power and Industrial Division 50 Prospect Avenue Tarrytown, NY 10591 U.

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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

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..... 23 12 Getting Started Introduction Introduction Main Features Congratulations on your purchase of an L2002 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 L2002 product line includes more than a dozen inverter models to cover motor sizes from 1/4 horsepower to 10 horsepower, in either 240 VAC or 480 VAC power input versions. The main features are: · 200V and 400V Class inverters · US or EU versions available (country-specific input voltage range and default values) · Built-in RS-485 MODBUS RTU as standard · New current limit function · Sixteen programmable speed levels · PID control adjusts motor speed automatically to maintain a process variable value The design in Hitachi inverters overcomes many of the traditional trade-offs between speed, torque and efficiency.

The performance characteristics are: · High starting torque of 100% at 6Hz · Continuous operation at 100% torque within a 1:10 speed range (6/60 Hz / 5/50 Hz) without motor derating A full line of accessories from Hitachi is available to complete your motor application: · Digital remote operator keypad · Panel-mount keypad bezel kit and DIN rail mounting adapter (35mm rail size) · Dynamic braking unit with resistors · Radio noise filters · CE compliance filters L200-004NFU2 L2002 Inverter 13 Getting Started Operator Interface Options The L2002 inverter can connect to an external digital operator via the front panel serial port connector. The separate keypad is shown to the right (part no. OPESRmini). This allows you to operate the inverter remotely, as shown (below left). A cable (part no.

ICS1 or ICS3, 1m or 3m) connects the modular connectors of the keypad and inverter. Hitachi provides a panel mount keypad kit OPESRmini (below, right). It includes the mounting flange, gasket, keypad, and other hardware. You can mount the keypad with the potentiometer for a NEMA1 rated installation. The kit also provides for removing the potentiometer knob to meet NEMA 4X requirements, as shown (part no.

4XKITmini). Cable ICS1 or ICS3 4XKITmini Digital Operator Copy Unit - The optional digital operator / copy unit (part no. SRW-0EX) is shown to the right. It has a 2-line display that shows parameters by function code and by name. It has the additional capability of reading (uploading) the parameter settings in the inverter into its memory. Then you can connect 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. SRW0EX 14 Getting Started Introduction Inverter Specifications Label The Hitachi L2002 inverters have product labels located on the right side of the housing, as pictured below.

Be sure to verify that the specifications on the labels match your power source, motor, and application safety requirements. Specifications label Regulatory agency approval labels (opposite side) 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: L200 037 H F E F 2 Version EMC filter Restricted distribution: E=Europe, U=USA, R=Japan Series name Configuration type F = with digital operator (keypad) Input voltage: N = single or three-phase 200V class H = three-phase 400V class L = three phase only, 200V class Applicable motor capacity in kW 022 = 2.2 kW 002 = 0.2 kW 030 = 3.0 kW 004 = 0.4 kW 037 = 3.7 kW 005 = 0.55 kW 040 = 4.

0 kW 007 = 0.75 kW 055 = 5.5 kW 011 = 1.1 kW 075 = 7.5 kW 015 = 1.

5 kW L2002 Inverter 15 Getting Started Inverter Specifications Model-specific tables for 200V and 400V class inverters The following tables are specific to L2002 inverters for the 200V and 400V class model groups. Note that "General Specifications" on page 110 apply to both voltage class groups. Footnotes for all specifications tables follow the table below. Item L2002 inverters, 200V models EU types USA type Applicable motor size \*2 Rated capacity (kVA) 230V 240V kW HP 200V Class Specifications 002NFEF2 004NFEF2 005NFEF2 007NFEF2 002NFE2 004NFE2 005NFE2 007NFE2 002NFU2 0.2 1/4 0.

5 0.5 004NFU2 0.4 1/2 1.0 1.0 -- 0.55 3/4 1.1 1.2 007NFU2 0.75 1 1.5 1.

6 011NFEF2 011NFE2 -- 1.1 1.5 1.9 2.0 Rated input voltage 1-phase: 200 to 240V ±10%, 50/60 Hz ±5%, 3-phase: 200 to 240V ±10%, 50/60 Hz ±5%, (037LFU2, 055LFU2, and 075LFU2 3-phase only) Single phase filter, Category C3 \*5 -- 3.1 1.8 1.4 90.5 16 19 5.8 3.

4 2.6 93.3 22 27 6.7 3.9 3.

0 94.4 23 28 100% at 6Hz 100%: 50Hz 50%: 60Hz Capacitive feedback type, dynamic braking unit and braking resistor optional, individually installed Variable operating frequency, time, and braking force kg lb kg lb 0.8 1.75 0.7 1.

54 0.7 1.54 0.95 2.09 0.85 1.87 0.85 1.87 0.95 2.

09 0.85 1.87 -- -- 1.4 3.09 1.8 3.97 1.8 3.97 1.4 3.

09 1.8 3.97 -- -- 9.0 5.2 4.

0 95.1 27 34 11.2 6.5 5.0 96.

2 30 42 Integrated EMC filter Rated input current (A) NFEF type NFE, NFU types 1-phase 3-phase Rated output voltage \*3 Rated output current (A) Efficiency at 100% rated output (%) Watt loss, at 70% output approximate (W) Starting torque \*7 Braking Dynamic braking, approx. % torque (short time stop from 50 / 60 Hz) \*8 DC braking NFEF type 3-phase: 200 to 240V (proportional to input voltage) at 100% output Weight NFE type NFU type 16 Getting Started Inverter Specifications Footnotes for the preceding table and the tables that follow: The protection method conforms to JEM 1030. 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.



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Note 3: The output voltage decreases as the main supply voltage decreases (except when using the AVR function). 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: When using the inverter with 3-phase power input, remove the single phase filter and install a 3-phase filter with the appropriate ratings. Note 6: For achieving approved input voltage rating categories: · 460 to 480 VAC Over-voltage Category 2 · 380 to 460 VAC Over-voltage Category 3 To meet the Over-voltage Category 3, insert an EN or IEC standard compliant isolation transformer that is earth grounded and star connected (for Low Voltage Directive). Note 7: At the rated voltage when using a Hitachi standard 3-phase, 4-pole motor.

Note 8: The braking torque via capacitive feedback is the average deceleration torque at the shortest deceleration (stopping from 50/60 Hz as indicated). It is not continuous regenerative braking torque. The average deceleration torque varies with motor loss. This value decreases when operating beyond 50 Hz. If a large regenerative torque is required, the optional regenerative braking resistor should be used. Note 9: The frequency command is the maximum frequency at 9.8V for input voltage 0 to 10 VDC, or at 19.6 mA for input current 4 to 20 mA. If this characteristic is not satisfactory for your application, contact your Hitachi sales representative. Note 10: If the inverter is operated outside the region shown in the graph to the right, the inverter may be damaged or its service life may be shortened.

Set B083 Carrier Frequency Adjustment in accordance with the expected output current level. Derating Curve Rated current 100% 70% Operating region 0 5.0 14.0 Carrier frequency Curve at 40°C Note 1: Note 2: kHz Note 11: The storage temperature refers to the short-term temperature during transport. Note 12: Conforms to the test method specified in JIS C0040 (1999).

For the model types excluded in the standard specifications, contact your Hitachi sales representative. L2002 Inverter L2002 Inverter Specifications, continued... 17 Getting Started Item L2002 inverters, 200V models EU types USA type Applicable motor size \*2 Rated capacity (kVA) 230V 240V kW HP 015NFEF2 015NFE2 015NFU2 1.

5 2 2.8 2.9 200V Class Specifications, continued 022NFEF2 022NFE2 022NFU2 2.2 3 3.9 4.1 -- 037LFU2 3.7 5 6.3 6.6 -- 055LFU2 5.5 7.

5 9.5 9.9 -- 075LFU2 7.5 10 12.7 13.3 Rated input voltage 1-phase: 200 to 240V ±10%, 50/60 Hz ±5%, 3-phase: 200 to 240V ±10%, 50/60 Hz ±5%, (037LFU2, 055LFU2, 075LFU2 3-phase only) Single phase filter, Category C3 \*5 -- 16.0 9.3 7.1 96.3 39 55 50%: 60Hz 22. 5 13.0 10.0 95.5 62 98 -- 20.0 15.

9 95.4 110 170 100% at 6Hz -- 30.0 24 95.6 175 244 -- 40.0 32 96.

0 210 300 -- Integrated EMC filter Rated input current (A) NFEF type NFE, NFU types 1-phase 3-phase Rated output voltage \*3 Rated output current (A) Efficiency at 100% rated output (%) Watt loss, at 70% output approximate (W) Starting torque \*7 Braking Dynamic braking, approx. % torque (short time stop from 50 / 60 Hz) \*8 DC braking Weight NFEF type 3-phase: 200 to 240V (proportional to input voltage) at 100% output 20%: 60Hz Capacitive feedback type, dynamic braking unit and braking resistor optional, individually installed Variable operating frequency, time, and braking force kg lb kg lb kg lb 1.9 4.2 1.8 3.97 1.8 3.97 1.9 4.2 1.

8 3.97 1.8 3.97 -- -- -- 1.9 4.2 -- -- -- 5.5 12.13 -- -- -- 5.7 12.57 NFE type NFU type 18 Getting Started Inverter Specifications Item 400V Class Specifications 004HFEF2 004HFE2 004HFU2 kW HP 0.

4 1/2 1.1 007HFEF2 007HFE2 007HFU2 0.75 1 1.9 015HFEF2 015HFE2 015HFU2 1.5 2 2.

9 022HFEF2 022HFE2 022HFU2 2.2 3 4.2 L2002 inverters, 400V models EU types USA type Applicable motor size \*2 Rated capacity (460V) kVA Rated input voltage \*6 Integrated EMC filter HFEF type 3-phase: 380 to 480V ±10%, 50/60 Hz ±5% Three phase filter, Category C3 \*5 -- 2.0 1.5 93.

5 20 26 3.3 2.5 94.0 30 42 100% at 6Hz 50%: 60Hz 5.0 3.8 95.3 45 70 7.0 5.5 95.7 65 95 20%: 60Hz 3-phase: 380 to 480V (proportional to input voltage) HFE, HFU types Rated input current (A) Rated output voltage \*3 Rated output current (A) Efficiency at 100% rated output (%) Watt loss, at 70% output approximate (W) Starting torque \*7 Braking Dynamic braking, approx.

% torque (short time stop from 50 / 60 Hz) \*8 DC braking Weight HFEF type at 100% output Capacitive feedback type, dynamic braking unit and braking resistor optional, individually installed Variable operating frequency, time, and braking force kg lb kg lb kg lb 1.4 3.09 1.3 2.87 1.3 2.87 1.8 3.97 1.7 3.

75 1.7 3.75 1.9 4.19 1.

8 3.97 1.8 3.97 1.9 4.

19 1.8 3.97 1.8 3.97 HFE type HFU type L2002 Inverter Item L2002 inverters, 400V models EU types USA type Applicable motor size \*2 Rated capacity (460V) kVA Rated input voltage \*6 Integrated EMC filter HFEF type HFE, HFU types 10.0 7.8 95.7 90 130 11.0 8.6 95.

9 95 150 100% at 6Hz Dynamic braking, approx. % torque (short time stop from 50 / 60 Hz) \*8 DC braking Weight HFEF type 19 Getting Started 400V Class Specifications, continued 030HFEF2 030HFE2 -- kW HP 3.0 4 6.2 040HFEF2 040HFE2 040HFU2 4.0 5 6.6 055HFEF2 055HFE2 055HFU2 5.5 7.5 10.3 -- -- 16.5 13 96.

6 135 187 20%: 60Hz Capacitive feedback type, dynamic braking unit and braking resistor optional, individually installed Variable operating frequency, time, and braking force kg lb kg lb kg lb 1.9 4.19 1.8 3.97 -- -- 1.

9 4.19 1.8 3.97 1.8 3.

97 5.5 12.13 3.5 7.72 5.4 11.91 5.7 12.57 5.6 12.

35 5.6 12.35 20.0 16 97.0 165 227 3-phase: 380 to 480V (proportional to input voltage) 075HFEF2 075HFE2 075HFU2 7.5 10 12.7 3-phase: 380 to 480V ±10%, 50/60 Hz ±5% Three phase filter, Category C3 Rated input current (A) Rated output voltage \*3 Rated output current (A) Efficiency at 100% rated output (%) Watt loss, at 70% output approximate (W) Starting torque \*7 Braking at 100% output HFE type HFU type 110 Getting Started Inverter Specifications General Specifications The following table applies to all L2002 inverters. Item Protective housing \*1 Control method Carrier frequency Output frequency range \*4 Frequency accuracy Frequency setting resolution Volt./Freq. characteristic Overload capacity Acceleration/deceleration time Input signal IP20 Sinusoidal Pulse Width Modulation (PWM) control 2kHz to 14kHz (default setting: 5kHz) 0.

5 to 400 Hz Digital command: 0.01% of the maximum frequency Analog command: 0.1% of the maximum frequency (25°C ± 10°C) Digital: 0.1 Hz; Analog: max. frequency/1000 V/f optionally variable, V/f control (constant torque, reduced torque) 150% of rated current for 1 minute 0.

01 to 3000 seconds, linear and S-curve accel/decel, second accel/decel setting available General Specifications Freq. Operator panel Up and Down keys / Value settings setting Potentiometer Analog setting External signal \*9 FWD/ REV Run 0 to 10 VDC (input impedance 10k Ohms), 4 to 20 mA (input impedance 250 Ohms), Potentiometer (1k to 2k Ohms, 2W) Operator panel Run/Stop (Forward/Reverse run change by command) External signal Forward run/stop, Reverse run/stop FW (forward run command), RV (reverse run command), CF1~CF4 (multi-stage speed setting), JG (jog command), DB (external

*braking), SET (set second motor), 2CH (2-stage accel.*



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/decel. command), FRS (free run stop command), EXT (external trip), USP (startup function), SFT (soft lock), AT (analog current input select signal), RS (reset), PTC (thermistor thermal protection), STA (start), STP (stop), F/R (forward/reverse), PID (PID disable), PIDC (PID reset), UP (remote control up function), DWN (remote control down function), UDC (remote control data clearing), OPE (operator control), ADD (ADD frequency enable), F-TM (force terminal mode), RDY (quick start enable) RUN (run status signal), FAI,2 (frequency arrival signal), OL (overload advance notice signal), OD (PID error deviation signal), AL (alarm signal), Dc (analog input disconnect detect), FBV (PID two-stage control output), NDc (network detection signal), LOG (logic output), OPDc (option card detection signal) PWM output; Select analog output frequency monitor, analog output current monitor or digital output frequency monitor ON for inverter alarm (1C contacts, both normally open or closed avail.) Intelligent input terminal Output signal Intelligent output terminal Frequency monitor Alarm output contact L2002 Inverter Item Other functions General Specifications 111 Getting Started AVR function, curved accel/decel profile, upper and lower limiters, 16-stage speed profile, fine adjustment of start frequency, carrier frequency change (2 to 14 kHz) \*10, frequency jump, gain and bias setting, process jogging, electronic thermal level adjustment, retry function, trip history monitor, 2nd setting selection, fan ON/OFF selection Over-current, over-voltage, under-voltage, overload, extreme high/ low temperature, CPU error, memory error, ground fault detection at startup, internal communication error, electronic thermal Operating (ambient): -10 to 40°C (\*10) / Storage: -25 to 60°C (\*11) 20 to 90% humidity (non-condensing) 5. 9 m/s<sup>2</sup> (0.6G), 10 to 55 Hz Altitude 1,000 m or less, indoors (no corrosive gasses or dust) Blue (DIC 14 Version No. 436) Remote operator unit, copy unit, cables for the units, braking unit, braking resistor, AC reactor, DC reactor, noise filter, DIN rail mounting Protective function Operat- Temperature ing Environ Humidity ment Vibration \*12 Location Coating color Options Signal Ratings Detailed ratings are in "Control Logic Signal Specifications" on page 4-6. Signal / Contact Built-in power for inputs Discrete logic inputs Discrete logic outputs Analog output Analog input, current Analog input, voltage +10V analog reference Alarm relay contacts 24VDC, 30 mA maximum 27VDC maximum 50mA maximum ON state current, 27 VDC maximum OFF state voltage 0 to 10VDC, 1 mA 4 to 19.6 mA range, 20 mA nominal 0 to 9.6 VDC range, 10VDC nominal, input impedance 10 k 10VDC nominal, 10 mA maximum 250 VAC, 2.5A (R load) max., 0.2A (I load, P.F.

=0.4) max. 100 VAC, 10mA min. 30 VDC, 3.0A (R load) max., 0.7A (I load, P.F.=0.4) max.

5 VDC, 100mA min. Ratings 112 Getting Started Inverter Specifications Derating Curves 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 2 kHz to 14 kHz.

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. An inverter may be mounted individually in an enclosure or side-by-side with other inverter(s) as shown below. Side-by-side mounting causes greater derating than mounting inverters separately. Graphs for either mounting method are included in this section. Refer to "Ensure Adequate Ventilation" on page 211 for minimum clearance dimensions for both mounting configurations.

Individual Mounting Enclosure Side-by-side Mounting Enclosure POWER Hz A RUN ALARM HITACHI POWER Hz A RUN ALARM HITACHI POWER Hz A RUN ALARM HITACHI 5 0.0 RUN FUNC. STOP RESET 5 0.0 RUN STR FUNC. STOP RESET 5 0.0 RUN FUNC. STOP RESET PRG PRG PRG 1 2 1 2 STR 1 2 STR L2002 L2002 L2002 Use the following derating curves to help determine the optimal carrier frequency setting for your inverter and find the output current derating. Be sure to use the proper curve for your particular L2002 inverter model number. Legend for Graphs: Ambient temperature 40°C max., individual mounting Ambient temperature 50°C max.

individual mounting Ambient temperature 40°C max., side-by-side mounting L2002 Inverter Derating curves: L200002NFE(F)2/NFU2 100% 95% 90% % of rated output current 85% 80% 75% 70% 2 L200004NFE(F)2/ NFU2, 005NFE(F)2 100% 95% 90% % of rated output current 85% 80% 75% 70% 2 L200007NFE(F)2/ NFU2, 011NFE(F)2 100% 90% 80% % of rated output current 70% 60% 50% 40% 2 4 6 8 10 12 14 Carrier frequency 4 6 8 10 12 14 Carrier frequency kHz kHz kHz 14 Carrier frequency 114 Getting Started Inverter Specifications Derating curves, continued... L200015NFE(F)2/NFU2 100% 95% 90% % of rated output current 85% 80% 75% 70% 2 L200022NFE(F)2/NFU2 100% 95% 90% % of rated output current 85% 80% 75% 70% 2 L200037LFU2 100% 90% 80% % of rated output current 70% 60% 50% 40% 2 4 6 8 10 12 14 Carrier frequency kHz 4 6 8 10 12 14 Carrier frequency kHz 4 6 8 10 12 14 Carrier frequency kHz L2002 Inverter Derating curves, continued... L200055LFU2 100% 90% 80% % of rated output current 70% 60% 50% 40% 2 L200075LFU2 100% 90% 80% % of rated output current 70% 60% 50% 40% 2 L200004HFE(F)2/HFU2 100% 90% 80% % of rated output current 70% 60% 50% 40% 2 4 6 8 10 12 14 115 Getting Started kHz 14 Carrier frequency kHz 14 Carrier frequency kHz

14 Carrier frequency 116 Getting Started Inverter Specifications Derating curves, continued...

L200007HFE(F)2/HFU2 100% 90% 80% % of rated output current 70% 60% 50% 40% 2 L200015HFE(F)2/HFU2 100% 90% 80% % of rated output current 70% 60% 50% 40% 2 L200022HFE(F)2/HFU2 100% 90% 80% % of rated output current 70% 60% 50% 40% 2 4 6 8 10 12 14 Carrier frequency kHz 4 6 8 10 12 14 Carrier frequency kHz 4 6 8 10 12 14 Carrier frequency kHz L2002 Inverter Derating curves, continued... L200030HFE(F)2,

-040HFE(F)2/HFU2 117 Getting Started 100% 90% 80% % of rated output current 70% 60% 50% 40% 2 4 6 8 10 12 14 Carrier frequency kHz L200055HFE(F)2/HFU2 100% 90% 80% % of rated output current 70% 60% 50% 40% 2 L200075HFE(F)2/HFU2 100% 90% 80% % of rated output current 70% 60% 50% 40% 2 4 6 8 10 12 14 Carrier frequency kHz 4 6 8 10 12 14 Carrier frequency kHz 118 Getting Started Introduction to Variable-Frequency Drives Introduction to Variable-Frequency Drives The Purpose of Motor Speed Control for Industry Hitachi inverters provide speed control for 3-phase AC induction motors.



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You connect AC power to the inverter, and connect the inverter to the motor.

Many applications benefit from a motor with variable speed, 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 motor drive for an AC motor can control 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. Power Input L1 L2 L3 Rectifier Variable-frequency Drive Converter Internal DC Bus Inverter + U/T1 V/T2 W/T3 Motor + The simplified drawing of the inverter shows three double-throw switches. In Hitachi inverters, the switches are actually IGBTs (insulated 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. L2002 Inverter 119 Getting Started 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  $V$  Constant torque 0 100%  $f$  Output frequency Today, with the advent of sophisticated microprocessors and digital signal processors (DSPs), it is possible to control the speed and torque of AC induction motors with unprecedented accuracy. The L2002 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-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. 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. Inverter Input and Three-Phase Power The Hitachi L2002 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 Europe, although the exact voltage level for commercial power may be slightly different from country to country.

Accordingly, a 200V class inverter requires (nominal) 200 to 240VAC, and a 400V class inverter requires from 380 to 480VAC.

Some 200V class inverters will accept single-phase or three-phase power, but all 400V class inverters require a three-phase power supply. TIP: If your application only has single phase power available, refer to L2002 inverters of 3HP or less; they 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 [R/L1], Line 2 [S/L2] and Line 3 [T/L3]. In any case, the power source should include an earth 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 221). 120 Getting Started Introduction to Variable-Frequency Drives Inverter Output to the Motor The AC motor must be connected only to the inverter's 3-Phase AC Motor output terminals. The output terminals are uniquely V/T2 labeled (to differentiate them from the input terminals) U/T1 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 Earth a particular inverter output to a particular motor lead for GND a new application.

The consequence of swapping any W/T3 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. 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. L2002 Inverter 121 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.



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*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 an optional dynamic braking unit. See "Introduction" on page 52 and "Dynamic Braking" on page 55 for more information on the BRDE2 and BRDEZ2 braking units. The L2002 inverter sends excess motor energy into a resistor in the dynamic braking unit to slow the motor and load. For loads that continuously overhaul the motor for extended periods of time, the L2002 may not be suitable (contact your Hitachi distributor).*

*For loads that continuously overhaul the motor for extended periods of time, the L2002 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. 122 Getting Started Introduction to Variable-Frequency Drives Velocity Profiles The L2002 inverter is capable of sophisticated speed control. A graphical representation of Speed that capability will help you understand and configure the associated parameters.*

*This manual makes use of the velocity profile 0 graph used in industry (shown at right). In the example, acceleration is a ramp to a set speed, and deceleration is a decline to a stop. Set speed Accel Decel t Velocity Profile Acceleration and deceleration settings specify Speed Maximum speed the time required to go from a stop to maximum frequency (or visa versa). The resulting slope (speed change divided by time) is the acceleration or deceleration. An increase in output frequency uses the acceleration 0 slope, while a decrease uses the deceleration t Acceleration slope. The accel or decel time a particular (time setting) speed change depends on the starting and ending frequencies. However, 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 L2002 inverter can store up to 16 preset speeds. And, it can apply separate acceleration Speed Speed 2 and deceleration transitions from any preset to Speed 1 any other preset speed.*

*A multi-speed profile (shown at right) uses two or more preset 0 speeds, which you can select via intelligent t input terminals. This external control can Multi-speed Profile 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 Speed direction. Separate FW and RV commands select the direction of rotation. The motion 0 profile example shows a forward motion followed by a reverse motion of shorter duration. The speed presets and analog signals control the magnitude of the speed, while the FWD and REV commands determine the direction before the motion starts. Forward move t Reverse move Bi-directional Profile NOTE: The L2002 can move loads in both directions.*

*However, it is not designed for use in servo-type applications that use a bipolar velocity signal that determines direction. L2002 Inverter 123 Getting Started Frequently Asked Questions Q. What is the main advantage in using an inverter to drive a motor, compared to alternative solutions? A. An inverter can vary the motor speed with very little loss of efficiency, unlike mechanical or hydraulic speed control solutions. The resulting energy savings usually pays for the inverter in a relatively short time.*

*Q. The term "inverter" is a little confusing, since we also use "drive" and "amplifier" to describe the electronic unit that controls a motor. What does "inverter" mean? A. The terms inverter, drive, and amplifier are used somewhat interchangeably in industry. Nowadays, the terms drive, variable-frequency drive, variable-speed drive, and inverter are generally used to describe electronic, microprocessor-based motor speed controllers.*

*In the past, variable-speed drive also referred to various mechanical means to vary speed. Amplifier is a term almost exclusively used to describe drives for servo or stepper motors. Q. Although the L2002 inverter is a variable speed drive, can I use it in a fixed-speed application? A. Yes, sometimes an inverter can be used simply as a "soft-start" device, providing controlled acceleration and deceleration to a fixed speed. Other functions of the L2002 may be useful in such applications, as well. However, using a variable speed drive can benefit many types of industrial and commercial motor applications, by providing controlled acceleration and deceleration, high torque at low speeds, and energy savings over alternative solutions. That depends on the required precision, and the slowest speed the motor will must turn and still deliver torque. The L2002 inverter will deliver full torque while turning the motor at only 0.5 Hz (15 RPM).*

*DO NOT use an inverter if you need the motor to stop and hold the load position without the aid of a mechanical brake (use a servo or stepper motion control system). Yes. L2002 inverters have built-in ModBus communications. See Appendix B for more information on network communications. Q. Can I use an inverter and AC induction motor in a positioning application? A. Q. Can the inverter be controlled and monitored via a network? A. Q. Why does the manual or other documentation use terminology such as "200V class" instead of naming the actual voltage, such as "230 VAC?" A.*

*A specific inverter model is set at the factory to work across a voltage range particular to the destination country for that model. The model specifications are on the label on the side of the inverter. A European 200V class inverter ("EU" marking) has different parameter settings than a USA 200V class inverter ("US" marking). The initialization procedure (see "Restoring Factory Default Settings" on page 68) can set up the inverter for European or US commercial voltage ranges. 124 Getting Started Frequently Asked Questions Q.*

*Why doesn't the motor have a neutral connection as a return to the inverter? A. The motor theoretically represents a "balanced Y" load if all three stator windings have the same impedance. The Y connection allows each of the three wires to alternately serve as input or return on alternate half-cycles. Yes, for several reasons. Most importantly, this provides protection in the event of a short in the motor that puts a hazardous voltage on its housing.*



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