DSPM INC.
DIGITAL SIGNAL POWER MANUFACTURER
www.DSPMManufacturing.com

$75
Price Each

Three Phase Frequency Converter

User's Manual #018-0168-01 Revision B

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About this Manual
Thank you for selecting this Three Phase Frequency Converter. It provides you with perfect protection for connected loads and equipment. This manual contains important instructions that should be followed during the installation and maintenance of this DSPM converter. It includes important safety and maintenance instructions for operating the Three Phase Frequency Converter. If you should have any problems with this Three Phase Frequency Converter, please refer to this manual and/or call technical support.

Your DSPM Converter is designed to provide reliable protection from power disturbances for many years. Please be sure to follow the manufacturers instructions to ensure optimum performance of the equipment. This manual contains descriptions of all controls and indicators required to operate the DSPM Converter. Please read this manual carefully and retain it for future reference.

To the best of our knowledge and at the time written, the information contained in this document is technically correct and the procedures accurate and adequate to operate this instrument in compliance with its original advertised specifications. While every precaution has been made to ensure accuracy and completeness in this manual, DSPM assumes no responsibility and disclaims all liability for damages resulting from the use of this information or for any errors or omissions.

This instrument is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely before making any measurements. Failure to follow directions can result in a serious or fatal accident.

How to use this Manual
This manual is designed for ease of use, giving the user easy and quick reference to information. This manual uses notice icons to draw attention to the user important information regarding the safe operation and installation of the Frequency Converter. The notice icons used in this manual are explained below, and should be taken into account and adhered to whenever they appear in the text of this manual.

Technical Assistance

Safety Recommendations: If any problems are encountered while following this manual, DSPM assistance and correspondence is recommended. For technical support or help with any questions not covered in the manual, contract.

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To expedite assistance if required, Please have the following information from your unit's System Label (found on the right side and inside door panel) available:

Model: _____
Model Number: _____
S/O Number: _____
Input Voltage: _____
Output Voltage: _____
Power Rating and Frequency: _____

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

SECTION - SAFETY

Notes and Safety Information

Following safety precautions is important when operating or servicing electrical equipment. Always heed these precautions since they are essential to the safe operation and servicing of this product. This Manual contains warning symbols which alert the user to check for hazardous conditions. The symbols are used extensively throughout this manual and are defined below. To ensure the safety of operating performance of this electrical equipment, these instructions must be adhered too.

WARNING: A Warning notice icon conveys information to protect the user and service personnel against hazardous conditions.

DANGER: A Danger notice icon conveys that there is a risk of electric shock, personal injury, or death to the user if instructions are not followed.

CAUTION: A Caution notice icon conveys to the user or service personnel information making them aware that there is a possibility of equipment damage.

NOTE: A Note notice icon indicates when the user should make a reference of information regarding the Frequency Converter operation, load status and display status. Such information is essential if DSPM, Inc. field service assistance and correspondence is required.

CAUTION!

ENSURE THAT NO FLUIDS OR OTHER FOREIGN OBJECTS CAN ENTER THE CONVERTER SYSTEM.

NOTE!

READ THIS MANUAL IN ITS ENTIRETY BEFORE PERFORMING THE INSTALLATION, START-UP, OPERATION, OR MAINTENANCE OF THE FREQUENCY CONVERTER SYSTEMS. FAILURE TO DO SO COULD RESULT IN ELECTROCUTION, FIRE, EXPLOSION, OR EQUIPMENT FAILURE.

WARNING!

ONLY FACTORY TRAINED OR AUTHORIZED PERSONNEL SHOULD ATTEMPT TO INSTALL OR REPAIR THE FREQUENCY CONVERTER SYSTEM. IMPROPER INSTALLATION HAS PROVEN TO BE THE SINGLE MOST SIGNIFICANT CAUSE OF START-UP PROBLEMS. HIGH AC AND DC ELECTRICAL VOLTAGES ARE PRESENT THROUGHOUT THE UNIT(S) AND INCORRECT INSTALLATION OR SERVICING COULD RESULT IN ELECTROCUTION, FIRE, EXPLOSION, OR

EQUIPMENT FAILURE.

CAUTION!

ALL POWER CONNECTIONS MUST BE COMPLETED BY A LICENSED ELECTRICIAN WHO IS EXPERIENCED IN WIRING THIS TYPE OF EQUIPMENT. WIRING MUST BE INSTALLED IN ACCORDANCE WITH ALL APPLICABLE NATIONAL AND LOCAL ELECTRICAL CODES. IMPROPER WIRING MAY CAUSE DAMAGE TO THE EQUIPMENTS, INJURY OR DEATH OF PERSONNEL. VERIFY THAT ALL HIGH AND LOW VOLTAGE INPUT POWER CIRCUITS ARE DE-ENERGIZED AND LOCKED OUT BEFORE INSTALLING CABLES OR MAKING ANY ELECTRICAL CONNECTIONS.

NOTE!

THIS EQUIPMENT GENERATES, USES, AND CAN RADIATE RADIO FREQUENCY ENERGY, AND, IF NOT INSTALLED AND USED IN ACCORDANCE WITH THIS MANUAL, MAY CAUSE INTERFERENCE TO RADIO COMMUNICATIONS. IT HAS BEEN TESTED AND FOUND TO COMPLY WITHIN THE LIMITS FOR A COMPUTING DEVICE PURSUANT TO SUB PART J OF PART 15 OF FCC RULES, WHICH ARE DESIGNED TO PROVIDE REASONABLE PROTECTION AGAINST SUCH INTERFERENCE WHEN OPERATED IN A COMMERCIAL ENVIRONMENT.

DANGER!

LETHAL VOLTAGES EXIST WITHIN THE EQUIPMENT DURING OPERATION. EXTREME CAUTION IS REQUIRED WHEN PERFORMING MAINTENANCE. OBSERVE ALL WARNINGS AND CAUTIONS IN THIS MANUAL. FAILURE TO COMPLY MAY RESULT IN SERIOUS INJURY OR DEATH. OBTAIN QUALIFIED SERVICE FOR THIS EQUIPMENT AS INSTRUCTED.

DANGER!

BE CONSTANTLY AWARE THAT THE FREQUENCY CONVERTER SYSTEM CONTAINS HIGH DC AS WELL AS AC VOLTAGES. WITH INPUT POWER OFF AND THE BATTERY, DISCONNECTED, HIGH VOLTAGE AT THE FILTER CAPACITORS AND POWER CIRCUITS SHOULD DISCHARGE WITHIN 30 SECONDS. HOWEVER, POWER CIRCUIT FAILURES CAN OCCUR, SO YOU SHOULD ALWAYS ASSUME THAT HIGH VOLTAGE MIGHT STILL EXIST 30 SECONDS AFTER SHUTDOWN. VERIFY THAT POWER IS OFF USING AC AND DC VOLTMETERS BEFORE MAKING CONTACT.

DANGER!

SOME COMPONENTS WITHIN THE CABINETS ARE NOT CONNECTED TO CHASSIS GROUND. ANY CONTACT BETWEEN FLOATING CIRCUITS AND THE CHASSIS IS A LETHAL SHOCK HAZARD.

DANGER!

OBSERVE ALL SAFETY PRECAUTIONS DURING SERVICE OF THE FREQUENCY CONVERTER. EVEN WITH THE MAIN CIRCUIT BREAKERS IN THE OFF POSITION, THE DANGER OF ELECTROCUTION MAY STILL BE PRESENT. THE UTILITY POWER TO THE UNIT MUST BE LOCKED AND TAGGED "OFF" BEFORE PERFORMING ANY SERVICE OR WORK ON THE UNIT. FAILURE TO FOLLOW THOSE INSTRUCTIONS AND THE INSTRUCTION LISTED ABOVE AND ELSEWHERE IN THIS MANUAL COULD RESULT IN AN EXPLOSION, FIRE, EQUIPMENT FAILURE, OR ELECTROCUTION.

CAUTION!

EXERCISE EXTREME CARE WHEN HANDLING FREQUENCY CONVERTER CABINETS TO AVOID EQUIPMENT DAMAGE OR INJURY TO PERSONNEL. CABINETS WEIGH SEVERAL HUNDRED POUNDS.

CAUTION!

TEST LIFT AND BALANCE THE CABINETS BEFORE MOVING. MAINTAIN MINIMUM TILT FROM VERTICAL AT ALL TIMES. THE BOTTOM STRUCTURE WILL SUPPORT THE UNIT ONLY IF THE FORKLIFT FORKS ARE COMPLETELY UNDERNEATH THE UNIT.

WARNING!

LEAD-ACID BATTERIES CONTAIN HAZARDOUS MATERIALS. BATTERIES MUST BE HANDLED, TRANSPORTED, AND RECYCLED OR DISCARDED IN ACCORDANCE WITH FEDERAL, STATE, AND LOCAL REGULATIONS. BECAUSE LEAD IS A TOXIC SUBSTANCE, LEAD-ACID BATTERIES SHOULD BE RECYCLED RATHER THAN DISCARDED.

Electrical Hazard

DO NOT DISPOSE OF BATTERIES IN A FIRE, THE BATTERIES MAY EXPLODE.

DO NOT OPEN OR MUTILATE THE BATTERIES. RELEASED ELECTROLYTE IS HARMFUL TO THE SKIN AND EYES AND MAY BE TOXIC.

A BATTERY CAN HAVE A HIGH SHORT CIRCUIT CURRENT AND PRESENT A RISK OF ELECTRICAL SHOCK. THE FOLLOWING PRECAUTIONS SHOULD BE OBSERVED WHEN WORKING ON BATTERIES:

1. **REMOVE WATCHES, RINGS OR OTHER METAL OBJECTS.**
2. **USE TOOLS WITH INSULATED HANDLES.**
3. **WEAR RUBBER GLOVES AND BOOTS.**
4. **DO NOT LAY TOOLS OR METAL PARTS ON TOP OF BATTERIES.**
5. **DISCONNECT CHARGING SOURCE PRIOR TO CONNECTING OR DISCONNECTING BATTERY TERMINALS.**
6. **DETERMINE IF BATTERY IS INADVERTENTLY GROUNDED. IF SO, REMOVE THE SOURCE OF THE GROUND. CONTACT WITH ANY PART OF A GROUNDED BATTERY CAN RESULT IN ELECTRICAL SHOCK. THE LIKELIHOOD OF SUCH SHOCK WILL BE REDUCED IF SUCH GROUNDS ARE REMOVED DURING INSTALLATION AND MAINTENANCE.**

7. **LEAD-ACID BATTERIES CAN PRESENT A RISK OF FIRE BECAUSE THEY GENERATE HYDROGEN GAS. THE FOLLOWING PROCEDURES SHOULD BE FOLLOWED:**
   - **DO NOT SMOKE WHEN NEAR BATTERIES.**
   - **DO NOT CAUSE FLAME OR SPARK IN BATTERY AREA.**
8. **DISCHARGE STATIC ELECTRICITY FROM YOUR BODY BEFORE TOUCHING BATTERIES BY FIRST TOUCHING A GROUNDED SURFACE.**

CAUTION!

IN CASE OF FIRE INVOLVING ELECTRICAL EQUIPMENT. ONLY CARBON DIOXIDE FIRE EXTINGUISHERS, OR THOSE APPROVED FOR USE ON ELECTRICAL EQUIPMENT, SHOULD BE USED. USE OF WATER ON FIRES INVOLVING LIVE HIGH VOLTAGE ELECTRICAL CIRCUITS COULD PRESENT AN ELECTROCUTION HAZARD.

DANGER!

TO REDUCE THE RISK OF ELECTRICAL SHOCK; DISCONNECT THE THREE PHASE FREQUENCY CONVERTER FROM THE MAIN SUPPLY BEFORE INSTALLING AN INTERFACE SIGNAL CABLE. RECONNECT THE POWER ONLY AFTER SIGNALING INTERCONNECTIONS HAVE BEEN MADE.

DO NOT DISMANTLE THE THREE PHASE FREQUENCY CONVERTER.

1. INTRODUCTION

1.1. GENERAL

The principles of operation described herein are applicable to all models. The product is an advanced Three Phase Frequency Converter based on Intelligent Microprocessor Control that meets or exceeds the life safety codes of UL924 and UL1778. Under normal power conditions, this design enables the system to adjust and filter power fluctuations continuously and automatically.

The this unit uses a Digital Signal Processing/Pulse-Width Modulation (DSP/PWM) Monitoring System for managing the system. The DSP/PWM Monitoring System is temperature compensated resulting in maintaining maximum operating parameters. It is listed for compliance to UL1778, UL924, UL924A and CSA107.1 standards. The Frequency Converter is available with a variety of three phase input and output voltages and frequencies. This information is provided on the System Labels located on the inside front door and the right side of the Converter. See Chapter 2 for a complete listing of the Frequency Converter specifications.

This manual provides an overview of the Frequency Converter components and their functions. The appearance and purpose of operator controls and indicators is described with procedures for operation, start-up, and basic maintenance included.

1.2 THEORY OF OPERATION

1.2.1. Standby Mode

After power is applied, the system is placed in STANDBY mode and a self-check starts. During this period, the start subroutine checks for the input voltage and proper operation of the converter. After the routine is completed and check confirmed OK, the system goes into the NORMAL mode.

1.3 OVERVIEW

1.3.1. Drive Principle of Operation

Figure 1.3.1 presents the block diagram of the Vacon drive unit. The drive mechanically consists of two units, the Power Unit and the Control Unit.
The three-phase AC-choke (1) at the mains end together with the DC-link capacitor (2) form an LC-filter, which, again, together with the diode bridge produce the DC-voltage supply to the IGBT Inverter Bridge (3) block. The AC-choke also functions as a filter against High Frequency disturbances from the mains as well as against those caused by the frequency converter to the mains. It, in addition, enhances the waveform of the input current to the frequency converter. The entire power drawn by the frequency converter from the mains is active power. The IGBT Inverter Bridge produces a symmetrical, 3-phase PWM-modulated AC-voltage to the motor/ Output Filter.

The Motor and Application Control Block is based on microprocessor software. The microprocessor controls the motor basing on the information it receives through measurements, parameter settings, control I/O and control keypad. The motor and application control block controls the motor control ASIC which, in turn, calculates the IGBT positions. Gate drivers amplify these signals for driving the IGBT inverter bridge.

The control keypad constitutes a link between the user and the frequency converter. The control keypad is used for parameter setting, reading status data and giving control commands. It is detachable and can be operated externally and connected via a cable to the frequency converter. Instead of the control keypad, also a PC can be used to control the frequency converter if connected through a similar cable.

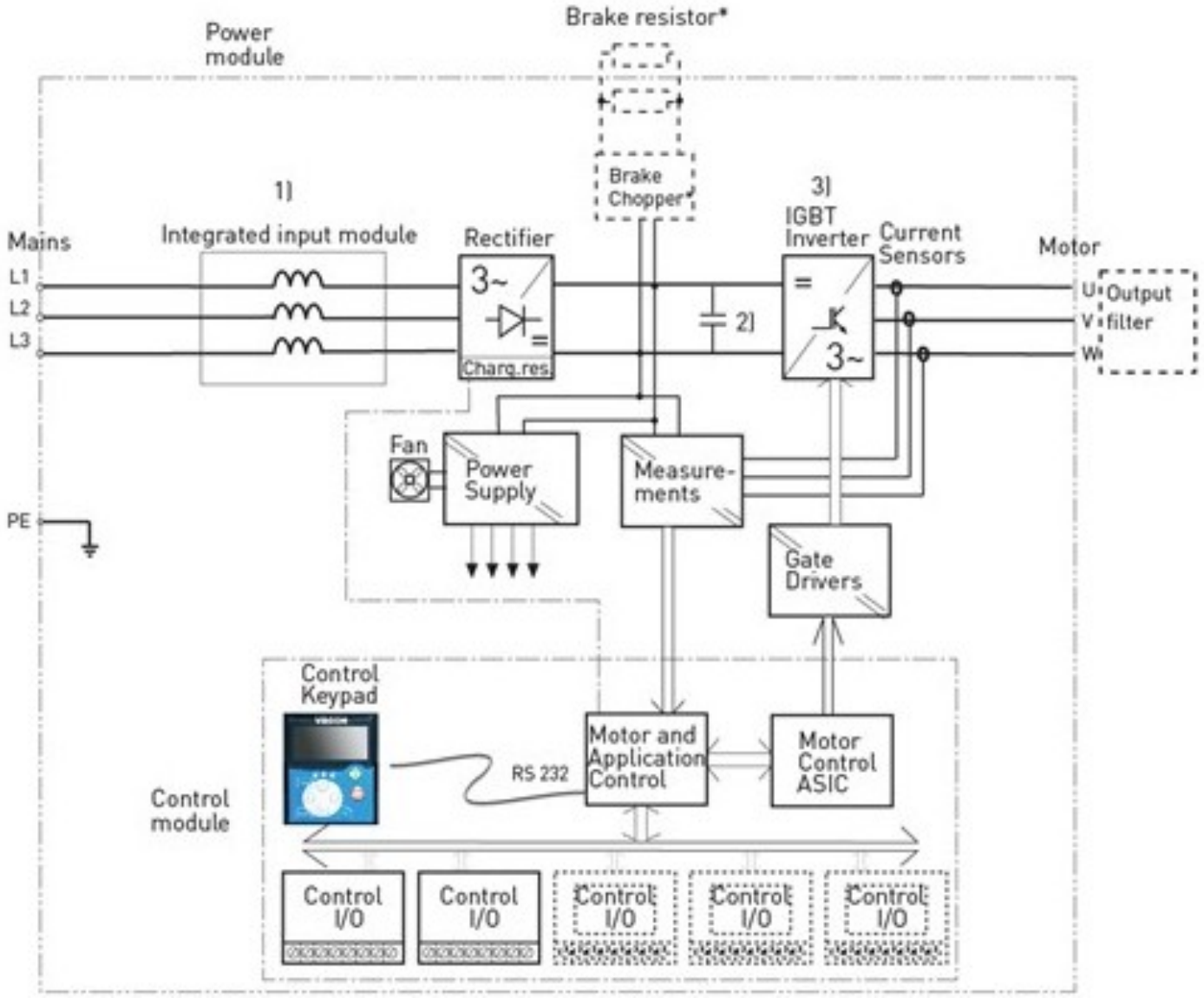

Power module
Brake resistor*
Brake Chopper*
1)
Integrated input module
Mains
L1
L2
L3
Rectifier
3~
Charg.res.
2)
3)
IGBT Inverter
Current Sensors
Motor
U
V
W
Output filter
Fan
Power Supply
Measure-ments
PE
Gate Drivers
Control Keypad
RS 232
Motor and Application Control
Motor Control ASIC
Control module
Control I/O
Control I/O
Control I/O
Control I/O
Control I/O

Figure 1.3.1

2. SPECIFICATIONS

The Frequency Converter maintains efficient AC Power to operate all output loads, providing superior dependability and security to commercial/industrial environments in a small footprint. The System Label displays the rated kW as well as nominal voltages. There are System Labels located on the interior side of the Frequency Converter front door and the exterior right side of the unit.

Table 2.1

Frequency Converter Series	Power Rating	Cabinet Dimensions			Weight	Voltage (VAC)		Output Protection	Safety Approvals
	kVA	W	H	D	(lbs)	Input	Output		
FC3	10	42"	71"	22.5"	1100	208, 380, 400, 415, 220, 380 or 480 VAC	208VY, 380VY, 400VY, 415VY, 220VΔ, 480VΔ, 208Y/120, 380Y/220, 400Y/230, 415Y/240, 220Y/127 or 480/277 VAC	Inpt and output circuit breakers standard	NFPA 101 NFPA 70 NEC
	12	42"	71"	22.5"	1200				
	16	42"	71"	22.5"	1300				
	20	42"	71"	22.5"	1400				
	24	42"	71"	22.5"	1500				
	30	42"	71"	22.5"	1600				
	40	42"	71"	22.5"	1700				
	50	50"	71"	32"	2050				
	60	50"	71"	32"	Consult Factory				
	80	50"	71"	32"	Consult Factory				
	100	50"	71"	32"	Consult Factory				
	125	50"	71"	32"	Consult Factory				

2.1. POWER RATING

Eight to one-hundred and twenty-five KVA three phase output unit uses the latest DSP/PWM technology to provide the most advanced performance and reliability features.

2.2. INPUT

Refer to Table 2.1

2.3. OUTPUT

Refer to Table 2.1

2.4. CODES

2.4.1. Listed to UL 924, meets NFPA 101, NFPA 70, NEC and OSHA standards
2.4.2. Cities of Chicago and New York approved
2.4.3. Complies with the Buy American Act

2.5. PROTECTION

2.5.1. Provides overload, surge and undercurrent protection using DSP/PWM technology to protect system performance and reliability
2.5.2. Surge protection against load surges as defined in ANSI/IEEE C62.45 category A and B

2.6. DIAGNOSTICS AND MAINTENANCE

2.6.1. DSP/PWM technology provides complete self diagnostic capabilities and LCD Monitoring
2.6.2. Informative advanced Display and Alarms keep you in control of your operating environment 24/7
2.6.3 Automatically performs periodic self-tests ensuring a safely operating environment *prior* to an emergency.
2.6.4. Water Dots are placed on every shelf and door panel to indicate if moisture is present or has got inside the unit. The Dots are originally white in color but will turn red when water are absorbed.

2.7. CABINET

2.7.1. Modular design enables flexible installation
2.7.2. Forced air cooling for maximum reliability
2.7.3. All systems are self contained

2.8. INSTALLATION

2.8.1. Modular design and small footprint allow easy installation in electrical closet or other convenient locations
2.8.2. Phone assisted factory start-up standard for all systems
2.8.3. Extended warranty available

2.9. SPECIAL APPLICATIONS

2.9.1. DSPM offers numerous UL924 optional devices to meet unusual or difficult application parameters
2.9.2. ECM - Environmental Circuit Module allows fixtures and lamps on the emergency circuit (s) to be operated by normal switching and/or dimming devices in non-emergency conditions
2.9.3. Dimming Panel Interface allows use with emergency lights controlled by common dimmer panel

2.10. WARRANTY

2.10.1. One-Year full warranty on system electronics
2.10.2. System 1-year on-site warranty labor with DSPM phone assisted start-up
2.10.3. Five-Year powertrain warranty
2.10.4. Maintenance contracts available

3. FIELD REPLACEABLE UNITS (FRUS)

Each FRUS comes with detail instructions of how the part should be performed. At the ends of most wires/ cables are labels that indicates their locations. When ordering replacement parts from the factory, supply the information from the System Label (refer to Technical Assistance section in this manual). Include the model number, serial number, input/output voltages, and power rating when ordering parts. Replacement parts must be replaced by qualified factory trained service personnel only.

Circuit boards and IGBTs contain ESDS (Electro-Static Discharge Susceptible) components. Handle and package ESDS devices in accordance with JEDEC standard JESD625-A. Use a grounded ESD wrist strap when handling the devices and circuit boards. Always package components and circuit boards in static-dissipative plastic bags or the static-dissipative material that the FRUS came in before transporting (Even if a device has failed). Failure to do so could result in further damage, complicating repair and failure analysis.

3.1. All Parts

Verify that the cables are marked before disconnecting. Replace the defective part with the new part. Reconnect wiring the same way as it was disconnected.

4. TRANSPORTATION, INSPECTION, AND INSTALLATION

4.1. HOW TO TRANSPORT THE SYSTEM

Note: Do not transport in a horizontal position. Cabinets should be maintained upright within +/- 15° of the vertical during handling.

4.2. INSPECTION

4.2.1. Upon receipt, inspect the container and pallet for shipping damage. If there was any damage during transportation; **Do Not turn on the unit**. Immediately notify the shipping agent/transportation carrier and DSPM. If no damage is evident, move the packed DSPM Frequency Converter to its installation location.

The packaging is recyclable; keep it for reuse or please disposed of it.

4.2.2. Using care to avoid puncturing the shipping material with any sharp objects, which would damage the contents, open the shipping material by carefully removing any banding and shipping material from the sides, ends and top.

4.2.3. Remove the packing and vapor barrier and inspect the equipment for any obvious shipping damage. It is recommended that the units not be loosened from the shipping pallet until after all handling by forklift or pallet jack is completed.

4.2.4. Immediately file a claim with the shipping agency if any damage, as a result of shipping, is observed.

4.2.5. Follow these steps to inspect all surfaces for abrasions and dents:

- **4.2.5.1.** Open the front door of the cabinet.
- **4.2.5.2.** Verify that all the transformers, inductors, electrical, and electronic devices are firmly mounted.
- **4.2.5.3.** Verify that the transformer coils and terminal lugs are free of contact with any grounded metal surface and that the transformer terminal wires are securely connected.
- **4.2.5.4.** Verify that the internal Wiring is not damaged.
- **4.2.5.5.** Verify that all wires to and from the output filter assembly, input filter assembly, inverter assembly, and bypass switch are securely connected.
- **4.2.5.6.** Verify that the circuit breakers are firmly seated and that the wires are securely connected.
- **4.2.5.7.** Inspect all batteries for damage (cracks, leaks, loose connections, etc.,)
- **4.2.5.8.** Reinstall all panels, covers and close all doors.

4.3 LOCATION AND PLACEMENT

4.3.1. Before starting, check the load tolerance of the floor and verify that the floor will be able to support the Frequency Converter at its final destination and the route to get it there. After verifying the weights verify that when the unit is placed in its final position that the minimum clearances required have been met. Install the Three Phase Frequency Converter in a protected area with adequate airflow and free from excessive dust. Do not operate the Three Phase Frequency Converter where the temperature and humidity is out of the specified limits. Water Dots are placed on every shelf and door panel to indicate if moisture is present or has got inside the unit. The Dots are originally white in color but will turn red when water is absorbed.

WARNING: Condensation of water may occur if the system is unpacked in a very low temperature environment. In this case it is necessary to wait until the system is fully dry inside before proceeding with the connection of any power; otherwise an electrical shock hazards might exist. Installation and wiring must be performed in accordance with the local electrical code and under the guidance or instructions of professional personnel.

Note: Per code requirements, leave 3” on each side of the cabinet (including the back) and 3 foot clearance in front (Refer to Figure 4.3.1).

Storage of the system should be in a cool and dry area with the unit being upright and covered. The warranty can be affected if the unit is stored for more then 3 months without charging the batteries.

Operating Temperature: 0º to 40ºC (32º to 104ºF); **Storage Temperature:** -20º to 60ºC (-4º to 140ºF)

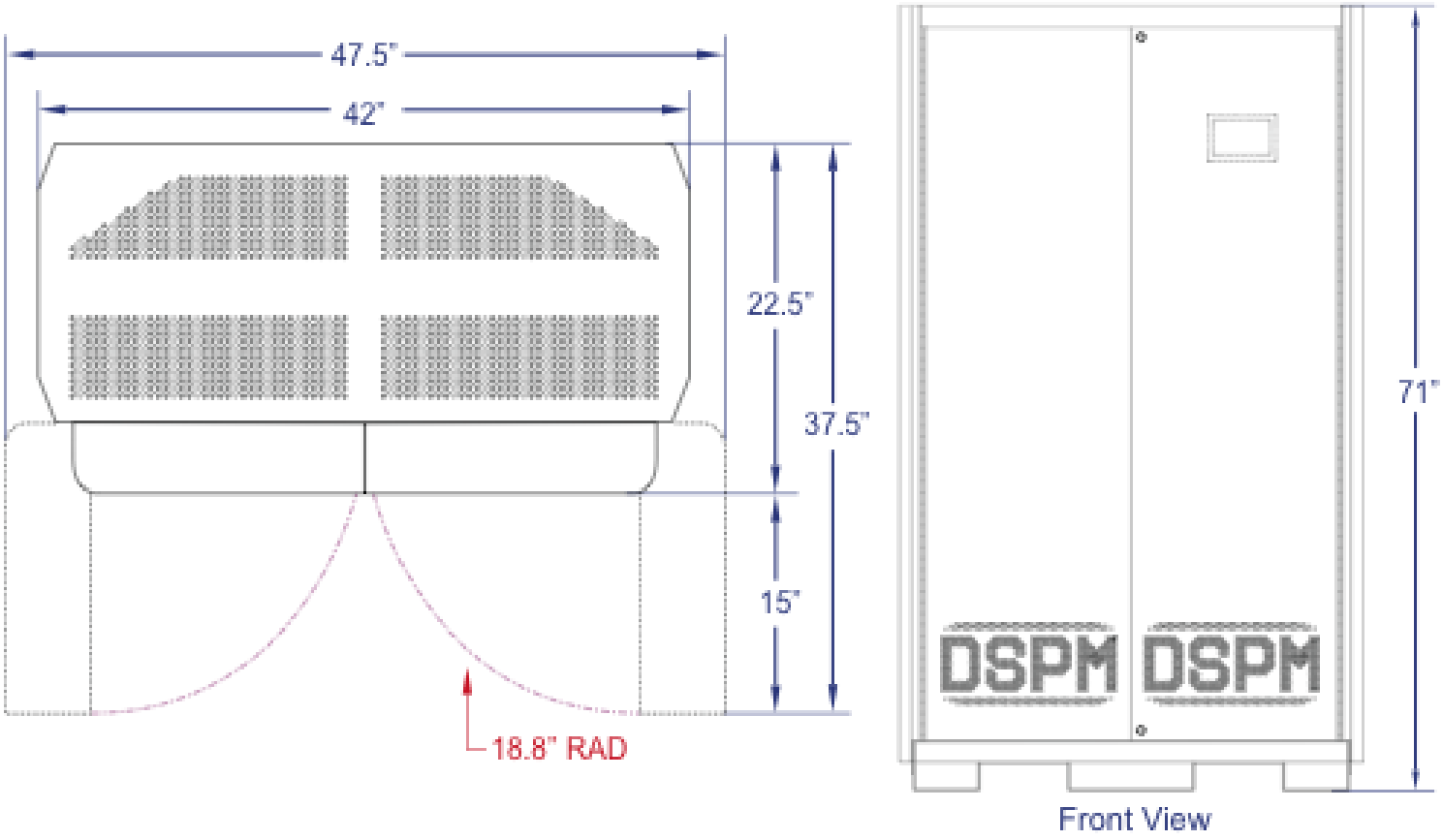


Figure 4.3.1

5. DESCRIPTION

5.1. DESCRIPTION OF FREQUENCY CONVERTER'S CABINET

5.1.1. SYSTEM COMPONENT LAYOUT

The following layouts will help you find the parts and components in your Emergency Lighting Inverter. **Maintenance should only be performed by factory-trained or qualified personnel.** Do not attempt to service. If you need technical assistance, please contact DSPM.

1	Input Terminal Block—TB1	2	Input Circuit Breaker—CB1
3	Output Circuit Breaker—CB2	4	Output Terminal Block—TB2
5	0-10V Reference Transformer—T3	6	Fan Transformer—T5
7	0-10V Bridge Rectifier	8	Fan Fuses—F3 and F4
9	0-10V Interface PCBA	10	Fan Assembly—Fan-1 and Fan-2
11	Variable Frequency Drive—VFD/IMU	12	Inverter input Filter Capacitors—C1, C2, and C3
13	Inverter Output Filter Capacitors—C3, C4, and C4	14	Inverter Output Filter Capacitors Terminal Block
15	Inverter Transformer—T1	16	Inductors—L1, L2, and L3
17	Remote LCD Control Panel—(Not shown in Figure)		

Table 5.1.1

Figure 5.1.1

The AC Input, AC Output Terminals Blocks are provided for the connection of incoming power and the connection of the load (equipment) intended to be powered by the Frequency Converter. Refer to Figure 5.1.1-Component Layout for these connections and their locations in the Frequency Converter Cabinet.

Electrical Hazard

Lethal voltages exist within the cabinet, even when the unit is on bypass. Only qualified service personnel with adequate training must service this equipment.

Electrical Hazard

6. INSTALLATION

6.1. INPUT POWER CONNECTIONS

It is highly recommended that a qualified electrician make all input power connections. The input power should be connected correctly at the required voltages and the ground cable should be of the same gauge as the input power cables. Ensure that the utility power to be connected is rated as on the system label. Make sure the hots, neutral and grounds are correctly identified and wired to the input terminal block as designated.

Phase rotation should be checked and verified for clockwise rotation. The DSPM System will automatically configure the phase rotation in the forward direction (even if the input power is miss-wired). However, the output of the DSPM System will not automatically configure the phase rotation in the forward direction. Therefore, the DSPM System output power should be checked for proper forward phase rotation.

The input power connections to the Frequency Converter come from the building supplied services. These connections are made inside the Frequency Converter cabinet (Refer to Figure 5.1.1a-Component System Layout). The input cables are connected to a five (5) pole terminal block(TB1) which is comprised of three (3) input power, neutral, and ground connections.

6.2. OUTPUT POWER CONNECTIONS

It is highly recommended that a qualified electrician make all output power connections. The output power should be connected correctly at the required voltages and the ground cable should be of the same gauge as the output power cables. Ensure that the loads to be connected are as listed on the system label, and the hots, neutral and grounds are correctly identified and are wired to the output terminal block as designated. Loads not powered by the system cannot use the neutral of the Three Phase Frequency Converter.

Do not bond the output neutral to chassis ground! The system has been bonded as required by the manufacturer and National Electrical Code.

These connections are made inside the Frequency Converter cabinet (Refer to Figure 5.1.1a-Component System Layout). The output cables are connected to a five (5) pole terminal block (TB1) which is comprised of three (3) input power, neutral, and ground connections. The output over current protection from the DSPM Frequency Converter System is the responsibility of the End User.

6.3. SYSTEM CURRENT RATINGS

All circuit breakers provided by the end user that are connected to the inputs and outputs, need to be of the “High Inrush” type. This is to prevent the breakers from tripping during the startup of the unit and its load. DSPM uses only the “High Inrush” type of breaker in its units. Refer to Charts 6.3.1-13 when determining the size of your input and output breakers.

kVA	Input Voltage	Utility Feed Amps
8	208	38.9
	220	36.8
	380	21.3
	400	20.2
	415	19.5
	480	16.9

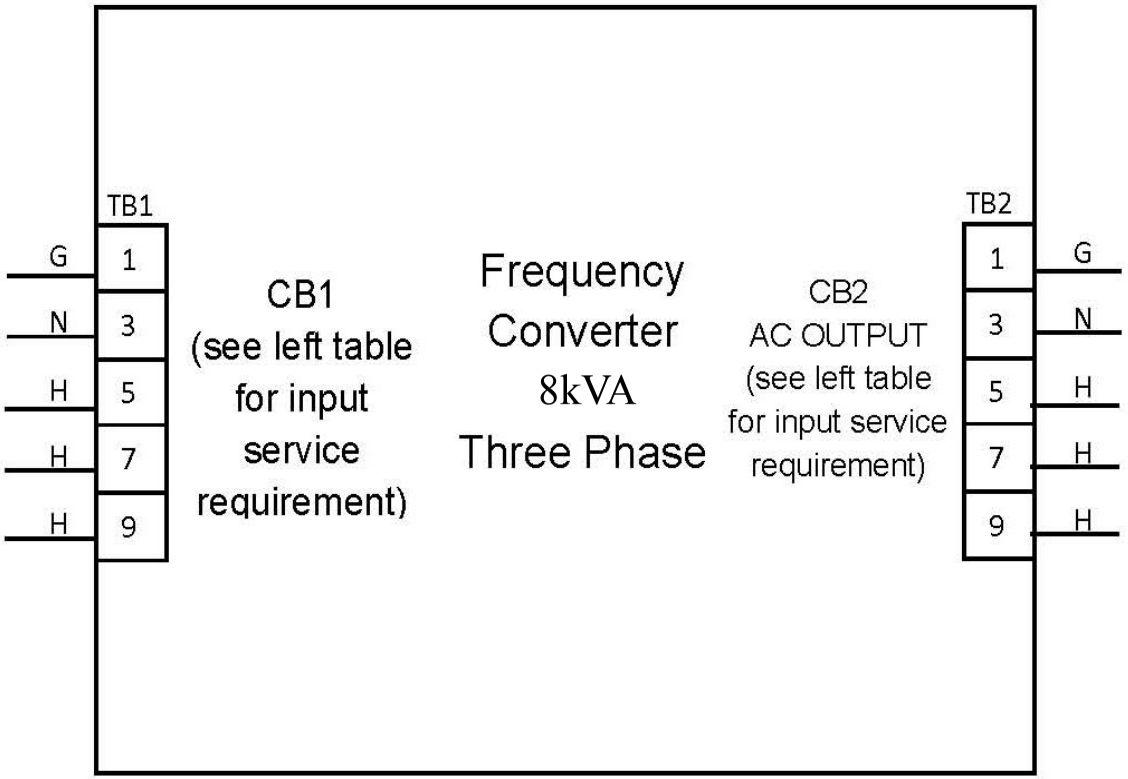


Chart 5.3.1

Input Voltage	Output Voltage	Max Output Amps
208	208	22.2
	380	12.2
	400	11.6
	415	11.1
	220	21
	480	9.6
220	208	22.2
	380	12.2
	400	11.6
	415	11.1
	220	21
	480	9.6
380	208	22.2
	380	12.2
	400	11.6
	415	11.1
	220	21
	480	9.6
400	208	22.2
	380	12.2
	400	11.6
	415	11.1
	220	21
	480	9.6
415	208	22.2
	380	12.2
	400	11.6
	415	11.1
	220	21
	480	9.6
480	208	22.2
	380	12.2
	400	11.6
	415	11.1
	220	21
	480	9.6

kVA	Input Voltage	Utility Feed Amps
10	208	48.6
	220	46
	380	26.6
	400	25.3
	415	24.4
	480	21.1

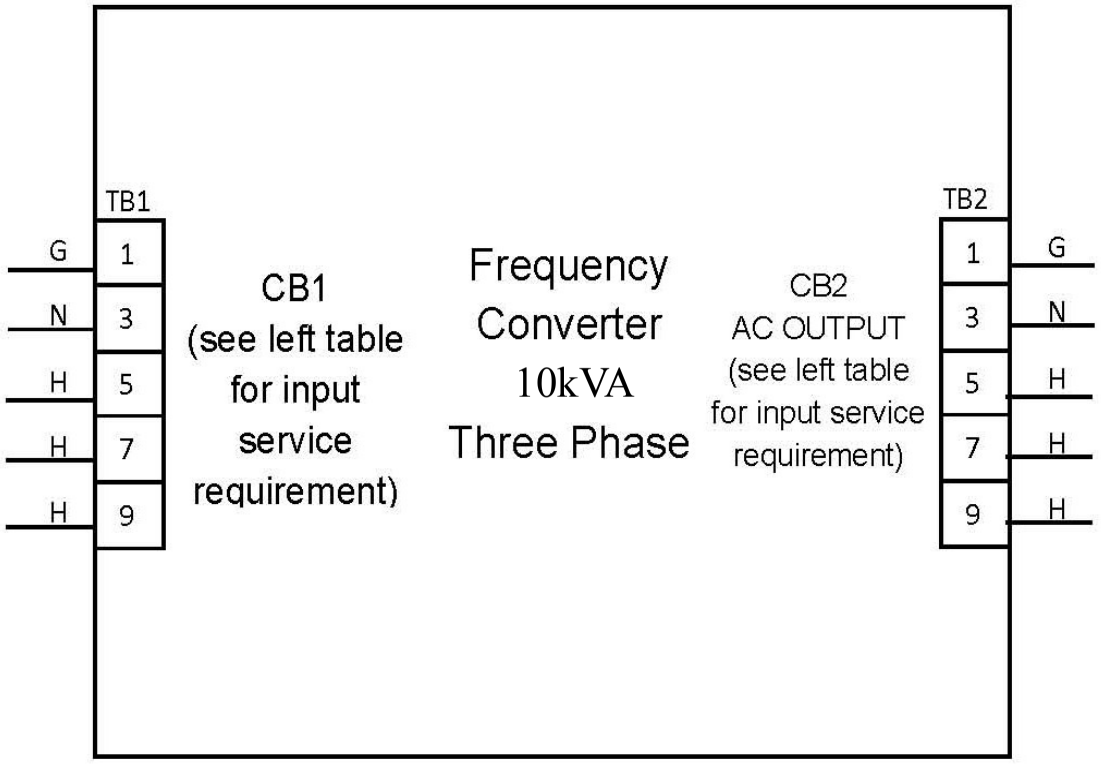
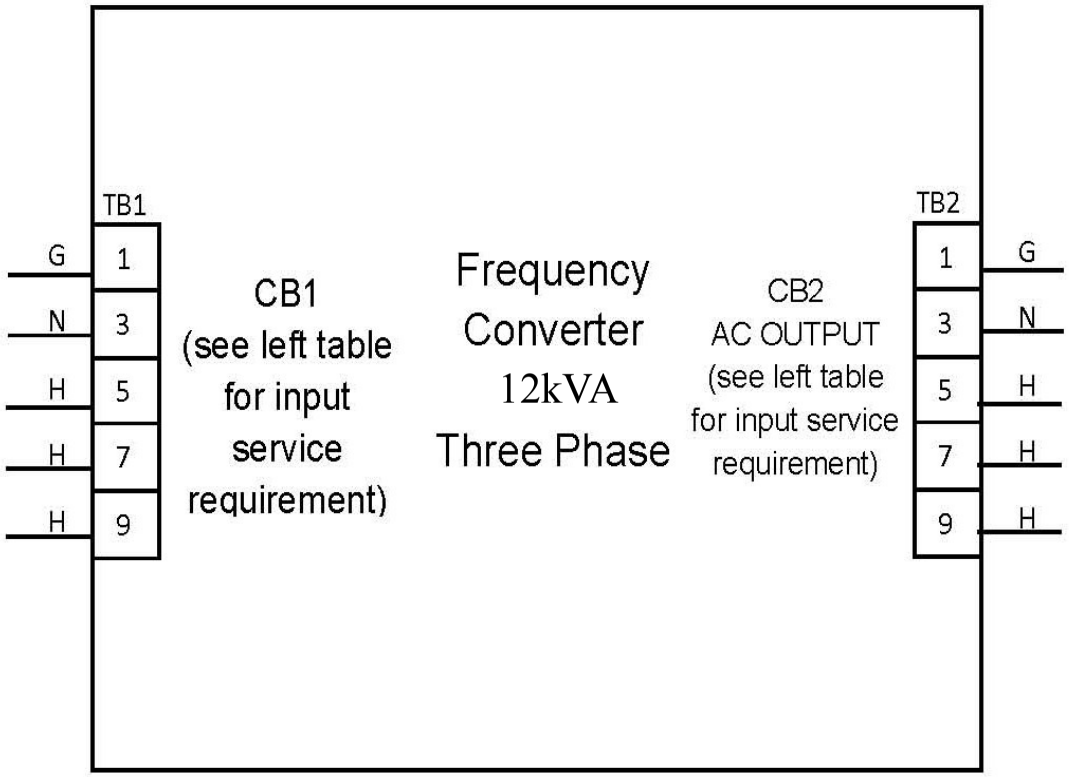


Chart 5.3.2

Input Voltage	Output Voltage	Max Output Amps
208	208	27.8
	380	15.2
	400	14.5
	415	13.9
	220	26.3
	480	12
220	208	27.8
	380	15.2
	400	14.5
	415	13.9
	220	26.3
	480	12
380	208	27.8
	380	15.2
	400	14.5
	415	13.9
	220	26.3
	480	12
400	208	27.8
	380	15.2
	400	14.5
	415	13.9
	220	26.3
	480	12
415	208	27.8
	380	15.2
	400	14.5
	415	13.9
	220	26.3
	480	12
480	208	27.8
	380	15.2
	400	14.5
	415	13.9
	220	26.3
	480	12

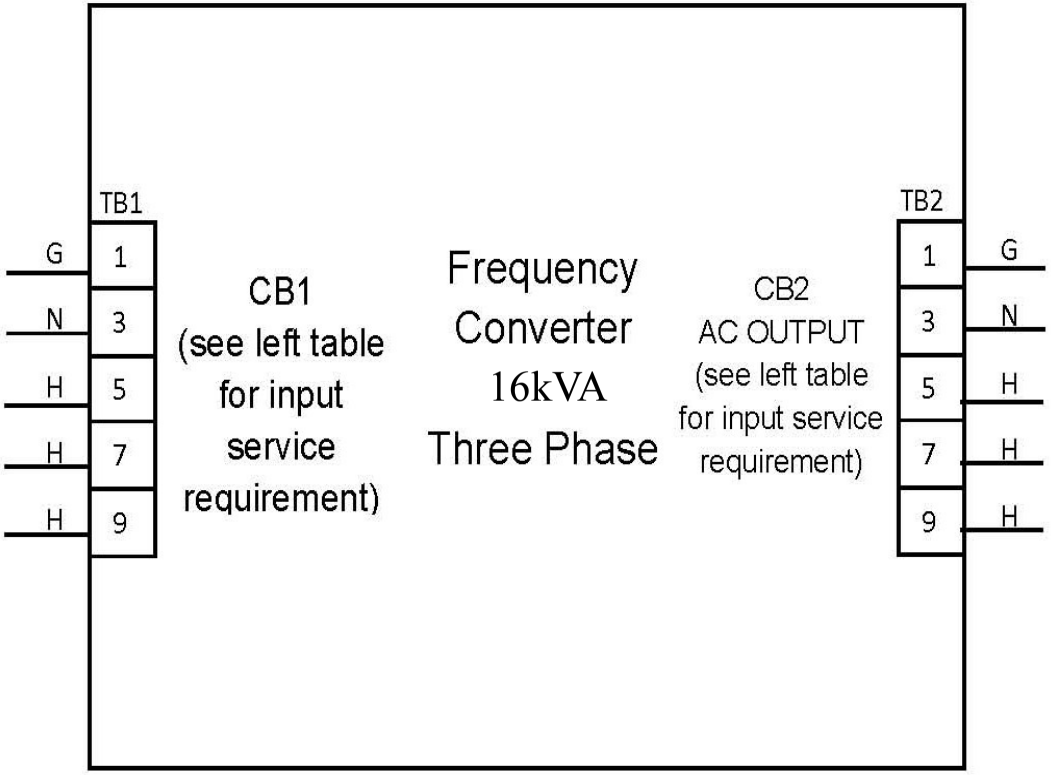
kVA	Input Voltage	Utility Feed Amps
12	208	58.4
	220	55.2
	380	31.9
	400	30.3
	415	29.2
	480	25.3



Input Voltage	Output Voltage	Max Output Amps
208	208	33.3
	380	18.3
	400	17.3
	415	16.7
	220	31.5
	480	14.5
220	208	33.3
	380	18.3
	400	17.3
	415	16.7
	220	31.5
	480	14.5
380	208	33.3
	380	18.3
	400	17.3
	415	16.7
	220	31.5
	480	14.5
400	208	33.3
	380	18.3
	400	17.3
	415	16.7
	220	31.5
	480	14.5
415	208	33.3
	380	18.3
	400	17.3
	415	16.7
	220	31.5
	480	14.5
480	208	33.3
	380	18.3
	400	17.3
	415	16.7
	220	31.5
	480	14.5

Chart 5.3.3

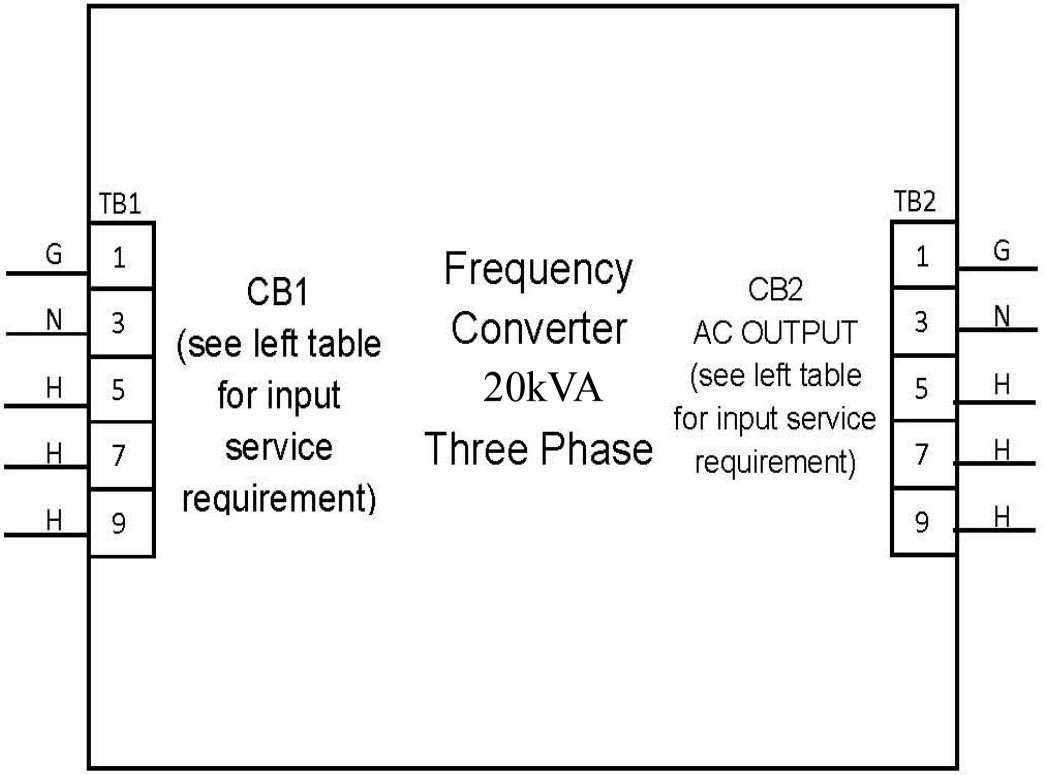
kVA	Input Voltage	Utility Feed
16	208	77.8
	220	73.6
	380	42.6
	400	40.5
	415	39
	480	33.7



Input Volt-	Output Volt-	Max Output
208	208	44.5
	380	24.3
	400	23.1
	415	22.3
	220	42
	480	19.3
220	208	44.5
	380	24.3
	400	23.1
	415	22.3
	220	42
	480	19.3
380	208	44.5
	380	24.3
	400	23.1
	415	22.3
	220	42
	480	19.3
400	208	44.5
	380	24.3
	400	23.1
	415	22.3
	220	42
	480	19.3
415	208	44.5
	380	24.3
	400	23.1
	415	22.3
	220	42
	480	19.3
480	208	44.5
	380	24.3
	400	23.1
	415	22.3
	220	42
	480	19.3

Chart 5.3.4

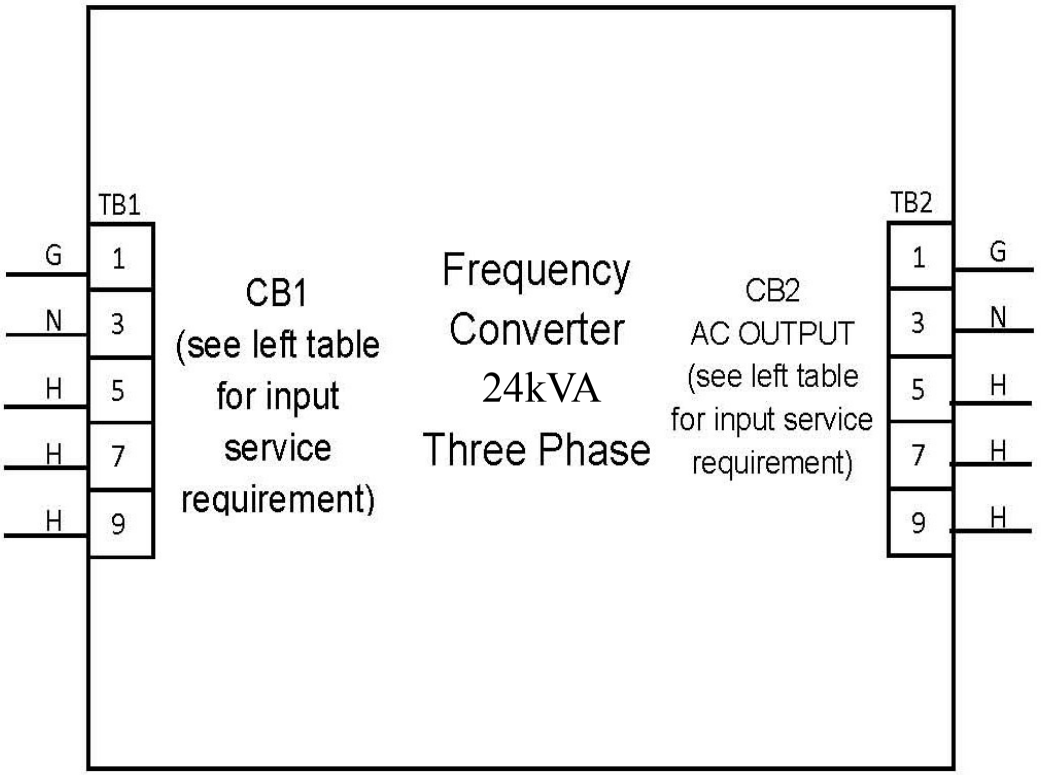
kVA	Input Voltage	Utility Feed Amps
20	208	97.3
	220	92
	380	53.2
	400	50.6
	415	48.7
	480	42.1



Input Voltage	Output Voltage	Max Output Amps
208	208	55.6
	380	30.4
	400	28.9
	415	27.9
	220	52.5
	480	24.1
220	208	55.6
	380	30.4
	400	28.9
	415	27.9
	220	52.5
	480	24.1
380	208	55.6
	380	30.4
	400	28.9
	415	27.9
	220	52.5
	480	24.1
400	208	55.6
	380	30.4
	400	28.9
	415	27.9
	220	52.5
	480	24.1
415	208	55.6
	380	30.4
	400	28.9
	415	27.9
	220	52.5
	480	24.1
480	208	55.6
	380	30.4
	400	28.9
	415	27.9
	220	52.5
	480	24.1

Chart 5.3.5

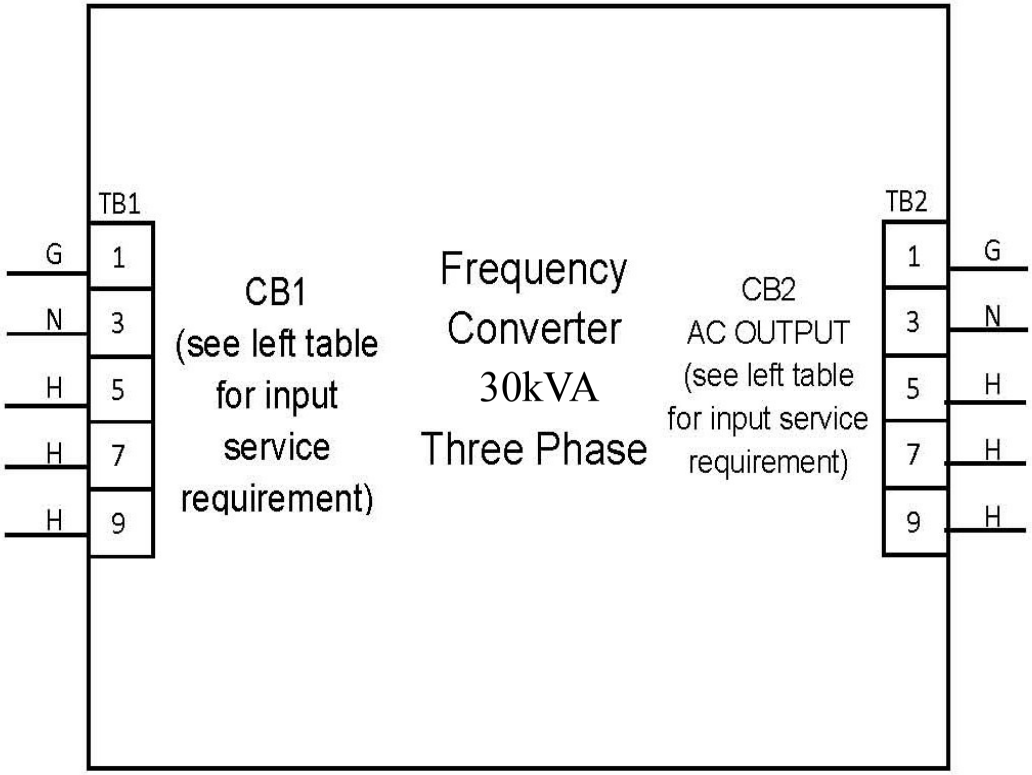
kVA	Input Voltage	Utility Feed Amps
24	208	116.7
	220	110.4
	380	63.9
	400	60.7
	415	58.5
	480	50.6



Input Voltage	Output Voltage	Max Output Amps
208	208	66.7
	380	36.5
	400	34.7
	415	33.4
	220	63.1
	480	28.9
220	208	66.7
	380	36.5
	400	34.7
	415	33.4
	220	63.1
	480	28.9
380	208	66.7
	380	36.5
	400	34.7
	415	33.4
	220	63.1
	480	28.9
400	208	66.7
	380	36.5
	400	34.7
	415	33.4
	220	63.1
	480	28.9
415	208	66.7
	380	36.5
	400	34.7
	415	33.4
	220	63.1
	480	28.9
480	208	66.7
	380	36.5
	400	34.7
	415	33.4
	220	63.1
	480	28.9

Chart 5.3.6

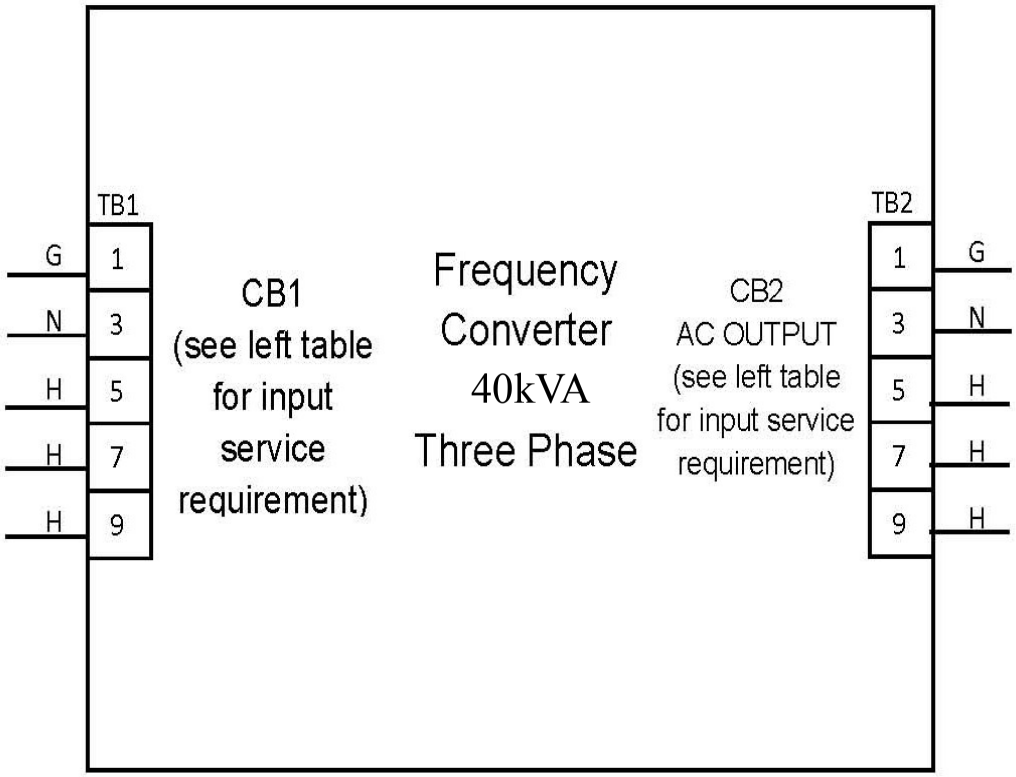
kV A	Input Volt-age	Utility Feed Amps
30	208	145.9
	220	137.9
	380	79.9
	400	75.9
	415	73.1
	480	63.2



Input Volt-age	Output Volt-age	Max Output Amps
208	208	83.4
	380	45.6
	400	43.4
	415	41.8
	220	78.8
	480	36.1
220	208	83.4
	380	45.6
	400	43.4
	415	41.8
	220	78.8
	480	36.1
380	208	83.4
	380	45.6
	400	43.4
	415	41.8
	220	78.8
	480	36.1
400	208	83.4
	380	45.6
	400	43.4
	415	41.8
	220	78.8
	480	36.1
415	208	83.4
	380	45.6
	400	43.4
	415	41.8
	220	78.8
	480	36.1
480	208	83.4
	380	45.6
	400	43.4
	415	41.8
	220	78.8
	480	36.1

Chart 5.3.7

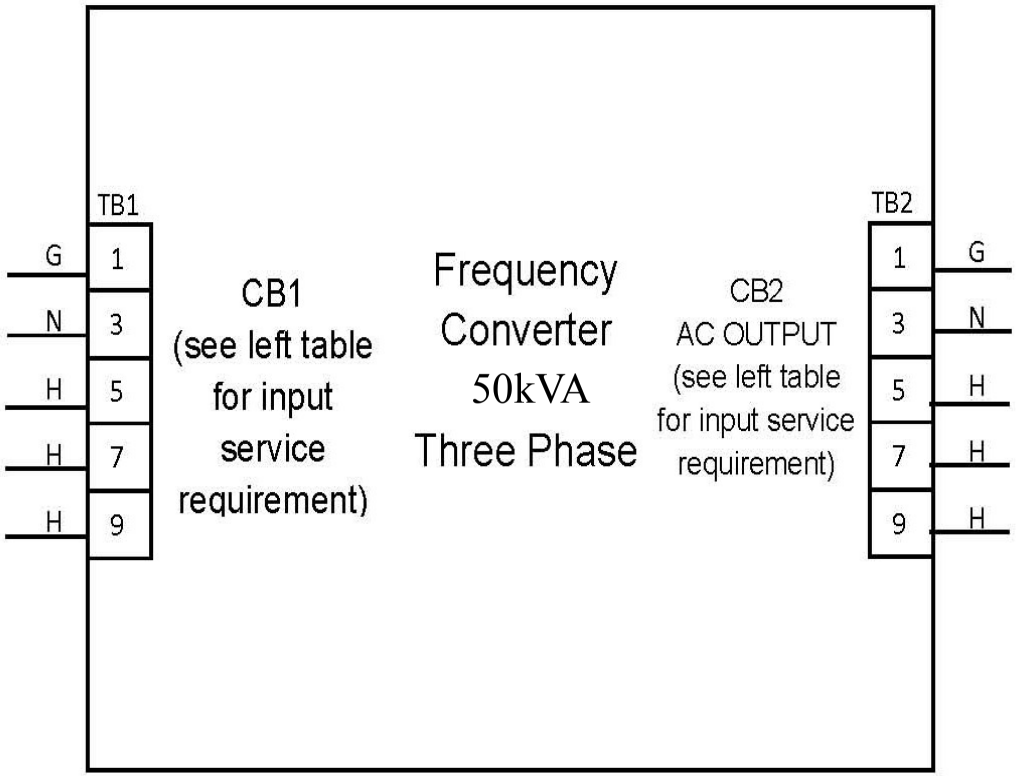
kVA	Input Voltage	Utility Feed Amps
40	208	194.5
	220	183.9
	380	106.5
	400	101.2
	415	97.5
	480	84.3



Input Voltage	Output Voltage	Max Output Amps
208	208	111.2
	380	60.8
	400	57.8
	415	55.7
	220	105.1
	480	48.2
220	208	111.2
	380	60.8
	400	57.8
	415	55.7
	220	105.1
	480	48.2
380	208	111.2
	380	60.8
	400	57.8
	415	55.7
	220	105.1
	480	48.2
400	208	111.2
	380	60.8
	400	57.8
	415	55.7
	220	105.1
	480	48.2
415	208	111.2
	380	60.8
	400	57.8
	415	55.7
	220	105.1
	480	48.2
480	208	111.2
	380	60.8
	400	57.8
	415	55.7
	220	105.1
	480	48.2

Chart 5.3.8

kVA	Input Voltage	Utility Feed Amps
50	208	243.2
	220	230
	380	133.1
	400	126.4
	415	121.9
	480	105.4



Input Voltage	Output Voltage	Max Output Amps
208	208	139
	380	76.1
	400	72.3
	415	69.6
	220	131.4
	480	60.2
220	208	139
	380	76.1
	400	72.3
	415	69.6
	220	131.4
	480	60.2
380	208	139
	380	76.1
	400	72.3
	415	69.6
	220	131.4
	480	60.2
400	208	139
	380	76.1
	400	72.3
	415	69.6
	220	131.4
	480	60.2
415	208	139
	380	76.1
	400	72.3
	415	69.6
	220	131.4
	480	60.2
480	208	139
	380	76.1
	400	72.3
	415	69.6
	220	131.4
	480	60.2

Chart 5.3.9

kVA	Input Voltage	Utility Feed Amps
60	208	291.8
	220	275.9
	380	159.7
	400	151.7
	415	146.2
	480	126.4

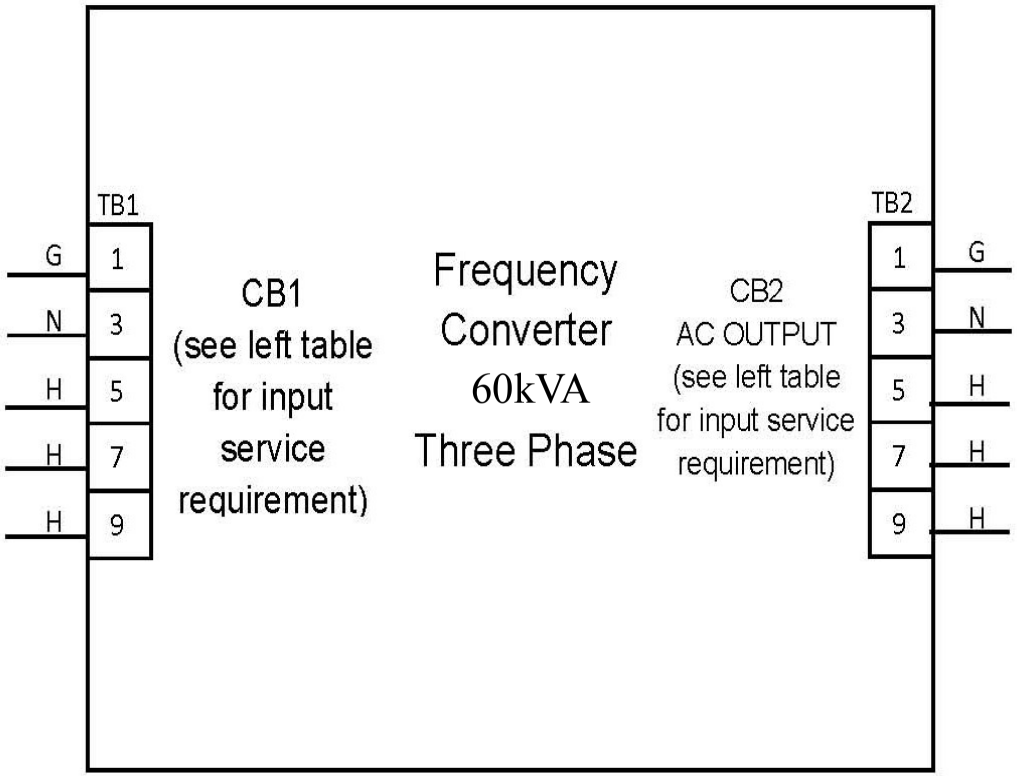
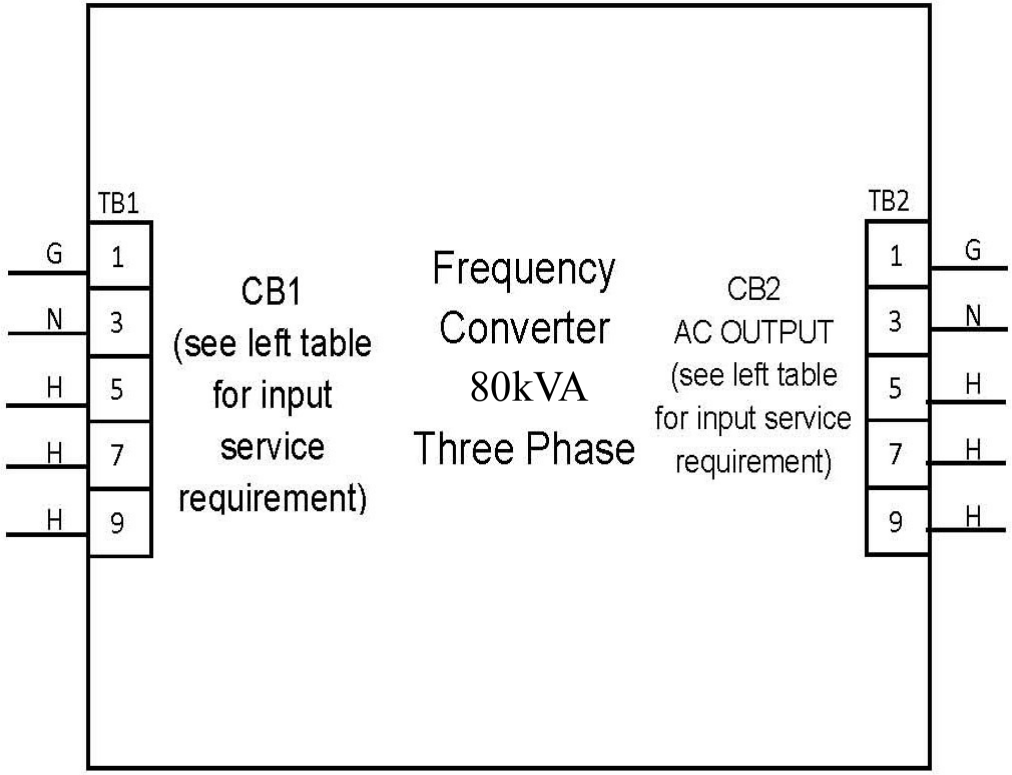


Chart 5.3.10

Input Voltage	Output Voltage	Max Output Amps
208	208	166.7
	380	91.3
	400	86.7
	415	83.6
	220	157.6
	480	72.3
220	208	166.7
	380	91.3
	400	86.7
	415	83.6
	220	157.6
	480	72.3
380	208	166.7
	380	91.3
	400	86.7
	415	83.6
	220	157.6
	480	72.3
400	208	166.7
	380	91.3
	400	86.7
	415	83.6
	220	157.6
	480	72.3
415	208	166.7
	380	91.3
	400	86.7
	415	83.6
	220	157.6
	480	72.3
480	208	166.7
	380	91.3
	400	86.7
	415	83.6
	220	157.6
	480	72.3

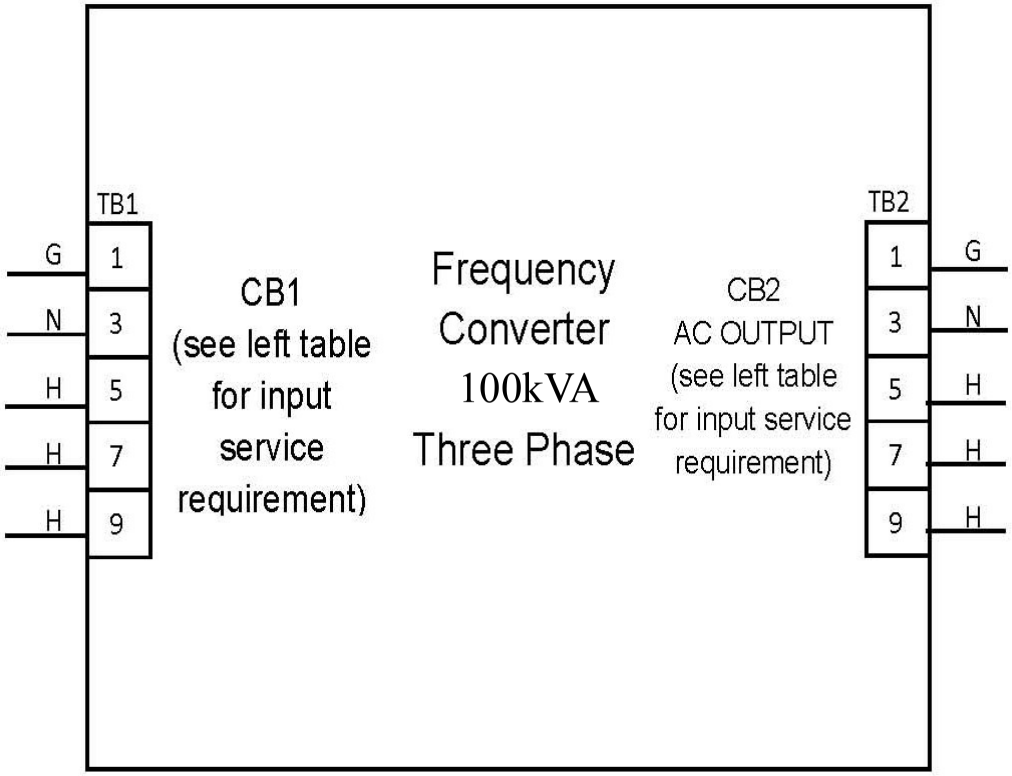
kVA	Input Voltage	Utility Feed Amps
80	208	389.1
	220	367.8
	380	213
	400	202.3
	415	195
	480	168.6



Input Voltage	Output Voltage	Max Output Amps
208	208	222.3
	380	210.2
	400	115.6
	415	111.4
	220	210.2
	480	96.3
220	208	222.3
	380	210.2
	400	115.6
	415	111.4
	220	210.2
	480	96.3
380	208	222.3
	380	210.2
	400	115.6
	415	111.4
	220	210.2
	480	96.3
400	208	222.3
	380	210.2
	400	115.6
	415	111.4
	220	210.2
	480	96.3
415	208	222.3
	380	210.2
	400	115.6
	415	111.4
	220	210.2
	480	96.3
480	208	222.3
	380	210.2
	400	115.6
	415	111.4
	220	210.2
	480	96.3

Chart 5.3.11

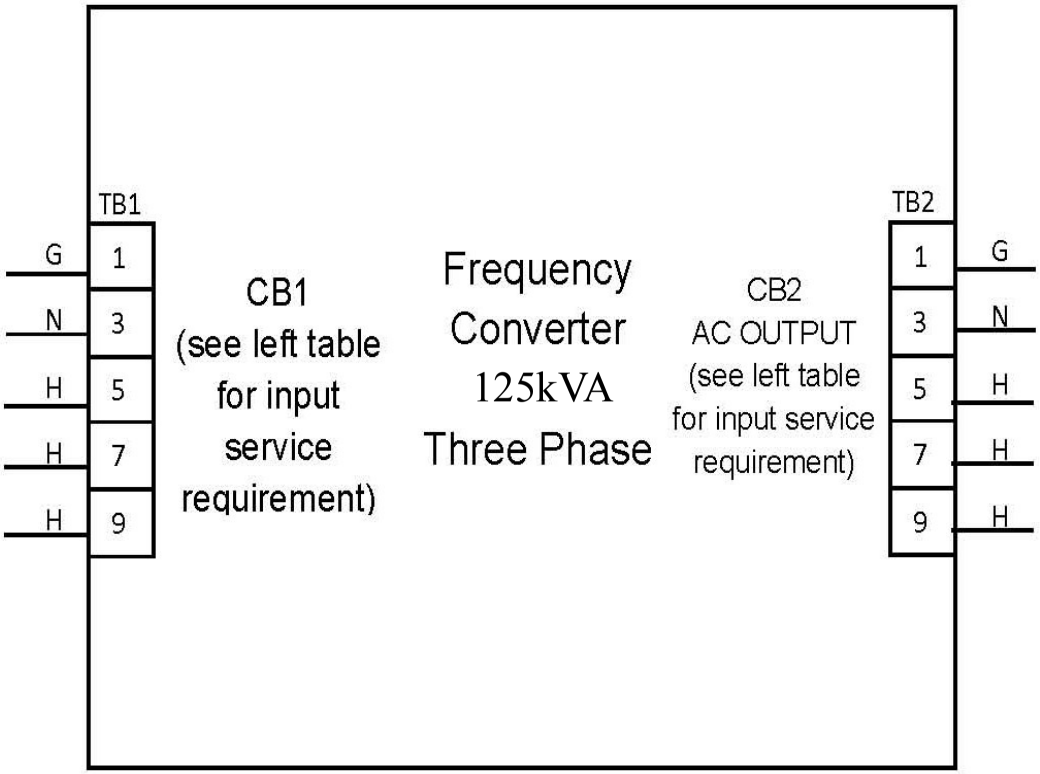
kVA	Input Voltage	Utility Feed Amps
100	208	486.3
	220	459.8
	380	266.2
	400	252.9
	415	243.7
	480	210.7



Input Voltage	Output Voltage	Max Output Amps
208	208	277.9
	380	152.1
	400	144.5
	415	139.3
	220	262.7
	480	120.4
220	208	277.9
	380	152.1
	400	144.5
	415	139.3
	220	262.7
	480	120.4
380	208	277.9
	380	152.1
	400	144.5
	415	139.3
	220	262.7
	480	120.4
400	208	277.9
	380	152.1
	400	144.5
	415	139.3
	220	262.7
	480	120.4
415	208	277.9
	380	152.1
	400	144.5
	415	139.3
	220	262.7
	480	120.4
480	208	277.9
	380	152.1
	400	144.5
	415	139.3
	220	262.7
	480	120.4

Chart 5.3.12

kVA	Input Voltage	Utility Feed Amps
125	208	607.9
	220	574.8
	380	332.8
	400	316.1
	415	304.7
	480	263.4



Input Voltage	Output Voltage	Max Output Amps
208	208	347.4
	380	190.1
	400	180.6
	415	174.1
	220	328.4
	480	150.5
220	208	347.4
	380	190.1
	400	180.6
	415	174.1
	220	328.4
	480	150.5
380	208	347.4
	380	190.1
	400	180.6
	415	174.1
	220	328.4
	480	150.5
400	208	347.4
	380	190.1
	400	180.6
	415	174.1
	220	328.4
	480	150.5
415	208	347.4
	380	190.1
	400	180.6
	415	174.1
	220	328.4
	480	150.5
480	208	347.4
	380	190.1
	400	180.6
	415	174.1
	220	328.4
	480	150.5

Chart 5.3.13

7. CONTROL KEYPAD

The control keypad is the link between the Vacon frequency converter and the user. The Vacon NX control keypad features an alphanumeric display with seven indicators for the Run status (RUN, , READY, STOP, ALARM, FAULT) and three indicators for the control place (I/O term/ Keypad/BusComm). There are also three Status Indicator LEDs (green - green - red), see Status LEDs (green – green – red) below.
The control information, i.e. the number of menu, description of menu or the displayed value and the numeric information are presented on three text lines.

The frequency converter is operable through the nine push-buttons of the control keypad. Furthermore, the buttons serve the purposes of parameter setting and value monitoring.

The keypad is detachable and isolated from the input line potential.

7.1 Indications on the Keypad display

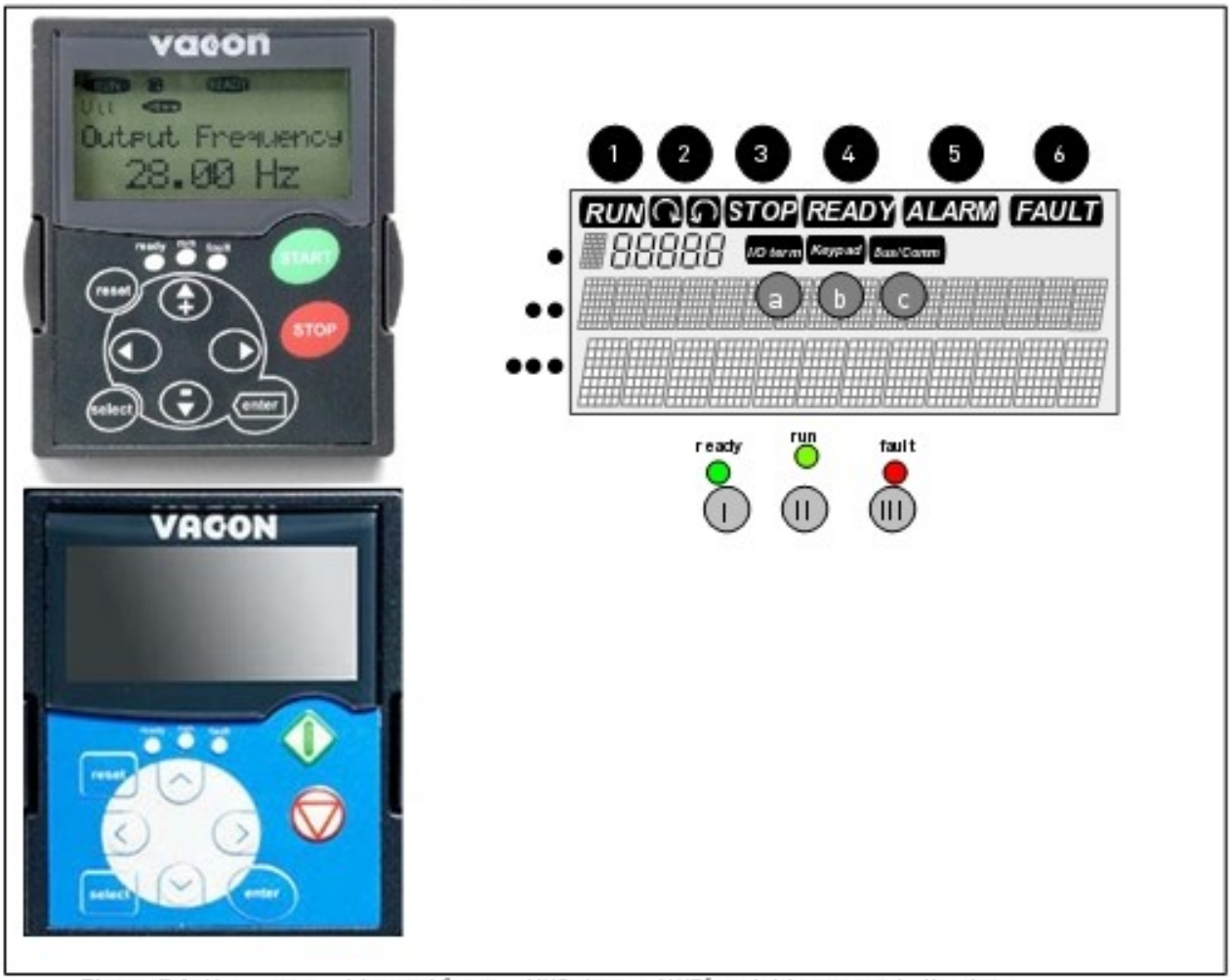


Figure 7-1. Vacon control keypad (upper: NXS, lower: NXP) and drive status indications

7.1.1 *Drive status indications*

The drive status indications tell the user what the status of the motor and the drive is and whether the motor control software has detected irregularities in motor or frequency converter functions.

1. RUN = Motor is running; Blinks when the stop command has been given but the frequency is still ramping down.
2.  = Indicates the direction of motor rotation.
3. STOP = Indicates that the drive is not running.
4. READY = Lights when AC power is on. In case of a trip, the symbol will not light up.
5. ALARM = Indicates that the drive is running outside a certain limit and a warning is given.
6. FAULT = Indicates that unsafe operating conditions were encountered due to which the drive was stopped.

7.1.2 *Control place indications*

The symbols *I/O term*, *Keypad* and *Bus/Comm* (see Figure 7-1) indicate the choice of control place made in the Keypad control menu (M3) (see chapter 7.3.3).

a. *I/O term* = I/O terminals are the selected control place; i.e. START/STOP commands or reference values etc. are given through the I/O terminals.

b. *Keypad* = Control keypad is the selected control place; i.e. the motor can be started or stopped, or its reference values etc. altered from the keypad.

c. *Bus/Comm* = The frequency converter is controlled through a fieldbus.

7.1.3 *Status LEDs (green – green – red)*

The status LEDs light up in connection with the READY, RUN and FAULT drive status indicators.

I ● = Illuminates with the AC power connected to the drive and no faults are active. Simultaneously, the drive status indicator READY is lit up.

II ● = Illuminates when the drive is running. Blinks when the STOP button has been pushed and the drive is ramping down.

III ● = Blinks when unsafe operating conditions were encountered due to which the drive was stopped (Fault Trip). Simultaneously, the drive status indicator FAULT blinks on the display and the fault description can be seen, see chapter 7.3.4, Active Faults.

7.1.4 *Text lines*

The three text lines (•, ••, •••) provide the user with information on his present location in the keypad menu structure as well as with information related to the operation of the drive.

● = Location indication; displays the symbol and number of menu, parameter etc. Example: M2 = Menu 2 (Parameters); P2.1.3 = Acceleration time

●● = Description line; Displays the description of menu, value or fault.

●●● = Value line; Displays the numerical and textual values of references, parameters etc. and the number of submenus available in each menu.

7.2 Keypad push-buttons

The Vacon alphanumeric control keypad features 9 push-buttons that are used for the control of the frequency converter (and motor), parameter setting and value monitoring.

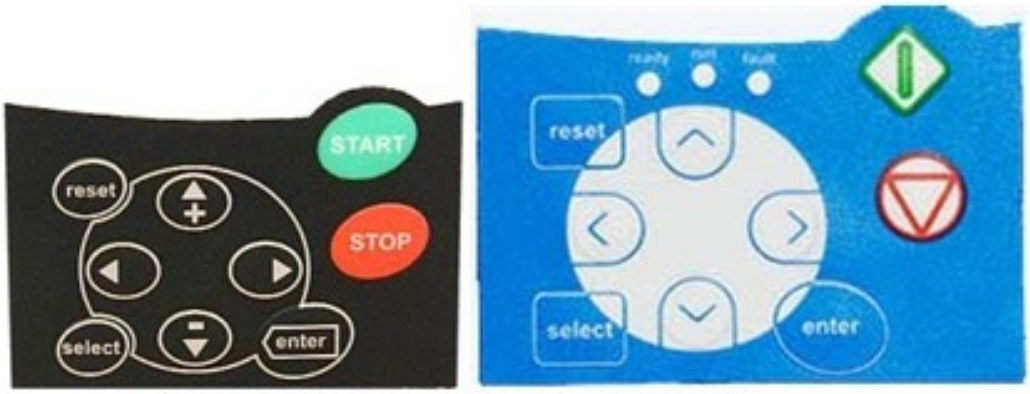


Figure 7-2. Keypad push-buttons, left: NXS, right: NXP

7.2.1 Button descriptions

reset = This button is used to reset active faults (see Chapter 7.3.4).

select = This button is used to switch between two latest displays. May be useful when you want to see how the changed new value influences some other value.

enter = The Enter button serves for:
1) confirmation of selections
2) fault history reset (2...3 seconds)

▲ / + = Browser button up
Browse the main menu and the pages of different submenus.
Edit values.

– / ▼ = Browser button down
Browse the main menu and the pages of different submenus.
Edit values.

◄ = Menu button left
Move backward in menu.
Move cursor left (in parameter menu).
Exit edit mode.
Hold down for 3 seconds to return to main menu.

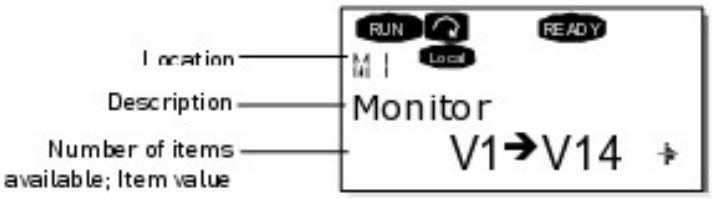
► = Menu button right
Move forward in menu.
Move cursor right (in parameter menu).
Enter edit mode.

start = Start button.
Pressing this button starts the motor if the keypad is the active control place. See Chapter 7.3.3.

stop = Stop button.
Pressing this button stops the motor (unless disabled by parameter R3.4/R3.6).
See Chapter 7.3.3.

7.3 Navigation on the control keypad

The data on the control keypad are arranged in menus and submenus. The menus are used for example for the display and editing of measurement and control signals, parameter settings (chapter 7.3.2), reference values and fault displays (chapter 7.3.4). Through the menus, you can also adjust the contrast of the display (page 104).



The first menu level consists of menus M1 to M7 and is called the *Main menu*. The user can navigate in the main menu using the *Browser buttons* up and down. The desired submenu can be entered from the main menu using the *Menu buttons*. When there still are pages to enter under the currently displayed menu or page, you can see an arrow (→) in the lower right corner of the display and by pressing the *Menu button right*, you can reach the next menu level.

The control keypad navigation chart is shown on the next page. Please note that the menu *M1* is located in the lower left corner. From there you will be able to navigate your way up to the desired menu using the menu and browser buttons.

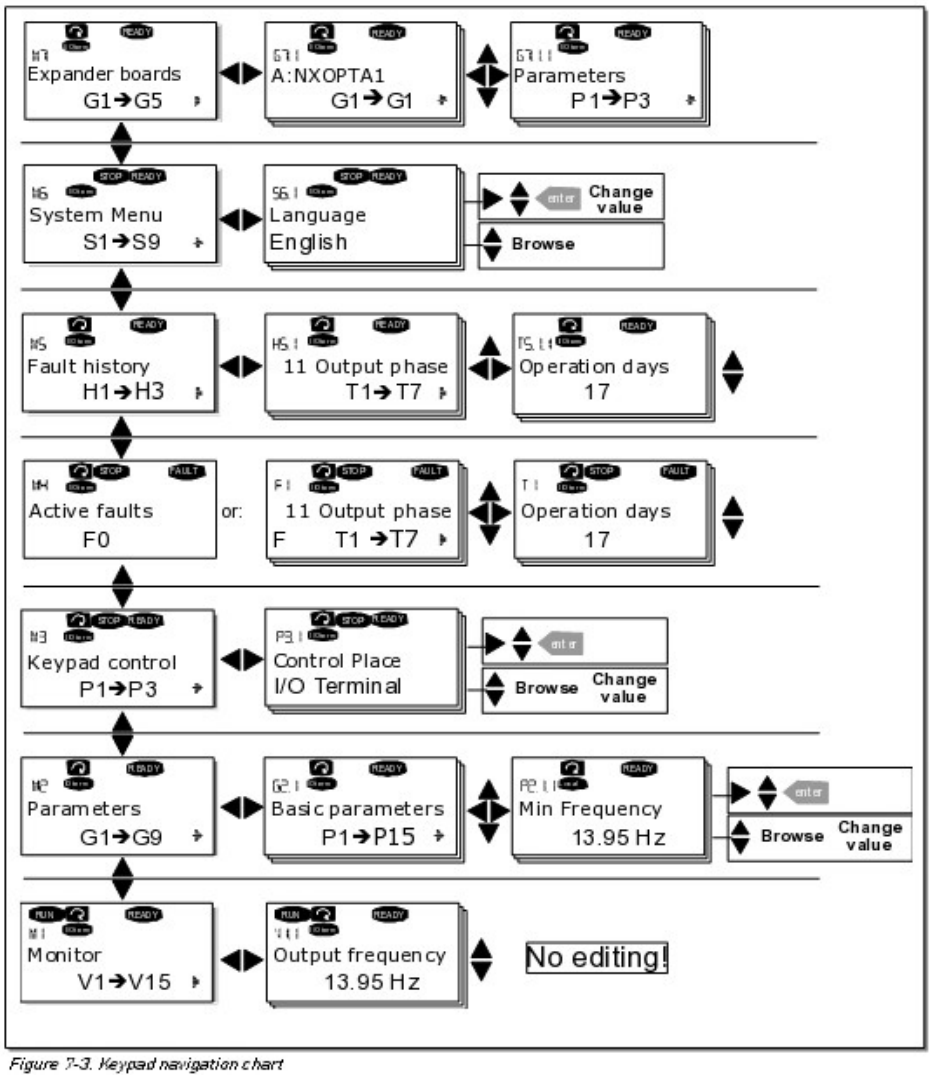


Figure 7-3. Keypad navigation chart

7.3.1 *Monitoring menu (M1)*

You can enter the Monitoring menu from the Main menu by pushing the *Menu button right* when the location indication M1 is visible on the first line of the display. How to browse through the monitored values is presented in Figure 7-4.
The monitored signals carry the indication V#.# and they are listed in Table 7-1. The values are updated once every 0.3 seconds.

This menu is meant only for signal checking. The values cannot be altered here. For changing values of parameters see Chapter 7.3.2.

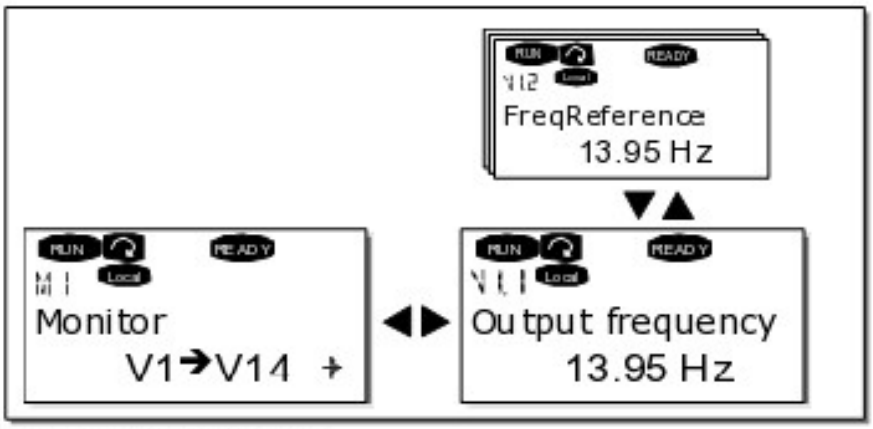


Figure 7-4. Monitoring menu

Code	Signal name	Unit	Description
V1.1	Output frequency	Hz	Frequency to the motor
V1.2	Frequency reference	Hz	
V1.3	Motor speed	rpm	Calculated motor speed
V1.4	Motor current	A	Measured motor current
V1.5	Motor torque	%	Calculated motor shaft torque
V1.6	Motor power	%	Calculated motor shaft power
V1.7	Motor voltage	V	Calculated motor voltage
V1.8	DC-link voltage	V	Measured DC-link voltage
V1.9	Unit temperature	°C	Heat sink temperature
V1.10	Motor temperature	%	Calculated motor temperature. See All in One application manual.
V1.11	Voltage input	V	AI1*
V1.12	Current input	mA	AI2*
V1.13	DIN1, DIN2, DIN3		Digital input statuses
V1.14	DIN4, DIN5, DIN6		Digital input statuses
V1.15	DO1, RO1, RO2		Digital and relay output statuses
V1.16	Analogue output	mA	AO1
M1.17	Multimonitoring items		Displays three selectable monitoring values. See chapter 7.3.6.5.

Table 7-1. Monitored signals

* If the unit is supplied with +24V only (for control board power-up) this value is not reliable.

The All in One applications embody more monitoring values.

7.3.2 *Parameter menu (M2)*

Parameters are the way of conveying the commands of the user to the frequency converter. The parameter values can be edited by entering the *Parameter Menu* from the *Main Menu* when the location indication M2 is visible on the first line of the display. The value editing procedure is presented in Figure 7-5.

Push the *Menu button right* once to move into the *Parameter Group Menu (G#)*. Locate the parameter group desired by using the *Browser buttons* and push the *Menu button right* again to enter the group and its parameters. Use again the *Browser buttons* to find the parameter *(P#)* you want to edit. From here you can proceed in two different ways: Pushing the *Menu button right* takes you to the edit mode. As a sign of this, the parameter value starts to blink. You can now change the value in two different manners:

1. Just set the new desired value with the *Browser buttons* and confirm the change with the *Enter button*. Consequently, the blinking stops and the new value is visible in the value field.
2. Push the *Menu button right* once again. Now you will be able to edit the value digit by digit. This editing manner may come in handy, when a relatively greater or smaller value than that on the display is desired. Confirm the change with the *Enter button*.

The value will not change unless the Enter button is pushed. Pressing the *Menu button left* takes you back to the previous menu.

Several parameters are locked, i.e. uneditable, when the drive is in RUN status. If you try to change the value of such a parameter the text **Locked** will appear on the display. The frequency converter must be stopped in order to edit these parameters.
The parameters values can also be locked using the function in menu M6 (see Chapter Parameter lock (P6.5.2)).

You can return to the *Main menu* anytime by pressing the *Menu button left* for 3 seconds.

The basic application package "All in One+" includes seven applications with different sets of parameters. You will find the parameter lists in the Application Section of this manual.

Once in the last parameter of a parameter group, you can move directly to the first parameter of that group by pushing the *Browser button up*.

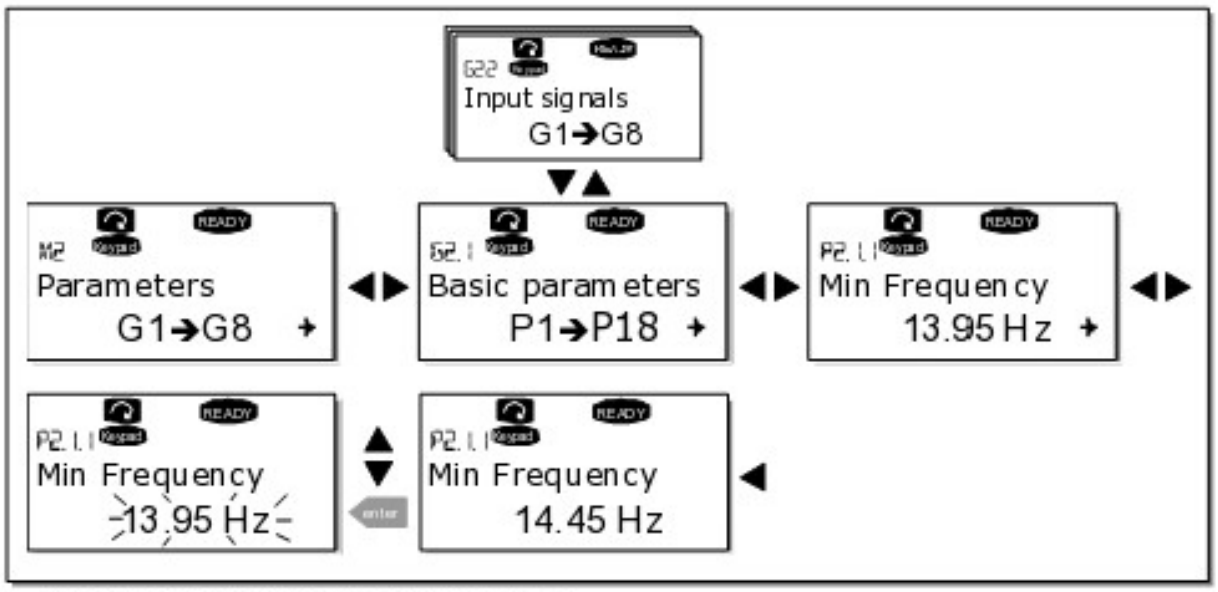


Figure 7-5. Parameter value change procedure

7.3.3.2 *Keypad reference*

The keypad reference submenu (P3.2) displays and allows the operator to edit the frequency reference. The changes will take place immediately. This reference value will not, however, influence the rotation speed of the motor unless the keypad has been selected as source of reference.
NOTE: The maximum difference in RUN mode between the output frequency and the keypad reference is 6 Hz.

See Figure 7-5 for how to edit the reference value (pressing the *Enter button* is not, however, necessary).

7.3.3.3 *Keypad direction*

The keypad direction submenu displays and allows the operator to change the rotating direction of the motor. This setting will not, however, influence the rotation direction of the motor unless the keypad has been selected as the active control place.

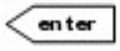
See Figure 7-6 for how to change the rotation direction.

> Note: Additional Information on controlling the motor with the keypad is given in Chapters 7.2.1 and 8.2

7.3.3.4 *Stop button activated*

By default, pushing the STOP button will always stop the motor regardless of the selected control place. You can disable this function by giving parameter 3.4 the value 0. If the value of this parameter is 0, the STOP button will stop the motor only when the keypad has been selected as the active control place.

NOTE! There are some special functions that can be performed when in menu *M3*:
Select the keypad as the active control place by keeping the START button pushed down for 3 seconds when the motor is running. The keypad will become the active control place and the current frequency reference and direction will be copied to the keypad.
Select the keypad as the active control place by keeping the STOP button pushed down for 3 seconds when the motor is stopped. The keypad will become the active control place and the current frequency reference and direction will be copied to the keypad.

Copy the frequency reference set elsewhere (I/O, fieldbus) to the panel by keeping the 

button pushed down for 3 seconds.

Note that if you are in any other than *M3* menu these functions will not work.
If you are in some other than *M3* menu and try to start the motor by pressing the START button when the keypad is not selected as the active control place you will get an error message *Keypad Control NOT ACTIVE*.

7.3.3 Keypad control menu (M3)

In the *Keypad Controls Menu*, you can choose the control place, edit the frequency reference and change the direction of the motor. Enter the submenu level with the *Menu button right*.

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P3.1	Control place	1	3		1		125	1=I/O terminal 2=Keypad 3=Fieldbus
R3.2	Keypad reference	Par. 2.1.1	Par. 2.1.2	Hz				
P3.3	Direction (on keypad)	0	1		0		123	0=Forward 1=Reverse
R3.4	Stop button	0	1		1		114	0=Limited function of Stop button 1=Stop button always enabled

Table 7-2. Keypad control parameters, M3

7.3.3.1 Selection of control place

There are three different places (sources) which the frequency converter can be controlled from. For each control place, a different symbol will appear on the alphanumeric display:

Control place	Symbol
I/O terminals	I/O term
Keypad (panel)	Keypad
Fieldbus	Bus/Comm

Change the control place by entering the edit mode with the *Menu button right*. The options can then be browsed through with the *Browser buttons*. Select the desired control place with the *Enter button*. See the diagram on the next page.

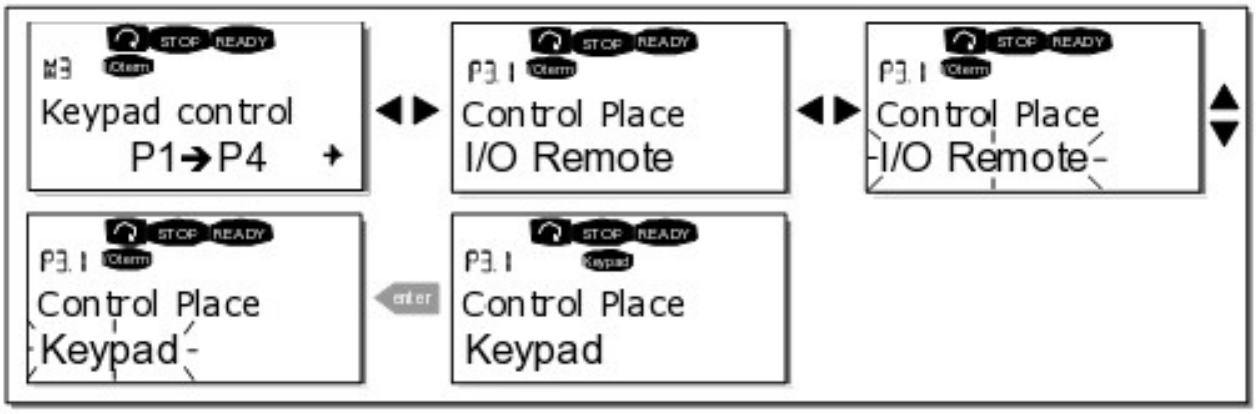


Figure 7-6. Selection of control place

8. OPERATION AND PROCEDURE
8.1. START-UP PROCEDURE

Model No. _____

Sales Order / Serial Number: _____

Input Voltage _____ Output Voltage _____ kVA/kW _____

I. Test Equipment Used

1. Digital Volt Meter
2. Digital AC/DC Amp Meter
3. Frequency Counter
4. Phase Sequence Tester (Optional)

II. Initial Checks:

4. Check wiring, for loose connections, loose hardware, etc.
5. Set the input Circuit Breaker and the Output Breaker to the "Off" position.
6. Measure the resistance between the Main Output Terminal Block Ground and Neutral. This value should be greater then 100K Ohms.
7. Measure the resistance between the Main Output Terminal Block Neutral and each of the Output Distribution Terminal Block Neutrals, this value should be less then 5 Ohms
8. Have the proper system input voltage, as indicated on the system label, connected to input terminal block.

III. Functional Testing:

1. Turn on Input Circuit Breaker in the converter.
2. Verify input phase sequence using the Phase Sequence Tester.
3. Record all the appropriate measured input values for the system below.

   A to B _____, B to C _____, C to A _____

   A to N _____, B to N _____, C to N _____

   N to G _____,

   Input Frequency _____ Hz

4. Turn on Output Circuit Breaker and verify that the output voltage matches the System Label.
5. Record all the appropriate measured output values for the system below.

   A to B _____, B to C _____, C to A _____

   A to N _____, B to N _____, C to N _____

   N to G _____,

   Output Frequency _____ Hz

Technician: _____ Date: _____

9. SERVICE PROGRAM DESCRIPTIONS

9.1. SERVICE PROGRAM DESCRIPTIONS

TOS Equipment Turn On Service WITHOUT On Site Warranty

- Equipment Turn On Service is for customer that would like to have start-up performed without adding additional coverage to the of the equipment warranty.
- This coverage can be performed as an On-Site Startup Service for any DSPM product.
- All parts and labor to repair if **NOT** covered under a current Warranty or Service Plan and will be billed from DSPM current rates unless covered by a current warranty or service plan.

CI Certification Inspection Visit

- The Certification/Inspection is a service provided to certify equipment capable is placed under a warranty/service plan.
- The Certification Inspection is complete when all repairs are completed
- The Certification Inspection is billed at DSPM current hourly rates based on time of day and day of week service is performed.
- All part needed to complete the repairs are billed from DSPM current list prices.

SW58 Extended On-Site Warranty 8-5 Mon.-Fri.

- This Extended Warranty Plan is to be purchased while the equipment is still under current warranty coverage, or after approval by DSPM and a Certification Inspection by DSPM.
- This plan covers all replacement parts and labor including travel time and expenses for all emergency calls to service the unit. All service calls will be made between 8:00 a.m. and 5:00 p.m. and will be limited to Monday through Friday with the exception of the DSPM's designated holidays.
- If the Customer requests remedial maintenance outside of the contracted coverage or preventive maintenance, DSPM will provide this service. This service will be charged to the Customer at DSPM's standard hourly rates in effect at the time of the service, and will be subject to an available field engineer.
- DSPM will provide all replacement parts for parts that are found defective during emergency service calls. If replaced parts are used from any Customer- spare parts kit, DSPM will replace them to the Customer-owned spare parts kit with no charges to the Customer.
- DSPM will include installation of any changes for safety reasons and at DSPM option, install any factory enhancements and upgrades, and reliability changes or improvements during the emergency service call. Uninterruptible Power Systems (UPS) and Emergency Lighting Inverter's batteries are **NOT** warranted under this plan unless specified. DSPM will provide the maintenance and testing for the batteries at DSPM's the hourly rates in effect for DSPM. DSPM unless specified otherwise in contract, will **NOT** provide Battery replacements but will assist the customer in the replacement of the batteries through the battery manufacturers warranty.

SW724 Extended On-Site Warranty 24Hr/day 7Days/week Except Holidays

- This Extended Warranty Plan is to be purchased while the equipment is still under current warranty coverage, or after approval by DSPM and a Certification Inspection by DSPM.
- This plan covers all replacement parts and labor including travel time and expenses for all emergency calls to service the unit. All service calls will be made Seven (7) days a week exception of the DSPM's designated holidays.
- If the Customer requests remedial maintenance outside of the contracted coverage or preventive maintenance, DSPM will provide this service. This service will be charged to the Customer at DSPM's standard hourly rates in effect at the time of the service, and will be subject to an available field engineer.
- DSPM will provide all replacement parts for parts that are found defective during emergency service calls. If Replaced parts are used from any Customer- spare parts kit, DSPM will replace them to the Customer-owned spare parts kit with no charges to the Customer.
- DSPM will include installation of any changes for safety reasons and at DSPM option, install any factory enhancements and upgrades, and reliability changes or improvements during the emergency service call. Uninterruptible Power Systems (UPS) and Emergency Lighting Inverter's batteries are **NOT** warranted under this plan unless specified. DSPM will provide the

maintenance and testing for the batteries at DSPM's the hourly rates in effect for DSPM. DSPM unless specified otherwise, will **NOT** provide Battery replacements but will assist the customer in the replacement of the batteries through the battery manufacturers warranty.

SW36 Extended On-Site Warranty 24Hr/day 7Days/week including Holidays

- This Extended Warranty Plan is to be purchased while the equipment is still under current warranty coverage, or after approval by DSPM and a Certification Inspection by DSPM.
- This plan covers all replacement parts and labor including travel time and expenses for all emergency calls to service the unit. All service calls will be made Seven (7) days a week exception of the DSPM's designated holidays.
- If the Customer requests remedial maintenance outside of the contracted coverage or preventive maintenance, DSPM will provide this service. This service will be charged to the Customer at DSPM's standard hourly rates in effect at the time of the service, and will be subject to an available field engineer.
- DSPM will provide all replacement parts for parts that are found defective during emergency service calls. If Replaced parts are used from any Customer- spare parts kit, DSPM will replace them to the Customer-owned spare parts kit with no charges to the Customer.
- DSPM will include installation of any changes for safety reasons and at DSPM option, install any factory enhancements and upgrades, and reliability changes or improvements during the emergency service call. Uninterruptible Power Systems (UPS) and Emergency Lighting Inverter's batteries are **NOT** warranted under this plan unless specified. DSPM will provide the maintenance and testing for the batteries at DSPM's the hourly rates in effect for DSPM. DSPM unless specified otherwise, will **NOT** provide Battery replacements but will assist the customer in the replacement of the batteries through the battery manufacturers warranty.

SF58-n Full Service Contract 8-5 Mon.-Fri.

- This Full Service Plan is to be purchased while the equipment is still under current warranty coverage, or after approval by DSPM and a Certification Inspection by DSPM.
- This Full Service Plan covers all emergency calls to service the unit and one (1) Preventive Maintenance call per year. Additional Preventive Maintenance calls can per purchased/added to the plan
- This plan covers all replacement parts and labor including travel time and expenses for all emergency calls and one (1) Preventive maintenance call to service the unit. All service calls will be made between 8:00a.m. and 5:00p.m. and are limited to Monday through Friday excluding DSPM's designated holidays.
- If the Customer requests remedial maintenance or preventive maintenance outside of the contracted coverage, DSPM will provide this service. This service will be charged to the Customer at DSPM's standard hourly rates in effect at the time of the service, and will be subject to an available field engineer.
- DSPM will provide all replacement parts for parts that are found defective during emergency service calls. If Replaced parts are used from any Customer- spare parts kit, DSPM will replace them to the Customer-owned spare parts kit with no charges to the Customer.
- DSPM will include installation of any changes for safety reasons and at DSPM option, install any factory enhancements and upgrades, and reliability changes or improvements during the preventive maintenance service call. Uninterruptible Power Systems (UPS) and Emergency Lighting Inverter's batteries are **NOT** warranted under this plan unless specified. DSPM will provide the maintenance and testing for the batteries at DSPM's the hourly rates in effect for DSPM. DSPM unless specified otherwise, will **NOT** provide Battery replacements but will assist the customer in the replacement of the batteries through the battery manufacturers warranty.

SF724-n Full Service Contract 24Hr/day 7 Days/week Except Holidays

- This Full Service Plan is to be purchased while the equipment is still under current warranty coverage, or after approval by DSPM and a Certification Inspection by DSPM.
- This Full Service Plan covers all emergency calls to service the unit and one (1) Preventive Maintenance call per year. Additional Preventive Maintenance calls can per purchased/added to the plan
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- If the Customer requests remedial maintenance or preventive maintenance outside of the contracted coverage, DSPM will provide this service. This service will be charged to the Customer at DSPM's standard hourly rates in effect at the time of the service, and will be subject to an available field engineer.
- DSPM will provide all replacement parts for parts that are found defective during emergency service calls. If Replaced parts are used from any Customer- spare parts kit, DSPM will replace them to the Customer-owned spare parts kit with no charges to the Customer.
- DSPM will include installation of any changes for safety reasons and at DSPM option, install any factory enhancements and upgrades, and reliability changes or improvements during the preventive maintenance service call. Uninterruptible Power Systems (UPS) and Emergency Lighting Inverter's batteries are **NOT** warranted under this plan unless specified. DSPM will provide the maintenance and testing for the batteries at DSPM's the hourly rates in effect for DSPM. DSPM unless specified otherwise, will **NOT** provide Battery replacements but will assist the customer in the replacement of the batteries through the battery manufacturers warranty.

SF365-n Full Service Contract 24Hr/day 7 Days/week including Holidays

- This Full Service Plan is to be purchased while the equipment is still under current warranty coverage, or after approval by DSPM and a Certification Inspection by DSPM.
- This Full Service Plan covers all emergency calls to service the unit and one (1) Preventive Maintenance call per year. Additional Preventive Maintenance calls can per purchased/added to the plan
- This plan covers all replacement parts and labor including travel time and expenses for all emergency calls and one (1) Preventive maintenance call to service the unit. All service calls will be made Seven (7) days a week with exception of the DSPM's designated holidays.
- If the Customer requests remedial maintenance or preventive maintenance outside of the contracted coverage, DSPM will provide this service. This service will be charged to the Customer at DSPM's standard hourly rates in effect at the time of the service, and will be subject to an available field engineer.
- DSPM will provide all replacement parts for parts that are found defective during emergency service calls. If Replaced parts are used from any Customer- spare parts kit, DSPM will replace them to the Customer-owned spare parts kit with no charges to the Customer.
- DSPM will include installation of any changes for safety reasons and at DSPM option, install any factory enhancements and upgrades, and reliability changes or improvements during the preventive maintenance service call. Uninterruptible Power Systems (UPS) and Emergency Lighting Inverter's batteries are **NOT** warranted under this plan unless specified. DSPM will provide the maintenance and testing for the batteries at DSPM's the hourly rates in effect for DSPM. DSPM unless specified otherwise, will **NOT** provide Battery replacements but will assist the customer in the replacement of the batteries through the battery manufacturers warranty.

Plan Type	COVERAGE	LABOR	PARTS	TRAVEL EXPANSES	EMERGENCY CALLS	PREVENTIVE MAINTENANCE
TOS	8-5 Mon-Fri	X	X[1]	X		
CI	Service is as per customer request	X		X		
SW58*	8-5 Mon-Fri	X	X	X	X	
SW724*	7 days per week 24 hours per day Except Holidays	X	X	X	X	
SW365*	7 days per week 24 hours per day Including Holidays	X	X	X	X	
SF58-n*	8-5 Mon-Fri	X	X	X	X	X
SF724-n*	7 days per week 24 hours per day Except Holidays	X	X	X	X	X
SF365-n*	7 days per week 24 hours per day Including Holidays	X	X	X	X	X

Table 3

NOTES:

X Included with Plan Type

X[1] Included If Performed During Warranty Period or With Unit Under a Service Contract. Coverage for parts must be from other coverage such as an Extended Warranty or Service Contract.

-n indicates the number of Preventive Maintenance Calls per year

* Must be purchased during an active original factory warranty, during an active Extended Warranty, during an active Service Contract, or After a CI with DSPM Management approval.

Multiple Unit discount for more then one unit at a single location only, and startups are all at the same time.

Expenses:

Travel expenses for all services **NOT** covered under an EXTENDED WARRANTY PLAN or a SERVICE CONTRACT will be billed at actual cost.

SERVICE AND SUPPORT AT ALL TIMES

When insulated grip tools are not available, a method for insulating grips on tools that we use at DSPM using Plasti Dip by Performix is illustrated in Figures 15a-f. The illustration is only an example of how to insulate your tools, i.e. you may want to insulate the open end of the wrench. The product give the user a lot of flexibility when it comes to how many coats to apply (as many as you want). Applying multiple coats by following the instructions on the can should insulate sufficiently.

Figures 16a-f

DSPM cannot control use of this product and will not accept liability.

1 - T3: Transformer
2 - Fuses
3 - K3: Contactor
4 - TB1: AC Input Terminal Block
5 - K2: Contactor
6 - T2: Transformer
7 - K1: Contactor
8 - CB1: AC Input Breaker
9 - CB4: AC Output Breaker
10 - TB4: Current Transformer Terminal Block
11 - System Label
12 - A8: PCB Transformer
13 - BR1: Bridge
14 - TB2: AC Output Terminal Block
15 - Fuses
16 - Input Filters
17 - Output Filters
18 - Transformer
19 - Inductors
20 - Inverter Filters

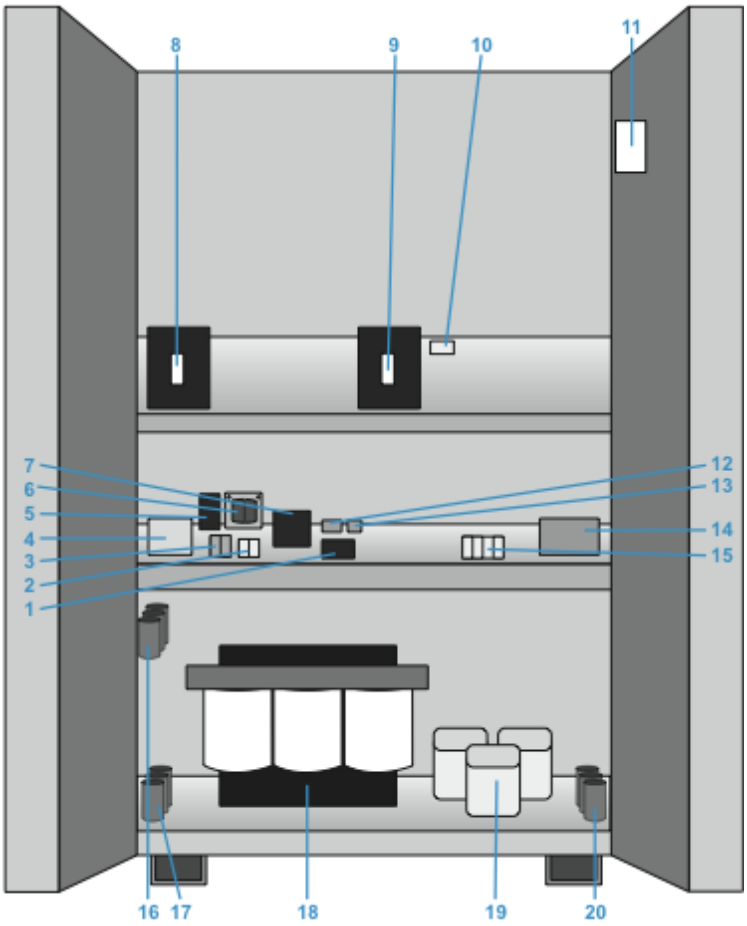

Figure 18a

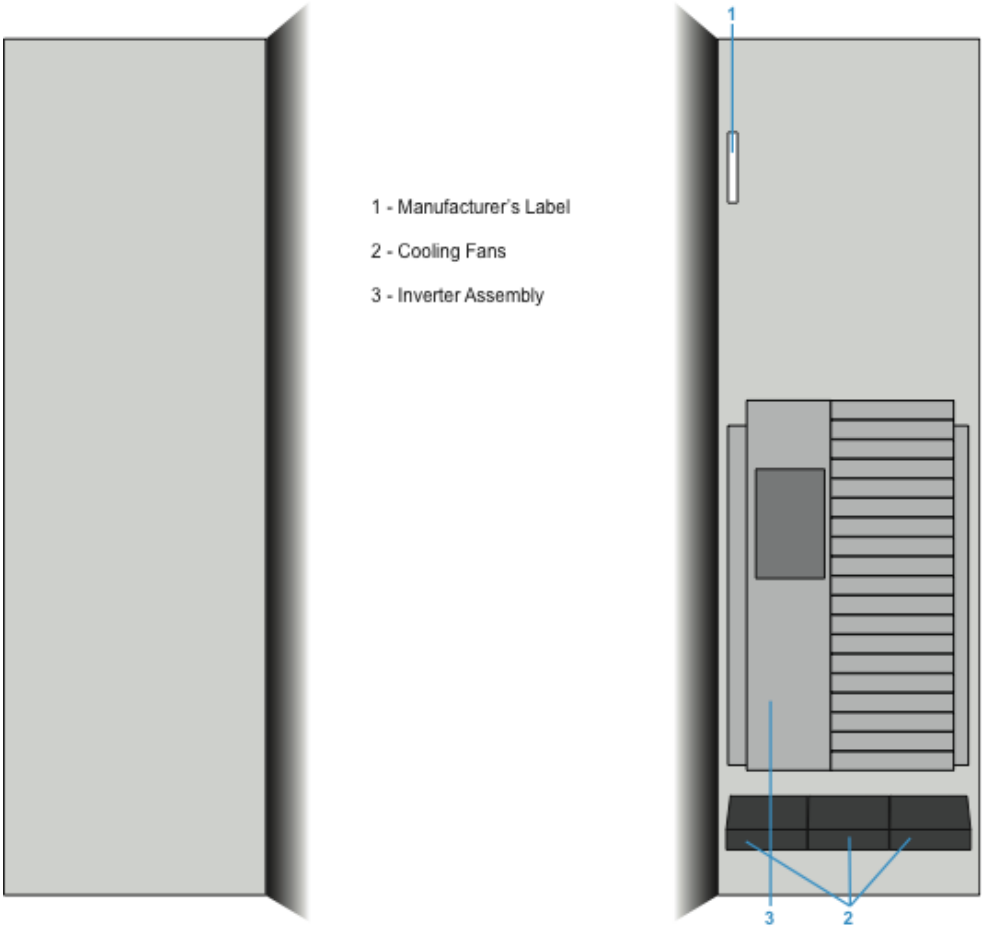

Figure 18b

10.3. NOTES