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Engineering Requirement

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TITLE:
PIC III VARIABLE FREQUENCY DRIVE, UNIT MOUNTED

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19XR / 23XR SERIES CHILLERS WITH PIC III CONTROL

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RELEASED FOR PRODUCTION

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RECORD OF REVISIONS

Revised Section	Description of Revision	Revised/approved By
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1.0 Purpose and Use

This engineering requirement provides information and data needed to design, build, and apply a low voltage unit mounted liquid cooled, non-reversing Variable Frequency Drive (VFD) for motors on Carrier models 19XR and 23XR rotary chillers.

In general, this specification is only applicable to the aforementioned model chillers that have Next Generation product integrated controls III (PIC III). The VFD controller shall communicate with Carrier's International Chiller Visual Controller hereafter referred to as the ICVC. The ICVC shall be or act as the Master Controller of the Chiller/VFD System.

The VFD controller shall be responsible for its core operations, VFD fault detection and protection of the motor. In addition it shall include Carrier proprietary requirements for execution of control outputs and diagnostic routines.

2.0 Application

2.1 Compressor Motors

Motors to be started and controlled are hermetic refrigerant cooled NEMA B low voltage squirrel cage induction motors driving variable or constant torque refrigeration compressors. Motors may require up to 100% of rated Amperage over the entire speed Range. All Motors shall be 3-Phase, 2 or 4 Pole Design. Motor Operating Frequency Range will vary between 5 to 300Hz. Typical motor power factor is 0.84 to 0.91; typical motor efficiency is 0.94 to 0.95.

Motors shall be started and run in the Delta configuration. START and VFD SPEED control commands shall only be honored from the ICVC.

With a power supply phase sequence A-B-C, motors rotate in the proper direction when phase A is connected to T1, phase B is connected to T2 and phase C is connected to T3.

2.2 VFD Assembly Performance

2.2.1 The VFD shall have the inherent ability to "boost" nominal input voltages as low as 346V up to 480V at the motor.

2.2.2 Available VFD Nameplate input voltages shall be 346V/50Hz, 400V/50Hz, 415V/50Hz, 380/60Hz, 416/60Hz, 440/60Hz, 460V/60Hz and 480V/60Hz. It shall be acceptable to rate each Nameplate Voltage at 50/60Hz as long as the VFD Control components and transformer is rated 50/60Hz.

2.2.2.1 Voltages Listed in the Carrier Unit Mount VFD Assembly Drawing may be a subset of the available VFD Nameplate Voltages.

2.2.3 The VFD shall be configured to control Motors speed in either a Volts/Hertz or a Sensorless Vector Mode.

2.2.4 VFD Efficiency shall be 0.97 minimum at 100% of VFD Rated Ampacity.

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2.2.5 VFD Input Power Factor shall be provided in terms of Apparent Power Factor and Displacement Power Factor.

2.2.5.1 Apparent Input Power Factor shall be 0.97 minimum at 100% of VFD Rated Ampacity. Where: Apparent PF = KW/KVA.

2.2.5.2 Displacement Input Power Factor shall be 0.99 minimum at 100% of VFD Rated Ampacity. Where: Displacement PF = the cosine (in degrees) between the input voltage and input current phase angles at the fundamental frequency.

2.2.6 VFD Harmonic Current Total Demand Distortion (TDD) shall be 5% maximum throughout the operating range when calculated per IEEE-519 and using the VFD circuit breaker input terminals as the point of common coupling (PCC).

2.2.7 VFD Voltage Total Harmonic Distortion (THD) shall be 3% maximum throughout the operating range when calculated per IEEE-519 and using the VFD circuit breaker input terminals as the point of common coupling (PCC).

2.2.8 The VFD shall have a short circuit interrupt and withstand capacity rating of 65,000 amps minimum with the standard circuit breaker.

2.2.9 The VFD shall have a short circuit interrupt and withstand capacity rating of 100,000 amps minimum with the high interrupt capacity circuit breaker option.

2.2.10 The VFD shall have a Minimum Output Frequency configuration down to 5 Hz and a Maximum Output Frequency configuration up to 400 Hz.

2.2.11 All VFD capacitors including those in the DC Bus shall discharge to less than 50 Vdc within 5 minutes of removing the AC voltage input to the Drive Assembly.

3.0 General

3.1 Submittal and Qualification Process for Supplier consideration

3.1.1 All suppliers must be approved by Carrier CSS Development Engineering, Manufacturing Quality and Purchasing before they can provide product for standard production. The request for consideration must be made to Carrier Engineering via the CSS Business Management Group. The minimum steps required for supplier qualification are outlined below:

3.1.2 A Complete set of submittals, which includes as a minimum:

3.1.2.1 Enclosure drawings
3.1.2.2 Component layout
3.1.2.3 Line and Load Connection locations
3.1.2.4 Power Module mounting details
3.1.2.5 Minimum service clearance requirements
3.1.2.6 Applicable lug sizes provided.
3.1.2.7 Short circuit withstand and interrupt ratings; with and without breaker options

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3.1.3 Drive Assembly and Test procedures
- 3.1.3.1 Power module
- 3.1.3.2 Process Documentation
- 3.1.3.3 Process test Report

3.1.4 Control and System schematic drawings

3.1.5 Drive electrical ratings (each frame size)
- 3.1.5.1 Maximum Input and output Amps ratings (each frame size)
- 3.1.5.2 Available Input Voltage ratings (Nameplate)
- 3.1.5.3 Ratings matrix at 102Hz and 60Hz. V/F (100%, 75%, 50%, 25% speed points). Data required, (EFF, Amps, Volts, PF, THD, TDD, Etc.)

3.1.6 Drive Package prices
- 3.1.6.1 Standard Drive Package base price, by frame size (electrical rating)
- 3.1.6.2 Options prices, matrix referenced by frame size

3.1.7 Statement of compliance to this requirement

3.1.8 Development milestones schedule

3.1.9 Manufacturing locations of power modules and Drive Package

3.1.10 Submittal of a Prototype Drive Package

3.1.11 Design review with Carrier Engineering after providing submittals

3.1.12 Final Submittals
- 3.1.12.1 Corrections, changes and updates to Drawings and Process documentation.
- 3.1.12.2 Installation, Operating, Maintenance, Troubleshooting and Replacement Parts Manuals
- 3.1.12.3 Final Review by Carrier Engineering

3.1.13 Delivery of a Manufacturing Check Sample Drive Package

3.1.14 Qualification of the quantity of Drive Packages on a Chiller required to prove reliability

3.2 Standards

VFD design and construction shall comply with the latest editions of the following standards applicable at the time of shipment. The VFD shall be cUL Listed and shall comply with the following Standards where applicable.

3.2.1 ANSI, NEMA standards publication, industrial controls and systems, pub. no.
- 3.2.1.1 ICS 1 General Rules
- 3.2.1.2 ICS 2 Contactors, Overload relays etc.
- 3.2.1.3 ICS 3 Motor Control Centers, Medium Voltage Controller and Synchronous Controller
- 3.2.1.4 ICS 4 Terminal Blocks
- 3.2.1.5 ICS 5 Control-Circuit and Pilot devices
- 3.2.1.6 ICS 6 Enclosures

3.2.2 UL standard 1995 – Heating and Cooling Equipment

3.2.3 UL standard 508 – Industrial Control Equipment (Devices)

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3.2.4 UL Standard 508A – Outline of Investigation (Control Panels)

3.2.5 UL Standard 508C – Power Conversion Equipment (Drives)

3.2.6 National Electric Code (NFPA 70,79)

3.2.7 ARI (American Refrigeration Institute) Standard 575 - Sound.

3.2.8 CE Marking (EN) – The basic VFD Assembly shall be CE marked to comply with the European Union EMC Directive 89/336 dated May 1989.

3.2.8.1 NOTE: Full CE Compliance to meet all applicable Directives requires ordering the CE Option (section 6.4)

3.3 Documentation

3.3.1 Order Information and Confirmation

Orders from Carrier to the manufacturer shall be confirmed as follows when requested by Carrier purchasing. The ordering process may be modified as required based on agreement between Carrier purchasing and the Supplier.

Orders for VFD assemblies shall be defined entirely by a pre-determined P/N on a Carrier VFD Assembly Drawing. Each order shall comply with the requirements within this specification and the information on the applicable Carrier VFD Assembly Drawing.

If the VFD part number specified by Carrier is not valid per the Carrier Unit Mount VFD drawing, the manufacturer shall notify Carrier and defer further action pending receipt of an official change notice.

3.3.1.3 Chiller Model type 19XR or 23XR.

3.3.1.4 Chiller electrical data
- (A) VFD Nameplate Input voltage and frequency
- (B) VFD Frame size (Ampacity)
- (C) Short circuit interrupt and withstand capacity.

3.3.1.5 Unit Mounted VFD drawing package (reference only)
- (A) Enclosure design parameters and definition
- (B) Location and length of power conductors and control cables.
- (C) Power conductor Terminal details
- (D) Location and configuration of VFD refrigerant connections.
- (E) Carrier part number for the VFD and Options configuration.
- (F) Carrier/VFD System interface schematic drawing

3.3.1.6 VFD Coolant Temperature

- (A) Coldplate entering temperature, design shall be 115°F (46 °C)
- (B) Applicable increased ratings at lower entering temperatures are listed in VFD Rating Tables 7.1 and 7.2

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3.3.2 Special Confirmations, Submittal Data and Ship to requests

3.3.2.1 The manufacturer shall upon request by Carrier Purchasing provide an acknowledgment copy of Carrier's purchase order reflecting the following information.

(A) Transmittal Sheets
(B) Promised ship date.
(C) Price Discrepancies
(C) Exceptions to any terms and conditions of order
(C) Certified Dimension Drawings
(D) Schematic and Wiring Diagrams

3.3.2.2 The Manufacturer shall on a per job basis ship directly to the job site when requested by Carrier Purchasing and given the following information.

(A) Carrier job name, number, machine serial number, ship to address and mark for.
(B) When applicable, reference to customer specification and/or Quotation number.
(C) Required manufacturer shipment date.

3.3.2.3 The Manufacturer shall on a per job basis when requested by Carrier Purchasing provide signed documentation acknowledging compliance with specifications and agency Standards and Codes required by Z-420 as follows.

A) This equipment shall comply with the latest edition of Carrier Engineering Requirement Z-420.
(B) (Only if applicable) This equipment shall comply with (name, identification and sections of national codes) applicable on the delivery date of the equipment.
(C) (Only if applicable) This equipment shall comply with (name, identification and sections of local codes) applicable on the delivery date of the equipment.

3.4 Quality

The compressor motor VFD is a critical component of the Carrier chiller control system. VFD quality has a direct impact on the chiller system quality. As a minimum, all Drive Modules shall be given a complete 100% load test and all Drive Assemblies shall be given a part-load test at a minimum of 5% Input and output current prior to shipment utilizing Carrier specified start and stop commands (protocol) via the RS-485 communications port. Carrier shall provide an ICVC with software or PC based software for this purpose.

The VFD supplier shall establish and maintain records providing evidence that the Drive package has been inspected and tested per the requirements of this specification. These records shall include test failures and indicate the person who verified conformance to this requirement.

The Drive package serial number shall be permanently marked inside the VFD enclosure and shall correlate with the supplier's records. The Drive software versions shall be read from parameters in the Drive for display purposes.

Prior approval by Carrier Engineering is required before changes can be made to equipment, Carrier proprietary logic and control of Carrier specified outputs as described in this requirement.

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Use of a Supplier Deviation Request (SDR) per the Carrier Supplier Quality Manual is required to make any changes to the VFD design or Software previously qualified by Carrier.

3.5 Materials and Workmanship

Use only new materials. Appearance must be neat and orderly. Loose wire strands are not permitted. Wires, cables and terminal header assemblies shall be securely latched, anchored or tied to the enclosure or other mounted components to avoid loosening. Wire terminations shall be retorqued as necessary to eliminate looseness from creep or set prior to shipment. Vacuum all debris from enclosure.

3.6 Reliability

The minimum Component and System reliability requirements are stated below. The supplier shall provide a quarterly report to Carrier's Manufacturing Quality group using field data supplied by Carrier and Data collected by the supplier's Reliability departments to verify reliability. If reliability targets are not being met, the supplier must provide Carrier's Manufacturing quality group with a corrective action plan and implement corrective actions in a timely manner. The corrective actions and timing of the corrections must be in accordance with the Carrier Supplier Quality Manual and meet the approval of Carrier's Quality and Engineering groups.

System Reliability-	Line rejects at Carrier (As Shipped)	0.1% Max
	Dead on Arrival (At startup or during first month)	2.0% Max
	First Year Failure Rate	5.0% Max
	Failure Rate (First 15 Years)	10.0% Max
Component Reliability-	First Year failure Rate	0.2% Max

Reliability Requirement assumes scheduled maintenance as recommended by the manufacturer. The typical VFD operates 5000 hours/year.

Minimum number of starts is 20,000. Nominal interval between starts is 15 minutes. Nominal interval between stop and start is 3 minutes. (15 minutes start to start interval and 3 minutes stop to start interval controlled by the ICVC. Minimum interval between starts can be 2 minutes when restarting after a power failure or voltage fault).

3.7 Ambient Operating Conditions

Vibration 1G @ random 3 – 150 Hz

Temperature 40 ^{o}F to 122 ^{o}F (5 ^{o}C to 50 ^{o}C)

This is the temperature of the space in which the VFD is located. The maximum temperature inside the VFD is 50 ^{o}C ambient plus the temperature rise within the VFD. Ampacity ratings may be increased at 104 ^{o}F (40 ^{o}C) ambient temperature as indicated in the VFD Rating Table. High temperature protection shall be provided in the VFD.

Humidity and Elevation

Relative Humidity	10% minimum. 95% maximum. (Non-condensing)
Location Elevation	3300 ft. (1000 m) standard; 6000 ft (1818 m) maximum. (Ampacity shall be derated 1% for

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	each additional 1000 ft above 3300 feet elevation)

3.8 Shipping and Storage Conditions

Temperature	-13 F to 140 ^{o}F (-25 ^{o}C to 60 ^{o}C)
Relative Humidity	10% min., 100% max. (non condensing)
Handling and Rigging	Provide skid or other means for handling with fork truck while packaged and lifting eyes or other means for rigging when uncrated.
Packaging	VFD shall be adequately packaged to provide protection from exposure to the elements and damage encountered during normal shipping and sheltered storage. Internal packing materials shall be acceptable for use with static sensitive electronic components. Shipping Survivability shall be 8G peak @ 11 Milliseconds and 1G at random Hz. The successful completion of a Carrier administered shipping survivability test shall suffice for this requirement.

4.0 General VFD Package

The VFD design shall include the following Control and Protective functionality. Prior approval by Carrier Engineering is required before changes can be made to Carrier specified logic or control of Carrier specified outputs as described in this requirement.

4.1 Communications interface, Control Methods and Discrete Outputs

1. All data exchange between the CARRIER Chiller Control (ICVC) and the VFD shall be via a Sensor Input Output (SIO) / Drive Peripheral Interface (DPI) Gateway. Communications between the SIO/DPI Gateway and the VFD shall be updated a minimum of two times per second utilizing the DPI protocol. The ICVC shall communicate to the Gateway via Carrier's SIO protocol and shall be or act as the Master of this System and the VFD shall be or act as the Slave. The VFD shall communicate its Actual Speed, Run status, Power status, Fault status and other data as specified and requested by the ICVC whenever the VFD controller is powered up.

2. The ICVC shall be the user interface for changing specified Drive set-up parameters, and configuration limits to avoid conflicts between the ICVC and VFD configuration tables; therefore, no keypad is required at the VFD. Configurations required for Drive operation and protection not specified in this requirement shall be pre-set as defaults by the supplier prior to final testing and shipment to Carrier. These values shall be restored on a "Restore Defaults" command. An optional configuration tool or software package shall be available to restore defaults or change Drive configurations that are not communicated by the ICVC.

3. When a fault exists at the VFD it shall make the fault status available to the ICVC and shall not enter into a Start Mode. If the VFD is running when a fault occurs, it shall shutdown. The VFD shall not clear a fault until the status has returned to normal and a reset fault command has been sent from the ICVC.

4. When no fault exists and a Start command is sent from the ICVC to the VFD, the VFD shall activate a VFD Start and indicate it is in the START mode. The VFD shall then ramp to the minimum speed configured within the VFD or to the speed set by the ICVC whichever is greater. The VFD shall provide indicators when it reaches the configured Minimum Speed and when it is in a valid RUN mode. During a valid run mode, the VFD's speed shall be controlled by the ICVC between the Minimum and Maximum speed values configured in the VFD by the ICVC.

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5. The VFD shall have (6) 115V discrete contact outputs that shall be controlled primarily by the ICVC. The VFD shall also include logic to control the circuit breaker shunt trip. These outputs may be used for 1) circuit breaker shunt trip, 2) chilled water pump, 3) condenser water pump, 4) tower fan low speed, 5) tower fan high speed and 6) alarm status. All outputs shall default to the OFF State during VFD Controller power-up/initialization or in the event of a Power Loss.

4.2 Control, Configurations, Protection and Analog Outputs:

The VFD shall have (1) 4 – 20mA analog outputs that will be controlled by the ICVC. The output may be used to modulate a valve and shall vary from 4 to 20mA in proportion to a 0 to 100% value from the ICVC.

The VFD shall have (3) discrete contact inputs that will be monitored individually by the ICVC. When shorted, the status of the input shall be (1), when open, the status of the input shall be (0)

1. The VFD Controller shall provide control, configuration and protection of the following as a minimum:

- Active Rectifier Section (AC Line Input Voltage and Output Current Rating)
- Inverter Output Section (AC Line Output Current Rating; Output Voltage default =480V)
- PWM Modulation frequency Range (XX KHz)
- IGBT heat sink Temperature (XXX.X ^{o}C maximum)
- Frequency skip configurations. (3 bands)
- Minimum speed configuration (Min Hz)
- Maximum speed configuration (Max Hz)
- Acceleration time (sec; 0 to 100% Hz)
- Deceleration time (sec; 100 to 0% Hz)

2. The VFD Controller shall provide configuration and protection of the following:

- VFD Input Rated Line Voltage (XXX Volts)
- Motor Nameplate Volts (XXX Volts)
- Motor Nameplate Amps (XXXX Amps)
- Motor Overload Amps (XXX.X)
- Motor Rated KW configuration (XXX KW)
- Single Cycle Dropout (Enable/Disable)
- Rectifier Input Voltage Unbalance and persistence (XX %)
- Rectifier Input Current Unbalance and persistence (XX %)
- Inverter Output Current Unbalance and persistence (XX %)
- Phase Reversal
- Input Phase Loss and persistence
- Ground Fault

3. The VFD Controller shall provide control and protection of the following:

- Drive Enable/disable Input (Condenser High Pressure Switch)
- Drive speed accuracy (+/- 1%)
- Drive speed regulation (+/- 0.25%)
- Peak Output Voltage (1000V max)
- Output Current Ripple (10% max)
- DC Bus (Over/Under voltage)
- Inductors+ (High temp)
- Input/Output Phase Loss+

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- Overcurrent Protection+ 1.5* Inverter or Rectifier maximum current rating after 5 seconds
- Inverter Output Section (AC Line Output Voltage)
- Short Circuit+ (65K Amps Standard; 100K Amps with 100KAIC breaker option)
- Basic surge and lightning +
- Total Harmonic Current Distortion (< 5%) throughout the operating range

+ Requirement is to Provide protection only; it is understood, these events may not be controlled.

4.3 Motor and VFD Protection

All VFD related fault limits shall be protected by the VFD Controller. VFD ultimate fault limits shall be set within the VFD Controller and shall not be exceeded by requests from the ICVC. Fault thresholds within the ultimate fault limits range shall be configurable by the ICVC. Upon detection of a fault, the VFD shall immediately Stop and prevent a Start until the fault condition is reset. The VFD shall only permit a reset when requested by the ICVC and all fault conditions have returned within the valid reset range.

The VFD Controller shall also provide the following protection.

4.3.1 Under-voltage and phase loss Protection (UV)

Low DC Bus voltage: Shutdown and fault shall be indicated when Bus voltage cannot be maintained to support proper Drive operation and the cause is not low line voltage. This protection shall be active when Start = True.

Low Line Voltage: Shutdown and fault shall be indicated when Bus voltage cannot be maintained to support proper Drive operation and the cause is low line voltage. Low Line Voltage is defined as; Line Voltage on two or more phases < 15% of nominal or < 311 volts. This protection shall be active when start = true.

Phase Loss: Shutdown and fault shall be indicated when Line Voltage on one phase is < 50% of nominal for the persistence (ride through) time and the line current imbalance is exceeded. This protection shall be active when start = true.

4.3.2 Over-voltage Protection (OV)

High Line Voltage: Shutdown and fault shall be indicated when Line Voltage on one or more phases is greater than 110% of Nameplate and the DC Bus voltage is greater than or equal to 800 Vdc. This protection shall always be active.

High DC Bus Voltage: Shutdown and fault shall be indicated when Line Voltage on one or more phases is less than or equal to 110% of Nameplate and the DC Bus voltage is greater than or equal to 800 Vdc.

4.3.3 Ground Fault Protection

Low level, instantaneous ground fault detection complete with integral current transformers shall be provided. Reset shall be controlled by the ICVC. Upon detection of a ground fault, the VFD shall immediately activate the shunt trip contact to open the main circuit breaker and the Precharge and Bypass contactors and coast to Stop.
The protection shall be set to trip within a range of 3 to 25 amps to ground. This protection shall always be active.

4.3.4 Phase Reversal Detection

Voltage or current sensing phase reversal detection (phase rotation) shall be indicated by the VFD when phase sequence is not ABC. This indication shall be active when Stop Complete = True.

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4.3.5 Phase Unbalance Protection

Three phase current and voltage monitoring to detect Rectifier input phase imbalance and three phase current monitoring to detect Inverter output phase imbalance shall be provided. Shutdown and fault shall be indicated when voltage imbalance is > configurable 5-15% or current imbalance is > configurable 5-40% for a configurable persistence of 1 to 5 seconds and average motor current is > 15%. In addition to the above, a fault on the input shall require the current on any input phase to exceed 1.05* Rated Line Amps; a fault on the output shall require the current on any output phase to exceed 1.05* Motor Rated Load Amps. This protection shall be active when Start = True.

4.3.6 Single cycle Voltage Loss Protection

Three phase voltage monitoring to detect a 50% loss of voltage on two or more phases for 12 to 60ms. This protection shall be active when Start = True.

4.3.7 Overload Protection

Integrated three-phase solid state NEMA class 10 Overload protection for the motor during both start and run shall be provided. The Overload calculation shall be performed by the Drive based on the Motor Overload Amps configuration value sent by the ICVC. The calculation shall represent an ultimate trip current equal to 1.08*chiller Rated Load Amps (RLA). This protection shall be active at all times.

4.3.8 Load Limit Control *(For application reference only)*

The ICVC prevents loading of the motor when the average motor current reaches 100% RLA. The ICVC reduces the motor load to 100% if average motor current exceeds 105%. The ICVC normally takes no action to reduce motor load when the average motor current is 100% to 105%. The VFD shall not perform this protection.

4.4 Ampere Rating

The VFD manufacturer shall verify that the VFD rating is based on continuous operation at the ambient and elevation conditions specified. Manufacturer may use definite purpose ratings based on Carrier specified motors and starting conditions. The VFD shall be capable of operating at 150% of its ampere rating for 5 seconds. Ampere rating based on ambient conditions and VFD coolant inlet temperatures are listed in section 7.0 of this specification.

4.5 VFD Power Modules

The temperature of the Active Rectifier section and the Inverter section will be controlled by the same coldplate. The coldplate and all VFD piping including the mating flanges that connects to the chiller piping mating flanges shall have a minimum ASME design working pressure of 185 PSIG and a total maximum leak rate of 0.5 ounces per year of R-134a at the design working pressure.
The thermal inertia of the coldplate shall permit 2 minutes of startup and operation of the compressor motor before liquid cooling is required when starting with an average coldplate temperature of 115F.
Provide a means to remove and replace the modules within the enclosure by rigging from overhead without cutting into the VFD enclosure.

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4.5.1 Active Rectifier Module

The Active Rectifier section shall be designed similar to the conventional AC drive inverter. It shall utilize IGBTs mounted to a refrigerant cooled coldplate. The firing of the IGBTs shall be controlled by a microprocessor based printed circuit board (PCB). An input filter to this section shall be designed to filter current distortions produced by the carrier frequency that would otherwise be injected onto the incoming AC line. Total Harmonic Current Distortion shall not exceed 5% at any load conditions. The Active Rectifier shall have the inherent ability to "boost" nominal input line voltages as low as 346VAC to a value that will allow the Inverter section to produce 480VAC to the motor.

4.5.2 Inverter Module

The Inverter section shall be designed to function as the conventional AC drive inverter. It shall utilize IGBT's which are controlled by a microprocessor based PCB and a main capacitor bank. The main capacitor bank will be shared by the Active Rectifier section and the Inverter section. The DC bus voltage produced by the Active Rectifier section shall be switched by the IGBTs in the Inverter section to produce a pulse-width modulated (PWM) sine wave. This sine wave will be used to control the speed of the motor.

4.6 Power Inductor

The Inductors shall be designed for continuous operation in the applied enclosure environment. The sound power emitted by the inductor shall not exceed 85 dBA per ARI 575.

4.7 Control Transformer and Circuit Breaker Disconnect

4.7.1 Compressor Motor Circuit Breaker

Provide a door-interlocked, externally gang-operated, three-pole main power circuit breaker including mechanical position indicator on enclosure exterior. Provide a means of pad-locking the operator handle in the open position. Circuit breaker ampacity must be de-rated as necessary to avoid premature trips based on the specified ambient temperature plus the temperature rise within the VFD enclosure. The standard circuit breaker shall have a 65K amp interrupt capacity. The high interrupt circuit breaker shall have a 100K amp interrupt capacity. The VFD short circuit withstand capacity shall be equal to or greater than the circuit breaker's interrupt capacity.

4.7.1.1 Compressor Motor 65KAIC Circuit Breaker with shunt trip
4.7.1.2 Optional 100KAIC Compressor Motor Circuit Breaker with shunt trip when requested.

4.7.2 Control Power and Oil Pump Circuit Breaker

Provide one 2-pole (23XR) or 3-pole (19XR), 15 Amp circuit breaker connected to the line side of the VFD circuit breaker. The circuit breaker shall comply with the short circuit withstand and interrupt ratings of the VFD Package. Connect the load side of the circuit breaker to the Control Power Transformer.

(For 19XR only; also connect the load side of the circuit breaker to a terminal strip labeled OS1, OS2, and OS3 or to a conduit with the stripped wire ends labeled OS1, OS2, OS3 or as indicated on the Carrier Unit Mount VFD drawing).

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4.7.3 Control Power Transformer

Provide a multi-tap 3 KVA control power transformer to deliver 115+/-5VAC at the secondary with Nameplate rated line voltage at the primary. Connect the primary of the transformer to the load side of the control power circuit breaker. This transformer size includes 0.5 KVA at 115V that may be consumed by the VFD.

For 23XR packages provide two separate power outputs from the secondary of the transformer, each fused at 15 amps or per code; whichever is lower. Label the power wires from the secondary of the transformer LL1 and LL2 and terminate each in a two-position plug or to a field wiring terminal strip as defined on a Carrier drawing. Also provide a PE/GND wire. If two-position plugs are provided, terminate the PE/GND wire with a #8 (min) ring terminal; otherwise terminate at the terminal strip.

For 19XRV packages provide only one circuit fused at 15, 20 or 30 amps per the Carrier Unit Mount VFD drawing. Also provide a PE/GND wire. Label the wires LL1, LL2 and PE/GND and terminate them at a field wiring terminal strip or route them in a conduit with the stripped wire ends labeled LL1, LL2 and PE/GND or as indicated on the Carrier Unit Mount VFD drawing.

4.8 Enclosure

Design shall be a sheet steel NEMA type 1 enclosure; formed, braced and welded, riveted or bolted into a self supporting structure accommodating all standard Drive components. All metal surfaces, inside and out, to be cleaned, and phosphatized, or primed with a suitable corrosion inhibitor and finished with an enamel or epoxy powder top coat; Color Matched to Federal Standard 595b, color #26231 (Carrier gray). Removable lifting lugs or other means for rigging the Drive shall be provided. Plugs shall be provided to seal holes for the lifting lugs. The exterior envelope and other critical dimensions for the enclosure shall be defined on a Carrier Unit Mount VFD Drawing. This drawing shall depict the critical enclosure characteristics required to integrate the Drive on the chiller.

The enclosure shall be mounted on the chiller using mounting brackets on the enclosure as defined by a Carrier Unit Mount VFD Drawing.

Provide a means to remove and replace the VFD Power modules and other components within the enclosure weighing more than 50 pounds by rigging them from overhead without having to cut into the VFD enclosure.

Doors must be lockable in the closed position and removable for access to internal components for maintenance. Doors providing access to or which allow contact with line voltage components or conductors shall be pad lockable in the closed position. The maximum door swing radius shall not exceed 35 inches.

Plate or paint latches, handles, and all other cabinet hardware to prevent corrosion from humidity and exposure to normal industrial environments.

VFD Power (line) conductors shall enter through a solid removable plate large enough to accommodate three electrical conduits; each capable of housing at least three 75 ^{o}C conductors (1 from each phase) sized for the largest Drive input current rating. Holes for the conduit openings shall be field cut. The plate shall be located on the top of the enclosure directly above the circuit breaker to minimize wire bending. Lug connections shall be located to provide adequate clearance and wire bending space for easy connection by field electrician and in accordance with the National Electric Code. When wire bending space based on 75 ^{o}C conductors cannot be provided with the standard plate alone, four side walls with assembly hardware shall be provided shipped inside the enclosure to erect a “Top-Hat” pull box using the standard top plate as the top.

Motor power (load) conductors shall exit through a hole in the rear of the enclosure. The location and dimensions shall be depicted on a Carrier Unit Mount VFD drawing. These conductors shall be prefabricated

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and preformed in shape to minimize installer bending during assembly and to avoid residual stresses at the motor terminals.

4.9 Power and Grounding Connections

Lugs within the VFD for line and load power connections shall be located to provide adequate clearance for easy connection of line conductors to the VFD input and manufacturer supplied output Cable or Bus to the VFD output. Terminals and lugs shall be UL or ETL listed for use with copper conductors. The size and quantity of input lugs shall be based on cable ampacities selected per NEC for 75 ^{o}C wiring material. Provide multiple lugs per phase if required.

The VFD field ground bus connection shall terminate at a single point provided by a double hole lug with minimum 2/0 capacity or an ampacity equivalent to 1 phase of the line supply conductors; whichever is greater. The lug shall be located near the point of line power entry and shall be identified by the letters PE and the graphic symbol EN 60417-2-IEC-5019. Provide adequate clearance for easy connection of the grounding conductors. One hole shall be used to bond the VFD/enclosure to earth and the other shall be used to bond the motor/machine to earth.

4.10 Power Conductors

Provide continuously rated copper main conductors. Conductors shall be designed for at least 65,000 amps symmetrical or the VFD withstand short circuit current whichever is greater when used with the optional Circuit Breaker or equivalent branch circuit protective device.

All control and power cable is to be stranded copper, 18 AWG minimum size type THNN, THWN MTW or equivalent.

Three (3) or six (6) motor (load) conductors and one (1) ground conductor with supplier designed terminations for connection to the Inverter and enclosure respectively at the VFD and Carrier specified terminations for connection at the motor terminals and ground lug must be provided. Conductors shall be made from braided or flexible copper and shall be shipped installed or packaged loose inside the VFD enclosure as indicated on the Carrier Unit Mount VFD drawing. Conductor lengths and terminations shall be as specified on a Carrier Unit Mount VFD drawing.

Conductors carrying 30V or less shall be separated from higher voltage conductors. They shall not be located in the same bundle or raceway.

4.11 Control Connections

Terminal blocks required for customer connections shall be mounted on a non-hinged stationary part of the enclosure and shall be permanently and clearly identified to match schematic and wiring diagrams per a Carrier Unit Mount VFD drawing.

Allow adequate clearance for easy connection of field wiring.

Include field wiring terminals for required contact outputs and for specified modifications. Terminals shall be separated and identified by voltage and arranged in numerical sequence.

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Terminal blocks shall have screw clamp pressure plate terminals rated for at least 10A, and for the rated voltage or 115V whichever is greater. Class 1 wire size shall be 18 AWG minimum.

Keep all VFD internal panel wiring on one side of terminal block. Opposite side shall be used exclusively for field conductors.

Do not connect more than three wires per terminal, add extra blocks and factory formed jumpers to obtain required terminal landing accommodations.

The chiller-VFD interface schematic is shown on a Carrier Unit Mount VFD drawing.

Chiller interface requirements shall be incorporated into the VFD manufacturer's schematic.

4.12 Control Components

Provide control components in accordance with diagrams on unit mounted VFD drawings and/or to perform all necessary functions.

No contacts are allowed in the grounded (neutral side) of relay coils or other devices.

Control relays shall have minimum 300V rated contacts for 115V circuits, quantity and type as required.

Only industrial or heavy-duty pushbutton switches, indicating lights or control switches shall be mounted on front of enclosure.

4.13 Identification and Labeling

All identification shall be clearly stated, legible and permanent.

A nameplate on the inside of the enclosure door shall include the Carrier P/N, VFD serial number, max ampere ratings, max voltage rating and short circuit and interrupt ratings when used with HACR type circuit breakers.

Provide safety warning label(s) to meet warning and safety requirements of all applicable codes; including but not limited to OSHA (Standards-29 CFR) 1910.145 – specifications for accident prevention signs and tags and ANSI Z535.

Affix a label stating; "This equipment conforms with Carrier Engineering Requirement Z-420".

Permanently attach a copy of the detailed schematic and wiring diagram(s) laminated in transparent film to inside of enclosure front door or some other accessible internal surface, or in a print pocket. Drawing shall be of best quality reproduction, good definition, non-fadeable, easy to read and absolutely legible. A basic schematic plus options sheets may be used as long as included options are clearly identified.

Permanently identify all components and terminals corresponding to drawings. Field wiring connection points and components that require regular field maintenance shall have their identification on or near them. Other components may be identified on the wiring diagram if it is permanently attached to the unit. Component identification must be attached to a non-removable, unobstructed surface. Exception: components identified on a wiring diagram that is permanently attached to a removable hinged door shall be acceptable.

Special internal wire numbers necessarily assigned by VFD manufacturer shall be coded so as to be easily distinguishable from Carrier assigned numbers.

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Install cUL, ETL, CSA, CE or other listed, recognized or compliant agency labels on VFD.

Affix a label adjacent to LL1, LL2, PE/GND; 115 volt field wiring terminal strips (if supplied) stating; "DANGER! Electrical shock hazard due to back feeding of voltage through control power transformer. Do not connect external power source to this terminal strip."

Affix a label in prominent position stating;
"IMPORTANT: The field wiring terminal connectors supplied on this controller are suitable for use with copper conductors only. If user/installer elects to use aluminum conductors, the sole responsibility for adequate termination is his own. Successful use of aluminum wiring requires special care and maintenance and falls beyond the scope of normal equipment warranties."

Affix label on inside of enclosure door or in prominent position stating;
"Motor overload is factory set within the controller and shall not be adjusted."

Label each end or color code all conductors. All conductors which can be above 50 volts when the main disconnect is open shall be colored solid yellow. Neutral conductors shall be white. Ground conductors shall be green with a yellow stripe per the CE directives.

Affix a label inside the VFD door providing the department and phone number of the Group or Department to call in the event that service is required. The name is not required if the number is for a warranty administration or customer service department.

The following warning labels or their equivalent must be applied to the outside of the front door of the enclosure.

Affix label adjacent to the handle of the circuit breaker stating:

"DANGER Electric Shock Hazard! Hazardous voltage is at line side terminals and control circuit breaker when VFD is not running"

This disconnect will not de-energize all internal circuits. Open all feeder and internal disconnects including the control power circuit breaker and confirm the absence of voltage before servicing this equipment"

Affix label adjacent to power module assembly access panel or door stating:

"DANGER Electric Shock Hazard! Capacitors retain hazardous DC Bus voltage up to 5 minutes after all power is removed from the VFD. Disconnect main supply power then wait 5 minutes and confirm absence of DC Bus voltage before servicing equipment.

5.0 Drive Control Input and Contact ratings

Drive discrete inputs and contact outputs interfacing with the chiller control must operate reliably under the following conditions.

5.1.1 Drive discrete inputs shall meet the requirements per Table 5A. Digital inputs shall be capable of monitoring a dry contact closure up to 1,000 ft away. One digital input shall monitor a Pressure Limiting device (Condenser High Pressure Switch) per UL 1995. The terminal connections to this input shall be labeled 42 &43 Condenser High Pressure Switch. Opening this contact (loss of input) shall prevent or stop Drive operation per UL 1995.

5.1.2 Oil Aux. Contact - (to terms 50 & 51) Closes when VFD initiates Start or when current flow to motor exceeds 10% Overload trip. Opens when VFD Stops and. current flow to motor < 5% Overload trip.

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Table 5A

Digital Input Device Requirements	Nominal Voltage	Min. "Open" Voltage	Max. "Closed" Voltage	Max. Sealed Current	Must Drop-Out Amps/Volts
Condenser High Pressure Switch	24 Vdc	10 Vdc	18 Vdc	60 MA	5 MA@ 24 Vdc
Spare safety, Remote Contact, Ice Build	24 Vdc	10 Vdc	18 Vdc	60 MA	5 MA@ 24 Vdc

Table 5B

Digital Contact Device Requirements	Nominal Voltage	Minimum Voltage	Maximum Current	Minimum Current
Oil Aux. Contact (To terms 50 & 51)	24 VAC	18 VAC	2.0 A	0.4 A
Pilot Relays (6 output contacts)	115/277 VAC		5/3 A	0.5A

6.0 Options

6.1 100KAIC Circuit Breakers

Provide a 100KAIC VFD Main Circuit Breaker with shunt trip and a 100KAIC Control power Circuit Breaker in lieu of the standard 65KAIC circuit breakers when this option is specified.

6.2 Meters

Meters shall be analog type and have a 1-1/2" minimum radius scale and be installed on the front door of the enclosure. Provide protection to prevent unintentional contact with hazardous live parts. Install required fuse protection and current transformers of the appropriate accuracy and burden when required.

6.2.1 Ammeter with three-phase, four position selector switch (Ph-1, Ph-2, Ph-3, and OFF).

6.2.1.1 Exception: If Ammeter does not use a line current transformer and the signal current does not exceed 1 ampere, a three-position selector switch; (Ph-1, Ph-2, Ph-3) may be used.

6.2.2 Voltmeter with three-phase, four position selector switch (Ph-1, Ph-2, Ph-3, and OFF).

6.2.2.1 Exception: If Voltmeter does not use a line voltage transformer and the signal voltage does not exceed 10 volts, a three-position selector switch; (Ph-1, Ph-2, Ph-3) may be used.

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6.3 Start-Up Service

When requested, VFD manufacturers shall provide start-up service by factory trained personnel at a pre-determined price.

6.4 CE Marking

When specified, provide a VFD Assembly that meets all applicable CE (EN) Directives along with a Declaration of Conformance for this component.

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7.0 Engineering Approved manufacturers

Rockwell is the only manufacturer approved for supplying VFDs that meets this specification.

7.1 Rockwell Drive Package Frame Sizes and Amp Ratings for the 23XR

(Input and Output Amps confirmed by Test)

Table 7.1 – 23XR Drive Assembly and Power Module Ratings Based on Conditions

Drive Assembly Number	Power Module Model Number	Frame Size	Inverter Carrier Freq	Max Ambient Air Temp	Max Inlet Refrig Temp	Max Input Amps	Max Output Amps
23XR2AA	LF200460AAR	2AA	4 kHz	122F	115F	405	405
23XR2AA	LF200460AAR	2AA	4 kHz	104F	115F	420	420
23XR2AA	LF200460AAR	2AA	4 kHz	104F	97F	440	440
23XR2AA	LF200460AAR	2AA	2 kHz	122F	115F	380	430
23XR2AA	LF200460AAR	2AA	2 kHz	104F	115F	400	440
23XR2AA	LF200460AAR	2AA	2 kHz	104F	97F	420	460
23XR2BA	LF200460BAR	2BA	4 kHz	122F	115F	506	420
23XR2BA	LF200460BAR	2BA	4 kHz	104F	115F	520	420
23XR2BA	LF200460BAR	2BA	4 kHz	104F	97F	520	440
23XR2BA	LF200460BAR	2BA	2 kHz	122F	115F	506	440
23XR2BA	LF200460BAR	2BA	2 kHz	104F	115F	520	440
23XR2BA	LF200460BAR	2BA	2 kHz	104F	97F	520	460
23XR2BB	LF200520BBR	2BB	4/2 kHZ	122F	115F	506	520
23XR2BB	LF200520BBR	2BB	4/2 kHZ	104F	115F	520	520
23XR2CC	LF200608CCR	2CC	4/2 kHZ	122F	115F	608	608

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7.2 Rockwell Drive Package Frame Sizes and Amp Ratings for the 19XRV

(Input and Output Amps to be confirmed by Test)

Table 7.2 – 19XRV Drive Assembly and Power Module Ratings Based on Conditions

Drive Assembly Number	Power Module Model Number	Frame Size	Inverter Carrier Freq	Max Ambient Air Temp	Max Inlet Refrig Temp	Max Input Amps	Max Output Amps
19XRA2AA	LF200460AAR	2AA	4 kHz	122F	115F	405	405
19XRA2AA	LF200460AAR	2AA	4 kHz	104F	115F	420	420
19XRA2AA	LF200460AAR	2AA	4 kHz	104F	97F	440	440
19XRA2AA	LF200460AAR	2AA	2 kHz	122F	115F	380	430
19XRA2AA	LF200460AAR	2AA	2 kHz	104F	115F	400	440
19XRA2AA	LF200460AAR	2AA	2 kHz	104F	97F	420	460
19XRA2BA	LF200460BAR	2BA	4 kHz	122F	115F	506	420
19XRA2BA	LF200460BAR	2BA	4 kHz	104F	115F	520	420
19XRA2BA	LF200460BAR	2BA	4 kHz	104F	97F	520	440
19XRA2BA	LF200460BAR	2BA	2 kHz	122F	115F	506	440
19XRA2BA	LF200460BAR	2BA	2 kHz	104F	115F	520	440
19XRA2BA	LF200460BAR	2BA	2 kHz	104F	97F	520	460
19XRA2CC	LF200608CCR	2CC	4/2 kHZ	122F	115F	608	608
19XRA2CC	LF200608CCR	2CC	4/2 kHZ	122F	115F	608	608
19XRA4AA	LF200810AAR	4AA	4 kHz	122F	115F	810	810
19XRA4AA	LF200810AAR	4AA	4 kHz	104F	115F		
19XRA4AA	LF200810AAR	4AA	4 kHz	104F	97F		
19XRA4AA	LF200810AAR	4AA	2 kHz	122F	115F	810	810
19XRA4AA	LF200810AAR	4AA	2 kHz	104F	115F		
19XRA4AA	LF200810AAR	4AA	2 kHz	104F	97F		
19XRA4CC	LF201210CCR	4CC	4 kHz	122F	115F	1210	1210
19XRA4CC	LF201210CCR	4CC	4 kHz	104F	115F		
19XRA4CC	LF201210CCR	4CC	4 kHz	104F	97F		
19XRA4CC	LF201210CCR	4CC	2 kHz	122F	115F	1210	1210
19XRA4CC	LF201210CCR	4CC	2 kHz	104F	115F		
19XRA4CC	LF201210CCR	4CC	2 kHz	104F	97F		

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8.0 Rockwell Drive Configuration Parameters

8.1 Rectifier Parameters/Configurations

(A1) MONITOR	Metering	Access	Type	Units	Std Default	Min	Max	New Default	RS 485	Comment
1	Line Frequency	R/O	UWORD	x.x Hz	NA	NA	NA		Read	116
2	Input Current: R	R/O	UWORD	x.x A	NA	NA	NA		Read	94
3	Input Current: S	R/O	UWORD	x.x A	NA	NA	NA		Read	95
4	Input Current: T	R/O	UWORD	x.x A	NA	NA	NA		Read	96
5	Active Current	R/O	SWORD	x.x A	NA	NA	NA		Read	102
6	Reactive Current	R/O	SWORD	x.x A	NA	NA	NA		Read	103
7	Input Voltage: RS	R/O	UWORD	x.x VAC	NA	NA	NA		Read	91
8	Input Voltage: ST	R/O	UWORD	x.x VAC	NA	NA	NA		Read	92
9	Input Voltage: TR	R/O	UWORD	x.x VAC	NA	NA	NA		Read	93
10	DC Bus Voltage	R/O	UWORD	x.x VDC	NA	NA	NA			
11	Active Voltage	R/O	SWORD	x.x VDC	NA	NA	NA		Read	100
12	Reactive Voltage	R/O	SWORD	x.x VDC	NA	NA	NA		Read	101
13	Input KW	R/O	SWORD	x.x kW	NA	NA	NA		Read	115
14	Input Power Factor	R/O	SWORD	x.xx	NA	NA	NA		Read	117
15	Motoring kWh	R/O	ULONG	x.x kWh	NA	NA	NA			
16	Regen kWh	R/O	ULONG	x.x kWh	NA	NA	NA			
17	Elapsed Run Time	R/O	ULONG	x.x Hr	NA	NA	NA			
18	Base Temperate	R/O	SWORD	x.x deg C	NA	NA	NA			
19	IGBT Temperature	R/O	SWORD	x.x deg C	NA	NA	NA			
20	IGBT Overload	R/O	UWORD	x.x %	NA	NA	NA		Read	118
21	I2T Overload	R/O	UWORD	x.x %	NA	NA	NA			
22	Line Current % Imbalance	R/O	UWORD	x.x %	NA	NA	NA		Read	82
23	Line Voltage % Imbalance	R/O	UWORD	x.x %	NA	NA	NA		Read	83
	Drive Data									
26	Rated kW	R/O	ULONG	x.xx kW	NA	NA	NA			
27	Rated Volts	R/O	UWORD	x.x VAC	NA	NA	NA			
28	Rated Amps	R/O	UWORD	x.x A	NA	NA	NA			
29	SW Version	R/O	UWORD	x.xxx	NA	NA	NA		Read	Config
(B2) CONFIGURATION	**AC Line**									
60	Voltage Imbalance Limit	R/W	UWORD	x.x %	10.0	2.0	20.0		R/W	Config
61	Voltage Imbalance Time	R/W	UWORD	x.x Sec	5.0	1.0	10.0		R/W	Config
62	Current Imbalance Limit	R/W	UWORD	x.x %	10.0	2.0	20.0		R/W	Config
63	Current Imbalance Time	R/W	UWORD	x.x Sec	5.0	1.0	10.0		R/W	Config
64	Ride Through Enable	R/W	BYTE	Enum	0=Disable	0	1		R/W	Config
65	Ride Through Time	R/W	UWORD	x.xx Sec	1.0	0.00	60.00			Config
(C3) DYNAMIC	**Control & Status**									

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(A1) MONITOR	Metering	Access	Type	Units	Std Default	Min	Max	New Default	RS 485	Comment
CONTROL										
100	Rectifier Control	R/W	UWORD	Bits	0	0	0xFFFF			
101	Rectifier Status	R/O	UWORD	Bits	0	0	0xFFFF			
	Reference									
102	Ramp Time	R/W	UWORD	x.x Sec	1.0	0.0	10.0			
103	Vdc Reference	R/W	UWORD	x.x VDC	725.0	400.0	750.0		Read	90
	Load Limits									
104	Input Load Amps	R/W	UWORD	x.x A	PB	RRA / 4	RRA * 1.5			RRA= Rect Rated Amps
105	Current Limit	R/W	UWORD	x.x A	PB	RRA / 4	RRA * 1.5			RRA= Rect Rated Amps
	Regulator Tuning									
110	VML KI	R/W	UWORD	x	PB	0	65535			
111	VML Kp	R/W	UWORD	x	PB	0	65535			
112	CML Ki	R/W	UWORD	x	PB	0	65535			
113	CML Kp	R/W	UWORD	x	PB	0	65535			
	Cold Plate	R/O								
120	Ambient Temperature	R/O	SWORD	x.x deg C	NA	NA	NA		Read	110
121	Inverter Temp	R/O	SWORD	x.x deg C	NA	NA	NA		Read	87
122	Rectifier Temp	R/O	SWORD	x.x deg C	NA	NA	NA		Read	88
123	EXV K1	R/W	SWORD	x	0	0	65535			
124	EXV K2	R/W	SWORD	x	0	0	65535			
125	EXV K3	R/W	SWORD	x	0	0	65535			
126	EXV K4	R/W	SWORD	x	0	0	65535			
127	EXV K5	R/W	SWORD	x	0	0	65535			
128	EXV K6	R/W	SWORD	x	0	0	65535			
129	EXV Output	R/W	SWORD	x	0	0	65535		Read	111
(D4) Internal	**Normalized**									
150	ILA Norm Amps	R/O	UWORD	x.x %	NA	NA	NA			
151	Current Limit	R/O	UWORD	x.x %	NA	NA	NA			
	Total Elapsed									
152	Life kWh	R/O	ULONG	x.x kWh	NA	NA	NA		Read	80
153	Life Run Time	R/O	ULONG	x.x Hr	NA	NA	NA			
154	Life Power Time	R/O	ULONG	x.x Hr	NA	NA	NA			
155	Life Power Cycles	R/O	ULONG	x	NA	NA	NA			
	DPI Counter									
156	DPI Error	R/O	UWORD	x	NA	NA	NA			
157	CS Msg Rx Cnt	R/O	UWORD	x	NA	NA	NA			
158	CS Msg Tx Cnt	R/O	UWORD	x	NA	NA	NA			
159	CS Timeout Cnt	R/O	UWORD	x	NA	NA	NA			
160	CS Msg Bad Cnt	R/O	UWORD	x	NA	NA	NA			
161	PC Msg Rx Cnt	R/O	UWORD	x	NA	NA	NA			
162	PC Msg Tx Cnt	R/O	UWORD	x	NA	NA	NA			
163	PC Timeout Cnt	R/O	UWORD	x	NA	NA	NA			
164	CAN Bus Off Cnt	R/O	UWORD	x	NA	NA	NA			
	D/A Output Sel									
171	D/A 1 Sel		UWORD	x	0	0	7432			
172	D/A 2 Sel		UWORD	x	0	0	7432			
173	D/A 3 Sel		UWORD	x	0	0	7432			
174	D/A 4 Sel		UWORD	x	0	0	7432			
(E5) UTILITY	**Drive Memory**									
196	Access Level	R/W	UBYTE	Enum	0	0	1			

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TITLE:	DATE	DOCUMENT NUMBER
PIC III VARIABLE FREQUENCY DRIVE, UNIT MOUNTED	3/17/03	**Z-420**

(A1) MONITOR	Metering	Access	Type	Units	Std Default	Min	Max	New Default	RS 485	Comment
197	Restore Defaults	R/W	UBYTE	Enum	0	0	3			
198	Restore UserSet	R/W	UBYTE	Enum	0	0	3			
199	Save UserSet	R/W	UBYTE	Enum	0	0	3			
200	Reset Meters	R/W	UBYTE	Enum	0	0	2			
201	Language	R/W	UBYTE	Enum	0	0	10			
203	Drive Checksum	R/O	UWORD	x	NA	NA	NA			
	Status									
211	Alarm Status	R/O	UWORD	Bits	NA	NA	NA			
214	Start Inhibits	R/O	UWORD	Bits	NA	NA	NA			
216	Dig In Status	R/O	UWORD	Bits	NA	NA	NA			
217	Dig Out Status	R/O	UWORD	Bits	NA	NA	NA			
	Fault Data									
220	Fault Frequency	R/O	UWORD	x.x Hz	NA	NA	NA		Read	116
221	Fault Current: R	R/O	UWORD	x.x A	NA	NA	NA		Read	94
222	Fault Current: S	R/O	UWORD	x.x A	NA	NA	NA		Read	95
223	Fault Current: T	R/O	UWORD	x.x A	NA	NA	NA		Read	96
224	Fault Active Current	R/O	SWORD	x.x A	NA	NA	NA		Read	100
225	Fault Reactive Current	R/O	SWORD	x.x A	NA	NA	NA		Read	101
226	Fault Bus Voltage	R/O	UWORD	x.x VDC	NA	NA	NA			
227	Fault Active Voltage	R/O	SWORD	x.x VDC	NA	NA	NA			
228	Fault Reactive Voltage	R/O	SWORD	x.x VDC	NA	NA	NA			
234	Testpoint 1 Sel	R/W	UWORD	x	499	0	65535			
235	Testpoint 1 Data	R/W	ULONG	x	0	0	65535			
236	Testpoint 2 Sel	R/W	UWORD	x	499	0	65535			
237	Testpoint 2 Data	R/W	ULONG	x	0	0	65535			
238	Fault Config									
	Fault Queue									
240	Fault Clear	R/W	UBYTE	Enum	0=Ready	0	2			
241	Fault To Inverter	R/W	UWORD	x	0	0	65535			
242	Power Up Marker	R/O	ULONG	x.xxxx Hr	NA	NA	NA			
243	Fault 1 Code	R/O	UWORD	x	NA	NA	NA			
244	Fault 1 Time	R/O	ULONG	x.xxxx Hr	NA	NA	NA			
245	Fault 2 Code	R/O	UWORD	x	NA	NA	NA			
246	Fault 2 Time	R/O	ULONG	x.xxxx Hr	NA	NA	NA			
247	Fault 3 Code	R/O	UWORD	x	NA	NA	NA			
248	Fault 3 Time	R/O	ULONG	x.xxxx Hr	NA	NA	NA			
249	Fault 4 Code	R/O	UWORD	x	NA	NA	NA			
250	Fault 4 Time	R/O	ULONG	x.xxxx Hr	NA	NA	NA			
(H6) COMMUNICATION	**In Data Links**									
300	Data In A1	R/W	UWORD	x	0	0	362			
301	Data In A2	R/W	UWORD	x	0	0	362			
302	Data In B1	R/W	UWORD	x	0	0	362			
303	Data In B2	R/W	UWORD	x	0	0	362			
304	Data In C1	R/W	UWORD	x	0	0	362			
305	Data In C2	R/W	UWORD	x	0	0	362			
306	Data In D1	R/W	UWORD	x	0	0	362	100		
307	Data In D2	R/W	UWORD	x	0	0	362	121		
	Out Data Links									
310	Data Out A1	R/W	UWORD	x	0	0	362			

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TITLE:	DATE	DOCUMENT NUMBER
PIC III VARIABLE FREQUENCY DRIVE, UNIT MOUNTED	3/17/03	**Z-420**

(A1) MONITOR	Metering	Access	Type	Units	Std Default	Min	Max	New Default	RS 485	Comment
311	Data Out A2	R/W	UWORD	x	0	0	362			
312	Data Out B1	R/W	UWORD	x	0	0	362			
313	Data Out B2	R/W	UWORD	x	0	0	362			
314	Data Out C1	R/W	UWORD	x	0	0	362			
315	Data Out C2	R/W	UWORD	x	0	0	362			
316	Data Out D1	R/W	UWORD	x	0	0	362	101		
317	Data Out D2	R/W	UWORD	x	0	0	362	241		
(J7) INPUTS & OUTPUTS	**Digital Inputs**									
361	Digital In 1 Sel	R/W	UBYTE	Enum	0	0	28			
362	Digital In 2 Sel	R/W	UBYTE	Enum	0	0	28			

8.2 Inverter Parameters/Configurations

Metering	Access	Type	Units	Std Default	Min	Max	New Default	485	Comment
Output Freq	R/O	SWORD	x.x Hz	NA	NA	NA		Read	104
Commanded Freq	R/O	SWORD	x.x Hz	NA	NA	NA			
Output Current	R/O	UWORD	x.x A	NA	NA	NA			
Torque Current	R/O	SWORD	x.x A	NA	NA	NA		Read	108
Flux Current	R/O	SWORD	x.x A	NA	NA	NA		Read	109
Output Voltage	R/O	UWORD	x.x VAC	NA	NA	NA			
Output Power	R/O	UWORD	x.x kW	NA	NA	NA		Read	113
Output Power Factor	R/O	SWORD	x.xx	NA	NA	NA		Read	112
Elapsed KWh	R/O	ULONG	x.x KWh	NA	NA	NA			
Elapsed Run Time	R/O	ULONG	x.x Hrs	NA	NA	NA			
MOP Frequency	R/O	SWORD	x.x Hz	NA	NA	NA			
DC Bus Voltage	R/O	UWORD	x.x VDC	NA	NA	NA		Read	89
DC Bus Memory	R/O	UWORD	x.x VDC	NA	NA	NA			
Analog In1 Value	R/O	SWORD	x.x V	NA	NA	NA			
Analog In2 Value	R/O	SWORD	x.x V	NA	NA	NA			
Analog In3 Value	R/O	SWORD	x.x V	NA	NA	NA			
Phase Current U	R/O	UWORD	x.x A	NA	NA	NA		Read	97
Phase Current V	R/O	UWORD	x.x A	NA	NA	NA		Read	98
Phase Current W	R/O	UWORD	x.x A	NA	NA	NA		Read	99
Drive Data									
Rated kW	R/O	ULONG	x.xx kW	NA	NA	NA			
Rated Volts	R/O	UWORD	x.x VAC	NA	NA	NA			
Rated Amps	R/O	UWORD	x.x A	NA	NA	NA			
Control SW Ver	R/O	UWORD	x.xxx	NA	NA	NA		Read	Config
Application									
Appl Digital Out	R/W	UWORD	Bits	0	0	0x07FF		Write - A1	107
Appl Analog Out	R/W	SWORD	x.xxx mA	0	0	32.767		Write - A2	105
Rectifier Config	R/W	UWORD	Enum	0=run at start	0	2			
Rectifier Control	R/W	UWORD	Bits	0	0	0x07FF			
Rectifier Status	R/O	UWORD	Bits	NA	NA	NA		Read	120
Rectifier Fault	R/O	UWORD	Enum	NA	NA	NA			
Motor Data									
Motor Type	R/W	UBYTE	Enum	0=induction	0	2			
Motor NP Volts	R/W	UWORD	x.x VAC	Product Dependent	0.0	480.0	480.0	R/W	Config
Motor NP FLA	R/W	UWORD	x.x A	Product Dependent	0.0	2 * DRA		R/W	Config

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TITLE:	DATE	DOCUMENT NUMBER
PIC III VARIABLE FREQUENCY DRIVE, UNIT MOUNTED	3/17/03	**Z-420**

Metering	Access	Type	Units	Std Default	Min	Max	New Default	485	Comment
Motor NP Hertz	R/W	UWORD	x.x Hz	Product Dependent	5.0	400.0			
Motor NP RPM	R/W	UWORD	x RPM	Product Dependent	60.0	24000.0		R/W	Config
Motor NP Power	R/W	ULONG	x.xx HP	Product Dependent	0.0	1000.0		R/W	Config
Mtr NP Pwr Units	R/W	UBYTE	Enum	Product Dependent	0	1	1(kW)		
Motor OL Hertz	R/W	UWORD	x.x Hz	Product Dependent	0.0	400.0	0.0		
Motor OL Factor	R/W	UBYTE	x.xx	1.00	0.20	2.00		R/W	Config
Mtr I Imbalance Limit	R/W	UWORD	x.x %	10.0	0.0	100.0		R/W	Config
Mtr I Imbalance Time	R/W	UWORD	x.x Sec	5.0	0.1	60.0		R/W	Config
Torque Attributes									
Torque Perf Mode	R/W	UBYTE	Enum	0=svc	0	3			
Maximum Voltage	R/W	UWORD	x.x VAC	Product Dependent	120.0	480.0	480.0		
Maximum Freq	R/W	UWORD	x.x Hz	Product Dependent	5.0	400.0		R/W	Config
Compensation	R/W	UBYTE	Blts	3	0	0x0007	2		
Flux Up Mode	R/W	UBYTE	Enum	0=manual	0	1			
Flux Up Time	R/W	UWORD	x.xx Sec	0	0.00	5.00			
Autotune	R/W	UBYTE	Enum	3=calculate	0	3			
IR Voltage Drop	R/W	UWORD	x.x VAC	Product Dependent	0.0	115.0			
Flux Current Ref	R/W	ULONG	x.xx A	Product Dependent	0.00	1600.00			
Volts per Hertz									
Start/Acc Boost	R/W	UWORD	x.x VAC	Product Dependent	0.0	115.0			
Run Boost	R/W	UWORD	x.x VAC	Product Dependent	0.0	115.0			
Break Voltage	R/W	UWORD	x.x VAC	Product Dependent	0.0	460.0			
Break Frequency	R/W	UWORD	x.x Hz	Product Dependent	0.0	400.0			
Speed Mode & Limits									
Speed Mode	R/W	UBYTE	Enum	0=open loop	0	2			
Minimum Speed	R/W	UWORD	x.x Hz	0.0	0.0	Max Speed		R/W	Config
Maximum Speed	R/W	UWORD	x.x Hz	Product Dependent	5.0	400.0		R/W	Config
Overspeed Limit	R/W	UWORD	x.x Hz	10.0	0.0	20.0			
Skip Frequency 1	R/W	UWORD	x.x Hz	0.0	-400.0	400.0		R/W	Config
Skip Frequency 2	R/W	UWORD	x.x Hz	0.0	-400.0	400.0		R/W	Config
Skip Frequency 3	R/W	UWORD	x.x Hz	0.0	-400.0	400.0		R/W	Config
Skip Freq Band	R/W	UWORD	x.x Hz	0.0	-400.0	400.0		R/W	Config
Speed References									
Speed Ref A Sel	R/W	UBYTE	Enum	2=analog In 2	1	23	22-DPI Port 5		
Speed Ref A Hi	R/W	UWORD	x.x Hz	Max Speed	-MaxSpeed	MaxSpeed			
Speed Ref A Lo	R/W	UWORD	x.x Hz	0.0	-MaxSpeed	MaxSpeed			
Speed Ref B Sel	R/W	UBYTE	Enum	11=preset 1	1	23			
Speed Ref B Hi	R/W	UWORD	x.x Hz	Max Speed	-MaxSpeed	MaxSpeed			
Speed Ref B Lo	R/W	UWORD	x.x Hz	0.0	-MaxSpeed	MaxSpeed			
TB Man Ref Sel	R/W	UBYTE	Enum	1=analog In 1	1	9			
TB Man Ref Hi	R/W	UWORD	x.x Hz	Max Speed	-MaxSpeed	MaxSpeed			
TB Man Ref Lo	R/W	UWORD	x.x Hz	0.0	-MaxSpeed	MaxSpeed			
Discrete Speeds									
Jog Speed	R/W	SWORD	x.x Hz	10.0	0.0	Max Speed			

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TITLE:	DATE	DOCUMENT NUMBER
PIC III VARIABLE FREQUENCY DRIVE, UNIT MOUNTED	3/17/03	**Z-420**

Metering	Access	Type	Units	Std Default	Min	Max	New Default	485	Comment
Preset Speed 1	R/W	SWORD	x.x Hz	5.0	-MaxSpeed	MaxSpeed			
Preset Speed 2	R/W	SWORD	x.x Hz	10.0	-MaxSpeed	MaxSpeed			
Preset Speed 3	R/W	SWORD	x.x Hz	20.0	-MaxSpeed	MaxSpeed			
Preset Speed 4	R/W	SWORD	x.x Hz	30.0	-MaxSpeed	MaxSpeed			
Preset Speed 5	R/W	SWORD	x.x Hz	40.0	-MaxSpeed	MaxSpeed			
Preset Speed 6	R/W	SWORD	x.x Hz	50.0	-MaxSpeed	MaxSpeed			
Preset Speed 7	R/W	SWORD	x.x Hz	60.0	-MaxSpeed	MaxSpeed			
Speed Trim									
Trim In Select	R/W	UBYTE	Enum	2=analog In 2	1	23			
Trim Out Select	R/W	UBYTE	Bits	0	0	0x03			
Trim Hi	R/W	SWORD	x.x Hz	Max Speed	-MaxSpeed	MaxSpeed			
Trim Lo	R/W	SWORD	x.x Hz	0	-MaxSpeed	MaxSpeed			
Slip Comp									
Slip RPM @ FLA	R/W	UWORD	x.x RPM	20.0	0.0	1200.0			
Slip Comp Gain	R/W	UWORD	x.x	40.0	1.0	100.0			
Slip RPM Meter	R/O	SWORD	x.x RPM	NA	-300.0	300.0			
Process PI									
PI Configuration	R/W	UBYTE	Bits	0	0	0x3F			
PI Control	R/W	UBYTE	Bits	0	0	0x07			
PI Reference Sel	R/W	UBYTE	Enum	0	0	23			
PI Setpoint	R/W	SWORD	x.xx %	50.00	-100.00	100.00			
PI Feedback Sel	R/W	UBYTE	Enum	2=Analog In 2	0	23			
PI Integral Time	R/W	UWORD	x.x Sec	2.00	0.00	100.00			
PI Prop Gain	R/W	UWORD	x.xx	1.00	0.00	100.00			
PI Lower Limit	R/W	SWORD	x.x Hz	-Max Freq	-Max Freq	Max Freq			
PI Upper Limit	R/W	SWORD	x.x Hz	Max Freq	-Max Freq	Max Freq			
PI Preload	R/W	SWORD	x.x Hz	0	-Max Freq	Max Freq			
PI Status	R/O	UWORD	Bits	NA	0	0x0F			
PI Ref Meter	R/O	SWORD	x.xx %	NA	-100.00	100.00			
PI Feedback Meter	R/O	SWORD	x.xx %	NA	-100.00	100.00			
PI Error Meter	R/O	SWORD	x.xx %	NA	-100.00	100.00			
PI Output Meter	R/O	SWORD	x.x Hz	NA	-Max Freq	Max Freq			
Ramp Rates									
Accel Time 1	R/W	UWORD	x.x Sec	10.0	0.1	3600.0		R/W	Config
Accel Time 2	R/W	UWORD	x.x Sec	10.0	0.2	3600.1			
Decel Time 1	R/W	UWORD	x.x Sec	10.0	0.3	3600.2		R/W	Config
Decel Time 2	R/W	UWORD	x.x Sec	10.0	0.4	3600.3			
S Curve %	R/W	UWORD	x %	0	0	100			
Load Limits									
Current Limit Sel	R/W	UBYTE	Enum	0=Curr Lim Val	0	2			
Current Limit Val	R/W	UWORD	x.x A	Product Dependent	DRA / 4	DRA * 1.5			DRA= Drive Rated Amps
Current Limit Gain	R/W	UWORD	x	250	0	5000			
Drive OL Mode	R/W	UBYTE	Enum	3=Both	0	3			
PWM Frequency	R/W	UWORD	kHz	Product Dependent	2	4			
Stop/Brake Modes									
Stop Mode A	R/W	UBYTE	Enum	1=ramp					
Stop Mode B	R/W	UBYTE	Enum	0=coast					
DC Brake Level Sel	R/W	UBYTE	Enum	0=DC brake Level	0	2			
DC Brake Level	R/W	UWORD	x.x A	Product Dependent	0.0	DRA			
DC Brake Time	R/W	UWORD	x.x Sec	0	0.0	90.0			

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TITLE:	DATE	DOCUMENT NUMBER
PIC III VARIABLE FREQUENCY DRIVE, UNIT MOUNTED	3/17/03	**Z-420**

Metering	Access	Type	Units	Std Default	Min	Max	New Default	485	Comment
Bus Reg Gain	R/W	UWORD	x	450	0	5000			
Bus Reg Mode A	R/W	UBYTE	Enum	1=Adjust Freq	0	4			
Bus Reg Mode B	R/W	UBYTE	Enum	4=Both	0	4			
DB Resistor Type	R/W	UBYTE	Enum	0=none	0	2			
Restart Modes									
Start At PowerUp	R/W	UBYTE	Enum	0=disabled	0	1			Hidden
Flying Start En	R/W	UBYTE	Enum	0=disabled	0	1			Hidden
Flying Start Gain	R/W	UWORD	x	4000	20	32767			
Auto Restart Tries	R/W	UBYTE	x	0	0	9			
Auto Restart Delay	R/W	UWORD	x.x Sec	1.0	0.5	30.0			
Power Loss									
Power Loss Mode	R/W	UBYTE	Enum	0=coast	0	1			
Power Loss Timer	R/W	UWORD	x.x Sec	0.5	0.0	60.0			
Direction Config									
Direction Mode	R/W	UBYTE	Enum	0=unipolar	0	2	Reverse Dis		
HIM Ref Config									
Save HIM Ref	R/W	UBYTE	Bits	1	0	1			
Man Ref Preload	R/W	UBYTE	Enum	0=disabled	0	1			
MOP Config	R/W								
Save MOP Ref	R/W	UBYTE	Bits	0	0	0x3			
MOP Rate	R/W	UWORD	x.x Hz/S	1.0	0.2	400.0			
Drive Memory									
Param Access Level	R/W	UBYTE	Enum	0	0	1			
Restore Defaults	R/W	UBYTE	Enum	0	0	3			
Load From User Set	R/W	UBYTE	Enum	0	0	3			
Save To User Set	R/W	UBYTE	Enum	0	0	3			
Reset Meters	R/W	UBYTE	Enum	0	0	3			
Language	R/W	UBYTE	Enum	0	0	10			
Voltage Class	R/W	UBYTE	Enum	Product Dependent	2	3			
Drive Checksum	R/O		x	NA	NA	NA			
Diagnostics									
Drive Status 1	R/O	UWORD	Bits	NA	NA	NA			
Drive Status 2	R/O	UWORD	Bits	NA	NA	NA			
Drive Alarm 1	R/O	UWORD	Bits	NA	NA	NA			
Drive Alarm 2	R/O	UWORD	Bits	NA	NA	NA			
Speed Ref Source	R/O	UBYTE	Enum	NA	NA	NA			
Start Inhibits	R/O	UWORD	Bits	NA	NA	NA			
Last Stop Source	R/O	UBYTE	Enum	NA	NA	NA			
Dig In Status	R/O	UWORD	Bits	NA	NA	NA		Read A1	86
Dig Out Status	R/O	UWORD	Bits	NA	NA	NA			
Drive Temp	R/O	SWORD	x.x deg C	NA	NA	NA			
Drive OL Count	R/O	UWORD	x.x %	NA	NA	NA		Read	119
Motor OL Count	R/O	UWORD	x.x %	NA	NA	NA		Read	114
Motor % Imbalance	R/O	UWORD	x.x %	NA	NA	NA			
Fault Frequency	R/O	SWORD	x.x Hz	NA	NA	NA			
Fault Amps	R/O	UWORD	x.x A	NA	NA	NA			
Fault Bus Volts	R/O	UWORD	x.x VDC	NA	NA	NA		Read	89
Status 1 @ Fault	R/O	UWORD	Bits	NA	NA	NA			
Status 2 @ Fault	R/O	UWORD	Bits	NA	NA	NA			
Alarm 1 @ Fault	R/O	UWORD	Bits	NA	NA	NA			
Alarm 2 @ Fault	R/O	UWORD	Bits	NA	NA	NA			
Testpoint 1 Sel	R/W	UWORD	x	499	0	65535			
Testpoint 1 Data	R/W	ULONG	x	0	0	4M			

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PIC III VARIABLE FREQUENCY DRIVE, UNIT MOUNTED	3/17/03	**Z-420**

Metering	Access	Type	Units	Std Default	Min	Max	New Default	485	Comment
Testpoint 2 Sel	R/W	UWORD	x	499	0	65535			
Testpoint 2 Data	R/W	ULONG	x	0	0	4M			
Faults									
Fault Config 1	R/W	UWORD	Bits	100 1110	0	0x7F			
Fault Clear	R/W	UBYTE	Enum	0	0	2		Write	121
Fault Clear Mode	R/W	UBYTE	Enum	1	0	1			
Power Up Marker	R/O	ULONG	x.xxxx Hr	NA	NA	NA			
Fault 1 Code	R/O	UWORD	x	NA	NA	NA		Read A2	84
Fault 1 Time	R/O	ULONG	x.xxxx Hr	NA	NA	NA			
Fault 2 Code	R/O	UWORD	x	NA	NA	NA			
Fault 2 Time	R/O	ULONG	x.xxxx Hr	NA	NA	NA			
Fault 3 Code	R/O	UWORD	x	NA	NA	NA			
Fault 3 Time	R/O	ULONG	x.xxxx Hr	NA	NA	NA			
Fault 4 Code	R/O	UWORD	x	NA	NA	NA			
Fault 4 Time	R/O	ULONG	x.xxxx Hr	NA	NA	NA			
Alarms									
Alarm Config 1	R/W	UWORD	Bits	11 1011 1111	0	0x3FF			
Comm Control									
DPI Data Rate	R/W	UBYTE	Enum	0=125k	0	1	500k		
Drive Logic Result	R/O	UWORD	Bits	NA	NA	NA			
Drive Ref Result	R/O	UBYTE	Enum	NA	NA	NA			
Drive Ramp Result	R/O	UBYTE	Enum	NA	NA	NA			
Masks & Owners									
Logic Mask	R/W	UWORD	Bits	10 1111	0	0x3F	10 0000		
Start Mask	R/W	UWORD	Bits	10 1111	0	0x3F			
Jog Mask	R/W	UWORD	Bits	10 1111	0	0x3F			
Direction Mask	R/W	UWORD	Bits	10 1111	0	0x3F			
Reference Mask	R/W	UWORD	Bits	10 1111	0	0x3F			
Accel Mask	R/W	UWORD	Bits	10 1111	0	0x3F			
Decel Mask	R/W	UWORD	Bits	10 1111	0	0x3F			
Fault Clear Mask	R/W	UWORD	Bits	10 1111	0	0x3F			
MOP Mask	R/W	UWORD	Bits	10 1111	0	0x3F			
Local Mask	R/W	UWORD	Bits	10 1111	0	0x3F			
Stop Owner	R/O	UWORD	Bits	NA	NA	NA			
Start Owner	R/O	UWORD	Bits	NA	NA	NA			
Jog Owner	R/O	UWORD	Bits	NA	NA	NA			
Direction Owner	R/O	UWORD	Bits	NA	NA	NA			
Reference Owner	R/O	UWORD	Bits	NA	NA	NA			
Accel Owner	R/O	UWORD	Bits	NA	NA	NA			
Decel Owner	R/O	UWORD	Bits	NA	NA	NA			
Fault Clear Owner	R/O	UWORD	Bits	NA	NA	NA			
MOP Owner	R/O	UWORD	Bits	NA	NA	NA			
Local Owner	R/O	UWORD	Bits	NA	NA	NA			
Datalinks									
Data In A1	R/W	UWORD	x	0	0	387	30		
Data In A2	R/W	UWORD	x	0	0	387	31		
Data In B1	R/W	UWORD	x	0	0	387			
Data In B2	R/W	UWORD	x	0	0	387			
Data In C1	R/W	UWORD	x	0	0	387			
Data In C2	R/W	UWORD	x	0	0	387			
Data In D1	R/W	UWORD	x	0	0	387	33		
Data In D2	R/W	UWORD	x	0	0	387	218		
Data Out A1	R/W	UWORD	x	0	0	387	216		
Data Out A2	R/W	UWORD	x	0	0	387	243		

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Metering	Access	Type	Units	Std Default	Min	Max	New Default	485	Comment
Data Out B1	R/W	UWORD	x	0	0	387			
Data Out B2	R/W	UWORD	x	0	0	387			
Data Out C1	R/W	UWORD	x	0	0	387			
Data Out C2	R/W	UWORD	x	0	0	387			
Data Out D1	R/W	UWORD	x	0	0	387	34		
Data Out D2	R/W	UWORD	x	0	0	387	35		
Analog Inputs									
Analog In Config	R/W	UWORD	Bits	00	0	0x3			
Analog In Sqr Root	R/W	UWORD	Bits	Disabled	0	0x3			
Analog In 1 Hi	R/W	UWORD	x.xxx V	10.0 volts	0.000	10.000			
Analog In 1 Lo	R/W	UWORD	x.xxx V	0.0 volts	0.001	10.000			
Analog In 1 Loss	R/W	UBYTE	Enum	Disabled	0	6			
Analog In 2 Hi	R/W	UWORD	x.xxx V	10.0 volts	0.000	10.000			
Analog In 2 Lo	R/W	UWORD	x.xxx V	0.0 volts	0.001	10.000			
Analog In 2 Loss	R/W	UBYTE	Enum	Disabled	0	6			
Analog Outputs									
Analog Out Config	R/W	UWORD	Bits	0	0	1	1		
Analog Out Absolute	R/W	UWORD	Bits	0	0	1			
Analog Out1 Sel	R/W	UBYTE	Enum	Output Freq	0	14	Appl Output		Head Pressure
Analog Out1 Hi	R/W	UWORD	x.xxx mA	10.0			20.0		
Analog Out1 Lo	R/W	UWORD	x.xxx mA	0.0			4.0		
Digital Inputs									
Digital In1 Sel	R/W	UBYTE	Enum	Stop	0	28	Aux Fault		High Pressure Relay
Digital In2 Sel	R/W	UBYTE	Enum	Start	0	28	Unused		Spare Safety
Digital In3 Sel	R/W	UBYTE	Enum	Jog	0	28	Unused		Ice Build
Digital In4 Sel	R/W	UBYTE	Enum	Speed Sel1	0	28	Unused		Remote Start
Digital In5 Sel	R/W	UBYTE	Enum	Speed Sel2	0	28	Unused		
Digital In6 Sel	R/W	UBYTE	Enum	Speed Sel3	0	28	Unused		
Digital Outputs									
Digital Out1 Sel	R/W	UBYTE	Enum	1=Fault	0	28	27=Shunt Trip		Shunt Trip
Dig Out1 Level	R/W	UWORD	x.x	N/A	0.0	819.2			
Dig Out1 OnTime	R/W	UWORD	x.xx Sec	0	0.00	600.00			
Dig Out1 Off Time	R/W	UWORD	x.xx Sec	0	0.00	600.00			
Digital Out2 Sel	R/W	UBYTE	Enum	4=Run	0	28			
Dig Out2 Level	R/W	UWORD	x.x	N/A	0.0	819.2			
Dig Out2 OnTime	R/W	UWORD	x.xx Sec	0	0.00	600.00			
Dig Out2 Off Time	R/W	UWORD	x.xx Sec	0	0.00	600.0			

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9.0 Rockwell VFD Fault Codes

Fault Code	Fault	Description
2	Auxiliary Input	Input is open.
3	Power Loss	DC bus voltage remained below 85% of nominal for longer than Power Loss Time (185). Enable/disable with Fault Config 1 (238).
4	Under Voltage	DC bus voltage fell below the minimum value of 407V DC at 400/480V input or 204V DC at 200/240V input. Enable/disable with Fault Config 1(233).
5	Over Voltage	DC bus voltage exceeded maximum value.
6	Current regulator saturated for > timeout	This fault code is never used in Liquiflo drives.
7	Motor Overload	Internal electronic overload trip. Enable/disable with Fault Config 1 (238).
8	Inverter Base Temp	Base temperature exceeded limit.
9	Inverter IGBT Temp	Output transistors have exceeded their maximum operating temperature.
12	HW Overcurrent	The drive output current has exceeded the hardware current limit.
13	Ground Fault	A current path to earth ground in excess of 7% of drive rated amps has been detected at one or more of the drive output terminals.
24	Decel Inhibit	The drive is not following a commanded deceleration because it is attempting to limit bus voltage.
25	Overspeed Limit	Functions such as slip compensation or bus regulation have attempted to add an output frequency adjustment greater than that programmed in Overspeed Limit (83).
29	Analog In Loss	An analog input is configured to fault on signal loss. A signal loss has occurred. Configure with Analog In 1, 2 Loss (324, 327).
33	Auto Restart Tries	Drive unsuccessfully attempted to reset a fault and resume running for the programmed number of Auto Restart Tries (174). Enable/disable with Fault Config 1 (238).

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Fault Code	Fault	Description
35	Current FBK lost	The magnitude of motor current feedback was less than 5% of the configured Motor Nameplate Amps for the time configured in the Motor Imbalance Time. Detection of this fault is disabled when the Motor Imbalance Time is set to the maximum value of 10.0 seconds.
36	SW Overcurrent	The drive output current has exceeded the software current.
37	Motor I Imbalance	Phase current displayed in Imbalance Display (221) > percentage set in Imbalance Limit (49) for time set in Imbalance Time (50).
38	Phase U to Ground	A phase-to-ground fault has been detected between the drive and motor in this phase.
39	Phase V to Ground	
40	Phase W to Ground	
41	Phase UV Short	Excessive current has been detected between output terminal and ground or between these two output terminals.
42	Phase VW Short	
43	Phase UW Short	
48	Parameters Defaulted	The drive was commanded to write default values to EEPROM.
63	Shear Pin	Programmed Current Limit Value (148) has been exceeded. Enabled/disable with Fault Config 1 (238).
64	Drive Overload	Drive rating of 110% for 1 minute or 150% for 3 seconds has been exceeded.
69	DB Resistor out of range	This fault code is never used in Liquiflo drives.
71- 75	Port 1-5 Net Loss	The network card connected to DPI port stopped communicating. The fault code indicates the offending port number (71 = port 1, 72 = port 2, etc.)
76	Peripheral fault at DPI port 6	This fault code is never used in Liquiflo drives.
77	IR Volts Range	The drive autotune default Calculated, and the value calculated for IR Drop Volts is not in the range of acceptable values.
78	FluxAmpsRef Range	The value for flux amps determined by the autotune procedure exceeds the programmed Motor NP FLA (42).
79	Excessive Load	Motor did not come up to speed in the allotted time.
80	Autotune Aborted	The autotune procedure canceled by the user.

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Fault Code	Fault	Description
81- 85	Port 1-5 DPI Loss	DPI port stopped communicating. An attached peripheral with control capabilities via Logic Source Select (89) (or OIM control) was removed. The fault code indicates the offending port number (81 = port 1, etc.)
86	DPI port 6 communication loss	This fault code is never used in Liquiflo drives.
87	Autotune: Ixo too large	Ixo voltage calculated from motor nameplate data is too high.
100	Parameter Checksum	The checksum read from the board does not match the checksum calculated.
101	UserSet1 Checksum	The checksum read from the user set does not match the checksum calculated.
102	UserSet2 Checksum	
103	UserSet3 Checksum	
104	Power Board Checksum 1	The checksum read from the EEPROM does not match the checksum calculated from the EEPROM data.
105	Power Board Checksum2	The checksum read from the board does not match the checksum calculated.
106	Incompatible MCB-PB	Drive rating information stored on the power board is incompatible with the Main Control board.
107	Replaced MCB-PB	Main Control board was replaced and parameters were not programmed.
120	I/O Board Mismatch	Incorrect I/O board identified.
121	I/O Board Comm Loss	Loss of communication to I/O board.
122	I/O Board Fail	Board failure.
200	Inverter Dsat U, V, W	High current was detected in an IGBT.
203	Inverter Overcurrent U, V, W	High current was detected in an IGBT.
206	Inverter Unused bit	Inverter section of power structure hardware reported unexpected fault.
207	Inverter Gate Kill	Inverter gate kill contact is open.
208	Rectifier Dsat U, V, W	High current was detected in an IGBT.
211	Rectifier IOC U, V, W	Rectifier Overcurrent
214	Reactor Temp	Temperature switch in reactor opened.
215	Rectifier Unused bit	Rectifier section of power structure hardware reported unexpected fault.
216	Rectifier Ground Fault	Excessive ground current measured.

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Fault Code	Fault	Description
217	Rectifier Base Temp	Excessive rectifier temperature measured.
218	Rectifier IGBT Temp	Excessive calculated IGBT temperature.
219	Rectifier IT Overload	Short-term current rating of rectifier exceeded.
220	Rectifier I2T Overload	Long-term current rating of rectifier exceeded.
221	Ride Thru Abort	Input power loss timed out.
222	High AC Line	Input line voltage is too high.
223	Low DC Bus	The bus voltage is too low.
224	Rectifier Over Volt	The bus voltage is too high.
225	Input Amp Imbalance	Input phase current imbalance exceeded limits.
226	Input Volt Imbalance	Input voltage imbalance exceeded limits.
227	AC Line Lost	Input power Lost
228	Line Frequency	Line frequency not in the range of 47-63 Hz.
229	Rectifier Checksum	The checksum read from the board does not match the checksum calculated.
230	Inverter HW detected a fault bit none was found.	Inverter section of power structure hardware reported unexpected fault.
231	Rectifier HW detected a fault bit none was found.	Rectifier portion of power structure hardware reported unexpected fault.
232	Rectifier Not OK	A fault was detected in the rectifier other than one specifically decoded.
233	Precharge closed	Precharge was closed when it should be open.
234	Precharge open	Precharge was open when it should be closed.
235	Rectifier Pwr Board	Drive rating information stored on the power board is incompatible with the Main Control board. The checksum read from the board does not match the checksum calculated.
236	Rectifier I/O Board	Loss of communication to I/O board. Board failure.
237	Rectifier Start Timed Out	The rectifier did not regulate to the desired bus voltage within the defined time.
238	Rectified Not Logged in	Rectifier took too long to connect to inverter.
239	Rectifier Power Phased ACB	Input power is phased ACB rather than ABC.

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