Model M3712

Single Phase Power Supply
For 3-Phase Variable Frequency Drives

Customer Reference Manual

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Bonitron, Inc.
Nashville, TN

An industry leader in providing solutions for AC drives.

ABOUT BONITRON

Bonitron designs and manufactures quality industrial electronics that improve the reliability of processes and variable frequency drives worldwide. With products in numerous industries, and an educated and experienced team of engineers, Bonitron has seen thousands of products engineered since 1962 and welcomes custom applications.

With engineering, production, and testing all in the same facility, Bonitron is able to ensure its products are of the utmost quality and ready to be applied to your application.

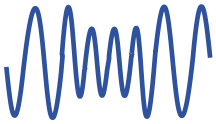
The Bonitron engineering team has the background and expertise necessary to design, develop, and manufacture the quality industrial electronic systems demanded in today's market. A strong academic background supported by continuing education is complemented by many years of hands-on field experience. A clear advantage Bonitron has over many competitors is combined on-site engineering labs and manufacturing facilities, which allows the engineering team to have immediate access to testing and manufacturing. This not only saves time during prototype development, but also is essential to providing only the highest quality products.

The sales and marketing teams work closely with engineering to provide up-to-date information and provide remarkable customer support to make sure you receive the best solution for your application. Thanks to this combination of quality products and superior customer support, Bonitron has products installed in critical applications worldwide.

AC Drive Options

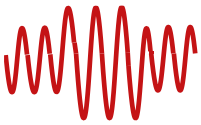
In 1975, Bonitron began working with AC inverter drive specialists at synthetic fiber plants to develop speed control systems that could be interfaced with their plant process computers. Ever since, Bonitron has developed AC drive options that solve application issues associated with modern AC variable frequency drives and aid in reducing drive faults. Below is a sampling of Bonitron's current product offering.

World Class Products



Undervoltage Solutions

Uninterruptible Power for Drives
(DC Bus Ride-Thru)
Voltage Regulators
Chargers and Dischargers
Energy Storage



Overvoltage Solutions

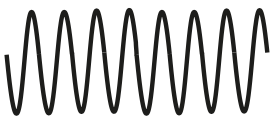
Braking Transistors
Braking Resistors
Transistor/Resistor Combo
Line Regeneration
Dynamic Braking for Servo Drives

Common Bus Solutions

Single Phase Power Supplies
3-Phase Power Supplies
Common Bus Diodes

Portable Maintenance Solutions

Capacitor Formers
Capacitor Testers



Power Quality Solutions

12 and 18 Pulse Kits

Green Solutions

Line Regeneration

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1. INTRODUCTION

1.1. WHO SHOULD USE

This manual is intended for use by anyone who is responsible for integrating, installing, maintaining, troubleshooting, or using this equipment with any AC Drive System.

Please keep this manual for future reference.

1.2. PURPOSE AND SCOPE

This manual is a user's guide for the Model M3712 Single Phase Power Supply. It will provide you with the necessary information to successfully install and use the M3712 modules in your application.

In the event of any conflict between this document and any publication and/or documentation related to the application, the latter shall have precedence.

1.3. MANUAL VERSION AND CHANGE RECORD

Updated Table 3-1, 3-2, 3-3, 3-4, 6-1 and Figure 3-2 in Rev 05a.

Table 3-1 was updated in Rev 05b.

Information for the 15HP M3712 was added in Rev 05c.

Update to Table 2-3 was made in Rev 05d.

Update to Table 3-3 was made in Rev 05e.

Update to section 3.3.3 in Rev 05f.

Updated table 6-1 in Rev 05g.

Updated table 6-2 in Rev 05h.

Added figure 5-2 showing 3712C2 board layout in Rev 05i.

Updated table 2-3 in Rev 05j.

Updated SCCR in table 2-3 in Rev 05k.

Updated table 6-1 in Rev 05m.

Updated section 4.1.2.3 in Rev 05n.

Updated section 6.1 in Rev 05p.

Fixed a typo in section 5.3.3.4.

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Update to table 6-1 in Rev 05g.Figure 1-1: Typical M3712 Single Phase Power Supplies

15HP

30HP and Above

Figure 1-2: Typical Reactor

1.4. SYMBOL CONVENTIONS USED IN THIS MANUAL AND ON EQUIPMENT

	Earth Ground or Protective Earth
	AC Voltage
	DC Voltage
 **DANGER!**	Electrical Hazard - Identifies a statement that indicates a shock or electrocution hazard that must be avoided.
 **DANGER!**	DANGER: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.
 **CAUTION!**	CAUTION: Identifies information about practices or circumstances that can lead to property damage, or economic loss. Attentions help you identify a potential hazard, avoid a hazard, and recognize the consequences.
 **CAUTION!**	Heat or burn hazard - Identifies a statement regarding heat production or a burn hazard that should be avoided.

2. PRODUCT DESCRIPTION

Standard variable frequency drives (VFDs) are constructed to operate from a 3-phase input. In situations where 3-phase power is not available, the drives are normally de-rated or are not recommended for use in any single phase application. Many manufacturers do not recommend this practice, as there are recognized precautions and limitations:

- Drives may be de-rated by 50% when single phase voltage is applied.
- Input reactors must be used to reduce peak rectifier and capacitor currents.
- Bus voltage is reduced with additional reactors which limits output capability.

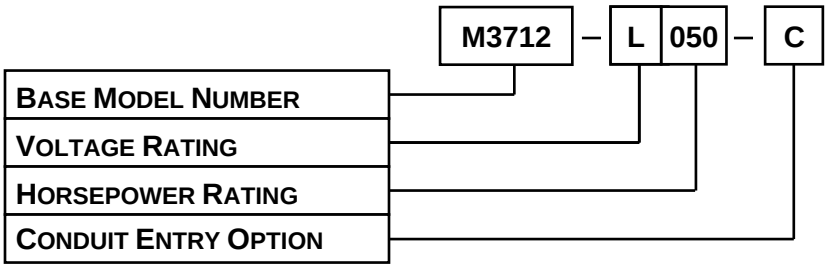
The M3712 converts single phase AC to filtered DC for 3-phase VFDs not rated for single phase. The M3712 has a selectable start-up current limit which is rated at approximately 20% of the full load rating for precharging the VFD bus.

The M3712 may be used for providing power to common bus drives and inverters that require a DC power supply.

The M3712 is recommended for use with a line reactor which is sold separately from the M3712.

2.1. PART NUMBER BREAKDOWN

Figure 2-1: Example of Part Number Breakdown



BASE MODEL NUMBER

The Base Model Number for all single phase power supplies is **M3712**.

VOLTAGE RATING

A 1-character code represents the single phase AC line input voltage to the M3712 module. The voltage rating must be selected for the system voltage that will be applied.

Table 2-1: Voltage Rating

RATING CODE	VOLTAGE
L	208 - 240VAC
H	460 - 480VAC

HORSEPOWER RATING

A 3-digit code represents the nominal horsepower that the M3712 is intended to support. Exceeding this limit may cause poor performance and possible failure.

Table 2-2: Horsepower Ratings

RATING CODE	NOMINAL DRIVE HORSEPOWER
015	15 HP
030	30 HP
050	50 HP
075	75 HP
125	125 HP

CONDUIT ENTRY OPTION

Optional conduit entry extension – see the dimensional outlines in Section 6.4.

2.2. GENERAL SPECIFICATIONS

Table 2-3: General Specifications Chart

PARAMETER	SPECIFICATION
Input Voltage	240VAC, 480VAC 1ϕ, 50/60 Hz
Output Voltage DC	Approximately 1.4x Input VAC
Short Circuit Current Rating	100kA
Intermittent Duty Limit	150% Full Load Rating for 60 seconds
Precharge Ramp Current Limit	20% Full Load Rating
Overcurrent Limit	200% Full Load Rating
Operating Temp	0°C to +40°C
Storage Temp	-20°C to +65 °C
Humidity	Below 90% Non-condensing
Atmosphere	Free of corrosive gas and conductive dust
Control I/O	Inputs: Dry contact • Enable Outputs: 250VAC, 120mA max • Ready
Indicators	Power Ready Status

2.3. General Precautions and Safety Warnings

DANGER!

- HIGH VOLTAGES MAY BE PRESENT!
- NEVER ATTEMPT TO OPERATE OR SERVICE THIS EQUIPMENT WITH ACCESS DOORS OR COVERS OPENED!
- FAILURE TO HEED THESE WARNINGS MAY RESULT IN SERIOUS BODILY INJURY OR DEATH!

CAUTION!

- HIGH TEMPERATURES MAY BE GENERATED BY THIS EQUIPMENT DURING NORMAL OPERATION!
- THIS EQUIPMENT SHOULD BE INSTALLED ON A NON-FLAMMABLE SURFACE IN A WELL VENTILATED AREA WITH A MINIMUM OF 2 INCHES OF CLEARANCE ALL AROUND.
- LETHAL VOLTAGES CAN EXIST IN UNIT AFTER POWER HAS BEEN REMOVED. ALLOW 5 MINUTES FOR CAPACITOR BANKS TO DISCHARGE, AND ENSURE THERE IS LESS THAN 40VDC ON THE DC BUS BEFORE ATTEMPTING SERVICE.
- ALWAYS ALLOW AMPLE TIME FOR THE UNIT TO COOL BEFORE ATTEMPTING SERVICE ON THIS PRODUCT!
- INSTALLATION AND/OR REMOVAL OF THIS PRODUCT SHOULD ONLY BE ACCOMPLISHED BY A QUALIFIED ELECTRICIAN IN ACCORDANCE WITH NATIONAL ELECTRICAL CODE OR EQUIVALENT REGULATIONS.

ANY QUESTIONS AS TO APPLICATION, INSTALLATION, OR SERVICE SAFETY SHOULD BE DIRECTED TO THE EQUIPMENT SUPPLIER.

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3. INSTALLATION INSTRUCTIONS

WARNING! *Installation and/or removal of this product should only be performed by a qualified electrician in accordance with National Electrical Code or local codes and regulations.*

Proper installation of the power supply modules should be accomplished following the steps outlined below. Be sure to refer to the AC drive instruction manual as these steps are performed. Please direct all installation inquiries that may arise during the installation and startup of this product to the equipment supplier or system integrator.

3.1. ENVIRONMENT

The module should be installed in an area protected from moisture and falling debris. Buildup of dust or debris may cause poor performance and possibly a failure. Operating in a wet environment can pose a shock hazard. The recommended temperature range for operating or storing this module is 0°C to +40°C.

3.2. UNPACKING

Upon receipt of this product, please verify that the product received matches the product that was ordered and that there is no obvious physical damage to the unit. If the wrong product was received or the product is damaged in any way, please contact the supplier from which the product was purchased.

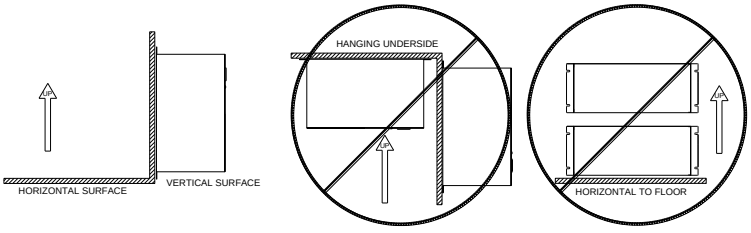
3.3. MOUNTING

3.3.1. MOUNTING THE M3712 SINGLE PHASE POWER SUPPLY

The installation site for the module should be chosen with several considerations in mind:

- The unit requires a minimum clearance of two (2) inches in all directions around it when mounted near a non-heat source.
- Unit should not be exposed to falling debris or condensation.
- Once the installation site has been selected as outlined above, the unit should be mounted in place. The M3712 must be properly oriented for proper heat flow through the unit. The M3712 must be mounted with the rear surface of the unit to the mounting surface. **Unit should be mounted vertically** as shown in Example A of Figure 3-1.
- **Do Not** mount the unit upside-down or on the underside of a mounting surface as shown in Example B of Figure 3-1.
- **Do Not** mount unit in a horizontal position with its side parallel to the mounting surface or floor as shown in Example C of Figure 3-1.

Figure 3-1: M3712 Mounting Orientation



Example A Example B Example C

3.3.2. MOUNTING THE REACTOR

Reactors rated 300 Amperes RMS and under are designed for mounting in both a vertical and horizontal position. Larger reactors must be mounted in a horizontal position typically on the floor of the enclosure. Include the power dissipation of the reactor along with all the other components located in the enclosure to determine the internal temperature rise and cooling requirements of the enclosure.

Reactors may be located in any region of the enclosure where the ambient temperature does not exceed 45°C. Allow a minimum side clearances of four (4) inches and vertical clearances of six (6) inches for proper heat dissipation and access. Do not locate the reactor next to resistors or any other component with operating surface temperatures above 125°C.

3.3.3. CONDUIT ENTRY EXTENSION NOTES

The conduit extension metalwork allows extra space to mount conduit fittings to the enclosure. All fittings must be installed as per local codes. See Figure 3-3 for installation instructions.

3.4. WIRING AND CUSTOMER CONNECTIONS

Be sure to review all AC Drive and system documentation for attached equipment as well as the information listed below before proceeding. Connection points and terminal numbers of the AC Drive will be found in the documentation provided with those units. Use copper wiring rated 75°C.

3.4.1. POWER WIRING

WARNING!

Only qualified electricians should perform and maintain the interconnection wiring of this product. All wiring should be done in accordance with local codes.

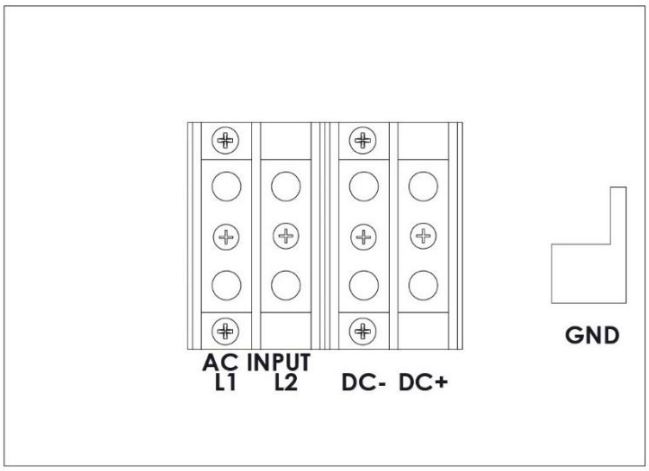
WARNING!

This unit contains substantial capacitance and can maintain lethal voltages for a long time after power is removed! Ensure that the DC bus level has dropped below 40VDC before attempting to work on or with this unit!

Table 3-1: Power Connection Specifications – 15HP Unit – T6 Chassis

VOLTAGE RATING	TEMINALS	ELECTRICAL RATING	CONNECTIONS PER PHASE / LEG	WIRE SIZE MINIMUM	WIRE SIZE MAXIMUM	TORQUE
L	L1, L2	87A	1	4 AWG	2 AWG	120 lb-in
	DC+, DC-	50A	1	6 AWG	2 AWG	120 lb-in
	GND		1	10 AWG	2 AWG	
H	L1, L2	58A	1	6 AWG	2 AWG	120 lb-in
	DC+, DC-	28A	1	10 AWG	2 AWG	120 lb-in
	GND		1	10 AWG	2 AWG	

Figure 3-2: 15HP Customer Power Connections



L015 & H015

Table 3-2: Power Connection Specifications – 30HP Unit – K7 Chassis

VOLTAGE RATING	TEMINALS	ELECTRICAL RATING	CONNECTIONS PER PHASE / LEG	WIRE SIZE MINIMUM	WIRE SIZE MAXIMUM	TORQUE
L	L1, L2	175A	1	2/0 AWG	2/0 AWG	120 lb-in
	DC+, DC-	100A	1	3 AWG	2/0 AWG	120 lb-in
	GND		1	6 AWG	2/0 AWG	
H	L1, L2	115A	1	2 AWG	2/0 AWG	120 lb-in
	DC+, DC-	55A	1	6 AWG	2/0 AWG	120 lb-in
	GND		1	6 AWG	2/0 AWG	

Figure 3-3: 30HP Customer Power Connections

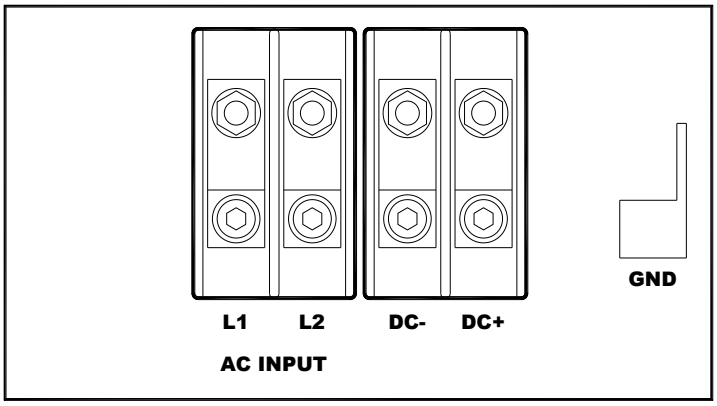


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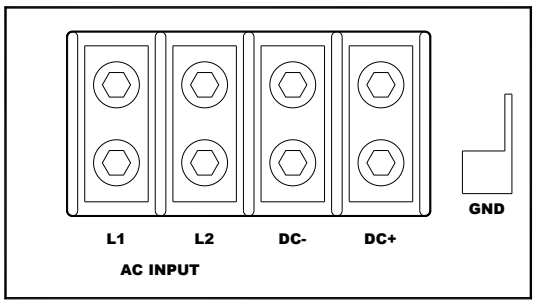
Table 3-3: Power Connection Specifications - 50HP Unit - K7Chassis

VOLTAGE RATING	TEMINALS	ELECTRICAL RATING	CONNECTIONS PER PHASE / LEG	WIRE SIZE MINIMUM	WIRE SIZE MAXIMUM	TORQUE
L	L1, L2	285A	1	300 kcmil	350 kcmil	275 lb-in
	DC+, DC-	160A	1	2/0 AWG	350 kcmil	275 lb-in
	GND		1	4 AWG	2/0 AWG	
H	L1, L2	185A	1	3/0 AWG	350 kcmil	275 lb-in
	DC+, DC-	90A	1	3 AWG	350 kcmil	275 lb-in
	GND		1	6 AWG	2/0 AWG	

Figure 3-4: 50HP Customer Power Connections

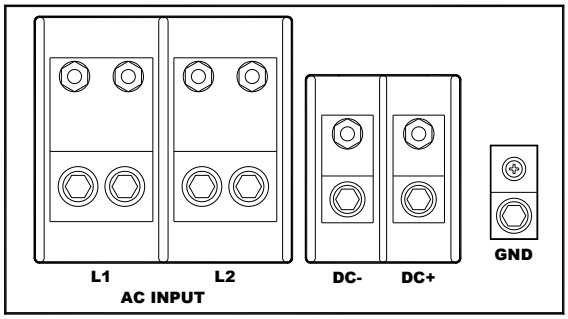


L050 & H050

Table 3-4: Power Connection Specifications – 75HP Unit – K12 Chassis

VOLTAGE RATING	TEMINALS	ELECTRICAL RATING	CONNECTIONS PER PHASE / LEG	WIRE SIZE MINIMUM	WIRE SIZE MAXIMUM	TORQUE
L	L1, L2	420A	2	4/0 AWG	350 kcmil	375 lb-in
	DC+, DC-	230A	1	4/0 AWG	350 kcmil	275 lb-in
	GND		1	1 AWG	250 kcmil	
H	L1, L2	250A	2	1 AWG	350 kcmil	375 lb-in
	DC+, DC-	135A	1	1/0 AWG	350 kcmil	275 lb-in
	GND		1	4 AWG	250 kcmil	

Figure 3-5: 75HP Customer Power Connections

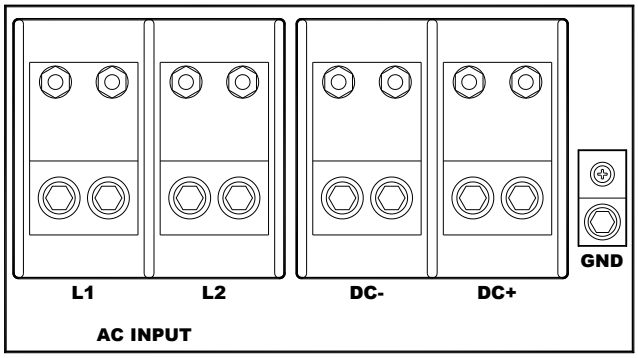


L075 & H075

Table 3-5: Power Connection Specifications - 125HP Unit – K14 Chassis

VOLTAGE RATING	TEMINALS	ELECTRICAL RATING	CONNECTIONS PER PHASE / LEG	WIRE SIZE MINIMUM	WIRE SIZE MAXIMUM	TORQUE
L	L1, L2	670A	2	400 kcmil	500 kcmil	375 lb-in
	DC+, DC-	360A	2	3/0 AWG	500 kcmil	375 lb-in
	GND		1	1/0 AWG	250 kcmil	
H	L1, L2	365A	2	3/0 AWG	500 kcmil	375 lb-in
	DC+, DC-	200A	2	3 AWG	500 kcmil	375 lb-in
	GND		1	3 AWG	250 kcmil	

Figure 3-6: 125HP Customer Power Connections



L125 & H125

Figure 3-7: Installation Instructions for Extended Conduit Access Covers

1. INSPECT CHASSIS

2A. REMOVE CONDUIT ACCESS COVER

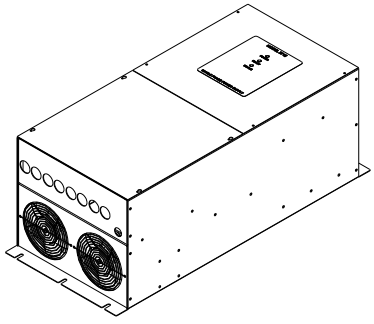
2B. REMOVE LOWER FRONT COVER

3A. INSTALL EXTENDED CONDUIT ACCESS COVER
USING (4) 8-32 X 3/8" SCREWS PROVIDED
DO NOT TIGHTEN YET

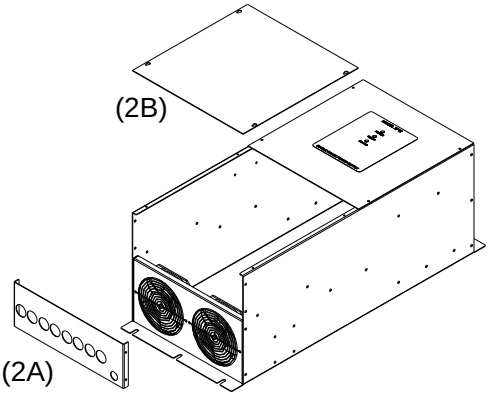
3B. INSTALL EXTENDED LOWER FRONT COVER
USING (6) 6-32 X 3/8" SCREWS PROVIDED
TIGHTEN ALL SCREWS

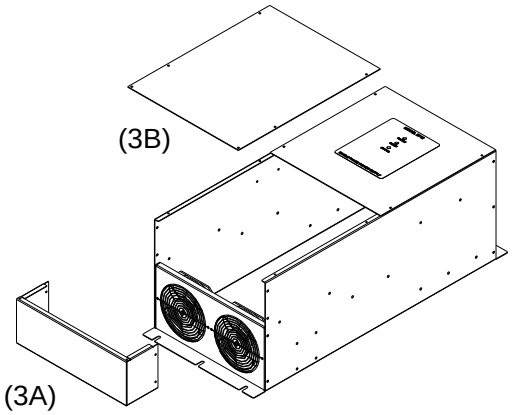
4. COMPLETE

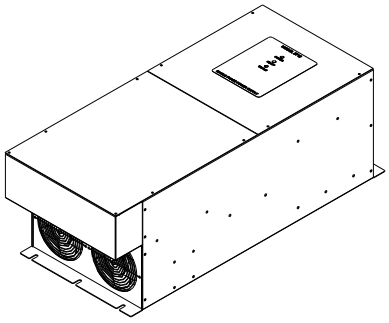
CHASSIS TYPE	REMOVE		INSTALL	
	COVER	CONDUIT	COVER	CONDUIT
K7	080187	080183	090309	090310
K12	080275	080269	090329	090328
K14	080346	090108	090331	090332



(1) INITIAL ASSEMBLY WITHOUT CONDUIT ACCESS OPTION







(4) FINISHED ASSEMBLY WITH CONDUIT ACCESS OPTION

3.4.1.1. MAIN AC INPUT

ATTENTION!

When operating this unit with generator, verify the generator is properly sized for required load. The generator may slow down when the drive is precharged and running at full load.

The AC input should be connected to a single phase source following the typical guidelines used when sizing for an inverter. Refer to the chart in Section 6.1 for guidance in conducting and overcurrent protection sizing.

Install the reactor provided with the M3712 (if supplied).

Reactors **"MUST"** be installed when using parallel power supplies.

Refer to the Application Notes in Section 7 for more information on input impedance.

3.4.1.2. OUTPUT TO VFD

"DC–" and "DC+" should be connected to the DC bus terminals of the VFD respectively. Ensure the polarity of the connection is correct, as this can cause severe damage to the drive. Refer to your drive manual for the exact location of this connection.

This link should be fused in accordance with the drive manufacturer's recommendations. If the M3712 is installed in the same cabinet as the VFD, DC link fusing may not be necessary. Semiconductor fuses such as the A70Q or FWP are recommended for this purpose.

It is usually not necessary to attach AC power to the drive. Refer to your drive manual for more information.

Do not connect the output of the M3712 to the braking terminals of the drive. This can also cause severe damage to the drive.

3.4.1.3. CONTROL VOLTAGE

TB1-1&2 "Control Voltage" should be connected to the line side of the reactor used with the Main AC input. Ensure that the phasing is correct and consistent with the Main AC input phasing, as shown in Fig 3-4. If the input phases are switched, the unit will not operate. Control wires should be routed away from power wiring to keep interference down.

3.4.1.4. GROUNDING CONSIDERATIONS

Using the ground stud provided, ground the chassis in accordance with local codes. Typically, the wire gauge will be the same as is used to ground the attached drive.

Refer to your local codes and standards for installation guidelines.

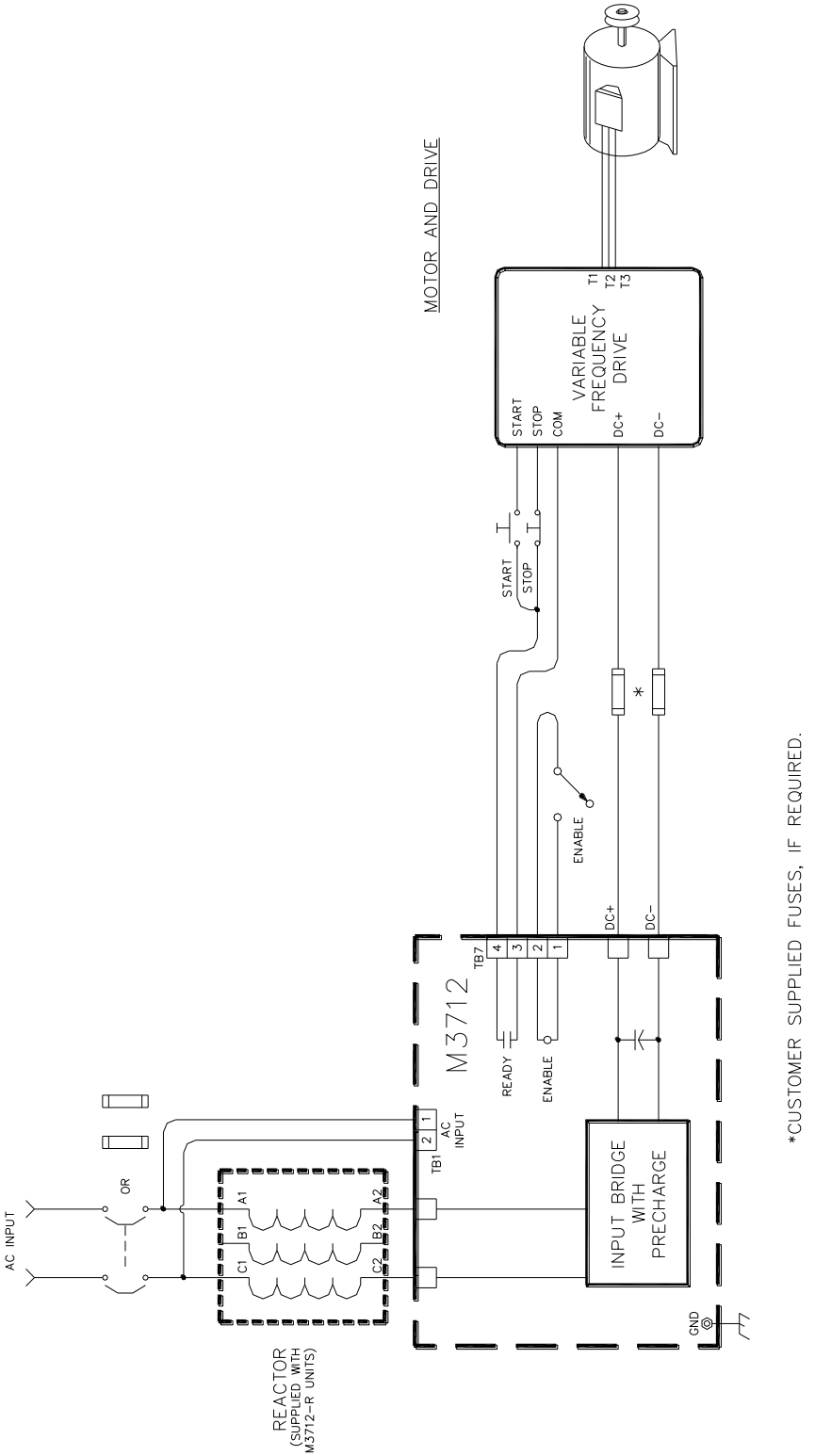
3.4.2. I/O WIRING

Table 3-7: I/O Wiring Specifications

TERMINAL	FUNCTION	ELECTRICAL SPECIFICATIONS	MIN WIRE AWG	MAX WIRE AWG	TORQUE LB-IN
TB1-1	Control Voltage L1	240V – 0.3A 480V – 0.16A	16	10	4.5 lb-in
TB1-2	Control Voltage L2	240V – 0.3A 480V – 0.16A	16	10	4.5 lb-in
TB7-1&2	Enable Input	Dry Contact (24V, 100mA)	18	12	4.5 lb-in
TB7-3&4	Ready Output	250VAC / 120mA max	18	12	4.5 lb-in

3.5. TYPICAL CONFIGURATIONS

Figure 3-8: M3712 Single Phase Power Supply Field Wiring Diagram



4. OPERATION

4.1. FUNCTIONAL DESCRIPTION

The M3712 single phase power supply uses an SCR bridge with phase control to provide DC voltage for 3-phase VFDs. These supplies may be used as common bus supplies for multiple drives and inverters.

4.1.1. I/O – INPUTS AND OUTPUTS

4.1.1.1. TB7-1&2 ENABLE INPUT

Closing the contact between TB7-1&2 will enable the unit for normal operation. These inputs are isolated so they may be interfaced with PLC or external switch.

Once the contact is closed, the unit will ramp the voltage to the maximum in approximately 0.5 seconds in order to precharge the bus capacitance. If the current during this ramp exceeds the current limit, the ramp will take longer. See Section 5.3.3.1 for details on setting this limit.

If the precharge sequence takes longer than 5 seconds, the unit will stop precharging.

If the Enable input is left open, unit will remain in standby.

4.1.1.2. TB7-3&4 READY CONTACTS

The ready contacts will close when the unit has completed precharging, and the unit is ready to operate at full capacity. The drive should not be started until the ready contacts close.

4.1.2. EXTERNAL INDICATORS

The unit has indicators in the front panel that will show basic status information for the supply.

4.1.2.1. POWER

The Power indicator on the front of the unit will be illuminated when control power is applied to the bridge.

4.1.2.2. READY (30HP AND ABOVE)

The Ready indicator illuminates when the unit has power applied and is ready to operate.

When the Enable input is activated, the indicator will be flashing during the precharge portion of operation.

When the unit is done precharging, this indicator will be solid, and the Ready contact will close.

4.1.2.3. STATUS INDICATOR

The Status Indicator illuminates when there is a fault active in the unit. When this indicator is on, the Ready contact will open, and the unit will not supply power to the VFD.

The blink sequence will indicate the specific fault.

Table 4-1: Blink Patterns

BLINK PATTERN	FAULT CONDITION
On – Off	Ramp Limit
On – On – Off	Overcurrent
On – On – On – Off	Over temperature
On – On – On – On - Off	Undervoltage
On – On – On – On – On - Off	Overvoltage*
On – On – On – On – On – On - Off	Logic Voltage*

*Only present on 15HP units.

4.1.2.3.1. RAMP LIMIT

When the Ready Indicator is flashing, this indicates that the unit is in the precharge ramp, but has not reached a sufficient output voltage level to go into full conduction. The ramp will continue for five seconds, and then the unit will go into a Ramp Limit fault. This indicates that the unit was unable to precharge the load.

This fault is reset on power down, or when the “Enable” input is removed.

See Troubleshooting in Section 5 for further assistance.

4.1.2.3.2. OVERCURRENT

If there is a sustained current demand over 200% of the units rated current output, the unit will shut down.

Do not use this fault as a substitute for circuit overcurrent protection. Fuses or circuit breakers should be installed in accordance with local codes and regulations.

This fault is reset on power down, or when the “Enable” input is removed.

4.1.2.3.3. OVERTEMP

This indicates that the unit’s heatsink has exceeded 160°F. The unit will shut down and the fault will not reset until the heatsink cools.

Once the unit cools, the fault can be reset on power down, or when the “Enable” input is removed.

4.1.2.3.4. UNDERVOLTAGE

If the unit goes through the precharge cycle and the output voltage is not high enough, this fault can indicate a problem with either the input voltage or a hookup problem. See Troubleshooting in Section 5 for further assistance.

4.1.2.3.5. OVERVOLTAGE(15HP ONLY)

This fault happens if the DC bus voltage rises to an abnormal level. On L class units that is approximately 400 VDC. On H class units that level is approximately 800VDC. This is a non-latching fault and will reset when the voltage lowers back down to approximately 390 VDC on L class or 780 VDC on H class units.

4.1.2.3.6. LOGIC UNDERVOLTAGE(15 HP ONLY)

This fault indicates that the voltage on the control board has dropped too low to function. This is a latching fault and once the condition has been cleared, the fault can be cleared by toggling the enable, or power cycling the unit.

4.1.3. INTERNAL INDICATORS (30HP AND ABOVE)

These indicators are located on the circuit board under the front cover of the unit. Use extreme caution if operating the unit with the cover removed, as hazardous voltages exist within the unit.

4.1.3.1. POWER

This indicator operates like the front panel power indicator, and shows that the system has power.

4.1.3.2. FRQ

This indicates the unit was able to lock onto the line frequency of the system.

4.1.3.3. ENABLED

This indicates that the system has been enabled through the “Enable” input described in section 4.1.1.

4.1.3.4. READY

This operates like the front panel ready indicator and shows that the system has gone through the precharge startup, and is ready for the attached VFD to start.

4.1.3.5. RAMP LIMIT

This indicates that the unit is enabled and in the precharge ramp at current limit. If the unit can precharge to a sufficient voltage, this indicator will go out and the ready light will come on.

4.1.3.6. OVERCURRENT FAULT

This indicates the unit had a sustained high current that made the unit shut down.

4.1.3.7. OVERCURRENT

The overload feature will activate if the unit encounters currents greater than 200% for a sustained period. This will allow the unit to protect against overcurrent conditions and/or power quality issues that may be present.

Note – This should not be used as an overcurrent protection device, the unit should be installed with appropriate fusing and/or circuit breakers.

When activated the IOC LED will be lit and the ready contacts will open. This is a latching fault that may only be cleared by toggling the Enable input or cycling power.

4.1.3.8. OVERTEMP

This indicates that the heatsink temperature of the unit has gone high enough to shut the unit down.

4.1.4. CONTROL FEATURES

4.1.4.1. RAMP LIMIT

The Ramp Limit feature is selectable by placing J5 in the “ON” position on the control board. See Figure 5-1 for the location of this jumper.

When Ramp Limit is selected, the unit will limit the charging current feeding the DC Output to approximately 20% of the full load current.

If J5 is in the “OFF” position the unit will charge the DC Output up to the 200% Overload limit. The “R Limit” LED will be lit when the unit is in current limit and will be ignored upon reaching the normal operating voltage.

DO NOT CHANGE THE POSITION OF THIS JUMPER WITH THE UNIT POWERED UP.

4.1.4.2. OVERTEMP

The Overtemp fault will activate upon the heatsink temperature exceeding 160° F. This is not a latching fault and unit will return to normal operation once the heatsink returns to a normal temperature.

4.2. STARTUP

This section covers basic checks and procedures that may be used when performing a startup with an M3712.

4.2.1. PRE-POWER CHECKS

- Ensure that all connections are tight and that all wiring is of the proper size and rating for operation.
- Verify continuity of all input fuses.
- Ensure that the polarity of the DC link to the attached drive is correct.
- Check for exposed conductors that may lead to inadvertent contact.
- Check for any debris, shavings, trimmings, etc that may cause shorts or obstruct ventilation on unit.
- Perform the pre-power checks required for the attached drive.

4.2.2. STARTUP PROCEDURE AND CHECKS

- After completing pre-checks and recommended checks for connected equipment, you may apply power to the system.
- The Power indicator on the front panel should illuminate.
- Close the contact on the Enable input.
- The Ready indicator should begin flashing during the precharge ramp.
- Once Precharge is complete, the Ready indicator should stay on solid, and the Ready contacts will close.
- The attached drive should then be started up according to its instructions.

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5. MAINTENANCE AND TROUBLESHOOTING

Repairs or modifications to this equipment are to be performed by Bonitron approved personnel only. Any repair or modification to this equipment by personnel not approved by Bonitron will void any warranty remaining on this unit.

5.1. PERIODIC TESTING

There are no requirements for periodic testing of these units. When performing routine maintenance it may be beneficial to repeat start-up procedures and checks.

5.2. MAINTENANCE ITEMS

Check periodically for debris, clear as necessary. Buildup can cause short circuits and dangerous conditions.

Reduced airflow can cause nuisance tripping and overheating.

Power should not be applied when blowing dust and debris out of unit.

5.3. TROUBLESHOOTING

WARNING!

This unit contains substantial capacitance and can maintain lethal voltages for a long time after power is removed! Ensure that the DC bus level has dropped below 40VDC before attempting to work on or with this unit!

ATTENTION!

Only qualified personnel familiar with adjustable frequency AC drives and associated machinery should plan or implement the installation, start-up, and subsequent maintenance of the system. Failure to comply may result in personal injury, death, and/or equipment damage!

5.3.1. POWER INDICATOR IS NOT ON

- Check AC input voltage at TB1 terminals 1 and 2. This voltage should be the same as the system voltage for the unit, either 240VAC for L units or 480VAC for H units.
- The control voltage also must be the same phase as the input voltages L1 and L2. Check that the line side of the reactor of L1 is connected to TB1-1 and the line side of the reactor of L2 is connected to TB1-2. See Section 3.5.
- If there is voltage at these terminals, and the Power indicator is not on, the unit may be damaged, and need repair. Contact your supplier or Bonitron for assistance.

5.3.2. ATTACHED DRIVE DOES NOT COME ON

- If the Power Indicator is on, make sure the enable input is activated by closing a contact between TB7 1 and 2 with either a switch or jumper.
- The Ready indicator should begin to flash, or come on solid.
- If the Ready indicator does not flash or come on solid, then check the connection to the Enable Input.
- If the Ready indicator comes on solid, check the connections between the M3712 and the attached drive. If there are fuses in the link, make sure they are not blown.

- If the Ready indicator does not come on solid, continue troubleshooting below.

5.3.3. READY INDICATOR FLASHES AND THEN THE STATUS INDICATOR COMES ON

Check the blink codes listed in Table 4-1 for the specific fault indicated.

5.3.3.1. RAMP LIMIT

Ramp Limit occurs when the unit is unable to precharge the output within 5 seconds. The input ramp current limit is factory set to 20% of the output rating of the unit. This is usually sufficient to precharge any attached load. If it is not, this can indicate one of the following:

1. The drive exceeds the ratings of the M3712.
2. The drive is already under enabled and loaded.
3. The drive may have a large capacitor bank.
4. The wiring may be faulty between the drive and M3712.

Follow these steps to try to determine the problem:

- Power down the unit and check the wiring thoroughly to make sure there are no faulty connections or shorts between the drive and the M3712.
- Ensure that the drive is not enabled or started during precharge. One way to ensure this is to use the “Ready” contact in the start/stop string of the drive’s control input.
- Check the DC Bus voltage during precharge. If the voltage rises during the precharge sequence, make sure the M3712 unit is rated for the drive attached.
- If you have checked the system sizing and the connection, it is possible to increase the current limit. USE EXTREME CAUTION when doing this, as this can lead to an overcurrent condition in the drive. Do not change the position of this jumper with the drive powered up. Do not change the position of this jumper if you think the drive may be damaged. See Section 4 for further details.

5.3.3.2. OVERCURRENT

If there is a sustained current demand over 200% of the unit’s rated current output, the unit will shut down.

Do not use this fault as a substitute for circuit overcurrent protection. Fuses or circuit breakers should be installed in accordance with local codes and regulations.

This fault is reset on power down, or when the “Enable” input is removed.

- Power down the unit and check the wiring thoroughly to make sure there are no faulty connections or shorts between the drive and the M3712.
- Enable the unit and check the current during operation.
- If the fault reappears, make sure the M3712 unit is rated for the drive attached. If so, there may be an issue with the attached drive.

5.3.3.3. OVERTEMPERATURE

This indicates that the unit’s heatsink has exceeded 160°F. The unit will shut down and the fault will not reset until the heatsink cools.

Once the unit cools, the fault can be reset on power down, or when the "Enable" input is removed.

5.3.3.4. UNDERVOLTAGE

This indicates the output DC voltage has dropped to a level insufficient to continue operation. If this occurs on the first start-up, verify the AC input phasing of the control voltage L1, L2 is going to the control board terminals TB1-1 and TB1-2 respectively. TB1-1&2 are *phase sensitive*.

- TB1-1 must be connected to the line side of the reactor for L1.
- TB1-2 must be connected to the line side of the reactor for L2. See Section 3.5.

When the AC input is reversed the unit will not ramp correctly and after brief delay will indicate this type fault. If this is on an existing application monitor the DC bus voltage and the AC input voltage. Verify that the source voltage is not being reduced too much when applying loading.

See Section 7.2 for additional information.

Figure 5-1: 3712C1 Board Layout (30HP and Up)

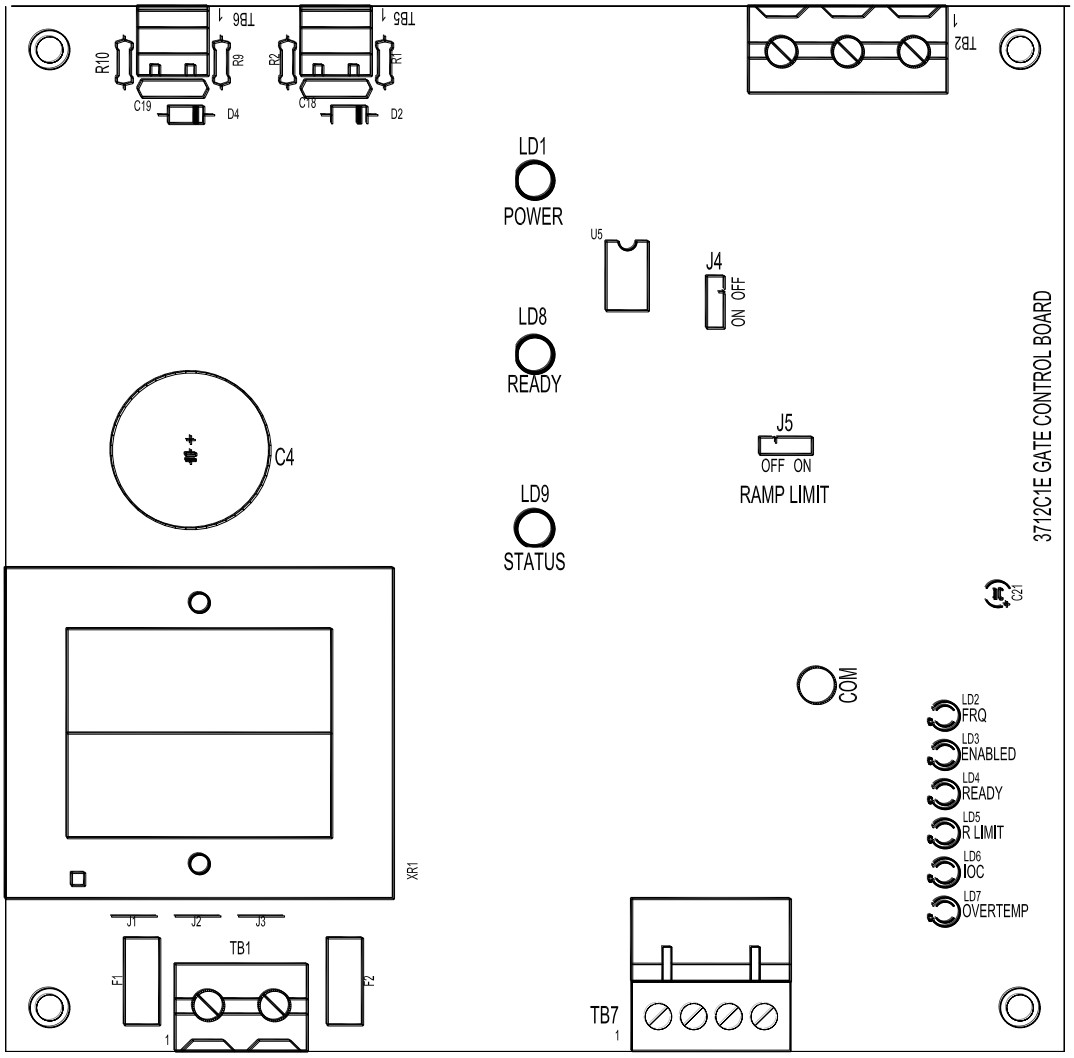
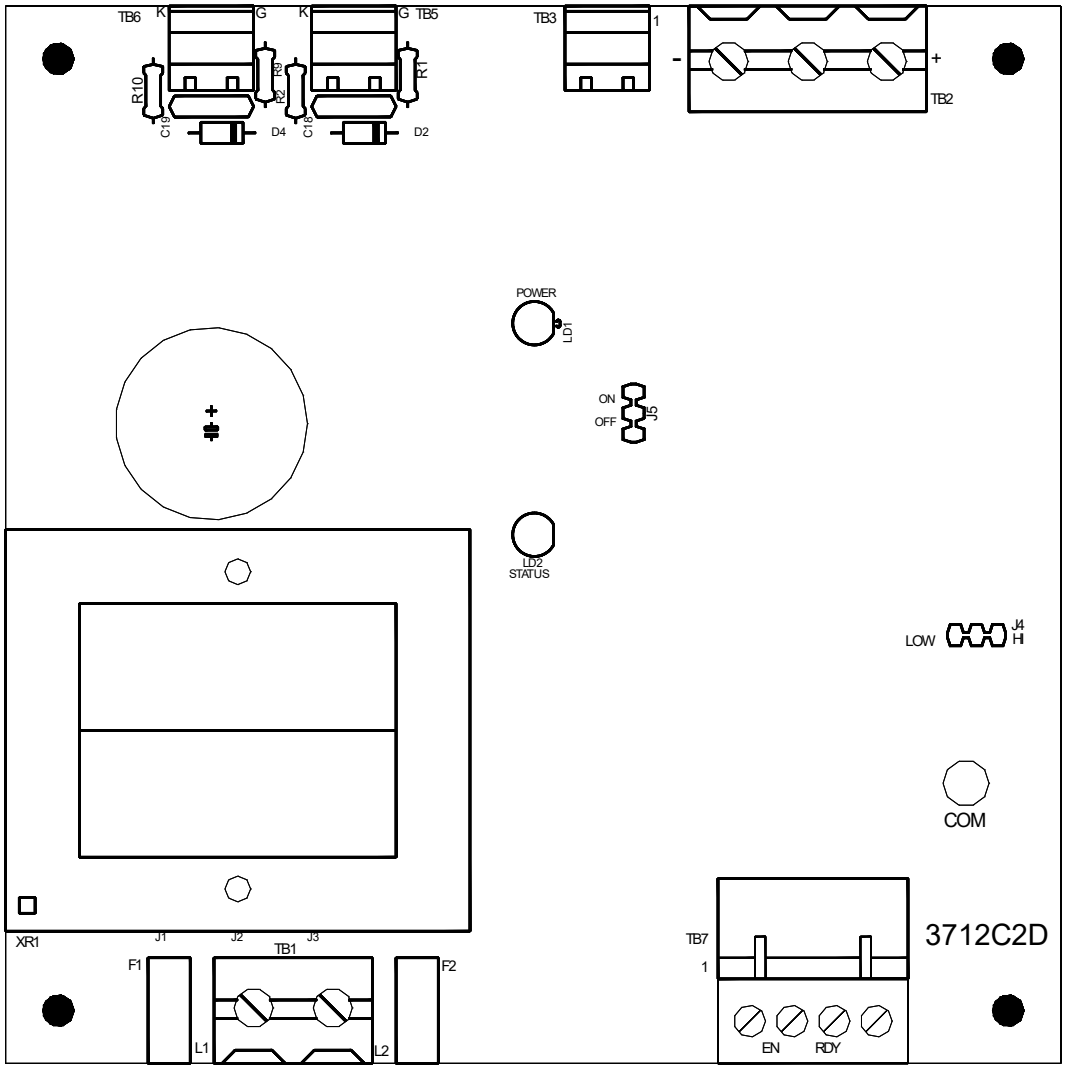


Figure 5-2: 3712C2 Board Layout (15HP)



5.4. TECHNICAL HELP – BEFORE YOU CALL

If technical help is required, please have the following information when calling:

- Model number of unit
- Serial number of unit
- Name of original equipment supplier (if available)
- Record the line voltage
- Record the DC Bus voltage immediately after the AC voltage
- Brief description of the application
- Drive and motor HP or kW
- kVA rating of power source
- Source configuration and grounding

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6. ENGINEERING DATA

6.1. RATINGS CHARTS

Table 6-1: Ratings Chart

MODEL NUMBER	SYSTEM VOLTAGE	NOMINAL DRIVE HP	MAXIMUM INPUT CURRENT (AC RMS) (1)	INPUT FUSE SIZE (CLASS J)	OUTPUT CURRENT (DC AVG)	DC LINK FUSES (SEMICONDUCTOR TYPE)
M3712-L015	240VAC	15	87 Amps	100	50 Amps	70
M3712-L030		30	175 Amps	175	100 Amps	150
M3712-L050		50	285 Amps	300	160 Amps	200
M3712-L075		75	550 Amps	600	290 Amps	350
M3712-L125		125	670 Amps	700	360 Amps	400
M3712-H015	480 VAC	15	58 Amps	70	28 Amps	30
M3712-H030		30	115 Amps	125	55 Amps	60
M3712-H050		50	185 Amps	200	90 Amps	100
M3712-H075		75	250 Amps	250	135 Amps	150
M3712-H125		125	365 Amps	400	200 Amps	225

(1) AC Input currents are dependent on source impedance and are listed here only as a guideline.

Table 6-2: Control Power Fuse Ratings

INPUT VOLTAGE	RECCOMENDED FUSE
240 VAC	FNQ-1/4
480 VAC	FNQ-1/8

Table 6-3: Reactor Specifications Chart

BONITRON MODEL NUMBER	INTERNAL CAPACITANCE	BONITRON REACTOR NUMBER	REACTOR INDUCTANCE	HARMONIC FILTERS
M3712-L015	4800 µF	IN RL-08001	200 µH	MSG0073A
M3712-L030	9400 µF	IN RL-13001	100 µH	MSG0140A
M3712-L050	18800 µF	IN RL-20001	55 µH	MSG0225A
M3712-L075	28200 µF	IN RL-32001	40 µH	MSG0430A
M3712-L125	56400 µF	IN RL-50001	25 µH	MSG0540A
M3712-H015	1200 µF	IN RL-04502	700 µH	MSG0047D
M3712-H030	2350 µF	IN RL-08001	200 µH	MSG0090D
M3712-H050	4700 µF	IN RL-13002	200 µH	MSG0165D
M3712-H075	7050 µF	IN RL-20002	110 µH	MSG0215D
M3712-H125	14100 µF	IN RL-25002	90 µH	MSG0310D

6.2. UL 508A SHORT CIRCUIT CURRENT RATINGS

The M3712 power supplies with power ratings of 30HP, 50HP, 75HP, and 125HP are listed under UL508C, file number E204386.The M3712 power supply is suitable for use on a circuit capable of delivering no more than 100 kA RMS symmetrical amperes at the drive supply voltage when protected by the recommended fuses.

6.3. WATT LOSS

Table 6-4 lists the maximum Watt Loss generated by the listed units. When installing M3712 units in an additional enclosure, consideration should be given to internal temperature rise. The Watt Loss rating in following table is based upon the maximum capability of each unit.

Table 6-4: Full Load Watt Loss

MODEL NUMBER	FULL LOAD OF POWER SUPPLY	REACTOR LOSS
M3712-L015	210 W	82 W
M3712-L030	550 W	108 W
M3712-L050	840 W	124 W
M3712-L075	1500 W	224 W
M3712-L125	1875 W	266 W
M3712-H015	150 W	62 W
M3712-H030	340 W	82 W
M3712-H050	440 W	180 W
M3712-H075	850 W	168 W
M3712-H125	1100 W	231 W

Applications that do not utilize the full capacity may be calculated as follows:

$$\text{Watt Loss} = \text{Full Load Watt Loss} * \left(\text{Average hp} / \text{Rated Horsepower} \right)$$

6.4. DIMENSIONS AND OUTLINES

Table 6-5: Chassis Dimensions

MODEL NUMBER	CHX	OVERALL (INCHES)				MOUNTING (INCHES)		WEIGHT (LBS.)
		HEIGHT WITH C[2]	HEIGHT W/OUT C[2]	WIDTH	DEPTH	HEIGHT	WIDTH	
M3712-L015	T6	16	15	6.20	7.3	15	4	13
M3712-L030	K7	21	20	7.12	10.3	19.25	5	30
M3712-L050	K7	21	20	7.12	10.3	19.25	5	35
M3712-L075	K12	25.25	24	12	12	23	9	45
M3712-L125	K14	34.1	32.1	14	12.2	31	5.5 [1]	90
M3712-H015	T6	16	15	6.2	7.3	15	4	13
M3712-H030	K7	21	20	7.12	10.3	19.25	5	30
M3712-H050	K7	21	20	7.12	10.3	19.25	5	35
M3712-H075	K12	25.25	24	12	12	23	9	45
M3712-H125	K14	34.1	32.1	14	12.2	31	5.5 [1]	90

[1] 3 holes with 5.5" centers – see Figure 6-5.

[2] C = Conduit Entry Box option

Table 6-6: Reactor Dimensions

(*The Reactor is mounted separately from the M3712 Module*)

BONITRON REACTOR NUMBER	FOR USE WITH	OVERALL (INCHES)			WEIGHT (LBS.)
		HEIGHT	WIDTH	DEPTH	
IN RL-08001	M3712-L015	7.2	9.0	6.3	25
IN RL-13001	M3712-L030	7.1	9.0	4.7	43
IN RL-20001	M3712-L050	7.5	9.0	7.3	38
IN RL-32001	M3712-L075	9.0	10.8	8.3	84
IN RL-50001	M3712-L125	9.0	10.8	10.5	93
IN RL-04502	M3712-H015	7.4	9.0	4.7	41
IN RL-08001	M3712-H030	7.2	9.0	6.3	25
IN RL-13002	M3712-H050	7.2	9.0	6.8	43
IN RL-20002	M3712-H075	7.5	9.0	8.3	54
IN RL-25002	M3712-H125	8.5	10.8	9.0	80

Figure 6-1: M3712 T6 Chassis Dimensional Outline for 15HP Unit

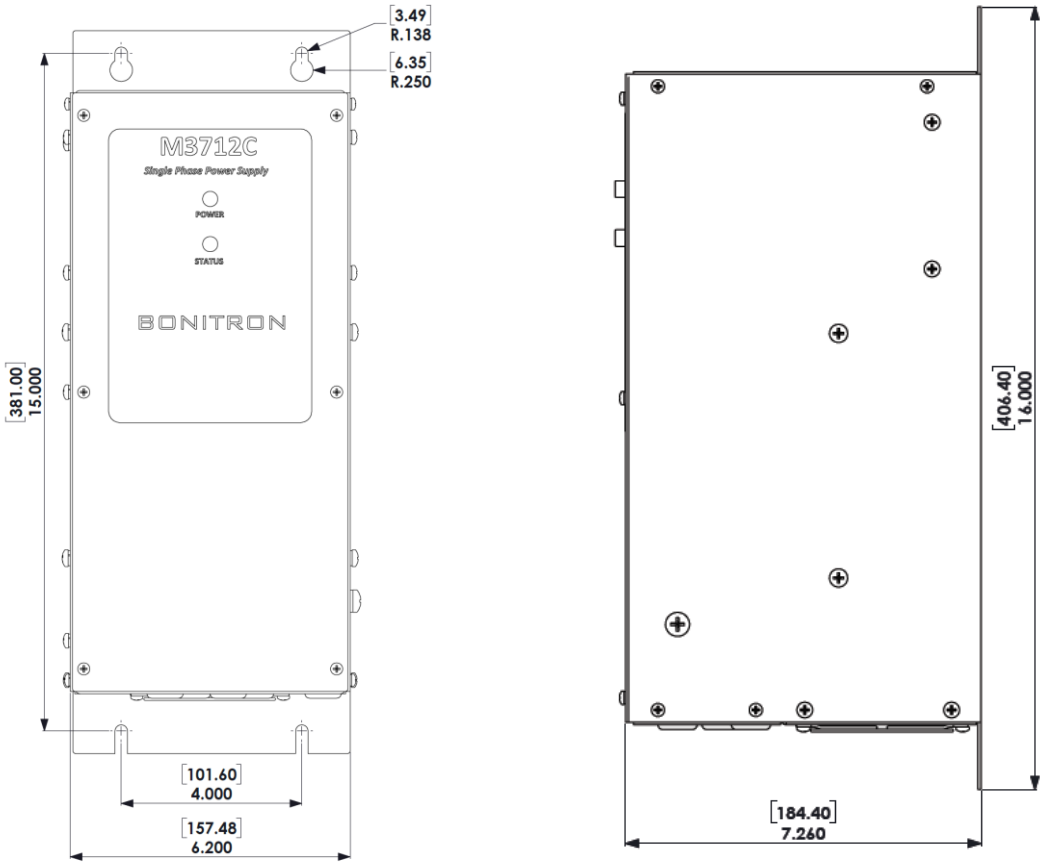


Figure 6-2: M3712 K7 Chassis Dimensional Outline for 30HP and 50HP Unit

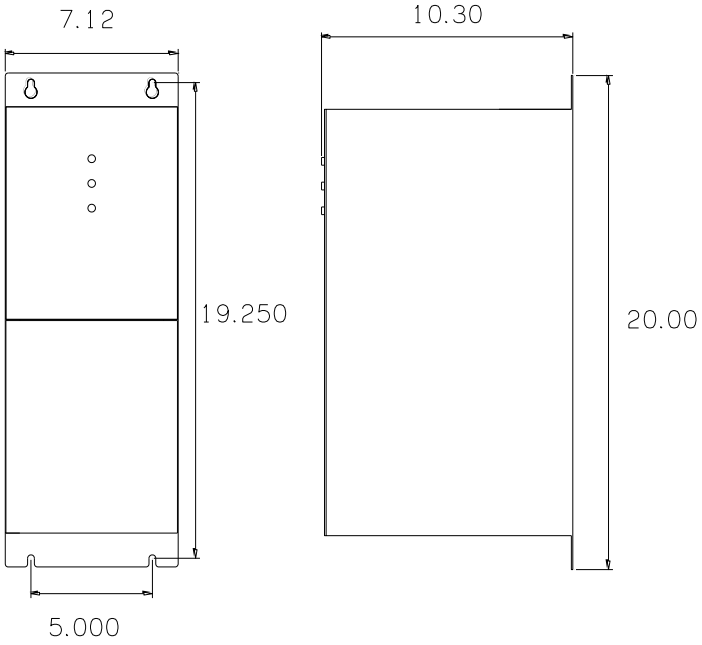


Figure 6-3: M3712 K7 Chassis Dimensional Outline C Option for 30HP and 50HP Unit

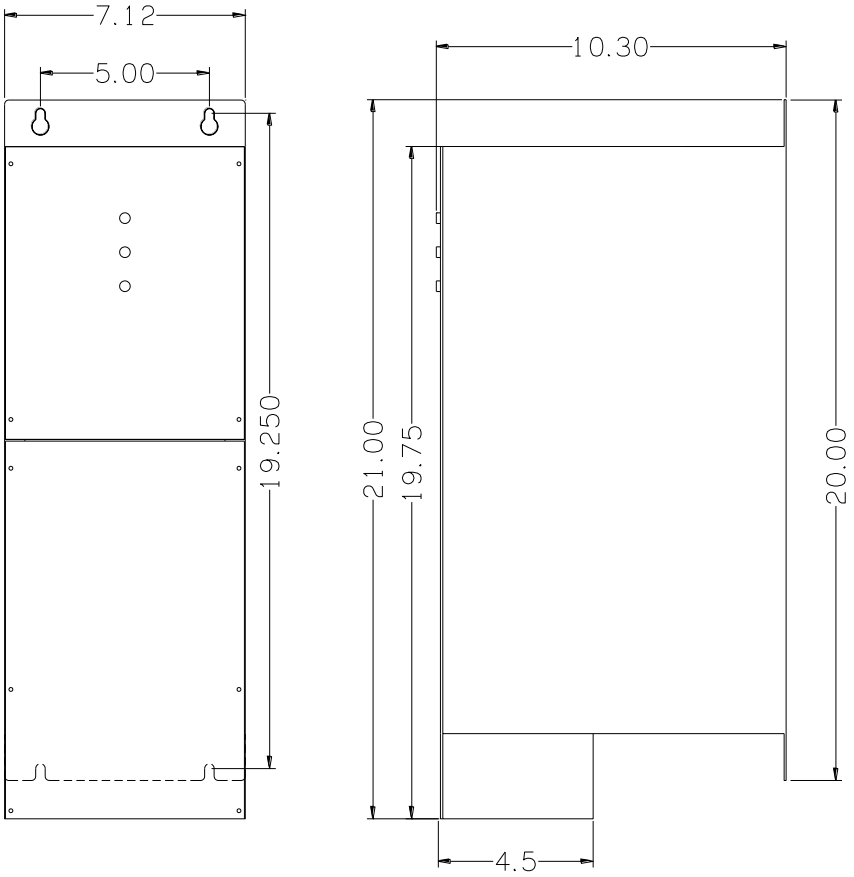


Figure 6-4: M3712 K12 Chassis Dimensional Outline for 75HP Unit

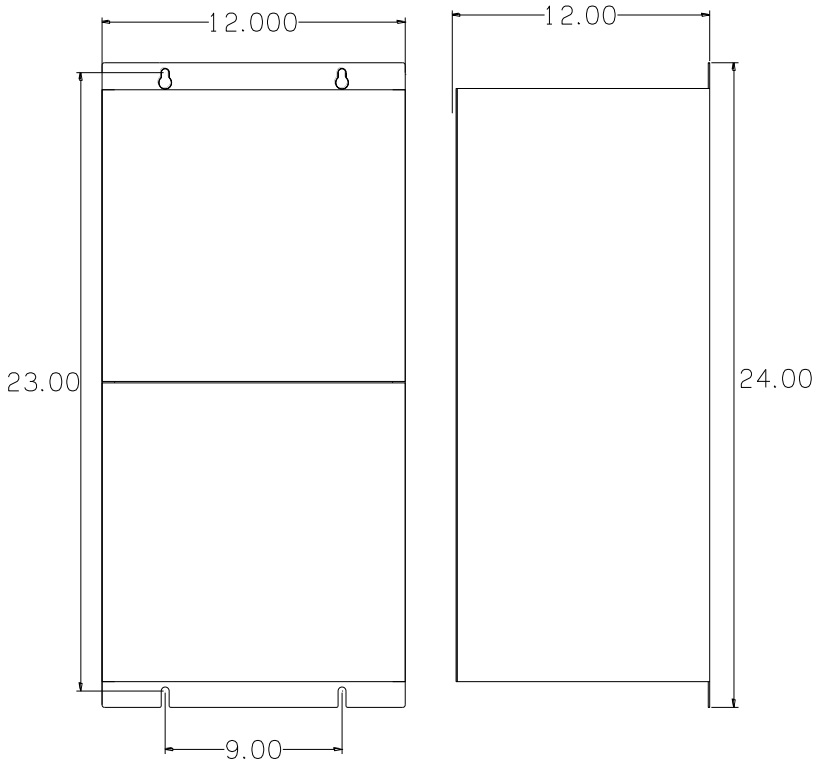


Figure 6-5: M3712 K12 Chassis Dimensional Outline C Option for 75HP Unit

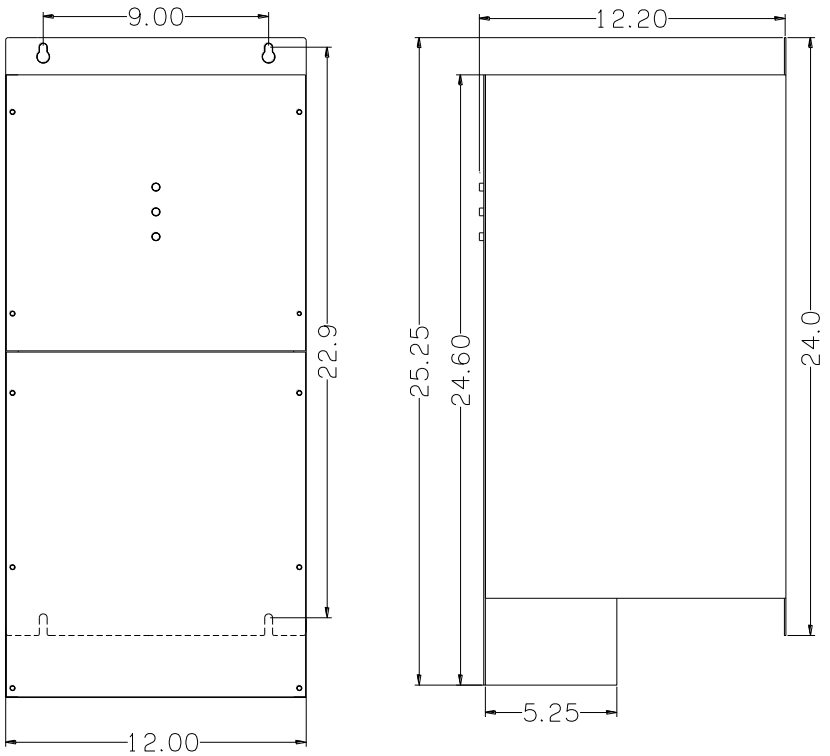


Figure 6-6: M3712 K14 Chassis Dimensional Outline for 125HP Unit

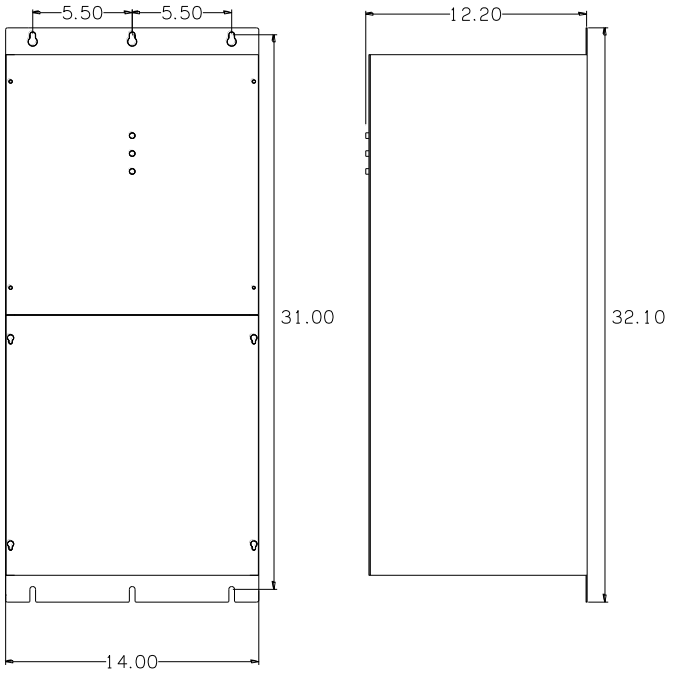
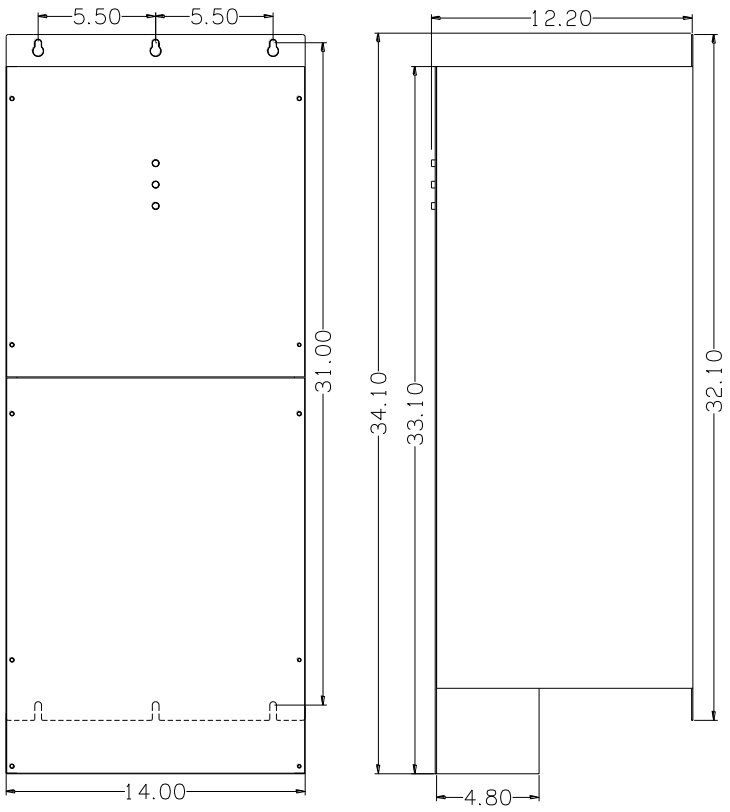
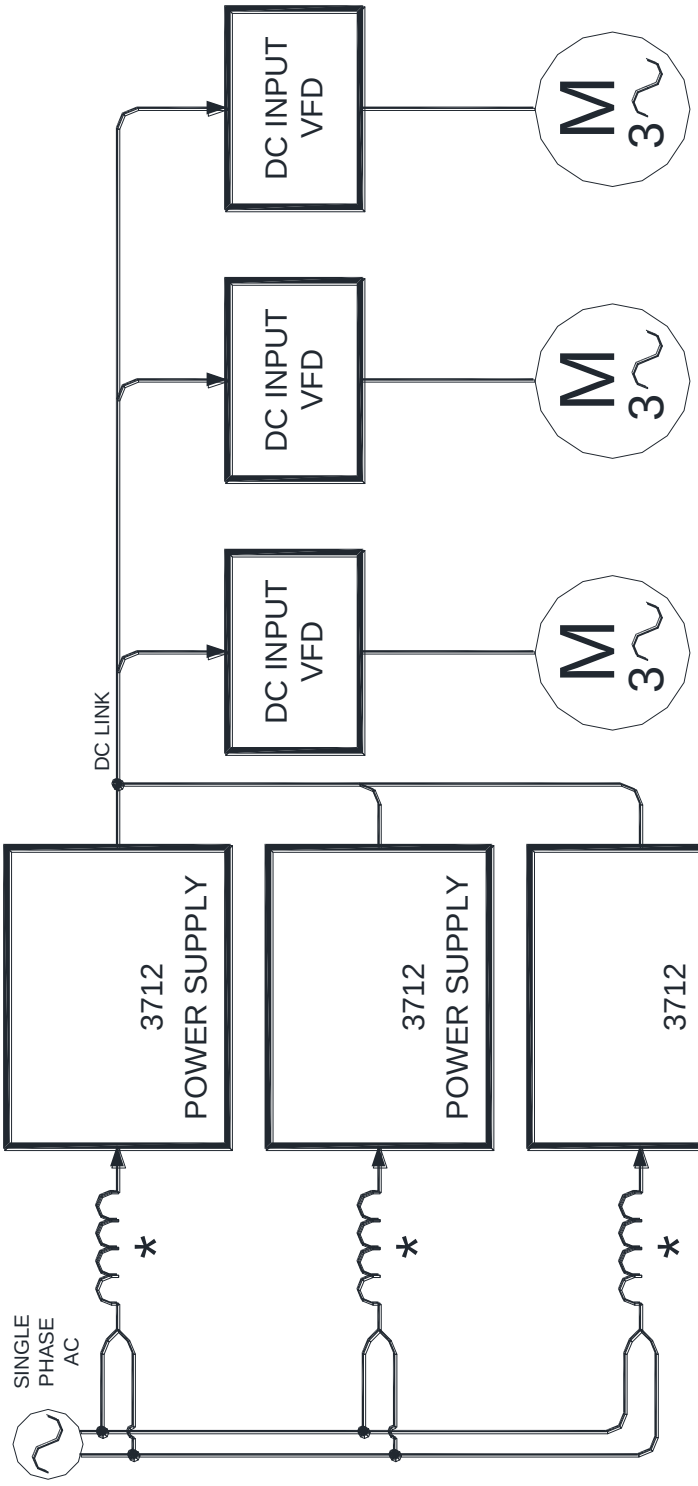


Figure 6-7: M3712 K14 Chassis Dimensional Outline C option for 125HP Unit



6.5. BLOCK DIAGRAMS

Figure 6-8: Functional Block Diagram



DC BUS POWER SUPPLY BLOCK DIAGRAM

* OPTIONAL FOR SINGLE UNITS
MANDATORY FOR PARALLEL UNITS

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7. APPLICATION NOTES

7.1. APPLICATION CONSIDERATIONS

The M3712 is a single phase DC power supply and does not supply 3-phase AC power. There are some issues that should be considered when designing the complete system.

7.1.1. DRIVES

Most Variable Frequency AC Drives are suitable for use with the M3712. Check the manual of the drive you are using, or call the technical support line for the drive manufacturer if you have questions on this hookup.
Some things to consider are listed below.

7.1.1.1. DC CONNECTION

The majority of variable frequency AC drives have DC bus connection terminals. These terminals allow the drive to be connected in a variety of configurations. The M3712 provides filtered DC voltage to the drive through these connections. The M3712 provides precharge for the DC output to the drive. See section 3.5 for typical configurations.

In general, the hookup can be described as a common bus input.

7.1.1.2. DRIVES UNABLE TO BE POWERED FROM DC BUS

Due to connection points and certain topologies some drives may not be compatible with external DC supplies. The following drives do not support external DC supplies. Please consult drive manufacturer for details and support.

- Allen Bradley Powerflex 4 series.
- Allen Bradley Powerflex 400-E frame.

7.1.1.3. AC INPUT LOSS DETECTION

Some variable frequency AC drives incorporate AC input line sensing that cause a fault in the drive when the AC input lines are not in use.

If the drive has phase loss detection, you can usually bypass this fault to allow the system to run without the AC input being connected.

7.1.1.4. 3-PHASE LOADS

A few large frame AC drives have 3-phase blower motors integral to the drive. If this is the case, the blower will not operate when the drive is powered from the M3712. This can cause overheating and drive faults or failure.

Some packaged drives may also have other 3-phase loads in the cabinets such as fans or power supplies.

If you have a drive that has an integral 3-phase motor, consult your drive manufacturer for a possible solution. One may be to install a small inverter or drive to power the 3-phase loads from the output of the M3712.

7.1.2. SINGLE PHASE CONTROLS

Make sure that AC power is attached to portions of the control circuit that require AC. You will need to consult your design or schematics to ensure all controls are powered.

If single phase loads have been distributed across the 3-phases, they will need to be rewired to allow them to operate from two connections.

7.2. SYSTEM VOLTAGE AND SOURCE IMPEDANCE

The M3712 is intended to be used with an input reactor for the reduction of peak currents and bus ripple. The reactor adds inductive impedance to the circuit to reduce these factors.

Other sources of inductive impedance in your installation are the main incoming transformer and the conductors to that transformer. If the total input impedance is too high, it will cause low voltage at the AC inputs of the M3712. This is referred to as a "soft" source. If the source is too "soft" this will result in the DC bus voltage of the drive being lower. When the DC bus falls too low, the motor can lose power or run hotter than usual. If the DC bus falls low enough, the drive will trip and not operate the motor. This typically is shown as an Undervoltage fault on the drive.

7.2.1. TRANSFORMERS

Transformers are rated in kVA and percent impedance. In order to see what kVA your system needs, you can roughly multiply the horsepower by 1000. Your transformer should be rated higher than this. In other words, a 50 horsepower system would require at least a 50kVA transformer.

If the transformer has 5% impedance, the voltage drop to the output of the transformer at full load will be 5%. For instance, a transformer with 5% impedance and an open terminal voltage of 480VAC can have only 456VAC at the terminals at full load.

If the transformer is much larger than the required kVA, or has a low percent impedance, the source is considered to be "stiff." A "stiff" source may cause high charging currents, high input harmonics, and system overheating.

If the source impedance is too high to the input of the M3712 can drop to the point where the DC bus of the drive will be out of specifications. When the DC bus falls too low, the motor can lose power or run hotter than usual. If the DC bus falls low enough, the drive will trip and not operate the motor. This typically is shown as an Undervoltage fault on the drive.

7.2.2. REACTORS

7.2.2.1. USE IN PARALLEL CONFIGURATIONS

Input reactors "**MUST**" be installed when using multiple units in parallel.
A minimum of 3% impedance should be used. To ensure good sharing between units, each M3712 must be derated 10% the combined power supply capacity. For instance, an M3712-H050 used in parallel will result in the normally 90A rated output being derated to 81A. Using three M3712-H050 power supplies in parallel will have a derated output of 243A.

7.2.2.2. REACTOR IMPEDANCE

There are situations where the existing system impedance may be high enough that the input reactor may be bypassed. The following steps will help determine if you should bypass the reactor.

- Measure the AC voltage at the input to the reactor (transformer side) with the unit disabled or turned off. If the AC voltage is lower than 95% of the nominal value, the transformer taps should be adjusted to raise the incoming voltage. If the AC voltage is between nominal and 110% continue to the next step.
- Enable the power supply and check the voltage at the output of the reactor (M3712 side) while the system is running at full power. If the AC voltage drops to below 90% of the nominal value, check the DC bus voltage of the drive, and make sure it is well within the operating range of the drive's specifications.
- Check the voltage at the input of the reactor (transformer side). If the voltage stays above 90% of the nominal voltage, you can operate your system without the reactor. If the voltage drops below 90% of the nominal voltage, you may need to upsize your input transformer or get a transformer with lower impedance for proper operation.

7.3. HARMONICS

The M3712 has a four diode bridge and as a result the system will have the same harmonic content as a VFD with a standard 6-pulse bridge is operating from a single phase power source. The harmonics for the system can be quite high compared to an equivalent three phase input.
If harmonics are a concern with your system, be aware of the specific requirements to have a system comply with IEEE 519. The Point of Common Coupling (PCC) is the point at which the Total Harmonic Distortion (THD) should be measured. The PCC is typically on the primary of the transformer on the utility side of the customer's service connection.
The supply impedance will have a significant impact on the THD of the input current. Placing a line reactor in the system will help to improve the harmonic content that is placed back on the line. If a specific harmonic content level is required, a single phase harmonic filter may be required.

NOTES

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