BONITRON

Solutions for AC Drives

Model ASM 3612EC

Bulk Drive Filter Capacitor Assemblies

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.

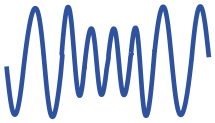
The Bonitron engineering team has the background and expertise necessary to design, develop, and manufacture the quality industrial electronic systems demanded in today's market. A strong academic background supported by continuing education is complemented by many years of hands-on field experience. 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

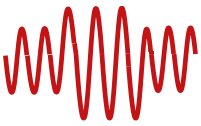
In 1975, Bonitron began working with AC inverter drive specialists at synthetic fiber plants to develop speed control systems that could be interfaced with their plant process computers. Ever since, Bonitron has developed AC drive options that solve application issues associated with modern AC variable 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

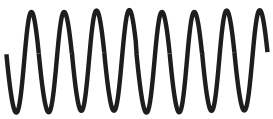
Braking Transistors
Braking Resistors
Transistor/Resistor Combo
Line Regeneration
Dynamic Braking for Servo Drives

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 ASM 3612EC Capacitor Assembly. It will provide you with the necessary information to successfully utilize the ASM 3612EC 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

Formatting changes and drawing updates added in Rev 00b.

Formatting changes and drawing updates added in Rev 00c

Capacitor information updated in Rev 00d

Part number breakdown was updated in Rev 00e.

Update to the manual template in Rev 00f.

BR4 chassis was added and update to Section 6.2 in Rev 00g.

Update made to the BR2A chassis in Rev 00h.

Figure 1-1: Typical ASM 3612EC Capacitor Assembly

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2. PRODUCT DESCRIPTION

The ASM 3612EC is a filter capacitor assembly for a common DC bus drive systems. The drives can be either servo or variable frequency drives intended for use with common bus capacitors. This can be used on system that may need extra filter capacitance for reduced DC bus ripple, energy savings or AC line sag tolerance.

2.1. RELATED PRODUCTS

2.1.1. COMMON BUS POWER SUPPLIES

- M3712 Single Phase Power Supply
  - Power 3-Phase drives via the DC bus from a single-phase source without de-rating the drive
- M3713SC 3-Phase Power Supply with Pre-charge
  - Six pulse Diode Bridge with pre-charge that can serve as the main power supply for common DC bus systems.
  - Multiples can be used to serve as 12 or 18 pulse building blocks.

2.1.2. COMMON BUS FILTERING

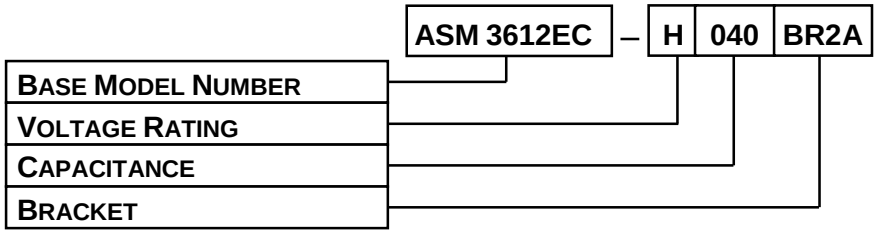
- M3612RC Common Bus Snubber
  - High frequency filter that limits spikes and ringing in DC bus systems caused by inverter switching, supply noise, bus reactance, and other such sources.

2.1.3. BRAKING AND OVERVOLTAGE PROTECTION

- M3452 and M3575T Modules add resistive dynamic braking to DC bus systems and VFDs.
- M3645 Modules are standalone line regeneration modules to add dynamic braking to DC bus systems and VFDs.

2.2. PART NUMBER BREAKDOWN

Figure 2-1: Example of Part Number Breakdown



BASE MODEL NUMBER

The Base Model Number for these Capacitor Assembly is **ASM 3612EC**.

VOLTAGE RATING

A 1-letter code represents the AC system voltage to the ASM 3612EC Capacitor Assembly. Select the Voltage Rating for the system voltage that will be applied.

Table 2-1: Voltage Rating

RATING CODE	SYSTEM VOLTAGE
L	240VAC
E	380VAC
H	480VAC

CAPACITANCE

A 3-digit code represents the nominal capacitance of the unit. The capacitance is found by multiplying the code by 100µF. (Example: **040** = 4,000µF).

Table 2-2: Capacitance Ratings

RATING CODE	NOMINAL CAPACITANCE (µF)
016	1,600
040	4,000
066	6,600
100	10,000

Note - Not all capacitance ratings are available in all voltage ratings.

BRACKET

A 3 or 4-digit code represents the bracket type for the ASM 3612.

Table 2-3: Bracket Codes

BRACKET CODE	DIMENSIONS (H X W X D)
BR2A	8.20 x 10.00 x 3.80
BR3	10.75 x 11.50 x 3.90

2.3. GENERAL SPECIFICATIONS

Table 2-3: General Specifications Table

PARAMETER	SPECIFICATION
Input System Voltage	230VAC, 380VAC, 480VAC 3Ø, 60Hz
Capacitance Tolerance	± 20% (M)
Rated ripple current at +105°C, 300Hz	35A
Rated ripple current at + 45°C, 300Hz	85A
Operating Temp	-25°C to +105°C
Humidity	Below 90% non-condensing
Atmosphere	Free of corrosive gas and conductive dust

2.4. General Precautions and Safety Warnings

DANGER!

- **High voltages may be present!**
- **This assembly is constructed without protection against accidental contact!**
- **Assembly must be installed in an enclosure that prevents accindental contact by personnel or equipment!**
- **FAILURE TO HEED THESE WARNINGS MAY RESULT IN SERIOUS 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 assembly to discharge, and ensure there are less than 40VDC on the DC bus before attempting service.**
- **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 Capacitor Assemblies should be done following the steps outlined below. Be sure to refer to the AC Drive instruction manual for information on proper integration.

3.1. ENVIRONMENT

DANGER!

- **HIGH VOLTAGES MAY BE PRESENT!**
- **THIS ASSEMBLY IS CONSTRUCTED WITHOUT PROTECTION AGAINST ACCIDENTAL CONTACT!**
- **ASSEMBLY MUST BE INSTALLED IN AN ENCLOSURE THAT PREVENTS ACCINDENTAL CONTACT BY PERSONNEL OR EQUIPMENT!**
- **FAILURE TO HEED THESE WARNINGS MAY RESULT IN SERIOUS INJURY OR DEATH!**

The module should be installed in an enclosure protected from moisture falling debris and accidental contact, as.

Buildup of dust or debris may cause poor performance, arcing, and 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.

Do not use/expose capacitors to the following conditions.

- Oil, water, salty water storage in damp locations.
- Direct sunlight
- Toxic gases such as hydrogen sulfide, sulfurous acid, nitrous acid, chlorine or its compounds, and ammonium
- Ozone, ultraviolet rays or radiation
- Severe vibration or mechanical shock conditions beyond the limits prescribed in the product specification

3.2. LONG TERM STORAGE

- If these capacitors are stored for more than 10 months without applying voltage, they will need to be reformed.
- Long term storage allows the capacitors to change chemically, and the ESR will rise greatly. If the capacitors are put into service without reforming, they will quickly overheat and can fail catastrophically.
- To reform the capacitor bank, voltage must be applied to the bank in slow increments over a period of 30 to 60 minutes.
- Please consult Bonitron for this procedure, or consult the M3628PCF Portable Capacitor Former manual for more guidance.

3.3. 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.

3.4. MOUNTING

3.4.1. MOUNTING THE ASM 3612EC CAPACITOR ASSEMBLY

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.
- **Unit should be mounted** as shown in Figure 3-1.

Figure 3-1: ASM 3612EC Mounting Orientation

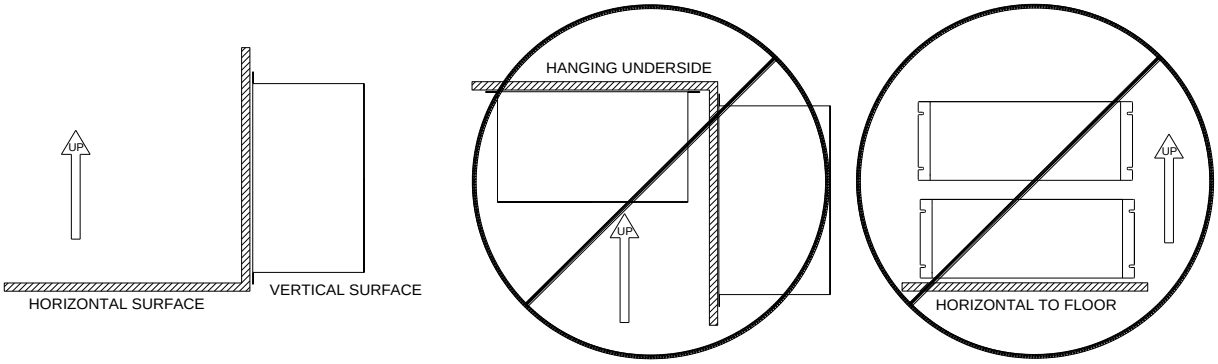


Fig A Fig B Fig C

3.5. 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.

3.5.1. 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

MODEL	TORQUE
ASM 3612EC-(any)	35.4 in-lbs (4Nm)

3.5.1.1. BUS CONNECTIONS

The outside "+" (plus) and "-"(minus) terminals should be connected in parallel to the DC bus of the common bus system. Ensure the polarity of the connection is correct, as this can cause severe damage to the capacitor assembly. Refer to your drive and power supply manuals for the exact location of this connection.

3.5.1.2. GROUNDING CONSIDERATIONS

The bracket of the assembly should be grounded either by contact with a grounded surface or with a separate wire to a mounting screw. If the mounting surface is painted, remove the paint to allow for conduction through the mounting screw.

Refer to your local codes and standards for installation guidelines.

3.5.1.3. CAPACITOR DRIVE SIZING

It's important to size the capacitor bank to the application correctly, otherwise the input RMS currents to the AC converter stage may be too high.
Likewise, the precharge must be considered to make sure that it does not overheat and fail during power up.
See section 7 for more application notes on sizing.

3.6. TYPICAL CONFIGURATIONS

Figure 3-2: ASM 3612EC Capacitor Assembly Field Wiring Diagram Option 1

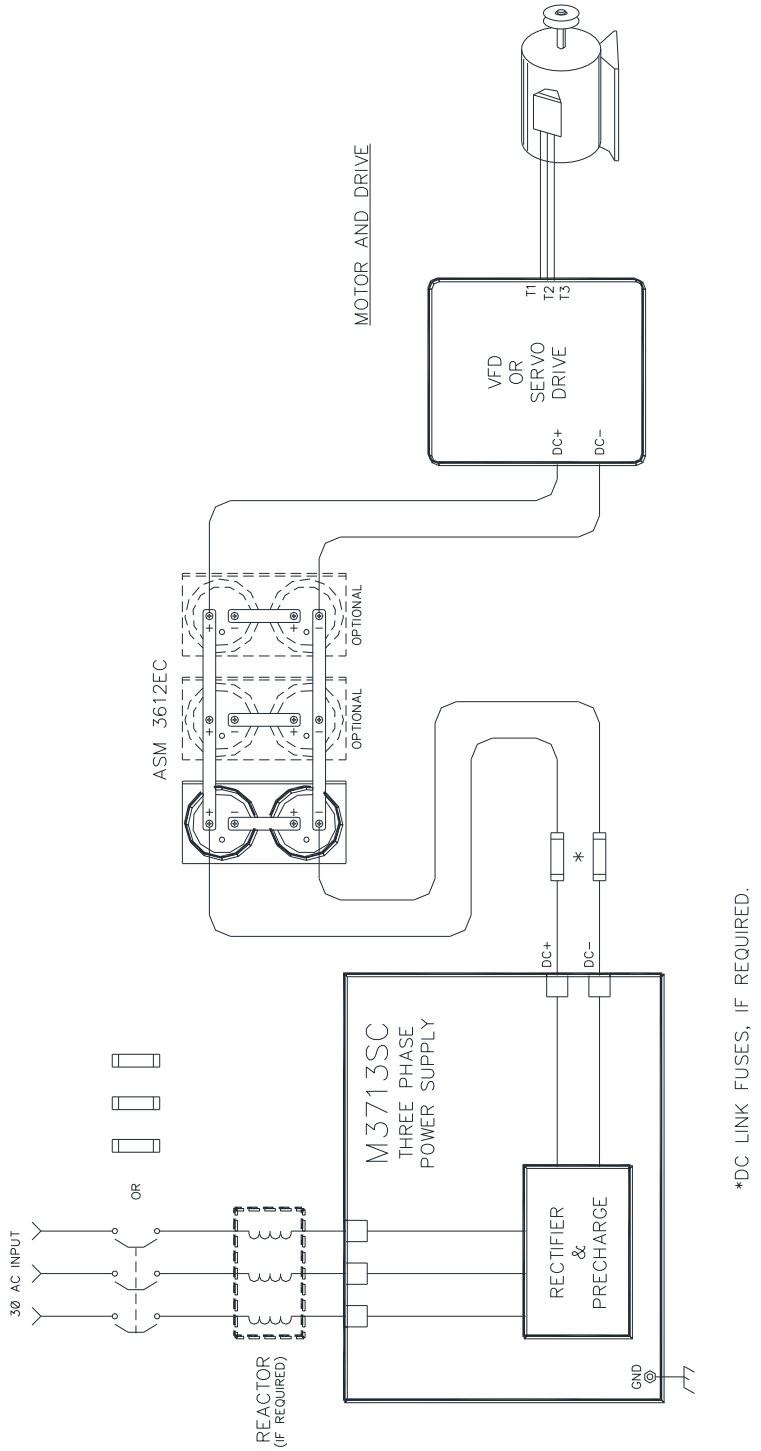
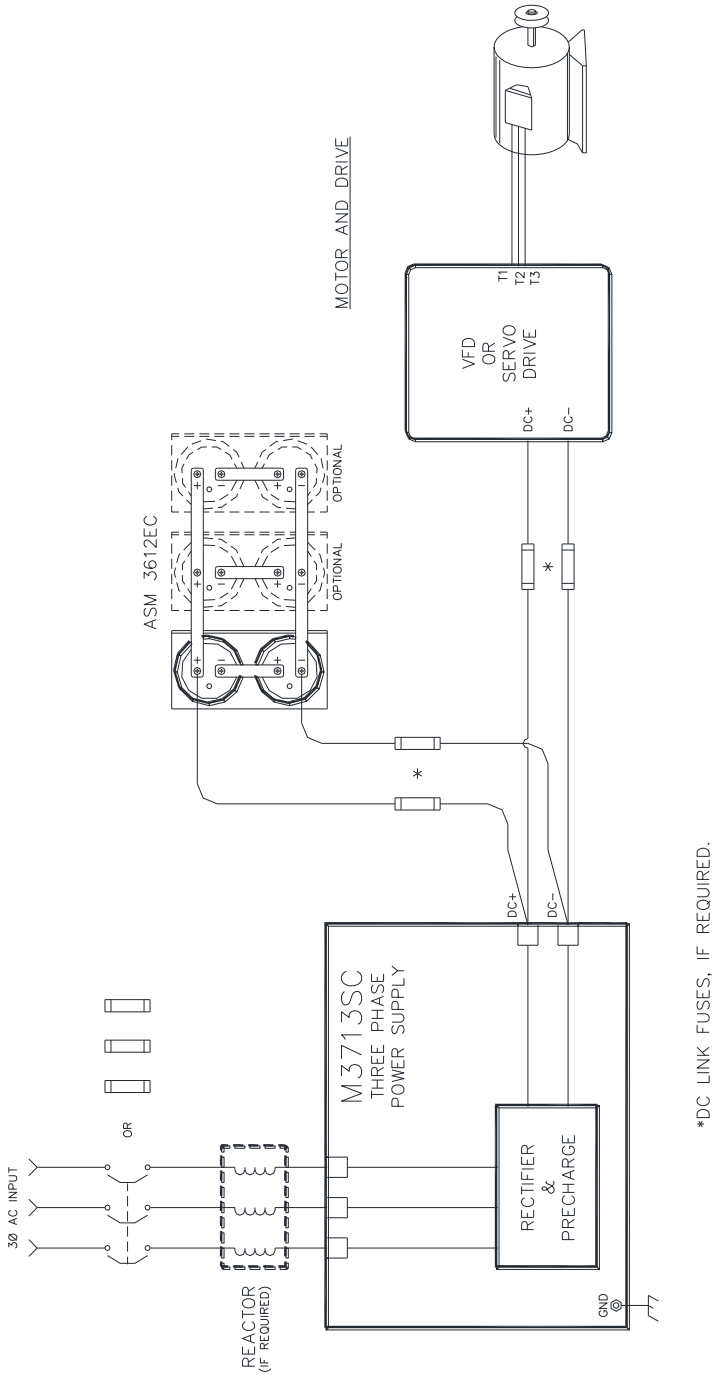


Figure 3-3: ASM 3612EC Capacitor Assembly Field Wiring Diagram Option 2



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4. OPERATION

4.1. FUNCTIONAL DESCRIPTION

The ASM 3612EC is a Capacitor Assembly with an integral bleeder resistor to build a DC bus by adding additional capacitance.

4.2. STARTUP

This section covers basic checks and procedures that may be used when performing a startup with an ASM 3612EC.

4.2.1. COMMISSIONING AFTER LONG TERM STORAGE

If these capacitors are stored for more than 10 months without applying voltage, they will need to be reformed.

Long term storage allows the capacitors to change chemically, and the ESR will rise greatly. If the capacitors are put into service without reforming, they will quickly overheat and can fail catastrophically.

To reform the capacitor bank, voltage must be applied to the bank in slow increments over a period of 30 to 60 minutes.

Please consult Bonitron for this procedure, or consult the M3628PCF Portable Capacitor Former manual for more guidance.

4.2.2. 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.

4.2.3. STARTUP PROCEDURE AND CHECKS

- After completing pre-checks and recommended checks for connected equipment, you may apply power to the system.
- Check bus voltage to make sure it is within the capacitance assembly specification.
- 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.

5.2. MAINTENANCE ITEMS

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

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

5.3. TROUBLESHOOTING

WARNING!

Capacitor assembly 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. ATTACHED DRIVE DOES NOT COME ON

- Ensure that power is applied to the input of the ASM 3612EC. Check all fuses, circuit breakers, disconnects, etc. that may interrupt power to the unit.
- Consult power supply manual for further assistance.

5.3.2. OVERHEATING

If the capacitors continually overheat during operation, you may need more capacitance. Check the bus ripple current to ensure it is within tolerance of the bank. If the unit is sized properly to the application, you may need to install an input reactor or choke. See Section 7 for guidelines.

5.3.3. BLOWN INPUT FUSES OR CIRCUIT BREAKERS

If these capacitors are stored for more than 10 months without applying voltage, they will need to be reformed.

Long term storage allows the capacitors to change chemically, and the ESR will rise greatly. If the capacitors are put into service without reforming, they will quickly overheat and can fail catastrophically.

To reform the capacitor bank, voltage must be applied to the bank in slow increments over a period of 30 to 60 minutes.

Please consult Bonitron for this procedure, or consult the M3628PCF Portable Capacitor Former manual for more guidance.

WARNING!

Blown overcurrent devices can indicate damage to the unit. Do NOT replace the input fuses and repower the unit as severe damage can occur.

Contact Bonitron Technical Support before attempting to restart the system.

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

6. ENGINEERING DATA

6.1. RATINGS

Additional Part Configurations are available upon request. Contact Bonitron for assistance.

Table 6-1: Ratings Table

MODEL NUMBER	SYSTEM VOLTAGE	MAX DC VOLTAGE	TOTAL CAPACITANCE	MAX RIPPLE CURRENT 100HZ 85°C	DC LINK FUSES (SEMICONDUCTOR TYPE)
ASM 3612EC-L066-BR2A	230 VAC	450 VDC	6,600 uF	20 A	40 A
ASM 3612EC-E100-BR3	400 VAC	800 VDC	10,000 uF	20 A	40 A
ASM 3612EC-H016-BR2A	480 VAC	900 VDC	1,600 uF	20 A	40 A
ASM 3612EC-H040-BR2A	480 VAC	900 VDC	4,000 uF	20 A	40 A
ASM 3612EC-H100-BR3	480 VAC	900 VDC	10,000 uF	20 A	40 A

6.2. WATT LOSS

Table 6-2 lists the maximum watt loss generated by the listed units. When installing M3612EC 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 6-2: Full Load Watt Loss

MODEL NUMBER	WATT LOSS
ASM 3612EC-L066-BR2A	28 W
ASM 3612EC-E100-BR3	28 W
ASM 3612EC-H016-BR2A	28 W
ASM 3612EC-H040-BR2A	28 W
ASM 3612EC-H100-BR3	28 W

6.3. DIMENSIONS AND OUTLINES

Table 6-3: Bracket Dimensions for M3612EC Module

BRACKET	OVERALL (IN INCHES)			MOUNTING (IN INCHES)	
	A HEIGHT	B WIDTH	C DEPTH	D HEIGHT	E WIDTH
BR2A	8.20	10.00	3.80	9.30	2.00
BR3	10.75	11.50	3.90	10.60	2.00

Figure 6-1: BR2A Bracket Dimensional Outline

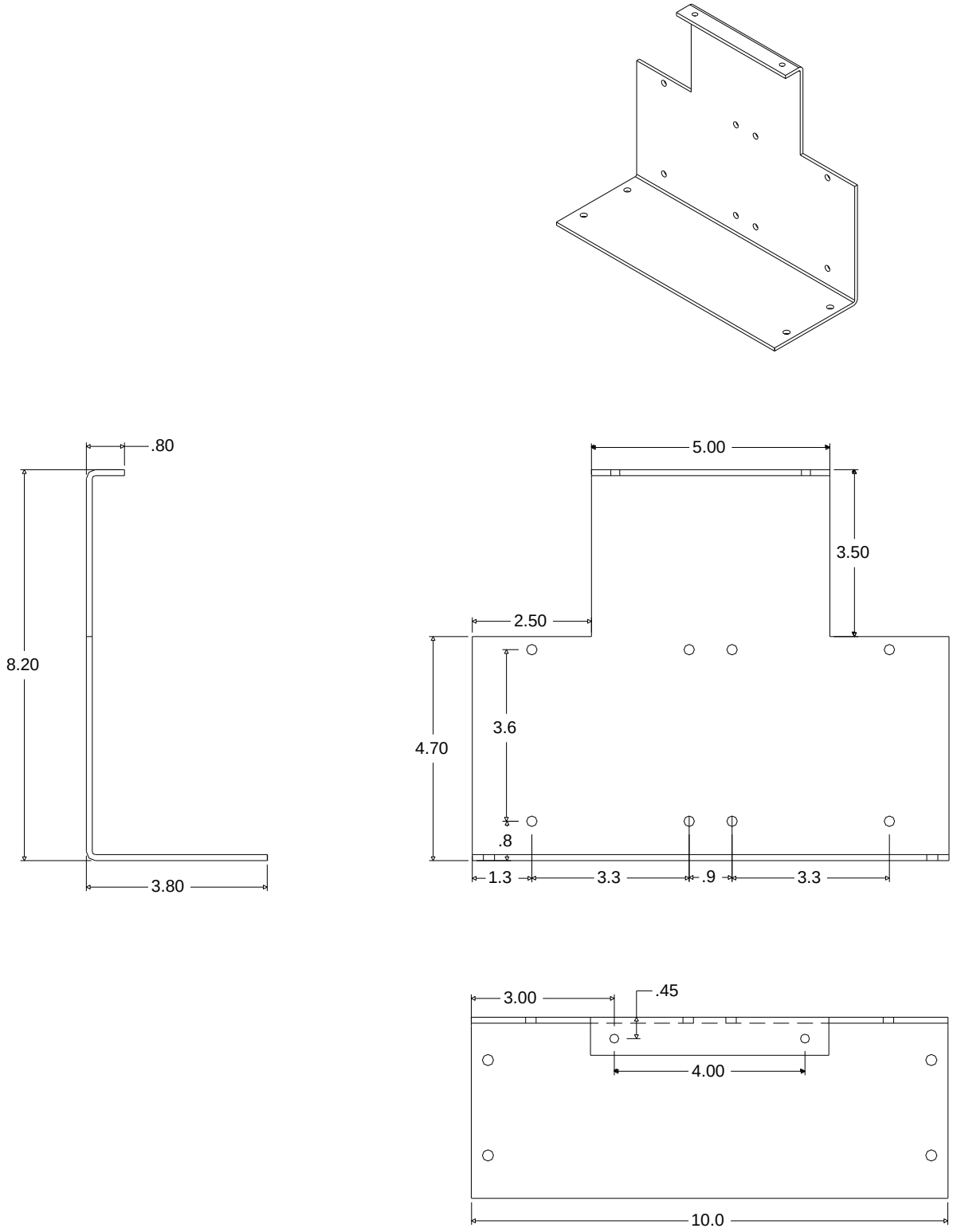
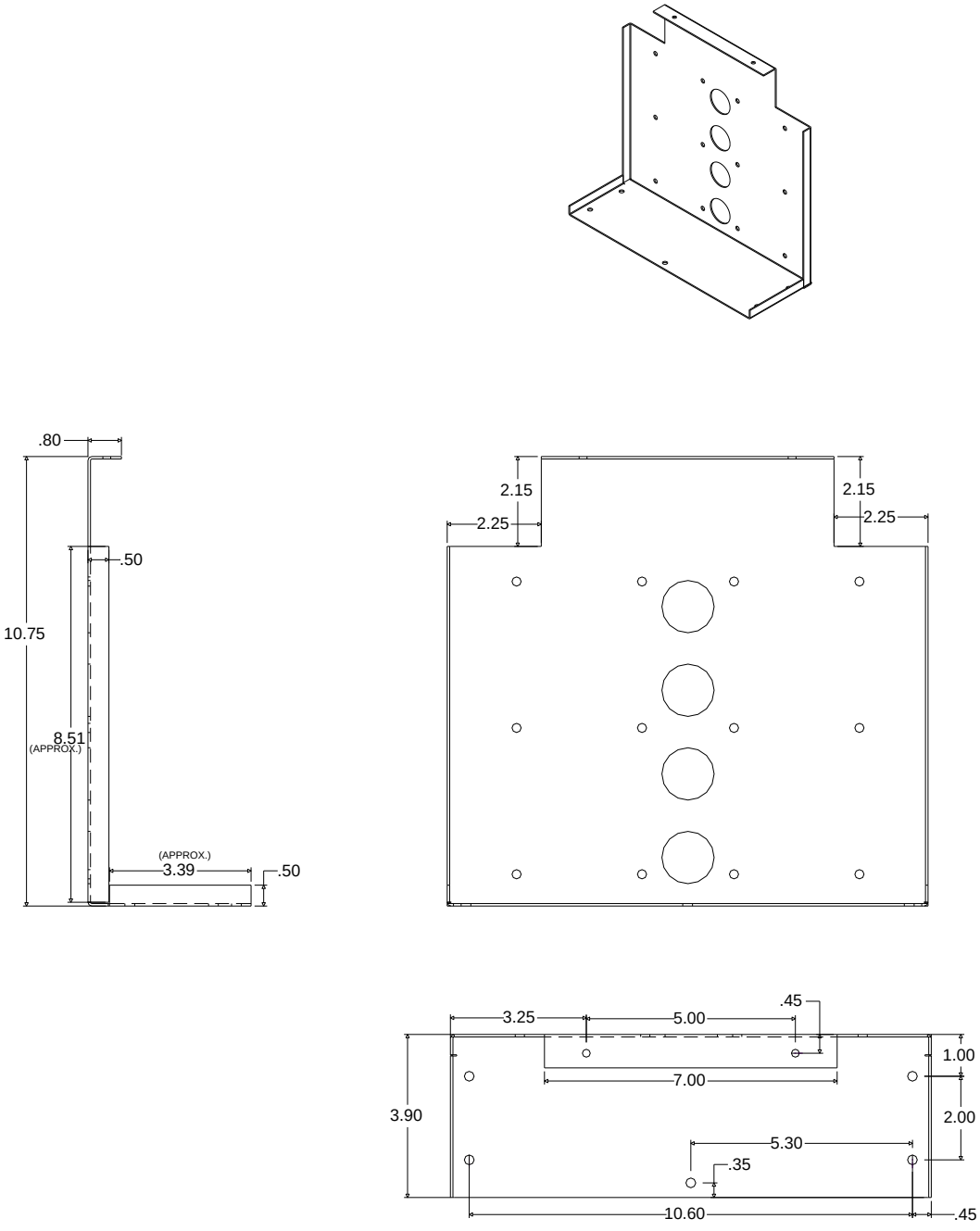
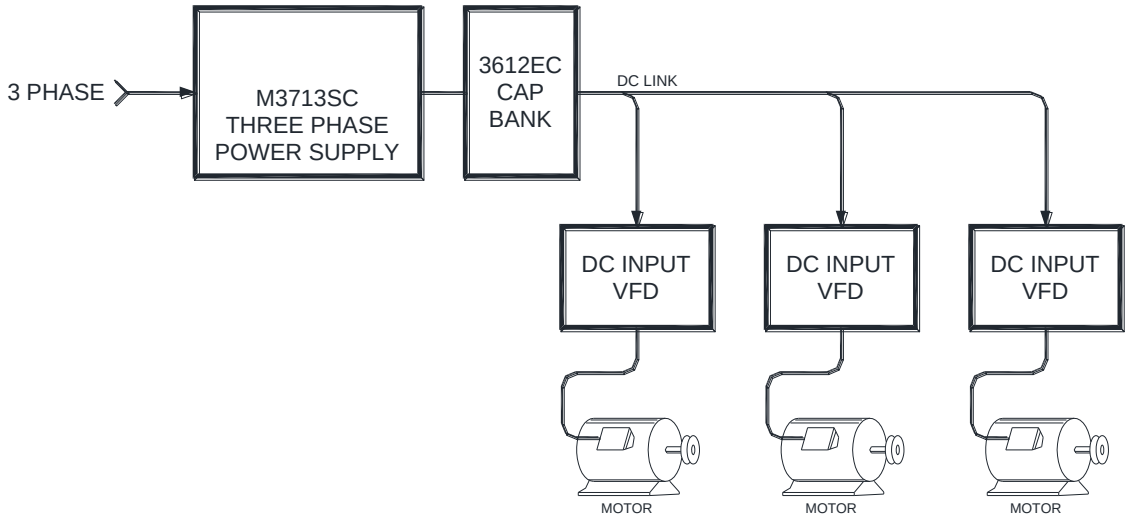


Figure 6-2: BR3 Bracket Dimensional Outline



6.4. BLOCK DIAGRAMS

Figure 6-3: Functional Block Diagram



6.5. CAPACITOR SPECIFICATIONS

Table 6-4: Capacitor Specifications Table

ITEM	CHARACTERISTICS
Operating Temperature Range	-25 to 105° C
Rated Voltage Range	350 to 450 VDC
Capacitance Range	2,200 to 15,000 µF
Capacitance Tolerance	20% (M) at 20°C,120 Hz
Leakage Current	I= 0.02*C*V (A) or 5 mA, whichever is smaller, after 5 minutes at 20° C. Where: • I=Leakage current (A), • C=Nominal capacitance (µF) and • V=Rated voltage (V)
Dissipation Factor (Tan δ)	0.15 maximum at 20°C,120 Hz
Low Temperature Characteristics	Capacitance change at 120 Hz: Capacitance at 25° C shall not be less than 70% of the specified value at 20° C
Insulation Resistance	The insulation resistance of the sleeve will measure no less than 100 MΩ with a 500 VDC potential between the mounting clamp and the sleeve. The mounting clamp shall be secured around the sleeve of the capacitor body, and the terminals shall be shorted together.
Dielectric Strength	The insulating sleeve will withstand a voltage of 2,000 VAC without electrical breakdown when the voltage is applied between the mounting clamp and the sleeve. The mounting clamp shall be secured around the sleeve of the capacitor body, and the terminals shall be shorted together.
Load Life	5000 hours The following specifications shall be satisfied when the capacitors are restored to 20° C after subjecting them to the DC rated voltage for 5,000 hours at 105° C with the rated ripple current applied. The sum of DC voltage and peak AC voltage must not exceed the full rated voltage of the capacitors. • Capacitance change: ≤ 20% of initial measured value • Tan δ (DF) : ≤ 200% of initial specified value • Leakage current : ≤ initial specified value
Shelf Life	2 years without reforming when stored at temperatures below 40º C. The following specifications shall be satisfied when the capacitors are restored to 20° C after exposing them for 1,000 hours at 105° C without voltage applied. The rated voltage shall be applied to the capacitors for a minimum of 30 minutes, at least 24 hours and not more than 48 hours, before the measurements. • Capacitance change: ≤ 20% of initial measured value • Tan δ (DF): ≤ 200% of initial specified value • Leakage current : ≤ initial specified value
Ambient Temperature Multipliers	45° C: 2.45 ; 65° C: 2.25 ; 85° C: 1.75 ; 105° C: 1.0
Ripple Current Multipliers	Frequency (Hz): 50 Hz: 0.8 ; 120 Hz: 1.0 ; 300 Hz: 1.1 ; 1 kHz: 1.3 ; 3 kHz: 1.4
Others	Satisfies characteristic B, class Y, of JIS C5141

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7. APPLICATION NOTES

7.1. DRIVES

Most variable frequency AC drives are suitable for use with the ASM 3612EC. Some things to consider are listed below.

- Check the manual for the drive you are using, or call the technical support line for the drive manufacturer if you have questions on this hookup.
- Adding large amounts of capacitance can cause the RMS input currents to exceed the input bridge rating. If the AC input RMS current is too high, they can be mitigated with input reactors or chokes. Consult your drive manual, or the specifications for the drive power supply for this specification.
- The precharge circuit of the system must also be checked to make sure it will not be overloaded on startup. Consult your drive manual, or the specifications for the drive power supply for this specification.

7.2. CAPACITOR ASSEMBLY SIZES FOR APPLICATIONS

Capacitance is used in Common DC bus systems to reduce the ripple voltage supplied by the rectifier section of the system. More capacitance will give lower ripple voltage on the DC Bus, as well as reduce the ripple current supplied by each individual capacitor.

The amount of capacitance required for any given application depends on the system loading and drive requirements. Your drive manual may offer specific amounts of capacitance required. In this case, use the amount recommended.

As a general rule of thumb, however, 40-50 uF of capacitance per amp of load should be used as a minimum.

More capacitance than this will further reduce the ripple voltage, and lead to longer system life.

7.3. CAPACITOR END OF LIFE

As the capacitor gradually deteriorates; the electrical parameters of the capacitor change. The criteria of judging the failures, vary with application and design factors.

Capacitance decreases and Tan δ increases are caused by the loss of electrolyte in the wear-out failure period. This is primarily due to loss of electrolyte by diffusion (as vapor) through the sealing material. Gas molecules can diffuse out through the material of the end seal. High temperature increase the electrolyte vapor pressure within the capacitor and the diffusion rate is therefore increased. This increases internal pressure may cause the seal to bulge caused by elevated temperatures. This bulging may accelerate diffusion and mechanically degrade the seal. Factors that can increase the capacitor temperature, such as ambient temperature and ripple current, can decrease the life of a capacitor.

7.4. CAPACITOR FAILURE MODE

The typical failure mode for non solid aluminum electrolytic capacitors is an open circuit. Overheating can cause the vent to open, and some material may be released.

If a non-solid aluminum electrolytic capacitor expels gas when venting, it will discharge odors or smoke, or burn in the case of a short-circuit failure. Immediately turn off or unplug the main power supply of the device.

When venting, a non-solid aluminum electrolytic capacitor blows out gas with a temperature of over 100°C. (A solid aluminum electrolytic capacitor discharges decomposition gas or burning gas while the outer resin case is burning.)

Never expose the face close to a venting capacitor. If your eyes should inadvertently become exposed to the spouting gas or you inhale it, immediately flush the open eyes with large amounts of water and gargle with water respectively. If electrolyte is on the skin, wash the electrolyte away from the skin with soap and plenty of water.

Do not ingest the electrolyte of non-solid aluminum electrolytic capacitors.

7.5. CAPACITOR LIFE

The nominal lifetime of a capacitor assembly under load is 5000 hours of use at 105°C.

When operated at temperatures less than 105°C, the capacitor life is increased. If the capacitors are operated within 45°C, expected lifetime is 12,000 hours.

7.6. DISPOSAL

Please consult with a local industrial waste disposal specialist when disposing of aluminum electrolytic capacitors.

NOTES

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