Model M3526DC

DC Motor Ramp Starter

Customer Reference Manual

Web: www.bonitron.com • Tel: 615-244-2825 • Email: info@bonitron.com

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 o

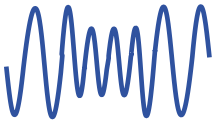
ver many competitors is combined on-site engineering labs and manufacturing facilities, which allows the engineering team to have immediate access to testing and manufacturing. This not only saves time during prototype development, but also is essential to providing only the highest quality products.

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

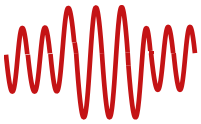
In 1975, Bonitron began working with AC inverter drive specialists at synthetic fiber plants to develop speed control systems that could be interfaced with their plant process computers. Ever since, Bonitron has developed AC drive options that solve application issues associated with modern AC variable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

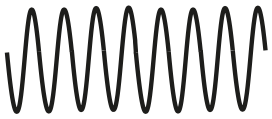
Braking Transistors
Braking Resistors
Transistor/Resistor Combo
Line Regeneration
Dynamic Braking for Servo Drives

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

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 DC motor.

Please keep this manual for future reference.

1.2. PURPOSE AND SCOPE

This manual is a user's guide for the model M3526DC-U050 DC motor ramp starter system. It provides you with the necessary information to successfully install and use the M3645 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

Initial release of the manual was revision 00.

Updated manual release was revision 01a.

Figure 1-1: Model M3526DC-U050 DC Motor Ramp Starter

1.4. SYMBOL CONVENTIONS USED IN THIS MANUAL AND ON EQUIPMENT

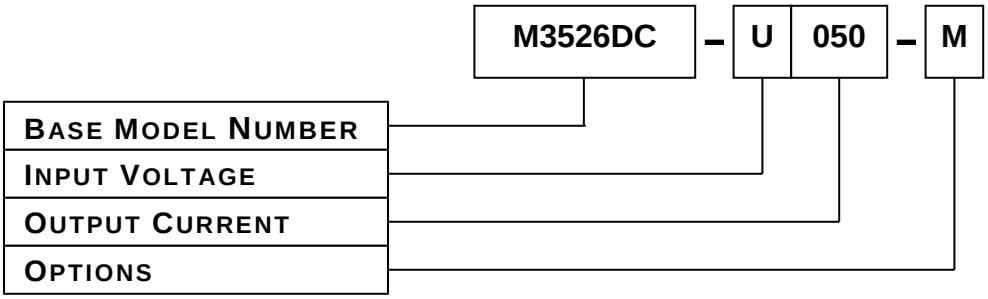
	Earth Ground or Protective Earth
	AC Voltage
	DC Voltage
 DANGER!	DANGER: Electrical hazard - Identifies a statement that indicates a shock or electrocution hazard that must be avoided.
 DANGER!	DANGER: Identifies information about practices or circumstances that can lead to personal injury or death, 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!	CAUTION: Heat or burn hazard - Identifies a statement regarding heat production or a burn hazard that should be avoided.

2. PRODUCT DESCRIPTION

The function of the model M3526DC DC motor ramp starter is to accelerate the motor smoothly, on command, from stall to full voltage and hold it at full voltage with a bypass contactor until the run command is removed.

2.1. PART NUMBER BREAKDOWN

Figure 2-1: Example of M3526DC Part Number Breakdown



BASE MODEL NUMBER

The base model number for all motor ramp starter units is **M3526DC**.

INPUT VOLTAGE RATING

A code letter represents the DC input voltage to the M3526DC. The DC motor ramp starter module will draw power from the DC bus. The See Table 2-1 for available voltage ratings.

Table 2-1: Voltage Ratings

RATING CODE	NOMINAL VOLTAGE
U	120 VDC

OUTPUT CURRENT RATING

A 3-digit number represents the maximum continuous DC current (Amps) the module can sustain.

OPTIONS

Two added options are available.

Table 2-2: Option Codes

OPTION CODE	DESCRIPTION
C	RUN command contact input, Motor Over Temperature contact input
M	Door mounted Motor Control Ammeter

2.2. GENERAL SPECIFICATIONS CHART

Table 2-3: General Specifications

PARAMETER	SPECIFICATION
DC Input Current	• 120 VDC input
Fusing	• Internally fused with FWX-100
Control Voltage	• Derived from 120 VDC inputl
LED Indicators	• Power • RUN Command • Motor Running • Bypass ON
Inputs	• RUN Command 24VDC - 5mA • RUN Command / Motor OT 24VDC – 5mA (Second Input available only for M3526DC with "C" Option)
Outputs	• Motor Running 30VDC - 1A or 125VAC – 15A • READY 30VDC - 1A or 125VAC – 15A • FIELD ON 30VDC - 1A or 125VAC – 15A • Motor Running 30VDC - 1A or 125VAC – 15A • OVERTEMP 30VDC - 1A or 125VAC – 15A
	•
Enclosure Rating	• NEMA 12 FMD wall mount with disconnect
Operating Temp	• 0 to +50^{O}C
Storage Temp	• -20^{O} to +65^{O}C

2.3. General Precautions and Safety Warnings

DANGER!

- High voltages may be present!
- Never attempt to operate this product with the access doors or covers opened!
- Never attempt to service this product without first disconnecting power to and from the unit!
- **FAILURE TO HEED THESE WARNINGS MAY RESULT IN SERIOUS BODILY INJURY OR DEATH!**

CAUTION!

- This product will generate high ambient temperatures during operation.
- This product should be installed on a non-flammable surface with clearances of at least two inches in all directions.
- Always allow ample time for the unit to cool before attempting service on this product.
- Before attempting installation or removal of this product, be sure to review all drive and/or resistive load documentation for pertinent safety precautions.
- 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.

This page intentionally left blank

3. INSTALLATION INSTRUCTIONS

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 model M3526DC DC motor ramp starter should be accomplished following the steps outlined below. Be sure to refer to the DC motor instruction manual as these steps are performed. Please direct all installation inquiries that may arise during the installation and start-up 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 this module is 0 to +50°C.
Device shall be installed in a Pollution Degree 2 environment.

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. M3526DC MOTOR RAMP STARTER MOUNTING

The installation site for the M3526DC should be chosen with several considerations in mind:

- When mounting the units the conduit access for field wiring is provided on the top of the enclosure.
- The unit requires a minimum clearance of two (2) inches in all directions around it when not mounted near a heat source. Heat sources may increase necessary clearances.
- 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.

3.4. WIRING AND CUSTOMER CONNECTIONS

Be sure to review all pertinent motor system documentation as well as the information listed below before proceeding.

3.4.1. POWER WIRING

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

The Model M3534DC-U050 "DC Motor Ramp Starter" system is powered from an external 120VDC input feed connected at the unit's input power disconnect switch. This disconnect switch, which has an instantaneous

over current trip rating of 2400 amps, is followed by two FWX-100 100A semiconductor fuses located, one per leg, in both the positive and negative legs of the power feed. Once fused, main power is routed to the precharge and IGBT switching circuitry as well as the bypass contactor, and also provides the source for control power within the system.

3.4.1.1. CONTROL POWER, 120VDC INPUT VOLTAGE (DISCONNECT SWT)

Make the 120VDC input voltage connections at main disconnect switch terminals TS1-1 (Pos.) and TS1-2 (Neg.). Terminals accept 4AWG to 4/0AWG wire. Tighten terminal screws securely.

Control power for the DC Motor Ramp Starter is derived from the fused 120VDC main power input previously described. Both the positive and negative legs of this input are fused using ATM-10 10A fuses. Once fused, the 120VDC control source is routed to the input of the 24VDC control power supply as well as to the 3526C2 Control board. The Control board then handles applying the 120VDC control source to the motor field winding and the bypass contactor coil at appropriate times as dictated by system conditions.

The 24VDC control power supply provides power for four aspects of the DC Motor Ramp Starter system. First, the supply provides 24VDC directly to the 3526C2 Control board to power all on-board logic relays as well as the precharge relay. Second, the supply provides a source for the 3527S1 DC/DC Converter board which provides ±15VDC to the 3526C2 Control board to power all control circuitry. Third, the supply powers the "POWER" and "MOTOR RUNNING" LEDs on the door of the enclosure. Fourth, the supply provides power for the internal cooling fan via a K2 "RUN" relay contact.

With 24VDC present and no IGBT driver fault indicated, the DC Motor Ramp Starter system should be ready to run as indicated by the closure of the dry contact of the K4 "READY" relay.**DC BUS INPUT**

The DC bus input may be connected to the DC bus of an AC drive, the DC output of a diode sharing unit, or to a common DC bus. If a reactor or choke are being used in the bus, make sure the actual connection is in parallel with filter capacitors of the drive/inverter.

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.

3.4.1.2. ARMATURE OUTPUT VOLTAGE (TS2-1,2)

Make the armature output connections at terminals TS2-1 (Pos.) and TS2-2 (Neg.). Terminals accept 3/8” ring lugs. Torque to 192 lb-in. maximum.

3.4.1.3. 24V RUN COMMAND (TS1-1,2)

Make the 24V Run Command input connections at terminals TS1-1 (24V Pos.) and TS1-2 (24V Neg.). Terminals accept 22AWG to 12AWG wire. Torque all terminal screws to 3.5 - 5.3 lb.-in.

3.4.1.4. MOTOR RUNNING OUTPUT (TS1-3,4)

The normally-open "Motor Running" status output contact closes when monitored motor current reaches approximately 10 amps. Interconnections for the "Motor Running" output signal are available at terminals TS1-3 (COM) and TS1-4 (N.O.) on field connection terminal strip TS1. Terminals accept 22AWG to 12AWG wire. Torque terminal screws to 3.5 - 5.3 lb.-in.

3.4.1.5. READY OUTPUT (TS1-5,6)

The normally-open "Ready" status output contact closes when 24VDC control power is present on the control board and there are no IGBT driver faults present. Interconnections for the "Ready" output signal are available at terminals TS1-5 (COM) and TS1-6 (N.O.) on field connection terminal strip TS1. Terminals accept 22AWG to 12AWG wire. Torque terminal screws to 3.5 - 5.3 lb.-in.

3.4.1.6. FIELD ON OUTPUT (TS1-7,8)

The normally-open "Field ON" status output contact closes when field current is detected during the ramp-up process. Interconnections for the "Field ON" output signal are available at terminals TS1-7 (COM) and TS1-8 (N.O.) on field connection terminal strip TS1. Terminals accept 22AWG to 12AWG wire. Torque terminal screws to 3.5 - 5.3 lb.-in.

3.4.1.7. OVERTEMP OUTPUT (TS1-9,10)

The normally closed "Over-Temp" status output thermal switch opens if the IGBT heatsink temperature reaches 160°F. The switch will close again when the heatsink temperature drops to approximately 130°F. The thermal switch contact is rated for 1A at 30VDC or 0.5A at 125VAC. Interconnections for the "Field ON" output signal are available at terminals TS1-9,10 on field connection terminal strip TS1. Terminals accept 22AWG to 12AWG wire. Torque terminal screws to 3.5 - 5.3 lb.-in.

3.4.1.8. SWITCHED FIELD VOLTAGE OUTPUT (TS1-11,12)

The "Switched Field Voltage" output is turned on when the ramp-up process begins. Make the "Switched Field Voltage" connections at terminals TS1-11(Pos.) and TS1-12(Neg.). Refer to motor data for corresponding terminations. Terminals accept 22AWG to 12AWG wire. Torque terminal screws to 3.5-5.3 lb.-in.

3.4.1.9. GROUND

Make the Ground connection to terminal TS1-13. Terminal accepts 22AWG to 12AWG wire. Torque terminal screw to 3.5-5.3 lb.-in.

3.4.1.10. OPTION "C": RUN COMMAND CONTACT INPUT / MOTOR OT CONTACT INPUT (TS1-1,14-16)

The RUN Command contact (N.O.) is connected between terminals TS1-1, TS1-16. The MOTOR O.T. contact (N.C.) is connected between terminals TS1-14 and TS1-15. Terminals accept 22AWG to 12AWG wire. Torque terminal screw to 3.5 - 5.3 lb.-in.

Figure 3-1: M3526DC Power Connections

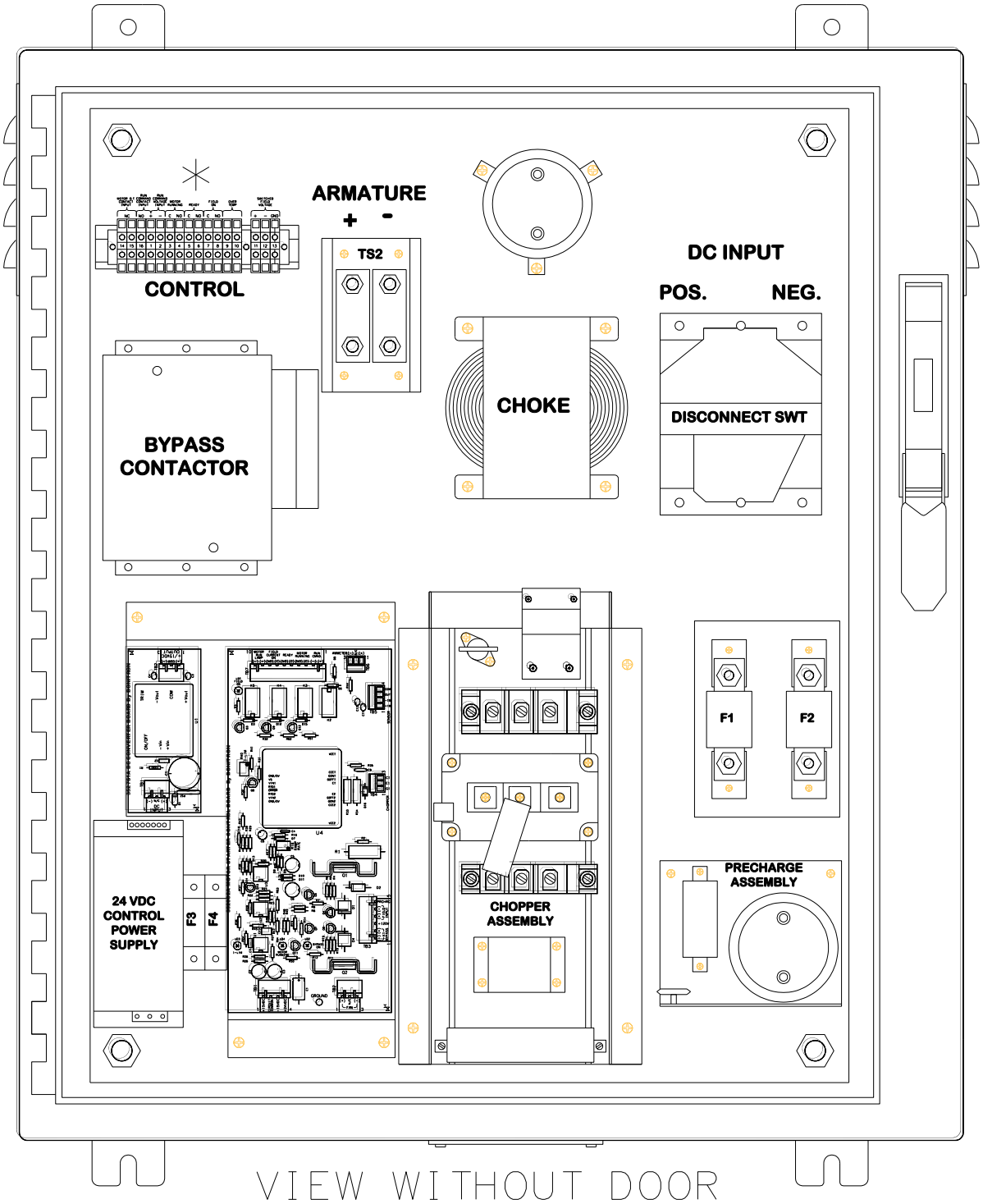


Figure 3-2: M3526DC User I/O Diagram

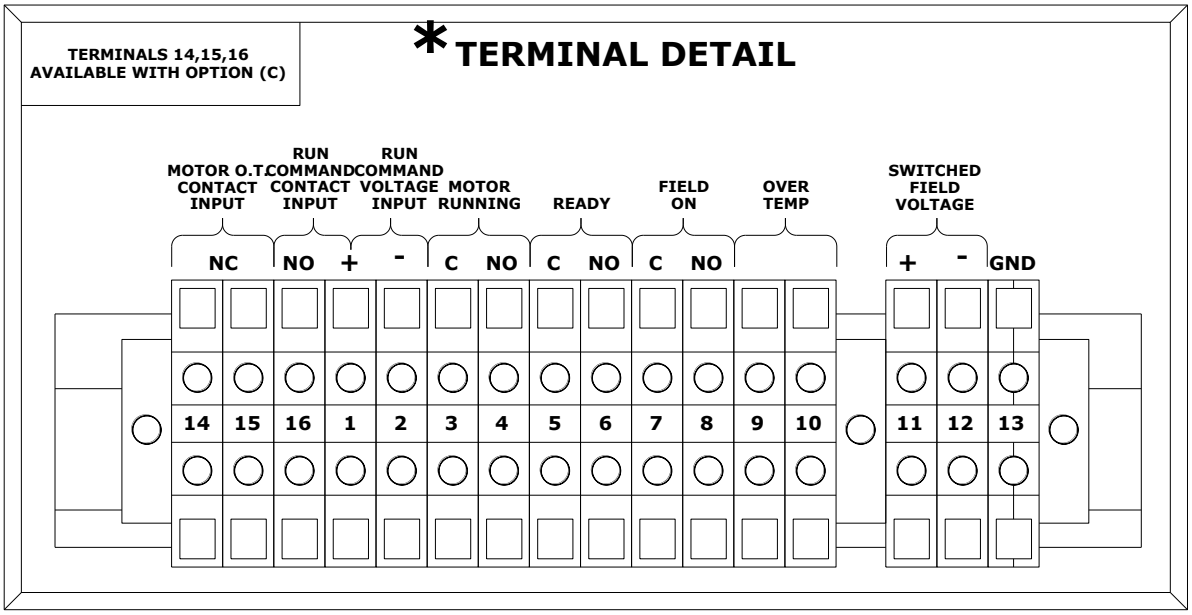
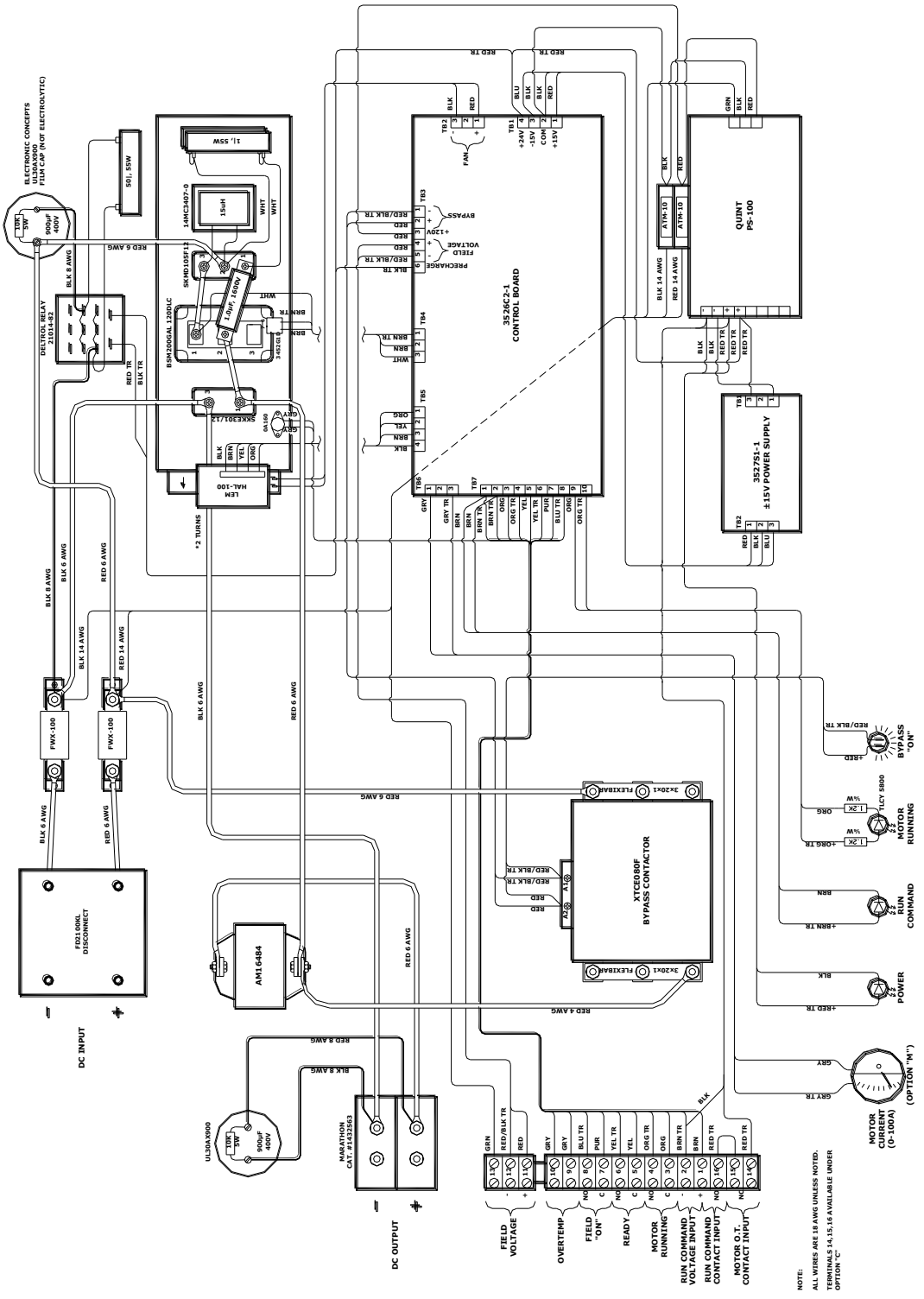


Figure 3-3: M3526DC DC Motor Ramp Starter System Internal Wiring



4. OPERATION

4.1. FUNCTIONAL DESCRIPTION

The model M3526DC Motor Ramp Starter is to accelerate the motor smoothly when commanded from stall to full voltage. Once at full voltage the DC Motor Ramp starter will hold it a full voltage with a bypass contactor until the run command is removed.

4.2. FEATURES

4.2.1. LEDS

Red, yellow, and green LEDs indicate the status of the regen.

4.2.1.1. POWER (GREEN) INDICATOR

The green LED indicates that the unit is powered on.

4.2.1.2. RUN COMMAND (RED) INDICATOR

The red LED indicates that the unit is has been commanded to run from an external 24VDC and the motor is beginning to ramp up.

4.2.1.3. MOTOR RUNNING (YELLOW) INDICATOR

The yellow LED indicates that at least 10A of motor current have been measured.

4.2.1.4. BYPASS ON (YELLOW) INDICATOR

The yellow LED indicates that the Bypass indicator has turned On and the Motor Ramp Starter has reached the steady state condition.

4.3. RAMP – UP PROCESS

When the ramp-up process begins, the output of op-amp U3-A, (pins 1, 2, and 3 of U3), will begin to ramp up from –15VDC to +15VDC. The "RAMP RATE" of the DC Motor Ramp Starter is normally factory set at approximately 10 seconds but can be field adjusted within a range of approximately 8–12 seconds using on-board adjustment pot R18.

During the first 1.5 volts of the ramp, Q1 will be turned ON which allows 2 things to happen. First, the fused 120VDC control source is applied to the motor FIELD winding. Second, the 24VDC control power is applied to the coil of the "PRECHARGE" relay. As motor field current is detected, the K5 "FIELD CURRENT" relay will be energized providing a dry contact closure suitable for monitoring purposes. This contact is available at terminals 7 and 8 of the system Control Terminal strip. When the "PRECHARGE" relay is energized, a short is made across the precharge resistor thus connecting the 900µf, 400VDC filter capacitor to the input power bus.

When the ramp voltage reaches 3 volts above it's starting voltage, the Pulse Width Modulator comparator U2-B, (pins 5, 6, and 7 of U2), becomes active. U2-B compares the slowly ramping voltage to a 2kHz triangular wave which is generated by U1. This comparison results in the application of a rectangular wave of increasing duty cycle to IGBT gate driver module U4 (SKHI22A) which in turn drives the gate of the chopper IGBT (BSM200GAL120DLC) module. The IGBT chops the fixed 120VDC input into a variable duty cycle 120V, 2kHz rectangular waveform which is applied to an output filter composed of a fast diode, choke, and capacitor. The output filter converts the rectangular voltage waveform back to the smooth DC voltage which is applied to the motor.

As the ramp voltage approaches +12VDC, the output of comparator U2-B becomes fully ON. When the ramp voltage reaches approximately +13.5VDC, the motor reaches full voltage and the bypass contactor turns ON. At this point, the motor current bypasses the power chopper circuitry to flow through the contactor. The gate driver to the IGBT remains ON but little or no current passes through the IGBT, thus reducing its losses to near zero while in this steady state condition.

A Hall Effect current sensor in the DC output circuit is used to measure the motor current output. The current sensor provides a motor current feedback signal of –4VDC per 50ADC of output current. This signal is monitored by op-amp U3-B, (pins 5, 6, and 7 of U3). If, during the ramp-up process, the motor current signal indicates that the output current has exceeded a preset "CURRENT LIMIT" reference value, a corrective signal is injected into op-amp U3-A to reduce the ramp rate. If this condition occurs, the LD3 "I-LIM" LED on the control board will turn ON.

The "CURRENT LIMIT" reference is factory preset to 100ADC and should not be tampered with unless first consulting the engineering staff at Bonitron, Inc. However, if an adjustment is determined to be necessary, it can be accomplished via on-board adjustment pot R40. A clockwise adjustment of this pot will produce an increase in the "CURRENT LIMIT" reference setpoint.

The motor current feedback signal is supplied to several additional functions of the 3526C2 Control board. It is used to drive the 0–100 amp "MOTOR CURRENT" ammeter which is located on the door of the enclosure. The signal is also fed to the input of comparator U2-A, (pins 1, 2, and 3 of U2), which controls the K3 "MOTOR RUNNING" relay. When the motor current output rises above approximately 10ADC, the K3 relay is energized providing a dry contact closure suitable for monitoring purposes. This contact is available at terminals 3 and 4 of the system Control terminal strip.

Dropping the "RUN" command will reverse this process by first opening the bypass contactor thus diverting the motor current back through a full ON IGBT which then ramps to zero in 1–2 seconds, turning OFF the motor field current and Precharge contactor at the end of the ramp down. The input filter cap remains across the input bus with a resistor in series with it during its waiting period.

5. ENGINEERING DATA

5.1. FUSE SELECTION

Blown fuses typically indicate a semiconductor device failure or a severe transient. In any case, blown fuses should not be replaced without first consulting Bonitron as catastrophic damage can occur. Use Tables 6-6 and 6-7 when initially constructing the system.

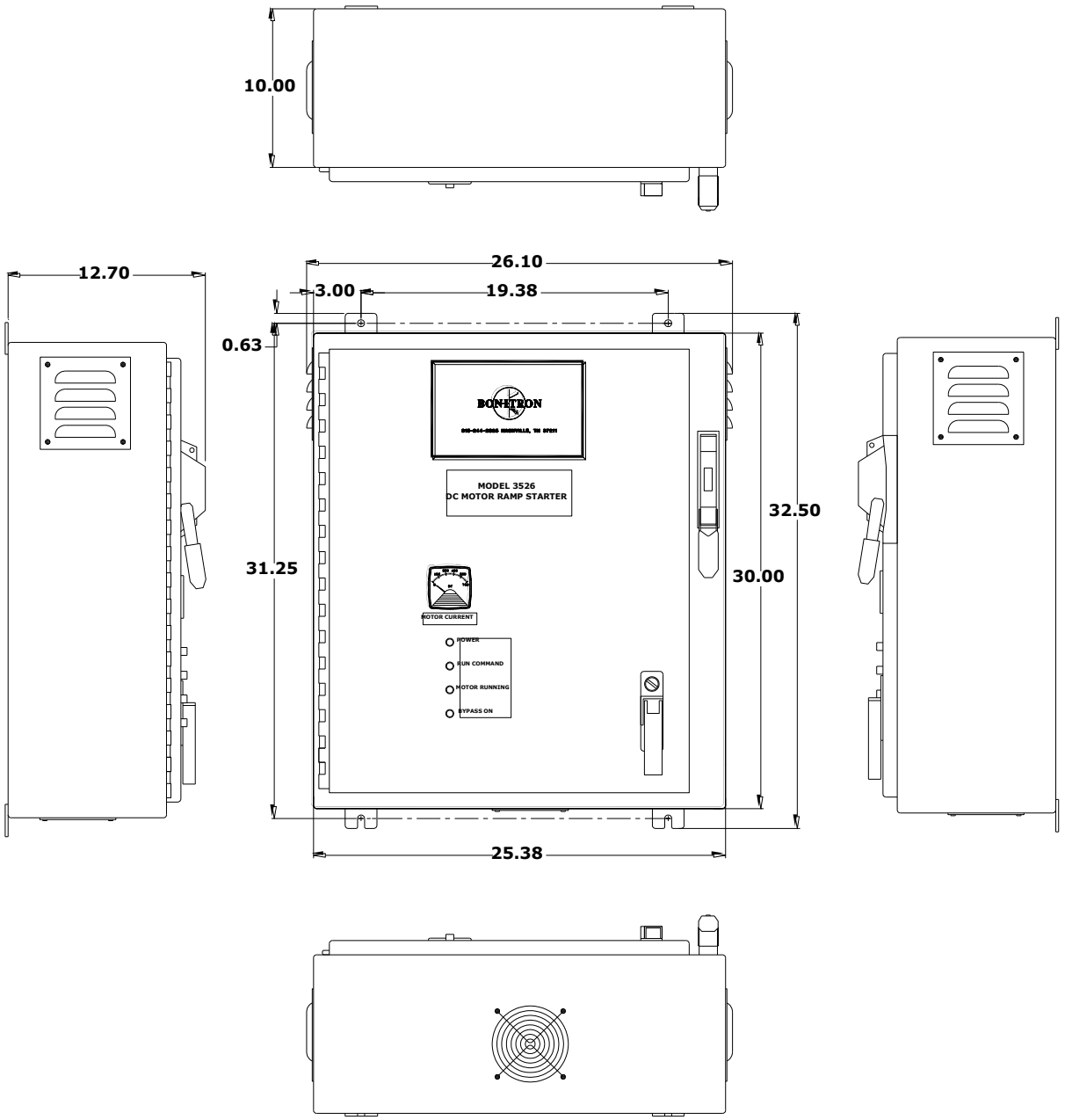
Note: AC fuses must be J-type or equivalent.

Table 5-1: Fuse Current Rating Requirements

FUSE	CURRENT RATING
FWX-100	100A

5.2. DIMENSIONS AND MECHANICAL DRAWINGS

Figure 5-1: M3526DC Enclosure Dimensional Outline



NOTES

521 Fairground Court ● Nashville, TN 37211 ● USA
Tel: (615) 244-2825 ● Fax: (615) 244-2833 ● Web: www.bonitron.com ● Email: info@bonitron.com