BONITRON

# Model M3575T

## Standard Duty Braking Transistor Module

## Customer Reference Manual

# Bonitron, Inc.

**An Industry Leader in AC Drive Systems and Industrial Electronics**

## OUR COMPANY

Bonitron is an international supplier of power controls designed to improve the performance and reliability of electronic systems and variable frequency drives. Located in Nashville, Tennessee, and founded in 1962, Bonitron has gained a reputation for designing and manufacturing products with the highest possible degree of quality and reliability.

Bonitron has all the necessary resources in-house for complete electronic product development and manufacturing. Engineering facilities include a CAD lab for circuit board design and engineering labs for prototype testing and evaluation. Production facilities include production areas for circuit board assembly, a machine tool and sheet metal shop for chassis fabrication, and a systems assembly and checkout area. With these assets, Bonitron is positioned to be a leader into the future while maintaining first class support for their current customer base.

Worldwide sales of equipment are generated mainly by reputation and referrals. Our customer base includes all of the major drive manufacturers, their distributors, OEMs, end users, and many other satisfied companies. Equipment is installed throughout the United States as well as in Canada, Mexico, Costa Rica, Argentina, Brazil, Chile, Venezuela, Northern Ireland, the Netherlands, Spain, Hungary, Israel, Turkey, China, India, Indonesia, Singapore, Taiwan, and the Philippines.

# TALENTED PEOPLE MAKING GREAT PRODUCTS

The engineering team at Bonitron has the background and expertise needed to design, develop, and manufacture the quality industrial systems demanded by today's client. A strong academic background supported by continuing education is complemented by many years of hands-on field experience. Expertise encompasses a broad range of applications and engineering solutions such as modern power conversion design techniques and microprocessor-based controls. This insures a solution tailored to the specific needs of the client.

A clear advantage that Bonitron has over many competitors is combined on-site engineering labs and manufacturing facilities. This allows the engineering team to have immediate access to and response from testing and manufacturing. This not only saves time during prototype development, but also is essential to providing only the best quality products.

# AC DRIVE OPTIONS

In 1975, Bonitron began working with the AC inverter drive specialists at synthetic fiber plants to develop speed control systems that could be interfaced to their plant process computers. Since that time, Bonitron has developed AC drive option modules that help overcome many of the problems encountered in applications of modern AC variable frequency drives.

Bonitron's Ride-Thru module provides protection from AC line voltage sags while the Line Regen and Resistive Braking modules provide DC Bus regulation for over-voltage due to regenerated voltage.

Bonitron AC drive modules are available to provide Undervoltage, Overvoltage, Line Side, Load Side, Maintenance, Power Quality, and Green / Sustainability solutions. These products are compatible with the drives of all major manufacturers and have become the standard in many industries including semiconductor, oil, and fiber.

# WORLD CLASS PRODUCTS

Bonitron has developed over 3000 different modules and systems. Bonitron is willing and able to meet the unique specifications the client may request.

Some Bonitron products include:

- Power Sag Ride-Thru Modules
- Power Outage Ride-Thru Modules
- Line Regen Modules
- Resistive Braking Modules
- Modular High Speed Precision AC Inverter Systems
- Inverter Upgrade Modules
- Multi-motor, Multi-phase Current Sensors
- Battery Production Charging Systems
- Data Acquisition Systems
- Process Controllers
- Temperature Control Systems
- RMS True Reading Digital Voltmeters, Ammeters, and Frequency Meters

*This page is intentionally left blank.*

# 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 M3575T Standard Duty Braking Transistor Module. It will provide the user with the necessary information to successfully install, integrate, and use the M3575T.

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

## 1.3. MANUAL VERSION AND CHANGE RECORD

The dimensions for the M Chassis are corrected in Rev 06h of this manual.

**Figure 1-1: Typical M3575T Module**

*This page is intentionally left blank.*

# 2. PRODUCT DESCRIPTION

The need for regenerated voltage control occurs in applications where the frequency of an AC motor at times exceeds that of its adjustable speed drive. In this case, the motor acts as a generator. The energy generated by the motor must be dissipated as heat, or returned to the power line. If this energy is not controlled, the motor may run with high peak voltages, the energy may be dissipated as heat in the motor, or the drive may trip on an over-voltage condition.

For applications where this condition occurs infrequently, dissipating the energy as heat through resistive braking control can be the most cost-effective solution.

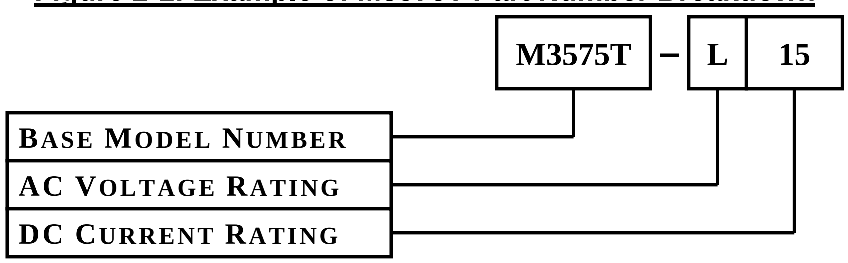
## 2.1. RELATED PRODUCTS

The Model M3575T series of braking products is designed to provide resistive braking control for applications utilizing a standard AC drive with a fixed DC bus. These modules have been designed for use with remotely mounted resistive loads such as the Model M3575R or M3775RK Resistive Load Modules.

For higher duty cycle applications, consider the M3452 series of Braking Transistor Modules.

## 2.2. PART NUMBER BREAKDOWN

**Figure 2-1: Example of M3575T Part Number Breakdown**




### BASE MODEL NUMBER

The Base Model Number **M3575T** indicates that the unit incorporates the braking transistor and its control circuitry only. An external resistive load is required for proper function of the braking module.

### AC VOLTAGE RATING

The AC Voltage Rating of the braking unit should match the input AC line voltage to the AC drive used with the braking module. This rating is represented by either of two letter codes.

**Table 2-1: AC Voltage Rating Codes**

| AC VOLTAGE RATING CODE | AC VOLTAGE NOMINAL AC LINE | DC BUS TRIGGER LEVEL |
|---|---|---|
| L | 230VAC | 375VDC |
| H | 460VAC | 750VDC |

## DC CURRENT RATING

The DC Current Rating indicates the maximum DC current level safely handled by the braking unit. This rating is represented numerically such that a value of "15" would indicate that the braking unit has a peak current rating of 15 amps DC. The RMS current rating of the unit depends on the application of the braking module. RMS current ratings have been calculated for braking as well as for overhauling applications. See Section 7 for application sizing assistance.

## CHASSIS INFORMATION

Chassis size is determined by the module rating. For additional information, please see Table 6-1 for Ratings Charts and Table 6-4 for Chassis Dimensions.

**Table 2-2: Chassis Determination**

**230VAC**

| MODEL NUMBER | CHASSIS | DIMENSIONS H" x W" x D" |
|---|---|---|
| M3575T-L15 | M3 | 12.75 x 3.00 x 8.70 |
| M3575T-L30 | M3 | 12.75 x 3.00 x 8.70 |
| M3575T-L60 | M4 | 12.75 x 4.00 x 8.70 |

**460VAC**

| MODEL NUMBER | CHASSIS | DIMENSIONS H" x W" x D" |
|---|---|---|
| M3575T-H15 | M3 | 12.75 x 3.00 x 8.70 |
| M3575T-H30 | M3 | 12.75 x 3.00 x 8.70 |
| M3575T-H75 | M4 | 12.75 x 4.00 x 8.70 |
| M3575T-H125 | B5 | 17.75 x 6.50 x 8.00 |
| M3575T-H150 | B5 | 17.75 x 6.50 x 8.00 |
| M3575T-H200 | B7 | 17.75 x 7.00 x 8.00 |
| M3575T-H300 | B7 | 17.75 x 7.00 x 8.00 |
| M3575T-H600 | B7 | 17.75 x 7.00 x 8.00 |

## 2.3. General Specifications

**Table 2-3: General Specifications Table**

| Parameter | Specification |
|---|---|
| Adjustments | Factory calibrated - no field adjustments necessary |
| Connections | Drive DC bus<br>Resistors<br>Fault contact |
| Enclosure | Type 1 |
| Status Output | Form-C contact rated at 1.0 Amp @ 24VDC or 0.5 Amp @ 120VAC – Normally open held closed<br>Status Output opens on:<br>• Open load<br>• Over temperature<br>• Transistor failure |
| Panel Indicators | DC Bus<br>Active Braking |
| Drive Voltage | For use with 230VAC and 460VAC drive systems |
| Control Power | Derived from DC bus voltage:<br>• 100-400VDC required for 230VAC drives<br>• 450-800VDC required for 460VAC drives |
| Braking Current | 15 – 600A<br>(Use Bonitron M3452 for applications requiring 600+ amps) |
| Turn-on Voltage | 375VDC (for 230VAC drives)<br>750VDC (for 460VAC drives) |
| Maximum On-Time | 60 seconds |
| Duty Cycle | 20% maximum for braking applications<br>6.67% maximum for overhauling applications<br>(Use Bonitron M3452 for applications requiring higher duty cycles) |
| UL Approval | Units rated up to and including 75 amps peak are UL approved<br>Refer to UL file number E204386 |
| Operating Temp | 0ºC to 40º C |
| Storage Temp | -20 ºC to +65ºC |
| 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!
- Never attempt to operate this product with the enclosure cover removed!
- **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 accordingly on non-flammable surfaces 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.
- No user-serviceable parts are contained within this product. Inoperable units should be replaced or returned for evaluation and/or repair by qualified technicians.
- 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.

**ATTENTION!**

**Important Notice about drives with DC link chokes!**

- During braking situations, energy stored in a drive's DC link chokes can create extreme over-voltage conditions for Braking Transistor Modules. To avoid these conditions, DC connections from braking transistor modules to the drive system should always be made directly in parallel with the drive's filter capacitors. These modules should never be connected in series with a drive's DC link chokes.
- Be sure to review all pertinent AC drive documentation to ensure that the proper connections are used.
- Contact the drive manufacturer or equipment supplier for assistance with drive connections.

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

# 3. INSTALLATION INSTRUCTIONS

## 3.1. ENVIRONMENT

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

- The mounting surface must be non-flammable, as the unit will generate high ambient temperatures during typical operation.
- The unit will require a minimum clearance of two inches in all directions around it.
- The unit will require adequate protection from the elements.

## 3.2. UNPACKING

Prior to installation, please verify that the product received matches the product that was ordered and that there is no physical damage to the unit. If the wrong product was received or is damaged in any way, please contact the supplier from which it was purchased.

## 3.3. MOUNTING

**WARNING!**

*Installation and/or removal of this product should only be accomplished by a qualified electrician in accordance with National Electrical Code or equivalent regulations.*

Proper installation of the Model M3575T Standard Duty Braking Transistor Module should be accomplished following the steps outlined below. Be sure to refer to your AC Drive's instruction manual as you perform these steps. Please direct all installation inquiries that may arise during the installation and start up of this braking product to your supplier or system integrator.

Once the installation site has been selected as outlined in Section 3.1, the unit should be mounted in place using two or four ¼ inch diameter bolts or studs. Mounting dimensions vary by unit chassis size. Refer to Table 6-1: Module Ratings in Section 6.1 of this manual to find the chassis size for your unit. Then refer to Section 6.5 of this manual to determine the correct mounting dimensions (Dim D and Dim E) for your unit's chassis size. See Table 6-4 for all chassis dimensions.

## 3.4. WIRING AND CUSTOMER CONNECTIONS

### 3.4.1. POWER WIRING

This section provides information pertaining to the field connection of the DC bus inputs to the M3575T and M3575R Resistive Braking Modules. Actual connection points and terminal numbers for the AC Drive module will be found in the documentation provided with the drive. Be sure to review all pertinent drive and system documentation as well as the Power Connection Notes listed below before proceeding.

**WARNING!**

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

**Table 3-1: Power Wiring Specifications**

| CHASSIS | TERMINAL | CONNECTION | TORQUE |
|---|---|---|---|
| M3, M4 | DC+, DC-, RES+, RES- | 16-12 AWG | 0.4-0.6 Nm<br>3.5-5.3 lb-in |
| B5 | DC+, DC-, RES+, RES- | 12-8 AWG | 0.8-1.6 Nm<br>7-14 lb-in |
| B7 (H300) | DC+, DC-, RES+, RES- | 6-2 AWG | 2.5-5.0 Nm<br>22-44 lb-in |
| B7 | DC+, DC-, RES+, RES- | ¼ x 20 stud | 5.7 Nm<br>50 lb-in |

**Attention!**

*The braking kit is rated in peak amperage. The wiring only needs to be sized to handle the RMS current value which can be found in Table 6-1 in Section 6 of this manual.*

#### 3.4.1.1. DC BUS CONNECTION

**WARNING!**

*DC bus polarity must be correct! Connecting the DC bus with the polarity reversed will cause damage to the equipment!*

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

Make sure that the DC bus connection polarity is correct. Improper polarity connections carry a high risk of damaging drive equipment if energized.

Some drives have a connection to an internal braking transistor. Do not use this connection. Connect only to the DC bus terminals.

#### 3.4.1.2. RESISTOR CONNECTION

The polarity of the resistor connections is not critical; however, it is critical that the resistor be connected to the proper terminals. Improper hookup can lead to the resistor being connected directly across the DC bus, which will cause severe overheating and drive stress.

Minimum load resistance requirements listed in Table 6-1: Module Ratings in Section 6 of this manual MUST be followed when selecting a resistive load for use with the M3575T unit.

#### 3.4.1.3. GROUNDING REQUIREMENTS

All units come equipped with either a ground terminal or ground stud that is connected to the module chassis. Ground the chassis in accordance with local codes. Typically, the wire gauge will be the same as is used to ground the attached drive.

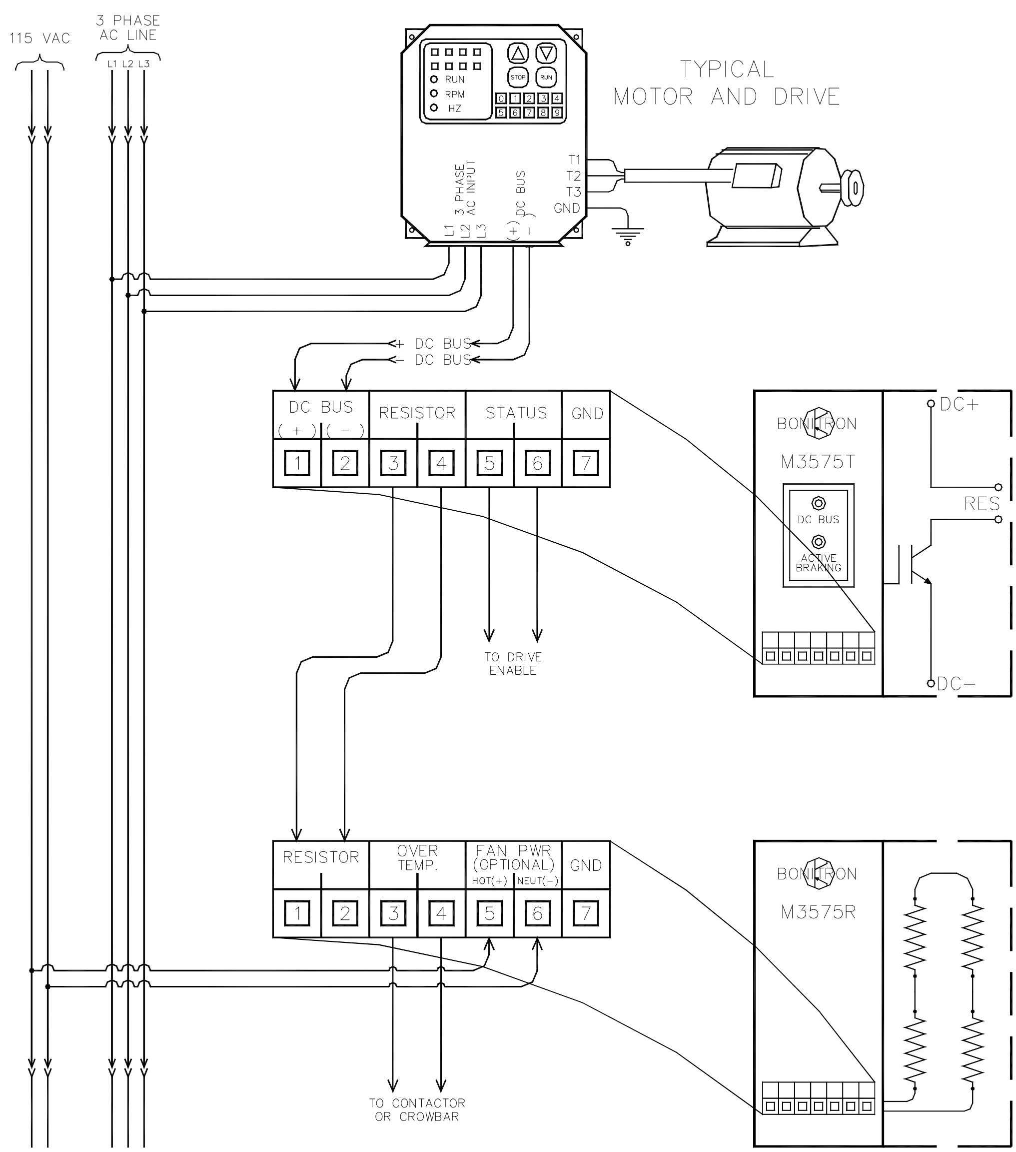
### 3.4.2. CONTROL INTERFACE WIRING

**Table 3-2: Status Connection Notes**

| TERMINAL | FUNCTION | ELECTRICAL SPECIFICATIONS | CONNECTION | TORQUE |
|---|---|---|---|---|
| TS 5-6 | Status Contacts | 1.0A @ 24VDC<br>0.5A @ 120VAC | 16-12 AWG | 0.4-0.6 Nm<br>3.5-5.3 lb-in |

## 3.5. TYPICAL CONFIGURATIONS

**Figure 3-1: Typical Power Interconnection Diagram**



*This page is intentionally left blank.*

# 4. OPERATION

## 4.1. FUNCTIONAL DESCRIPTION

The M3575T Module controls the bus voltage of a variable frequency drive by transferring energy to a resistor.

When the drive's DC bus voltage exceeds a fixed setpoint, the Dynamic Braking Transistor Module's control electronics turns on an IGBT transistor connecting a resistive load across the DC bus. When the DC bus drops below another threshold, the IGBT turns off. The turn on setpoint is fixed at 375VDC for 230VAC systems, and 750VDC for 460VAC systems.

## 4.2. FEATURES

### 4.2.1. INDICATORS

#### 4.2.1.1. DC BUS

The DC Bus indicator illuminates when the voltage between the DC+ and DC- terminals is greater than 40VDC.

| CAUTION! | *Do not use this light as an indication that the DC Bus is safe to work on! **Always** check the DC bus with a working voltmeter before servicing equipment, as the DC bus light may be broken!* |
|---|---|

#### 4.2.1.2. ACTIVE BRAKING

This indicator illuminates when the chopper IGBT is on. When the drive is idle, this light should not be on. During braking, this light will be on or flashing, depending on the amount of braking energy.

### 4.2.2. TERMINAL STRIP I/O

See Figure 3-1.

#### 4.2.2.1. STATUS CONTACTS

- When the module is ready for operation, TS 5&6 close.
- These contacts OPEN on the following conditions:
  - Failed IGBT (power transistor)
  - Open Load
  - Overtemperature in module

If one of these conditions exists, the module will not operate, and the DC bus will not be regulated through the braking resistor.

| CAUTION! | *Bonitron Braking Transistor Modules are designed to be used with stand-alone or common DC bus drive/inverter systems with bus capacitors. When using the Bonitron modules on common bus systems, special considerations may apply. Refer to and review the Application Notes found in Section 7 prior to energizing this type of system!* |
|---|---|

## 4.3. PRE-POWER CHECKS

Ensure that all connections are tight, DC bus polarity is correct, and that all customer wiring is of the proper size for operational requirements. Check for exposed conductors that may lead to inadvertent contact. Verify the load bank is properly sized for the application. The ohms value and wattage rating of the load bank are important for proper and reliable system operation! ***Remember**; do not operate the module with less than its minimum ohms value rating!* See Section 7 for sizing information.

## 4.4. STARTUP PROCEDURE AND CHECKS

Apply AC power to the drive system and the Dynamic Braking Transistor Module. Do not start the motors on the system.

On the Dynamic Braking Transistor Module, verify the following:

- Green **Control Power** indicator is **ON**.
- Amber **DC Bus** indicator is **ON**.
- Red **Active Braking** indicator is **OFF**! **Immediately** turn off all power if the indicator is **ON** to avoid possible load bank overheating and/or other equipment damage
- Verify the drive system DC bus voltage, and make sure it is within tolerance for the drive system.
- Verify the DC current flow through the load bank is zero amps. Even though the Red **Active Braking** indicator is **OFF**, any significant current flow could indicate incorrect connections or damaged equipment. ***Immediately** turn off all power to avoid possible load bank overheating and/or other equipment damage if current flow is indicated!*
    - Note: Depending on the type of measuring equipment used, small currents could just be noise pickup and could be ignored.
- Check status contacts to insure they are all closed. This indicates that the module is ready for operation.

If any of the above conditions are not as indicated, turn off all power and allow ample time for all system energy sources to discharge. **Verify that all voltages are below 40V with a meter!** Check all wiring connections and jumper configurations. Refer to the Troubleshooting Section of this manual for more information. For further assistance, contact Bonitron Technical Support.

Once the pre-checks are complete, the drive system can be enabled. Once the drive system is operational, run the motors with light deceleration, and decrease the braking time until the red **Active Braking** indicator lights.

## 4.5. OPERATIONAL ADJUSTMENTS

No adjustments are necessary for this module. All regulation points are factory adjusted, and should not be changed in the field. If your module is not functioning properly, refer to Troubleshooting in Section 5 of this manual or contact Bonitron for assistance.

# 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

At least every other month, visually inspect the front panel indicator lights to be sure they are operating correctly. With control power applied, the green **Control Power** indicator should be illuminated. The amber **DC Bus** indicator will be on if the drive bus is above 40VDC. The red **Active Braking** indicator will only be on or flashing if the module is absorbing energy from the DC Bus. There are no operational tests to be performed.

## 5.2. MAINTENANCE ITEMS

Monthly, check the module for buildup of dust, debris, or moisture. Dangerous voltages exist within the module and the buildup of dust, debris, and moisture can contribute to unwanted arcing and equipment damage. Keep the module clean and moisture free.

Monthly, check the cooling fan and heatsink for any buildup of debris. If they require cleaning, **power down the drive system** and blow the debris out with clean dry air to maintain proper cooling performance. **Note:** After blowing out the fan and/or heatsink, blow off any dust or debris that may have gotten on any of the circuit boards.

## 5.3. TROUBLESHOOTING

**WARNING!**

*Lethal voltages exist in these systems! Before attempting checks or repair, follow all precautions to insure safe working conditions, including lockout/tagout procedures, and verifying safe working voltages with proper meters. Do not rely on the DC Bus indicator to insure a safe condition!*

**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!*

Feel free to call Bonitron any time the equipment appears to be having problems.

### 5.3.1. DC BUS LIGHT NOT ILLUMINATED

This can be a normal condition in systems where DC Bus power and logic control power is applied. This indicates that there is less than 40VDC on the inverter bus.

**CAUTION!**

*Do not use this light as an indication that the DC bus is safe to work on! Always check the DC Bus with a working voltmeter before servicing equipment, as the DC bus light may be broken!*

- Use a DC voltmeter to check the Bus Voltage at the module terminals DC bus + and DC bus –.
- If the DC bus is above 40VDC, and the light is not illuminated, the light or control circuit may be damaged, and the unit should be returned for repair.
- The main DC bus fuse may be blown. See below.

### 5.3.2. BLOWN DC BUS FUSE

**CAUTION!**

*Do NOT replace a blown DC bus fuse and reapply power to the system without determining the cause!*

This usually indicates serious problems exist and reenergizing the system can cause significant or catastrophic failure! In most cases, the module will need to be returned for repair. Contact Bonitron before changing the fuse.
Possible causes for a blown fuse are:

- Shorted heatsink IGBT power transistor.
- Shorted heatsink commutation diode.
- Load bank in use below minimum ohms value.
- Shorted load bank.
- Shorted resistor cabling and or ground fault in cable.
- Operating braking module on a DC bus without inverters present. This is typically encountered in common bus systems when drives are removed from service. See Section 7 for more information.

### 5.3.3. FAN RUNS CONSTANTLY

The fan only runs when the braking module heatsink is hot. If the heatsink is above 110°F, then the fan runs until the heatsink cools to 80°F. If the ambient temperature is above 80°F, the fan may run continuously. A constantly running fan does not indicate a problem with the module. If the heatsink temperature is below 80°F, the thermostat may be damaged. This will not affect DC Bus regulation.

### 5.3.4. FAN DOESN'T RUN

The fan only runs when the braking module heatsink is hot. If the heatsink is above 110°F, then the fan runs until the heatsink cools to 80°F.
If the fan never runs, even when the heatsink is hot or during heavy braking operation, the module may shutdown on heatsink over-temperature. This occurs at a heatsink temperature of 160°F. If for any reason the fan does not appear to be working properly, check the following:

- Input and output fuses on the fan transformer. These will be located on or around the fan transformer itself.
- Check fan for blockage. Clean if necessary.
- Check fan transformer primary voltage and insure it is within tolerance for the control voltage input for that module.
- Replace fan.
- If fan still doesn't operate, the heatsink temperature switch may be faulty. Contact Bonitron for return for repair.

### 5.3.5. CONTROL READY CONTACTS WON'T CLOSE

If the Status Contacts listed in Section 4.2.2.1 above will not close, this indicates one of the following conditions:

- Open Load – There is no load connected to the unit, or it is connected improperly.
- Overtemperature – see below.
- Damaged IGBT – IGBT has failed, and must be returned for repair.

### 5.3.6. MODULE OVER-TEMP, OR MODULE SEEMS TOO HOT

It is normal for this module to produce heat. Temperatures of 150°F are not uncommon. If the modules fan is running, and the module is operating properly, it is within normal tolerances.

If the fan is not running, see Section 5.3.4 above for assistance.

If the fan is running, check to make sure the airflow through and around the module is unobstructed.

If the ambient temperature is high in the cabinet or installation area, the module may overheat. Make sure the environment is within the operating temperature requirements listed in the General Specifications in Table 2-3.

### 5.3.7. DRIVE TRIPS ON OVERVOLTAGE

*Make sure the DC+ and DC- connections are made directly to the drive system bus. They should not be connected to terminals dedicated to an internal transistor circuit, on the inverter*.

If the drive trips on overvoltage and the module is ready to operate, watch the "Active Braking" light on the front of the module. If it never illuminates, check the connections to the DC bus of the drive system. Check the DC Bus voltage and make sure the bus voltage at the braking module exceeds the trip point of the module, i.e. 750VDC for a 460VAC nominal system. (See Table 2-1) If the "Active Braking" light comes on, check the wiring to the load bank, and check the current to the load bank with a clamp on current meter. If the wiring to the load bank is good, make sure the DC bus fuse is good, if installed.

If the "Active Braking" light comes on, and current is flowing to the load bank, check to make sure that the module is sized properly for the system. If the resistance of the load bank is too high, not enough current will flow to allow for the braking energy to be dissipated. Check the system design to make sure the braking requirements are matched with the braking module capacity.

### 5.3.8. BRAKING LIGHT FLICKERS

During motor deceleration, the braking LED may flicker if the braking cycle energy is low. This is normal.

If the braking light flickers when the inverter is idle, this may indicate high voltage, excessive noise, or harmonics on the main system rectifier input AC voltage. Check the incoming AC line for these problems. Consult the project engineer for the appropriate corrective action.

In rare instances, the module is installed on a system that has very little capacitance, or the inverters have been removed from the bus. This configuration can cause damage to the braking module. See Section 7 for more information.

### 5.3.9. BRAKING LIGHT STAYS ON ALL THE TIME

- System voltage is too high or high harmonic content is present. Check main system rectifier input AC voltage. Refer to the DC Bus Trigger Level found in Table 2-1. The undistorted main system rectifier AC input voltage should always be less than DC bus trigger level ÷ 1.414.
  - Note: If the measured DC bus (in standby) is greater than the RMS line voltage*1.414, then harmonic distortion may exist. Consult the project engineer for the appropriate corrective action.
- Setpoint too low. The DC Bus Setpoint pot on the main control board may have been tampered with. If this is a possibility, then the module needs to be sent in for recalibration.
- Wrong braking module installed. Check the module chassis sticker for the part number. Refer to Section 2.2 of this manual and verify that the sticker information represents the correct part number for your application and voltage levels. Remove and replace as required.
- Main control board has gone bad. Module needs to be sent in for repair.

## 5.4. TECHNICAL HELP – BEFORE YOU CALL

If possible, please have the following information when calling for technical help:

- Model number of unit
- Serial number of unit
- Name of original equipment supplier
- Brief description of the application
- Drive and motor hp or kW
- The line to line voltage on all 3 phases
- The DC bus voltage
- kVA rating of power source
- Source configuration Wye/Delta and grounding

# 6. ENGINEERING DATA

## 6.1. RATINGS CHARTS

**Table 6-1: Module Ratings**

| MODEL NUMBER | DRIVE VOLTAGE | $I_{PK}$ | $I_{RMS}$ | UL RATING | DUTY CYCLE | MAX BRAKING | MIN LOAD | CHASSIS SIZE |
|---|---|---|---|---|---|---|---|---|
| M3575T-L15 | 230VAC | 15A | 3.87A | 20% | 20% | 8hp | 25Ω | M3 |
| M3575T-L30 | | 30A | 7.75A | 20% | 20% | 15hp | 12.5Ω | M3 |
| M3575T-L60 | | 60A | 15.5A | 20% | 60% | 30hp | 6.25Ω | M4 |
| M3575T-H15 | 460VAC | 15A | 3.87A | 20% | 20% | 15hp | 50Ω | M3 |
| M3575T-H30 | | 30A | 7.75A | 20% | 20% | 30hp | 25Ω | M3 |
| M3575T-H75 | | 75A | 19.36A | 20% | 60% | 75hp | 10Ω | M4 |
| M3575T-H125 | | 125A | 32.27A | 20% | 20% | 125hp | 6Ω | B5 |
| M3575T-H150 | | 150A | 38.73A | 20% | 20% | 150hp | 5Ω | B5 |
| M3575T-H200 | | 200A | 51.64A | 20% | 20% | 200hp | 3.75Ω | B7 |
| M3575T-H300 | | 300A | 77.46A | 20% | 20% | 300hp | 2.5Ω | B7 |
| M3575T-H600 | | 600A | 154.92A | 20% | 20% | 600hp | 1.25Ω | B7 |

## 6.2. WATT LOSS

Ratings assume losses during highest braking currents. Total heat produced will depend on the duty cycle of the braking function.

**Table 6-2: Watt Loss**

| BRAKE MODULE M3575T-XXX | CONTROL POWER WATT LOSS | HEATSINK WATT LOSS |
|---|---|---|
| L15 | 25 | 20 |
| L30 | 25 | 35 |
| L60 | 25 | 75 |
| H15 | 25 | 10 |
| H30 | 25 | 20 |
| H75 | 25 | 45 |
| H125 | 25 | 75 |
| H150 | 25 | 100 |
| H200 | 25 | 120 |
| H300 | 25 | 150 |
| H600 | 25 | 300 |

## 6.3. CERTIFICATIONS

Units rated up to and including 75 amps peak are UL approved. Refer to UL file number E204386.

## 6.4. FUSE SIZING AND RATING

Some installations may require fuses to be placed in the DC link of the braking system. In these cases, the following fuses are recommended. Breakers are not recommended for overcurrent protection.

**Table 6-3: Recommended Fuses**

| BRAKE MODULE M3575T-XXX | FUSE |
|---|---|
| L15 | FWP-15 |
| L30 | FWP-30 |
| L60 | FWP-60 |
| H15 | FWP-15 |
| H30 | FWP-30 |
| H75 | FWP-80 |
| H125 | FWP-125 |
| H150 | FWP-150 |
| H200 | FWP-200 |
| H300 | FWP-300 |
| H600 | FWP-600 |

## 6.5. Dimensions and Mechanical Drawings

**Figure 6-1: Chassis Dimensional Outline Drawing**

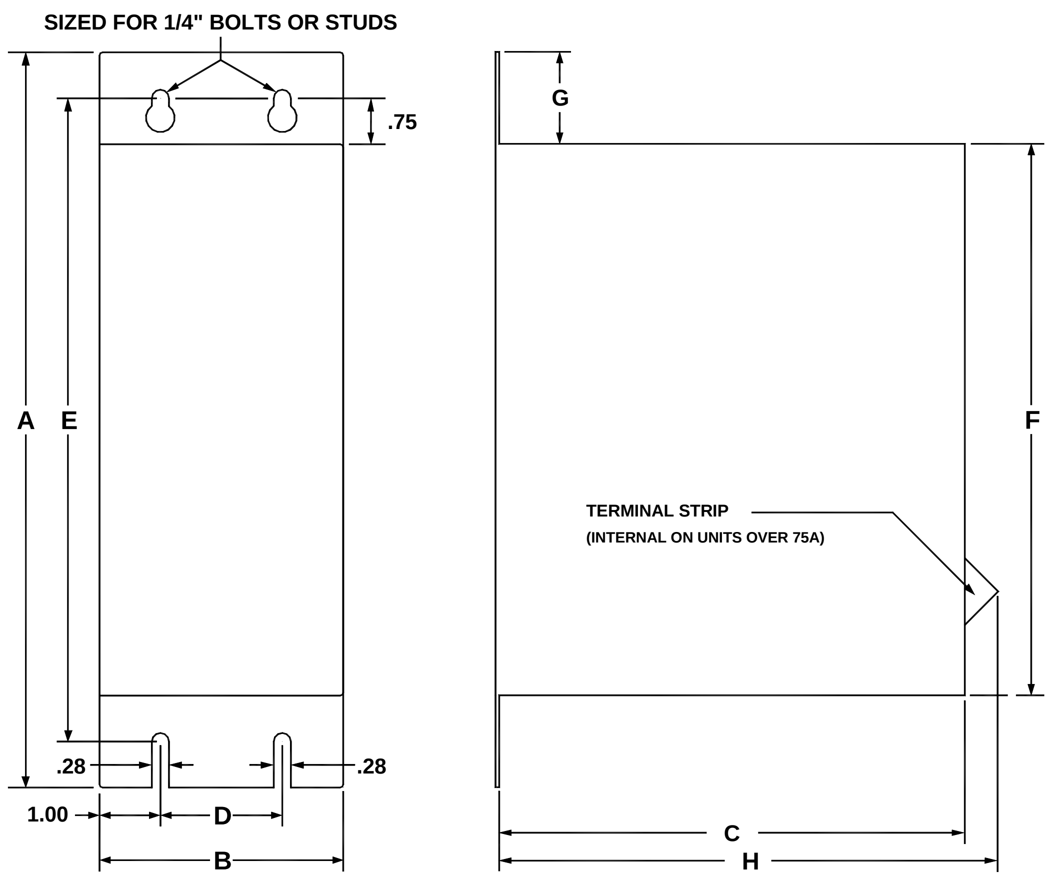



**Table 6-4: Chassis Dimensions**

**MINI-CHASSIS**

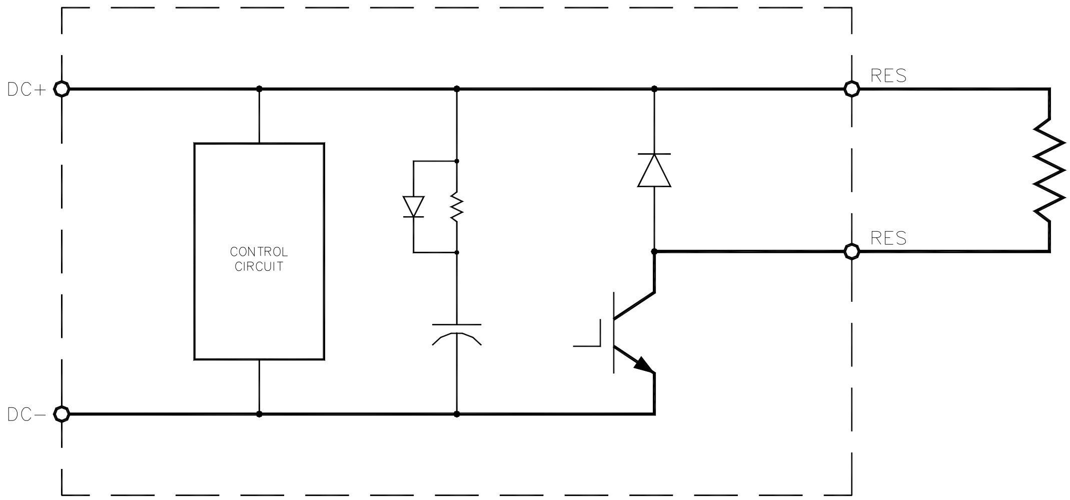
| CHX | DIM A OVERALL HEIGHT | DIM B UNIT WIDTH | DIM C UNIT DEPTH | DIM D MOUNTING WIDTH | DIM E MOUNTING HEIGHT | DIM F UNIT HEIGHT | DIM G MOUNTING FLANGE | DIM H OVERALL DEPTH |
|---|---|---|---|---|---|---|---|---|
| M3 | 12.75 | 3.00 | 7.70 | N/A | 12.00 | 10.50 | 1.13 | 8.70 |
| M4 | | 4.00 | | 1.75 | | | | |

**BOOKSHELF CHASSIS**

| CHX | DIM A OVERALL HEIGHT | DIM B UNIT WIDTH | DIM C UNIT DEPTH | DIM D MOUNTING WIDTH | DIM E MOUNTING HEIGHT | DIM F UNIT HEIGHT | DIM G MOUNTING FLANGE | DIM H OVERALL DEPTH |
|---|---|---|---|---|---|---|---|---|
| B5 | 17.75 | 6.50 | 8.00 | 3.00 | 16.75 | 15.00 | 1.38 | N/A |
| B7 | | 7.00 | | 5.00 | | | | |

## 6.6. BLOCK DIAGRAM

**Figure 6-2: Block Diagram**



# 7. APPENDIX

## 7.1. APPLICATION NOTES

### 7.1.1. SIZING YOUR BRAKING REQUIREMENTS

Braking Transistor Modules are sized by peak current requirements and system voltage. Please use the following guidelines:

- Verify the amount of peak power needed for braking. This must be determined from the mechanical system layout, and should be calculated in either peak watts or horsepower.
- VFD's are rated for braking power as well as peak braking capacity. This information is available in the drive manual. This will be the maximum amount of power that the output inverter stage of the VFD can absorb from the load before having an overcurrent condition. Refer to your VFD documents for information on drive sizing. Keep in mind that the current rating of the drive is for three phase current, not DC bus current. The braking current in the DC bus will be higher than the AC current absorbed from the load.
- Because Bonitron Braking Transistor Modules are rated for peak current, determine the *peak* braking power required.

#### 7.1.1.1. HORSEPOWER TO WATTS

Once the braking requirements for the mechanical load are determined, multiply the horsepower by the scaling factor of 746 to determine the wattage required. For instance, with a 400hp system, the peak braking power may be 600hp. In this case the peak power required would be:

$$P_{brake} = hp._{Braking} * 746 \qquad P_{brake} = 600hp * 746 = 447600 watts$$

#### 7.1.1.2. PEAK AMPERAGE

The peak amperage of the braking cycle can be determined by dividing the peak braking wattage by the system bus trip point of the Braking Transistor Module used. If the above example were on a 480VAC system, the trip point is 750VDC, as determined from Table 2-1. In this case the peak current required would be:

$$I_{brake} = P._{Braking} / 750VDC \qquad I_{brake} = 447600 watts / 750VDC = 596.8\text{ADC}$$

In this case, a 600 amp module should be used.

#### 7.1.1.3. OHMIC VALUE

The ohmic value of the resistive load can usually be determined from the module ratings (see Table 6-1). This ohmic value indicates the capacity of the braking transistor module, and may not be directly related to the horsepower of the drive. In order to calculate the required ohmic value for the braking load, use the following formula:

$$R_{brake} = {(V_{\text{DCbus}})^2} \big/ {P_{brake}}$$

The DC bus voltage for the equation is determined by the level that the drive begins braking. For 460/480VAC systems, this is typically 750VDC, for 230VAC systems, it is typically 375VDC. Refer to your drive manual for specifics.

For the above example, the ohmic value would be:

$$R_{brake} = {(750VDC)^2}\big/{447600watts} = 1.26ohms$$

This value must be verified with the ratings of the Braking Transistor Module selected that it is not less than the "minimum ohmic value" for that model. If so, the braking requirements may be more than the Braking Transistor Module can absorb, and a larger module may be required.

It is also possible to parallel two modules with two separate braking resistors to achieve the braking power required.

If the ohmic value calculated is greater than the value listed in the ratings table, it is possible to select a resistor value lower than the calculated value.

#### 7.1.1.4. DUTY CYCLE

The duty cycle is based on the amount of time the drive is actually braking as opposed to accelerating, running at constant speed, or idle. For instance, if a pick and place operation requires 3 seconds to accelerate, traverses for 44 seconds and then decelerates for 3 seconds, the total cycle time is:

$$T_{cycle} = T_{acc} + T_{run} + T_{dec} = 3 + 44 + 3 = 50\sec$$

The duty cycle for braking is:

$$\%_{duty} = {T_{dec}}\big/{T_{cycle}} = .06 = 6\%$$

This rating assumes the load will be linearly decreasing from peak braking power to zero braking as the load comes to a stop.

Check this rating against the modules duty cycle rating, and if it is higher than rated, go to the next higher rated module. If a duty cycle is required over 50%, please call for assistance with your application.

#### 7.1.1.5. CONTINUOUS RATING

The continuous rating is listed for long term heating calculations should the unit be installed in an area where heat dissipation is an issue. The rating is based on a triangular cycle that starts at peak value and reduces to zero within the rated duty cycle. Therefore, the average braking power during the deceleration cycle is ½ the power required if full power was required during the entire braking cycle. This value is:

$$P_{continuous} = P_{peak} * \%_{duty} / 2$$

For the above example, the

$$P_{continuous} = 447600\mathrm{W} * 6\% / 2 = 13428W$$

### 7.1.2. STATUS CONTACT CONNECTION NOTES

The Model M3575R series of Resistive Load modules is available in a variety of load sizes and configurations for use with the M3575T Braking Transistor Modules or with the drive's integral braking control module. Bonitron, Inc. also offers the Model M3575W series of Fuse Clearing "Crowbar" modules which provide definite circuit disconnection of the DC bus between the AC drive and external devices. Contact your drive distributor for more information.

This section provides possible schemes for the field connection of the Status Contact outputs provided in the M3575T, M3575R Resistive Braking Modules, and 3575W Fuse Clearing Modules. The connection schemes shown in Figures 7-1 thru 7-3 show several possibilities for utilizing the status contacts that are provided with these modules. Please refer to the drive system documentation for field control interlock connection details. Actual connection points and terminal numbers for the AC Drive module should be found in the documentation provided with the drive. Be sure to review all pertinent drive and system documentation as well as the Status Connection Notes in Table 3-2 before proceeding.

1. The connection diagrams shown below assume the use of the model M3575R resistive load module. The actual load module used may vary. Refer to the drive system documentation for details on the actual load module used.
2. Optional components shown in Figures 7-1 thru 7-3 such as input transformers, contactors, or M3575W "Crowbar" modules are not supplied with the M3575T Standard Duty Braking Transistor Modules. Please contact the drive supplier or system integrator for the availability of these items if desired.

**ATTENTION!**

*Please note that the status contact within the M3575T remains **CLOSED** until a fault condition occurs. Fault conditions include Open Load, Over Temperature, and Transistor Failure.*

**Figure 7-1: Typical Status Contact Wiring with Input Contactor**

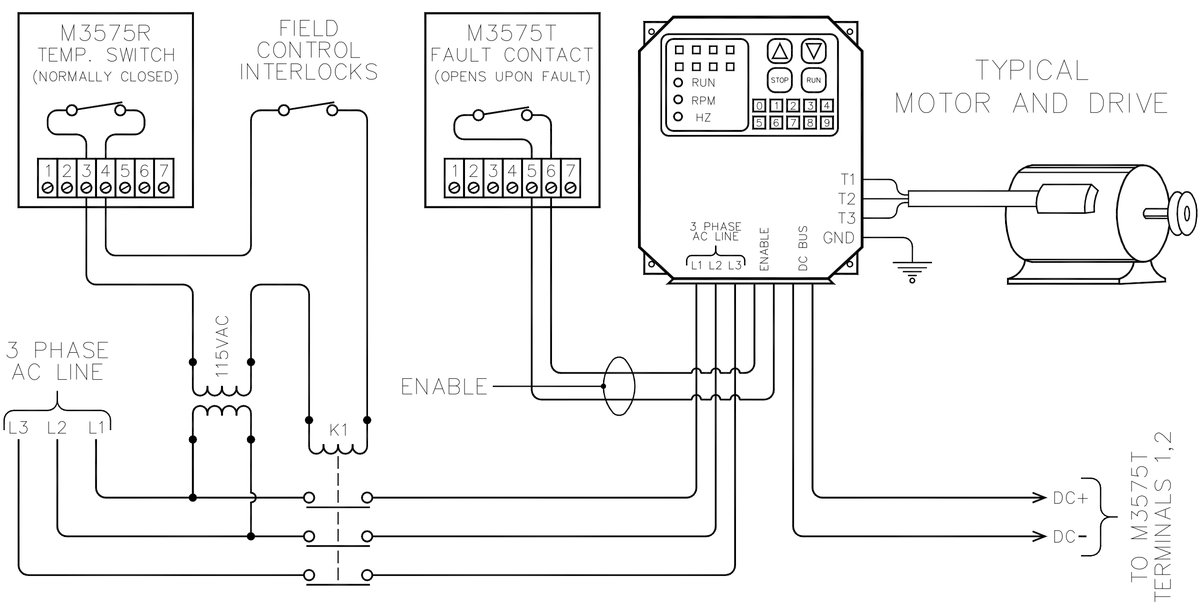


**Figure 7-2: Typical Status Contact Wiring with Crowbar Control**

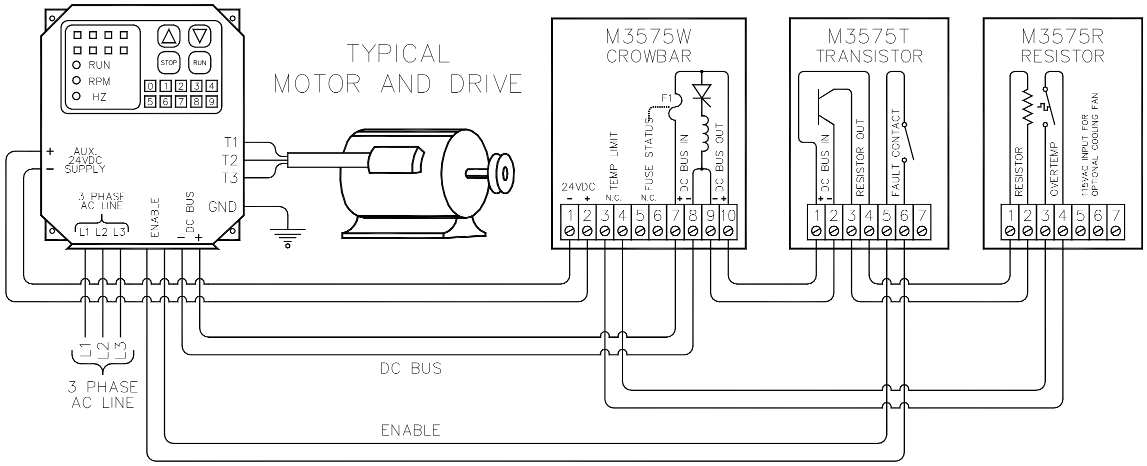
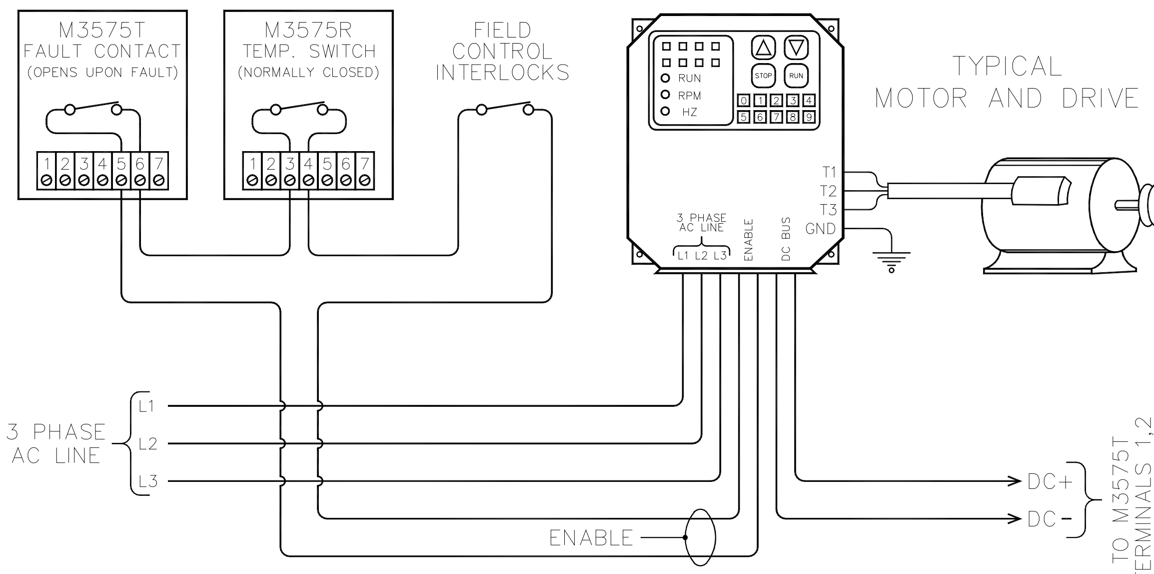



**Figure 7-3: Typical Status Contact Wiring with Drive Interlock Control**




### 7.1.3. COMMON BUS NOTES

Bonitron Dynamic Braking Transistor Modules are designed to be compatible with individual stand-alone inverter/drive systems, or systems that incorporate a Common DC Bus arrangement. The Common DC Bus can be composed of multiple inverter/drive sections tied together where all or some of the sections use their respective AC input, or there may be a large independent Master DC Bus Supply feeding the DC inputs of all inverter/ drive sections. In the case of the large Master DC Bus supply, it is common to find multiple rectifier sections in parallel to provide very high power levels. Some high power systems also include redundant or back up sections as well.



Dwg #s: 020246 Rev: 20021211 and 000392 Rev: 20000505

Once power is applied, all Bonitron modules are designed to be connected to DC buses that have all the bus capacitors present.

Common DC Bus Systems composed of separate Master DC bus or rectifier sections have important imbedded differences. It is common to have a main distributed DC bus, and this is typically where the Dynamic Braking Transistor Modules connect. In this way, the Resistive Braking system is always present, even if some of the inverter/drive sections need to be removed from the bus for maintenance or other purposes. In emergency situations, it may even be necessary to "limp" along until repairs or swap outs can occur. Even though the modules are well suited for use in these systems, the following modes of operation could arise or exist and **are not allowed**:

1. **Do not** connect the Dynamic Braking Transistor Module on the rectifier side of a DC link choke. The connections must always be made to the inverter/drive side directly to the DC bus capacitors. During normal system operation, the choke can cause the braking system to begin ringing. This ringing causes high voltages that will damage the system.
2. **Do not** energize the system with no inverters/drives present on the distributed DC Bus.
3. **Do not** energize, operate, or run the system with less than 60% of the total expected system capacitance present.
4. Operating the modules in conditions 2 and 3 may make the modules respond to inbound line transients caused by SCR type rectifiers, powering up the system, or any number of other sources. Without sufficient DC bus capacitance, the DC bus will not be filtered, and can cause ringing that will produce high voltages that will damage the system
5. In some drives, the pre-charge contactor may open under fault conditions, leaving the bulk system capacitance only resistively coupled to the Braking Transistor Modules. **Do not** use the modules in this situation. Review inverter/drive DC Bus pre-charge circuit operation with the drive manufacturer.

Always consult Bonitron with any questions or concerns surrounding this topic.

*This page is intentionally left blank.*

# NOTES

*This page is intentionally left blank.*