

**Model M3534R**  
**20A DC Bus Ride-Thru**  
**for Variable Frequency AC Drives**

**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

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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 20 Amp Model M3534R 2-Second, 50% DC Bus Sag Ride-Through module. It will provide the user with the necessary information to successfully install, integrate, and use the M3534R module in a variable frequency AC drive system.

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

DP10 details were clarified in Rev 02a of this 20A (12kW) manual.

The 40A (24kW) to 85A (50kW) models are covered by a separate manual.

**Figure 1-1: M3534R 20A in A5 Chassis**



## 2. PRODUCT DESCRIPTION / FEATURES

Variable Frequency Drives (VFDs) are commonly used in industry to improve control over continuous process applications, such as in the textile and semiconductor industries, where very accurate motor speed control is required. Unfortunately, these systems are quite susceptible to problems caused by fluctuations of incoming power, such as AC line voltage sags or outages. Long downtimes as well as large and costly production losses have been experienced due to VFD shutdowns caused by these occurrences. Including a Model M3534 RTM as part of a fixed bus inverter system will enable the system to surpass SEMI-47 compliancy specifications.

Bonitron's Model M3534 series of DC Bus Ride-Thru Modules (RTM) provide protection from AC line voltage sags and outages for AC drive systems that use a fixed DC bus as with AC PWM (VFDs). The Model M3534 series of DC Bus Ride-Thru Modules provides protection from line voltage sags or the momentary loss of one phase by temporarily storing energy internally and releasing it back into the DC bus when needed. This allows the drive to "ride through" these events, maintaining motor speed and torque, without experiencing drive shutdown.

The majority of AC line voltage fluctuations that occur in three-phase distribution systems have a magnitude (decrease from nominal voltage) of less than 50% and duration of less than 2 seconds. The Model M3534R DC Bus Ride-Thru Control module provides sufficient ride through capability to handle these types of voltage sags. However, 100% power outages can still occur, and even one such instance can be costly. For this reason, the M3534BR (Battery Ride-Thru) and M3534CR (Capacitor Ride-Thru) series of Full Outage DC Bus Ride-Thru Modules incorporate additional Bus Support Modules (BSMs) with the base M3534R Controller module. These BSMs, which can be battery banks or capacitive energy reservoirs, allow the RTM to supply DC bus power to the inverter during total outages of a predetermined duration in addition to its normal sag protection to allow sufficient time for auxiliary power systems to engage before shutdown occurs. Or, it may allow the drive system to ride through the outage completely thus avoiding the problems associated with other power supply backup methods.

### 2.1. RELATED PRODUCTS

#### **S3534UR AND S3534BR SERIES RIDE-THRU MODULES**

Adding ultra capacitor (UR) or battery (BR) energy storage allows M3534R modules to maintain loads under 100% outage conditions.

#### **M3460 SERIES RIDE-THRU MODULES**

The M3460R 230-575VAC Ride-Thru System is designed to maintain inverter bus under 3-phase 50% sag conditions with multiple cabinet systems rated up to 1200kW.

The M3460B4 350-400VDC Ride-Thru System is designed to boost a battery bank up to inverter level under 100% outage conditions.

#### **M3528 ULTRA CAP / BATTERY CHARGER**

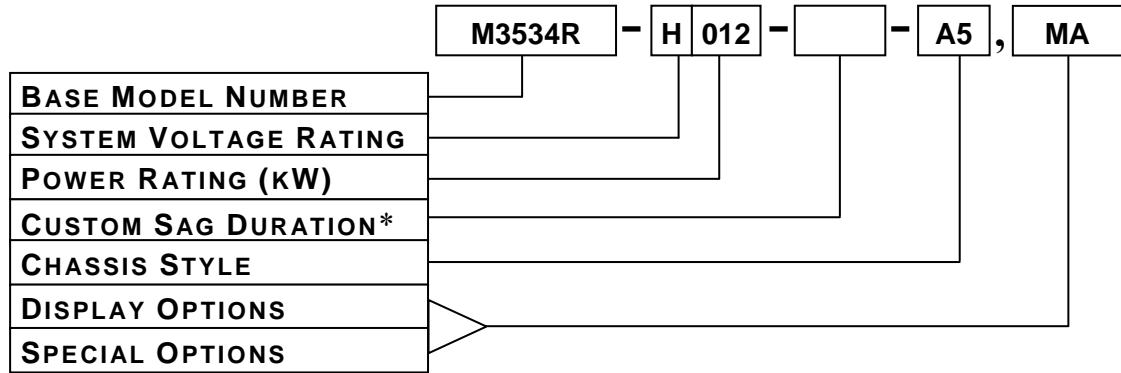
M3528 is a voltage and current limited power supply used to charge electrical energy storage devices such as battery banks or ultra capacitor reservoirs for industrial voltage levels of 240, 480, and 600V. User inputs allow for remote enable and second setpoint charging for battery equalization.

**M3628 ULTRA CAP DISCHARGE CONTROLLER AND BATTERY BANK TESTER**

M3628 systems deplete hazardous stored energy in Ultra Capacitor Ride-Thru Systems. Standard packages are typically sized to discharge the voltage to 50V in 1 minute.

**2.2. PART NUMBER BREAKDOWN**

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



**BASE MODEL NUMBER**

The Base Model Number for all 2 second, 50% sag, DC Bus Ride-Thru Modules (RTM) is M3534R.

**SYSTEM VOLTAGE RATING**

The System Voltage rating indicates the nominal AC/DC voltage levels of the AC Drive system the RTM is intended to support. Units are available for several standard AC/DC voltages. The System Voltage is indicated by a code letter.

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

RATING CODE	VOLTAGES (NOMINAL AC LINE / DC BUS)
U	115VAC Line / 160VDC
L	230VAC Line / 320VDC
E	400VAC Line / 565VDC
H	460VAC Line / 640VDC

**POWER (kW)**

The Power Rating indicates the maximum power in kilowatts that can safely be handled by the M3534R RTM control unit during outage durations of 2 seconds. This rating is directly represented by a 3-digit value based on the nominal DC system voltage rating and the maximum output current rating of the RTM. For instance, the rating code for a 12kW RTM is **012**.

Units are also available for each of the various system voltages listed above in Table 2-1 at 40A, or 85A maximum output current.

**CUSTOM SAG DURATION\***

\*This placeholder is omitted when the Standard M3534R Sag Duration (2 seconds) is ordered. Please contact Bonitron for more information.

The Custom Sag Duration Rating indicates the maximum length of time that the M3534R RTM will support the DC bus at the minimum bus voltage setpoint for the specified system voltage.

For Custom Sag Durations, the sag duration is directly represented in seconds by a 3-digit value. For example, a sag duration rating of 3 seconds maximum is indicated as **03.0**. External energy reservoirs can be added to achieve extended sag durations or full outage protection.

### **CHASSIS STYLE**

The 20 amp Model M3534R RTM comes in the A5 Type-1 panel-mountable enclosure.

**Table 2-2: Chassis Codes**

OPTION CODE	MAXIMUM CURRENT OUTPUT	CHASSIS SIZE
A5	20 Amp	18.6" H x 5.1" W x 9.4 D"

### **OPTIONS (REMOTE DISPLAY, METER, COUNTER)**

All standard Model M3534R DC Bus Ride-Thru Modules are supplied with a basic set of status indicator lights as shown in the Status Display Features section of this manual. In addition to these indicators, there are three local meter and counter options available as well as a series of remote display panels as listed in Table 4-7.

Options are represented by an alphanumeric code as seen in Table 2-3. These Option Codes can be appended after a comma at the end of the model number. If no options are ordered, this placeholder is omitted.

**Table 2-3: Remote Display, Meter, and Counter Option Codes**

OPTION CODE	DESCRIPTION
RTA	Ride-Thru Activity Counter (Resettable)
MV	DC Bus Voltmeter only
MA	DC Bus Ammeter only
DP10*	Remote Status Display w/Counter & TEST

\* If desired, remote display panels of other configurations are also available.

*Refer to Table 4-7 later in this manual for a list of all available DP\* Series Remote Mountable Ride-Thru display panels and the features of each.*

### **SPECIAL OPTIONS**

Special Options are represented by an alpha code which can be appended after a comma at the end of the model number. Special Options can be used in conjunction with the Options listed above. (ex: ,DP10,K).

**Table 2-4: Special Option Codes**

OPTION CODE	DESCRIPTION
K	Kinetic Buffering

The Kinetic Buffering Option intercepts an externally generated KB or shutdown signal and allows it to pass only when the M3534R can no longer maintain adequate DC bus level.

### 2.3. GENERAL SPECIFICATIONS

**Table 2-5: General Specifications Chart**

PARAMETER	SPECIFICATION
Input / Output Voltage	Units are available for various standard AC Input / DC Output voltages. See Section 6.1 of this manual for available Input/ Output voltage ratings.
Max. DC Output Current	Units are available with ratings of 20A maximum DC output current.
Maximum Kilowatt Rating	12kW for 460VAC systems 6kW for 230VAC systems
Maximum Sag Duration	Full load for 2 seconds at 50% sag across all 3 phases of AC line or total loss of one phase of AC line with remaining 2 phases at rated voltage 90% load for 1 second at 60% sag across all 3 phases of AC line
Duty Cycle Rating	1% duty rated at 50% voltage with 100% load
Pre-charge Time	Less than 100 milliseconds
Inactive Power Usage	See Section 6.2
System Fusing	20 amp models provide fusing on each phase of the incoming AC line and each leg of the output DC bus. See Table 6-1 for fuse ratings.
Fault / Status Indicators	LED is located on the M3534R control module front panel for each of the following: <ul style="list-style-type: none"> <li>• Power (PWR)</li> <li>• Overtemp (OT)</li> <li>• RT Active (RTA)</li> </ul>
Counters and Meters	A counter to track Ride-Thru activity is available as an option DC Bus voltmeter and/or ammeter options are also available
Kinetic Buffering	Allows buffering signal to be passed only after booster no longer maintains bus levels
Power Connections	3-Phase AC Line Input, Ground DC Bus Output External Energy Reservoir or Bus Support Module
Control Inputs	24V input initiates TEST cycle 24V input disables BOOST mode
Status Outputs	OT relay contacts available on all models RTA relay contacts available on all models
Enclosure	Available in Type-1 panel mount enclosure
Operating Temp.	40°C
Storage Temp	-20°C to +65°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!**
- **NEVER ATTEMPT TO OPERATE THIS PRODUCT WITH THE ENCLOSURE COVER REMOVED!**
- **NEVER ATTEMPT TO SERVICE THIS PRODUCT WITHOUT FIRST DISCONNECTING POWER TO AND FROM THE UNIT!**
- **ALWAYS ALLOW ADEQUATE TIME FOR RESIDUAL VOLTAGES TO DRAIN BEFORE REMOVING THE ENCLOSURE COVER.**
- **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.**
- **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.**

### 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 Model M3534R Ride-Thru Module should be accomplished following the steps outlined below.

Be sure to refer to the AC Drive instruction manual as these steps are performed.

Please direct all installation inquiries that may arise during the installation and start up of this braking product to the equipment supplier or system integrator.

See Installation Considerations in Section 7 of this manual for additional information.

#### 3.1. SITE SELECTION

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

- The unit has a Type-1 rating and will therefore require some protection from the elements.
- Conduit access for field power wiring is provided through the bottom surface of the enclosure, and for control / status through the top.
- The unit will require a minimum clearance of two (2) inches above and below it to allow for proper airflow for cooling. Avoid mounting the RTM with its bottom air intake near heat sources.
- The mounting surface should be clean and dry.

#### 3.2. PRODUCT INSPECTION

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

Once the installation site has been selected as outlined above, the unit should be mounted in place. The RTM enclosure is provided with mounting slots and slotted holes to be mounted on 1/4" diameter studs or bolts (2 for A5-chassis). Required mounting hardware is not supplied with the RTM.

Mounting holes should be drilled and mounting studs or anchors installed before positioning the enclosure. Once the studs or bolts are in place the RTM can be hung in position. Be sure all mounting hardware is tightened securely.

To determine the correct mounting dimensions and provisions for the unit being mounted, refer to the Dimensional Outline in Section 6.5 of this manual.

## 3.4. WIRING AND CUSTOMER CONNECTIONS

This section provides information pertaining to the field wiring connections of the M3534R Ride-Thru Module. Actual connection points and terminal numbers of the AC Drive system will be found in the documentation provided with that system.

Be sure to review all pertinent AC Drive System documentation as well as the RTM to Drive Interconnection details listed below before proceeding.



*Interconnect wiring of this product should only be done by a qualified electrician in accordance with National Electrical Code or local codes and regulations.*

**Table 3-1: 20 Amp Field Wiring Connections**

TERMINAL TYPE	FUNCTION	ELECTRICAL SPECIFICATIONS	MIN WIRE AWG	MAX WIRE AWG	TORQUE LB-IN
Triple Fuse Block (Lug or Spade)	AC Input L1 L2 L3	600VAC / 30 Amps	14	10	20 lb-in
Triple Terminal Block	DC Input + -	600VAC / 85 Amps	22	8	20 lb-in
Dual Fuse Block (Lug or Spade)	DC Output + -	600VAC / 30 Amps	14	10	20 lb-in
Stud (Ring Lug)	Gnd		18	10	20 lb-in

### 3.4.1. POWER WIRING - RTM TO DRIVE INTERCONNECTIONS

Illustrations and a table are provided to assist with the field connection of the M3534R Ride-Thru Module to an existing AC drive system. Also, be sure to refer to the documentation supplied with the drive system for field connection points within that system. The DC bus should always be connected directly to the drive output capacitor bank. Connecting upstream of the DC bus inductors may cause damage to the drive and Ride-Thru module.

Typical Field Connection terminal layouts for the M3534R RTM are shown in Figures 3-1 and 3-2. Figure 3-3 shows a typical power interconnection of the M3534R Ride-Thru Module with an existing AC drive system.

Field connection terminals for the Ground, AC Line Input, External Energy Reservoir, and DC Bus are located near the bottom of the RTM enclosure and can be accessed by removing the cover panel from the enclosure. For additional terminal identification, please refer to the chassis dimensional outline drawing in Section 6.5 of this manual.

#### **3-PHASE AC LINE INPUT (TS1-3,4,5)**

The 3-phase AC Line input connections are made directly to the fuse block terminals for F1 (L1), F2 (L2), and F3 (L3). Connections can be made using 10 AWG wire. These screw terminals will accept #10 ring or fork lugs. Torque all terminal screws to 20 lb-in minimum.

#### **DC BUS OUTPUT CONNECTIONS**

The DC Bus Output connections are made directly to the fuse block terminals for F4 (DC Pos) and F5 (DC Neg). Connections can be made using 10 AWG wire. These screw terminals will accept #10 ring or fork lugs. Torque all terminal screws to 20 lb-in minimum.

## **EXTERNAL ENERGY STORAGE CONNECTIONS (BUS STORAGE MODULE (BSM))**

For all units in the A5-chassis type, make the DC input connections from the external storage bank to TS1 located just above the DC Output fuses. (See Figure 3-1.) Connections can be made using 10 AWG wire. TS-1 will accept 8 AWG wire max. Torque terminal screws to 20 lb-in minimum.

### **3.4.1.1. SOURCE CONSIDERATIONS**

Input feed must be capable of delivering 2x rated current for 2 seconds @ 50% sag levels. Feeds sized to account for 150 - 200% inverter starting torque are adequate.

NOTE: Drive and Ride-Thru will not pull power at the same time.

### **3.4.1.2. GROUNDING REQUIREMENTS**

Earth ground stud is provided on the chassis for all models.

Make the Ground interconnection to Ground stud located on the lower left inner wall of the RTM enclosure. Connection to the Ground terminal can be made using 10 AWG wire. Terminal will accept a #10 ring or fork lug termination. Torque nut on ground stud to 20 lb-in minimum.

## **3.4.2. CONTROL INTERFACE WIRING**

### **3.4.2.1. TEST INPUT CONNECTIONS**

Test input connections may be made across **TB3-5 (+)** and **TB3-6 (-)** of the ASB 3534R2 Control Board. Torque terminal screws to 2 lb-in max. See Figure 4-2.

### **3.4.2.2. DISABLE INPUT CONNECTIONS**

Disable input connections may be made across **TB4-1 (Positive)** and **TB4-2 (Negative)** of the ASB 3534R2 Control Board. Torque terminal screws to 2 lb-in max. See Figure 4-2.

For units utilizing the DP10 Option, connect @ I3 **TB4-6 (+)** and **5 (-)**. See Figures 4-4, 6-11 and 6-13.

### **3.4.2.3. FAULT / STATUS MONITORING CONNECTIONS FOR STANDARD MODELS**

On the ASB 3534R2 Control Board:

**OVERTEMP (OT) Relay:** **TB4-5-5 (OT)** and **TB5-3 (Common)**. See Figures 4-4, 6-11 and 6-13.

**Ride-Thru Active (RTA) Relay:** **TB5-4 (RTA)** and **TB5-3 (Common)**.

Torque all connections to 2 lb-in max.

See Figure 4-2.

### **3.4.2.4. FAULT / STATUS MONITORING CONNECTIONS FOR MODELS WITH DP10 (3534I3 BOARD)**

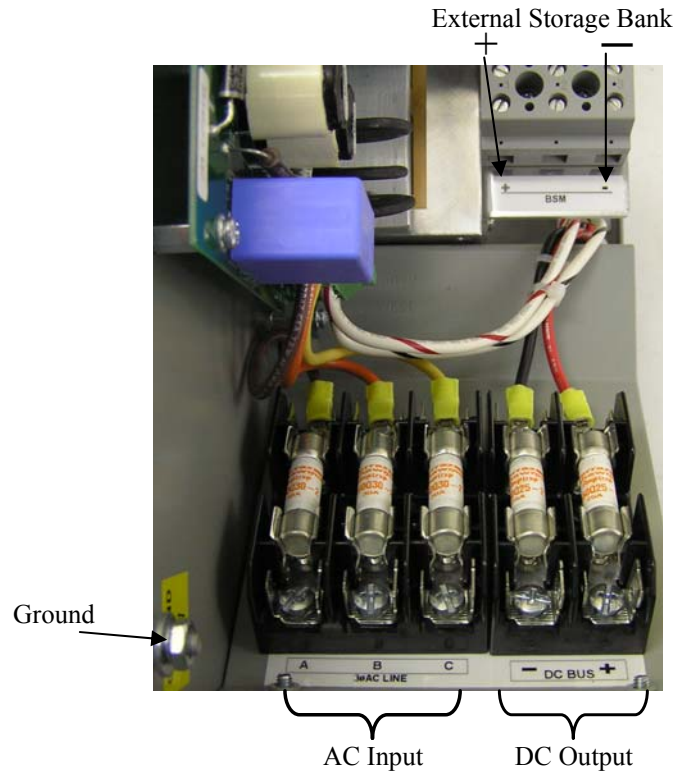
On the ASB 3534I3 Interface Board:

**Ride-Thru Active (RTA) Relay:** **TB4-1 (J2 post)** and **TB4-2 (common)**. See Figures 4-4, 6-11 and 6-13.

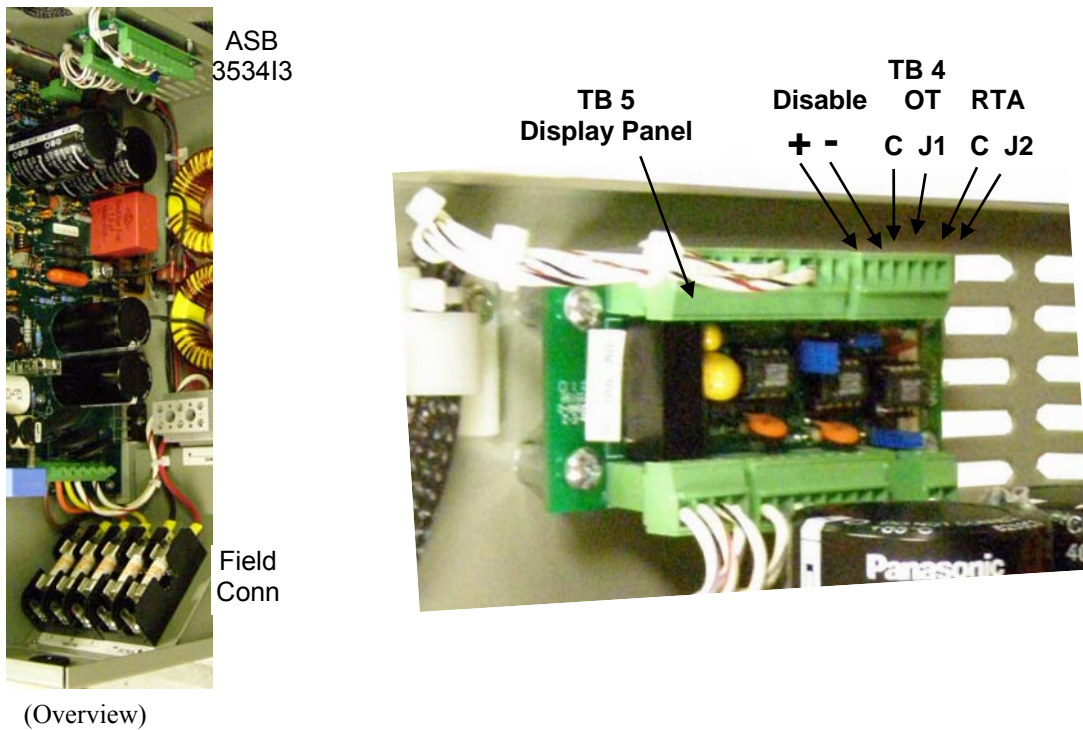
**Over-Temp (OT) Relay:** **TB4-3 (J1 post)** and **TB4-4 (common)**. See Figures 4-4, 6-11 and 6-13.

Torque all connections to 2 lb-in max.

**Figure 3-1: A5 Chassis Field Connection Terminal Layout**

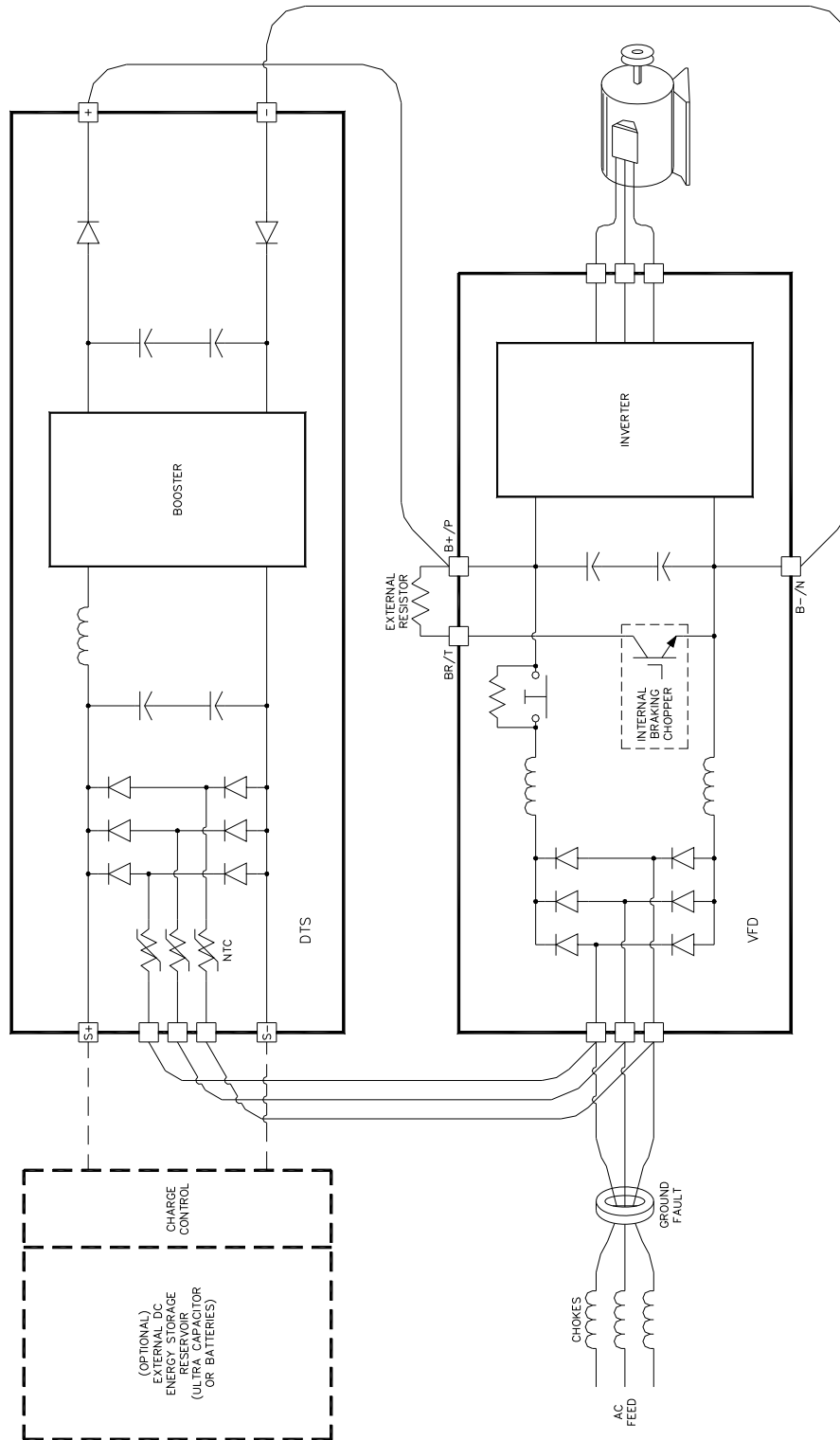


**Figure 3-2: Typical A5 Control and Status Connections with I3 Interface**



### 3.5. TYPICAL CONFIGURATIONS

**Figure 3-3: Typical 20 Amp M3534R Interconnection with Existing Drive System**



~NOTES~  
 1. CONNECT DC DIRECTLY TO MAIN CAP BANK. USE THE SAME CONNECTION AS USED FOR EXTERNAL BRAKING CHOPPER. CONNECT AC DOWNSTREAM OF ANY LINE CHOKES OR HARMONIC FILTERING.

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## 4. OPERATION

### 4.1. FUNCTIONAL DESCRIPTION

The M3534R series of Ride-Thru Modules (RTMs) employs IGBT switching technology to regulate the inverter DC bus to a preset minimum voltage level. As the incoming AC voltage level drops, the RTM “activates”, boosting a rectified DC voltage up to the minimum DC bus voltage level specified for the inverter, allowing it to “ride through” the sag or outage event.

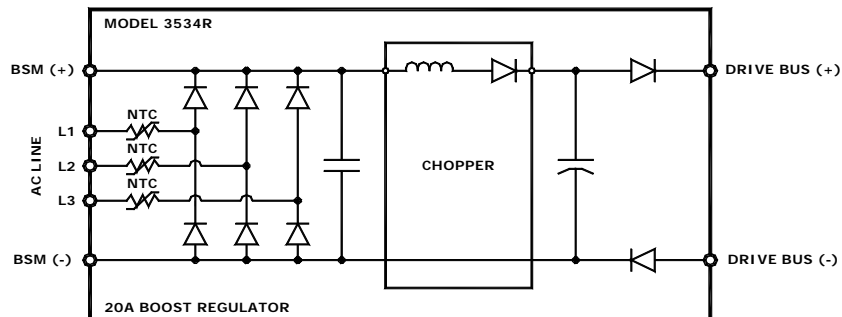
Upon application of power to the M3534R, its DC bus will begin to precharge via internal NTC surge limiters. When the bus reaches 150VDC, the internal logic power supply of the RTM will begin switching, and will supply the +24V and ±15V DC needed to power the control circuitry. At this point the PWR LED will illuminate. In addition, the RTA relay within the RTM and its corresponding RTA LED may turn on briefly during the RTM’s precharge period. Once the RTM’s DC bus has fully precharged to its preset nominal value (see Ratings chart in Section 6 for voltage levels), the control module’s PWR LED will be **ON**, and the RTA and OVERTEMP LEDs will be **OFF**. The RTM is now ready to protect the inverter system from voltage sags up to and beyond SEMI-47 conditions.

During a voltage sag or outage, the inverter DC bus level will decrease, pulling the RTM bus down with it. Once the DC bus drops below a preset low limit (“threshold”) the RTM will become “active”. When this occurs, the RT ACTIVE front panel LED will illuminate, the internal RTA relay contact will change states, the cooling fan will begin running in order to cool the internal IGBT heatsink, and the DC bus level will be supported by the RTM. The RT ACTIVE LED and internal relay will be **ON** only while the RTM is active (real time). The cooling fan will continue running for 2 minutes after activity stops. A special Kinetic Buffering option will hold off an externally generated KB signal until the RTM can no longer maintain threshold DC bus level.

If the RTM begins supplying power continuously, possibly due to a low line level, incorrect threshold adjustment, or inverter fuse failure, an over temperature condition may occur. If this happens, the OVERTEMP front panel LED will turn **ON** and the internal OT relay will energize, shutting down the switching circuits and allowing the DC bus to drop to the nominal level. At this point, the RTM will continue supplying power, via an internal bridge rectifier, at the nominal line level.

If the sag duration exceeds 50% while the RTM is fully loaded, the output DC bus level will begin to drop. If the inverter’s LOW BUS trip level is reached, the inverter will shut down. When the DC bus drops to 100V, the RTM’s internal logic supply will shut down.

**Figure 4-1: Basic 20A M3534R RTM Internal Power Flow Circuit Diagram**



## 4.2. FEATURES

### 4.2.1. TERMINAL STRIP I/O

See Figure 6-3 for physical connection locations.

See Figures 6-10 and 6-14 for details.

#### 4.2.1.1. CONTROL INPUTS

##### FOR STANDARD MODELS

- The DISABLE command is connected to TB4 1&2 of the 3534R2 control board. 24V will inhibit the module from boosting. No connection allows normal operation. Use this to prevent excessive battery cycling while system power is normal.
- The TEST command is connected to TB3 5&6 on the 3534R2 control board. 24V initiates TEST. Input is insulated from drive common.

##### FOR MODELS WITH DP10 OPTION (I3 BOARD)

- The DISABLE is connected to the 3534I3 interface board @ TB4-6&5.

#### 4.2.1.2. RTM FAULT LOGIC DETAIL OVERVIEW

All standard M3534R Ride-Thru Control Modules are equipped with basic Fault / Status outputs. These outputs are accessible via on-board terminal strip TB5 for 20 amp models. Each output is jumper selectable to provide for either “Normally Open” or “Normally Closed” dry contact output. Each contact is in its “Normal” condition while its controlling relay is “Inactive” or at rest.

All units are shipped with all Fault / Status outputs in the “Normally Open” position.

Refer to the ASB 3534R2 Control Board layout drawing in Figure 6-10 for the locations of each of the components listed in Tables 4-1 thru 4-6, and to Figure 6-12 for the schematic.

#### 4.2.1.3. ASB 3534R2 STATUS OUTPUT CONFIGURATION JUMPERS

##### FOR MODELS WITH DP10 OPTION (I3 BOARD)

Fault Signals are available on the 3534I3 board as described in Section 4.2.2.4.

##### FOR STANDARD MODELS

The purpose and setting for each of the configuration jumpers provided on the ASB 3534R2 RTM Control board is described below. Please refer to Figure 4-2 for the locations of each of the jumpers listed below. (See Figures 6-10 and 6-12 for additional details.)

Each output is jumper selectable to provide “Normally Open” (**NO**) or “Normally Closed” (**NC**) dry contact outputs. Each contact is in its “Normal” condition while its controlling relay is “Inactive” or at rest. Leaving a jumper **OFF** will disable the fault output.

Each Fault / Status Output has a corresponding LED indicator. When a Fault / Status LED is **ON**, its corresponding relay can be assumed to be “Active”.

##### JUMPER J1 – OVER-TEMP FAULT OUTPUT:

This jumper allows the user to select the output contact state of Over-Temp fault relay K2. K2 is pulled in when power is applied and there is

no overtemp condition. This jumper must be set to “Normally Closed” (NC) for cabinet systems.

**JUMPER J2 – RIDE-THRU ACTIVE STATUS OUTPUT:**

This jumper allows the user to select the output contact state of Ride-Thru Active status relay K3. This jumper **must** be set to “Normally Open” (NO) for cabinet systems.

**Table 4-1: Control Signal Details- 3534R2 Control Board for Standard Models**

BOARD		DISABLE	TEST
3534R2	Rating	6mA @ 24V 3kV Isolation	8mA @ 24V 3kV Isolation
	Terminal	TB4-1(+), 2(-)	TB3-5(+), 6(-)
	State	24V to disable	24V to test

**Table 4-2: Control Board Control Signal Details for Modules with DP10 “I3” Option**

BOARD		DISABLE
3534I3	Rating	20mA @ 24V 3kV Isolation
	Terminal	TB4-6(+), 5(-)
	State	Jumper Selectable

**Table 4-3: Status Signal Component Details- 3534R2 Control Board for Standard Models**

BOARD	FAULT/STATUS COMPONENTS	FAULT / STATUS SIGNAL COMPONENT ID	
		OVERTEMP (OT)	RIDE-THRU ACTIVE (RTA)
3534R2	Jumper	J1	J2
	Relay	K1	K2
	Contact Ratings	1 Amp @ 24VAC .5 Amp @ 115 VAC	1 Amp @ 24VAC .5 Amp @ 115 VAC
	Indicator	LD2	LD3
	Control Board Terminations	TB5-5,3	TB5-4,3
	Isolation	1kV	1kV

**Table 4-4: Status Signal Component Details for Modules with DP10 “I3” Option**

BOARD	FAULT/STATUS COMPONENTS	FAULT / STATUS SIGNAL COMPONENT ID	
		RIDE-THRU READY (RTR)	RIDE-THRU ACTIVE (RTA)
3534I3	Jumper	J1	J2
	Relay	K2	K3
	Contact Ratings	120mA @ 350VDC	120mA @ 350VDC
	Indicator	None	None
	Interface Board Terminations	TB4-3&4	TB4-1&2
	Isolation	3kV	3kV

**Table 4-5: Control Status Signal Component Specifications**

BOARD	TERMINAL TYPE	FUNCTION	ELECTRICAL SPECIFICATIONS	MIN WIRE AWG	MAX WIRE AWG	TORQUE LB-IN
3534R2	Phoenix plug TB5	Status	120VAC / .5 Amp 1kV Isolation	22	16	2 lb-in
	Phoenix plug TB3	Test	24VDC / 20mA 3kV Isolation	22	16	2 lb-in
	Phoenix plug TB4	Disable	24VDC / 20mA 3kV Isolation	22	16	2 lb-in

**Table 4-6: Fault / Status Contact Logic Details – 3534R2 Board**

RTM FAULT / STATUS CONDITION	INDICATORS			JUMPER POSITIONS & CONTACT STATES			
	PWR	OT	RTA	OT (J1)		RTA (J2)	
	(LD1)	(LD2)	(LD3)	N.C.	N.O.	N.C.	N.O.
Power off or P.S. failure	OFF	OFF	OFF	X	O	X	O
Power on in normal condition	ON	OFF	OFF	O	X	X	O
Power on in Overtemp condition	ON	ON	OFF	X	O	X	O
Power on & Ride-Thru Active	ON	OFF	ON	O	X	O	X

NOTES:

X = contact is closed under stated conditions

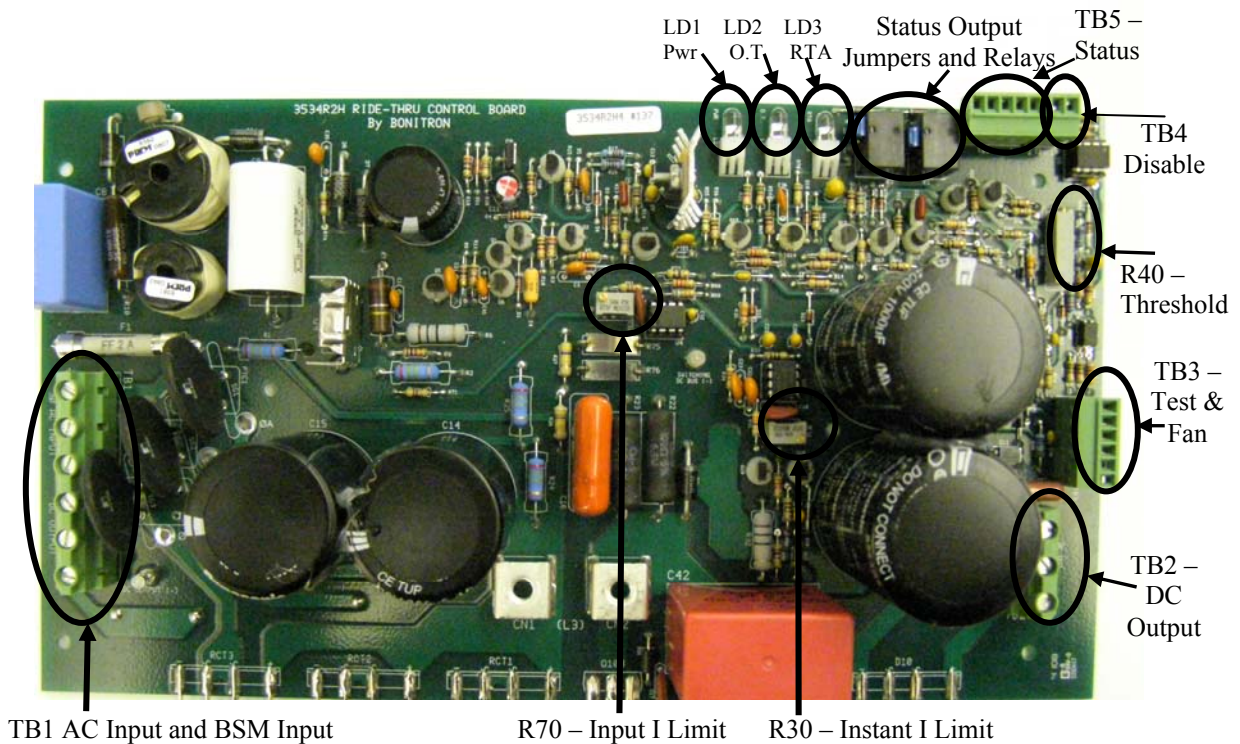
O = contact is open under stated conditions

4.2.2. INDICATORS

4.2.2.1. ASB 3534R2 CONTROL BOARD

The ASB 3534R2 is the main control board of the Ride-Thru Control module used in all 20 Amp M3534R Ride-Thru Control Modules. Figure 4-2 shows the locations of all major components of the board, which are described in detail below.

**Figure 4-2: ASB 3534R2 RTM Control Board Features**



**ASB 3534R2 STATUS INDICATORS**

The purpose and function of each status indicator provided on the ASB 3534R2 RTM Control board is described below. Please refer to Figure 4-2 above for the locations of each of the indicators listed below.

**LD1 – PWR (POWER):**

The LD1 PWR indicator shows the presence of control power within the M3534R RTM Control Module. This indicator is ON when power is present.

**LD2 – OT (OVER-TEMP):**

The LD2 O.T. indicator shows the presence of an Over-Temp condition within the M3534R RTM Control Module. This indicator directly tracks the activity of **Over-Temp** status output relay **K1**. This indicator is **ON** and the relay is de-energized when an Over-Temp condition is present.



## **LD3 – RTA (RIDE-THRU ACTIVE):**

The **LD3 RTA** indicator shows when the M3534R RTM Control Module is actively supporting the DC bus. This indicator directly tracks the activity of **RTA** status output relay **K2**. This indicator is **ON** and the relay is energized when ride through activity is present (must have a minimum of 0.25 amps load current).

### **4.2.2.2. OPTIONS**

The Model M3534R Ride-Thru Module can optionally be equipped with a single counter or meter mounted on a bracket to be visible through a front panel cutout as well as specific options. Each of these is described below.

#### **DC BUS VOLTAGE METER:**

The DC bus voltmeter displays the output DC bus voltage of the M3534R module.

#### **DC BUS CURRENT METER:**

The DC bus ammeter displays the output DC bus current of the M3534R module during a sag or outage event.

#### **RIDE-THRU EVENT COUNTER:**

This counter tracks and displays the number of times the RTM was active. The counter is triggered by any Ride-Thru activity greater than 0.25 amps. It is factory configured to be resettable but can easily be reconfigured to be non-resettable if desired.

#### **KINETIC BUFFERING HOLD OFF / BYPASS:**

This option intercepts a KB (kinetic buffering) signal between the power supply and drive system. As long as the Ride-Thru can maintain DC bus level, the KB signal is held off. Once the DC bus drops out of regulation, the KB signal will be passed to the drive system to begin the buffering process. The Kinetic Buffering option is currently only available on the 85A model.

### **4.2.2.3. ASB 3534K1 KINETIC BUFFERING BOARD**

Some power supplies produce a “Dip” or “Kinetic Buffering” signal to slow the inverter speed when a drop of incoming voltage is detected. This slowing in speed causes regenerated energy to pump up the inverter DC bus, which allows the motor to slow instead of the inverter tripping from an under-voltage fault. The inverter then regains speed when incoming power returns. If all motors drop in speed proportionally, some processes can continue to run. This method may help keep the process from complete shut down due to power sags, but the product quality usually still needs to be downgraded.

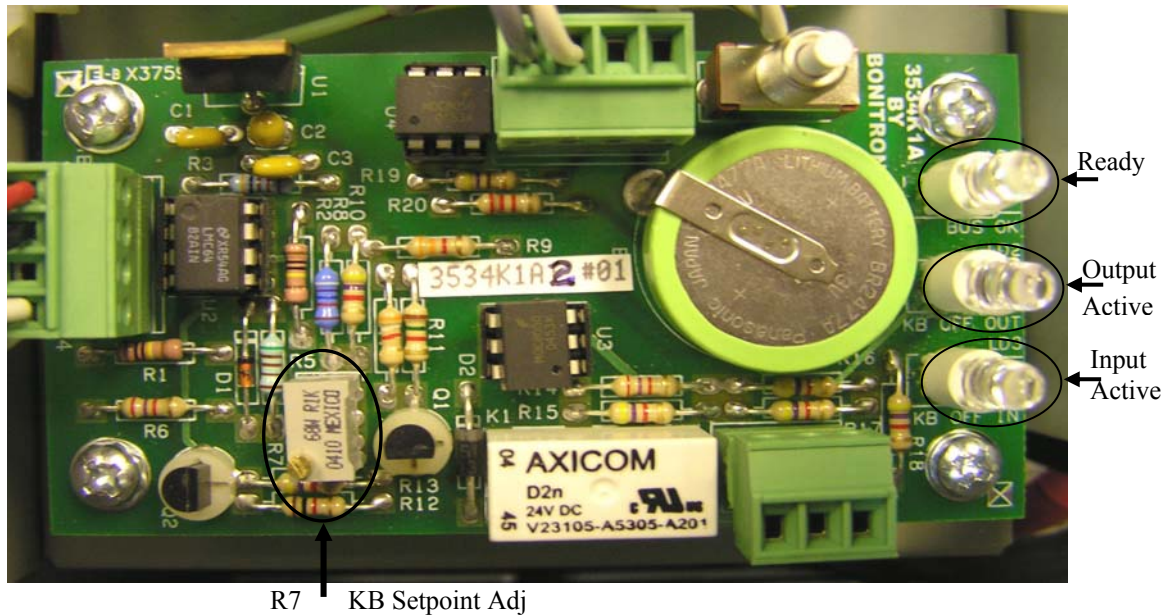
The Bonitron “Kinetic Buffering” option intercepts a systems 24VDC Kinetic Buffering signal. When the AC line drops, this signal is held off from the inverter while the DRT keeps the bus at “threshold level”.

At some point the DRT can no longer hold up the DC bus. Once the 2 second time out occurs, the kW rating is exceeded, or the sag is too large, the DC bus will sag beyond the threshold, and the Ride-Thru will pass along the “Kinetic Buffering” signal in order for the inverter to begin Kinetic Buffering.

Kinetic buffering is usually set to become active about 5% below the threshold level, but still above the drive trip level. On a 380VAC system the DC bus threshold would typically be set for 485VDC, and the Kinetic Buffering hold-off would be set to pass the signal when the bus drops to 460VDC. If the threshold is set lower, the Kinetic Buffering hold-off should be adjusted accordingly.

ASB 3534K1 controls an external kinetic buffering signal for the M3534R Ride-Thru Module. Figure 4-3: *ASB 3534K1 Kinetic Buffering Board Features* shows the locations of all major components of the board.

**Figure 4-3: ASB 3534K1 Kinetic Buffering Board Features**



## **ASB 3534K1 STATUS INDICATORS**

The purpose and function of each status indicator provided on the ASB 3534K1 Kinetic Buffering Board is described below. Please refer to Figure 4-3 above for the locations of each of the indicators listed below.

### **IN:**

The **IN** indicator will illuminate if Kinetic Buffering input is active.

### **OUT:**

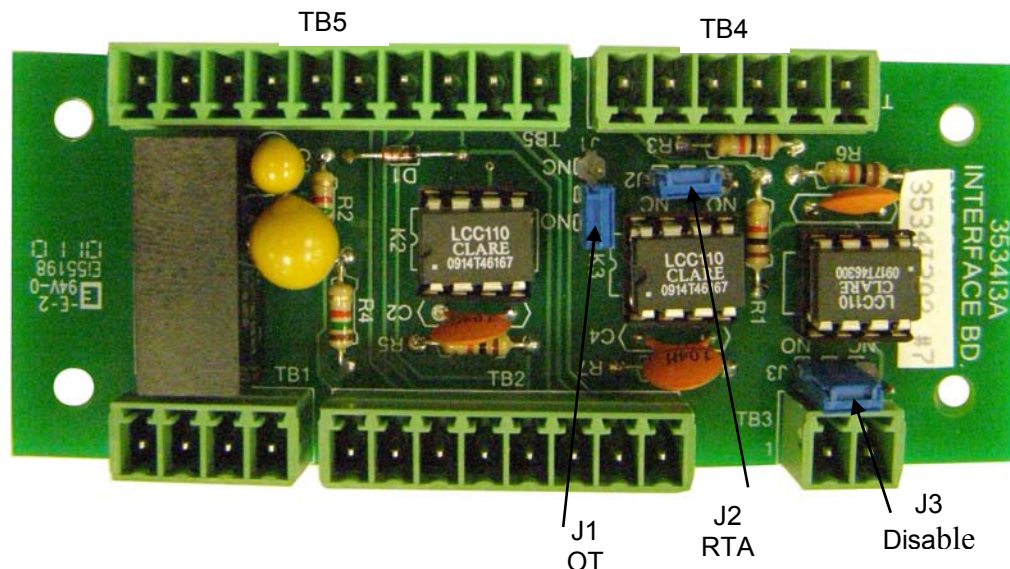
The **OUT** indicator will illuminate if Kinetic Buffering output is active.

### **READY:**

The **READY** indicator will illuminate if the DC bus is above the KB setpoint.

#### 4.2.2.4. ASB 3534I3 INTERFACE BOARD

**Figure 4-4: ASB 3534I3 Interface Board Features**



#### **3534I3 INTERFACE BOARD JUMPER SET-UP**

The 3534I3 interface card isolates the front panel from the drive system voltage, and provides an output for remote monitoring of Ready and Active signals. Jumpers select the contact of each opto FET relay device. See Section 6 for basic schematic of I/O signals.

**J1:** Selects N.O. or N.C. contact for the Overtemp (OT) signal. With J1 in the “N.O.” position the contact will be made while the module temperature is within specified limits.

**J2:** Selects N.O. or N.C. contact for the Ride-Thru Active (RTA) signal. With J2 in the “N.O.” position the contact will be made while the module is “ACTIVE”.

**J3:** Selects N.O. or N.C. contact for the Disable (DIS) signal. With J3 in the “N.O.” position the boost module will be disabled if there is 15-24VDC on the disable input terminals.

**TB4:** The TB4 connector provides a field connection point for Disable, Overtemp and Active signals. Signals are isolated up to 3000V.

- Overtemp – available on TB4 terminal 3 (J1 post) and terminal 4 (common).
  - 350VDC, 120mA max
- Active - available on TB4 terminal 1 (J2 post) and terminal 2 (common)
  - 350VDC, 120mA max
- Disable - Input on TB4 terminal 5 (neg DC) and terminal 6 (pos DC)
  - 15-28VDC, (20mA @ 28VDC)

#### 4.2.3. LOCAL METERS

A single voltmeter, ammeter, or counter can be installed in the front of the standard Type-1 chassis. See Table 2-3 and Section 4.2.2.2.

## 4.2.4. REMOTE OR CABINET DOOR SYSTEM STATUS DISPLAY AND TEST MODULE

The Ride-Thru Diagnostic Display Panel provides visual indication of the Ride-Thru module's operating status. Currently, there are 4 DPxx display panel configurations. The most common combinations of features are detailed in Table 4-7 and Figure 4-4 on the next page.

The monitored functions include **POWER**, **RIDE-THRU ACTIVE**, and **OVERTEMP**. In addition, this panel provides the system **TEST** switch required for threshold voltage adjustments and system calibration. This display panel has 1000V of electrical isolation from the drive system.

The function of each indicator is described below.

### **PWR (POWER)**

The GREEN **POWER** LED is **ON** if power is applied to the system.

### **RTA (RIDE-THRU ACTIVE)**

The AMBER **RIDE-THRU ACTIVE** LED is **ON** if the module is regulating the DC bus voltage under an input line dip condition.

### **OT (OVER-TEMP)**

The RED **OVERTEMP** LED is **ON** if the heatsink temp exceeds 70° C.

### **TEST SYSTEM SWITCH**

The Test System push-button switch will cause the Ride-Thru section to raise the DC bus dip setpoint by 17%. The inverter input current will drop and the Ride-Thru current will start. This test will run and the DC bus dip setpoint will remain raised for as long as the switch is pressed.

#### 4.2.4.1. **BUS VOLTAGE METER**

The Bus Voltage Meter indicates the Ride-Thru DC bus voltage. The voltmeter can be driven from the 3534I2 board or the 3660M1 board depending on application parameters. Each of these boards uses a voltage divider connected across the DC bus to drive the panel meter. The Voltmeter will read slightly lower than the drive bus when idle.

#### 4.2.4.2. **BUS CURRENT METER**

The Bus Current Meter indicates the positive DC bus current supplied by the Ride-Thru module. For voltage-isolated panels, the current is sensed by a Hall Effect device and the meter is driven from the 3534I2 board.

#### 4.2.4.3. **ACTIVE CYCLES COUNTER**

The Active Cycles Counter indicates the number of times the Ride-Thru module has been active since this counter was last reset. The counter is battery powered and therefore does not lose its count during a power outage. The counter may be reset to zero by pressing the Reset push-button. This button is located to the right on the front face of the counter.

#### 4.2.4.4. **TOTAL RTA CYCLES COUNTER**

The Total RTA Cycles Counter indicates the lifetime total number of times the Ride-Thru module has been active. The counter is battery powered and therefore does not lose its count during a power outage. This counter is not affected by the Reset push-button located to the right

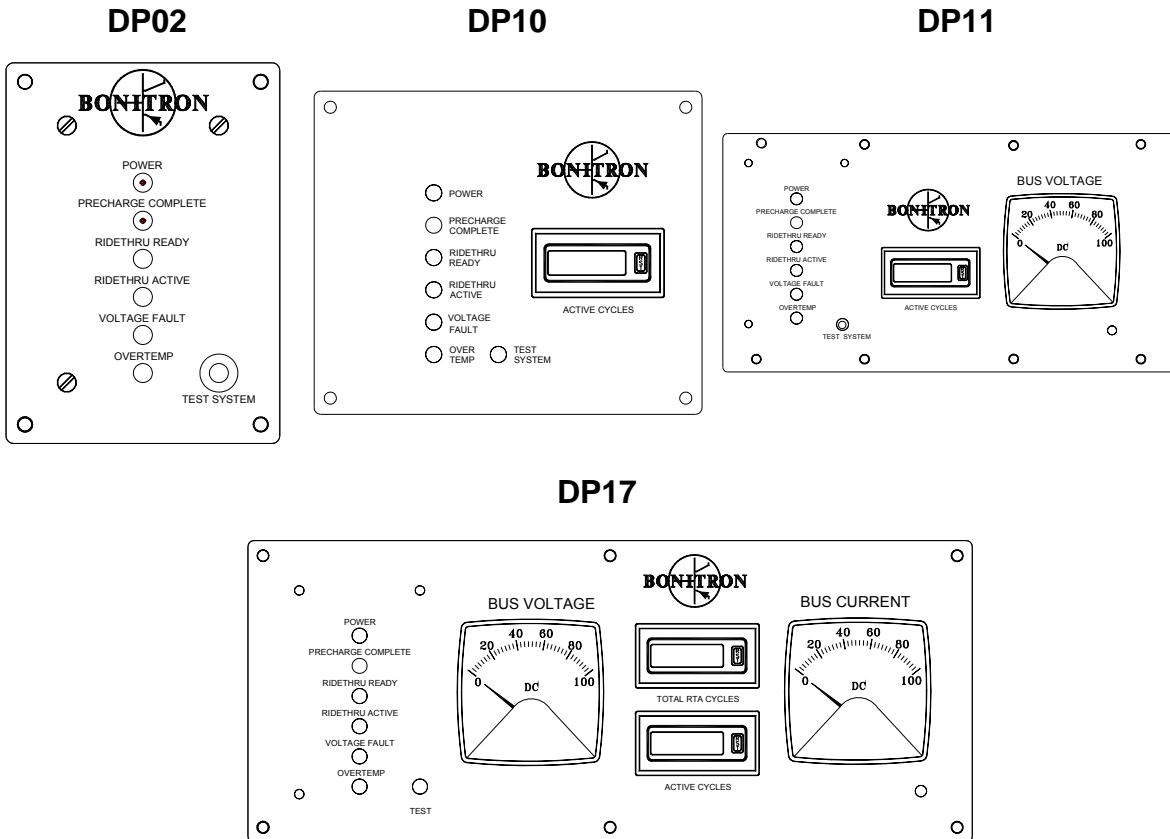
on the front face of the counter. To reset the Total RTA Cycles Counter please consult Bonitron Engineering.

**Table 4-7: Diagnostic Display Panel Configurations**

PANEL NUMBER	LEDs & TEST SWITCH	METERS		COUNTERS		PANEL DIMS.
		VOLTMETER	AMMETER	TOTAL CYCLES	ACTIVE CYCLES	
DP2	✓					5" x 3.6"
DP10	✓				✓	5" x 6"
DP11	✓	✓			✓	5" x 9"
DP17	✓	✓	✓	✓	✓	5" x 12"

\* DP17 requires an external interface card (3534I2)

**Figure 4-5: DP\*\* Series Remote Display Panel Layouts**



## 4.3. STARTUP



*The M3534R RTM contains capacitive elements for energy storage. Be aware that high voltages may exist inside the module even after the unit has been disconnected. Always allow ample time for these voltages to discharge before attempting service. Only qualified technicians should complete this start up procedure. Failure to heed this warning may result in severe bodily injury or death!*

### 4.3.1. PRE-POWER CHECKS

Before beginning, be sure that the main disconnect for the M3534R is in the OFF position.

- Ensure that the model M3534R Ride-Thru module has been properly installed and wired as previously outlined in the Installing the M3534R Ride-Thru Module and Wiring the M3534R Ride-Thru Module sections of this manual.
- The DC bus threshold setpoint of the M3534R RTM must be coordinated with the under voltage trip setting of the inverter. If the threshold is too close to the nominal bus, the RTM may supply power to the drive continuously, and overheat. If the threshold is too close to the under voltage trip level of the inverter, the RTM may not ride through, and under voltage trips on the drive may still occur during sag events.

Most inverters have an under voltage trip point of 15% below nominal DC bus levels. Some inverters can be reprogrammed to change this trip level. Bonitron typically sets the DC bus threshold to be approximately 10% below nominal level. For example, Bonitron sets all 460VAC systems to hold the 640VDC bus to 585VDC. Refer to the inverter documentation for details on adjusting its under voltage trip setting if the factory default setting is other than 15% below nominal DC bus level.

### 4.3.2. STARTUP PROCEDURE AND CHECKS

1. De-sensitize or disable inverter ground fault circuits when using a 20A Ride-Thru Module as pre-charge may cause uneven current levels in all 3 phases.
2. Ensure that the associated inverter is on-line and functioning properly.
3. Ensure that the DC bus polarity is correctly wired at the disconnect switch connecting the inverter DC bus with the RTM DC bus.
4. Apply power to the M3534R module and verify the following start-up sequences:
  - M3534R module POWER LED comes **ON**, the RT ACTIVE LED flashes **ON**, and the OVERTEMP LED remains **OFF**.
  - If the Kinetic Buffering Option is installed: The kinetic buffering READY LED comes **ON**, KB IN and OUT remain **OFF**.

Please note that the M3534R uses a thermistor in its start-up circuitry. If the thermistor is still warm from a previous run when power is applied there may be a delay of a few seconds before the power up sequence above occurs.

20A units use NTC devices to limit inrush current. Precharge will be complete in less than 10ms with a surge of up to 100A for 1ms. The RTM is then ready to provide ride-thru support (ground fault circuits may need to be de-sensitized or delayed.)

## 4.3.2.1. VERIFY RIDE-THRU CAPABILITY

1. Apply 24V to TEST input, or press TEST button if DP Series front panel option is installed.
  - DC bus voltage will rise for duration of test
  - Drive input current will drop for duration of test

This proves power is transferred from RT module to inverter, and that the RT is functioning. See THRESHOLD procedure below for more detailed description.

2. Remove power from the inverter only.
  - If the Kinetic Buffering Option is installed: KB **IN** LED comes **ON**.
  - M3534R module **RT ACTIVE** LED will come **ON** for duration of event. LED intensity is directly related to load levels.
  - When fully loaded, the inverter DC bus will drop to the minimum regulated voltage level as defined in Table 6-2: *Model M3534R Ride-Thru Module Voltage Levels* in Section 6.1 of this manual.
  - Inverter should be able to keep motor speed and torque constant.



**CAUTION!**

*Remember not to exceed the 2-second sag duration limit for this test. Also, this test should not be repeated with a frequency that exceeds the module's 1% duty cycle rating.*

## 4.4. OPERATIONAL ADJUSTMENTS

### 4.4.1. THRESHOLD VOLTAGE ADJUSTMENT PROCEDURE FOR MODEL M3534 RIDE-THRU MODULES

The "Threshold" voltage level is the voltage at which the Bonitron Model M3534 Ride-Thru module maintains the DC bus during a power dip. Whenever the DC bus level drops to the "Threshold" setpoint, the Ride-Thru module becomes active to regulate the DC bus voltage to the "Threshold" setpoint voltage.

Generally, the "Threshold" level should be set at 10-15% below the nominal DC bus level. If running on single phase system, threshold and battery levels may need to be lowered to prevent excessive activity. An actual on-site level setting must be determined by the loaded DC bus level as well as the amount of ripple present on the DC bus. The Ride-Thru Module should not become active during normal everyday operation.

During a test cycle the "Test boost" level is typically elevated 17% above threshold on all Bonitron Model M3534 Ride-Thru Modules. These approximate levels are specified in the General Specifications section of the Customer Reference manual for each Ride-Thru module and are based on the original factory setting of the threshold level. Some field adjustment of this level may be required to achieve the optimum setpoint level for any given system. Refer to Figures 7-3 & 7-4 for typical DC bus voltage levels.

Table 4-8 lists the typical factory setpoints for the "Threshold", "Over-Voltage", and "Test Boost" levels for the Model M3534 Ride-Thru modules based on the system AC or DC input voltage requirements. Be sure to check the Customer Reference manual for each Ride-Thru module for specific setpoint levels.

**Table 4-8: Factory Setpoints for Threshold and Test Boost Voltages**

INPUT VOLTAGE	THRESHOLD	TEST BOOST	OVER-VOLTAGE
208VAC	265VDC	+45VDC	360VDC
230VAC	285VDC	+48VDC	360VDC
380VAC	485VDC	+82VDC	630VDC
400VAC	500VDC	+85VDC	630VDC
415VAC	515VDC	+87VDC	630VDC
460VAC	585VDC	+100VDC	710VDC

#### 4.4.2. DETERMINING THRESHOLD VOLTAGE SETPOINT

Testing and adjustment of the "Threshold" voltage setpoint can be performed on systems in either an "On-line and loaded" or an "Off-line and unloaded" condition as described in Methods 1 and 2 below. Each of the two methods described require that you monitor the DC bus voltage during the testing and adjustment procedures.

Be sure to read through both adjustment methods completely before attempting any adjustment of the "Threshold" voltage setpoint.

##### **METHOD 1: DETERMINING THE THRESHOLD VOLTAGE SETPOINT FOR AN ON-LINE AND LOADED SYSTEM**

###### **1) VERIFY PROPER INSTALLATION.**

Ensure that the Bonitron Model M3534 Ride-Thru Module has been properly installed and wired according to all applicable system and module wiring diagrams.

###### **2) PUSH THE TEST BUTTON.**

Push the "Test" button while monitoring the DC bus voltage.

On modules so equipped, the "Test" button is located on the module's control/display front panel. For modules without a control/display front panel, a normally-open momentary switch should be installed to serve as a test switch for this procedure. Refer to applicable field wiring diagrams for switch connection points.

###### **3) READ THE DC BUS METER AND SUBTRACT THE BOOST VOLTAGE.**

When the TEST button is pushed, the Threshold voltage level is "Boosted" above the threshold setpoint. The Boost will be maintained in real-time by the TEST button for as long as the button is pressed.

During this "Boost" period, you should see the DC bus level increase. The amount that the DC Bus actually increases will depend on the Threshold level adjustment as well as the input voltage and DC bus output current.

For example, for a Ride-Thru system with an input voltage of 460VAC, the Threshold voltage level is preset to be 585VDC and the Boost voltage level is factory preset for an increase of 17% (100VDC).

Assuming that these preset levels have not been altered, initiating the test described above on a lightly loaded system of this nature would cause the DC bus level to rise to 685VDC (585VDC + 100VDC). Subtracting the Boost voltage (100VDC) from this reading shows that the actual Threshold voltage level is 585VDC.

Initiating this test on a heavily loaded system of this nature would also cause the DC bus level to rise. However, the DC bus would stop rising once current limit is reached.

**NOTE:** The Boost voltage level is factory preset and is not adjustable in the field.

## **METHOD 2: DETERMINING THE THRESHOLD VOLTAGE SETPOINT FOR AN OFF-LINE AND UNLOADED SYSTEM**

### **1) REMOVE INPUT VOLTAGE SUPPLY FROM SYSTEM.**

Disconnect the input voltage to the Ride-Thru while monitoring the DC bus voltage. As the DC bus drops to the Threshold setpoint voltage, the Ride-Thru module will become active. The Ride-Thru will then maintain the DC bus voltage at the Threshold setpoint level for approximately 1 second while the primary capacitor discharges, at which point, the DC bus will continue to drop. Read the DC bus voltage as it is being maintained. This is the Threshold setpoint voltage.

#### **4.4.2.1. ADJUST THE SETPOINTS AND REPEAT THE TEST**

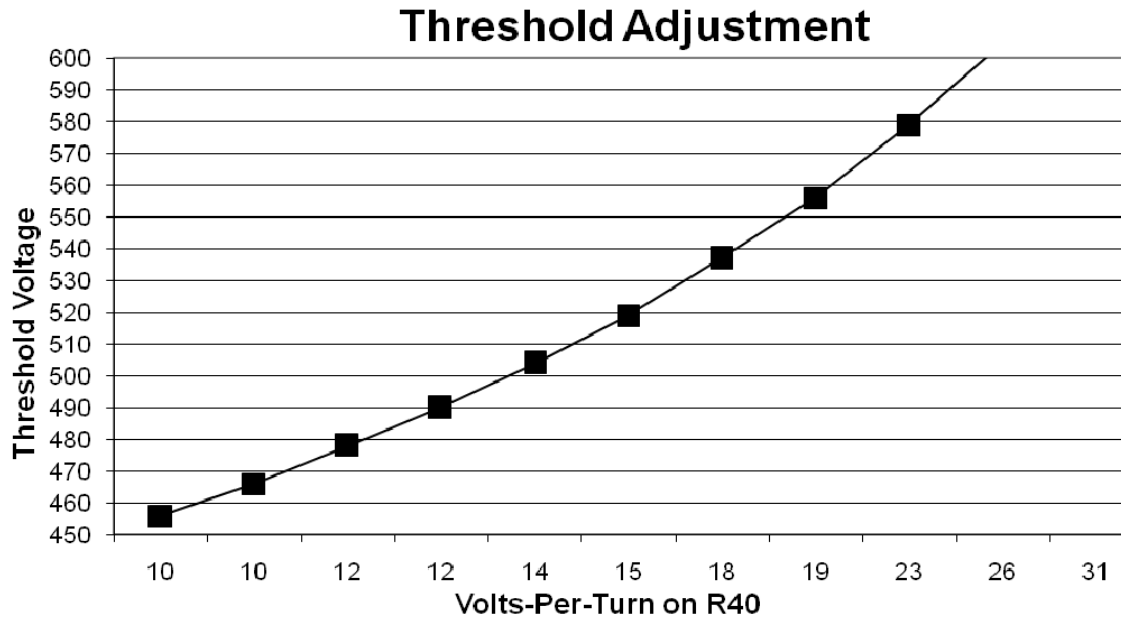
Once the actual Threshold voltage has been determined you can make adjustments, if required, to achieve the optimum setting for your system.

The Threshold voltage should be set to approximately 10% below the nominal DC bus **under normal load**, or 15% below unloaded bus level. Coordinate to be above the associated inverter's under-voltage trip level, and below normal line level. Most inverters have an under-voltage trip point lower than 15% below the nominal DC bus. Some inverters can be reprogrammed to change this trip level as needed.

Adjustment pot R40 on the 3534R2 control board (see Figure 4-2) is used to set the "Threshold" voltage level. Adjusting the pot in a clockwise direction will raise the setpoint level; alternately, a counter-clockwise adjustment of the pot will lower the setpoint level. The Threshold setpoint level can be adjusted between 400 and 600V for "E" and "H" models. See Figure 4-6 for approximate volts-per-turn ratio.

After making the adjustments, repeat the test from Section 4.4.2 to verify the new setpoint. Fine tune the adjustment and retest as necessary.

**Figure 4-6: Volts-per-Turn on R40**



### 4.4.3. ADJUSTMENT POTS

#### 4.4.3.1. ASB 3534R2 ADJUSTMENT POTS

The purpose and setting for each adjustment pot provided on the ASB 3534R2 Control board is described below. Please refer to *Figure 4-2: ASB 3534R2 Control Board Features* for the locations of each of the adjustment pots listed below.

##### **R30 – INSTANTANEOUS OVER-CURRENT**

Factory set ---- do not adjust!

Clockwise adjustment will increase the setpoint value. However, this adjustment pot is factory preset; therefore no field calibration of this setpoint will be necessary.

##### **R40 – THRESHOLD**

Factory set - adjustment BY TRAINED PERSONNEL ONLY!

Clockwise adjustment will increase the setpoint value. This adjustment pot is factory preset. However, field calibration of this setpoint may be necessary if the AC line level is more than 7% below the nominal AC requirement listed on the RTM module nameplate. Contact Bonitron, Inc. for additional information as needed.

##### **R70 – INPUT CURRENT LIMIT**

Factory set ---- do not adjust!

Clockwise adjustment will increase the setpoint value. However, this adjustment pot is factory preset; therefore no field calibration of this setpoint will be necessary.

#### 4.4.3.2. ASB 3534K1 ADJUSTMENT POTS

The purpose and setting for the adjustment pot provided on the ASB 3534K1 Kinetic Buffering board is described below. Please refer to *Figure 4-3* for the location of the R7 adjustment pot.

## R7 – KB SETPOINT ADJUST`

Clockwise adjustment will raise the trip level; Counterclockwise adjustment lowers the trip level. The setpoint is factory preset for 460VDC for 380V systems, and 560VDC for 460V systems.

## **4.5. CALIBRATION**

There are no calibrations needed for M3534R Modules.

## 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

The Bonitron Ride-Thru is designed to be low maintenance. While the amount of ride-thru time does not depend on energy storage devices that degrade over time, Bonitron still recommends a yearly test of the system in order to ensure the electronics package is operating. The following steps can be taken to ensure reliability and give comfort that the system is still able to ride-thru a sag event.

#### 5.1.1. PERIODIC MAINTENANCE PROCEDURES FOR M3534R MODULE WITHOUT OPTIONAL DISPLAY PANEL

1. Monitor Type-1 box LEDs (Control Board LEDs).
  - PWR LED should be **ON**.
  - RTA LED should be **OFF**.
  - OT LED should be **OFF**.
2. Verify DC bus voltage level.
  - Ride-Thru bus should be a few volts below the Inverter bus.
3. Verify "Threshold" by opening the AC disconnect to the Ride-Thru module (if equipped). Refer to Section 4.4.1 *Threshold Voltage Adjustment Procedure* (document # 073002).
  - The DC bus voltage should drop until it reaches the threshold.
  - Ride-Thru Active LED should begin to flash.
  - DC bus should hold for a second at the threshold.
  - This threshold level should be approximately 10-12% below the nominal loaded inverter bus.

Each Bonitron Ride-Thru should be tested under load during initial start up to verify the functionality of the test circuit and that the test does not negatively affect the process. However, Bonitron recommends that, if the process is critical, the test cycle be initiated only during a shutdown to avoid unforeseen problems.

4. Verify switching circuits by causing a TEST cycle while running the inverter at full load.
  - Ride-Thru DC bus current should flow during the 2-second test cycle.
  - Inverter input current should drop.
  - Ride-Thru DC bus voltage should rise above the threshold. (+17% if lightly loaded, less if fully loaded.)
  - Inverter DC bus voltage should rise above the threshold. (+17% if lightly loaded, less if fully loaded.)
  - Ride-Thru Active LED should turn **ON**.
  - Motor speed should remain constant.
  - Active cycle counter (if used) should count test cycles.

This completes the maintenance procedure.

## 5.1.2. PERIODIC MAINTENANCE PROCEDURES FOR M3534R MODULE WITH OPTIONAL DP10 AND DP17 DISPLAY PANEL

1. Check Active cycle counters.
  - More than 10 counts per month may mean the Ride-Thru is improperly adjusted. Refer to Section 4.4.1 *Threshold Voltage Adjustment Procedure* (document # 073002) for adjustment details.
  - Note count for factory records.
  - Report count to Bonitron via your local service representative.
2. Monitor front panel LEDs.
  - For the DP10 and DP17 Display Panels:
    - Power LED should be **ON**.
    - Ride-Thru Active LED should be **OFF**.
    - Over-temperature LED should be **OFF**.
3. Verify DC bus current meter. (DP17 only)
  - Meter should read zero amps under normal conditions.
4. Verify DC bus voltage meter. (DP17 only)
  - Ride-Thru bus should be a few volts below the inverter bus.
5. Verify Threshold by opening the AC disconnect to the Ride-Thru module (if equipped). Refer to Section 4.4.1 *Threshold Voltage Adjustment Procedure* (document # 073002).
  - The DC bus voltage should drop until it reaches the threshold.
  - Ride-Thru Active LED should begin to **flash**.
  - DC bus should hold for a second at the threshold.
  - This threshold level should be approximately 10-12% below the nominal loaded inverter bus.

Each Bonitron Ride-Thru should be tested under load during initial start up to verify the functionality of the test circuit and that the test does not negatively affect the process. However, Bonitron recommends that, if the process is critical, the TEST cycle be initiated only during a shutdown to avoid unforeseen problems.

6. Verify switching circuits by pressing the **TEST** button while running the inverter at full load.
  - Ride-Thru DC bus current should flow during the 2-second test cycle.
  - Inverter input current should drop.
  - Ride-Thru DC bus voltage should rise above the threshold. (+17% if lightly loaded, less if fully loaded.)
  - Inverter DC bus voltage should rise above the threshold. (+17% if lightly loaded, less if fully loaded.)
  - Ride-Thru Active LED should turn **ON**.
  - Motor speed should remain constant.
  - Active cycle counter (if used) should count test cycles.

This completes the maintenance procedure.

## 5.2. MAINTENANCE ITEMS

### 5.2.1. CAPACITOR REPLACEMENT RECOMMENDATIONS

#### 5.2.1.1. CAPACITOR REPLACEMENT CRITERIA

Bonitron Model 3534R Ride-Thru uses high quality aluminum electrolytic capacitors and is designed for long life without maintenance. While a typical inverter may require capacitor replacement after a certain time due to the heavy ripple currents, the M3534R typically is in a standby mode waiting for a power disturbance.

With typical operating conditions of 35°C, caps running at 75% rated voltage, and a duty cycle of one sag per month, Bonitron recommends the capacitors be checked or replaced every 20 years.

#### 5.2.1.2. CAPACITOR TESTING PROCEDURE

With power applied, measure voltage across each cap and make note for future reference.

- Any voltage difference of more than 15% indicates a substantial change in capacitance.

Ex: DC bus = 540V, each series cap = 270V 15% of 270 = 40.5V  
cap1=290V, cap2 = 250V.

#### 5.2.1.3. CLEANING

Cleaning cycle depends entirely upon the surrounding environment and the quality of air inside cabinet.

Cleaning off dust, debris, or chemical build-up on high voltage bus bars or other exposed components may be necessary. If cleaning is needed:

1. Remove power and allow all voltages to drain.
2. Check for residual voltages with meter.
3. Clean affected areas with rag, brush, or denatured alcohol, depending on the type of contamination.
4. Once area is clean and dry, reapply power.

#### 5.2.1.4. FANS

- Fans run only while RT is active and should have a life of 20 years if the RT is properly adjusted.
- To check operation of fan, initiate activity.
  - 20 and 40 Amp models: Fan should run for 2-3 minutes.
- If fan does not run, replace with equivalent 24V fan.

### 5.3. TROUBLESHOOTING

**Table 5-1: Detailed Troubleshooting Guide**

<b>SYMPTOM</b>	<b>ACTION</b>
No Panel LEDs	Check incoming power Replace 3534R2
RTA never ON	Check DISABLE command Initiate test cycle or remove power <ul style="list-style-type: none"> <li>• Watch and listen for signs of activity               <ul style="list-style-type: none"> <li>• Check RTA contact and LED</li> <li>• Ticking sound</li> </ul> </li> </ul> Check power quality data to confirm sag events should have caused activity to occur If no activity ever replace 3534R2
RTA always ON	Check DC Bus levels on both sides of output diodes Check for low line level <ul style="list-style-type: none"> <li>• Too much activity can cause stage fuse failures, and overheating</li> </ul> Check threshold level, if changed over time adjust level or replace 3534R2 Lower threshold by at least 10V
Overtemp	Check for constant current on the negative or positive DC bus links Check for missing phase in drive power feed Check for low line level Check temp sensors on IGBT heatsink Check activity record – too much activity may cause overtemp Check precharge network for overheating – (cause of low bus and constant activity)
Kinetic Buffering (KB) Ready LED not ON	Check DC bus level to be above setpoint (460VDC) <ul style="list-style-type: none"> <li>• If OK adjust setpoint or replace 3534K1</li> <li>• If low, check incoming AC and precharge circuits</li> </ul>
KB IN LED will not come ON	Check 24V input from power supply under low voltage condition <ul style="list-style-type: none"> <li>• If OK, replace 3534K1</li> <li>• If not OK, troubleshoot power supply</li> </ul>
KB OUT LED will not come on	Cause KB IN LED to come from power supply under low voltage condition Allow DC bus to drop below 460VDC <ul style="list-style-type: none"> <li>• If LED not ON, adjust R7 setpoint pot CW</li> <li>• If LED never comes on, replace 3534K1</li> </ul>
TEST won't work	Check DC bus level – too high causes no test activity Check blown fuse LED during test – If ON check stage fuses Check test input to 3534R2 If OK, replace 3534R2
Voltage fluctuates during TEST mode	Check threshold and test boost level settings. Over-voltage shutdown can occur if settings are too high on 460V systems, causing an oscillation affect. <ul style="list-style-type: none"> <li>• Lower threshold level and retry</li> </ul>
Stays in TEST mode	Threshold way too high <ul style="list-style-type: none"> <li>• Only appears to be in test mode</li> <li>• Can occur in 400V systems if RT is factory set for 585V</li> </ul> Check test input to 3534R2 If OK replace 3534R2

## 6. ENGINEERING DATA

### 6.1. RATINGS CHARTS

**Table 6-1: Model M3534R Ride-Thru Module Ratings**

MODEL NUMBER	AC INPUT	MAX. OUTPUT POWER	RECOMMENDED FUSE RATINGS (AC INPUT / DC OUTPUT)	MAX. DC OUTPUT CURRENT	CHX SIZE
M3534R-U003-A5	115VAC	3kW /4hp	A60Q30-2 / A70Q25-2	20ADC	A5
M3534R-L006-A5	230VAC	6kW /8hp	A60Q30-2 / A70Q25-2	20ADC	A5
M3534R-E010-A5	400VAC	10kW /13hp	A60Q30-2 / A70Q25-2	20ADC	A5
M3534R-H012-A5	460VAC	12kW /16hp	A60Q30-2 / A70Q25-2	20ADC	A5

Table 6-1 Notes:

The codes listed in the **CHX SIZE** column of the table above refer to specific Bonitron chassis designs. For chassis details see the Dimensional Outline in Section 6.5.

**Table 6-2: Model M3534R Ride-Thru Module Voltage Levels**

AC INPUT VOLTAGE	DC BUS VOLTAGE LEVELS		
	THRESHOLD	MIN @ FULL LOAD	NOMINAL
115VAC	145VDC	135VDC	160VDC
208VAC	265VDC	255VDC	290VDC
230VAC	285VDC	275VDC	320VDC
380 / 400 / 415VAC	485VDC	475VDC	535 - 565VDC
460VAC	585VDC	575VDC	640VDC

Table 6-2 Notes:

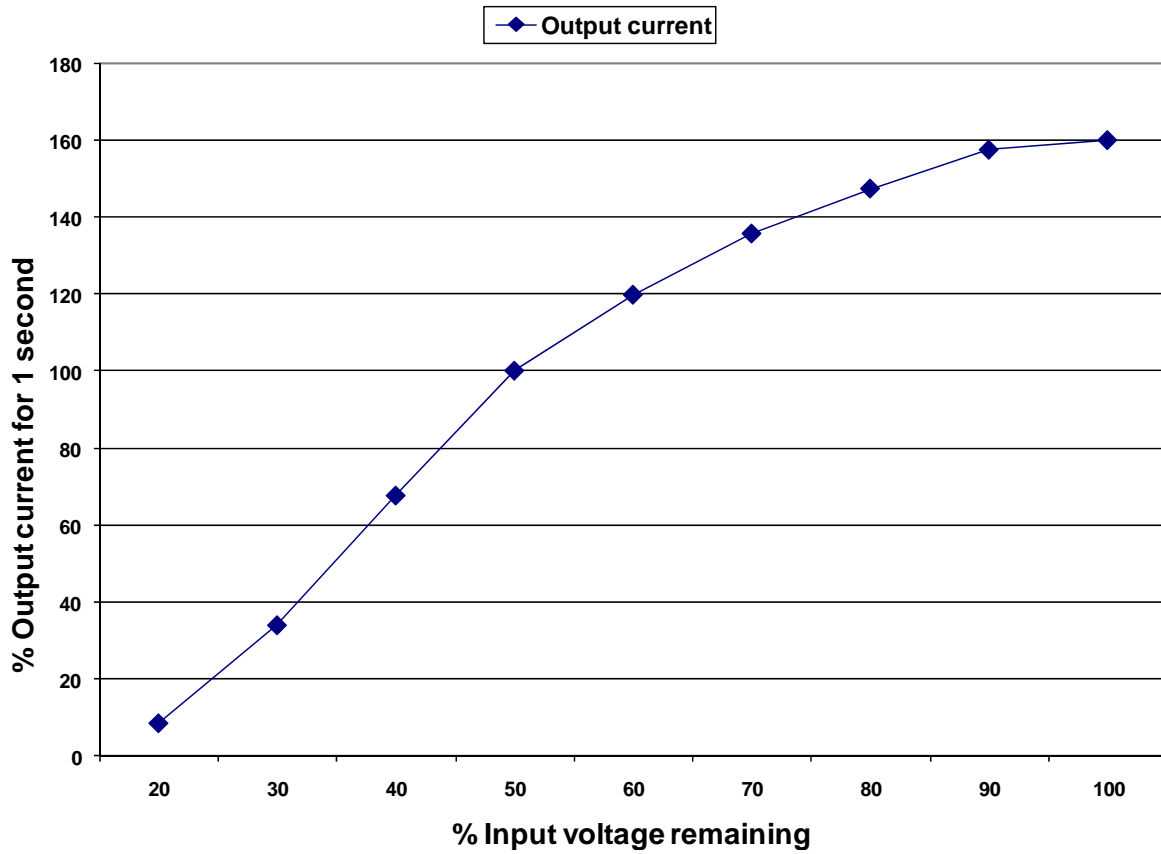
The **Min @ Full Load** column in the table above lists the minimum voltage level at which the DC bus will be maintained when the RTM is active. This is usually about 90% of the nominal DC bus level, and 7-10V below the THRESHOLD where “activity” begins.

The **NOMINAL** column in the table above lists the normal operating DC bus voltage level.

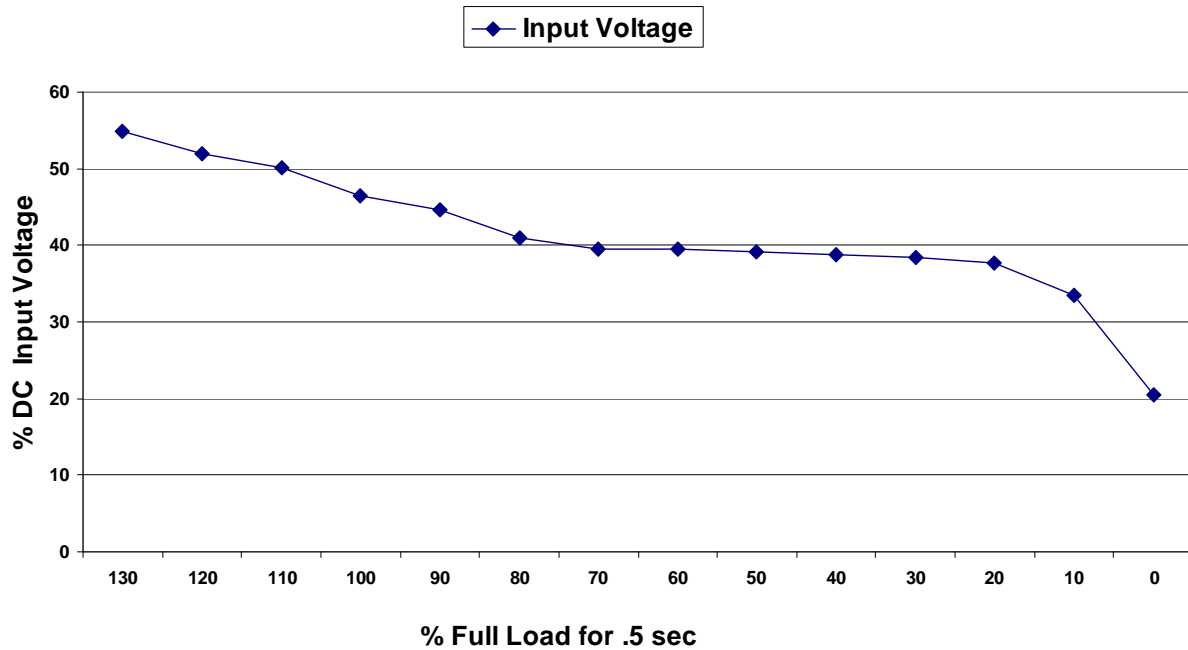
**Table 6-3: De-Rating Table**

SYSTEM VOLTAGE RATING CODE	AC LINE VOLTAGE	KW RATING
L	208	5
	<b>230</b>	<b>6</b>
E	380	9
	<b>400</b>	<b>10</b>
	415	10
H	433	11
	<b>460</b>	<b>12</b>
C	575	Not available

**Figure 6-1: Typical M3534R Input Voltage vs. Output Current**



**Figure 6-2: Typical M3534R Input Voltage vs. % Load @ .5 sec**



## 6.2. WATT LOSS

### STANDBY MODE

- Less than 15 watts for 20A units
- Approximately 3 watts for DP Series panels

### BOOST MODE

All units are 95% efficient or better at full load.

## 6.3. CERTIFICATIONS

M3534R-EH010 is certified by PSL Laboratory to exceed Semi-47 requirements.

## 6.4. FUSE/CIRCUIT BREAKER SIZING AND RATING

### 6.4.1. RECOMMENDED INPUT POWER WIRING SIZES AND POWER SOURCE FUSING

The following data is supplied for assistance in selecting the appropriate field wiring sizes and power source fuse ratings for the model M3534R Cabinet Mounted and Open-chassis Ride-Thru systems.

- Wire size must be coordinated with circuit protection devices and IR drop of wire. It is NOT necessary to size wire for continuous duty. Maximum allowed duty cycle for the M3534R Ride-Thru is one 2-second run every 4 minutes.

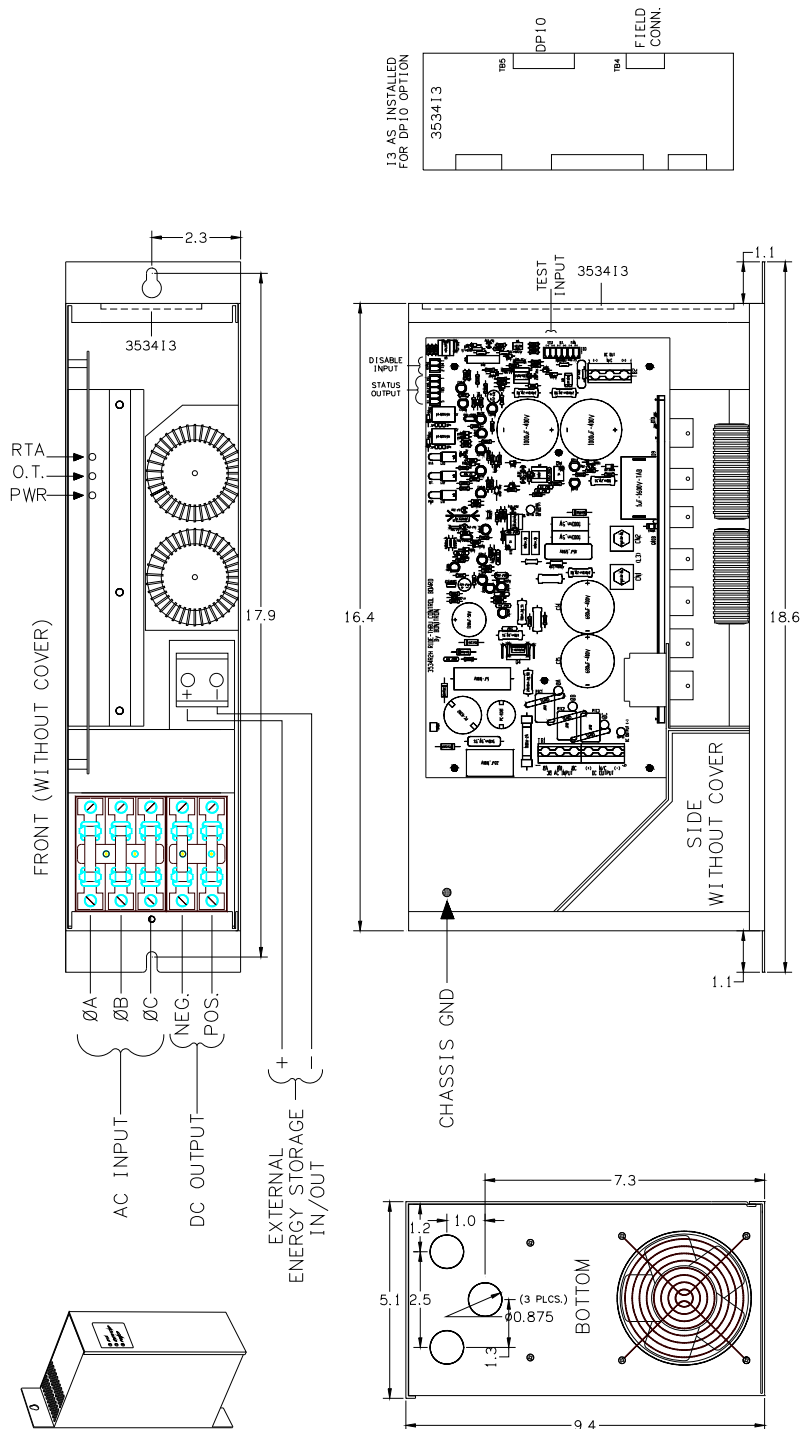
**Table 6-4: Input Power Wiring Sizes and Fusing**

SYSTEM HP	SYSTEM kW	RIDE-THRU DC BUS CURRENT RATING	MIN. SOURCE FUSING SEMICONDUCTOR	RECOMMENDED FIELD WIRING SIZES	MCM EQUIVALENT WIRING SIZES
13 - 16	10 - 12.5	20 Amps	30 Amps	14-10 AWG	4 MCM

See Section 6.1 for additional information.

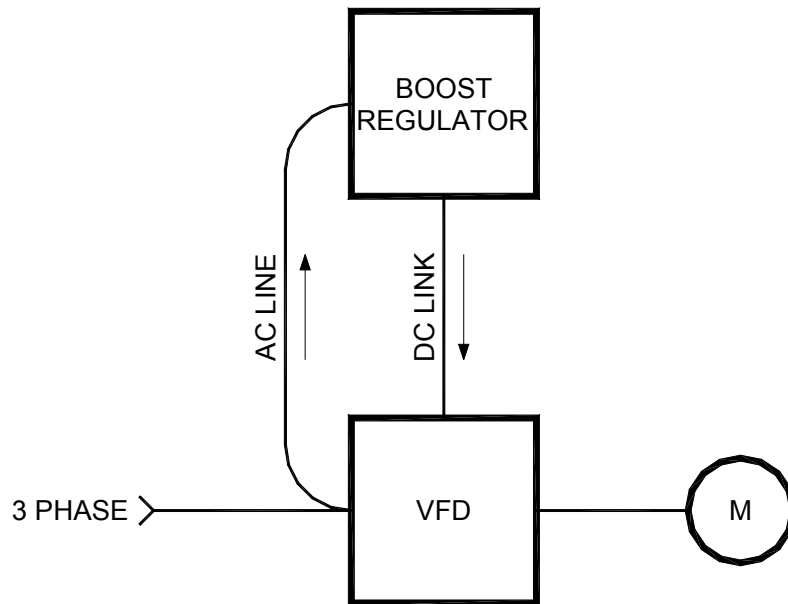
### 6.5. DIMENSIONS AND MECHANICAL DRAWINGS

**Figure 6-3: M3534R Control Module A5 Chassis Dimensional Outline**



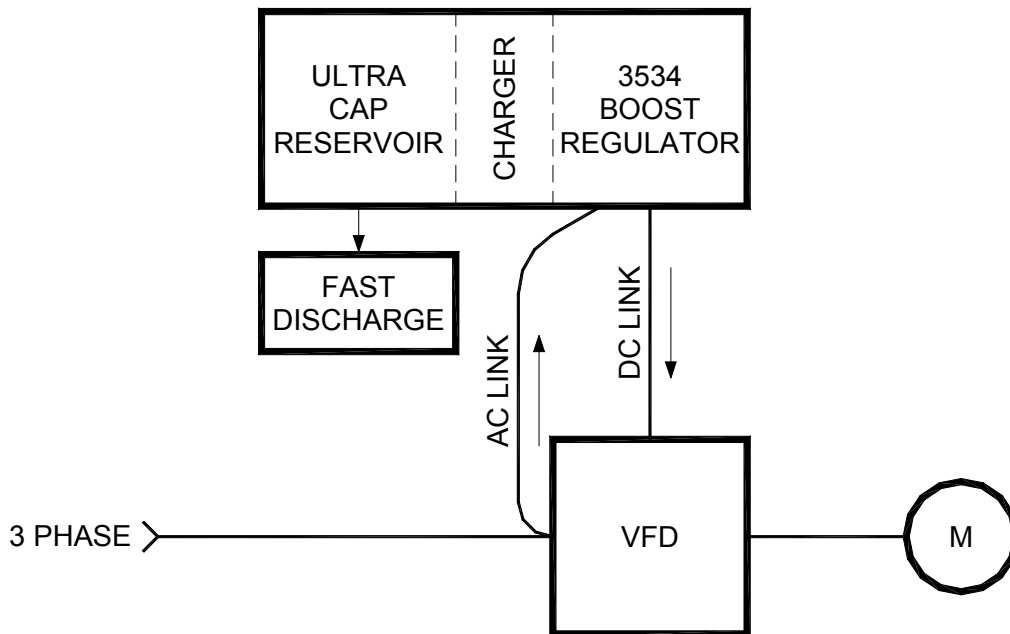
6.6. BLOCK DIAGRAMS

**Figure 6-4: M3534R Ride-Thru System Configuration 1**



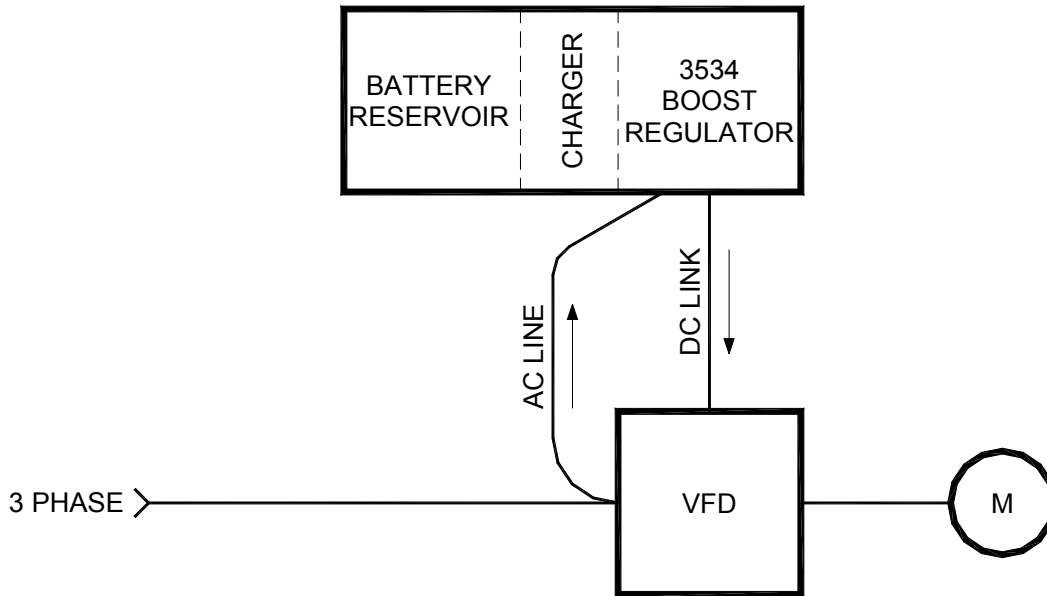
2 SECOND, 50% SAG PROTECTION USING DC BOOSTER ONLY

**Figure 6-5: S3534UR Ride-Thru System Configuration 3**



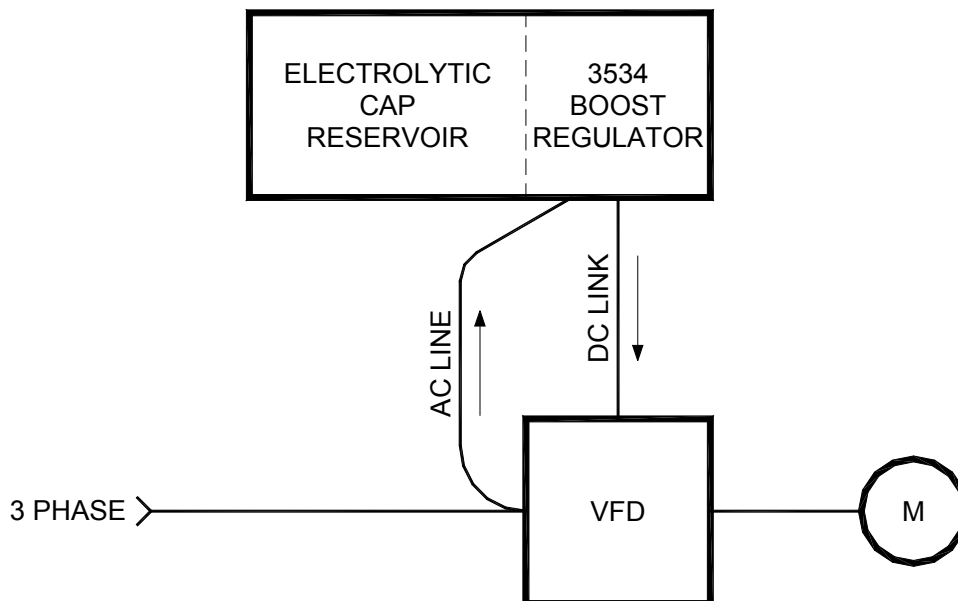
50KW & BELOW, 0.5 - 2 SECOND, 100% OUTAGE PROTECTION USING DC BOOSTER WITH ULTRA CAP RESERVOIR SINGLE CABINET POWERED FROM AC LINE

**Figure 6-6: S3534BR Ride-Thru System Configuration 5**



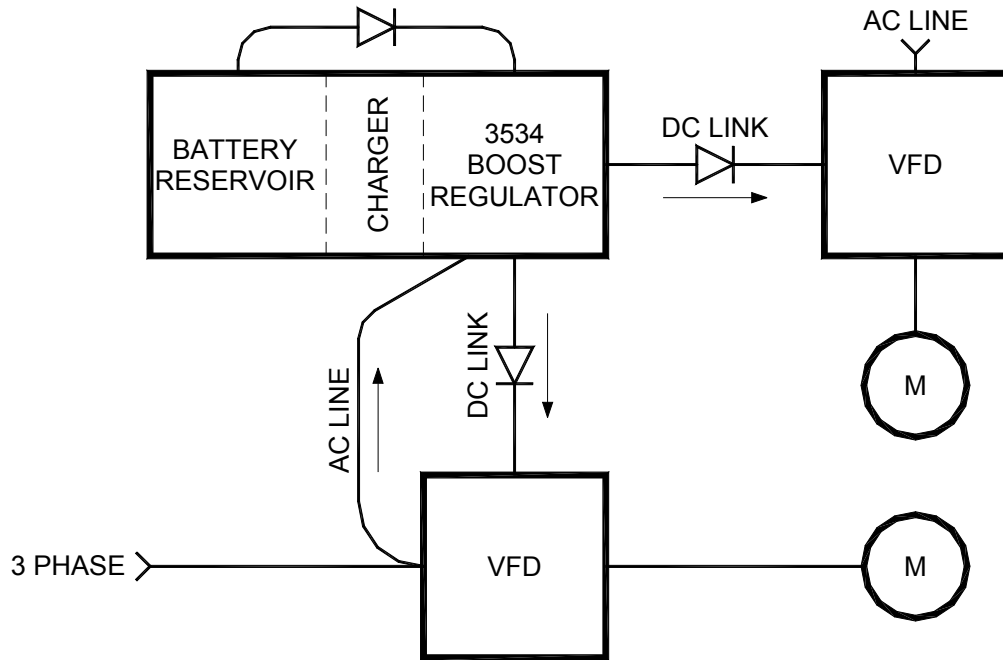
50KW & BELOW, 2 SECOND - 2 MINUTE, 100% OUTAGE PROTECTION USING DC BOOSTER WITH BATTERY BANK

**Figure 6-7: S3534CR Ride-Thru System Configuration 10**



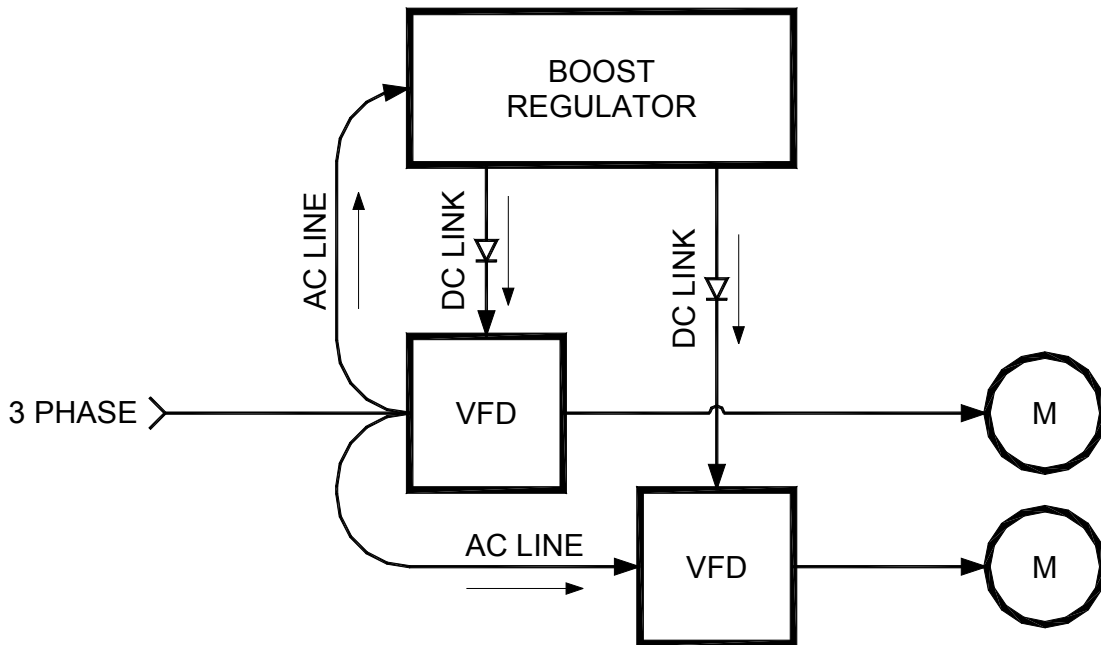
12KW & BELOW, 0.5 - 1 SECOND, 100% OUTAGE PROTECTION USING DC BOOSTER WITH ELECTROLYTIC CAP RESERVOIR SINGLE CABINET POWERED FROM AC LINE

**Figure 6-8: S3534BR Ride-Thru System Configuration 12**



50KW & BELOW, 2 SECOND - 2 MINUTE, 100% OUTAGE PROTECTION USING DC BOOSTER WITH BATTERY BANK AND DUAL OUTPUT

**Figure 6-9: M3534R Ride-Thru System Configuration 19**

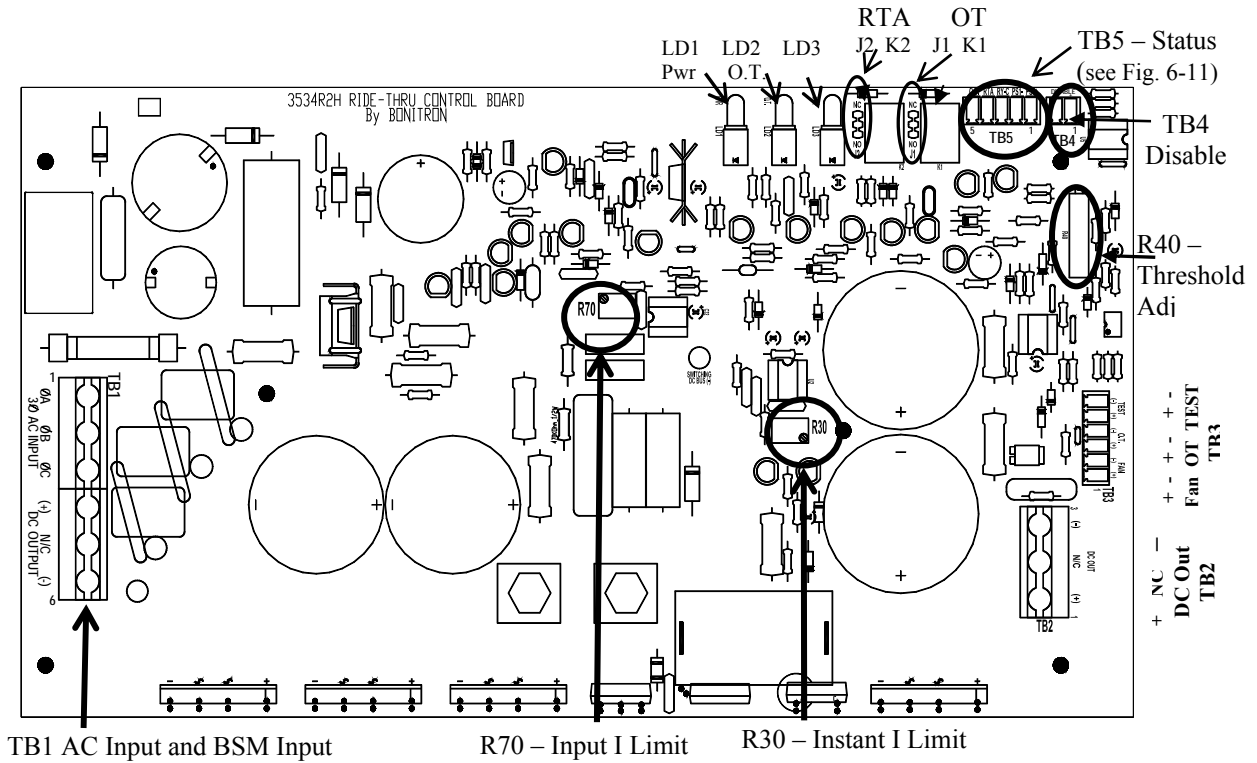


2 SECOND, 50% SAG PROTECTION FOR EQUIVALENT DRIVES WITH EQUAL LOADS USING DC BOOSTER AND DIODE ISOLATION

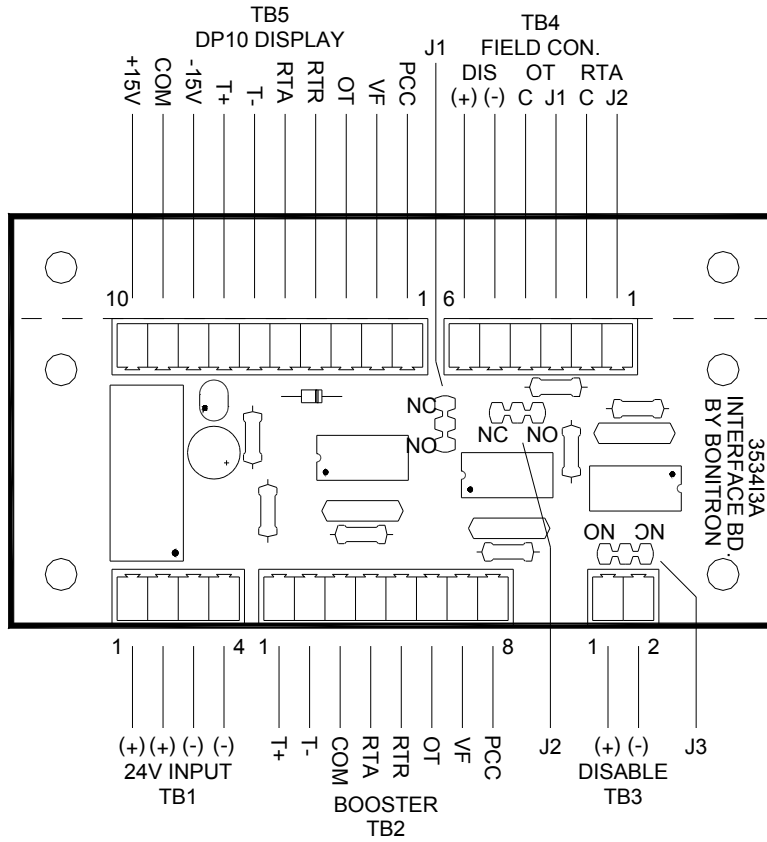
6.7. SUPPLEMENTAL DRAWINGS

6.7.1. CNTRL BOARD FAULT/STATUS SIGNAL COMPONENT LOCATIONS

Figure 6-10: ASB 3534R2 Control Board Fault / Status Signal Component Locations

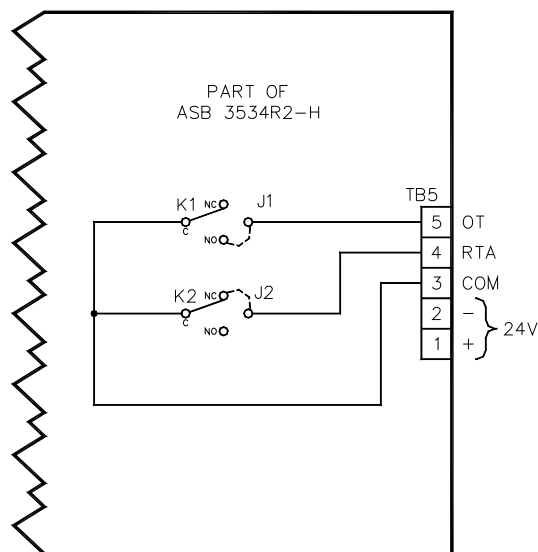


**Figure 6-11: ASB 3534I3 Control Board Status Signal Component Locations**

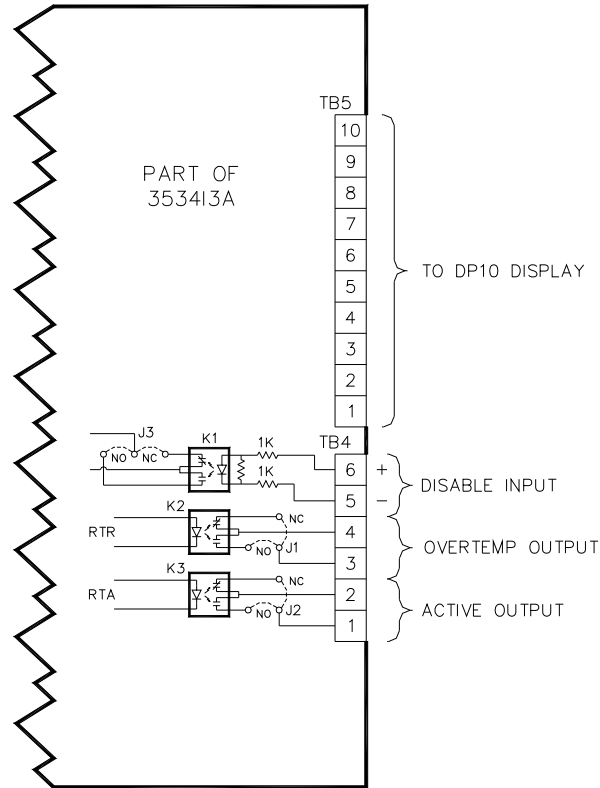


**6.7.2. SCHEMATICS**

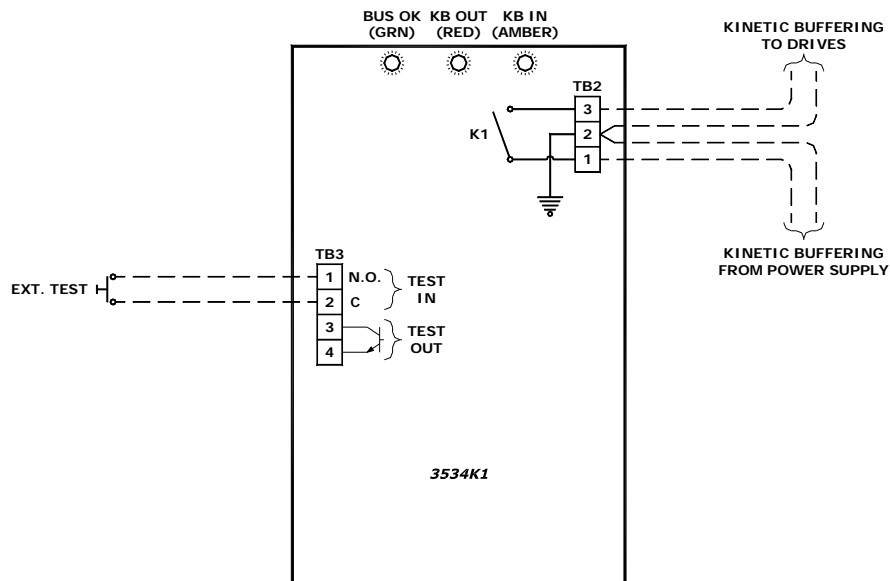
**Figure 6-12: 3534R2 TB5 Status Signal**



**Figure 6-13: 3534I3 Control and Status Signal**



**Figure 6-14 : Kinetic Buffering Status Signals**



## 6.8. RECOMMENDED SPARE PARTS

Table 6-6 lists the major components for the M3534R modules.

These lists are intended for use as a reference when ordering spare parts for the Ride-thru modules becomes necessary. Please remember to refer to the complete Bonitron part number when ordering parts.

Each printed circuit board has a serial sticker (i.e. 3534R3D10 #125). Please refer to Table 6-5 below. Please include every character when ordering spare PCBs to help ensure a proper order.

Parts should be ordered by the responsible party through your local distributor or system integrator.

**NOTE:** Spare circuit boards are available for companies who have active personnel with training certificates on file with Bonitron.

**Table 6-5: Example of PCB Serial Sticker**

MODEL #	FUNCTION	LAYOUT VERSION	COMPONENT VERSION	SERIAL NUMBER
3534	R3	D	10	#125

**Table 6-6: Spare Parts List for 20 Amp Units**

PART NUMBER	DESCRIPTION	QTY
ASB 3534R2-x	Control / power pcb assembly	1
ASB 3534I3	Optional interface board	1
FN 3.6-24DC-62	24V fan	1
FS A60Q30	30 amp semiconductor fuse	3
FS A60Q25	25 amp semiconductor fuse	2
IN FM-8047	Chopper choke	1
LD RED-LENS-L05	Red lens cap	1
LD GRN-LENS-L05	Green lens cap	1
LD AMB-LENS-L05	Amber lens cap	1
LD RED-LENS-L05-W	Neoprene washer	3

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## 7. APPENDICES

### 7.1. DRIVE RIDE-THRU SELECTION GUIDE

Bonitron manufactures several different DRT models for specific applications. The following is a general guideline for applying the appropriate model for best cost effectiveness. Short term outage is defined as less than 2 seconds, and long term outage is defined as more that 2 seconds.

1. Fractional to 3hp, 50% sag or 100% short term outage should consider M3534EC
2. Fractional to 3hp, 100% long term outage should consider S3534BR
  - See Figures 6-6 and 6-8
3. 3hp to 67hp 50% sag should consider M3534R
  - See Figures 6-4 and 6-9
4. 3hp to 15hp 100% short term outage should consider S3534CR
  - See Figure 6-7
5. 15hp to 67hp 100% short term outage should consider S3534UR
  - See Figure 6-5
6. 3hp to 67hp 100% long term outage should consider S3534BR
  - See Figures 6-6 and 6-8
7. 75hp to 2000hp 50% sag should consider M3460R
8. 75hp to 2000hp 100% short term outage should consider S3460UR
9. 75hp to 2000hp 100% long term outage should consider S3460BR

#### 7.1.1. M3534R RIDE-THRU ADVANTAGES

1. Easy retrofit installation
  - Use existing wiring
  - Use existing feed breakers
  - Works with most any fixed bus PWM drive
  - Only 5 connections
    - 3 to AC line
    - 2 to drive DC bus
2. Inexpensive
  - \$100 to \$200 per kW
  - Less expensive than other options
    - Traditional UPS
    - Flywheel technology
    - Capacitive energy storage
3. Easy testing
  - Can test system on-line
  - Can take off-line for repair or testing without disrupting the process
4. No maintenance
  - Ride-Thru time not based on traditional energy storage
  - Does not degrade after time
  - Uses less than 75 watts when inactive
  - No fans or filters needed for cabinet
5. Ability to add outage backup
  - Energy storage can be added later
6. Instant response
  - No "switchover time"
  - Maintain control of motor speed and torque

7. Easy commissioning
  - No programming
  - Can power up/down with system "on-line"
  - Single fine tune level adjustment
8. No RF interference
  - Feeds DC to inverter bus
  - Common mode filtering available
9. DCS communications
  - Alarm contacts or complex I/O signals
10. System monitoring
  - LEDs
  - Voltage and current monitoring
  - Activity counter
11. Over 3 years of on-site experience
  - Over 100 Ride-Thru units installed
12. Custom options available
  - Ability to adapt for custom configurations

## **7.2. INSTALLATION CONSIDERATIONS FOR DRIVE RIDE-THRU SYSTEMS**

The following items should be considered when installing a Bonitron Ride-Thru:

1. Inverter logic voltage must be "backed up"
  - Most new Inverters derive logic supply from DC bus
  - Install UPS on circuits with AC feed
2. Any control or Interlock relays must be "backed up"
  - Test Relays at half voltage for dropout
  - Use DC relays on logic supply
  - Install UPS on circuits with AC feed
3. Determine the maximum motor voltage needed
  - To ensure "Threshold" level is sufficient to supply motor
    - Most inverters automatically compensate RMS to motor
4. Verify actual AC line voltage and DC bus level
  - To ensure "Threshold" level is set – 10% of nominal DC bus level
  - To ensure valleys of ripple do not cause unwanted activity
5. Determine Inverter low bus trip point
  - To ensure "Threshold" level is above inverter dropout
6. Determine Inverter high bus trip point
  - To ensure "Test" level will not over voltage inverter
7. Inverter ground fault circuits
  - Ride-Thru currents on 20 amp model may use inverter bridge neg diodes during operation
  - Circuits can be de-sensitized
  - External ground fault circuits may be added
8. Electrical safety
  - Ride-Thru should not have AC power when inverter does not
    - RT and Inverter should feed from same point
    - Use shunt trip interlock between Inverter and Ride-Thru if RT power is not fed downstream of inverter power switch
    - Label inverter as having two power sources
9. DCS monitoring of status signals
  - Alarm contacts

10. Input feed should be capable of 2x rated current during the 2 sec 50% sag for 3534RT models
  - RT RMS rating is 1 percent of system kW
  - Most inverter feeds have been sized for a 150-200% surge for motor starting
11. IR drop of wiring
  - This subtracts from the 50% sag spec
12. Maximum wire sizes allowed into Ride-Thru
  - Different models have standard max sizes
13. Local wiring codes
14. Ambient temperature
  - Under 50°C
15. Corrosive environment
  - Determines cabinet type

### 7.3. APPLICATION NOTES FOR M3534R MODULES

1. A disable command should be given in cases where activity extends beyond the specified ride through time.

### 7.4. HOW TO BUILD A HIGH VOLTAGE ULTRA CAP BANK

Bonitron booster Models 3460R and 3534R can have energy storage devices added to cover complete outages. This involves adding a charging circuit and an Ultra capacitor bank. Complete capacitor cabinets can be purchased from Bonitron or individual capacitors can be purchased from various manufacturers and then integrated with the existing boost module. This app note gives some instructions for building your own cap bank.

#### **NEED TO KNOW SYSTEM PARAMETERS:**

1. System AC Line Voltage (to determine DC bus levels)
2. System KW (to determine needed joules)
3. Time of Ride-Thru (to determine needed joules)
4. Calculated joules (to determine needed cap bank)
5. Minimum DC bus desired (determines cap "start" voltage, "threshold" is typically -10% of nominal DC bus level)
6. Minimum Ride-Thru Input voltage (determines cap "end" voltage, typically 50% of nominal DC bus for 3460R and 3534R models)

#### **RULES OF THUMB:**

1. Ultra caps do not like constant ripple current, so they should NOT be applied directly to an inverter DC bus, and should be held at least 10% below bus level.
2. ESR is a major concern at high power levels
3. Ultra caps store 75% of their power in the first 50% of voltage
4. Some types of capacitors will have a 10-20% decrease in available energy when discharged quickly at high energy levels.
5. Max cap current depends on time of discharge.  $I = C \times V / T$  (in seconds) Most cap cells can be short circuited so ESR determines max available current for one discharge.

**Joules** =  $\frac{1}{2} \times C \times V^2$  squared (  $\frac{1}{2} CV^2$  ) or power (in watts) x time (in seconds)

**Capacitance** =  $(2 \times J) \div V^2$  squared ( $2J/V^2$ )

## **BUILD CAP BANK:**

1. Choose the highest voltage Cap building blocks available.
2. Series cap modules so total voltage is above booster minimum input, (typically 50% of nominal DC bus) and below booster “threshold” level. (typically -10% of nominal DC bus)
3. Calculate current needed by dividing needed kW by booster minimum input voltage and ensure cap module can supply the current.
4. Add parallel strings to increase available current or choose different cap.
5. Calculate ESR voltage drop from needed current at minimum voltage, and capacitor ESR rating.
6. Add worst case ESR drop to the min RT input voltage. This is the minimum cap bank voltage for calculation purposes.
7. Calculate available joules between charged cap voltage and the above calculated min cap bank voltage. This is the available joules that can be used.
  - a. Figure initial voltage (step2- below booster “threshold”)
  - b. Figure Capacitance of series or series parallel bank
  - c. Figure initial joules based on initial voltage and above Farad calculation
  - d. Figure final voltage (step 2 above booster minimum)
  - e. Figure final joules based on final voltage and above Farad calculation
  - f. Find available or usable joules by subtracting final joules (step e) from initial joules (step c)

OR - contact Bonitron for aid in sizing.

## **7.5. DIODE SHARING WITH A BONITRON RIDE-THRU**

Diode sharing is used to decrease the cost of implementing regeneration, braking, or Ride-Thru modules to existing drive systems that are not common bussed. The use of diodes prevent drive busses from “back feeding” each other, by allowing energy to pass one way only.

For regenerative applications the energy is allowed to pass from the drive bus to the regen or resistive braking module, but is blocked from passing from regen or brake module to the drive.

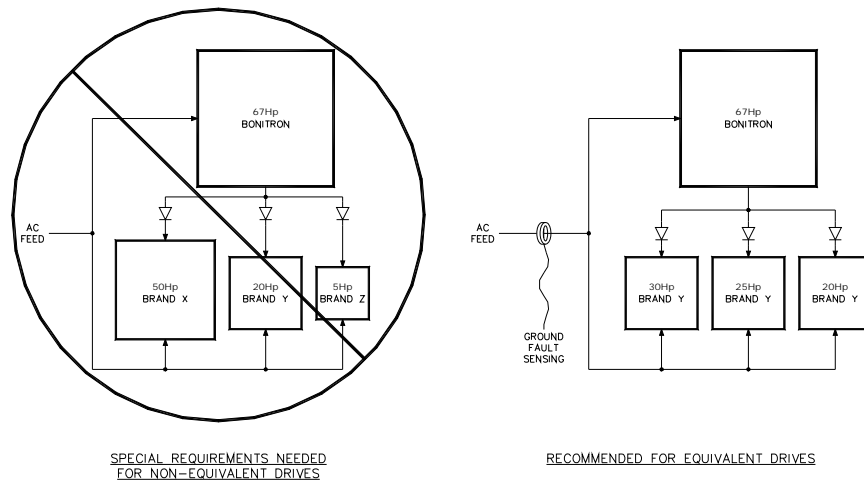
For Ride-Thru applications, the energy is allowed to pass from the Ride-Thru module to the drives, but is blocked from the drives to the Ride -Thru. Figure 6-9 is a block diagram example of a Ride-Thru / diode application.

Below are some basic guidelines for using diodes in this manner for 50% sag Ride-Thru applications:

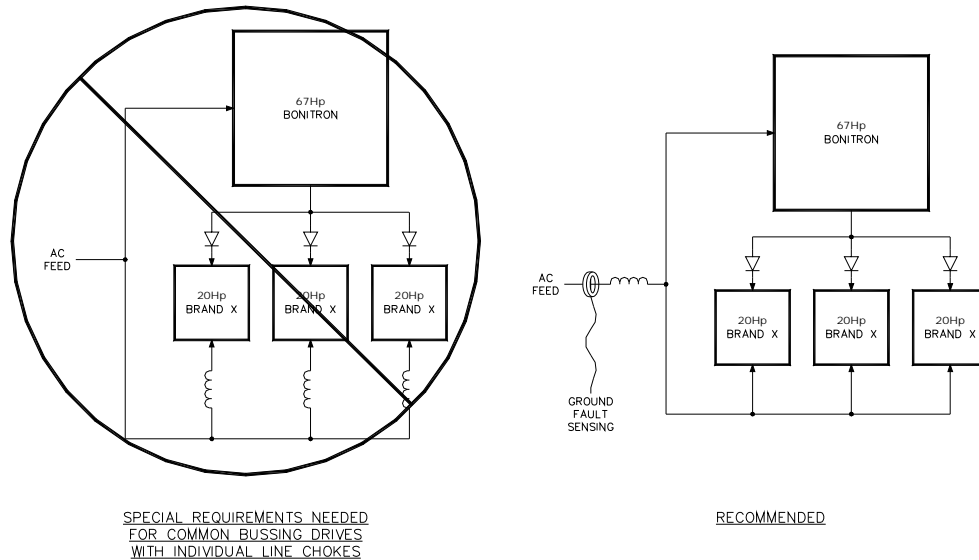
1. Drives should have equivalent DC bus levels as would be found on equal size drives of a common manufacturer. (see Figure 7-2)
  - b. If positive and negative busses are different potentials, the standard precharge may overheat and the Ride-Thru may be constantly active.
2. Drives should be on same AC feeder in same cabinet or close proximity.
  - a. Different feeds may have different potentials and may cause circulating currents or ground faults.
3. Drives should have a common line choke or harmonic filter
  - a. Any input filter should be common to all drives on a single Ride-Thru. (see Figure 7-1)
    - The use of individual input harmonic filters or line chokes can cause unequal potentials with respect to earth.

4. Ride-Thru connection should be downstream of any input line filter.
  - a. Input line filters cause lower DC bus levels. If a Ride-Thru is placed upstream, the Ride-Thru DC bus will be higher than the drive bus, and energy will flow full time out of the Ride-Thru module which may cause constant activity and overheating.
  - b. Special SCR input models are available for applications where a downstream connection point is not available.
    - It may be necessary to lower the threshold for these applications.
5. Ground Fault sensing should be done upstream at common point of line connection, upstream of line filter if used.

**Figure 7-1: Diode Sharing (Not) Recommended With (Non) Equivalent Drives**

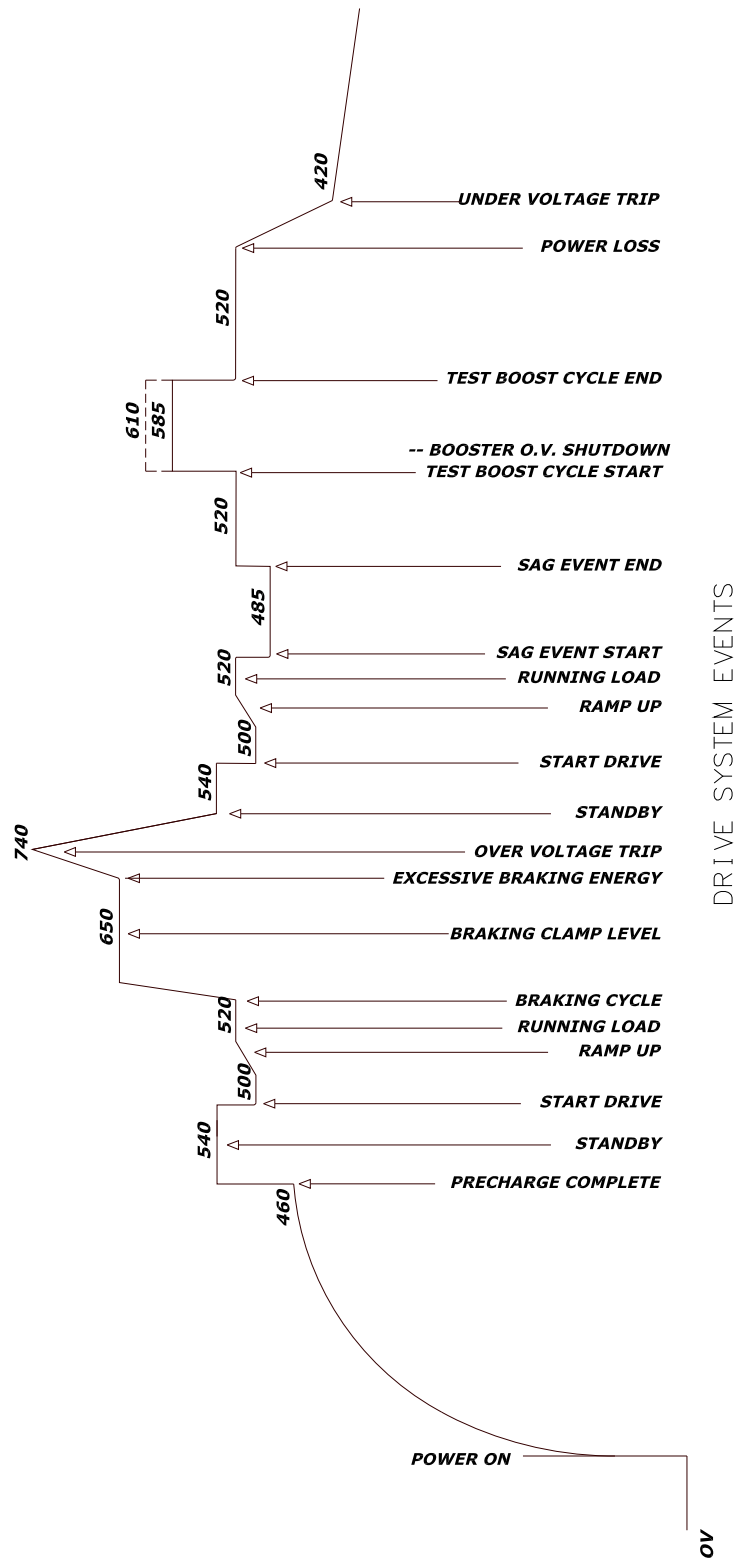


**Figure 7-2: Diode Sharing (Not) Recommended With Individual Line Chokes**

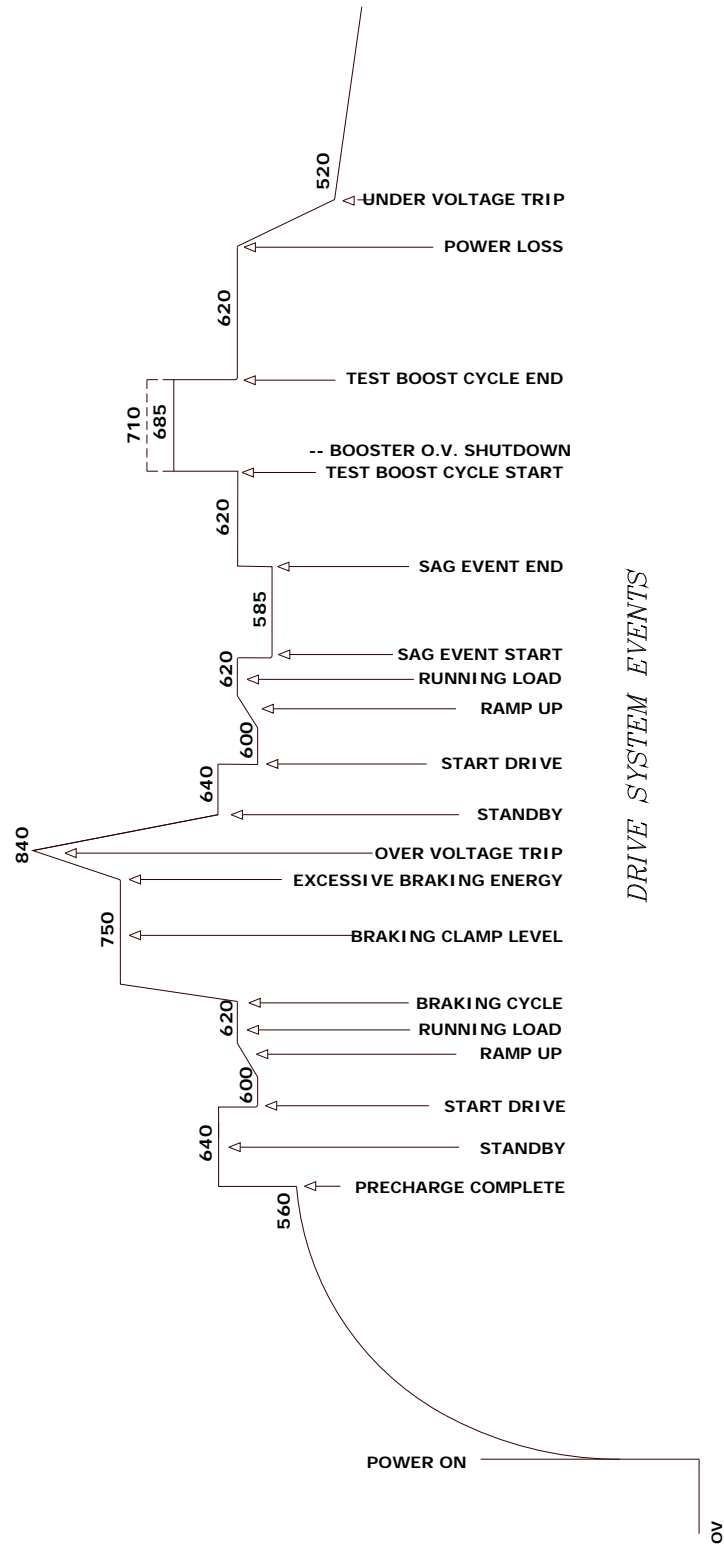


### 7.6. TYPICAL DRIVE BUS VOLTAGE LEVELS

**Figure 7-3: Typical Drive Bus Voltage Levels for 400VAC Systems (VDC)**



**Figure 7-4: Typical Drive Bus Voltage Levels for 460VAC Systems (VDC)**





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