BONITRON

Model M3534B

Battery Regulator Module

Customer Reference Manual

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Bonitron, Inc.

An Industry Leader in AC Drive Systems and Industrial Electronics

OUR COMPANY

Bonitron Inc. is an industrial electronics and electrical systems design, engineering, and manufacturing company founded in 1962 and located in Nashville, Tennessee. Bonitron designs and manufactures custom and standard product modules and systems for industry 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. Today, many drive system integrators use Bonitron AC drive option modules with their variable frequency drives.

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

1. INTRODUCTION

1.1. WHO SHOULD USE THIS MANUAL

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

Please keep this manual for future reference.

1.2. PURPOSE AND SCOPE

This manual is a user's guide for the Model M3534B 60 second 100% outage DC Voltage Boost module. It will provide the user with the necessary information to successfully install, integrate and use the M3534B 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

Rev 01b is the initial printing of this manual, incorporating the new part number and appendices.

Figure 1-1: M3534B in K9 Chassis

2. PRODUCT DESCRIPTION

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 3-phase distribution systems have a magnitude (decrease from nominal voltage) of less than 50% and duration of less than 2 seconds. The Model M3534R series 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 M3534B (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.

For a failsafe battery system, M3534B allows bypassing an open battery cell while under load. A typical battery string is only as good as the worst battery. When any battery gets weak or opens, the whole string is ruined. If Bonitron’s Open Battery Bypass Option is used and a battery opens during discharge, the battery monitor will show which battery is open, and the diode will automatically bypass that battery. The RTM will make up the lost voltage and maintain the drive bus at threshold. Batteries can now be replaced on a one-by-one basis.

2.1. RELATED PRODUCTS

RIDE-THRU MODULES AND SYSTEMS

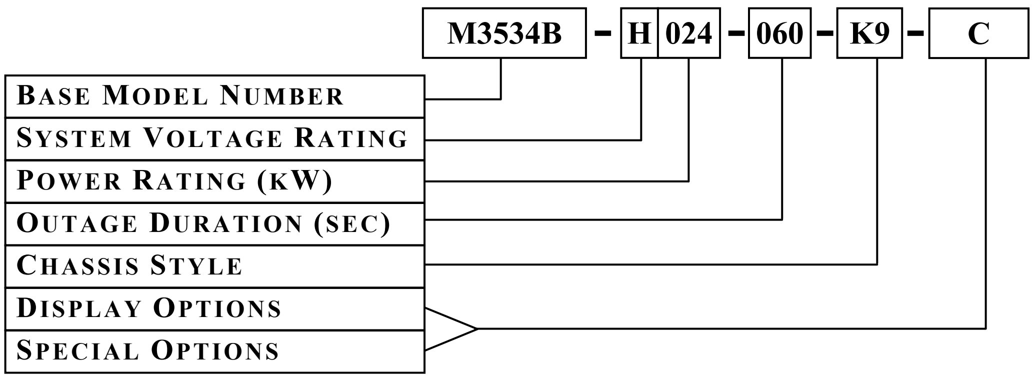
See the Drive Ride-thru Selection Guide in Section 7 for additional information.

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.

2.2. PART NUMBER BREAKDOWN

Figure 2-1: Example of Part Number Breakdown



BASE MODEL NUMBER

The Base Model Number for all Battery Regulator 100% outage, DC Bus Ride-Thru Modules (RTM) is **M3534B.**

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. A code letter indicates the system voltage.

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 RATING

The Power Rating indicates the maximum power in kilowatts that can safely be handled by the M3534B RTM Control Module.

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 24kW RTM is 024.

OUTAGE DURATION

The Outage Duration indicates the amount of time (in seconds) the M3534B module is able to hold the DC bus at the threshold level while loaded to the rated current. This duration is directly represented by a 3-digit value. For example, 060 in this position represents 60 seconds of Outage Duration.

CHASSIS STYLE

The Chassis Style is determined by the Power Rating as shown in Table 2-2.

Table 2-2: Chassis Information

CHX CODE	POWER RATING	TYPE	DIMENSIONS (H" x W" x D")
A5	12kW 20A	Type 1 Enclosure	18.6 x 5.1 x 9.4
K9	24kW 40A	Type 1 Enclosure	20 x 9.05 x 10.25
V	50kW 85A	Type 1 Enclosure	27 x 10 x 14

DISPLAY OPTIONS

All standard Model M3534B DC Bus Ride-Thru Modules are supplied with a basic set of status indicator lights on the ASB 3534R Control Board as shown in the Control Boards 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 2-3: Meter/Counter Option Codes.

Any 1 of the option codes listed below can be appended after a comma at the end of the model number. The display option is represented by an alphanumeric code.

Table 2-3: Meter/Counter Option Codes

OPTION CODE	DESCRIPTION
RTA	Ride-Thru Event 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 4-8 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
C	Automatic Current Sharing

KINETIC BUFFERING

The Kinetic Buffering Option intercepts an externally generated KB or shutdown signal and allows it to pass only when the M3534B can no longer maintain adequate DC bus level.

CONTROL SCHEME

All standard Model M3534B DC Bus Ride-Thru Modules are supplied with the RUN Command. If Automatic Current Sharing is required, add **C** as a Special Option.

2.3. GENERAL SPECIFICATIONS

Table 2-5: General Specifications Chart

PARAMETER	SPECIFICATION
Input / Output Voltage	• Units available for various standard AC Input / DC Output voltages. • See Section 6.1 of this manual for available Input / Output voltage ratings.
Control Inputs	• Isolated DISABLE Command 24V @10ma • Isolated TEST Command 24V @10ma
Max. DC Output Current	• Units available with ratings of 20A, 40A, 85A max DC output current.
Max. Power Rating	• Units available for up to 50kW based on the nominal DC system voltage rating and the maximum output current rating of the RTM. • Two units may be used in a Master / Slave combination to supply 100kW. *(see Section 3 of this manual)*
Max. Outage Duration	• Up to 60 seconds @40°C
Minimum Cooling Time	• 30 minutes
Precharge Time	• Approximately 5 seconds

Fault / Status Indicators	• LED located on the ASM 3534R RTM Control Board for each of the following:
	  • Power (PWR)
	  • Overtemp (OT)
	  • RT Active (RTA)

Counters and Meters	• A counter to track Ride-Thru activity is optionally available. • DC Bus voltmeter and/or ammeter options are also available.
Power Connections	• DC Battery Input, Ground • DC Bus Output

Fault / Status Outputs	• 3 outputs, each jumper selectable for N.O. or N.C. contact state
	• Each Form C dry contact output is rated for 1A @ 24VDC, resistive or 0.5A @ 120VAC, resistive.
	• 1 output available for each of the following signals via the ASB 3534R2 or ASB 3534R3 Control board for the M3534B RTM Control Module:
	  • Overtemp (OT)
	  • Ride-Thru Active (RTA)
	• 1 output for the Ride-Thru Ready (RTR) signal is available via the ASB 3534P3 Power Chopper board on the 85 Amp M3534B and via the ASB 3534P6 on the 40 Amp M3534B.

Operating Temp	• 0°C to 40°C

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.
- ALWAYS ALLOW AMPLE TIME FOR THE UNIT TO COOL BEFORE ATTEMPTING SERVICE ON THIS PRODUCT!
- THIS PRODUCT SHOULD BE INSTALLED ACCORDINGLY ON NON-FLAMMABLE SURFACES WITH CLEARANCES OF AT LEAST TWO INCHES IN ALL DIRECTIONS.
- 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. INSTALLING THE M3534B RIDE-THRU MODULE

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 M3534B 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 product to the equipment supplier or system integrator.

3.1. ENVIRONMENT / SITE SELECTION

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

- The unit has a UL Type-1 rating and will therefore require some protection from the elements.
- The unit will require a minimum clearance of two (2) inches above and below it to allow for proper airflow for cooling.
- The mounting surface should be clean and dry.

3.2. PRODUCT INSPECTION / UNPACKING

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

3.3. MOUNTING

Once the installation site has been selected as outlined above, the unit should be mounted in place. The RTM is provided with mounting slots and slotted holes to be mounted on 1/4" diameter studs or bolts, (2 for 20 Amp; 4 for 40 and 85 Amp modules). 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, please refer to the appropriate Dimensional Outline in Section 6.5 of this manual:

- Figure 6-9 for the M3534B 20A A5 Chassis Dimensional Outline
- Figure 6-10 for the M3534B 40A K9 Chassis Dimensional Outline
- Figure 6-11 for the M3534B 85A V Chassis Dimensional Outline

Also see Figures 3-1 and 3-2 for the optional Display Panels.

Figure 3-1: Typical 3.6" and 9" Diagnostic Display Panel and Mounting Dims

DP02 **DP10**

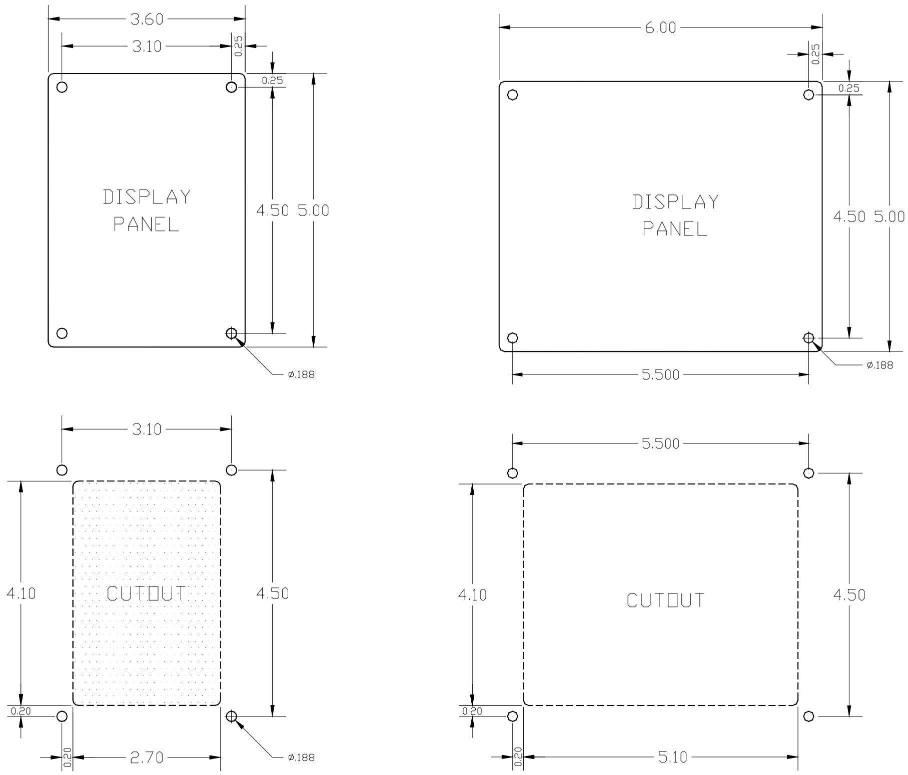
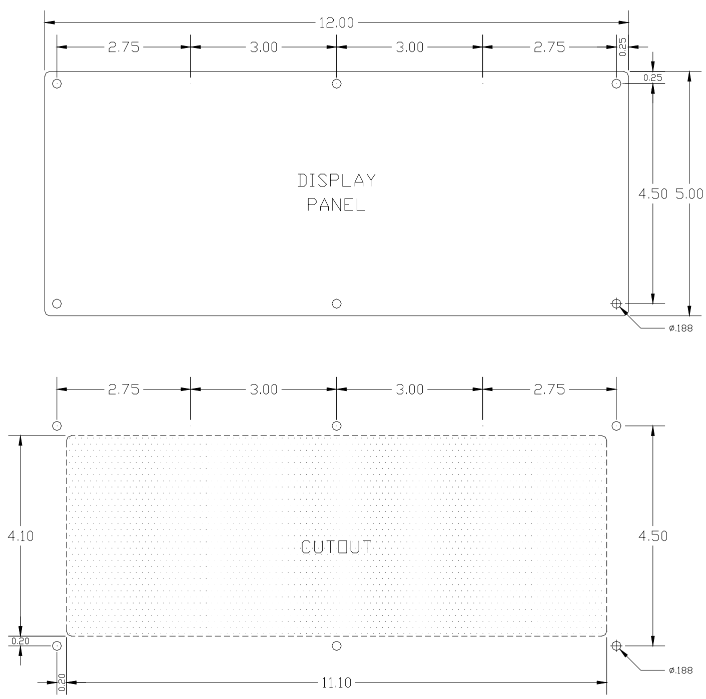


Figure 3-2: Typical 12" Diagnostic Display Panel and Mounting Dimensions

DP17



3.4. Wiring the M3534B Ride-Thru Module

This section provides information pertaining to the field wiring connections of the M3534B 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.

WARNING!

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

Table 3-1: 20 Amp Power Wiring Connections

Terminal Type	Function	Electrical Specifications	Min Wire AWG	Max Wire AWG	Torque lb-in
Triple Fuse Block (Lug or Spade)	AC input + —	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

Table 3-2: 40 Amp Power Wiring Connections

Terminal Type	Function	Electrical Specifications	Min Wire AWG	Max Wire AWG	Torque lb-in
Triple Fuse Block (Lug or Spade)	AC input + —	600VAC / 30 Amps	14	10	20 lb-in
Terminal block (bare wire)	DC Input + —	600VAC / 95 Amps	12	4	32 lb-in
Dual Fuse Block (Lug or Spade)	DC Output + —	750VAC / 30 Amps	14	10	20 lb-in
Stud (Ring Lug)	Gnd		18	10	20 lb-in

Table 3-3: 85 Amp Power Wiring Connections

Terminal Type	Function	Electrical Specifications	Min Wire AWG	Max Wire AWG	Torque lb-in
Terminal block (bare wire)	AC input + —	600VAC / 95 Amps	12	4	32 lb-in
Terminal block (bare wire)	DC Input + —	600VAC / 95 Amps	12	4	32 lb-in
Terminal block (bare wire)	DC Output + —	600VAC / 95 Amps	12	4	32 lb-in
Stud (Ring Lug)	Gnd		18	10	20 lb-in

3.4.1. POWER WIRING

- **20 Amp units:** See Table 3-1 and Figure 3-5.
- **40 Amp units:** See Table 3-2 and Figure 3-6.
- **85 Amp units**: See Table 3-3 and Figure 3-7.
- **170 Amp paralleled units:** The DC Bus connection and battery connections of two 85 Amp units are to be paralleled keeping wire lengths as close as possible. Connections can be made using 6 AWG wire using a ¼" ring lug. Torque all terminal screws to 45 lb-in max.
- **For ALL Parallel Units:** If connection to drive cap bank is less than 3 feet, a 25uH choke is recommended to decrease high frequency ripple currents between RTM and drive. Connect the DC output together close to RTM as shown in Figure 3-3, then run wire from common point to the drive capacitor bank.

3.4.1.1. SOURCE CONSIDERATIONS

All line feed must be capable of supplying battery charging current.

3.4.1.2. GROUND REQUIREMENTS

- **All units**: 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 WIRING

See Figures 6-16 through 6-19 for terminal locations.

3.4.2.1. DISABLE INPUT CONNECTIONS

20 Amp units:

- Connection is made at **TB4-1** (+) and **TB4-2** (–).

40 and 85 Amp units:

- Connection is made to K1 DISABLE relay. (See Figures 3-8, 3-9)

3.4.2.2. TEST INPUT CONNECTIONS

20 Amp units:

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

40 & 85 Amp units:

- Test input connections may be made across **TB6-1** (Positive) and **TB6-2** (Negative) of the ASB 3534R3 Control Board.
- Torque terminal screws to 2 lb-in max.

All test inputs are isolated from drive potential.

3.4.2.3. FAULT / STATUS MONITORING CONNECTIONS

<u>20 Amp units</u> on the ASB 3534R2 Control Board:

- To monitor the Over Temp Fault Relay connect across **TB5-5** (OT) and **TB5-3** (Common).
- To monitor the Ride-Thru Active Relay connect across **TB5-4** (RTA) and **TB5-3** (Common).
- Torque all connections to 2 lb-in max.

<u>40, 85 Amp units</u> on the ASB 3534R3 Control Board:

- To monitor the Over Temp Fault Relay connect across **TB5-2** (OT) and **TB5-4** (Common).
- To monitor the Ride-Thru Active Relay connect across **TB5-3** (RTA) and **TB5-4** (Common).

<u>40 Amp Model only:</u>

- Ride-Thru Ready Relay – ASB 3534P6 connect across **TB2-3** (common) **and TB2-2** (NO) **or TB2-1** (NC).
- Under Voltage Relay – ASB 3534P6 connect across **TB3-6** (common) **and TB3-5** (NO) **or TB3-4** (NC).

<u>85 Amp Model only:</u>

- Ride-Thru Ready Relay – ASB 3534P3 **TB3-1** (common) **and** ASB 3534P3 **TB3-2** (NO) **or** ASB 3534P3 **TB3-3** (NC).
- Torque all connections to 2 lb-in max.

3.4.2.4. OPERATING MODULES IN PARALLEL FOR INCREASED RATING

<u>85 Amp units</u>: Models with option "C" incorporate automatic current sharing capability. Operating 2 units in parallel will achieve 170 Amps.

<u>For Parallel Operation</u> (Reference Figure 3-3)

- Ensure thresholds are set within 1 volt of each other.
- Wire RUN commands in parallel.
- Wire INPUTs and OUTPUTs in parallel.
- Use one or both sets of status contacts.

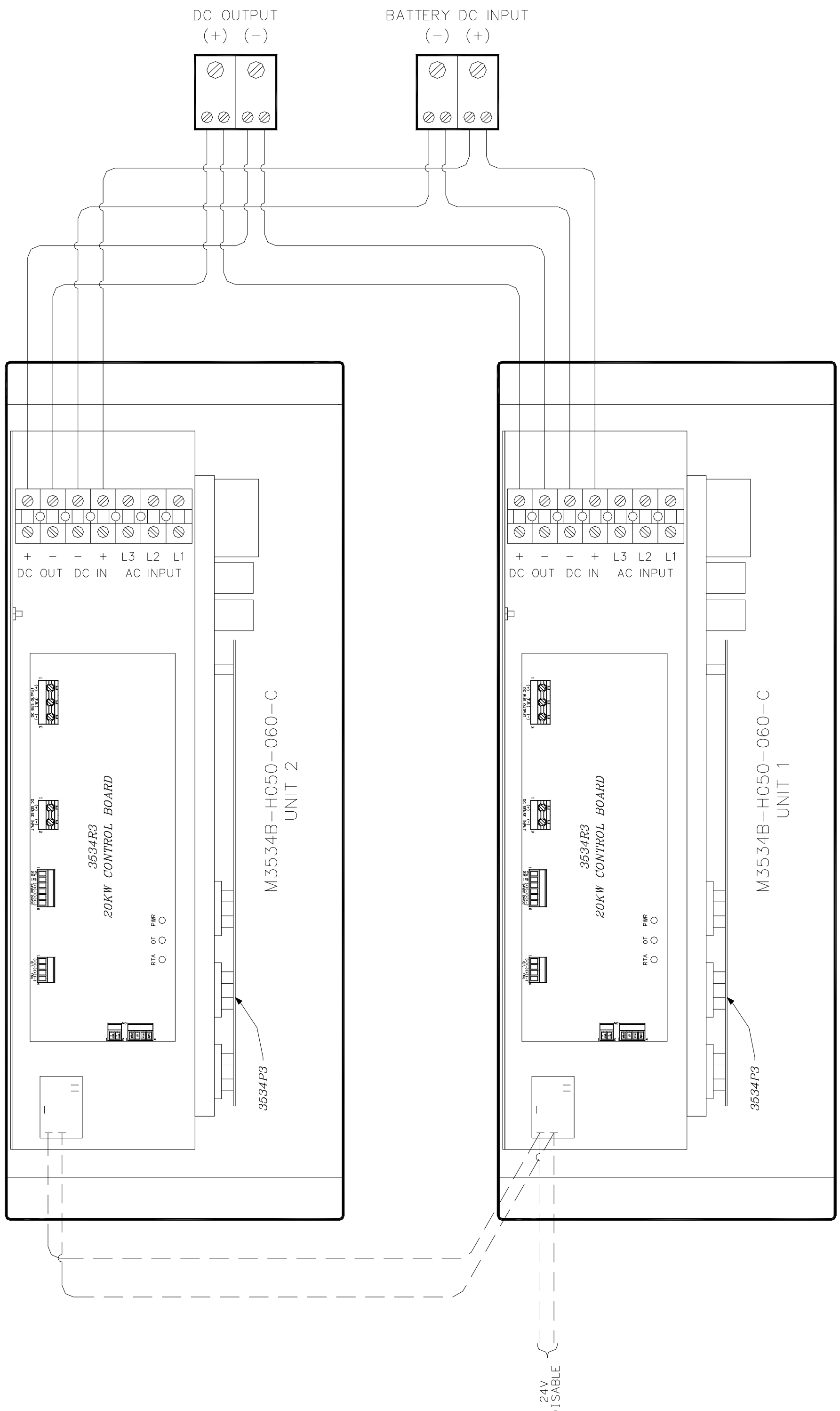
3.4.3. SYSTEM WIRING - RTM TO DRIVE INTERCONNECTIONS

Several illustrations are provided to assist with the field connection of the M3534B 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 must always be directly connected to the drive output cap bank. Connecting upstream of the DC bus inductors may damage both the Drive and the Ride-Thru unit.

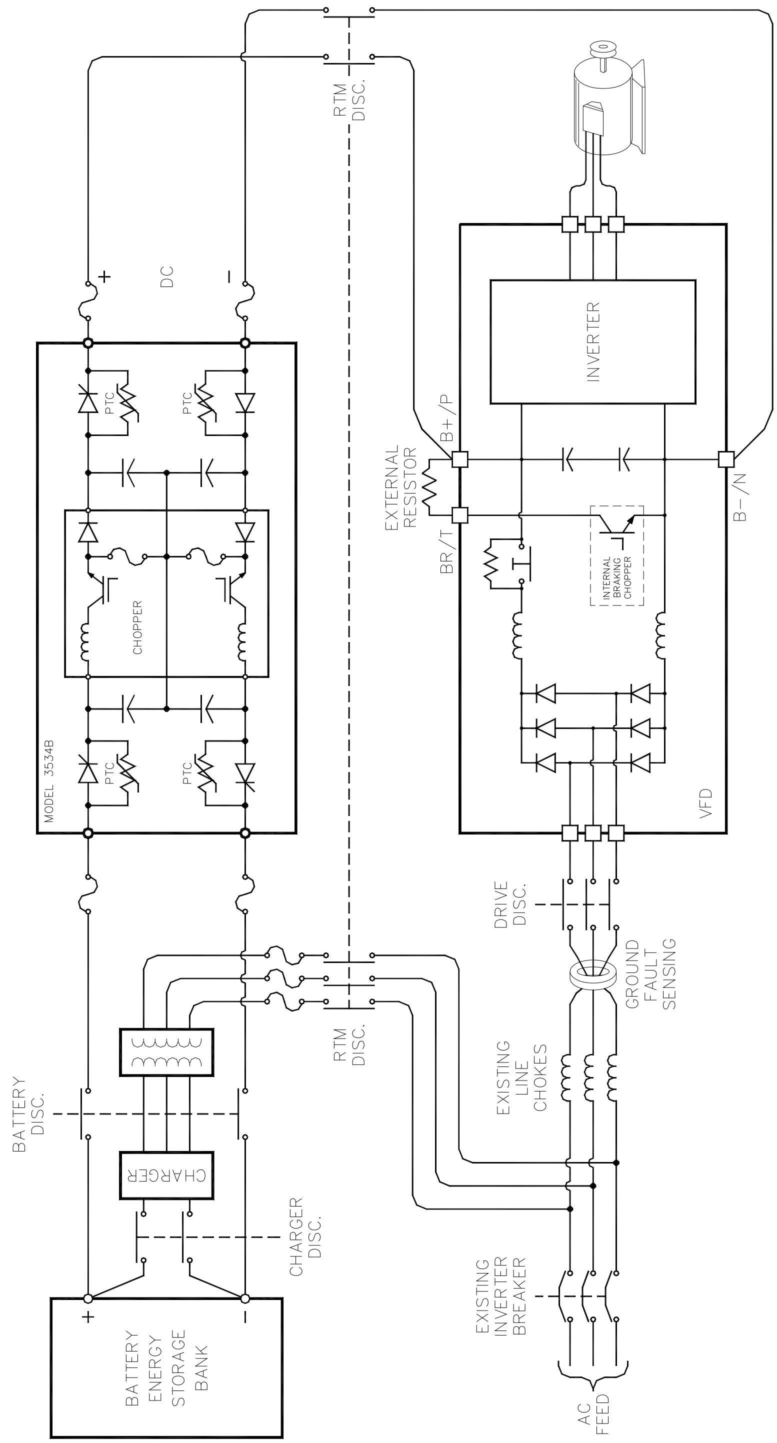
Typical Field Connection Terminal layouts for the M3534B RTM are shown in Figures 3-5 through 3-7. Figure 3-4 shows a typical power interconnection of the M3534B Ride-Thru Module with an existing AC Drive System.

3.5. Typical Configurations

Figure 3-3: Parallel Operation Wiring



<u>Figure 3-4: Typical M3534B Power Interconnection With Existing Drive System</u>



Note:

While the RTM module in Figure 3-4 above is depicted as a 40 Amp Ride-Thru module, the illustration is intended to show the basic interconnection of the M3534B module and an existing AC drive system. The basic interconnection scheme is identical for 20 Amp and 85 Amp RTMs as well.

Figure 3-5: Typical 20 Amp A5 Chassis Field Connection Terminal Layout

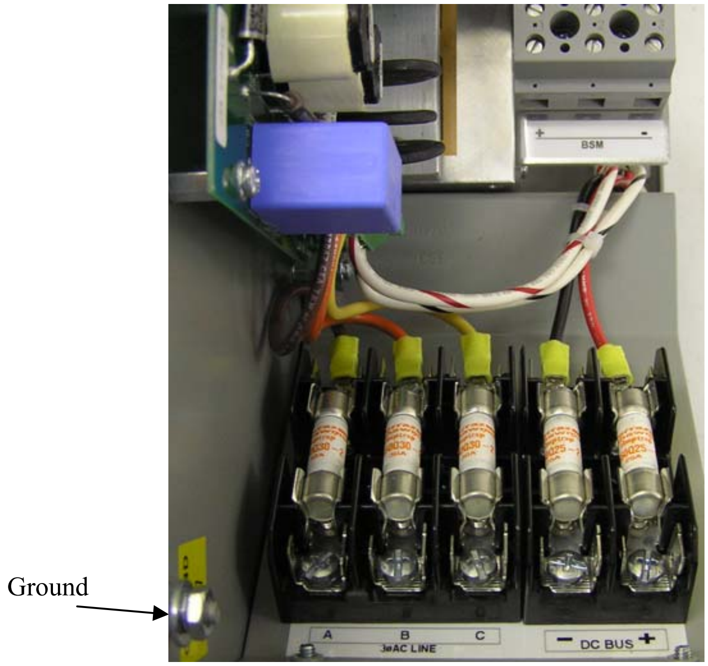


Figure 3-6: Typical 40 Amp K9 Chassis Field Connection Terminal Layout

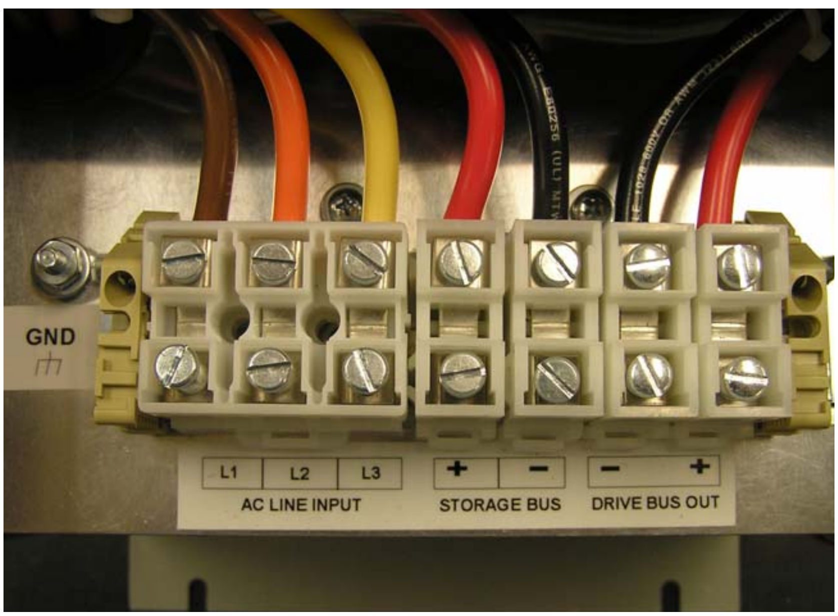


Figure 3-7: Typical 85 Amp V Chassis Field Connection Terminal Layout

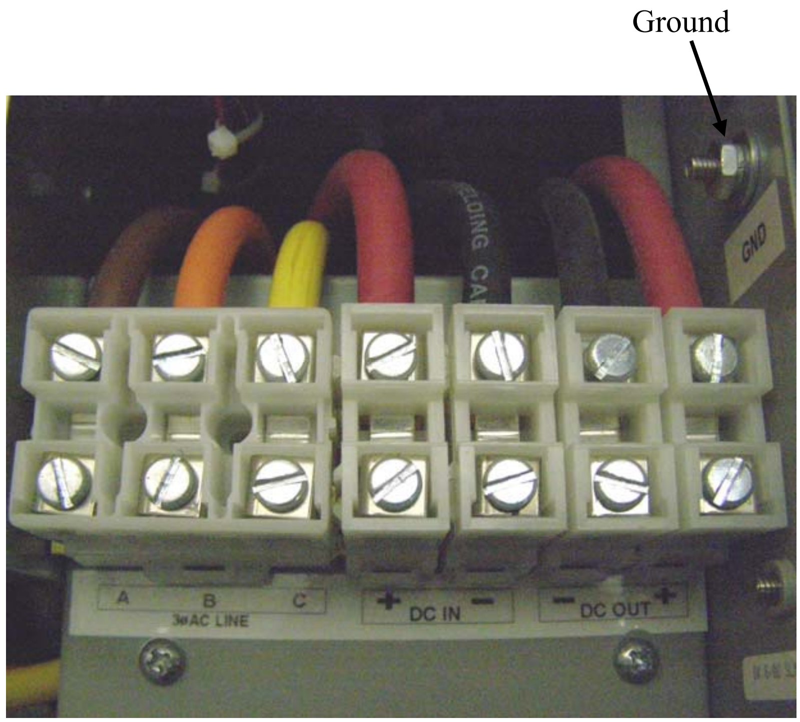


Figure 3-8: K9 Chassis Disable Relay

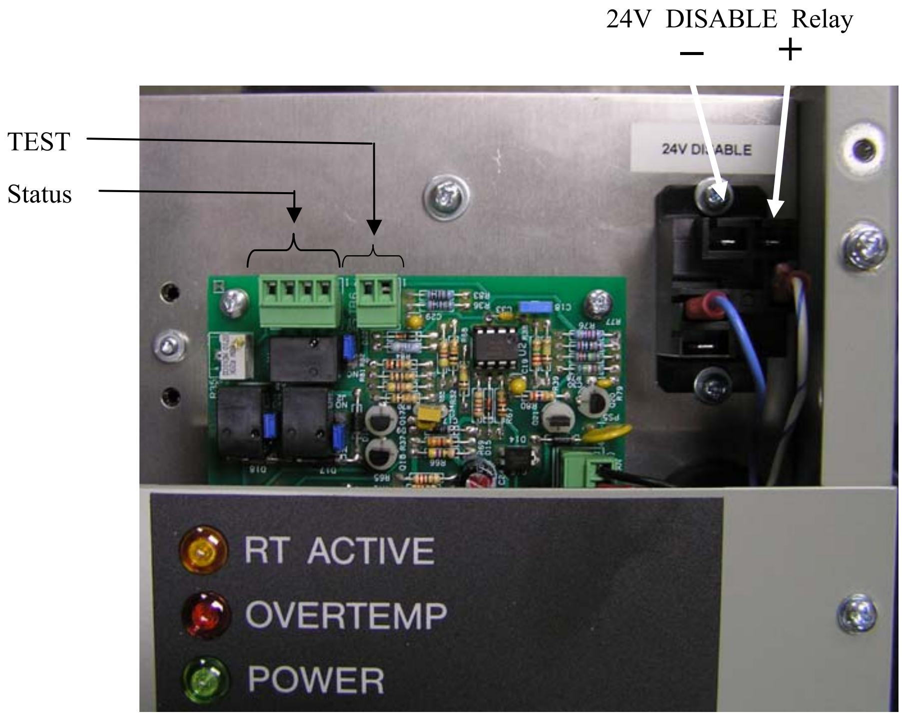
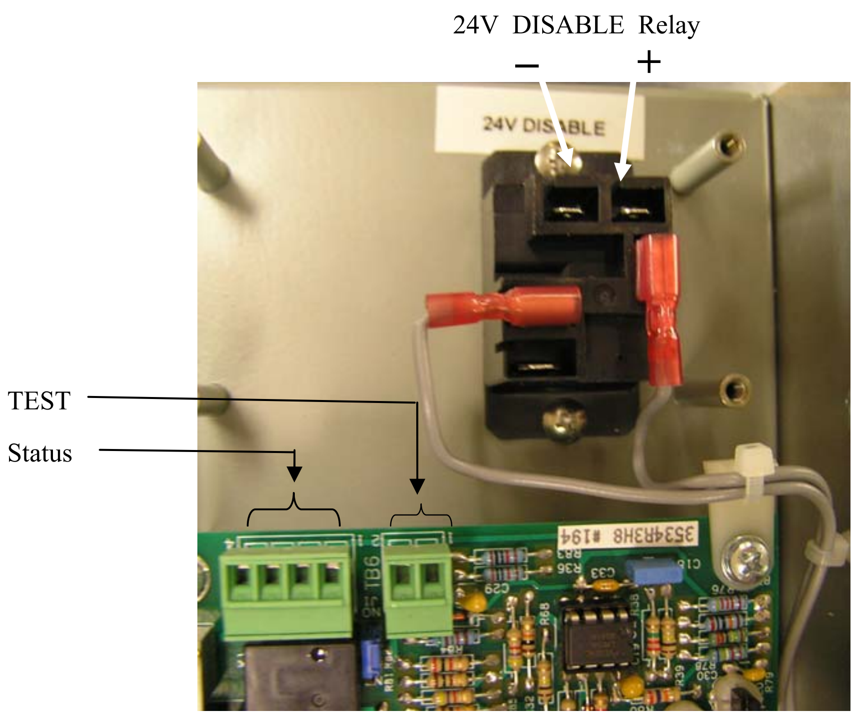


Figure 3-9: V Chassis Disable Relay



4. OPERATION

4.1. FUNCTIONAL DESCRIPTION

The M3534B series of Ride-Thru Modules (RTMs) employs IGBT switching technology and energy storage banks to regulate the inverter DC bus to a preset minimum voltage level. As the incoming AC voltage disappears, the RTM "activates", boosting the battery DC voltage up to the minimum DC bus voltage level specified for the inverter allowing it to "ride through" the sag or outage event. An external RUN command inhibits boosting.

4.1.1. POWER UP FROM BATTERY BANK

Upon application of power to the M3534B, its DC bus will begin to precharge via internal PTC surge limiters. When the bus reaches 100VDC, the internal logic power supply of the RTM will begin switching, and will supply the +24VDC and ±15VDC needed to power the control circuitry. At this point the **PWR** relay in the RTM will energize and its corresponding **PWR** LED will illuminate. At 400VDC the **RTA** relay within the RTM may turn **ON** briefly at the end of the RTM's precharge period.

Once the RTM's DC bus has fully pre-charged to its preset nominal value (see Ratings in Section 6.1 for voltage levels), the control module's **PWR** LED will be **ON**, the **OVERTEMP** LED will be **OFF** and the **RTA** LED will be barely **ON** depending on the input voltage and output load. The output voltage will be the "threshold" level as set at Bonitron, typically 585VDC for a 460VAC system. The **DISABLE** command will cause the unit to stop boosting and the output voltage will drop to slightly below the battery input.

When the drive DC bus is connected, the bus level should rise above the threshold and **RTA** should go **OFF**. The RTM is now ready to protect the inverter system from complete loss of voltage.

4.1.2. OPERATION DURING OUTAGE EVENT

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 after activity stops.

As energy is drained, the battery voltage will drop and the RTM will regulate the bank voltage up to the threshold level. If the Open Battery Bypass Option is used, and a battery opens during discharge, the battery monitor will show which battery is open, and will automatically bypass that battery. The RTM will make up the lost voltage and maintain the drive bus at threshold.

4.1.3. CONTINUOUS OPERATION

If the RTM begins supplying power continuously, possibly due to a low line level, overheated PTC devices, incorrect threshold adjustment, or inverter failure, an overtemp 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 continues supplying power at the battery voltage level, but will not boost. Continuous currents can cause permanent damage. The **RTA** signal should not be active unless there is a power loss condition.

If the battery voltage drops too low 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.

The 24kW model includes input undervoltage (IUV) sensing and is set to change states when the input DC battery bank voltage drops below a predetermined level (400VDC for 460VAC systems). It is recommended to activate the **DISABLE** command when battery bank drops below its recommended level in order to save the battery bank from deep discharge.

4.1.4. OPERATING (2) 85 AMP UNITS IN PARALLEL

85 Amp units with suffix "C" are capable of automatic current sharing. Power wiring is to be done in parallel. (See Figure 3-3: Parallel Operation Wiring.) RUN commands should be wired in parallel, while status signals can be taken from 1 unit or can be wired in series / parallel combinations. See Figures 6-21 and 6-22 for basic schematics. Thresholds must be set within 1V of each other for best operation. Thresholds differing by 4V can decrease run time by as much as 15% on highest module full load. See Figures 4-3 and 4-4 for sharing curves.

Figure 4-1: Basic 20A M3534B RTM Internal Power Flow Circuit Diagram

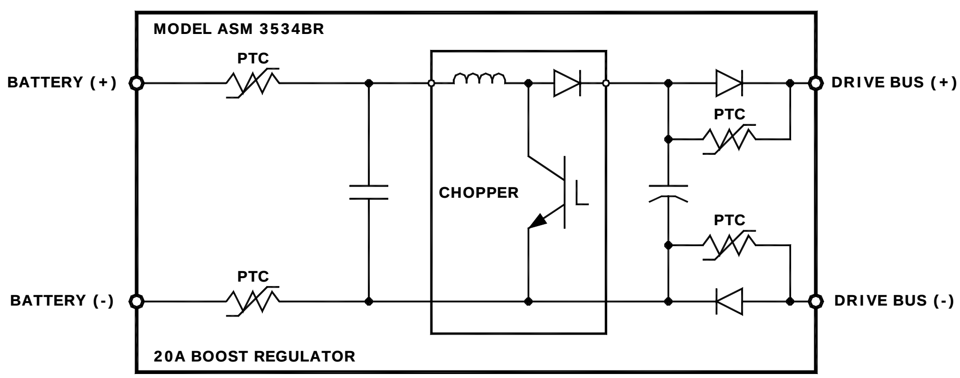


Figure 4-2: Basic 40A & 85A M3534B RTM Internal Power Flow Circuit Diagram

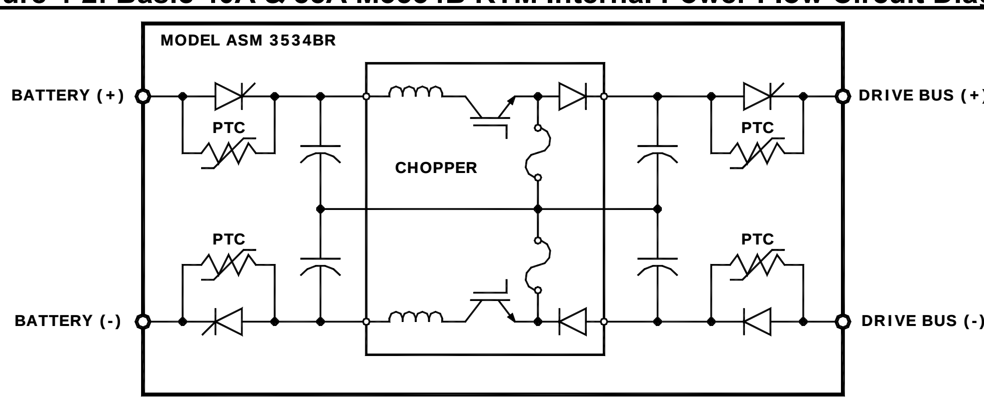


Figure 4-3: Equal Threshold Sharing

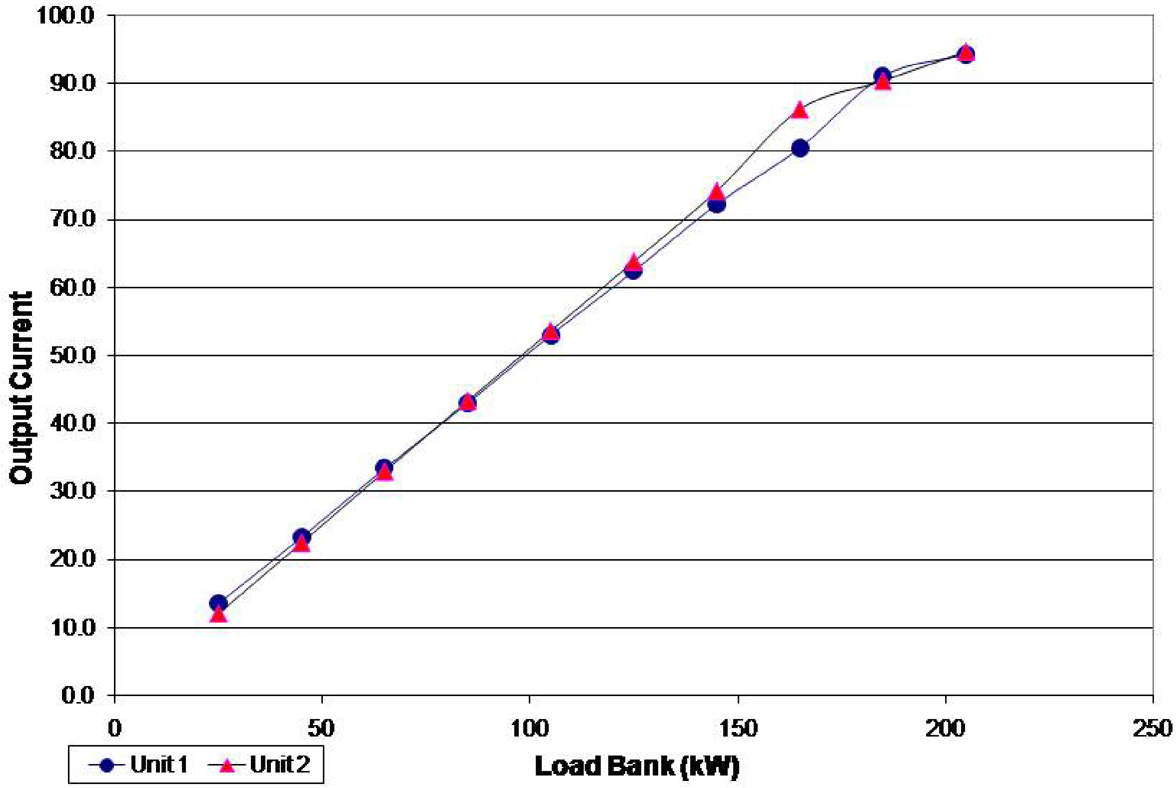
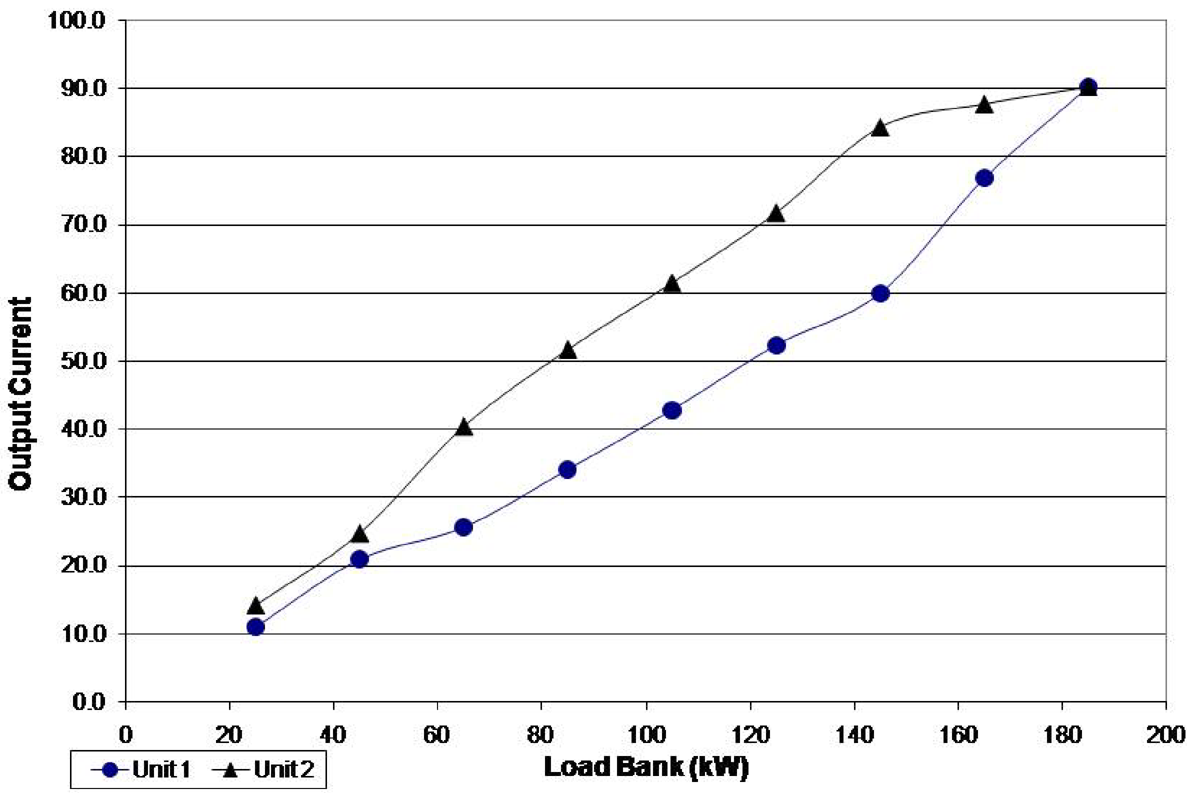


Figure 4-4: Thresholds 1 Volt Apart

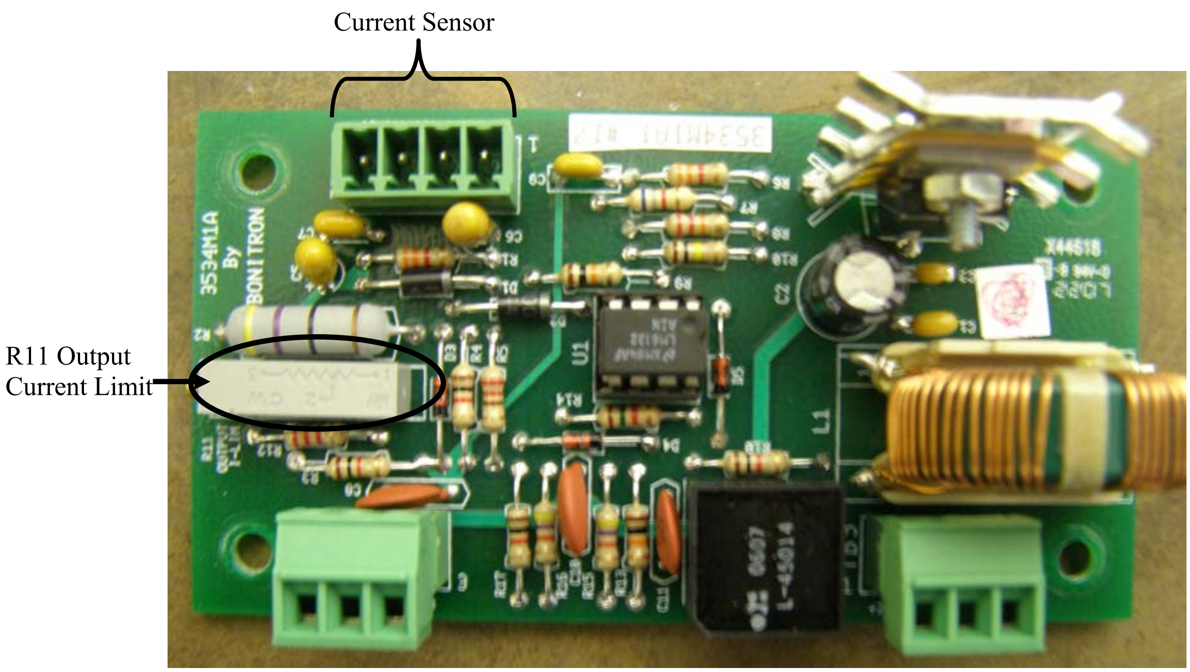


4.2. Features

ASB 3534M1 Current Sharing PCB

ASB 3534M1 is used to limit the output current of each individual booster module in cases where sharing is needed or in cases where the booster module is used on an oversized VFD running at low power loads.

Figure 4-5: M1 Board



4.2.1. Terminal Strip I/O

4.2.1.1. Control Inputs

20 Amp Units

- 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 isolated from drive common.

See Figure 4-6 and 6-16 thru 6-23 for control and status connections.

40 and 85 Amp Units

- The DISABLE command is connected directly to the K1 DISABLE Relay. 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 input is connected directly to TB6 on the 3534R3 control board. 24V initiates TEST. Input is insolated from drive common.

See Figures 3-8, 3-9, 4-7, and 6-16 thru 6-23 for control and status connections.

4.2.1.2. ASB 3534R2 RTM CONTROL BOARD (12KW 20AMP MODELS)

The ASB 3534R2 is the main control board of the Ride-Thru Control module used in all 20 Amp M3534B Ride-Thru Control Modules.

Figure 4-6 shows the location of the jumpers described below.

ASB 3534R2 STATUS OUTPUT CONFIGURATION JUMPERS

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 4-6 in Section 4.2.2.1 for the locations of each of the jumpers listed below and to Figure 6-20 for the basic schematic.

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 OUTPUT

This jumper allows the user to select the output contact state of **Over-Temp** fault relay **K1**. 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 **K2**. This jumper must be set to "Normally Open" (**NO**) for cabinet systems.

ASB 3534R2 FAULT LOGIC DETAILS

All standard M3534B Ride-Thru Control modules are equipped with basic Fault / Status outputs. These outputs are accessible via 3534R2 Control board terminal strip TB4. Each output is jumper selectable to provide "Normally Open" or "Normally Closed" dry contact outputs. Each contact is in its "Normal" condition while its controlling relay is "Inactive" or at rest. When a Fault / Status LED is ON, the corresponding relay can be assumed to be "Active".

Please refer to Table 4-3 for complete details.

4.2.1.3. ASB 3534R3 RTM CONTROL BOARD (24-50KW 40-85A MODELS)

The ASB 3534R3 is the main control board of the Ride-Thru Control module used in all 40 and 85 Amp M3534B Ride-Thru Control Modules. Figure 4-7 shows the location of the jumpers described below.

ASB 3534R3 STATUS OUTPUT CONFIGURATION JUMPERS

The purpose and setting for each of the configuration jumpers provided on the ASB 3534R3 RTM Control board is described below. Please refer to Figure 4-7 in Section 4.2.2.2 for the locations of each of the jumpers listed below and to Figure 4-21 for the basic schematic.

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 J2: OVER-TEMP FAULT OUTPUT:

This jumper allows the user to select the output contact state of **OVERTEMP** fault relay **K2**. This jumper must be set to "Normally Closed" (**NC**) for cabinet systems.

JUMPER J3: 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.

ASB 3534R3 FAULT LOGIC DETAILS

All standard M3534B Ride-Thru Control modules are equipped with basic Fault / Status outputs. These outputs are accessible via 3534R3 Control board terminal strip TB5. Each output is jumper selectable to provide "Normally Open" or "Normally Closed" dry contact outputs. Each contact is in its "Normal" condition while its controlling relay is "Inactive" or at rest. When a Fault / Status LED is ON, the corresponding relay can be assumed to be "Active".

Please refer to Table 4-4 for complete details.

4.2.1.4. ASB 3534P3 POWER CHOPPER BOARD (50KW 85A MODELS)

The ASB 3534P3 is the power regulating board for the 85 Amp version of the M3534B Ride-Thru Control Module. Figure 4-8 in Section 4.2.2.3 shows the locations of all major components of the board.

ASB 3534P3 FAULT LOGIC DETAILS

All standard M3534B Ride-Thru Control modules are equipped with basic Fault / Status outputs. These outputs are accessible via 3534P3 Power Chopper board terminal strip TB3. Each output provides both the "Normally Open" and "Normally Closed" dry contact outputs. Each contact is in its "Normal" condition while its controlling relay is "Inactive" or at rest. When a Fault / Status LED is ON, the corresponding relay can be assumed to be "Active".

Please refer to Table 4-5 for complete details.

4.2.1.5. ASB 3534P6 POWER CHOPPER BOARD STATUS INDICATORS (24KW 40A MODELS)

The ASB 3534P6 is the power regulating board for the 40 Amp version of the M3534B Control Module. Figure 4-9 in Section 4.2.2.4 shows the locations of all major components of the board.

ASB 3534P6 FAULT LOGIC DETAILS

All 40 Amp M3534B Ride-Thru Control modules are equipped with basic Fault / Status outputs. These outputs are accessible via 3534P6 Power Chopper board terminal strip TB2. Each output provides both the "Normally Open" and "Normally Closed" dry contact outputs. Each contact is in its "Normal" condition while its controlling relay is "Inactive" or at rest. When a Fault / Status LED is ON, the corresponding relay can be assumed to be Active. Refer to Table 4-5 for complete details.

4.2.1.6. RTM Fault Logic Details – Control System

All standard M3534B Ride-Thru Control modules are equipped with basic Fault / Status outputs. These outputs are accessible via on-board terminal strip TB4 for 20 amp models, or TB5 for 40 and 85 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. When a Fault / Status LED is ON, the corresponding relay can be assumed to be "Active".

All units are shipped with all Fault / Status outputs in the "Normally Open" position. Refer to Figure 6-16 and Figure 6-17 for the locations of each of the components listed in Tables 4-1 thru 4-4 below.

Table 4-1: Fault / Status Signal Component Details – R2 Control Board

Fault / Status Components	Fault / Status Signal Component Id		
	Power (PWR)	OverTemp (OT)	Ride-Thru Active (RTA)
Jumper		J1	J2
Relay		K1	K2
Indicator	LD1	LD2	LD3
Control Board Terminations		TB4-7 & 5	TB4-6 & 5

Table 4-2: Fault / Status Signal Component Details – R3 Control Board

Fault / Status Components	Fault / Status Signal Component Id		
	Power (PWR)	OverTemp (OT)	Ride-Thru Active (RTA)
Jumper		J2	J3
Relay		K2	K3
Indicator	LD1	LD2	LD3
Control Board Terminations		TB5-2 & 4	TB5-3 & 4

Table 4-3: Fault / Status Contact Logic Details – R2 Control Board

RTM Fault / Status Condition	Indicators			Jumper Positions and Contact States			
				J1 & K1		J2 & K2	
	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 & DC bus OK	ON	OFF	OFF	O	X	X	O
Power on & OverTemp	ON	ON	OFF	X	O	X	O
Power on & Ride-Thru active	ON	OFF	ON	O	X	O	X
Power on & Disabled	ON	OFF	OFF	O	X	X	O

Table 4-4: Fault / Status Contact Logic Details – R3 Control Board

RTM Fault / Status Condition	Indicators			Jumper Positions and Contact States			
	LD1	LD2	LD3	J2 & K2		J3 & K3	
				N.C.	N.O.	N.C.	N.O.
Power off or P.S. failure	OFF	OFF	OFF	X	O	X	O
Power on & DC bus OK	ON	OFF	OFF	O	X	X	O
Power on & OverTemp	ON	ON	OFF	X	O	X	O
Power on & Ride-Thru active	ON	OFF	ON	O	X	O	X
Power on & Disabled	ON	OFF	OFF	X	O	X	O

Table 4-3 and Table 4-4 Notes:

X = contact is closed under stated conditions
O = contact is open under stated conditions

4.2.1.7. RTM Fault Logic Details – Power System

The 40 and 85 Amp Ride-Thru Control modules are equipped with a Ride-Thru Ready Status output. This output is accessible via on-board terminal strips. The output is a dry contact output and is in the Normally Closed position when the controlling relay (K1) is in the Inactive or Rest state. A Blown Fuse (BF) or Unbalance condition (UB) will cause K1 to change states. If LD1 (RTR) is lit then the relay (K1) can be assumed to be active, and the Ride-thru is ready to operate. Refer to Figures 4-8 and 4-9 for the location of components listed in the following tables.

Table 4-5: Fault / Status Signal Component Details – Power Boards

DRT Model	Circuit Board	Contact Terminals		UB	BF	RTR	OV	UV
		N.O.	N.C.					
40 Amp	ASB 3534P6	TB2-3 & 2	TB2 1 & 3	LD2	LD1	LD3	LD4	LD5
		TB2-6 & 5	TB2 6 & 4					
85 Amp	ASB 3534P3	TB3-1 & 2	TB3 1 & 3	LD2	LD1	LD3	LD4	

Table 4-6: Fault / Status Contact Logic Details – RTR K1 Contacts

RTM Status	RTR K1 Contact		UB	BF	RTR	IUV
	N.O.	N.C.	LDx	LDx	LDx	LDx
Power off or P.S. failure	O	X	OFF	OFF	OFF	OFF
Power on and DC bus OK	X	O	OFF	OFF	ON	OFF
Power on and Ride-Thru Active	X	O	OFF	OFF	ON	OFF
Unbalance condition	O	X	ON	OFF	OFF	OFF
Blown Fuse condition	O	X	OFF	ON	OFF	OFF

Table 4-7: Fault / Status Contact Logic Details – IUV K2 Contacts

RTM Status	IUV K2 Contact		UB	BF	RTR	IUV
	N.O.	N.C.	LDx	LDx	LDx	LDx
Low Input Condition	O	X	OFF	OFF	ON	ON

4.2.2. INDICATORS

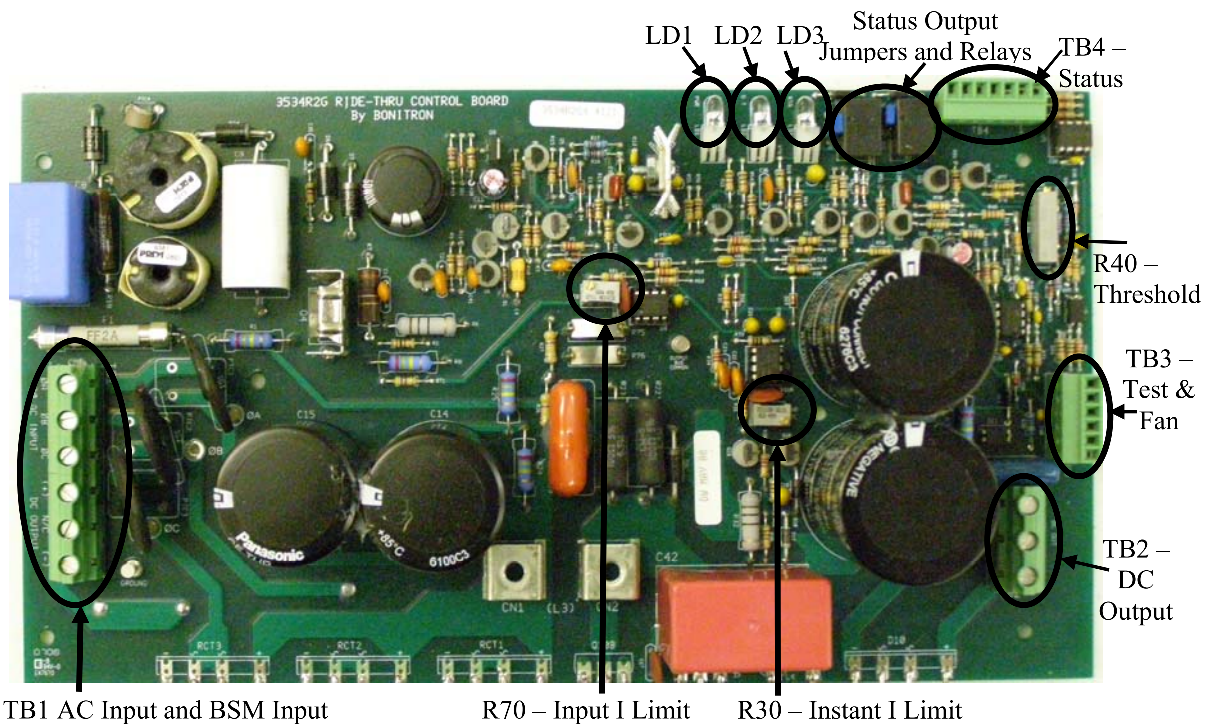
4.2.2.1. ASB 3534R2 RTM CONTROL BOARD STATUS INDICATORS (FOR 12KW 20A MODELS)

The ASB 3534R2 is the main control board used in all 20 Amp M3534B Ride-Thru Control Modules.

Figure 4-6 shows the locations of all major components of the board, which are described in detail below.

For 40 and 85 Amp modules, please see Section 4.2.2.2.

Figure 4-6: 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. Refer to Figure 4-6 for the locations of each of the indicators listed below.

LD1: POWER (PWR)

The **LD1 PWR** indicator shows the presence of control power within the M3534B RTM Control Module.

LD2: OVER-TEMP (O.T.)

The **LD2 O.T.** indicator shows the presence of an Over-Temp condition within the M3534B RTM Control Module . This indicator directly tracks the activity of **Power** status output relay **K1**. This indicator is **ON** and the relay is active when power is present.

LD3: RIDE-THRU ACTIVE (RTA)

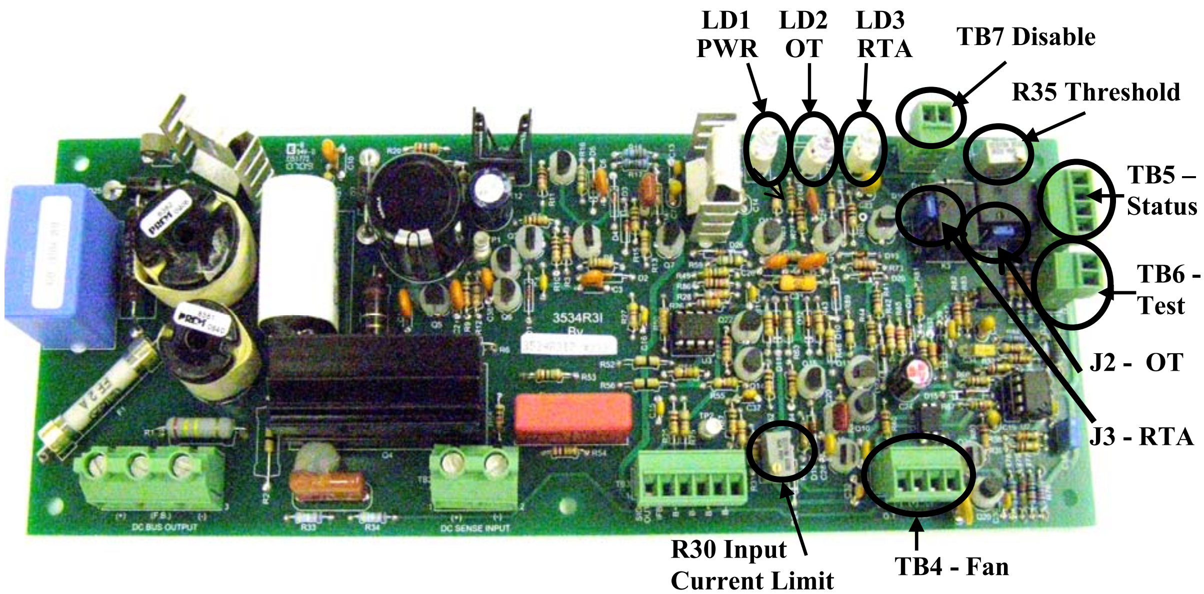
The **LD3 RTA** indicator shows when the M3534B RTM Control module is actively supporting the DC bus. This indicator directly tracks the activity of **RTA** status output relay **K2**. This indicator is **ON** and the relay is active when ride through activity is present (must have a minimum of 0.25 Amps of load).

4.2.2.2. ASB 3534R3 RTM CONTROL BOARD STATUS INDICATORS (24-100KW 40-170A MODELS)

The ASB 3534R3 is the main control board used in all 40 and 85 Amp M3534B Ride-Thru Control Modules. Figure 4-7 below shows the locations of all major components of the board.

For 20 Amp modules, please see Section 4.2.2.1 *ASB 3534R2 RTM Control Board Features*.

Figure 4-7: ASB 3534R3 RTM Control Board Features



ASB 3534R3 STATUS INDICATORS

The purpose and function of each status indicator provided on the ASM 3534R3 RTM Control board is described below. Refer to Figure 4-7 for the locations of each of the indicators listed below.

LD1: POWER (PWR):

The **LD1 PWR** indicator shows the presence of control power within the M3534B RTM Control Module.

LD2: OVER-TEMP (O.T.):

The **LD2 O.T.** indicator shows the presence of an **OVERTEMP** condition within the M3534B RTM Control Module. This indicator directly tracks the activity of **OVERTEMP** status output relay **K2**. This indicator is **ON** and the relay is active when an **OVERTEMP** condition is present.

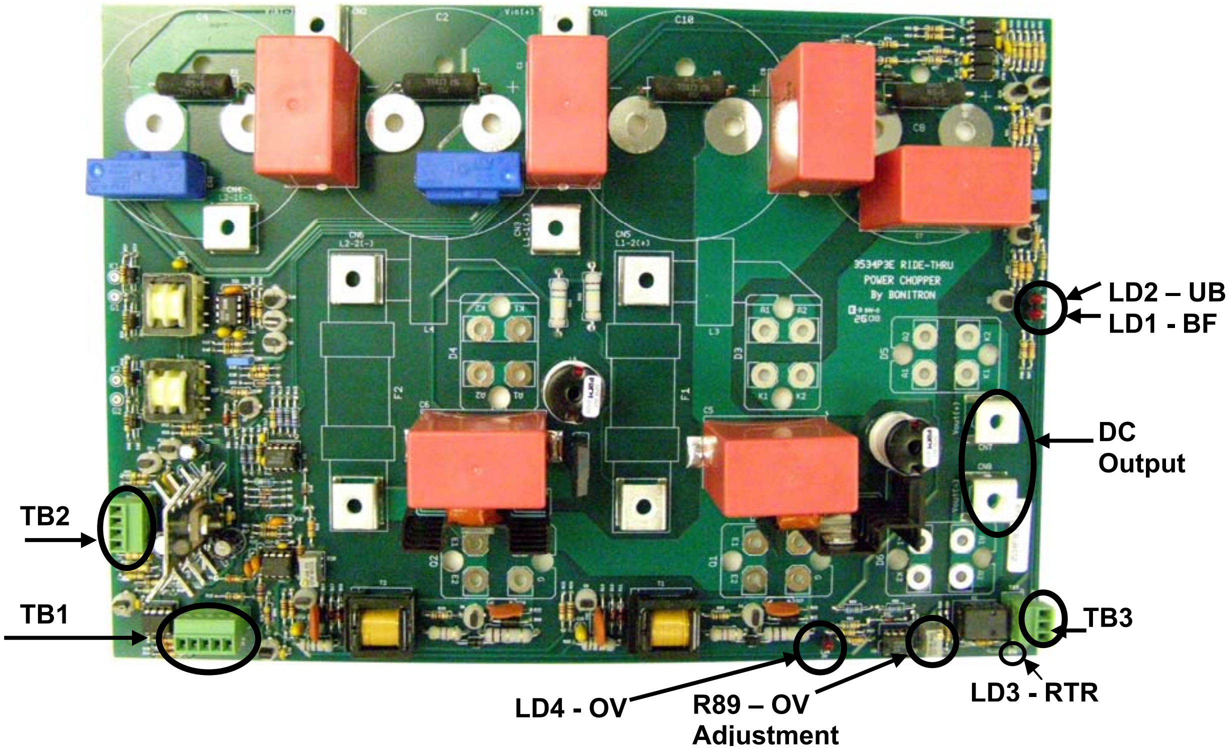
LD3: RIDE-THRU ACTIVE (RTA):

The **LD3 RTA** indicator shows when the M3534B RTM Control Module is actively supporting the DC bus. This indicator directly tracks the activity of **RTA** status output relay **K3**. This indicator is **ON** and the relay is active when ride through activity is present (must have a minimum of 0.25 Amps of load).

4.2.2.3. ASB 3534P3 Power Chopper Board Status Indicators (50kW 85A Models)

The ASB 3534P3 is the power regulating board for the 85 Amp version of the M3534B Ride-Thru Control Module. Figure 4-8 below shows the locations of all major components of the board.

Figure 4-8: ASB 3534P3 Power Chopper Features



ASB 3534P3 Status Indicators

The purpose and function of each status indicator provided on the ASB 3534P3 RTM Power Chopper board is described below. Please refer to Figure 4-8 above for the locations of each of the indicators listed below.

LD1: BF (Blown Fuse):

The **LD1 BF** indicator will illuminate if an IGBT Fuse is open and power is applied.

LD2: UB (Unbalance):

The **LD2 UB** indicator will illuminate if the output filter voltages exceed 400V.

LD3: RTR (Ride-Thru Ready):

The **LD3 RTR** indicator will illuminate if power is applied and there are no Blown Fuse, Unbalance, or Over Voltage faults.

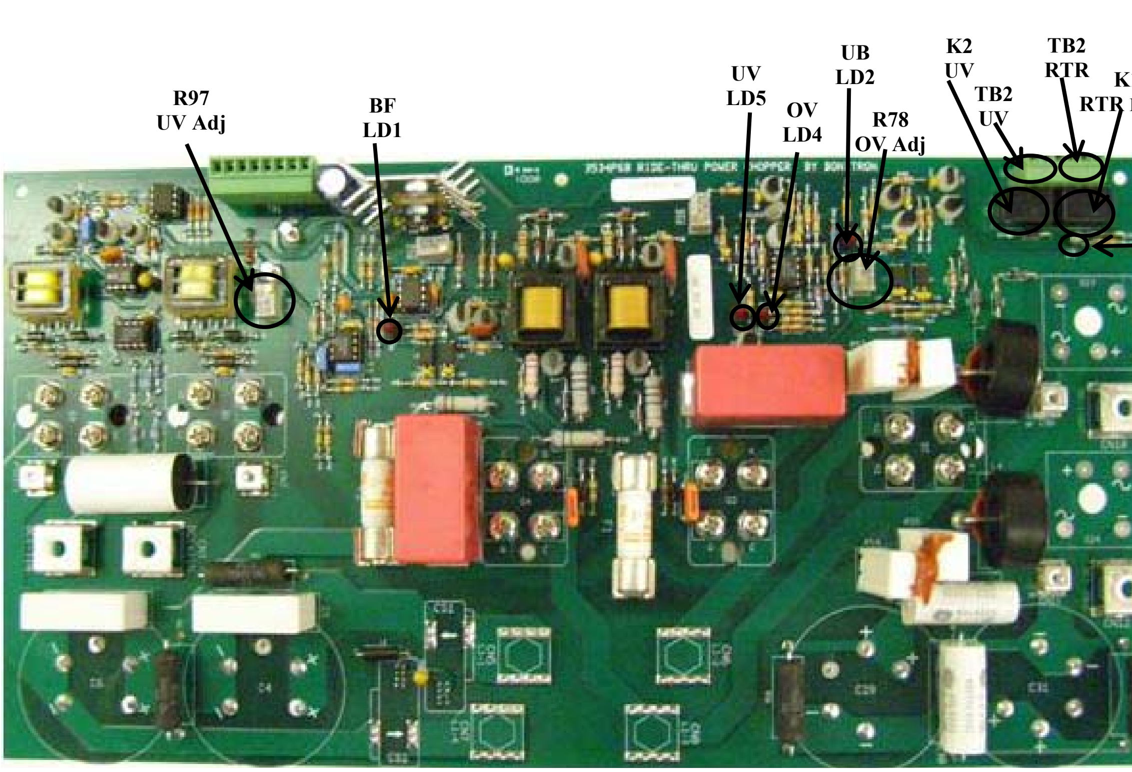
LD4: OV (Over-Voltage):

The **LD4 OV** indicator will illuminate if the DC Bus is above the OV Threshold. The OV Threshold is set by adjusting potentiometer R89 (Clock-wise to increase setpoint). The setpoint is factory preset at 710VDC for a 460VAC system.

4.2.2.4. ASB 3534P6 POWER CHOPPER BOARD STATUS INDICATORS (24KW 40AMP MODELS)

The ASB 3534P6 is the power regulating board for the 40A version of the M3534B Control Module. Figure 4-9 below shows the locations of all major components of the board.

Figure 4-9: ASB 3534P6 Power Chopper Features



ASB 3534P6 STATUS INDICATORS

The purpose and function of each status indicator provided on the ASB 3534P6 RTM Power Chopper Board is described below. Please refer to Figure 4-9 above for the locations of each of the indicators listed below.

LD1: BF (BLOWN FUSE):

The **LD1 BF** indicator will illuminate if an IGBT Fuse is open and power is applied.

LD2: UB (UNBALANCE):

The **LD2 UB** indicator will illuminate if the output filter voltages exceed 400V.

LD3 : RTR (RIDE-THRU READY):

The **LD3 RTR** indicator will illuminate if power is applied and there are no Blown Fuse, Unbalance, or Over Voltage faults.

LD4: OV (OVER-VOLTAGE):

The **LD4 OV** indicator will illuminate if the DC Bus is above the OV Threshold. Potentiometer R78 is used to set the OV setpoint (Clock-wise to increase setpoint). The setpoint is factory preset.

LD5: UV (UNDER-VOLTAGE):

The **LD5 UV** indicator will illuminate if the input DC Bus is below the Low

Battery Threshold. Potentiometer R97 is used to set the UV setpoint (Clock-wise to increase setpoint). The setpoint is factory preset.

4.2.3. STATUS DISPLAY FEATURES

Each model M3534B RTM is equipped with indicators to track RTM status.

4.2.3.1. STANDARD STATUS INDICATORS

The Model M3534B Ride-Thru Module is equipped with 3 indicators located on the ASB 3534R control board. These indicators provide the user with current RTM status information. A brief description of each indicator is given below. For further details on the operation of each indicator, refer to the appropriate Control Board Detail in Sections 4.2.2.1 and 4.2.2.2 of this manual.

RT ACTIVE:

This **AMBER** indicator comes **ON** when the RTM is actively supporting the DC bus.

OVERTEMP:

This **RED** indicator comes **ON** when the internal heatsink temperature exceeds 70°C.

POWER:

This **GREEN** indicator comes **ON** when control power is present in the RTM.

4.2.3.2. OPTIONAL DP**SERIES REMOTE DISPLAY PANELS

The Ride-Thru Diagnostic Display Panel provides visual indication of the Ride-Thru module's operating status and also permits a system test to be performed. Currently, there are 17 DPxx display panel configurations. The most common combinations of features are detailed in Table 4-8 and Figure 4-10.

4.2.3.3. SYSTEM STATUS DISPLAY AND TEST MODULE

The system status display module provides visual indication of various system functions. The monitored functions include POWER, RIDETHRU ACTIVE, and OVERTEMP. In addition, this module provides the system TEST switch required for threshold voltage adjustments and system calibration.

The functions of each of these indicators are described below.

POWER LED

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

(RTA) RIDE-THRU ACTIVE LED

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

OVER TEMPERATURE LED

The **RED** OVERTEMP LED is **ON** if the heatsink temperature 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.

For parallel units test should connect to both units using a double pole relay.

4.2.3.4. Bus Voltage Meter (DP11 and DP17)

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.

4.2.3.5. Bus Current Meter (DP17)

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.

4.2.3.6. 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.

4.2.3.7. Total RTA Cycles Counter

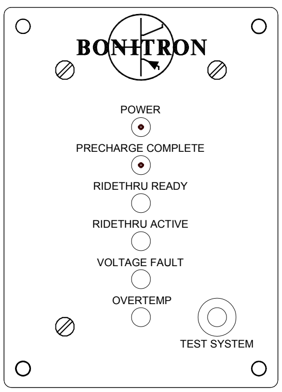
The Total RTA Cycles Counter indicates the lifetime total number of times the Ride-Thru module has been active. The counter is battery powered and therefore does not lose its count during a power outage. This counter is not affected by the Reset push-button located to the right on the front face of the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

Table 4-8: Diagnostic Display Panel Configurations

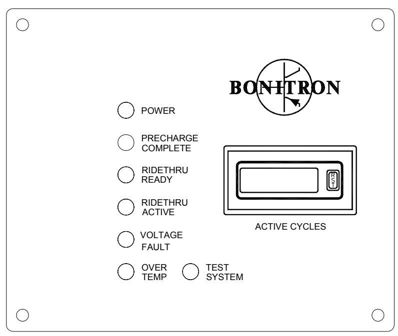
Panel Number	LEDs & Test Switch	Meters		Counters		Panel Dims.
		Voltmeter	Ammeter	Total Cycles	Active Cycles	
DP2	✓					5" x 3.6"
DP10	✓				✓	5" x 6"
DP11	✓	✓			✓	5" x 9"
DP17	✓	✓	✓	✓	✓	5" x 12"

Figure 4-10: DP Series Remote Display Panel Layouts**

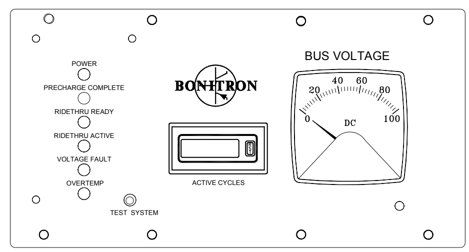
DP02



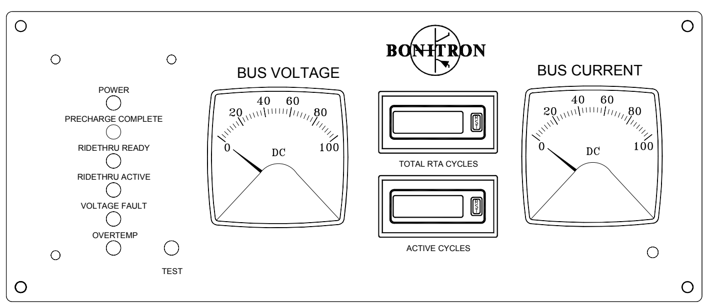
DP10



DP11



DP17



4.3. M3534B RIDE-THRU FIELD START-UP PROCEDURE

WARNING!

The M3534B RTM contains capacitive elements for filtering. 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 electricians 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 DC link between the drive and Ride-Thru is OPEN.

1. Ensure that the Model M3534B Ride-Thru Module has been properly installed and wired as previously outlined in the Installing the M3534B Ride-Thru Module and Wiring the M3534B Ride-Thru Module sections of this manual.
2. The DC bus threshold setpoint of the M3534B 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-Thru", and under voltage trips on the drive may still occur during sag events.
3. 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.
   - Some inverters automatically change this setting when main voltage is programmed, and is typically 80-85% of full DC bus voltage.
4. If start-up must be done during production runs, disable the inverter ground fault until testing can be done. See Section 7.2, step 7.
5. Ensure that the associated inverter is on-line and functioning properly.
6. Ensure that the DC bus polarity is correctly wired at the disconnect switch connecting the inverter DC bus with the RTM DC bus.
7. Ensure the battery bank DC polarity is correctly wired at the disconnect switch connecting the Battery bank DC bus with the RTM DC input.
8. Ensure DISABLE command is enabled to inhibit boosting.

4.3.2. START-UP PROCEDURE AND CHECKS

1. Apply DC power to the M3534B module from the battery bank and verify the following start-up sequences:
   - M3534B module **POWER** LED comes **ON**, the **RT ACTIVE** LED remains **OFF**, and the **OVERTEMP** LED remains **OFF**.

CAUTION!

Please note that the M3534B uses a thermistor in its logic power 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.

40A AND 85A UNITS:

   - Approximately 4 seconds after logic power comes up the precharge will be complete and the RTM is ready to accept the RUN command and provide ride-thru support.
   - Output bus will be a few volts below input battery level.
2. Remove DISABLE command.
   - Output bus will rise to threshold.
   - As output bus threshold rises, the **RTA** LED may increase in intensity, depending on battery voltage level and output load..

CAUTION!

Double check polarity of DC busses on both sides of disconnect before closing.

3. Connect the Drive bus to the RTM bus.
   - Output bus rises to within 5-15V of drive bus (depending on whether or not fan is running).
   - **RTA** LED will be **OFF.**
4. Verify Ride-Thru capability by removing power from the system.
   - M3534B 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 threshold level as defined in Table 4-9: Factory Setpoints for Threshold and Test Boost Voltages.
   - Inverter should be able to keep motor speed and torque constant.

CAUTION!

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

5. Re-apply power to the system at the end of the outage test and allow time for the unit to cool.

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 sag. 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. 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. Table 4-9 below 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. Refer to Figures 7-1 and 7-2 for typical DC bus voltage levels.

4.4.1.1. Parallel Units

For parallel units, thresholds should be set within 1 volt of each other for proper operation.

Table 4-9: Factory Setpoints for Threshold and Test Boost Voltages

System AC Voltage	Battery Input Voltage Range	Threshold	Test Boost	Over-Voltage
440 - 480VAC	400 - 585VDC	585VDC	+100VDC	710VDC
380 - 415VAC	350 - 485VDC	485VDC	+82VDC	630VDC

4.4.2. Determining Threshold Voltage Setpoint

Testing and adjustment of the THRESHOLD voltage setpoint can be performed on systems on the test bench, while unloaded and offline, or under on-line and loaded condition as described in Methods 1 and 2 below. Both of the methods described require that you monitor the DC bus voltage during the testing and adjustment procedures.

Note that threshold level drops by approximately 7V-10V from no-load to full-load. See Figure 4-11 for approximate volts-per-turn.

Adjusting Thresholds on Parallel Systems

With INPUT DC connected and OUTPUT DC disconnected, turn on 1 DISABLE command at a time and adjust the active unit. Adjust for equal settings under full load conditions. See Figures 4-3 and 4-4 for sharing curve.

CAUTION!

Be sure to read through all adjustment methods completely before attempting any adjustment of the threshold voltage setpoint.

4.4.2.1. Method 1: Determining the Threshold Voltage Setpoint on the Test Bench

1. Lower DC input to 62% using VARIAC.
   - When input is lower than threshold, the RTM will become active. With **RT ACTIVE** LED on bright, measure RTM DC output level. This is the THRESHOLD setpoint voltage.

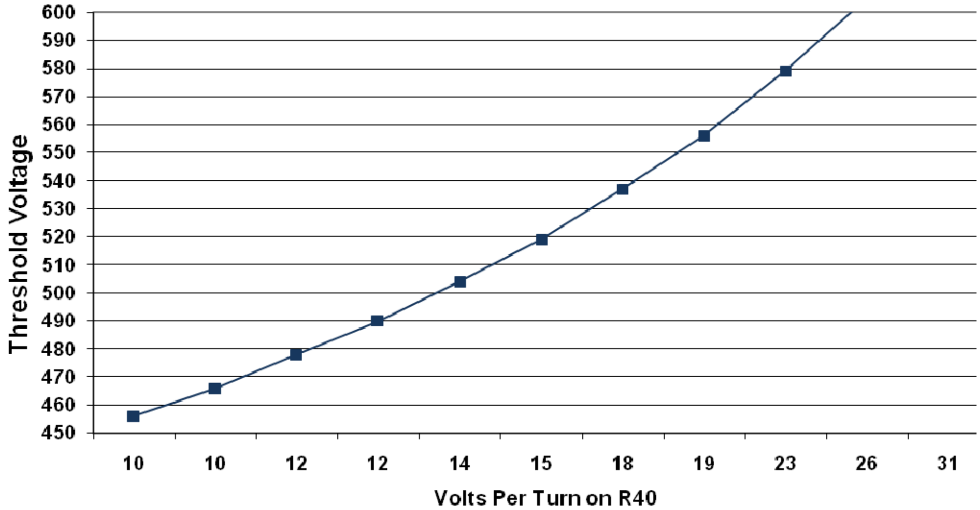
4.4.2.2. Method 2: Determining the Threshold Voltage Setpoint for an On-Line and Loaded System

1. Remove input voltage supply from drive system.
   - When 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 using energy from the connected battery bank.
2. Read the DC bus voltage as it is being maintained. This is the THRESHOLD setpoint voltage.
   - Readings and adjustments must be made within runtime limits of booster.
   - Once the actual THRESHOLD voltage has been determined you can make adjustments, if required, to achieve the optimum setting for your system. Use the Volts-per-Turn Chart in Figure 4-11.
   - 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.
   - **<u>For 20 Amp units:</u>** Adjustment pot R40 on the 3534R2 control board (see Figure 4-6) 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 600VDC for "E" and "H" models. See Figure 4-11 for approximate Volts-Per-Turn ratio.
   - **<u>For 40 and 85 Amp units:</u>** Adjustment pot R35 on the 3534R3 control board (see Figure 4-7) 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 600VDC for "E" and" H" models. Make equal adjustments to parallel units. See Figure 4-11 for approximate Volts-Per-Turn ratio.

After making the adjustments, repeat the test from Step 1 to verify the new setpoint. Fine tune the adjustment and retest as necessary.

NOTE: The Boost Voltage Level is factory preset and is not adjustable in the field.

Figure 4-11: Volts-per-Turn Chart



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 4-6 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 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 3534R3 Adjustment Pots

The purpose and setting for each adjustment pot provided on the ASB 3534R3 Control board is described below. Please refer to Figure 4-7 earlier in this section for the locations of each of the adjustment pots listed below.

R30 – 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.

R35: 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 for additional information as needed.

4.4.3.3. ASB 3534P3 ADJUSTMENT POTS

The purpose and setting for each adjustment pot provided on the ASB 3534P3 Power Chopper board is described below. Please refer to Figure 4-8 earlier in this section for the locations of each of the adjustment pots listed below.

R89: OVERVOLTAGE ADJUST

Clockwise adjustment will increase the setpoint value. The setpoint is factory preset for 710VDC for 460VAC systems, therefore no field calibration of this setpoint will be necessary.

4.4.3.4. ASB 3534P6 ADJUSTMENT POTS

The purpose and setting for each adjustment pot provided on the ASB 3534P6 Power Chopper board is described below. Please refer to Figure 4-9 at the beginning of this section for the locations of each of the adjustment pots listed below.

R78: OVER-VOLTAGE ADJUST

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

R97: UNDER-VOLTAGE ADJUST

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

4.4.3.5. ASB 3534M1 ADJUSTMENTS

ASB 3534M1 is factory adjusted for proper sharing between units and should not be adjusted in the field. Thresholds MUST be adjusted as close to each other as possible to obtain full ratings of parallel units. Thresholds unequal by 4 volts can result in decreased rating of 15%, and up to 50% if the current sharing adjustment has been tampered with.

When the sharing pcb is adjusted for proper sharing, the extended ratings curves do not apply (see Figures 6-1 & 6-2) as this adjustment limits output current to 90 amps maximum regardless of input voltage level. To disable current limit for the purpose of obtaining extended ratings with higher input voltages simply pull the plug between the current sensor and the 3534M1 pcb. (See Figure 4-5.)

4.5. CALIBRATION

None

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5. MAINTENANCE AND TROUBLESHOOTING

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

5.1. PERIODIC TESTING

5.1.1. PERIODIC MAINTENANCE PROCEDURES FOR M3534B WITH DIAGNOSTIC DISPLAY OPTIONS

The Bonitron voltage booster is designed to be low maintenance, but because the M3534B units are part of a Ride-Thru system that uses batteries, Bonitron recommends a yearly test of the system in order to ensure the electronics package and batteries are operating. The following steps can be taken to ensure reliability and give comfort that the system is still able to ride through a sag event.

1. Check Active cycle counters (if equipped).
    - More than 10 counts per month may mean the Ride-Thru is improperly adjusted. Refer to Section 4.4.1 for adjustment details.
    - Note count for factory records.
    - Report count to Bonitron via your local service representative.
2. Monitor front panel LEDs for the DP17 Display Panel:
    - **POWER** LED should be **ON**.
    - **RIDE-THRU ACTIVE LED** should be **OFF**.
    - **OVERTEMP** LED should be **OFF**.
3. Verify DC bus current meter.
    - Meter should read zero amps under normal conditions.
4. Verify DC bus voltage meter.
    - Ride-Thru bus should be about 10–35VDC below the Inverter bus.
5. Verify battery voltage. (See Table 7-1.)
6. Verify THRESHOLD and outage time by opening the AC disconnect to the Ride-Thru module (if equipped). (Refer to Section 4.4.)
    - The DC bus voltage should drop until it reaches the threshold.
    - Current meter should read according to power required by inverter.
    - **RIDE-THRU ACTIVE** LED should begin to flash.
    - DC bus should hold at the threshold.
    - This threshold level should be 10-30 volts below the nominal loaded inverter bus. (See Table 4-9)
    - Consider full TEST when outage time reaches spec, or when battery voltage drops to discharged level as shown in Table 7-1.
7. Verify switching circuits by initiating the TEST sequence 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 as much as 17% above the threshold.
    - Inverter DC bus voltage should rise an equivalent amount.
    - **RIDE-THRU ACTIVE** LED should turn **ON**.

- Motor speed should remain constant.
- Active cycle counter should increment.

This completes the maintenance procedure.

5.2. Maintenance Items

5.2.1. Capacitor Replacement Recommendations

5.2.1.1. Capacitor Replacement Criteria

Bonitron Model 3534B 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 M3534 typically is in a standby mode waiting for a power disturbance, and by design has 50% more capacitance than needed.

The capacitor manufacturer has given a rating of 11 years MTBF if ambient temp is 50°C, capacitors are held at 100% rated voltage, and caps run full ripple current at 1% duty.

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.

The recommended test is to measure the voltage across each series set of capacitors. Any voltage difference greater than 15% between each set of series caps would indicate a change in value in one cap and would constitute a more detailed out of circuit capacitance check. (A difference of 5% is allowed at time of production.)

5.2.1.2. Capacitor Testing Procedure

1. With power applied, measure voltage across each cap and make note for future reference.
   - Any voltage difference more than 15% indicates a substantial change in capacitance.
   - Example: DC bus = 540V, each series cap = 270V.
   - 15% of 270 = 40.5V   cap 1 = 290V,   cap 2 = 250V.
2. Remove power and replace both capacitors.

5.2.1.3. Cleaning

- Cleaning off dust, debris, or chemical build-up on high voltage bus bars or other exposed components may be necessary. If cleaning is needed:
  - Remove power and allow all voltages to drain.
  - Check for residual voltages with meter.
  - Clean affected areas with rag, brush or denatured alcohol, depending on the type of contamination.
  - Once area is clean and dry, reapply power.

5.2.1.4. Fans

1. Fans run only while RT is active and should have a life of 20 years if the RT is properly adjusted.
2. To check operation of fan, initiate activity.
   - 20 and 40 Amp models: Fan should run for 2-3 minutes.
   - 85 Amp models: Fan should run for 30 minutes.

3. If fan does not run, replace with equivalent 24V fan.

5.2.2. BATTERY REPLACEMENT RECOMMENDATIONS

Follow battery cabinet manufacturer's recommendations.

5.3. TROUBLESHOOTING

Table 5-1: Troubleshooting Guide

SYMPTOM	ACTION
No LEDs	• Check incoming power • Check power supply on 3534R2 or 3534R3 for 24V • Replace 3534R2 or 3534R3 control pcb if incorrect
No LEDs on power pcb	• Check power supply on 3534R3 for 24V • If OK, then replace 3534P3 or 3534P6 power pcb
No RTR	• Check for RUN command • Check BF LED on 3534P3 or 3534P6 • Check UB LED on 3534P3 or 3534P6 • Check OV LED on 3534P3 or 3534P6 • If OK replace control pcb
RTA always ON	• Check DC Bus levels on both sides of diodes • Check for overheated precharge ckt • Too much activity can cause stage fuse failures, overheating and draining of the battery • Check threshold level, if changed over time adjust level or replace 3534R2 or 3534R3 • Lower threshold by at least 10V

RTA never ON	• Check DISABLE command
	• Initiate test cycle or remove power
	    • Watch and listen for signs of activity
	        • Check RTA contact and LED
	        • Ticking sound
	• If RTR is OK, and no activity, replace 3534R2 or 3534R3
	• If RTR is NOT OK, replace 3534R2 or 3534P3 or 3534P6
	• Check power quality data to confirm sag events should have caused activity to occur
	• If never any activity, replace 3534R2 or 3534R3

Overtemp	• Check for constant current on the negative or positive DC bus links • Check temp sensor on heatsink • Check activity record – too much activity may cause overtemp • Check precharge network for overheating – (cause of constant activity)
Blown Fuse LED ON	• Check stage fuses – BF LED on 3534P3 or 3534P6 will be ON • If all stage fuses are OK replace 3534P3 or 3534P6 power pcb
Blown stage fuses	• Check for shorted IGBT • Replace 3534R2 or 3534P3 or 3534P6 or repair gate drive circuits if IGBT is shorted • Check activity record – too much activity may cause fuse fatigue

SYMPTOM	ACTION
Unbalance LED ON	• Check DC voltage across both bus capacitors • If not within 5% replace capacitors • If OK replace 3534R2 or 3534P3 or 3534P6
Overvoltage LED ON	• Check DC bus level. OV factory set for 710VDC for 460VAC system • OV can occur in TEST mode if threshold is set too high
TEST won't work	• Check DC bus level – too high causes no test • Check blown fuse LED during test • If ON, check stage fuses • Check TEST input to 3534R2 or 3534R3 • If OK, replace 3534R2 or 3534R3
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 • Lower threshold level and retry

Stays in TEST mode	• Threshold way too high
	    • Only appears to be in test mode
	    • Can occur in 400V systems if RT is factory set for 585V
	• Check TEST input to 3534R2 or 3534R3
	• If OK replace 3534R2 or 3534R3

Precharge overheated	• Check DC bus ripple voltage. Too much ripple can cause PTCRs to overheat
	    • Add parallel precharge PTCRs
	    • Change series precharge resistance
	    • Add fan to cool PTCRs
	    • Add isolated bias supply
	• Precharge can only be done 3 consecutive times before overheating can occur

5.4. TECHNICAL HELP – BEFORE YOU CALL

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

- 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: Model M3534B Ride-Thru Module Ratings @ 60 Sec

MODEL NUMBER	AC INPUT (VAC)	MAX OUTPUT POWER	RECOMMENDED FUSE RATINGS (DC INPUT / DC OUTPUT)	MAX DC OUTPUT CURRENT	CHASSIS SIZE (H x W x D INCHES)
M3534B-H012	460	12kW	A70Q30 / A70Q25	20ADC	18.6 x 5.1 x 9.4
M3534B-H024	460	24kW	A70Q75 / A70Q50	40ADC	20 x 9.05 x 10.25
M3534B-H050	460	50kW	A60Q125 / A70Q80	85ADC	27 x 10 x 14

Table 6-1 Notes:

For higher ratings, batteries can be added and 85 Amp or 170 Amp units can be paralleled. See Section 3.4.2.4 for parallel schemes and Figures 6-1 and 6-2 for extended rating charts.

Table 6-2: Model M3534B Ride-Thru Module Voltage Levels

AC INPUT VOLTAGE	DC BUS VOLTAGE LEVELS	
	THRESHOLD	NOMINAL
115VAC	145VDC	160VDC
230VAC	285VDC	320VDC
400VAC	495VDC	565VDC
460VAC	585VDC	640VDC

Table 6-2 Notes:

The THRESHOLD column in the table above lists the voltage level at which the DC bus will be maintained when the RTM is active during a power loss. This is usually calibrated about 90% of the nominal DC bus level and will drop another 7V when fully loaded.

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
	230	**6**
E	380	9
	400	**10**
	415	10
H	433	11
	460	**12**
C	575	Not available

Figure 6-1: Extended Ratings Typical for 85 Amp 400VAC Systems

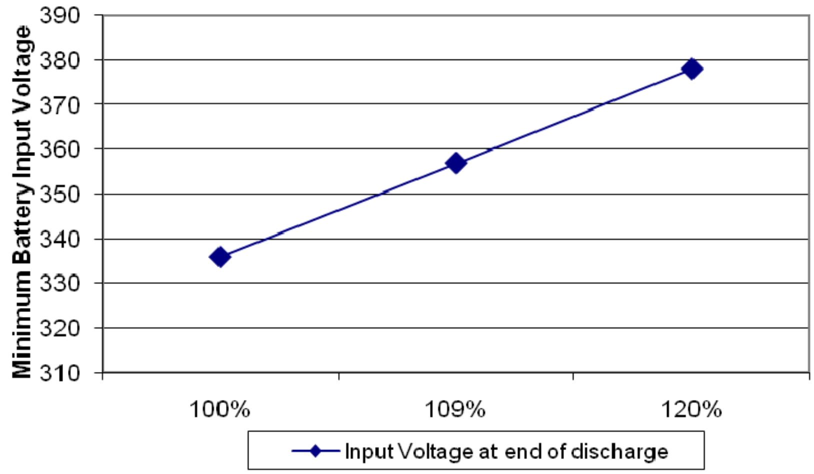


Figure 6-2: Extended Ratings Typical for 85 Amp 460VAC Systems

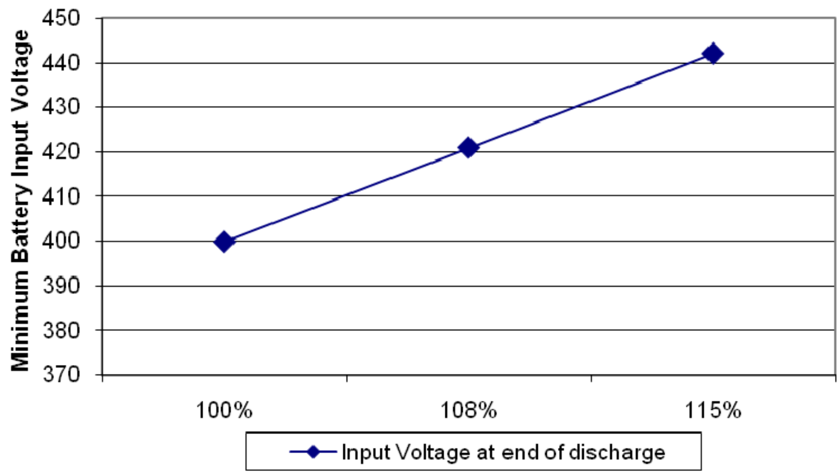
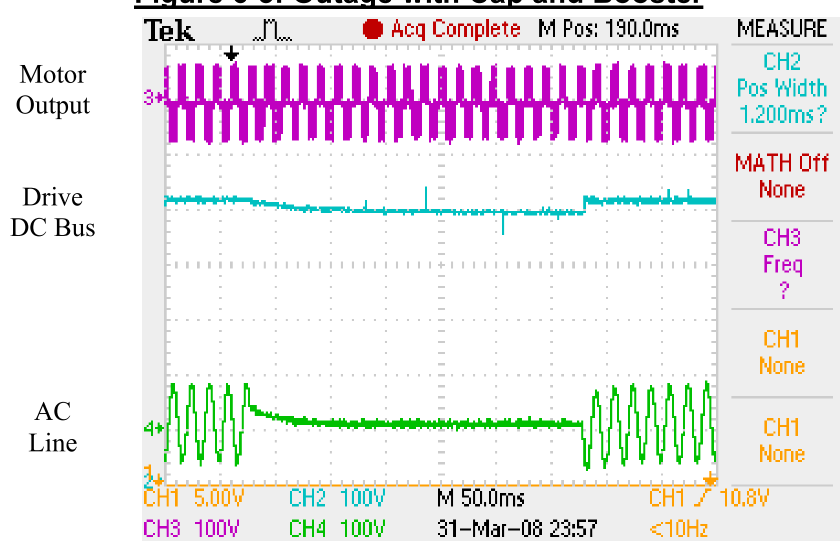


Figure 6-3: Outage with Cap and Booster



6.1.1. BATTERY SELECTION DATA

When selecting a battery string for use with the Model M3534B Battery Regulator Ride-Thru modules, please note that the battery string voltage must remain within a certain range for proper system operation. See Table 7-1 for typical battery voltage levels. Refer to Table 6-4 for Typical Storage Bank Configurations if using Bonitron M3528B series battery modules.

Table 6-4: Bonitron M3528B Storage Bank Configurations

Not to replace manufacturer's recommendations.

	SYSTEM AC VOLTAGE	208	230	400	460
Battery Bank	Nominal Voltage	216	240	420	480
	108VDC banks in series (model M3528B-108-40-B5)	2	0	4	0
	120VDC banks in series (model M3528B-120-40-B5)	0	2	0	4
	Full or Float Charge Voltage	243	270	473	540
	Equalize Voltage	249	277	484	554
	Discharged Voltage	180	200	350	400
M3534R	Threshold	265	285	485	585

Figure 6-4: Power Curves For 6kW to 25kW Systems

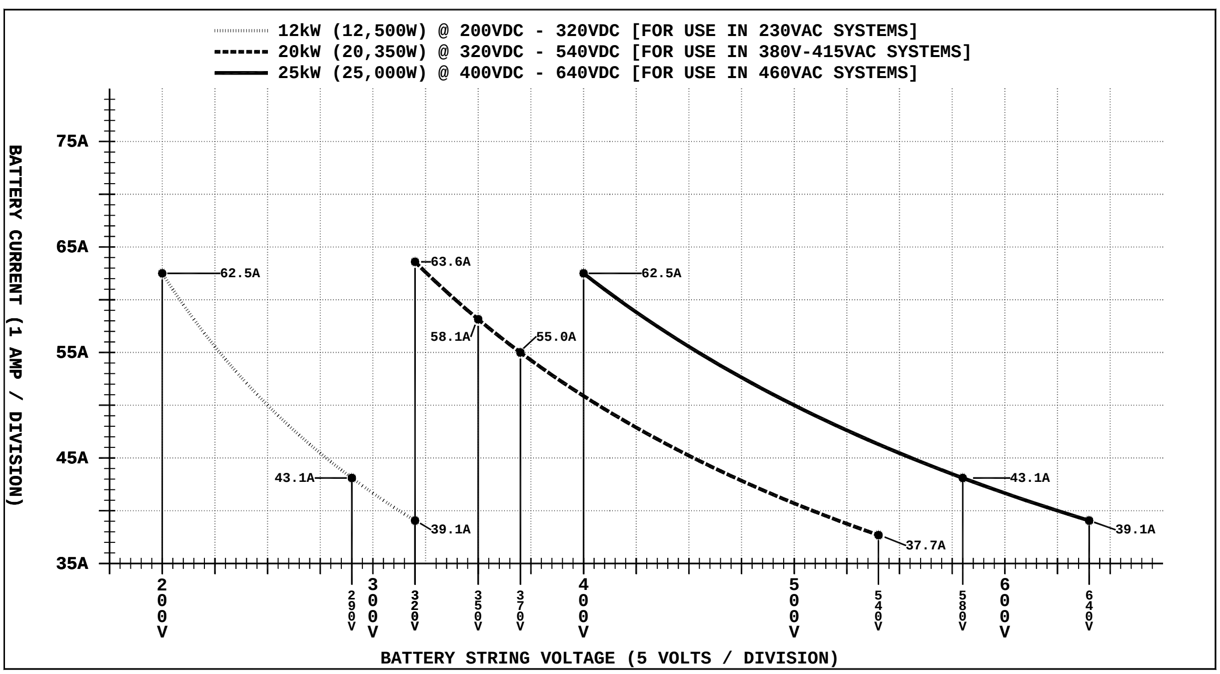


Figure 6-5: Power Curves For 18kW to 37kW Systems

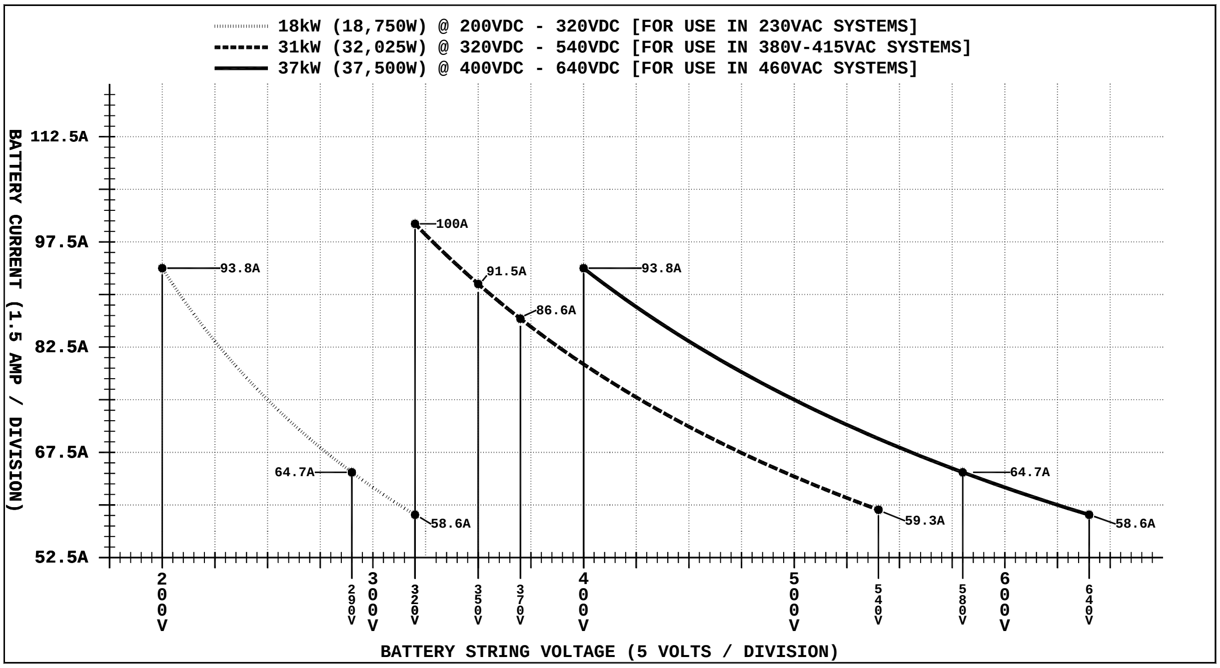


Figure 6-6: Power Curves For 25kW to 50kW Systems

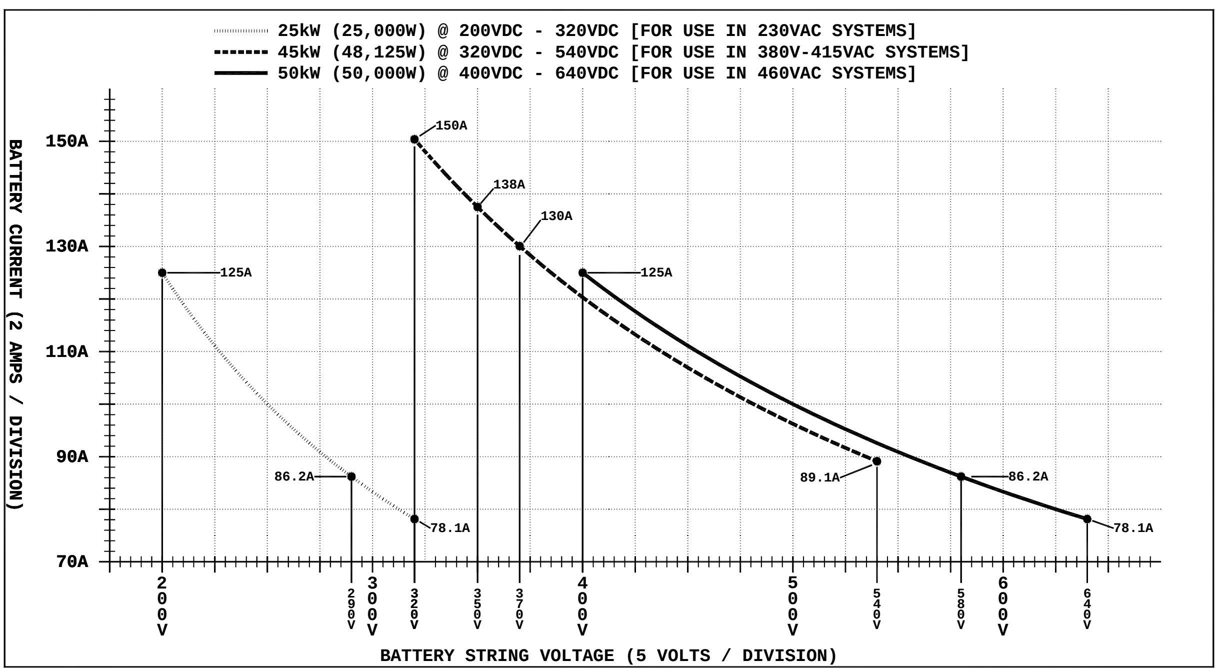


Figure 6-7: Power Curves For 37kW to 75kW Systems

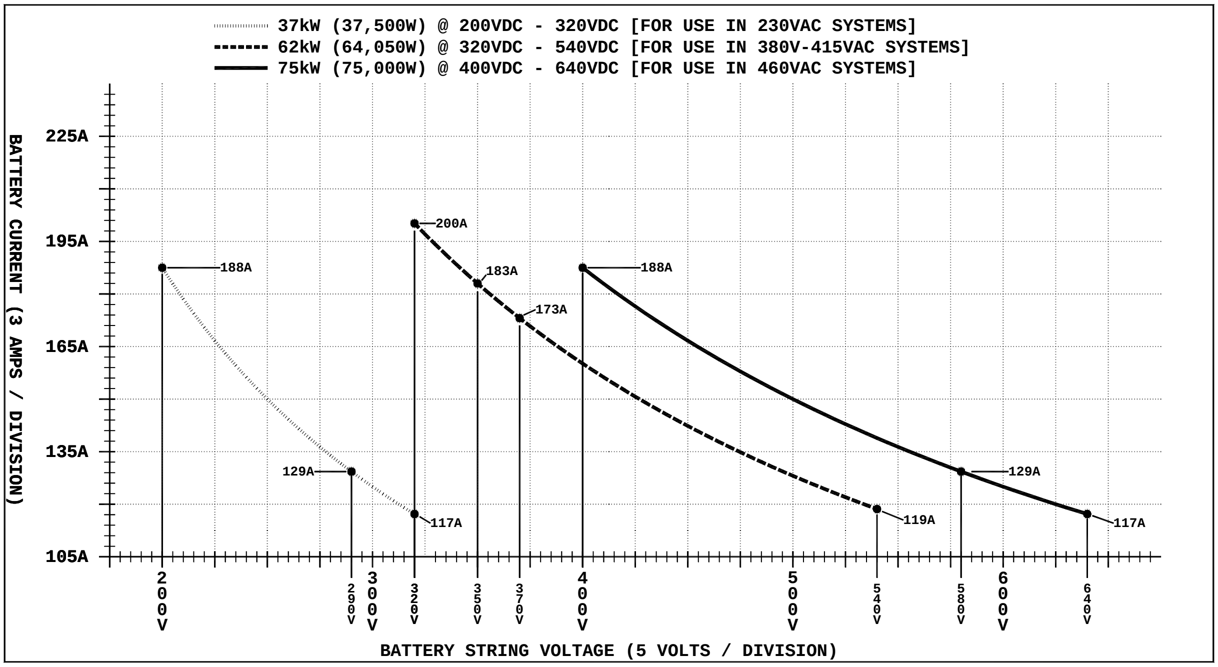
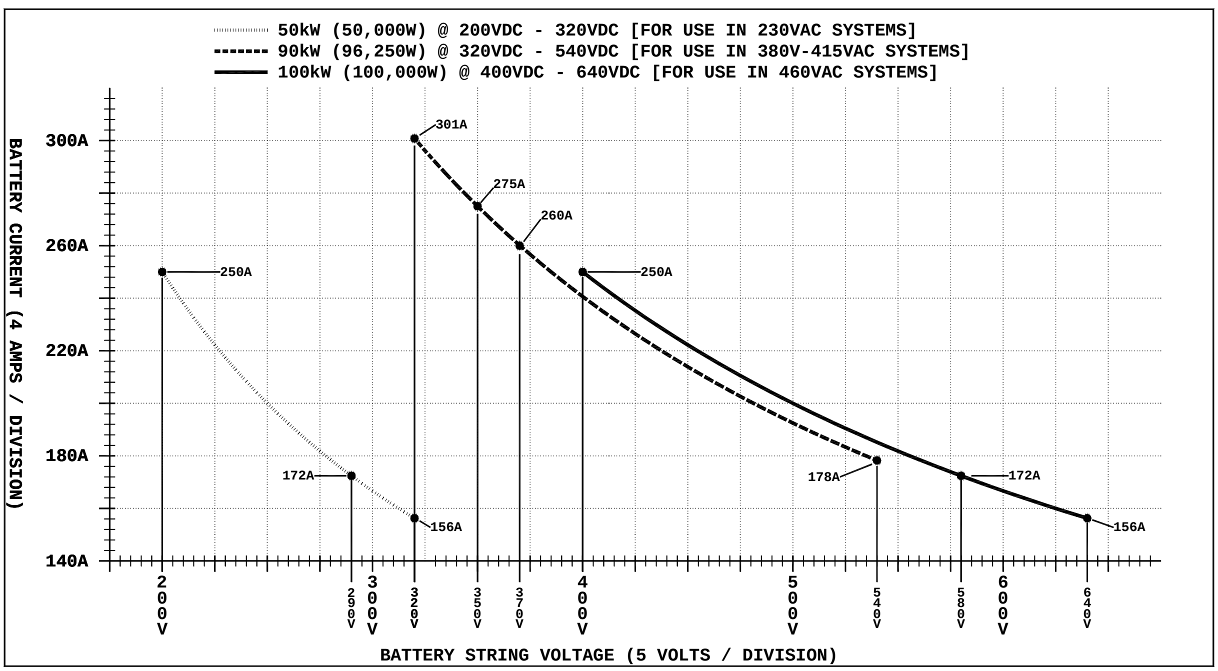


Figure 6-8: Power Curves For 50kW to 100kW Systems



6.2. WATT LOSS

Static loss less than:

- 20 watts for 20A units
- 35 watts for 40A units
- 40 watts for 85A units

Units are 95% efficient or better @ full load.

6.3. CERTIFICATIONS

M3534RT-EH010 is certified by PSL Laboratory to exceed Semi-47 requirements.

6.4. FUSE/CIRCUIT BREAKER SIZING AND RATING

6.4.1.1. 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 M3534B 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 M3534B Ride-Thru is one 2-minute run every 30 minutes.

Table 6-5: Input Power Wiring Sizes and Fusing

SYSTEM KW	RIDE-THRU DC BUS CURRENT RATING	MIN. SOURCE FUSING SEMICONDUCTOR	RECOMMENDED FIELD WIRING SIZES	MCM EQUIVALENT WIRING SIZES
5 - 6	20 Amps	30 Amps	12 AWG	6 MCM
20 - 24	40 Amps	60 Amps	8 AWG	16 MCM
43 - 50	85 Amps	125 Amps	4 AWG	41 MCM

6.5. Dimensions and Mechanical Drawings

Figure 6-9: M3534B 20 Amp A5 Chassis Dimensional Outline

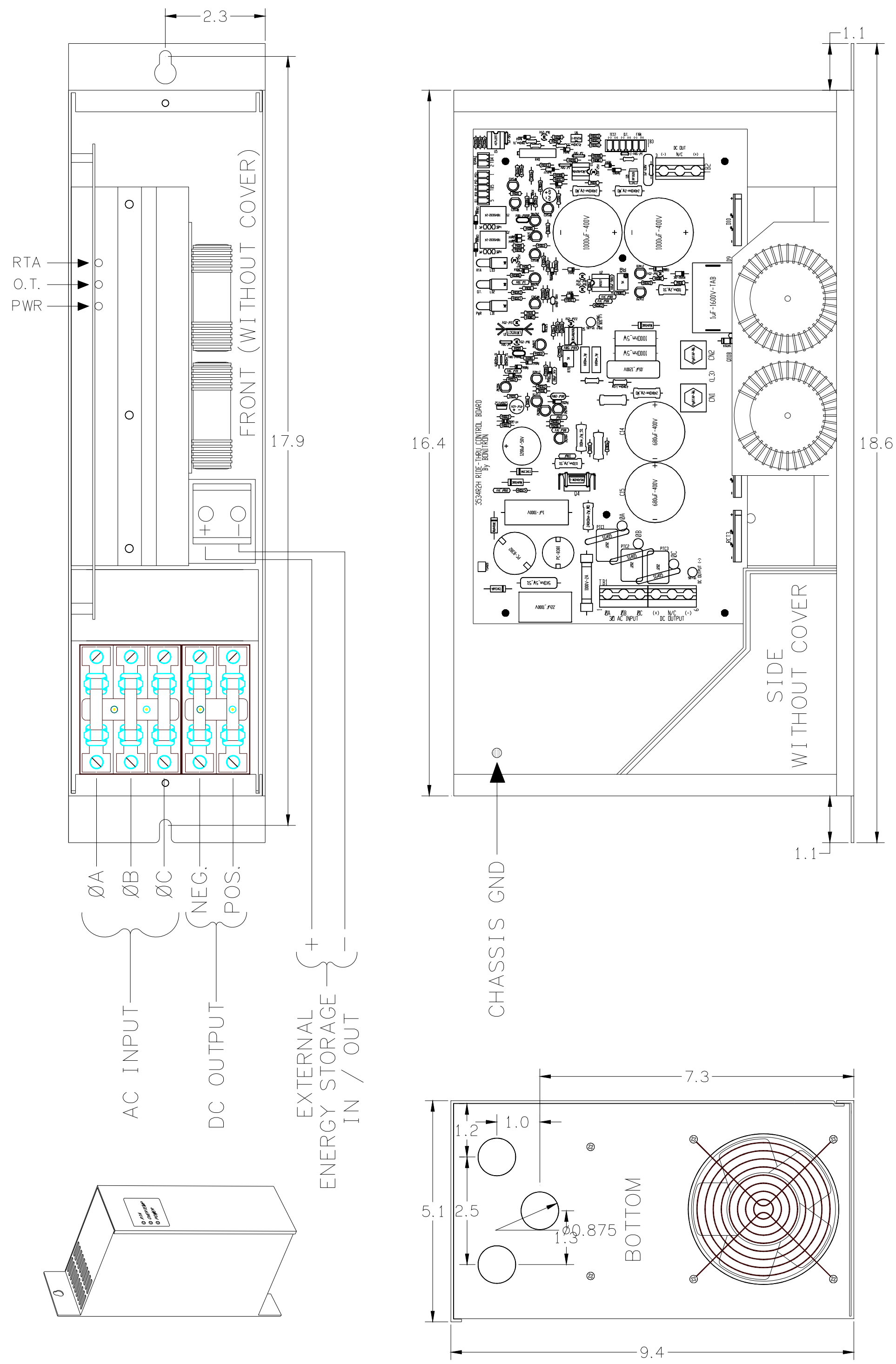


Figure 6-10: M3534B 40 Amp K9 Chassis Dimensional Outline

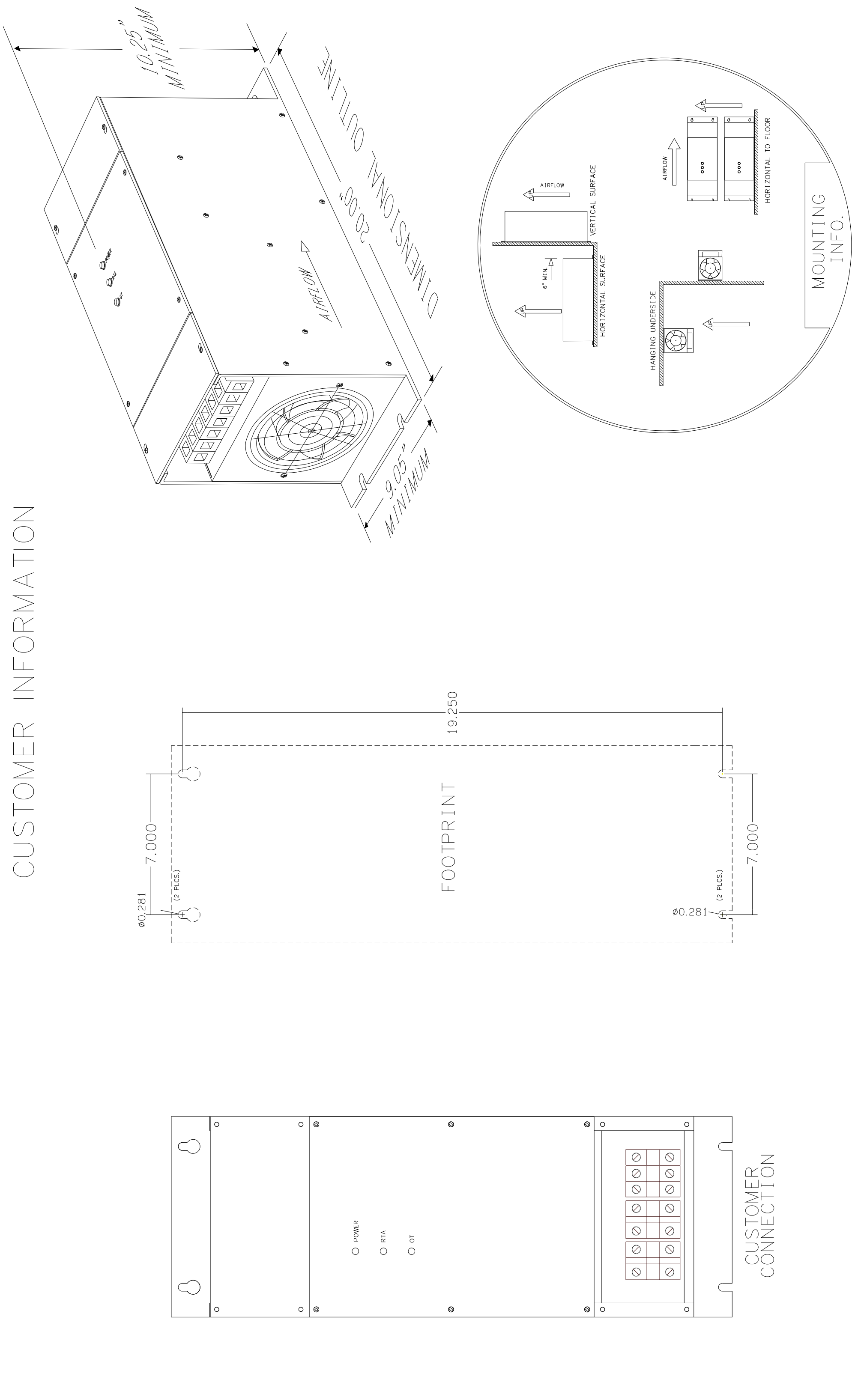
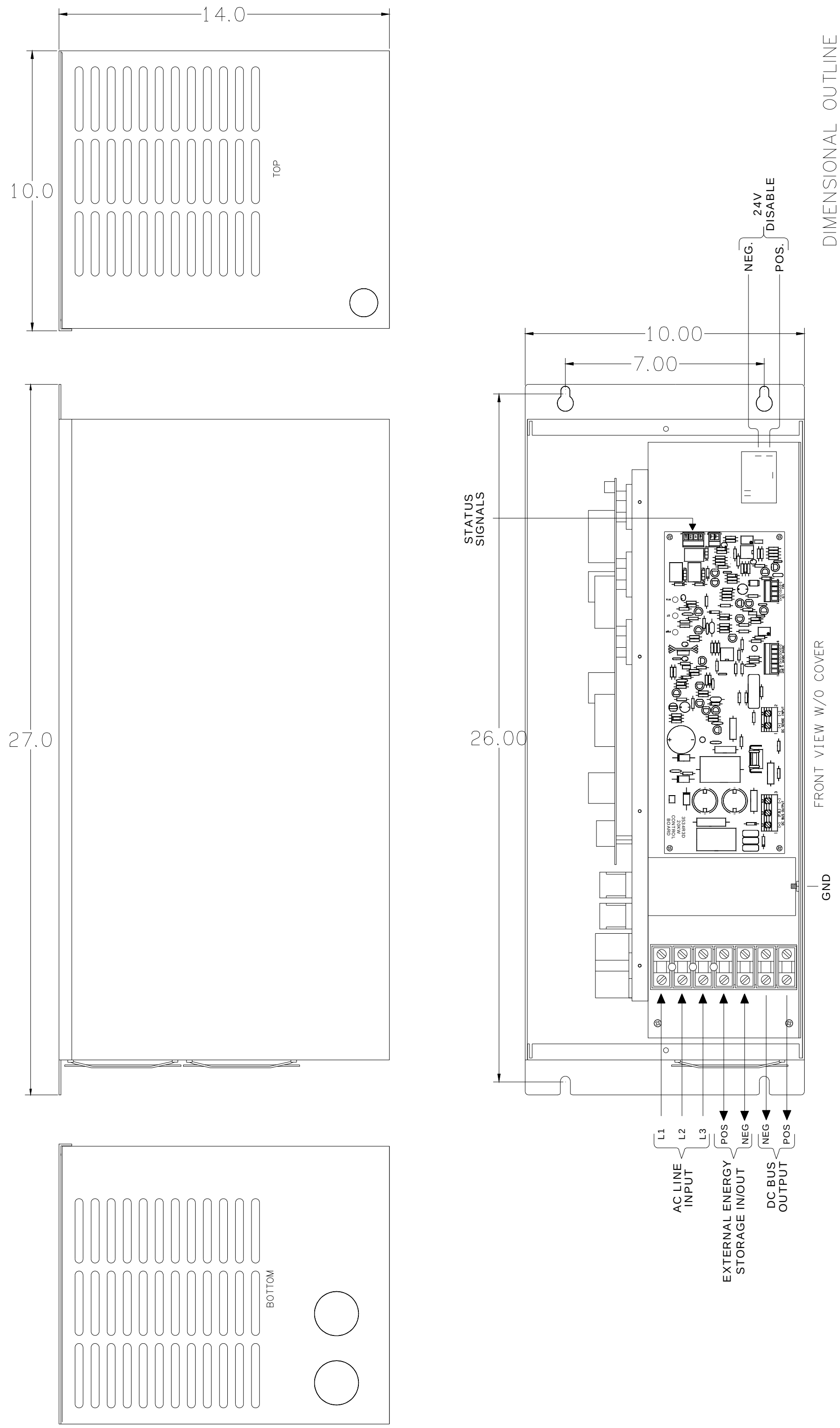
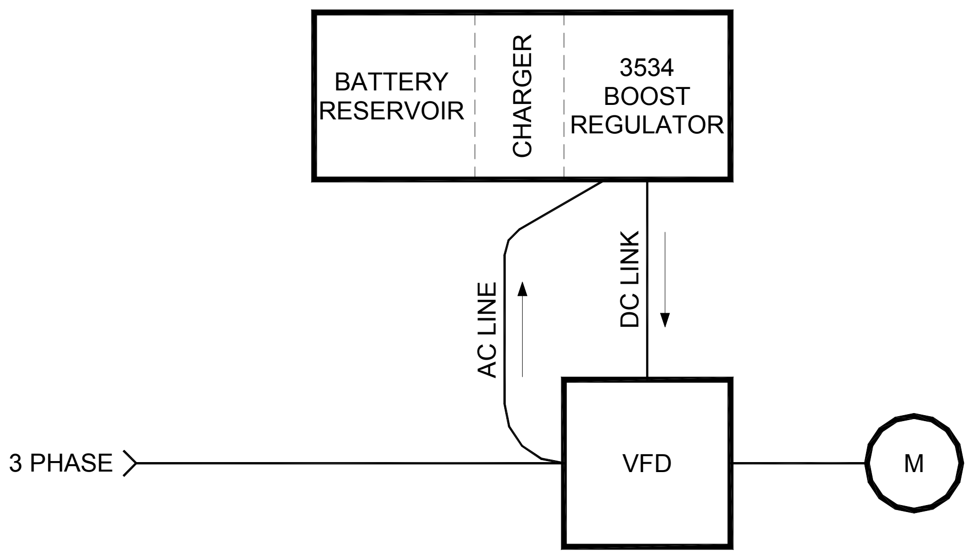


Figure 6-11: M3534B 85 Amp V Chassis Dimensional Outline



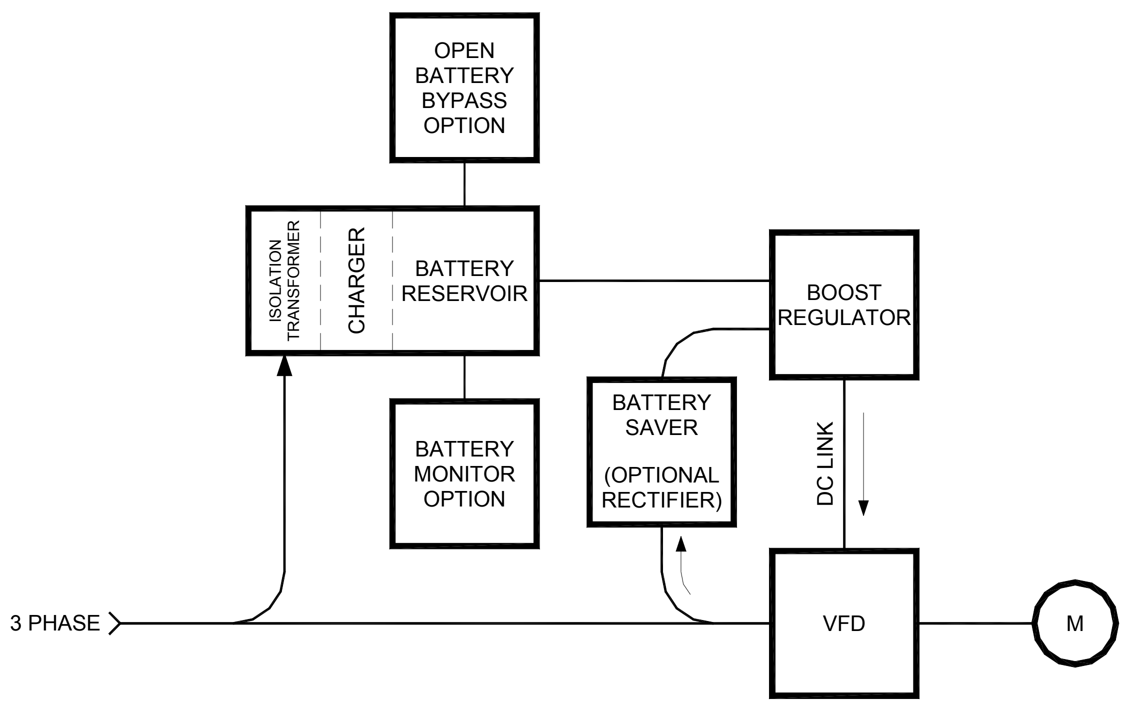
6.6. Block Diagrams

Figure 6-12: DRT Ride-Thru System Configuration 5



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

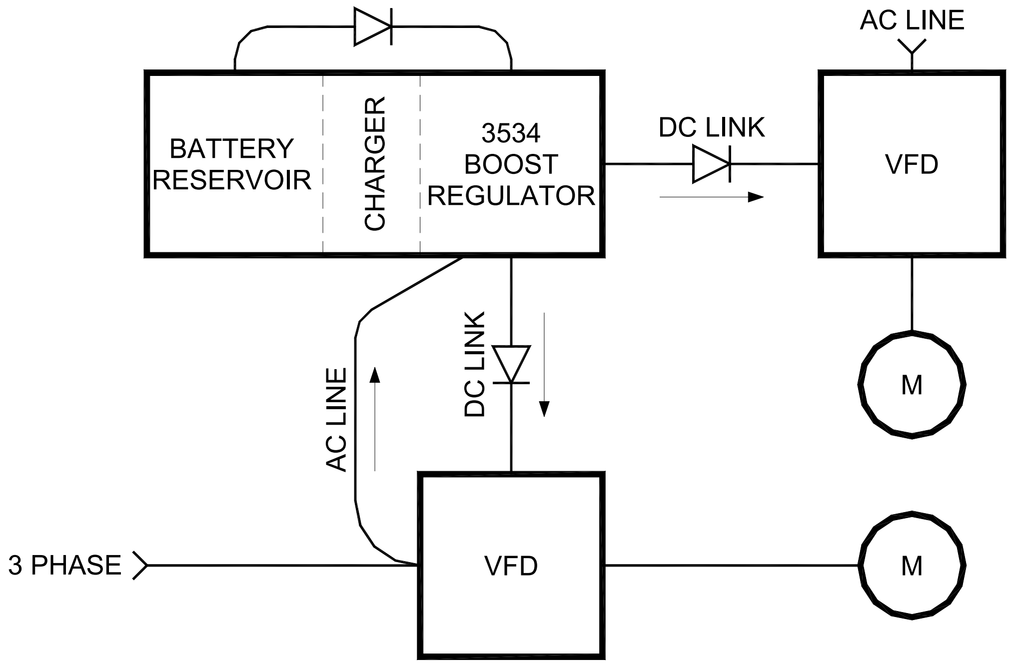
Figure 6-13: DRT Ride-Thru System Configuration 6



30 SECOND - 60 MINUTE, 100% OUTAGE PROTECTION
USING DC BOOSTER WITH PROTECTED BATTERY BANK

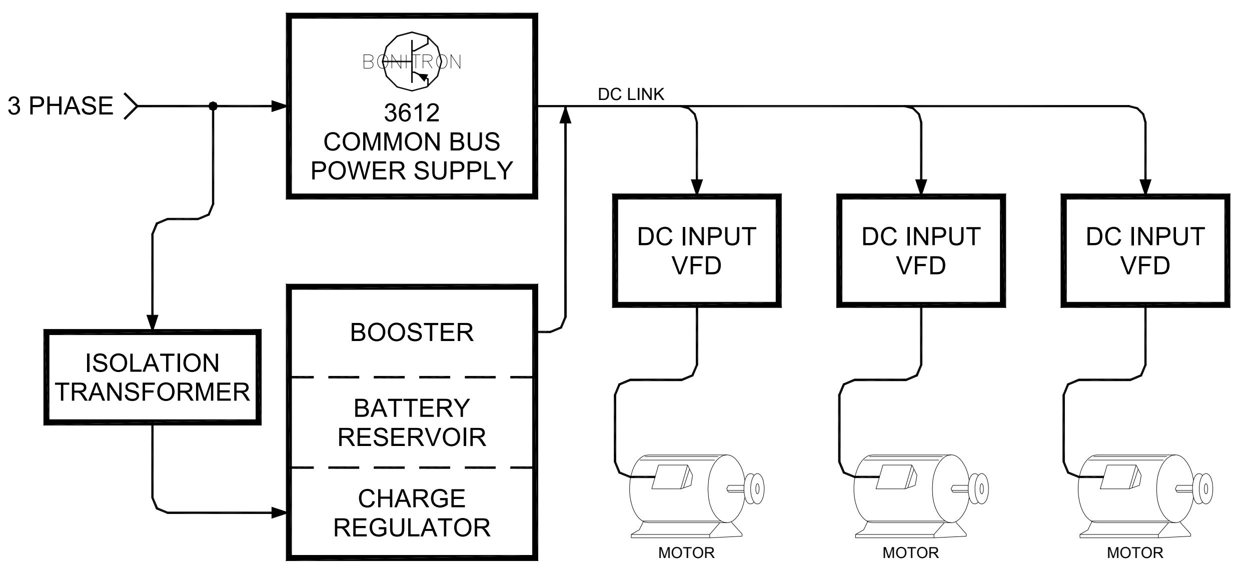
Dwg #s: 040205 Rev: 20081201 and 040206 Rev: 20090512

Figure 6-14: DRT Ride-Thru System Configuration 12



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

Figure 6-15: DRT Ride-Thru System Configuration 24



COMMON DC BUS RIDE-THRU FOR LONG TERM 100% OUTAGE PROTECTION
USING DC BOOSTER WITH BATTERY RESERVOIR

6.7. Supplemental Drawings

6.7.1. Control Board Fault / Status Signal Component Locations

Figure 6-16: ASB 3534R2 Fault / Status Signal Component Locations

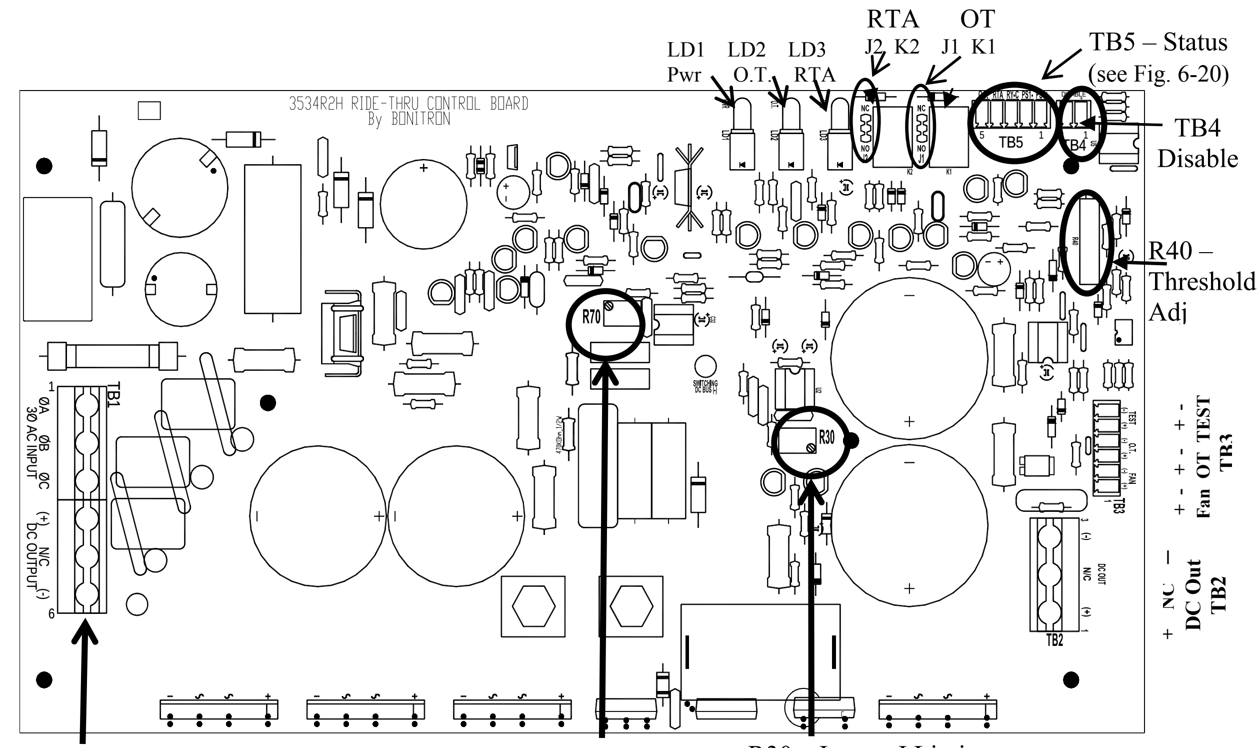
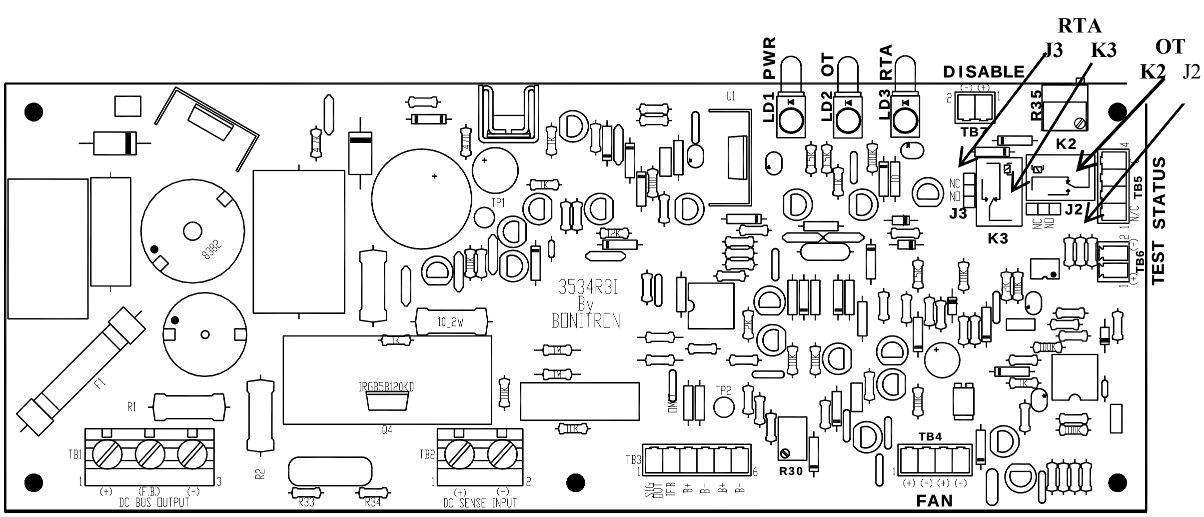


Figure 6-17: ASB 3534R3 Control Board Fault / Status Signal Component Locations



Dwg #s: 3534R2H and 3534R3I_Fault-Component-Locations

6.7.2. Control Board Fault / Status Signal Component Locations

Figure 6-18: ASB 3534P3 Power Board Fault / Status Signal Component Locations

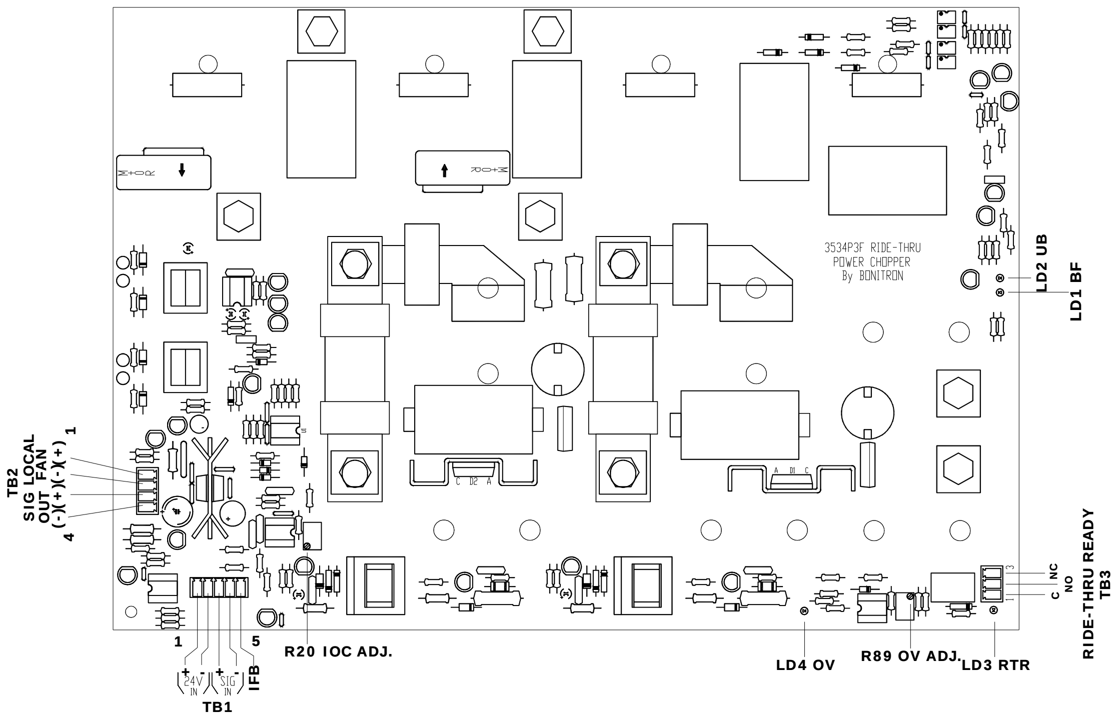
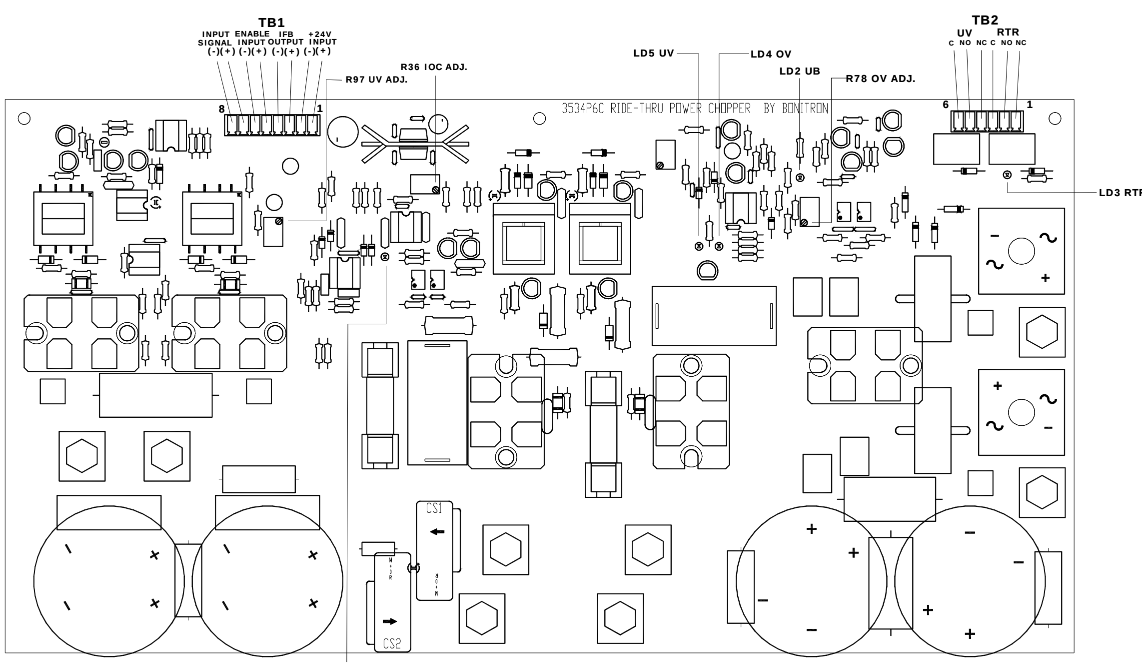


Figure 6-19: ASB 3534P6 Power Board Fault / Status Signal Component Locations



Dwg #s: 3534P3F and 3534P6C_Fault-Component-Locations

6.7.3. SCHEMATICS

Figure 6-20: 3534R2 TB5 Status Signal

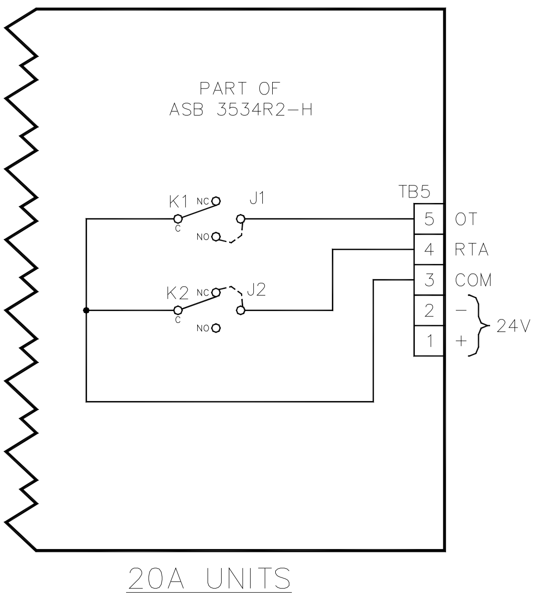


Figure 6-21: 3534R3 TB5 Status Signal

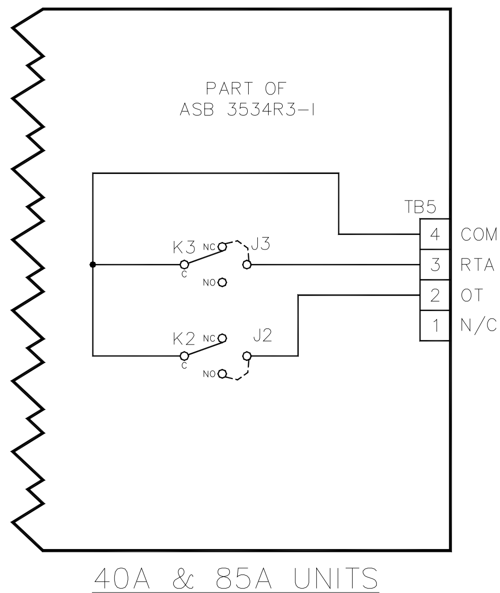


Figure 6-22: 3534P3 TB3 Status Signal

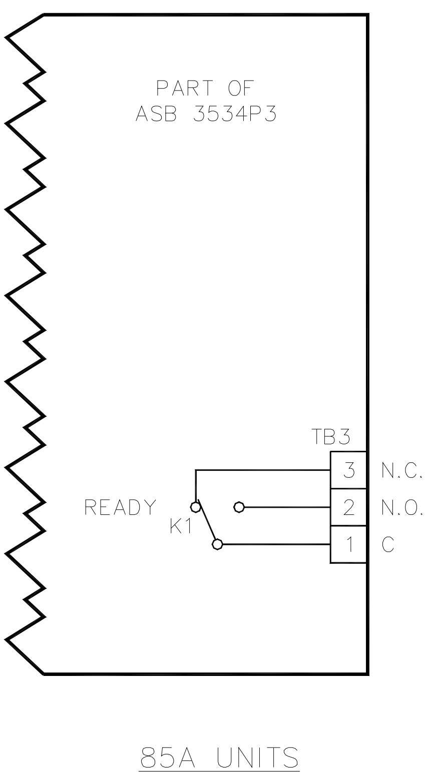


Figure 6-23: 3534P6 TB2 Status Signal

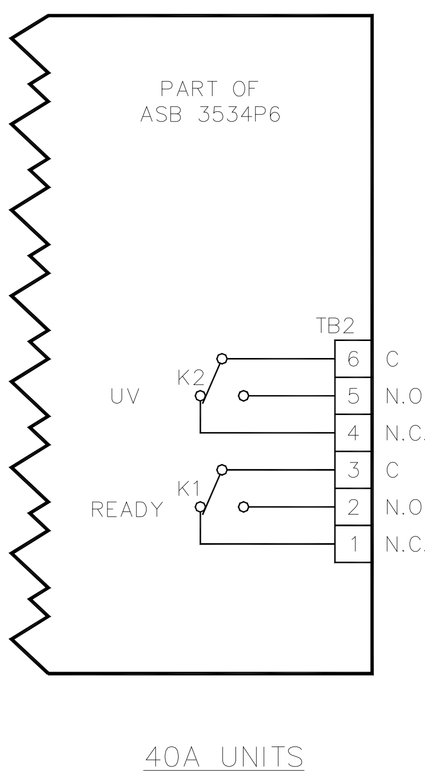
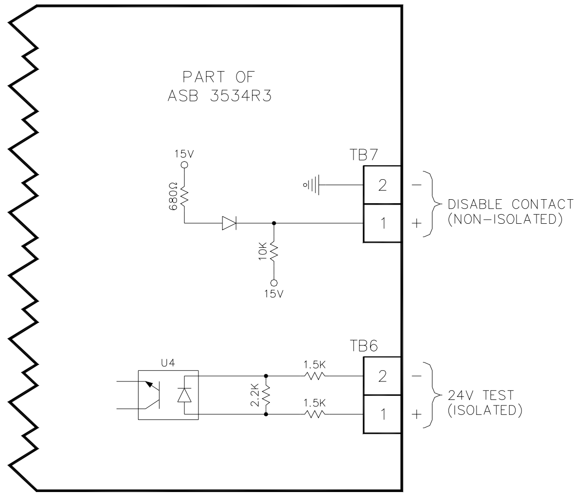


Figure 6-24: 40A & 85A Basic Control Input Schematic



6.8. RECOMMENDED SPARE PARTS

6.8.1. SPARE PARTS LIST

The part numbers listed in Tables 6-7 through 6-9 represent a listing of all major components and the quantities of each used in various Bonitron Model M3534B modules.

This list is intended for use as a reference if 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 6-6 below. Remember to 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.

Table 6-6: Example of PCB Serial Sticker

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

Table 6-7: Spare Parts List for 20 Amp 12kW Units

PART NUMBER	DESCRIPTION	QTY
ASM 3534R2-x	Control / power PCB assembly	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

Table 6-8: Spare Parts List for 40 Amp 24kW Units

COMPONENT	DESCRIPTION	QTY
ASB 3534P6-1	Ride-Thru Power Chopper	1
ASB 3534R3-11	400 - 460V 24kW Battery Ride Thru	1
FN 4.7-24DC-180	Sunon Pmd2412pmb2-A(2).Gn 180 Cfm	1
FS A60Q40-2	Ferraz A60Q40-2 Ferrule Fuse	3
FS A70Q50-4	Gould A70Q50-4 Fuse	2
FS PTCR-305C19-K01	Ceramite 30 Ohm 18a Ptc Res W/ Bkt	4
IN FM-8142	080038: FROST FM-8142 160 uH Inductor	1
LD AMB-LENS-L05	Jemco L05-0211-A012	1
LD GRN-LENS-L05	Jemco L05-0211-A012	1
LD RED-LENS-L05	Jemco L05-0211-A004: Red Lens	1
LD RED-LENS-L05-W	NEOPRENE WASHER for JEMCO L05 RED LENS	3
RY T9AP1D52-24	P&B 24V CHASSIS MT RELAY N.O. Contact Only	1
SW TS-67F055	Airpax 67F055 Thermostat	1

Table 6-9: Spare Parts List for 85 Amp 50kW Units

COMPONENT	DESCRIPTION	QTY
ASB 3534R3-10	Control pcb	1
ASB 3534P3-1	Power Chopper pcb	1
FN 4.7-24DC-120	24 VDC 120 cfm plastic frame fan	1
FS PTCR-305C19-K01	CERAMITE 30 OHM 18A PTC assembly	4
FS FWH-100	FWH-100B FUSE	2
IN FM-8083	Choke	1
IST TS-OA160	OA-160-temp sensor	1
SW TS-67F070	temp sensor 70°C	1

7. APPENDICES

7.1. DRIVE RIDE-THRU SELECTION GUIDE

Bonitron manufactures several different Drive Ride-Thru (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 than 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
3. 3hp to 67hp 50% sag should consider M3534R
4. 3hp to 15hp 100% short term outage should consider S3534CR
5. 15hp to 67hp 100% short term outage should consider S3534UR
6. 3hp to 67hp 100% long term outage should consider S3534BR
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 M3460B

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 M3534B MODULES

When selecting a Battery Regulator Ride-Thru Module, be certain to choose a module with a power rating (kW) equal to or exceeding that of the drive(s) being supplied by the module.

1. A disconnect should be installed between the drive DC bus and the booster DC output for maintenance purposes.
2. Fusing should be installed between the drive DC bus and the booster DC output. A70Q series or FWP series 700V are OK.
3. A disconnect should be installed between the charger and the battery bank. (AC and DC fusing is included inside charger box)
4. Fusing should be installed in the isolation transformer primary circuit. 500V slow blow type.
5. A disconnect should be installed between the battery bank and booster module.
6. Fusing should be installed between the battery bank and the booster input. Semiconductor 600V is OK.
7. Airflow must be supplied to the cabinet housing the booster and charger modules to remove heat during outage and recharge time, and can use thermal temp switch, RTA signal, or power loss to initiate cooling. Airflow must be supplied for the purpose of removing hydrogen build up from charging the batteries. This fan should run continuously or be switched from a hydrogen sensor. Standby power losses are less than 300W for booster and charger and transformer. Cooling should continue 12 hours after active cycle starts.
8. A disable command should be given in cases where activity extends beyond the specified ride through time, or in cases where the battery voltage drops below its recommended level.
9. VFD ground fault circuits should be checked. Some VFDs have very sensitive ground faults, and when using external DC input they can be tripped. Be sure it can be disabled if there should be a problem, and be ready to add a ground fault detection somewhere upstream of the drive if that safety aspect is essential to the application.

7.3.1. BATTERY SELECTION GUIDE FOR BONITRON BATTERY VOLTAGE REGULATORS

Use the following steps in conjunction with "Battery Voltage Selection Curves" to aid in selecting batteries for use with Bonitron Drive Ride Thru Systems. Table 7-1 below shows typical battery voltage levels for various system AC voltages.

Table 7-1: Typical Battery Voltage Levels

SYSTEM AC VOLTAGE	BATTERY SERIES QTY	NOMINAL DC VOLTAGE	DISCHARGED VOLTAGE	CHARGING VOLTAGE	EQUALIZE VOLTAGE
460	40	480	400	540	554
433	38	456	380	513	526
415	36	432	360	486	498
400	35	420	350	473	484
380	34	408	340	459	470
230	20	240	200	270	277
208	18	216	180	243	249

To choose batteries, follow these steps. We will use a 460VAC system rated for 24W, in need of 1 minute of ride through time for our example. Use Table 7-1 for data.

1. Find max current at min DC battery voltage for the given kW rating of the system.
   a. Ex: 460VAC 24kW system, ÷ 400VDC min DC input = 60 amps.
      ** Battery bank must be capable of 60 amps.
2. Next choose enough series batteries to get the minimum voltage when discharged. Use this to ensure the battery bank has enough voltage for the boost regulator module to work from. (See Table 7-1 for min DC voltages.)
   a. Battery life is dependent on discharge voltage. The lower they are allowed to discharge, the shorter the life.
      i. We use 1.67 per cell as a minimum, which equals 10V per battery.
      ** 400VDC minimum ÷ 10V discharge level = 40 series batteries.
   b. NOTE: Charging voltage should not exceed the threshold voltage of the boosting system. (Typically 585VDC for 460VAC drive system.)
      ii. Typical recommended charging voltage is 1.125 x battery voltage.
      iii. 40batt x 12V x 1.125 = 540VDC.
3. Choose a battery with enough watts per cell for the time you need.
   a. Add up all the power consumption to be sure the batteries have enough storage.
      i. Ensure drive losses have been accounted for (95% efficient).
      ii. Ensure booster losses have been accounted for (95% efficient).
      iii. Add 15% in time or kW for headroom.
   b. Battery specs usually have watts per cell at discharge rates.
      i. Watts per cell usually refers to the 2V cell inside the battery.
      ii. Each 12V battery has 6 cells.

iii. Available watts per cell increases with a longer discharge time.

c. Ex: 24kW for 1 minute (24kW ÷ .95eff ÷ .95eff + 15% headroom = 30.5) x 60 sec = 1.83 mega joules.

i. 40 series batteries x 6 cells each = 240 cells total.

ii. 1.83 MJ ÷ 240 cells, ÷ 240 sec = 31 watts per cell.

For this application you will need 40 batteries rated for 60 amps that can deliver 31W per cell for 1 minute, with an end voltage of 1.67V per cell.

7.4. TYPICAL DRIVE BUS VOLTAGE LEVELS

Figure 7-1: Typical Drive Bus Voltage Levels for 400VAC Systems (VDC)

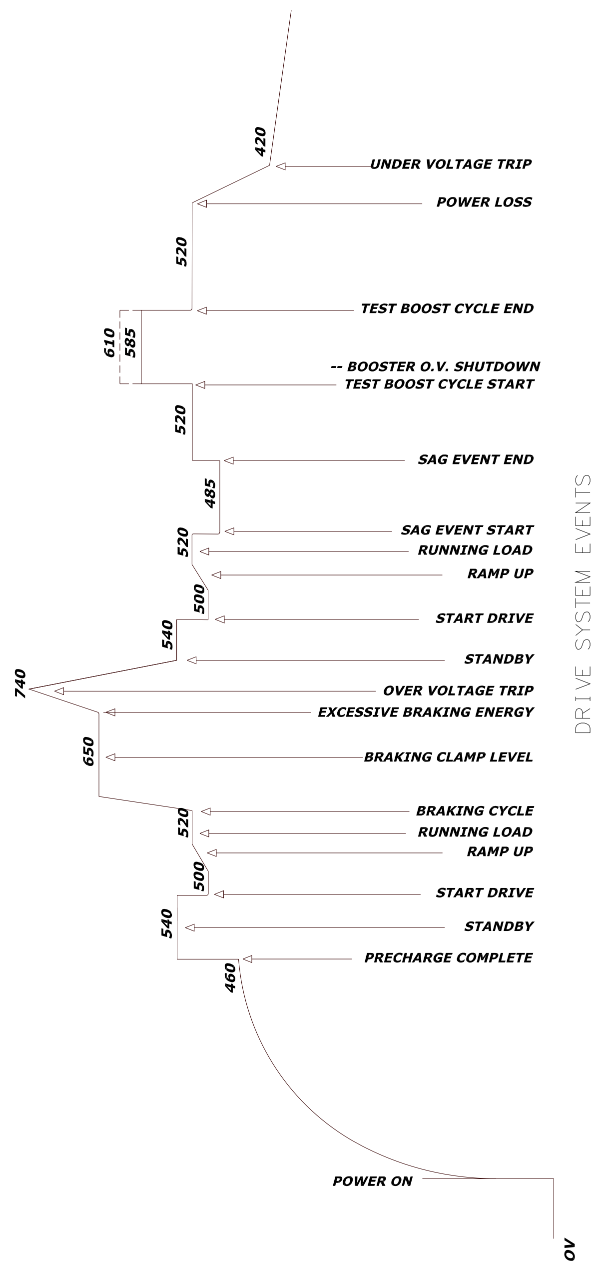
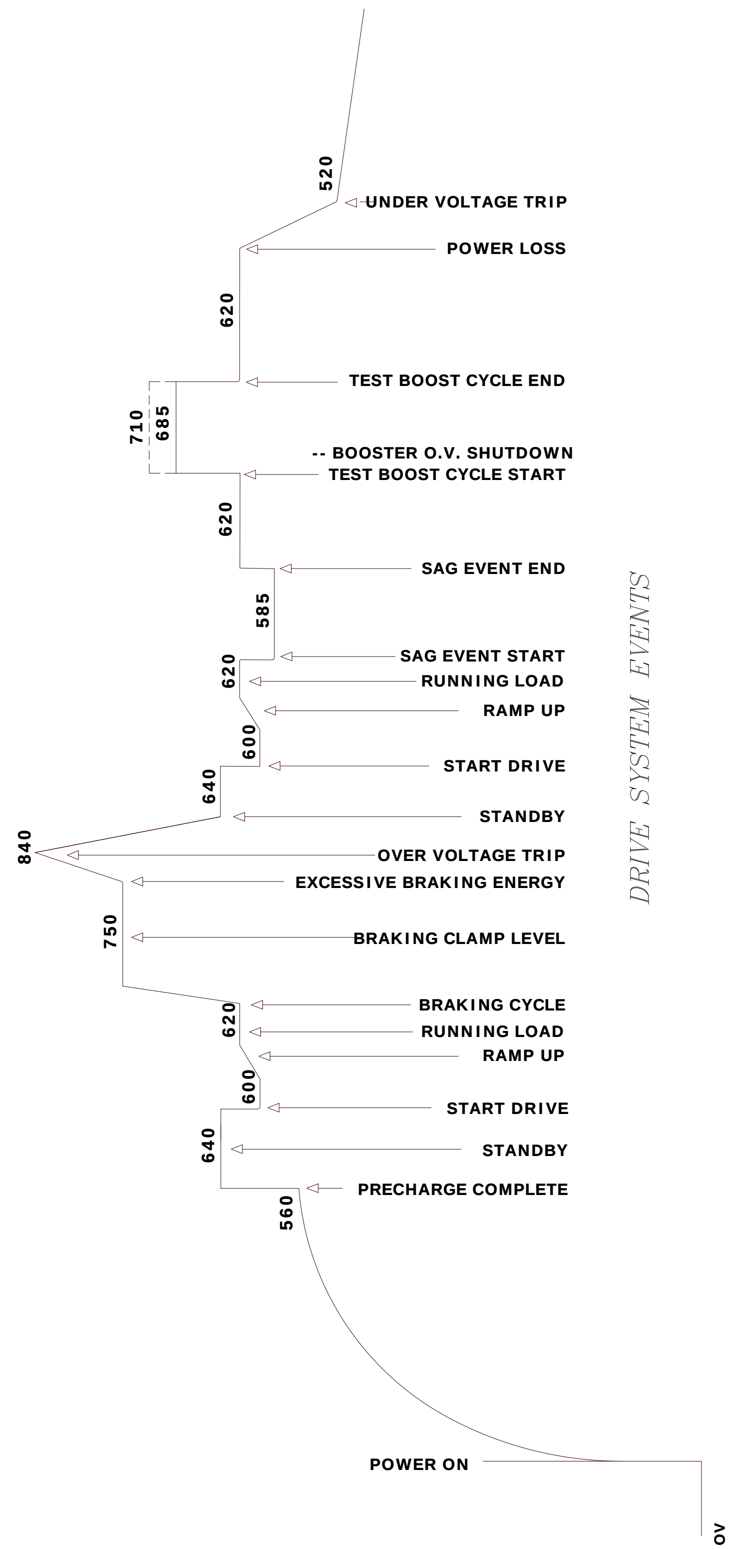


Figure 7-2: Typical Drive Bus Voltage Levels for 460VAC Systems (VDC)



NOTES