Legacy Model M3534R-RY

40 & 85 Amp DC Bus Ride-Thru
for Variable Frequency AC Drives

Customer Reference Manual

Bonitron, Inc.
Nashville, TN

An industry leader in providing solutions for AC drives.

ABOUT BONITRON

Bonitron designs and manufactures quality industrial electronics that improve the reliability of processes and variable frequency drives worldwide. With products in numerous industries, and an educated and experienced team of engineers, Bonitron has seen thousands of products engineered since 1962 and welcomes custom applications.

With engineering, production, and testing all in the same facility, Bonitron is able to ensure its products are of the utmost quality and ready to be applied to your application.

The Bonitron engineering team has the background and expertise necessary to design, develop, and manufacture the quality industrial electronic systems demanded in today's market. A strong academic background supported by continuing education is complemented by many years of hands-on field experience. A clear advantage Bonitron has over many competitors is combined on-site engineering labs and manufacturing facilities, which allows the engineering team to have immediate access to testing and manufacturing. This not only saves time during prototype development, but also is essential to providing only the highest quality products.

The sales and marketing teams work closely with engineering to provide up-to-date information and provide remarkable customer support to make sure you receive the best solution for your application. Thanks to this combination of quality products and superior customer support, Bonitron has products installed in critical applications worldwide.

AC Drive Options

In 1975, Bonitron began working with AC inverter drive specialists at synthetic fiber plants to develop speed control systems that could be interfaced with their plant process computers. Ever since, Bonitron has developed AC drive options that solve application issues associated with modern AC variable frequency drives and aid in reducing drive faults. Below is a sampling of Bonitron's current product offering.

World Class Products

Undervoltage Solutions

Uninterruptible Power for Drives
(DC Bus Ride-Thru)
Voltage Regulators
Chargers and Dischargers
Energy Storage

Overvoltage Solutions

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

Common Bus Solutions

Single Phase Power Supplies
3-Phase Power Supplies
Common Bus Diodes

Portable Maintenance Solutions

Capacitor Formers
Capacitor Testers

Power Quality Solutions

12 and 18 Pulse Kits

Green Solutions

Line Regeneration

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1. INTRODUCTION

1.1. WHO SHOULD USE

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

Please keep this manual for future reference.

1.2. PURPOSE AND SCOPE

This manual is a user's guide for the 40 and 85 amp models of the M3534R 2-Second, 50% DC Bus Sag Ride-Thru system. It will provide the user with the necessary information to successfully install, integrate, and use the M3534R module in a variable frequency AC drive system.

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

1.3. MANUAL VERSION AND CHANGE RECORD

DP10 details were clarified in Rev 02a of this M3534R 40A (24kW) to 85A (50kW) manual. The 20A (12kW) unit is covered by a separate manual.

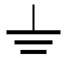
Rev 02b has minor formatting and chassis description corrections.

Rev 02d has updated wiring and formatting changes.

The Legacy version M3534-RY was updated in Rev 03a.

Figure 1-1: M3534R in the K7 Chassis

1.4. Symbol Conventions Used in this Manual and on Equipment

	Earth Ground or Protective Earth
	AC Voltage
	DC Voltage
 **DANGER!**	Electrical Hazard - Identifies a statement that indicates a shock or electrocution hazard that must be avoided.
 **DANGER!**	DANGER: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.
 **CAUTION!**	CAUTION: Identifies information about practices or circumstances that can lead to property damage, or economic loss. Attentions help you identify a potential hazard, avoid a hazard, and recognize the consequences.
 **CAUTION!**	Heat or burn hazard - Identifies a statement regarding heat production or a burn hazard that should be avoided.

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.

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 by temporarily storing energy internally and releasing it back into the DC bus when needed. This allows the drive to "ride through" these events, maintaining motor speed and torque, without experiencing drive shutdown.

The majority of AC line voltage fluctuations that occur in three-phase distribution systems have a magnitude (decrease from nominal voltage) of less than 50% and duration of less than 2 seconds. The model M3534R DC Bus Ride-Thru Control module provides sufficient ride through capability to handle these types of voltage sags.

2.1. RELATED PRODUCTS

S3534UR AND S3534BR SERIES RIDE-THRU MODULES

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

M3460 SERIES RIDE-THRU MODULES

The M3460R 230-480VAC Ride-Thru Module is designed to maintain inverter bus under 3-phase 50% sag conditions with multiple cabinet systems rated up to 1200kW.

The M3460B 350-540VDC Ride-Thru Module is designed to boost a battery bank up to inverter level under 100% outage conditions.

M3528 ULTRA CAP / BATTERY CHARGER

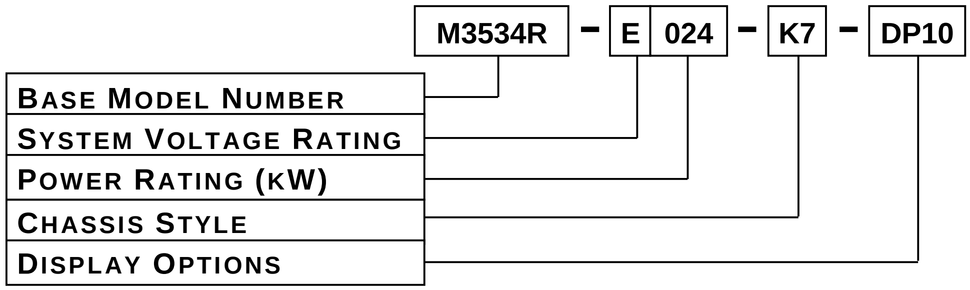
M3528 is a voltage and current limited power supply used to charge electrical energy storage devices such as battery banks or ultracapacitor reservoirs for industrial voltage levels of 208 - 480VAC. User inputs allow for remote enable and second setpoint charging for battery equalization.

M3628 ULTRA CAP DISCHARGE CONTROLLER AND BATTERY BANK TESTER

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

2.2. PART NUMBER BREAKDOWN

Figure 2-1: Example of Part Number Breakdown



BASE MODEL NUMBER

The Base Model Number for all M3534 Series 2 second, 50% sag, DC Bus Ride-Thru Modules (RTM) is M3534R.

SYSTEM VOLTAGE RATING

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

Table 2-1: System Voltage Rating Codes

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

POWER (KW)

The Power Rating indicates the maximum power in kilowatts that can safely be handled by the M3534R RTM during outage durations of 2 seconds. This rating is directly represented by a 3-digit value based on the nominal DC system voltage rating and the maximum output current rating of the RTM. For instance, the rating code for a 24kW RTM is **024**.

CHASSIS STYLE

The 40A Model M3534R RTM comes in the K7 chassis, while the 85A Model M3534R RTM comes in the A9 chassis. Both are Type-1, panel mountable enclosures. Refer to Section 6.4 for chassis dimensions.

DISPLAY OPTIONS

The 40A and 85A Models M3534R RTM are available with a DP10 display option. This includes several status indicator LEDs, a Ride-Thru Active counter and a push-button to initiate the 'test" feature.

2.3. General Specifications

Table 2-2: General Specifications Chart

Parameter	Specification
AC Input Voltage	208 - 480VAC
DC Output Voltage	265 - 585VDC minimum 295 - 650VDC nominal
Max. DC Output Current	40A – 85A
Maximum Kilowatt Rating	24kW – 50kW
Maximum Sag Duration	2 seconds
Duty Cycle Rating	1% duty rated at 50% voltage with 100% load
Pre-charge Time	Less than 100 milliseconds
Inactive Power Usage	Less than 25W
Fault / Status Indicators	• Power (PWR) • Overtemp (OT) • Ride-Thru Active (RTA) • Ride-Thru Ready (RTR)
Power Connections	3-Phase AC Line Input, Ground DC Bus Output External Energy Reservoir or Bus Support Module
Control Inputs	24V input initiates TEST cycle 24V input disables BOOST mode
Status Outputs	OT relay contacts available on all models RTA relay contacts available on all models
Operating Temp.	40°C
Storage Temp	-20°C to +65°C
Humidity	Below 90% non-condensing
Atmosphere	Free of corrosive gas and conductive dust

2.4. GENERAL PRECAUTIONS AND SAFETY WARNINGS

DANGER!

- HIGH VOLTAGES MAY BE PRESENT!
- NEVER ATTEMPT TO OPERATE THIS PRODUCT WITH THE ENCLOSURE COVER REMOVED!
- NEVER ATTEMPT TO SERVICE THIS PRODUCT WITHOUT FIRST DISCONNECTING POWER TO AND FROM THE UNIT!
- ALWAYS ALLOW ADEQUATE TIME FOR RESIDUAL VOLTAGES TO DRAIN BEFORE REMOVING THE ENCLOSURE COVER.
- **FAILURE TO HEED THESE WARNINGS MAY RESULT IN SERIOUS BODILY INJURY OR DEATH!**

CAUTION!

- THIS PRODUCT WILL GENERATE HIGH AMBIENT TEMPERATURES DURING OPERATION.
- THIS PRODUCT SHOULD BE INSTALLED ACCORDINGLY ON NON-FLAMMABLE SURFACES WITH CLEARANCES OF AT LEAST TWO INCHES IN ALL DIRECTIONS.
- ALWAYS ALLOW AMPLE TIME FOR THE UNIT TO COOL BEFORE ATTEMPTING SERVICE ON THIS PRODUCT.
- BEFORE ATTEMPTING INSTALLATION OR REMOVAL OF THIS PRODUCT, BE SURE TO REVIEW ALL DRIVE AND / OR RESISTIVE LOAD DOCUMENTATION FOR PERTINENT SAFETY PRECAUTIONS.
- INSTALLATION AND/OR REMOVAL OF THIS PRODUCT SHOULD ONLY BE ACCOMPLISHED BY A QUALIFIED ELECTRICIAN IN ACCORDANCE WITH NATIONAL ELECTRICAL CODE OR EQUIVALENT REGULATIONS.

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

3. INSTALLATION INSTRUCTIONS

DANGER!

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

Proper installation of the Model M3534R Ride-Thru Module should be accomplished following the steps outlined below.

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

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

See Installation Considerations in Section 7.2 of this manual for additional information.

3.1. PRODUCT INSPECTION

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

3.2. SITE SELECTION

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

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

3.3. MOUNTING

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

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

To determine the correct mounting dimensions and provisions for the unit being mounted, refer to the Dimensional Outlines in Section 6.4 of this manual.

3.4. Wiring and Customer Connections

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

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

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

Table 3-1: 40 Amp Field Power Wiring Connections

Terminal	Function	Wiring Specifications	Min Wire AWG	Max Wire AWG	Torque lb-in
L1 L2 L3	AC Input	600VAC	14	10	20 lb-in
Storage Bus + –	DC Input	600VAC	12	4	32 lb-in
DC Bus + –	DC Output	600VAC	14	10	20 lb-in
GND	Ground	600VAC	18	10	20 lb-in

Table 3-2: 85 Amp Field Power Wiring Connections

Terminal	Function	Wiring Specifications	Min Wire AWG	Max Wire AWG	Torque lb-in
L1 L2 L3)	AC Input	600VAC	12	4	32 lb-in
Storage Bus + –	DC Input	600VAC	12	4	32 lb-in
DC Bus + –	DC Output	600VAC	12	4	32 lb-in
GND	Ground	600VAC	18	10	20 lb-in

3.4.1. Power Wiring - RTM To Drive Interconnections

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

Typical Field Connection terminal layouts for the M3534R RTM are shown in Figures 3-1 through 3-5. Figure 3-6 shows a typical power interconnection of the M3534R Ride-Thru Module with an existing AC drive system.

Field connection terminals for the Ground, AC Line Input, External Energy Reservoir, and DC Bus are located near the bottom of the RTM enclosure and can be accessed by removing the cover panel from the enclosure. For additional terminal identification, please refer to the appropriate chassis dimensional outline drawing in Section 6.4 of this manual.

3.4.1.1. 3-PHASE AC LINE INPUT (L1, L2, L3)

- **<u>40A units</u>**: The 3-phase AC Line input connections are made directly to the fuse block terminals for F1 (L1), F2 (L2), and F3 (L3). Connections can be made using 10 AWG wire. These screw terminals will accept #10 ring or fork lugs. Torque all terminal screws to 20 lb-in maximum.
- **<u>85A units:</u>** The input connections for the 3-phase AC Line are made at the input terminals for phase A (L1), phase B (L2), and phase C (L3). These terminals will accept 12-4 AWG wire. Torque all terminal screws to 32 lb-in maximum.

3.4.1.2. GROUND

- **<u>All units</u>:** 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 maximum.

3.4.1.3. DC BUS OUTPUT (DC BUS + –)

- **<u>40 Amp units</u>:** The DC Bus Output connections are made directly to the fuse block terminals at DC+ –. Connections can be made using 10 AWG wire. These screw terminals will accept #10 ring or fork lugs. Torque all terminal screws to 20 lb-in maximum.
- **<u>85 Amp units</u>:** The DC Bus Output connections are made at the output terminals at DC+ –. Connections can be made using 6 AWG wire. These terminals will accept 12-4 AWG wire. Torque all terminal screws to 32 lb-in maximum.
- **<u>For ALL Parallel Units</u>:** 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, then run wire from common point to the drive capacitor bank.

3.4.1.4. EXTERNAL ENERGY STORAGE (BUS STORAGE MODULE (BSM))

- **<u>40 Amp units:</u>** For all units in the K7-chassis type, make the DC input connections at DC Storage Bus + –. on the terminal strip. Refer to Figure 3-1. Connections can be made using 12-4 AWG wire. Torque terminal screws to 32 lb-in maximum.
- **<u>85 Amp units</u>:** For all units in the A9-chassis type, make the DC input connections at DC Storage Bus + –. Refer to Figure 3-2. Connections can be made using 4 AWG wire. Torque all terminal screws to 32 lb-in maximum.

3.4.1.5. SOURCE CONSIDERATIONS

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

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

3.4.1.6. GROUNDING REQUIREMENTS

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

3.4.2. CONTROL INTERFACE WIRING

3.4.2.1. TEST INPUT CONNECTIONS

40 and 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.

3.4.2.2. DISABLE INPUT CONNECTION

The Disable Input connections are made directly to the DISABLE relay at the top of the module. Use .20” female spade lugs. See Figures 3-3 and 3-4. If DP10 option is installed (I3 board), the Disable Input is at TB4-5(-) & 6(+).

3.4.2.3. FAULT / STATUS MONITORING CONNECTIONS FOR STANDARD MODELS

40 and 85 Amp units: On the ASB 3534R3 Control Board:

See Figures 3-3 and 3-4.

To monitor the OVERTEMP 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).

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

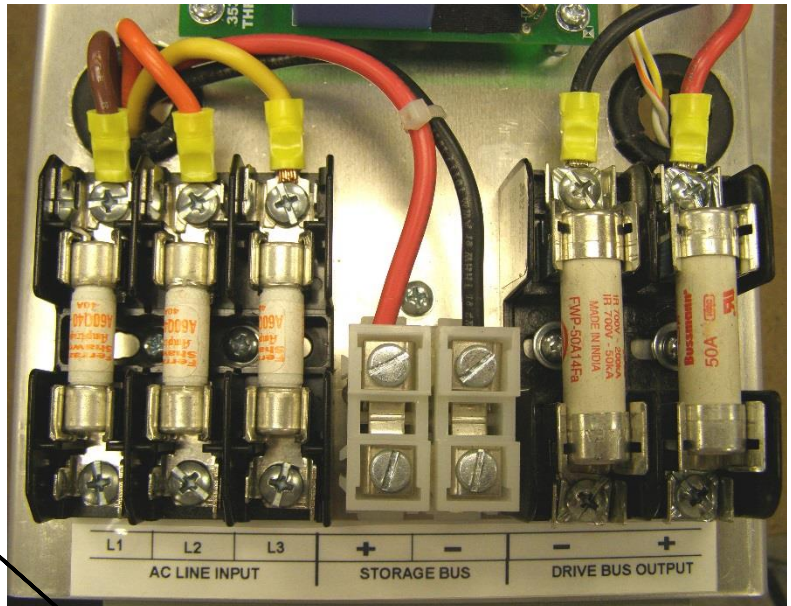
Ride-Thru Active (RTA) Relay: On the ASB 3534I3 Interface Board:

TB4-1 (J2 post) and **TB4-2** (common).

Ride-Thru Ready (RTR) Relay: On the ASB 3534I3 Interface Board:

TB4-3 (J1 post) and **TB4-4** (common).

Figure 3-1: Typical K7 Chassis Field Connection Terminal Layout



(On side wall)

Ground

Figure 3-2: Typical A9 Chassis Field Connection Terminal Layout

Ground

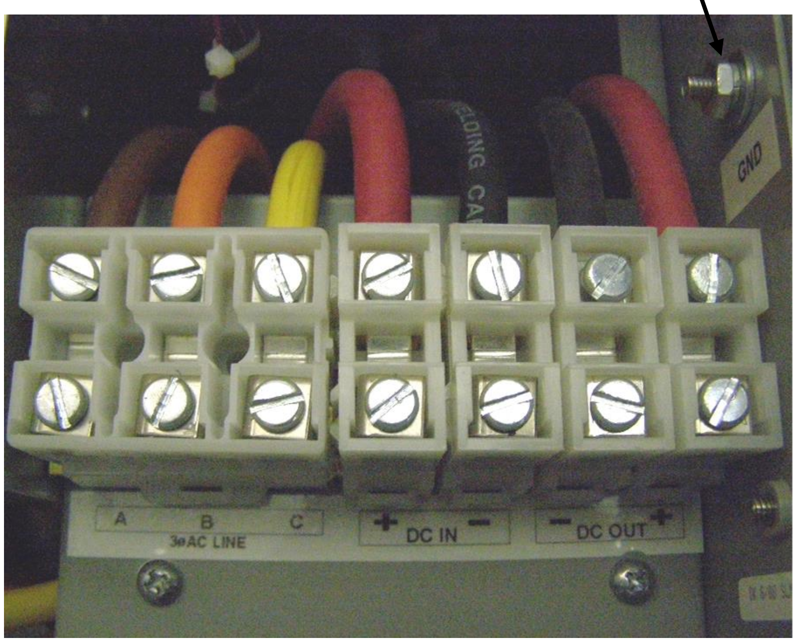


Figure 3-3: K7 Chassis Standard Model Disable Relay

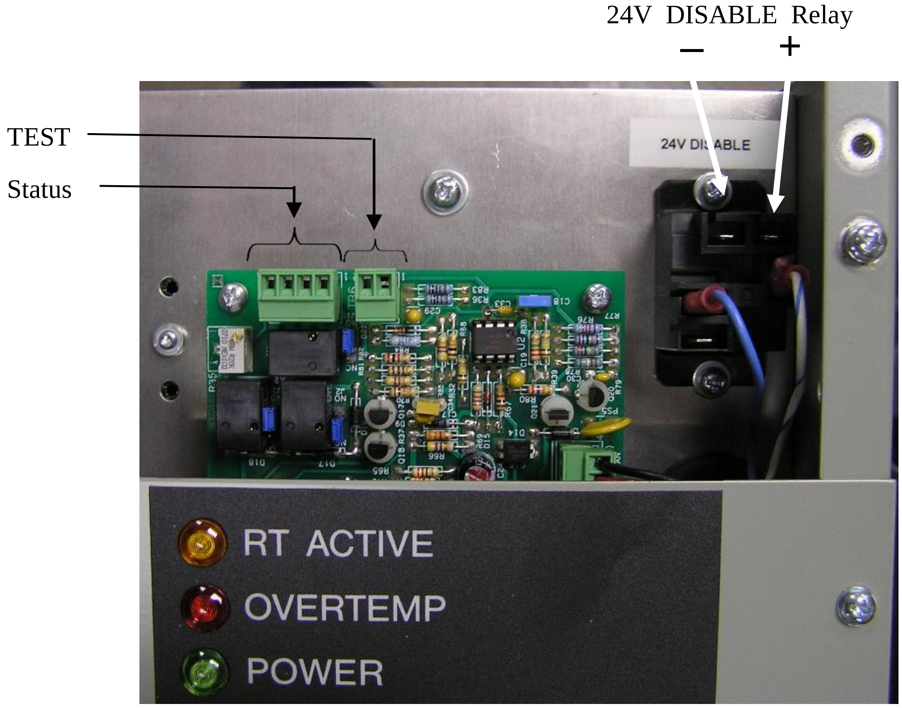


Figure 3-4: A9 Chassis Standard Model Disable Relay

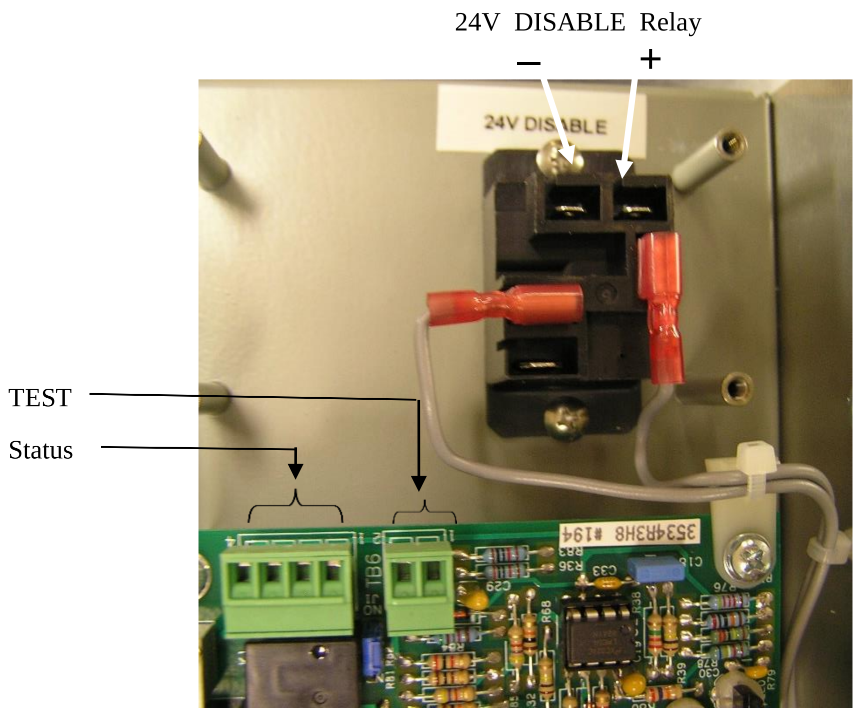
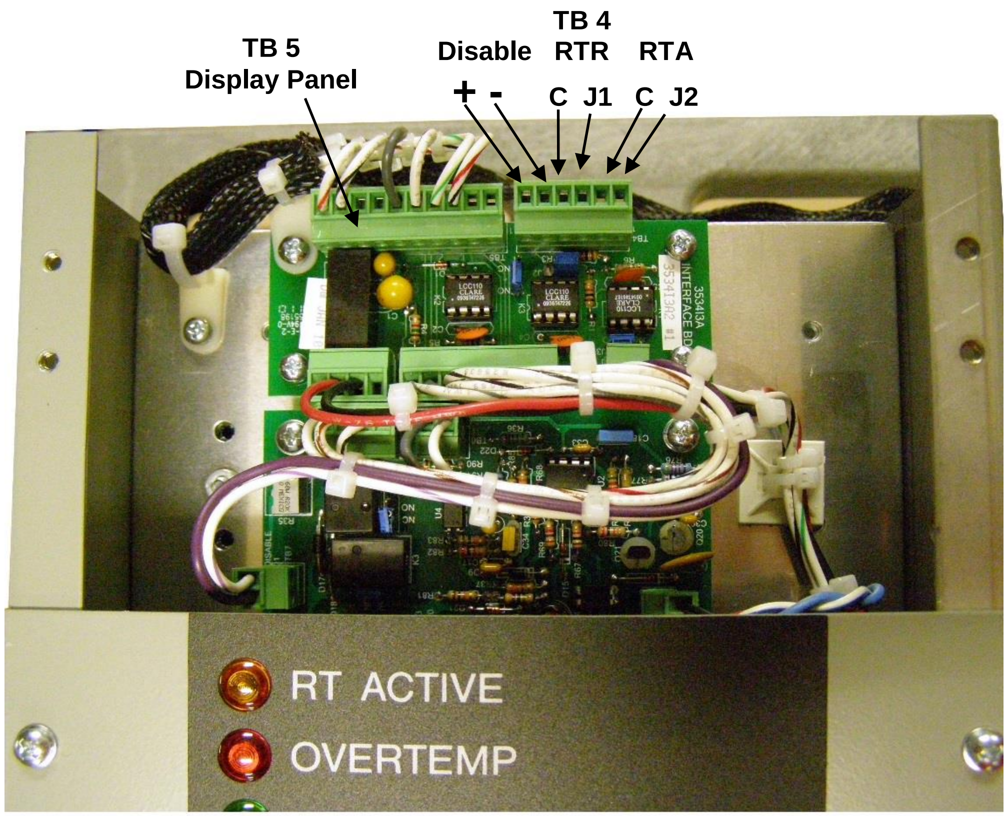
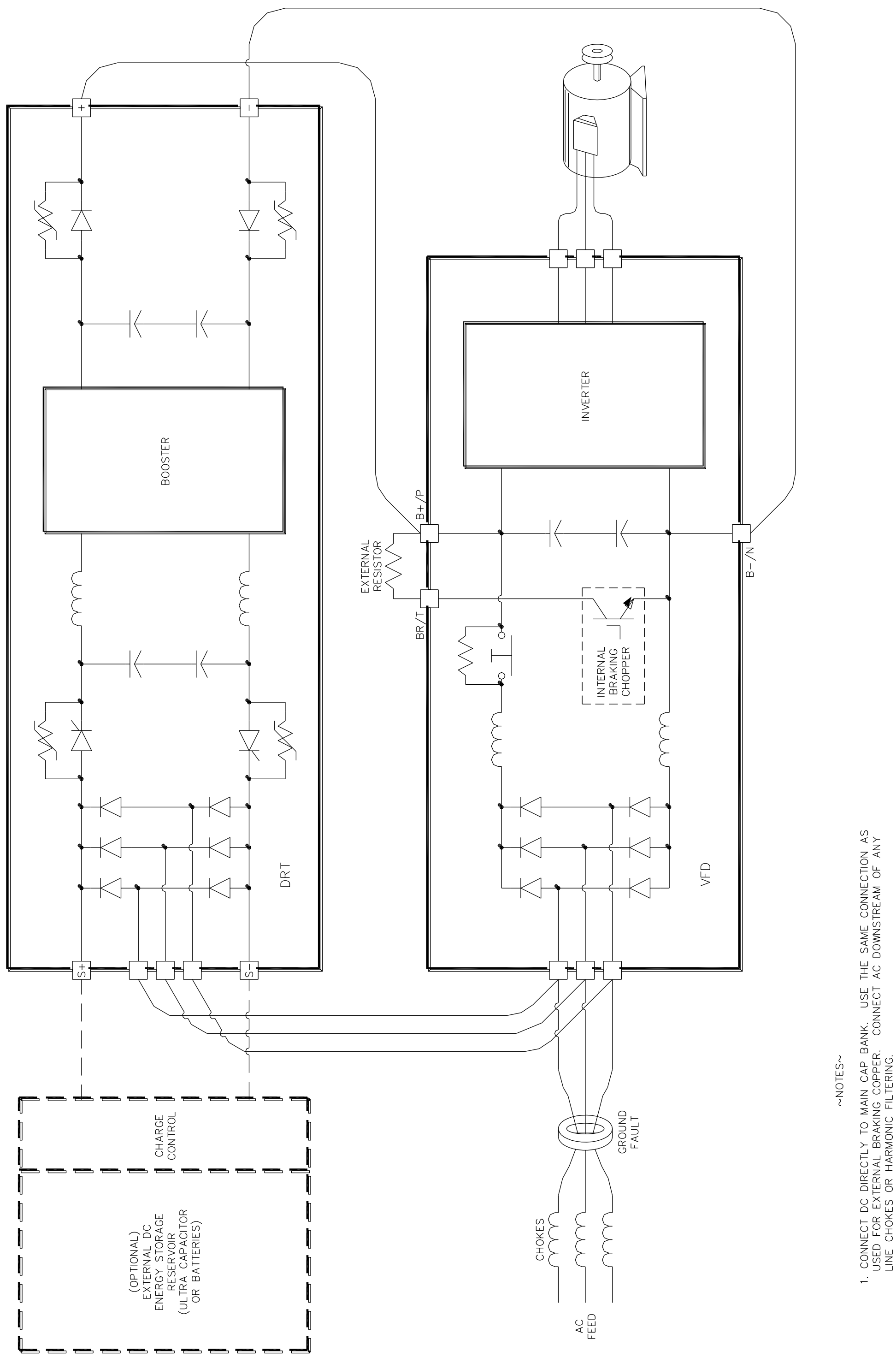


Figure 3-5: Typical Control and Status Connections with I3 Interface



3.5. Typical Configurations

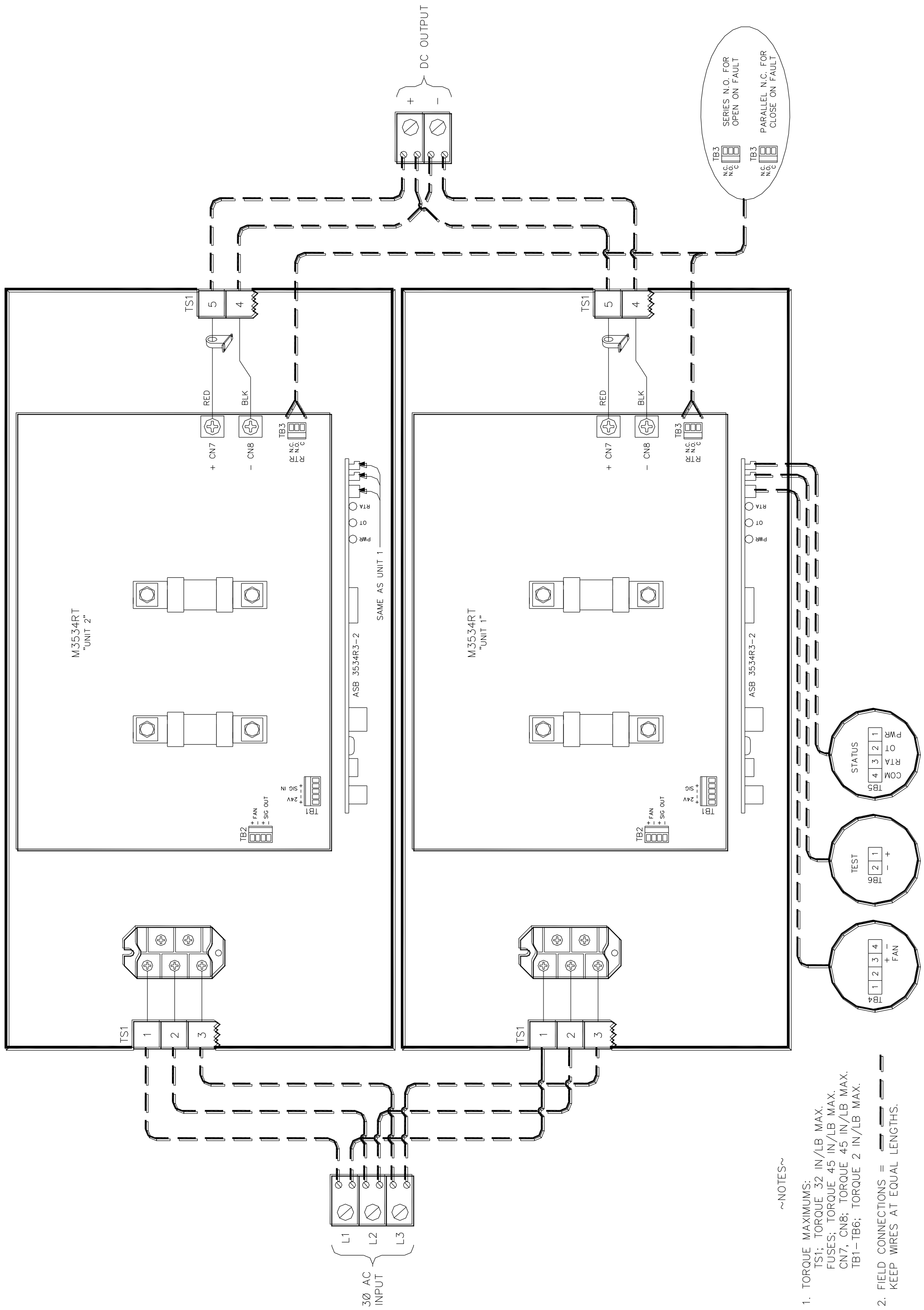
Figure 3-6: Typical M3534R Interconnection with Existing Drive System



Note: Typical 40 Amp model shown

Figure 3-7: Typical 85 Amp (A9 Chassis) M3534R Parallel Wiring Diagram

Note: Special Option "C" must be purchased for sharing to work properly.



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4. OPERATION

4.1. FUNCTIONAL DESCRIPTION

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

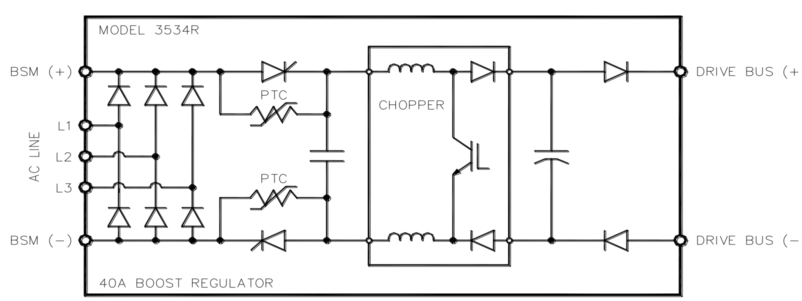
Upon application of power to the M3534R, its DC bus will begin to precharge via internal PTC surge limiters. When the bus reaches 150VDC, the internal logic power supply of the RTM will begin switching, and will supply the +24V and ±15V DC needed to power the control circuitry. At this point the PWR LED will illuminate. In addition, the RTA relay within the RTM and its corresponding RTA LED may turn on briefly during the RTM's precharge period. Once the RTM's DC bus has fully precharged to its preset nominal value (see Ratings chart in Table 6-2 for voltage levels), the control module's PWR LED will be ON, and the RTA and OVERTEMP LEDs will be OFF. The RTM is now ready to protect the inverter system from voltage sags up to and beyond SEMI-47 conditions.

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

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

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

Figure 4-1: Basic 40A & 85A M3534R RTM Internal Power Flow Circuit Diagram



4.2. FEATURES

4.2.1. TERMINAL STRIP I/O

See Figures 6-3 and 6-4 for physical connection locations.

4.2.1.1. CONTROL INPUTS

FOR STANDARD MODELS

The DISABLE command is connected directly to the K1 DISABLE Relay. 24V will inhibit the module from boosting. No connection allows normal operation.

The TEST input is connected directly to TB6 on the 3534R3 control board. 24V initiates TEST. Input is isolated from drive common.

FOR MODELS WITH DP10 OPTION (I3 BOARD)

The DISABLE is connected to the 3534I3 interface board and the TEST button is provided on the DPx Series panel.

4.2.1.2. ASB 3534R3 FAULT LOGIC OVERVIEW

All standard 40 and 85 amp M3534R Ride-Thru Control modules are equipped with basic 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. Please refer to Table 4-1 for details.

4.2.1.3. ASB 3534R3 STATUS OUTPUT CONFIGURATION JUMPERS

FOR STANDARD MODELS

The purpose and setting for each of the configuration jumpers provided on the ASB 3534R3 RTM Control board is described below

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.

Some Fault / Status Outputs have a corresponding LED indicator. When a 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 Over-Temp fault relay K2. This jumper must be set to “Normally Closed” (NC) for cabinet systems. K2 will be pulled in when power is ON and temperature is normal.

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. K3 will be pulled in when power is ON and the booster module is switching.

<u>FOR MODELS WITH DP10 OPTION (I3 BOARD)</u>

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

Table 4-1: Control Status Signal Connection Details for Standard Models

BOARD	TERMINAL TYPE	FUNCTION	ELECTRICAL SPECIFICATIONS	MIN WIRE AWG	MAX WIRE AWG	TORQUE LB-IN
3534R3	Phoenix plug TB5	Status	120VAC / .5 Amp 1kV Isolation 24VDC / 1 Amp 1kV Isolation	22	16	2 lb-in
	Phoenix plug TB6	Test	24VDC / 20mA 1kV Isolation	22	16	2 lb-in
	.20" Female Spade Lug	Disable	24VDC / 20mA 1kV Isolation	22	16	

Table 4-2: Control Signal Connection Details for Models with DP10 "I3" Option

BOARD	TERMINAL TYPE	FUNCTION	ELECTRICAL SPECIFICATIONS	MIN WIRE AWG	MAX WIRE AWG	TORQUE LB-IN
3534I3	Phoenix plug TB4	Disable	15-24VDC / 20mA 3kV Isolation	22	16	2 lb-in

Table 4-3: Status Signal Component Details for Standard Models

BOARD	STATUS COMPONENTS	STATUS SIGNAL COMPONENT ID	
		OVERTEMP (OT)	RIDE-THRU ACTIVE (RTA)
3534R3	Jumper	J2	J3
	Contact Ratings	1A at 24VAC 0.5A at 115VAC	1A at 24VAC 0.5A at 115VAC
	Indicator	LD2	LD3
	Control Board Terminations	3534R3 TB5-2,4	3534R3 TB5-3,4
	Isolation	1kV	1kV

NOTE: *The 3534R3 Ride-Thru Control Board is used in all **<u>K7</u>** and **<u>A9</u>** chassis modules.*

Table 4-4: Status Signal Component Details for Models with DP10 "I3" Option

Board	Status Components	Status Signal Component ID	
		Ride-Thru Active (RTA)	Ride-Thru Ready (RTR)
3534I3	Jumper	J2	J1
	Contact Ratings	120mA at 350VDC	120mA at 350VDC
	Indicator	None	None
	Interface Board Terminations	3534I3 TB4-1,2	3534I3 TB4-3,4
	Isolation	3kV	3kV

Table 4-5: Status Contact Logic Details – R3 Control Board

RTM Status Condition	Indicators			Jumper Positions & Contact States			
	PWR	OT	RTA	OT (J2)		RTA (J3)	
	(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

NOTES:

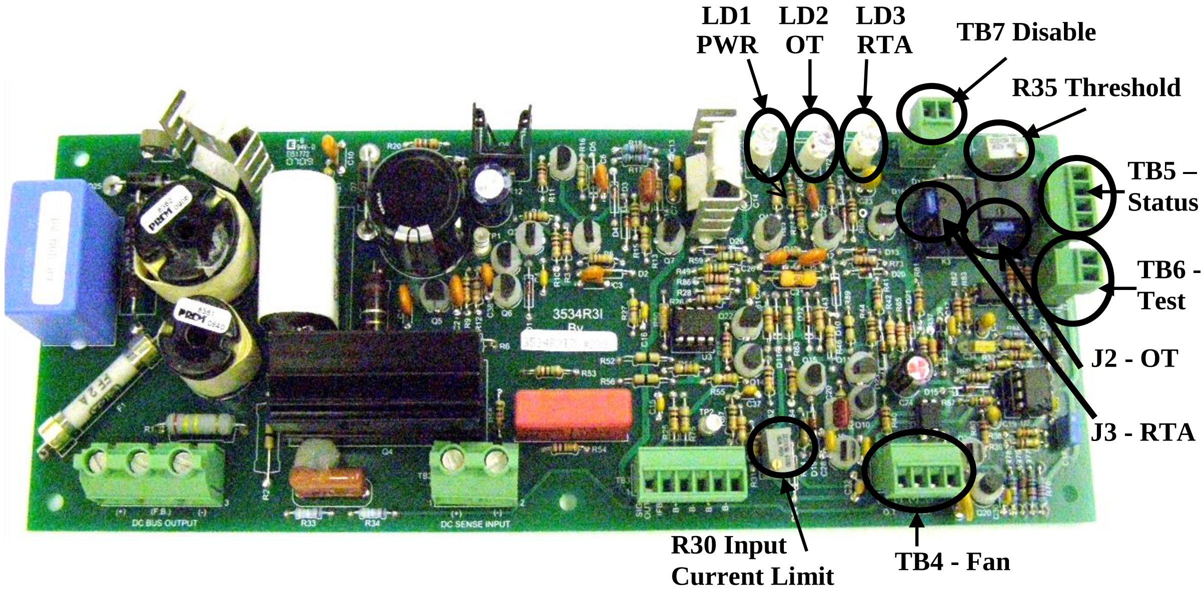
X = contact is closed under stated conditions
O = contact is open under stated conditions

4.2.2. Indicators

4.2.2.1. ASB 3534R3 RTM Control Board

The ASB 3534R3 is the main control board of the Ride-Thru Control Module used in all M3534R Ride-Thru Control Modules built in the K7 or A9 chassis type.

Figure 4-1: ASB 3534R3 Control Board Features



ASB 3534R3 STATUS INDICATORS

The purpose and function of each status indicator provided on the ASB 3534R3 RTM Control board is described below.

LD1 – PWR (POWER):

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

LD2 – OT (OVER-TEMP):

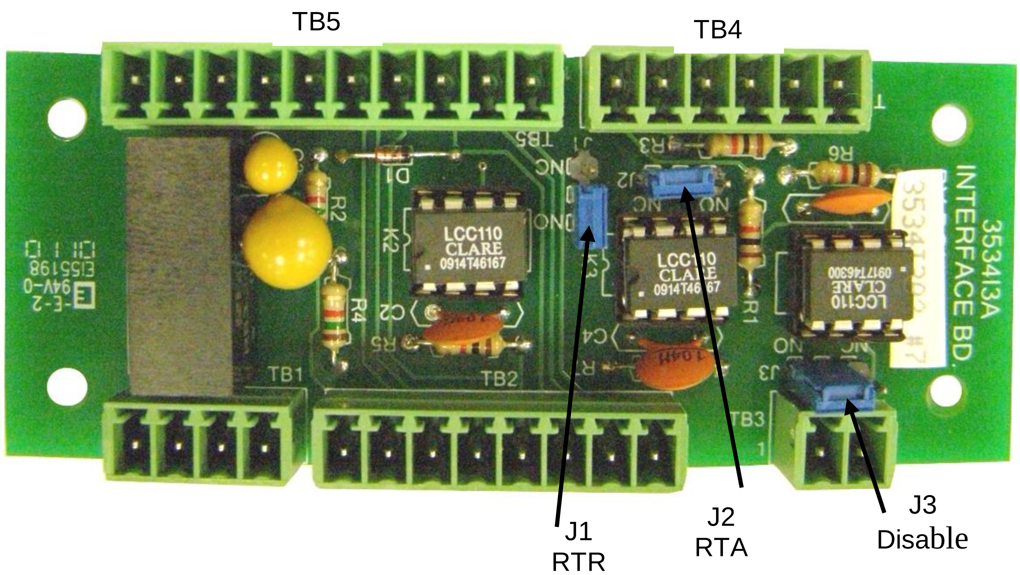
The LD2 O.T. indicator shows the presence of an Over-Temp condition within the M3534R RTM Control module. This indicator directly tracks the activity of **Over-Temp** status output relay K2. This indicator is ON and the relay is de-energized when an Over-Temp condition is present.

LD3 – RTA (RIDE-THRU ACTIVE):

The LD3 RTA indicator shows when the M3534R RTM Control module is actively supporting the DC bus. This indicator directly tracks the activity of RTA status output relay K3. This indicator is ON and the relay is energized when ride through activity is present (must have a minimum of 0.25 amps load current).

4.2.2.2. ASB 3534I3 Interface Board

Figure 4-2: ASB 3534I3 Interface Board Features



3534I3 Interface Board Jumper Set-up

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

J1: Selects N.O. or N.C. contact for the Ride-Thru Ready (RTR) signal. With J1 in the "N.O." position the contact will be made while the module is "READY".

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

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

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

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

4.2.3. Remote or Cabinet Door System Status Display and Test Module

The Ride-Thru Diagnostic Display Panel provides visual indication of the Ride-Thru module's operating status..

The monitored functions include **POWER**, **RIDE-THRU ACTIVE, RIDE-THRU READY,** and **OVERTEMP**. In addition, this panel provides the system

TEST switch required for threshold voltage adjustments and system calibration. This display panel has 1000V of electrical isolation from the drive system.

The function of each indicator is described below.

PWR (POWER)

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

RTR (RIDE-THRU READY)

The GREEN **RIDE-THRU READY** LED is **ON** if the module is operating properly.

RTA (RIDE-THRU ACTIVE)

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

OT (OVER-TEMP)

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

4.2.3.1. BUS VOLTAGE METER

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

4.2.3.2. BUS CURRENT METER

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

4.2.3.3. ACTIVE CYCLES COUNTER

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

4.2.3.4. TOTAL RTA CYCLES COUNTER

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

4.3. STARTUP

WARNING!

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

4.3.1. PRE-POWER CHECKS

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

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

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

4.3.2. STARTUP PROCEDURE AND CHECKS

Ensure that the associated inverter is on-line and functioning properly.

Ensure that the DC bus polarity is correctly wired at the disconnect switch connecting the inverter DC bus with the RTM DC bus.

Apply power to the M3534R module and verify the following start-up sequences:

- M3534R module POWER LED comes **ON**, the RT ACTIVE LED flashes **ON**, and the OVERTEMP LED remains **OFF**.

- **40A & 85A units**: Approximately 4 seconds after logic power comes up the precharge will be considered complete and the RTM is ready to provide ride-thru support.

4.3.2.1. VERIFY RIDE-THRU CAPABILITY

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

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

2. Remove power from the inverter only.
   - M3534R module **RT ACTIVE** LED will come **ON** for duration of event. LED intensity is directly related to load levels.
   - When fully loaded, the inverter DC bus will drop to the minimum regulated voltage level as defined in Table 6-2 in Section 6.1 of this manual.
   - Inverter should be able to keep motor speed and torque constant.

CAUTION!

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

4.4. OPERATIONAL ADJUSTMENTS

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

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

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

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

Table 4-7 lists the typical factory setpoints for the "Threshold", "Over-Voltage", and "Test Boost" levels for the Model M3534 Ride-Thru modules based on the system AC or DC input voltage requirements. Be sure to check the Customer Reference manual for each Ride-Thru module for specific setpoint levels.

Table 4-6: Factory Setpoints for Threshold and Test Boost Voltages

INPUT VOLTAGE	THRESHOLD	TEST BOOST	OVER-VOLTAGE
208VAC	265VDC	+45VDC	360VDC
230VAC	285VDC	+48VDC	360VDC
380VAC	485VDC	+82VDC	630VDC
400VAC	495VDC	+85VDC	630VDC
415VAC	505VDC	+87VDC	630VDC
460VAC	585VDC	+100VDC	710VDC

4.4.2. DETERMINING THRESHOLD VOLTAGE SETPOINT

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

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

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

1) VERIFY PROPER INSTALLATION.

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

2) PUSH THE TEST BUTTON.

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

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

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

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

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

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

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

Subtracting the Boost voltage (100VDC) from this reading shows that the actual Threshold voltage level is 585VDC.

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

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

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

1) REMOVE INPUT VOLTAGE SUPPLY FROM SYSTEM.

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

4.4.2.1. ADJUST THE SETPOINTS AND REPEAT THE TEST

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

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

For 40 & 85 Amp units: Adjustment pot R35 on the 3534R3 control board (see Figure 4-1) is used to set the Threshold voltage level. Adjusting the pot in a clockwise direction will raise the setpoint level; alternately, a counter-clockwise adjustment of the pot will lower the setpoint level. The Threshold setpoint level can be adjusted between 400 and 600V for "EH" models.

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

4.4.3. ADJUSTMENT POTS

4.4.3.1. 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 4-1 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, Inc. for additional information as needed.

5. MAINTENANCE AND TROUBLESHOOTING

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

5.1. PERIODIC TESTING

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

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

1. Monitor boost module LEDs.
   - **PWR LED should be ON.**
   - RTA LED should be **OFF.**
   - OT LED should be **OFF**.
2. Verify DC bus voltage level.
   - Ride-Thru bus should be about 5 – 15V DC below the Inverter bus.
3. Verify "Threshold" 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.
   - Ride-Thru Active LED should begin to flash.
   - DC bus should hold for a second at the threshold.
   - This threshold level should be approximately 10-12% below the nominal loaded inverter bus.

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

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

This completes the maintenance procedure.

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

1. Check Active cycle counters.

- More than 10 counts per month may mean the Ride-Thru is improperly adjusted. Refer to Section 4.4.1 for adjustment details.
- Note count for factory records.
- Report count to Bonitron via your local service representative.

2. Monitor front panel LEDs.
   - For the DP10 / DP17 Display Panel:
     Power LED should be **ON**.
     Ride-Thru Ready should be **ON**.
     Ride-Thru Active LED should be **OFF**.
     Over-temperature LED should be **OFF**.
3. Verify DC bus current meter (DP10 / DP17 only).
   - Meter should read zero amps under normal conditions.
4. Verify DC bus voltage meter (DP10 / DP 17 only).
   - Ride-Thru bus should be about 5 – 15V DC below the inverter bus.
5. Verify Threshold by opening the AC disconnect to the Ride-Thru module (if equipped). Refer to Section 4.4.1.
   - The DC bus voltage should drop until it reaches the threshold.
   - Ride-Thru Active LED should begin to **flash**.
   - DC bus should hold for a second at the threshold.
   - This threshold level should be approximately 10-12% below the nominal loaded inverter bus.

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

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

This completes the maintenance procedure.

5.2. MAINTENANCE ITEMS

5.2.1. CAPACITOR REPLACEMENT RECOMMENDATIONS

5.2.1.1. CLEANING

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

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

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

5.2.1.2. FANS

- Fans run only while RT is active and should have a life of 20 years if the RT is properly adjusted.
- To check operation of fan, initiate activity.
  - 40 Amp models: Fan should run for 2-3 minutes.
  - 85 Amp and above models: Fan should run for 30 minutes.
- If fan does not run, replace with equivalent 24V fan.

5.3. TROUBLESHOOTING

Table 5-1: Troubleshooting Guide

SYMPTOM	ACTION
No LEDs	▪ Check incoming power.
No RTR Output	▪ Check Enable input.
Test Mode Does Not Raise Output Voltage	▪ Check Enable input. ▪ Check Test input ▪ Check incoming and outgoing fuses ▪ Check normal DC bus voltage. If the DC bus is normally too high, the DC bus test setpoint may not raise the output voltage.
RTA Always On	▪ Check DC bus threshold voltage setting.
Ride-Thru Active Output Never Comes On or Attached Drive Trips On Outages	▪ Check Enable input ▪ Check DC link to attached drive. ▪ Initiate Test Mode. If the test does not raise the DC bus and / or the Ride-Thru Active output does not activate, there could be internal damage ▪ Check power quality data to confirm sag events should have caused activity to occur
Overtemp	▪ Check for constant current on the negative and positive DC bus links to the drive. Circulating currents may be overheating the unit in standby. ▪ Check activity record – too much activity causes overtemp
Voltage Fluctuates During Test Mode	▪ Check DC bus threshold voltage setting and test boost level. Overvoltage shutdown can occur if settings are too high, causing an oscillation effect. Lower threshold level and retry.
Stays in Test Mode	▪ Check to make sure test input is properly configured and not active.
Precharge Overheated	▪ Not enough time between power up / power down during testing. Pre-charge can only be done 3 consecutive times before overheating can occur ▪ Check DC bus ripple voltage. Too much ripple can cause the precharge circuit to overheat.

CAUTION!

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.

5.4. TECHNICAL HELP – BEFORE YOU CALL

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

- Exact model number of affected units
- Serial number of unit
- Name and model number of attached drives
- Name of original equipment supplier
- Brief description of the application
- The AC line to line voltage on all 3 phases
- The battery bank voltage
- The DC Bus voltage
- KVA rating of power source
- Source configuration Wye/Delta and grounding

This information will help us support you much more quickly. Please contact us at (615) 244-2825 or through www.bonitron.com

6. ENGINEERING DATA

6.1. RATINGS CHARTS

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

MODEL NUMBER	AC INPUT	MAX. OUTPUT POWER	RECOMMENDED FUSE RATINGS (AC INPUT / DC OUTPUT)	MAX DC OUTPUT CURRENT	CHX SIZE
M3534R-L012-K7	230VAC	12kW /16hp	A60Q40-2 / A70QS50-14F	40ADC	K7
M3534R-L025-A9	230VAC	25kW /33hp	A60Q125 / A60Q80	85ADC	A9
M3534R-E020-K7	400VAC	20kW /26hp	A60Q40-2 / A70QS50-14F	40ADC	K7
M3534R-E043-A9	400VAC	43kW /57hp	A60Q125 / A70Q80	85ADC	A9
M3534R-H024-K7	460VAC	24kW /32hp	A60Q40-2 / A70QS50-14F	40ADC	K7
M3534R-H050-A9	460VAC	50kW /67hp	A60Q125 / A70Q80	85ADC	A9

The codes listed in the **CHX SIZE** column of the table above refer to specific Bonitron chassis designs. For chassis details see the dimensional outlines in Section 6.4.

For higher ratings, batteries can be added and 85 Amp units can be paralleled.

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

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

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

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

6.2. WATT LOSS

STANDBY MODE

- Less than 25 watts for 40A units
- Less than 25 watts for 85A units
- Approximately 3 watts for DP Series panels

BOOST MODE

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

6.3. FUSE/CIRCUIT BREAKER SIZING AND RATING

6.3.1. RECOMMENDED INPUT POWER WIRING SIZES AND POWER SOURCE FUSING

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

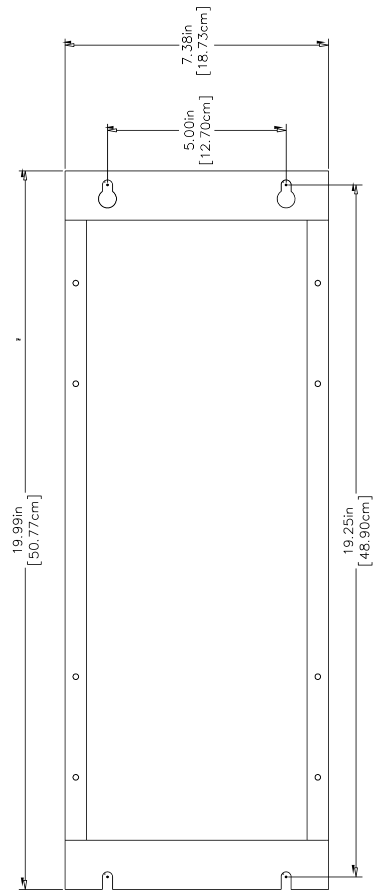
- Wire size must be coordinated with circuit protection devices and IR drop of wire. It is NOT necessary to size wire for continuous duty. Maximum allowed duty cycle for the M3534R Ride-Thru is one 2-second run every 4 minutes.

Table 6-3: 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
20 - 24	40 Amps	60 Amps	8 - 10 AWG	16 MCM
43 - 50	85 Amps	125 Amps	4 - 6 AWG	41 MCM

6.4. DIMENSIONS AND MECHANICAL DRAWINGS

Figure 6-1: 24kW Ride-Thru K7 Chassis Dimensional Outline



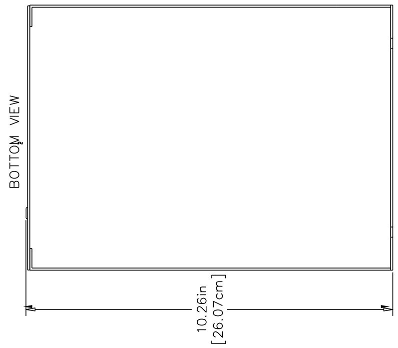
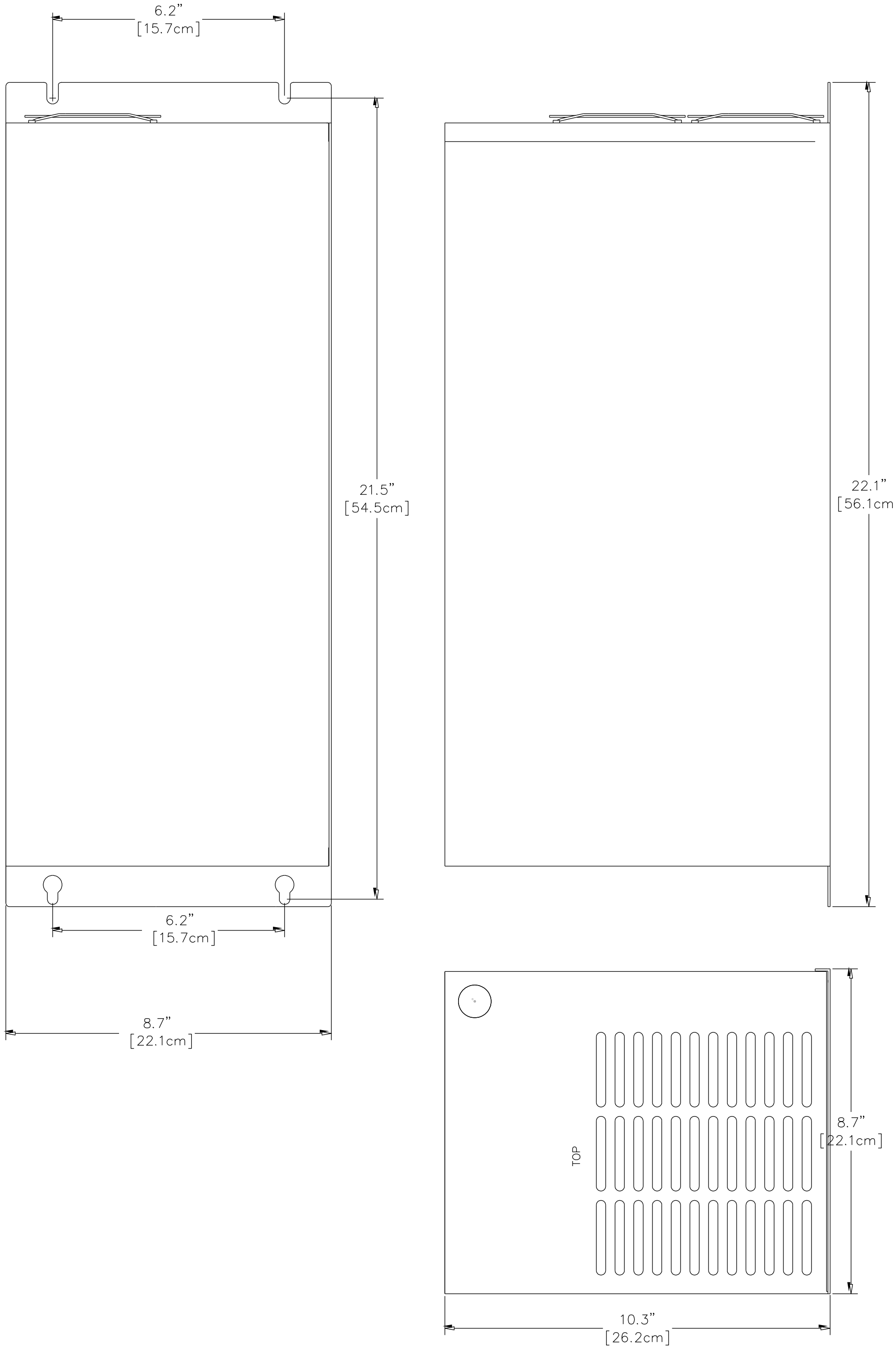


Figure 6-2: M3534R 50kW A9 Chassis Dimensional Outline



6.5. SUPPLEMENTAL DRAWINGS

Figure 6-3: 3534R3 TB5 Status Signal

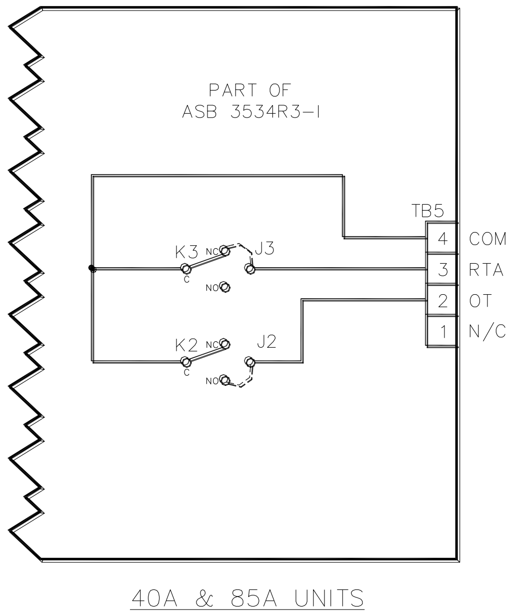
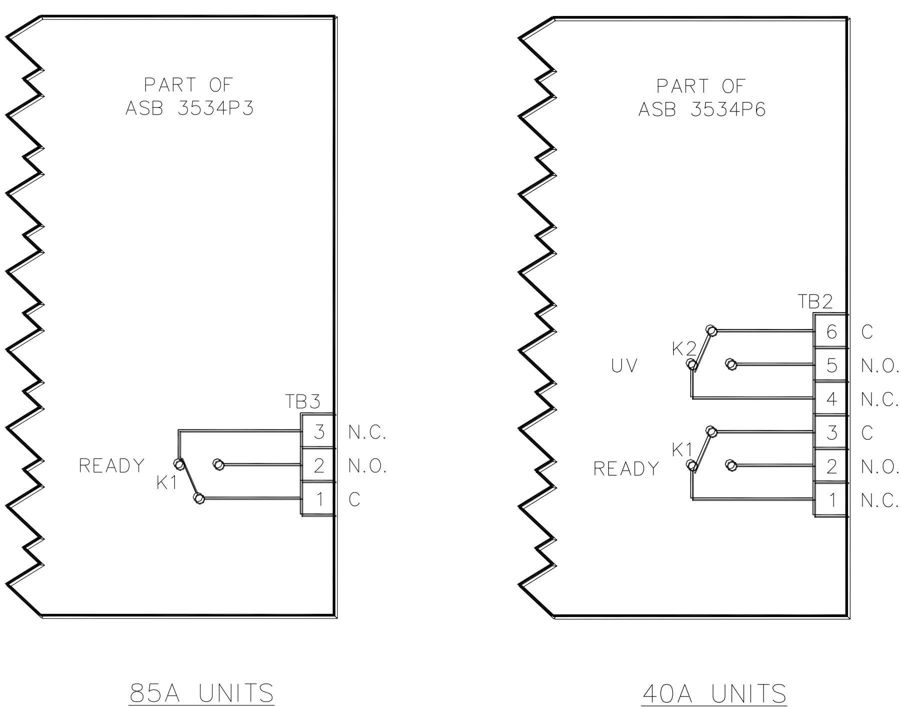
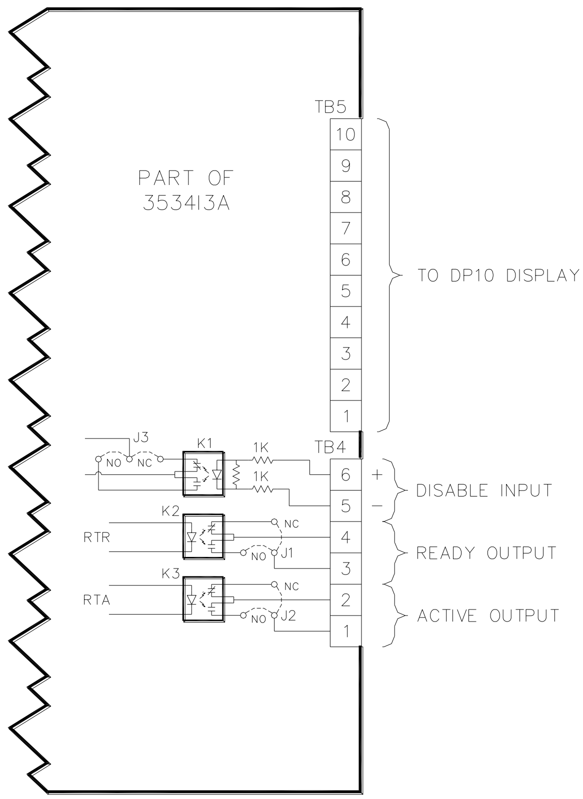


Figure 6-4: 3534R Status Signal Schematics



Dwgs: 060165 Rev: 20090615 and 070001 Rev: 20090624

Figure 6-5: 3534I3 Control and Status Signal



6.6. RECOMMENDED SPARE PARTS

Tables 6-6 and 6-7 list the major components for the M3534R modules.

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

Each printed circuit board has a serial sticker (i.e. 3534R3H10 #125). Please refer to Table 6-5 below. Please include every character when ordering spare PCBs to help ensure a proper order.

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

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

Table 6-4: Example of PCB Serial Sticker

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

Table 6-5: Spare Parts List for 32hp 24kW 40 Amp Unit

PART NUMBER	DESCRIPTION	QTY
ASB 3534R3-x	Control PCB	1
ASB 3534P6-1	Power chopper PCB & Semiconductors	1
ASB 3534I3	Optional Interface Board	1
FN 4.7-24DC-108-1	24V Fan	1
FS A60Q40-2	40 amp semiconductor fuse	3
FS A70Q50-4	50 amp semiconductor fuse	2
LD AMB-LENS-L05	Red lens cap	1
LD GRN-LENS-L05	Green lens cap	1
LD RED-LENS-L05	Amber lens cap	1
LD RED-LENS-L05-W	Neoprene Washer	3

Table 6-6: Spare Parts List for 67hp 50kW 85 Amp Unit

PART NUMBER	DESCRIPTION	QTY
ASB 3534R3-x	Control PCB	1
ASB 3534P3-1	Power Chopper PCB	1
ASB 3534I3	Optional Interface Board	1
FS FWP-100	FWP-100B Semiconductor Fuse	2
LD AMB-LENS-L05	Red lens cap	1
LD GRN-LENS-L05	Green lens cap	1
LD RED-LENS-L05	Amber lens cap	1
LD RED-LENS-L05-W	Neoprene Washer	3

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

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7. APPENDICES

7.1. DRIVE RIDE-THRU SELECTION GUIDE

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

1. Fractional to 3hp, 50% sag or 100% short term outage should consider M3534EC
2. Fractional to 3hp, 100% long term outage should consider M3534BR
3. 3hp to 67hp 50% sag should consider M3534R
4. 3hp to 15hp 100% short term outage should consider M3534CR
5. 15hp to 67hp 100% short term outage should consider M3534UR
6. 3hp to 67hp 100% long term outage should consider M3534BR
7. 75hp to 2000hp 50% sag should consider M3460R
8. 75hp to 2000hp 100% short term outage should consider M3460UR
9. 75hp to 2000hp 100% long term outage should consider M3460BR

7.2. INSTALLATION CONSIDERATIONS FOR DRIVE RIDE-THRU SYSTEMS

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

1. Inverter logic voltage must be "backed up"
   - Most new Inverters derive logic supply from DC bus
   - Install UPS on circuits with AC feed
2. Any control or Interlock relays must be "backed up"
   - Test Relays at half voltage for dropout
   - Use DC relays on logic supply
   - Install UPS on circuits with AC feed
3. Determine the maximum motor voltage needed
   - To ensure "Threshold" level is sufficient to supply motor

   Most inverters automatically compensate RMS to motor
4. Verify actual AC line voltage and DC bus level
   - To ensure "Threshold" level is set – 10% of nominal DC bus level
   - To ensure valleys of ripple do not cause unwanted activity
5. Determine Inverter low bus trip point
   - To ensure "Threshold" level is above inverter dropout
6. Determine Inverter high bus trip point
   - To ensure "Test" level will not over voltage inverter
7. Inverter ground fault circuits
   - Ride-Thru currents on 20 amp model may use inverter bridge neg diodes during operation
   - Circuits can be de-sensitized
   - External ground fault circuits may be added
8. Electrical safety
   - Ride-Thru should not have AC power when inverter does not

   RT and Inverter should feed from same point

   Use shunt trip interlock between Inverter and Ride-Thru if RT power is not fed downstream of inverter power switch

   Label inverter as having two power sources
9. DCS monitoring of status signals
   - Alarm contacts

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

7.3. APPLICATION NOTES FOR M3534R MODULES

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

7.4. SPECIFYING AN ULTRACAPACITOR STORAGE BANK FOR FULL OUTAGE PROTECTION WITH THE M3534R

Bonitron M3534R models can have energy storage devices added to cover complete outages. This involves adding a capacitor bank with an appropriate charging and discharging system. Bonitron can source complete capacitor cabinets or individual capacitors. This section gives some instruction for sizing and specifying these storage devices.

The process described below is a good way to estimate the capacitor bank required. Since the discharge characteristic of a capacitor bank with a constant power load is a nonlinear differential equation, optimizing the capacitor bank selection is an iterative process. A general estimate of needs must be used to build a capacitor bank and then the actual values must be cross checked to make sure they are suitable.

There are several steps in the process. The capacitor bank will be comprised of capacitors connected in series for voltage support, with one or more strings in parallel to support the energy requirements. Since the extraction losses due to the electrostatic resistance (Esr) of the capacitor can be significant, they must be taken into account. If the Esr losses get too high, parallel capacitor strings can be used to reduce the current in each series string.

The steps to specify the string will include:

1. Determine the energy required for the outage.
2. Determine the minimum voltage acceptable for full power backup.
3. Determine the maximum current required to support the load at minimum voltage.
4. Specify the capacitor to be evaluated.
5. Estimate the losses for each capacitor.
6. Determine the minimum number of capacitors per series string required for the minimum voltage.
7. Add capacitors in series for outage energy.
8. Determine if parallel strings are required to provide outage energy.

These are the definitions of the variables we will use in the following equations:

C_{eol} - Capacitance at end of life
C_{tot} - Total capacitance of the entire cap bank
Esr_{tot} - Total equivalent ESR for the entire cap bank
Esr - Internal resistance at end of life
I_{peak} - Peak current into the M3534 during the discharge cycle
$J_{Available}$ - Total energy in charged capacitor bank prior to discharge
$J_{LossTot}$ - Total losses during discharge
J_{out} - Energy required to hold up the system during the outage
n_{series} - Number of capacitors in each series string
P_{sys} - System power in kilowatts
T_{out} - Time outage in seconds
V_{Charge} - Charge voltage at beginning of discharge
V_{CapEnd} - The capacitor string voltage at the end of the discharge
V_{CapMax} - Maximum charge voltage for the capacitor
V_{end} - Lowest voltage the capacitor bank can reach
$V_{TermEnd}$ - Terminal voltage of an individual capacitor during discharge

7.4.1. Energy Required for Outage

The total energy required for the event must be calculated first.

Using the following equation, the total number of joules required for the outage can be calculated:

$$\mathrm{J_{Out}} = \mathrm{P_{sys}} * \mathrm{T_{out}}$$

We will use a specification of 100 hp. for a 2 second outage for this example. For instance, a 100 hp drive outage for 2 seconds would be

$$\mathrm{P_{sys}} = 100\mathrm{hp} * .746\ {}^{\mathrm{kwatts}}/_{\mathrm{horsepower}} = 75\mathrm{kW}$$

The total number of joules required is:

$$\mathrm{J_{Out}} = 75\mathrm{kW} * 2\mathrm{s} = 150\mathrm{kJ}$$

7.4.2. Minimum Capacitor Bank Voltage

There is a minimum voltage level that must be maintained at the end of the discharge during backup. An M3534R for a 460VAC nominal system has a minimum input voltage of 320VDC. Therefore, the final discharge voltage of the capacitor bank (V_{end}) should be 320 VDC.

These data are available in the specifications for the specific M3534R by nominal system voltage.

7.4.3. PEAK CURRENT

The peak current from the capacitor bank will occur at the minimum voltage. This can be estimated from the equation

$$\mathrm{I_{peak}} = \frac{\mathrm{P_{sys}}}{\mathrm{V_{end}}}$$

For our example,

$$\mathrm{I_{peak}} = \frac{75\mathrm{kW}}{320\mathrm{Vdc}} = 235\mathrm{A}$$

7.4.4. CAPACITOR SPECIFICATIONS

At this point, a specific capacitor's characteristics can be used. It is best to use the values that are listed at end of life for the capacitor to make sure that the storage system is sized for the eventual degradation of performance over time. The critical points to use are

Esr = *Internal resistance at end of life, typically 150-200% of the initial value.*

C_{eol} = *Capacitance at end of life*

V_{CapMax} = *Maximum charge voltage for the capacitor. (A general rule is to* use 95% of the value listed on the datasheet for a reasonable margin)

For our example, we will use the following values:

Esr = *.01Ω*

C_{eol} = *132F*

V_{CapMax} = *46V*

7.4.5. MINIMUM SERIES STRING

From V_{capMax}, we can calculate the minimum series string of capacitors that will be required by the voltage rating. Below this voltage, there is an amount of stored energy that cannot be used, and will remain in the capacitor bank. Since there can be significant terminal voltage drop at the end of the discharge cycle due to Esr, it is best to use the terminal voltage of the capacitors ($V_{TermEnd}$) for this calculation.

$$\mathrm{V_{TermEnd}} = \mathrm{V_{CapMax}} - \left(\mathrm{I_{peak}} * \mathrm{Esr}\right)$$

$$\mathrm{V_{TermEnd}} = 46\mathrm{V} - (235\mathrm{A} * 0.01\Omega) = 43.7\mathrm{V}$$

For our example, the minimum number of caps in a series string would be:

$$\mathrm{n_{series}} = \frac{\mathrm{V_{end}}}{\mathrm{V_{TermEnd}}} = \frac{320\mathrm{V}}{43.7\mathrm{V}} = 8$$

7.4.6. AVAILABLE JOULES

At this point, the available maximum joules for the string can be calculated.

$$\mathrm{V_{Charge} = n_{series} * V_{CapMax}}$$

$$V_{Charge} = 8 * 46V = 368V$$

The capacitor voltage at the end of the discharge V_{CapEnd} will be given by:

$$\mathrm{V_{CapEnd} = V_{end} - n_{string} * I_{peak} * Esr}$$

$$\mathrm{V_{CapEnd} = 320V + 8 * 235A * 0.01\Omega = 338V}$$

The total capacitance of the series string is given by:

$$\mathrm{C_{tot} = \frac{C_{eol}}{n_{series}} * n_{parallel}}$$

$$\mathrm{C_{tot} = \frac{132F}{8} * 1 = 16.5F}$$

Now, the total energy that can be delivered to the load is given by:

$$\mathrm{J_{Available}} = \frac{1}{2} * \mathrm{C_{tot}} * \left(V_{Charge}^2 - V_{CapEnd}^2\right)$$

$$\mathrm{J_{Available} = \frac{1}{2} * 16.5F * (368V^2 - 338V^2) = 175kJ}$$

The equivalent Esr of the string is given by

$$\mathrm{Esr_{tot} = \frac{n_{string} * Esr}{n_{parallel}}}$$

$$\mathrm{Esr_{tot} = \frac{8 * 0.01\Omega}{1} = 0.08\Omega}$$

The total extraction losses of the string is given by

$$\mathrm{J_{LossTot} = Esr_{tot} * I_{Peak}^2 * T_{out}}$$

$$\mathrm{J_{LossTot} = 0.08\Omega * 235A^2 * 2s = 9kJ}$$

Now the total required energy can be compared.

$$\mathrm{J_{Out} + J_{LossTot} < J_{Available}}$$

$$\mathrm{150kJ + 9kJ} < 175kJ$$

This combination of capacitors will be adequate for our example application.

If the application required more energy, then capacitors can be added in series, and the calculations redone as in 7.3.1. If the charge voltage exceeds the maximum input voltage for the M3534R, then the minimum series string combination should be used in parallel and the process repeated.

7.5. DIODE SHARING WITH A BONITRON M3534 RIDE-THRU

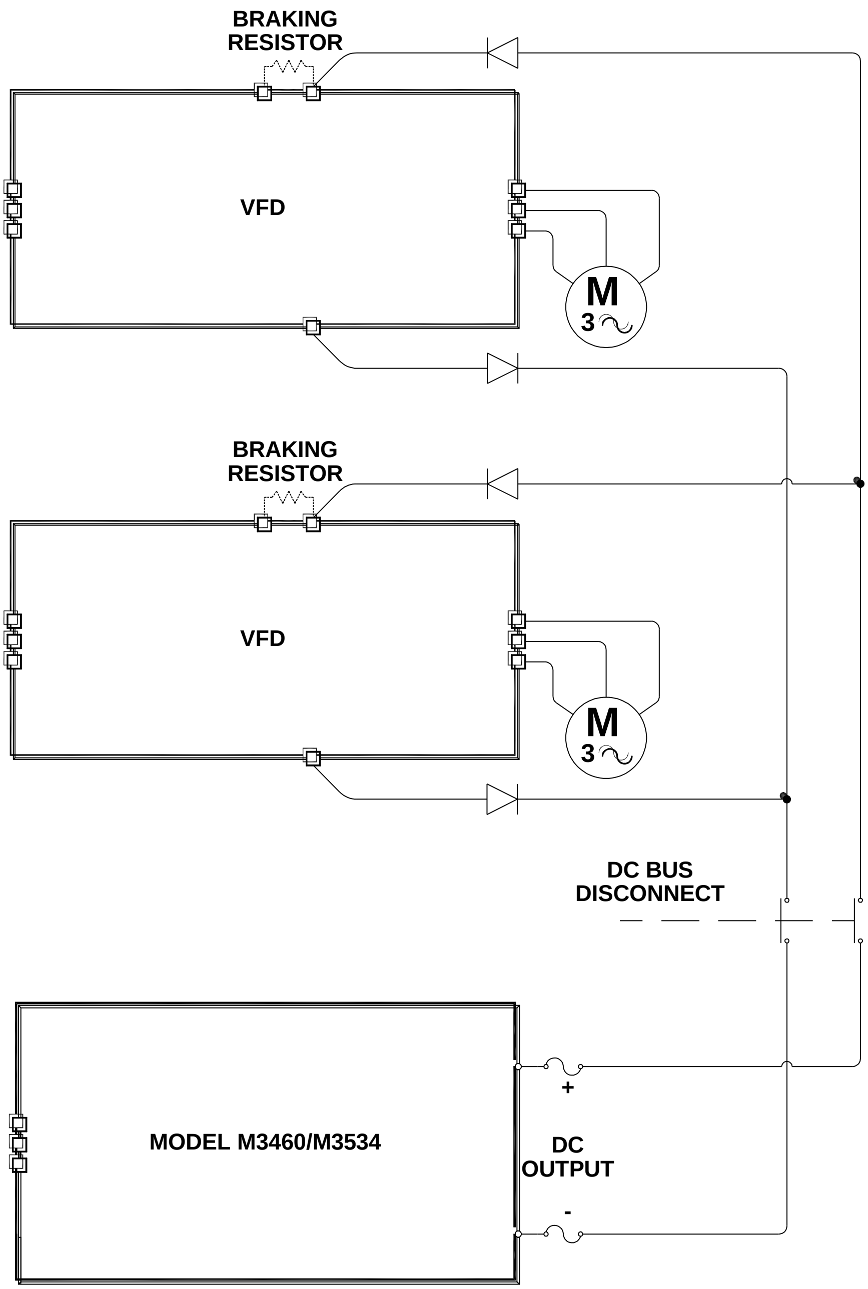
Diode sharing is used to decrease the cost of implementing M3534 modules to existing drive systems that are not common bussed. The use of diodes will prevent drive busses from “back feeding” each other, by allowing energy to pass one way only.

For Ride-Thru applications, the energy is allowed to pass from the M3534 to the drives, but is blocked from the drives to the M3534. Figure 7-1 is a block diagram of a diode sharing example.

Below are some basic guidelines for using diodes in this manner for M3534 applications.

1. Drives should have equivalent DC bus levels as would be found on equal size drives of a common manufacturer.
2. Drives should be on same AC feed and grounding. There must be no isolation transformers between the drives and or M3534 modules. Different feeds may have different potentials and may cause circulating currents or ground faults.
3. If line chokes or harmonic filters are used, all the drives should be connected to the output of a single choke or filter. Individual input harmonic filters or line chokes can cause unequal potentials with respect to earth.
4. The 3534 connection should be downstream of any input line filter. Input line filters cause lower DC bus levels. If a M3534 is placed upstream, the Ride-Thru DC bus can be higher than the drive bus, and current can flow through the M3534. This can cause constant activity and overheating. It may be necessary to lower the threshold for these applications.
5. Ground Fault sensing should be done upstream at common point of line connection, upstream of line filter, if used.

Figure 7-1: Diode Sharing Example



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