Commissioning

Start-up Commissioning Services

Start-up will be performed at the customer's site. Rockwell Automation requests a minimum of four- (4) weeks notice to schedule each start-up.

The standard Rockwell Automation work hours are between 9:00 AM to 5:00 PM EST, (8 hr/day) Monday through Friday, not including observed holidays. Additional working hours are available on a time and material basis.

Rockwell Automation recommends the following:

Drive Commissioning

1. A pre-installation meeting/conference call with the customer to review:
   - The Rockwell Automation Start-up Plan
   - The Start-up Schedule
   - The Drive(s) installation requirements
2. Inspect the drive's mechanical and electrical devices.
3. Perform a tug test on all internal connections within the drive and verify wiring.
4. Verify critical mechanical connections for proper torque requirements.
5. Verify and adjust mechanical interlocks for permanent location.
6. Confirm all inter-sectional wiring is connected properly.
7. Re-verify control wiring from any external control devices such as PLCs, etc.
8. Confirm cooling system is operational.
9. Verification of proper phasing from isolation transformer to drive.
10. Confirm cabling of drive to motor, isolation transformer and line feed.
11. Collect test reports indicating megger / hipot test has been performed on line and motor cables.
12. Control power checks to verify all system inputs such as starts/stops, faults, and other remote inputs.

Start-up Commissioning Services (cont.)

13. Apply medium voltage to the drive and perform operational checks.
14. Bump motor and tune drive to the system attributes. (If the load is unable to handle any movement in the reverse direction the load should be uncoupled prior to bumping the motor for directional testing).
15. Run the drive motor system throughout the operational range to verify proper performance.

Please Note: Customer personnel will be required on-site to participate in the start-up of the system.

Commissioning the Drive

Information contained in this chapter will assist in commissioning a PowerFlex air-cooled medium voltage AC drive. This chapter contains reference material with information including:

- Recommended Tools and Equipment
- Safety Checks
- Drive line-up Data Sheets
- Pre-Power Checks
- Control Power Checks

Review the information contained in this chapter prior to commissioning the drive. It will be used as a reference while the drive line-up commissioning is performed. **Record all the information requested in the data sheets. The information recorded on the data sheets will be useful during future maintenance and troubleshooting exercises.**

Perform the commissioning checks illustrated in this chapter in the sequence that they have been presented. Failure to do so may result in equipment failure or personal injury.

ATTENTION

Servicing energized industrial control equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of control equipment. Hazardous voltages may exist in the cabinet even with the circuit breaker in the off position. Recommended practice is to disconnect or lock out control equipment from power sources, and confirm discharge of stored energy in capacitors. If it is necessary to work in the vicinity of energized equipment, the safety related work practices of NFPA 70E, Electrical Safety requirements for Employee Work places, must be followed.

Notwithstanding the safety references here, all local codes and safety practices are to be utilized when working on this product.

ATTENTION

The CMOS devices used on the control circuit boards can be destroyed or damaged by static charges. If personnel will be working near static sensitive devices, they must be appropriately grounded.

Pre-Commissioning Responsibilities

In order to avoid complications during commissioning, it is important to ensure that the drive line-up is ready to be commissioned. Included in this chapter is a seven-point Pre-Commissioning Checklist. It is necessary that the checklist be reviewed to ensure that all points are completed in the order that they have been presented prior to beginning the drive commissioning. Completing the items in the checklist prior to commencing drive commissioning will help to ensure that the start-up is performed in an organized and efficient manner.

Please print the following information:

Medium Voltage Support	**Name:**	**Date:**
Rockwell Automation	**Company:**	
Fax: 1 (866) 465-0103 *or*	**Phone:**	**Pages:**
Fax: 1(519) 740-4756	**Fax:**	

PowerFlex 7000 'A' Frame Pre-Commissioning Checklist

Once all points of the checklist are complete, initial each check box and provide the date. Photocopy the checklist and fax the copy to Medium Voltage Support, along with the planned start-up date. Upon receiving this checklist, the Medium Voltage Support will contact the site to finalize arrangements for a start-up engineer to travel to site if so desired by the end user.

Drive Serial Number: _____
CSM Service Engineer Requested (YES/NO): _____
Scheduled Commissioning Date: _____

1. Receiving and Unpacking

Initials	Date		
		☐	The drives have been checked for shipping damage upon receiving.
		☐	After unpacking, the item(s) received are verified against the bill of materials.
		☐	Any claims for breakage or damage, whether concealed or obvious, are made to the carrier by the customer as soon as possible after receipt of shipment.
		☐	All packing material, wedges, or braces are removed from the drive.

2. Installation / Mounting

Initials	Date		
		☐	The drive is securely fastened in an upright position, on a level surface. Seismic zones require special fastenings. Consult factory.
		☐	Lifting Angles have been removed.
		☐	Bolts have been inserted into original location on top of drive (leakage of cooling air).
		☐	All contactors and relays have been operated manually to verify free movement.

PowerFlex 7000 'A' Frame Pre-Commissioning Checklist

3. Safety

Initials	Date		
		☐	All mechanical interlocks and door Ram Interlocks are tested for proper functionality and are not defeated or damaged.
		☐	All Kirk key interlocks are installed and tested for proper functionality.
		☐	The grounding of the drive should be in accordance with CEC (Canadian Electrical Code), NEC (National Electrical Code), or IEC regulations.
		☐	If the drive has an isolation transformer, the transformer enclosure and/or frame must be bonded to system ground at a minimum of two locations.
		☐	If the drive has an isolation transformer, the wye secondary neutral point must not be grounded.
		☐	If shipping splits exist in the line-up, the ground bus between cabinets has been installed.

4. Control Wiring

Initials	Date		
		☐	All low voltage wiring entering the drive is labeled, appropriate wiring diagrams are available, and all customer interconnections are complete.
		☐	If a tachometer is used, the tachometer must be isolated from the motor frame. The tachometer cables should be routed in grounded steel conduit for electrical noise suppression, and the conduit must be grounded at junction box but left isolated from the tachometer with an insulated bushing.
		☐	The tachometer cable shield to the drive is connected to the ground bus at the drive end only.
		☐	All AC and DC circuits are run in separate conduits.
		☐	All wire sizes used are selected by observing all applicable safety and CEC / NEC / IEC regulations.
		☐	Remote I/O Interface is properly configured / active.
		☐	All 3-phase control wiring is with in specified levels and has been verified for proper rotation, UVW.
		☐	All single-phase control wiring is within specified levels and has grounded neutrals.

PowerFlex 7000 'A' Frame Pre-Commissioning Checklist

5. Power Wiring

Initials	Date		
		☐	The power cable connections to the drive, motor and isolation transformer adhere to CEC, NEC, IEC or appropriate local standards.
		☐	The cable terminations, if stress cones are used, adhere to the appropriate standards.
		☐	Appropriate cable insulation levels are adhered to, as per Rockwell Automation specifications (refer to tables in Chapter 2 of User Manual for Cable Insulation Requirements).
		☐	All shields for shielded cables must be grounded at the source end only.
		☐	If shielded cables are spliced, the shield must remain continuous and insulated from ground.
		☐	All wire sizes used are selected by observing all applicable safety and CEC / NEC / IEC regulations.
		☐	All power connections are torqued as per Rockwell Automation Specifications. (Refer to information in Appendix B "Torque Requirements")
		☐	All customer power cabling has been Meggered or Hi-Pot tested before connecting to drive system.
		☐	Power wiring phase rotation has been verified per the specific electrical diagrams supplied by Rockwell Automation.

6. Drive line-up Status

Initials	Date		
		☐	The medium voltage and low voltage power is available for startup activities.
		☐	The motor is uncoupled from the driven load.
		☐	The load is available for full load testing.

PowerFlex 7000 'A' Frame Pre-Commissioning Checklist

NOTES OR COMMENTS:

Commissioning Preparation

The following section identifies all the tools and resources required to successfully commission a PowerFlex 7000 'A' Frame drive line-up. In addition, it identifies how to obtain the required equipment in the event that it is not readily available prior to commissioning the drive. It is recommended that all items listed below be obtained prior to attempting to commission the drive. Ensure that the contents of this section are reviewed and that the uses of the equipment described within are understood prior to commencing commissioning of the drive. If further support or additional information is required, contact your local Rockwell Automation service office or Medium Voltage Support at (519) 740-4790.

Recommended Tools and Equipment

Hand Tools
- Metric and Imperial wrenches, sockets, and Hex keys
- Torque wrench
- Assortment of screw drivers
- Assortment of electrical tools (wire strippers, electrical tape, crimpers, etc.)

Electrical Equipment
- High voltage gloves – 10 kV insulation rating (minimum)
- Approved high voltage potential tester – 10 kV rating (minimum)
- Anti-static strap

Test Equipment
- 100 MHz oscilloscope with at least 2 channels and memory
- 600-Volt (1000V rating) digital multimeter with assorted clip leads
- 5000 Volt megohmmeter

Computer Requirements and Software
- Laptop computer (486 or higher installed with Microsoft (MS) Windows)
- Microsoft HyperTerminal (Provided with MS Windows)
- Rockwell Automation Software (RS) drive tools (Optional)
- RS Logix ❷
- Required computer cables
  - 9-Pin Null Modem ❸
  - 9-Pin Serial ❸
  - Remote I/O (SCANport DeviceNet…) ❶
  - PLC Communications Cable ❷

❶ Only required when Remote I/O has been provided with the drive.
❷ Only required when PLC has been provided with the drive
❸ Refer to Publication 7000-UM151_-EN-P, Chapter 5 – Component Definition and Maintenance.

Technical Publications

Each drive is shipped with the following publications:

- User Manual ❶ – provides general information required by the User
- Technical Data, PowerFlex 7000 Medium Voltage AC Drives, Firmware Version x.xxx ❶ - provides detailed information about the firmware parameters and troubleshooting information
- PowerFlex 7000 MV Drives General Handling Procedures, Installation Instructions (affixed to the enclosure)

If, applicable, the following publications are also included:

- PowerFlex 7000 AC Drive with Direct-to-Drive Technology Re-Installing a Common Mode Choke, Installation Instructions ❶
- Bulletin 1502 - 400 amp MV Contactor, Series E - User's Manual ❶
- IntelliVAC™ Contactor Control Module User's Manual (Series E) Bulletin 1503VC*

❶ - These are located in a cardboard box within the drive enclosure.

Service Manual

A project-specific service manual is created for each drive order. Three (3) CD copies of the manual are mailed to the customer. The contents include:

- Safety guidelines
- Shipping, handling, and storage recommendations
- Installation procedure
- Dimensional drawing set
- Electrical drawing set
- Manuals/information sheets/specifications of principal R-A or third-party manufactured components
- General terms and conditions of sale
- Test procedures
- Recommended spare parts listing

Reference Manual

A generic Reference Manual is also available for each drive frame (“A”, “B”, and “C”). It goes into greater technical/service/replacement detail related to the drive components.

Contact your local Rockwell Automation Sales Office to order additional copies of the User Manuals and/or Reference Manuals.

IMPORTANT NOTE FOR COMMISSIONING ENGINEER

The COMMISSIONING ENGINEER is advised to go through this commissioning package and follow the steps outlined herein to commission PF7000 drive(s). It is the **responsibility** of the commissioning engineer to complete all datasheets included in this package and collect any other relevant information that may not have been included in the package. ***Important guidelines for capturing waveforms are also included in the package for quick reference. These must be reviewed and followed properly by the commissioning engineer***. Anything that is not clear, please contact MV Tech Support for assistance:

Phone: **519-740-4790**

Option 1 for technical and **option 4** for commissioning questions
MVSupport_technical@ra.rockwell.com or MVSupport_services@ra.rockwell.com

After successful commissioning of the drive, the commissioning engineer is required to return the completed commissioning package along with his field service reports to the project manager within one week after completion of job. If job is not completed and some data collected it must be sent to project manager within one week after leaving the site. The items listed below MUST be included when submitting the commissioning package.

1. All checklists and tables in this document (commissioning checklist, customer data, motor data, daily service summary, etc.)
2. Harmonics waveforms must be captured on AFE drives under drive-not-running and full-load conditions
3. DC current test waveforms (dc voltage and dc current) and variables while running DC test
4. Load Test waveforms (line and load voltage and current waveforms at 50% and 100% load or whatever maximum load and speed allowed by the customer)
5. Final drive parameter settings and variables (running motor at max speed and load) captured at *SERVICE LEVEL ACCESS*.
6. Modified PLC program (if applicable)
7. Synchronous transfer waveforms (for synchronous transfer applications)
8. Marked-up drawings
9. Summary of issues/failures encountered during commissioning

It must be ensured that all documents and data files (waveforms, parameter settings, variables, trend data, etc.) submitted by the commissioning engineer are properly named, labeled and organized.

NOTE: It should be noted that if the commissioning datasheets submitted by the commissioning engineer are incomplete and/or the required commissioning data, such as harmonic waveforms, dc test waveforms, sync xfer waveforms etc, are not captured correctly or the required data is missing, then it can delay the processing of expense invoices submitted by the engineer.

IMPORTANT: While the FSE is still at the site, he MUST send the following information to MV Tech Support for review via e-mail at mvsupport_service@ra.rockwell .

- Drive setup after completing the auto-tuning
- Drive variables captured in running condition (at load or no load or uncoupled or with load)
- Line voltage and line current waveforms for harmonics on AFE drives when drive is energized.

Key Steps to Commissioning a PF7000 Drive

As a guide for a commissioning engineer, the major steps involved in the commissioning of medium voltage PF7000 drives are outlined below in a sequential order. For detailed instructions, always refer to PowerFlex7000 User Manual.

- Review the drawings and identify all sources of energy that apply to the drive system and get better understanding of the application to which the drive system is applied.
- Follow Safety Procedures and apply LOTO before working on the equipment
- Complete all Power Off checks and note down motor and drive nameplate data
- Apply control power and perform Power On checks
- Perform Gating Test
- Program the drive after verifying the information on EDs and DDs against the equipment nameplate data.
- Perform System Test and verify operation of the drive and the associated controls
- Remove any jumpers used during system test
- Inspect the drive line-up and ensure that no tools are left inside the cabinets before closing them.
- Apply medium voltage and complete incoming line phasing checks and take harmonic measurements
- Perform DC Test. Ensure that the Diagnostic Trend is setup and ready before attempting the DC Test.
- Perform Stationary Autotune tests (first 2 autotune tests)
- Bump the motor for rotation check
- Complete Rotating Autotune tests (last autotune test)
- Save the parameters in NVRAM and also transfer them from Drive to Memory and also print the Drive Setup to your laptop
- Start the drive in normal operation, print variables and capture waveforms
- Complete commissioning documentation

PowerFlex 7000 "A" and "B" Frame Commissioning Datasheets

It is imperative for Medium Voltage Product Support division to have the following information filled-out and returned to Rockwell Automation Canada, Cambridge office immediately upon completion of the drive system commissioning. It is the responsibility of the Field Service Engineer to fill-out the required information and submit the completed documents along with the Field Service Report. The Field Service Engineer must endeavor to fill these forms out as accurately and legibly as possible.

Please refer to the PowerFlex7000 User Manual for the Commissioning Procedure and necessary guidelines.

POWERFLEX 7000 MEDIUM VOLTAGE DRIVE

Drive Firmware Revision Level: ☐
Terminal Firmware Revision Level: ☐

JOB NUMBER:	
CUSTOMERNAME:	

ROCKWELL AUTOMATION CANADA
135 Dundas Street
Cambridge, Ontario, N1R 5X1
Canada

MV Support Contact Info:

Office Hours: 9:00am - 5:00pm EST, Monday to Friday
Phone: 1-519-740-4790, (Option 1 for Tech Support, Option 2 for MV Parts)

After Hours Support: 5:00pm – 9:00am EST, 365 days
Digital Pager: 1-519-654-5616

PowerFlex 7000 "A" and "B" Frame Drive Commissioning Check List

A commissioning check list has been provided as a quick reference to assist in starting up the drive system. This checklist should not be used as a detailed instruction or in no way includes all necessary steps to commission every possible drive configuration. Refer to the procedures in the PowerFlex 7000 "A" or "B" Frame user manual for detailed commissioning instructions or contact either the local Rockwell Automation office or Medium Voltage Support directly for assistance if necessary.

Drive Application Review

- ☐ Study Rockwell Automation prints provided with the Drives System
- ☐ Study the system one-line diagram and identify all sources of power
- ☐ Verify one-line diagram. Trace power cables back to their sources and verify that equipment tag ID numbers agree with the customer's one-line diagram
- ☐ Inspect the process for hazards. Verify that the load is not turning due to process (A freewheeling motor will generate voltage).

Safety Tests

- ☐ Lock out and tag all sources of power as per OSHA guidelines
- ☐ Test for voltage potential in the cabinet with appropriate safety equipment
- ☐ Remove step down CPT or PT fuses and place them in a safe place outside of the drive cabinet (**To be done with control power off**)
- ☐ Check fuse and O/L values and compare them to the values specified on the schematic diagrams.

Installation Review

- ☐ Examine the drive for shipping damage.
- ☐ Inspect cabinets for debris.
- ☐ Ensure that protective barriers removed for drive commissioning have been re-installed.
- ☐ Verify that the drive line-up and all associated equipment have system power grounding cable installed.
- ☐ Power cabling is appropriately rated and stress-coned, if required.
- ☐ Power cabling has been Hi-potted or Meggered.
- ☐ Power cabling has been torqued per table in Appendix B.
- ☐ Control reactor wiring has been correctly installed as shown on the Rockwell Automation electrical diagrams.
- ☐ Control wiring routing has been examined to ensure that AC, DC and fiber optic wiring are separated from each other.
- ☐ All additional controls not shown on the prints has been identified, documented and forwarded to the factory for future reference.
- ☐ Verify that all low voltage cables in the medium voltage cabinet have sufficient clearance from power components [3 inch (76.2 mm) minimum for 4160 V]
- ☐ Verify that all connectors, cables and components are secure.
- ☐ Verify tachometer wiring (if supplied with tachometer).
- ☐ Verify that fan hood has been assembled and mounted properly.

PowerFlex 7000 "A" and "B" Frame Drive Commissioning Check List

Service Data

- ☐ Record customer name, location, date and drive ID number
- ☐ Record drive nameplate data
- ☐ Record motor nameplate data and compare it to the dimensional drawings
- ☐ Record tachometer nameplate data, if applicable.
- ☐ Record harmonic filter nameplate data, if applicable.
- ☐ Record source of control power, auxiliary cooling information, environmental conditions, drive password.
- ☐ Record all Dip switch settings, jumper settings and revision levels on printed circuit boards, power supplies, communication modules and protective relays.

Control Power Off Tests

- ☐ Verify mechanical interlocks.
- ☐ Perform a resistance check on all devices and snubber circuits.
- ☐ Verify that the 3-phase control power coming into the control section is within specification. Most drives will not have this option.
- ☐ Verify that all additional sources of low voltage power are within specification and have grounded neutrals.

Control Power On Tests

Power Supply Tests

- ☐ Apply control power and verify that AC voltages are within specifications.
- ☐ Verify the AC/DC output is 56 Volts DC at the input of the DC/DC converter and at the input to gate driver power supplies. Adjust if necessary.
- ☐ Verify the 20V output of SGCT IGDPS boards.
- ☐ Verify that all of the DC outputs in the DC/DC converter are at rated value.
- ☐ Verify that healthy lights are on for all control boards and firing boards (Use wire harness with power supply adapter to test SCR gate driver boards).

Converter Tests

- ☐ Confirm that SCR and SGCT gating pulse sequence are correct for all devices.

Programming the Operator Interface

- ☐ Verify preliminary parameter settings.
- ☐ Calibrate signal conditioners
- ☐ Set analog outputs
- ☐ Fault masks / External faults
- ☐ Analog I/O
- ☐ PLC In/Out

System Tests

- ☐ Perform a system test with low voltage control/test power.
- ☐ Prove all protection functions as desired.
- ☐ Verify that all emergency stop devices are functioning correctly.
- ☐ Calibrate the analog I/O.
- ☐ Verify that the drive cooling fan(s) is/are operating properly.
- ☐ Measure input contactor drop out time. (2-cycle advance warning needed if input contactor is not part of drive line-up)

PowerFlex 7000 "A" and "B" Frame Drive Commissioning Check List

Medium Voltage Tests

Pre-Power Tests

- ☐ Inspect cabinets for debris (tools, hardware, metal shavings, etc.).
- ☐ Re-install control fuses (to be done with control power off).

Power Tests

- ☐ Verify that line voltage is at rated value.
- ☐ Perform a phasing check (***18-pulse drives only***).
- ☐ Verify input line harmonic by checking line voltage and current waveforms at ACB board (***only for AFE rectifier drive***). Save the waveforms.
- ☐ Perform IDC Test and verify dc current and voltage waveforms
- ☐ Autotune the drive
- ☐ Review parameters settings for operating the drive with unloaded motor
- ☐ Program the drive for operation at full load
- ☐ Run the drive at rated load and rated speed, and record variables.
- ☐ Capture line side and load side voltage and current waveforms under running condition.

Paperwork

- ☐ Print **DRIVE SETUP**, which gives all parameters, firmware revisions, PLC links, etc.
- ☐ Complete the Commissioning Datasheets.
- ☐ Mark up EDs with modifications or corrections done in the control circuit
- ☐ Add revision notes to modified PLC program.
- ☐ Have the customer sign sign-off documents.
- ☐ Provide customer with parameter settings, marked-up drawings, commissioning package, PLC program and Field Report.
- ☐ Forward Waveforms, PLC program, modified drawings, Commissioning Package and Field report to Medium Voltage Support group.

Drive Application Review

In order to ensure trouble free commissioning, it is necessary for all involved in the start-up to familiarize themselves with the drive line-up and application. Service on the equipment should not be performed without a clear understanding of how the equipment has been designed to function and how the equipment has been applied. If questions arise that have not been addressed within this manual, they can be addressed by contacting your local GMS office or by contacting Medium Voltage Support directly.

Rockwell Automation Drive Line-up Drawings

Prior to performing any service work on the drive line-up, the electrical and dimensional drawings provided with the equipment must be studied and understood. Within these drawings is detailed information and instructions required for commissioning and installation of the equipment including the following:

Dimensional Drawings
- Power cable termination locations
- Ground bus locations
- Shipping split locations
- Control and medium voltage power ratings
- Drive options
- Remote I/O protocol
- PLC options
- Motor and load specifications
- Drive power component selection ratings
- Heat exchanger ratings, connections

Electrical Drawings
- Contactor locations (electrically)
- Drive topology
- General notes
- Cable isolation ratings
- Symbol table
- Component designations

Device Designations	Color Designations	Wire No. Designations	SGCT Designations
Ribbon Cable Designations	Location of Relay and Contactor Contacts	Location of Relays	Drawing Location References

- Customer power and control wiring locations (electrically)
- Control and medium voltage power ratings
- Fuse ratings and locations (electrically)

If the dimensional and electrical prints are not available, a copy can be sent from the factory. In addition, if the drawings require changes to accurately suit the installation and application of the system, please fax or e-mail them to the factory so they may be revised.

Electrical System One-line Diagram

Once the Rockwell Automation electrical and dimensional drawings are clearly understood, a copy of the electrical system one-line drawing should be obtained. In studying this drawing, all relevant equipment tag Identification names and number should be identified. The system should be studied for sources of power and parallel paths of medium voltage power to the drive. A copy of the one-line diagram should be retained for the drive commissioning and if possible sent to the Medium Voltage division where it will be archived and used in the event that future customer assistance is required.

Verify One-line Diagram on Site

Once all documentation has been reviewed, an on site inspection of the drive line-up is required. While referencing the one-line diagram and Rockwell Automation prints, identify all the locations of the components within the drive line-up by their Tag Identification name or number. Trace the power cables from point to point while following the electrical diagrams. Any discrepancy between the physical installation and the electrical prints should be reviewed prior to commencing the drive commissioning.

Inspect Process

Before commencing commissioning on the drive line-up it is important to inspect the process which the drive has been applied to. This step is not only important as a means of identifying and understanding how the equipment is designed to adapt to the customer's application, but it will also be used to identify any potential hazards. Review the process and determine what measures need to be taken to ensure that commissioning the equipment will not expose anyone to hazardous situations or in any way do damage to the equipment involved in the application.

ATTENTION

Verify that the load is not turning due to the process. A freewheeling motor can generate voltage that will be back-fed to the equipment being serviced. Take all action necessary to ensure that motor regeneration into the drive does not occur while the equipment is being serviced.

Safety Tests

The information contained in this section of the commissioning chapter must be completed in order to ensure that the commissioning continues in an environment safe to all those involved in servicing the drive line-up. Every point included in this section must be completed prior to continuing with the drive commissioning. Ensure that commissioning of this drive line-up is performed in accordance with local safety standards.

ATTENTION

Servicing energized industrial control equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of control equipment. Hazardous voltages may exist in the cabinet even with the circuit breaker in the off position. Recommended practice is to disconnect or lock out control equipment from power sources, and confirm discharge of stored energy in capacitors. If it is necessary to work in the vicinity of energized equipment, the safety related work practices of NFTA 70E, Electrical Safety requirements for Employee Work places, must be followed.

ATTENTION

Before attempting any work, verify the system has been locked out and tested to have no potential.

Lockout Tagout

Prior to opening the doors to the drive line-up cabinets, proper lockout tagout procedures must be performed to ensure that the working environment is safe. In addition, the equipment must be tested for potential prior to servicing the equipment. Even though the input to the drive may be open, it is still possible for potential to be present.

ATTENTION

Live capacitors in circuit. Before touching anything, ensure that the drive is isolated from medium voltage and wait five minutes for the capacitors to discharge. Test the circuit for potential before servicing the equipment. Failure to do so can result in severe injury or death.

ATTENTION

Ensure that the motor is not spinning due to a driven load. A spinning motor can generate a high potential into the drive's motor filter capacitors, which can result in severe injury or death.

Refer to local safety guidelines for detailed procedures on how to safely isolate the equipment from hazards.

The door to the medium voltage cabinets can only be opened after the lockout and tagout are successfully completed.

Step Down Transformer Fusing

Transformers are used in the drive to step down medium voltage to low voltage. With all sources of power removed from the drive (Medium Voltage and Control Power), remove the step down transformer fuses from the fuse clips and place them in a safe place outside of the drive cabinet. Removing the control power fuses will prevent a separate source of control power from being stepped up to Medium Voltage in the event that the safety interlocks fail to function.

Fuse and O/L Protection

While referencing the electrical diagrams, locate all fuses and overload relays within the drive line-up. Verify that all installed fuses and overload are the same as indicated by Rockwell Automation. Fuses and overload settings are also identified by stickers located on the cabinet structure in close proximity to the fuse or overload. Ensure the settings match the rating identified on the sticker.

Replacement fuses have been shipped with the drive in the event that a fuse opens during commissioning.

Installation Review

Prior to commencing the commissioning of the drive line-up it is recommended that the installation of the equipment be re-inspected. Identifying errors in the drive installation prior to commencing the commissioning as opposed to mid way through the commissioning process will greatly reduce the amount of time required to commission the drive line-up.

Inspect for Shipping Damage

Prior to continuing verifying the installation of the equipment, open the cabinets to all equipment supplied by Rockwell Automation and inspect each component installed for signs of damage. Any damage claim should be made back to the Medium Voltage Business as soon is it is identified so the damaged components can be replaced as quickly as possible.

Inspect Cabinets for Debris

Once the safety checks have been completed and the drive line-up has been successfully isolated, inspect all cabinets in the drive line-up for foreign material left behind during the installation. Ensure that no tools, hardware or wiring debris have been left in the drive. Note that some electric components used within the drive create magnetic fields that may attract metal shavings left behind if drilling or metal cutting was required during the installation process. Ensure that all metal shavings have been removed from the cabinet and take care not to get shavings into the cabinets if drilling or cutting is required during drive installation.

Protective Barriers

In confined spaces, it is common for the electricians responsible for the installation to remove protective barriers to allow for more space within the cabinets. Ensure that all protective barriers removed during the installation have been re-installed. Failure to re-install a protective barrier may result in equipment damage or personal injury.

Component Grounding

Verify that the drive and all its associated equipment have system power ground cabling installed and that the cables are terminated at both ends. Power cable shield grounds to be terminated at both ends. Ensure that all grounding hardware is sufficiently torqued (See Appendix B "Torque Requirements"). All drive line-up components (Drives, Switcher, Motors, Transformers and Reactors) must be grounded to the installations ground grid.

In drive line-ups supplied with Isolation Transformers, it is important to leave the secondary of the isolation transformer floating so the drive line-up can reference system ground from the upstream distribution transformer. Failure to do so may result in unreliable drive operation.

Information on Splice Kits

The drive line-up may have been shipped in sections. Verify that the bus splice kits provided in this circumstance are installed and properly torqued at shipping split locations.

Power Cabling

All customer power and control wiring required for drive line-up installation have been identified on the electrical drawings by a dashed line (See electrical drawing – General Notes, for additional information).

ATTENTION

Power cabling should be installed in accordance with local codes and guidelines. The information in this section is to be used as reference only and is not intended to replace practices outlined in the electrical code.

Trace the power cabling from termination point to termination point while examining the cable and its routing for mechanical damage, sharp bend radiuses and sources of induced noise and heat. Ensure that the power cabling is sufficiently braced so as to contain the cabling in the event of a ground fault situation.

Verify that all cables are terminated on each end and are sufficiently torqued (see Appendix B "Torque Requirements").

Verify that the cable installed meets the recommended power rating outlined in the electrical drawings and installation section of the manual. Ensure that the cable terminations are stress coned if required.

Verify that the customer power cables have been Hi-Potted or Meggered and read a sufficient insulation value.

Installation Review (cont.)

Control Wiring

Identify all customer-required control wiring detailed on the electrical diagram and located it within the terminal blocks in the drive. Examine it to verify that the cable insulation has not been tightened into the terminal. Verify that all connections have proper continuity.

Ensure factory jumpers installed and marked with notes “to remove if remote equipment installed” have been removed.

Inspect the control cable routing to ensure that DC Control wiring and AC control wiring are separated from each other. Routing them together in the same bundle, wire-way or panduit may result in unwanted noise being induced in the drive control. In the overhead cable tray provided at the front of the drive, ensure that the AC Control, DC control and Fiber optic cables remain isolated from each other by the dividers provided.

Inspect for additional control not shown on the electrical diagram. Determine its purpose, mark the changes on the electrical diagram and send the prints to the factory for future reference.

Perform a tug test on all control cables to ensure that they are securely fastened, and check each plug and connector to ensure it is properly seated in its socket.

ATTENTION

Ensure that there is sufficient clearance between the installed control wiring to the control cabinet and components carrying medium voltage. Verify that closing the low voltage door does not swing the low voltage cables into the medium voltage cabling section.

Service Data

This section of the commissioning chapter has been included in this manual so that all of the system nameplate data and variable set points can be captured as commissioned.

Why this Information is Needed

When a PowerFlex 7000 'A' Frame medium voltage AC drive is commissioned, the start-up sometimes occurs in an artificial environment. There's usually no actual process being performed, and no load, at least not a full load. Therefore, the application situation is artificial and this isn't an ideal time to establish parameter baselines to signature the drive. After commissioning is complete, the drive is at full capacity and realistic load conditions occur; parameters such as speed regulation may begin to drift and the drive will not perform as designed to meet processing requirements.

It is important that the information required on the following pages is completed in a detailed and accurate manner and that immediately after their completion, the following data sheets are submitted to the customer and to the factory. They will be required to perform modifications on the drive line-up once production commences.

It is common for modifications to be made to the drive's program some time during the two-month period following the drive commissioning. This is done to ensure that speed control, direction, starting and stopping functions are all performing with precision.

In addition to system modifications, the factory will use the data sheet as an indication that the system is running. The date on the commissioning data sheets will indicate to the factory the date that the system has been started and will be used to commence the product warranty.

In the unlikely event the system is not operating as designed, it will be possible to trend performance between similar applications and topologies. In the event a product notification or recall is required, the datasheets will be used to identify if the customer falls under the definition for an update.

These data sheets will be archived at the factory for future reference.

Customer Information

COMPANY NAME:		
ADDRESS:		
CITY:		POSTAL/ZIP CODE:
PROV/STATE/COUNTRY:		
SERVICE CONTACT:		
TELEPHONE:	FAX:	E-MAIL:
APPLICATION:	SERIAL NO.:	
DRIVE TAG ID NO.:		
COMMISSIONING ENGINEER:		COMMISSIONING DATE:

Motor Nameplate Data		
MOTOR TYPE: INDUCTION ☐ SYNCHRONOUS ☐		
MANUFACTURER:	MODEL NO.	SERIAL NO:
HP / KW:	VOLTS:	CURRENT:
KVA:	POWER FACTOR:	FREQUENCY:
RPM:	SERVICE FACTOR:	EFFICIENCY:
CODE:	TYPE:	FRAME:
NEMA TYPE:	RTD TYPE:	
	BEARING:	STATOR:
EXCITATION (For Synchronous Motors Only):		
EXCITER TYPE:	VOLTS:	CURRENT:

Tachometer/Encoder Nameplate Data		
TACHOMETER ☐	POSITION ENCODER ☐	STATOR FEEDBACK (NONE) ☐
MANUFACTURER:	MODEL NO.:	SERIAL NO.:
PPR:	GEAR RATIO:	

Drive Nameplate Data				
CATALOG NO.:		SCHEMATIC DIAGRAM:		
Control Cell				
MAX VOLTS:		Hz:		
Power Cell				
UNIT SERIES:	Hz:	BIL (kV):	CURRENT (Amp):	RECTIFIER TYPE:
MAX VOLTS:	MVA:		NEMA TYPE	SERVICE FACTOR:
Motor Filter Capacitors				
MANUFACTURER:	MODEL NO.:	Number of Capacitors:		
		Each Cap KVAR:		
VOLTS:	Hz:			
Line Filter Capacitors (AFE Rectifier Only)				
MANUFACTURER:	MODEL NO.:	Number of Capacitors:		
		Each Cap KVAR:		
VOLTS:	Hz:			
DC Link				
MANUFACTURER:	SERIAL NO.:	MODEL:		
CURRENT (Amp)	INDUCTANCE (mH)	INSULATION CLASS	TEMP RISE	
Input Reactor				
CONFIGURATION		MANUFACTURER	MODEL NO.	SERIAL NO.
LINE REACTOR ☐	ISOL. TRANSFORMER ☐			
VOLTAGE		mH/KVA / CURRENT	TEMP. RISE	IMPEDANCE
PRIMARY:	SECONDARY:			

Miscellaneous Information		
Auxiliary Cooling Blower Motor (if any)		
HP/KW:	VOLTS:	PHASE:
FLC:	RPM:	S.F.:
MANUFACTURER:	MODEL:	FRAME SIZE:
Drives Source of Control Power		
UPS:	LIGHTING PANEL NUMBER:	OTHERS: (SPECIFY)
Environmental conditions		
AIR CONDITIONED ☐	FAN FORCED AIR ☐	OTHERS: (SPECIFY)
Other Pertinent Information		

Drive Circuit Boards				
ACRONYM	**PRODUCTION ASSEMBLY PART NUMBER**	**HARDWARE REVISION**	**FIRMWARE REVISION**	
ACB	80190-560-		---	
DPM	80190-580-			
OIB L (A,B,C)	80190-099-		---	
OIBB	80190-600-		---	
OIB M (A,B,C)	80190-099-		---	
XIO ❶	80190-299-		---	
VSB L 1	81000-199-		---	
VSB L 2	81000-199-		---	
VSB M 1	81000-199-		---	
Operator Interface	2711-KSASL11		**PV Firmware ❷**	**PV Software ❸**
TFB L	80190-639- *or* 80190-539-		---	
TFB M	80190-639- *or* 80190-539-		---	
SCR SPGDB ❶	80190-219-		---	
IGDPS L (1-3)	80026-044-		---	
IGDPS M (1-3)	80026-044-		---	
PS1 (A-F) ❶ [AC/DC Converter]	80026-520 or 524 -		---	
PS2 [DC/DC Converter]	81002-440-		---	
PS4 [24V DC Power supply]			---	
CPT	80022-069-		---	
UPS			---	
PRINTER			---	

❶ The drive can have more than one of this circuit board.

❷ ***PV Firmware*** is located on a sticker on the back of the unit.

❸ ***PV Software*** is located on the main display screen (top left corner).

Control Power Off Tests

The following checks listed in this section of the chapter should be performed prior to applying control power to the drive. It is recommended that these checks be completed in the sequence that they have been presented in this chapter.

Interlocking

When the input contactor option is purchased a key interlock is provided to prevent access to the medium voltage compartments of the drive unless the input isolation switch is locked in the open position.

Where the input switching device is provided by others, Rockwell Automation will provide a key interlock on the medium voltage compartment of the drive, and a matching interlock for installation by others on the upstream device. The interlock shall be installed in a manner that ensures the power to the drive is off and the drive is electrically isolated whenever the key is freed.

Although Key interlocks shipped with all medium voltage equipment are aligned in the factory, they often move out of position during shipping or are often misaligned when the cabinet is set down on an uneven floor. The following instructions will assist the field engineers in quickly and accurately aligning the deadbolt key interlock with its counterpart.

ATTENTION

Servicing energized industrial control equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of control equipment. Hazardous voltages may exist in the cabinet even with the circuit breaker in the off position. Recommended practice is to disconnect or lock out control equipment from power sources, and confirm discharge of stored energy in capacitors. If it is necessary to work in the vicinity of energized equipment, the safety related work practices of NFTA 70E, Electrical Safety requirements for Employee Work places, must be followed.

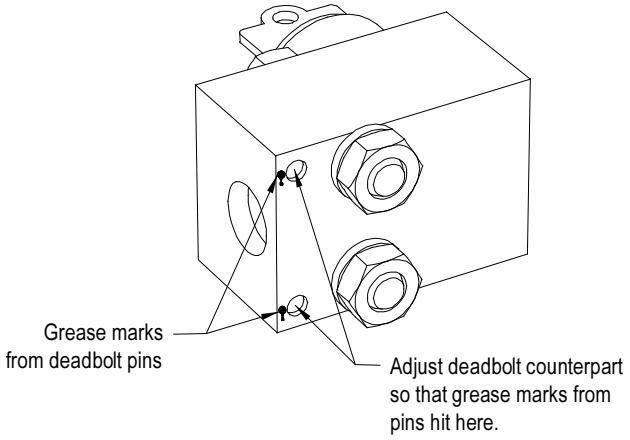

Figure 4.1 – Deadbolt Assembly Mounted to Door

1. Lock out and isolate the drive from medium voltage. Verify with a hot stick that there is no medium voltage present.

2. Determine that the key interlock is correctly aligned by securely bolting the medium voltage doors of the cabinet closed and removing the key from the lock. The key should turn easily; if any force is required to turn the key, the deadbolt alignment requires adjustment.

3. Open the doors of the cabinet and inspect the key assembly. Place high visibility grease on the pins of the deadbolt counterpart. The factory recommends using yellow torque sealant, however if it is unavailable almost any grease will do. (See Figure 4.1)

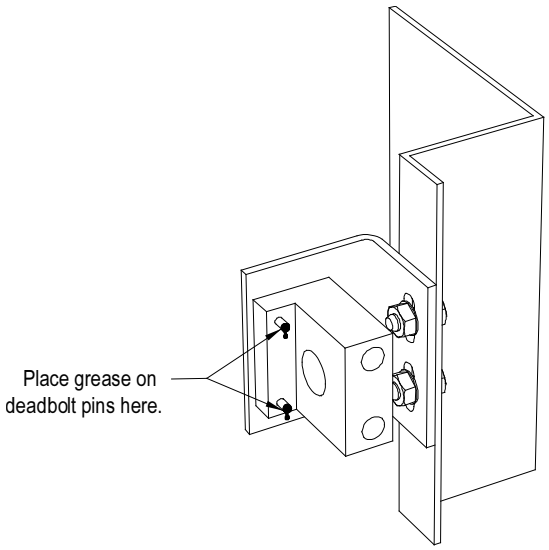

Figure 4.2 – Deadbolt Counterpart Mounted to Cabinet

Control Power Off Tests (cont.)

4. Bolt the cabinet door closed so the pins on the dead bolt counterpart make contact with the deadbolt assembly. Doing so should leave two marks of torque sealant or grease on the assembly where the pins made contact (See Figure 4. 3 – Deadbolt assembly).

5. Slightly loosen the adjustment bolts on the counterpart and make the necessary movements on the counterpart to ensure that the pins align with the landing plates on the deadbolt assembly. As the amount of counterpart movement required is an estimate, it may take a couple attempts to properly align the assembly.

6. Clean the torque seal/grease from the key interlock once finished aligning the counterpart.

Once properly aligned, the key should turn freely when the cabinet door is fully bolted shut. If the key does not function when the door is tightly bolted closed, adjustments will have to be made to the depth of the counterpart. This can be done by adding shims on the landing plate where the counterpart is mounted.

Resistance Checks

Prior to applying control power to the drive, power semiconductor and snubber circuit resistance measurements must be taken. Doing so will ensure that no damage has occurred to the converter section during shipment. The instructions provided below detail how to test the following components:

- Inverter or AFE Rectifier Bridge
  - Anode-to-Cathode Resistance Test (Sharing Resistor and SGCT)
  - Snubber Resistance Test (Snubber Resistor)
  - Snubber Capacitance Test (Snubber Capacitor)
- SCR Rectifier Bridge
  - Anode-to-Cathode Resistance Test (Sharing Resistor and SCR)
  - Gate-to-Cathode Resistance Test (SCR)
  - Snubber Resistance Test (Snubber Resistor)
  - Snubber Capacitance Test (Snubber Capacitor)

ATTENTION

Before attempting any work, verify that the system has been locked out and tested to have no potential.

SGCT Testing

The following steps outline how to verify SGCT semiconductors and all associated snubber components. A quick reference to the expected resistance and capacitance values can be found in the table below. A simple schematic in Figure 4.3 shows how the snubber components are connected across a SGCT.

Table 4.A – SGCT Snubber Circuit Resistance and Capacitance Values

SGCT Rating	Sharing Resistor ❶	Snubber Resistor	Snubber Capacitor
1500 Amp	80 kΩ	6 Ω (AFE Rectifier)	0.2 µf
1500 Amp	80 kΩ	7.5 Ω (Inverter)	0.2 µf
800 Amp	80 kΩ	10 Ω	0.1 µf
400 Amp	80 kΩ	15 Ω (AFE Rectifier)	0.1 µf
400 Amp	80 kΩ	17.5 Ω (Inverter)	0.1 µf

❶ 2300V drives will not have a sharing resistor on devices.

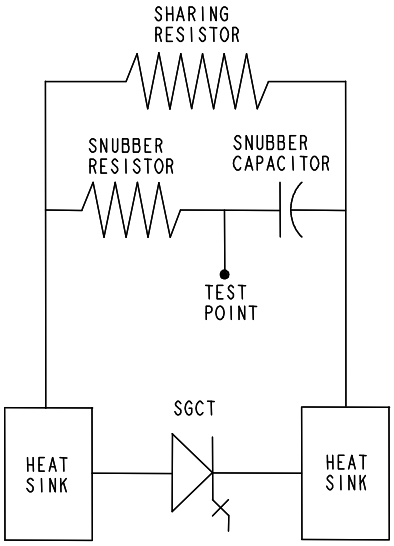

Figure 4.4 – SGCT Snubber Circuit Connections

SGCT Resistance Measurement	Measured Resistance			
	Inverter		Rectifier (AFE only)	
SGCT Anode-Cathode Resistance (Heatsink to Heatsink) **k-Ω**	(Lowest)	(Highest)	(Lowest)	(Highest)
Snubber Resistance (Test Point – Heatsink above) **Ω**	(Lowest)	(Highest)	(Lowest)	(Highest)
Snubber Capacitance (Test Point – Heatsink on Right) **µF**	(Lowest)	(Highest)	(Lowest)	(Highest)

If a device or snubber component is found to be damaged, it must be replaced using the detailed procedures in Component Definition and Maintenance.

Resistance Checks (cont.)

SGCT Anode-to-Cathode Resistance

Performing an Anode-to-Cathode resistance test not only tests the integrity of the SGCT but also the integrity of the sharing resistor. An abnormal device resistance measurement will indicate either a shorted device or damaged sharing resistor.

Using an ohmmeter, measure the anode-to-cathode resistance of each SGCT in the inverter bridge, looking for similar resistance values across each device. Easy access from the anode-to-cathode is available by going from heatsink-to-heatsink as shown in the diagram below:

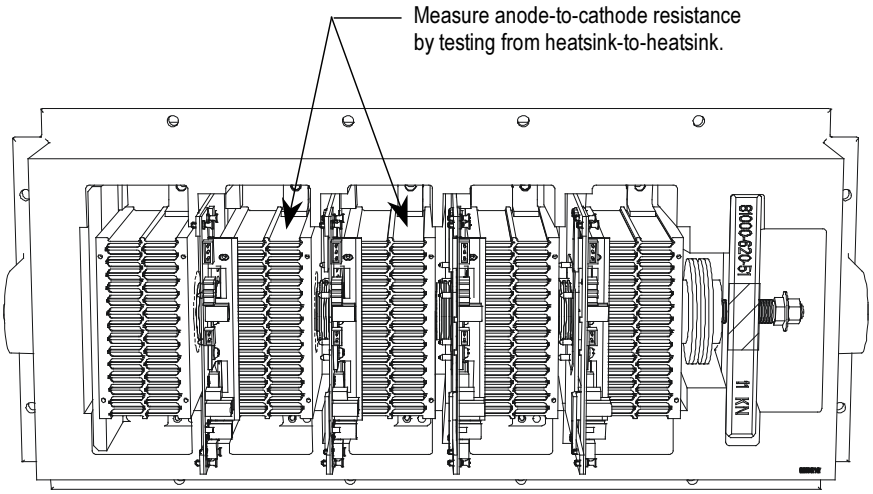

Figure 4.5 – Anode-to-Cathode Resistance Test Points

An SGCT when not gated on is an open circuit. A healthy device resistance value should be close to the value of the sharing resistor, however due to parallel resistances in the firing card, the resistance value will be slightly lower.

Example: The resistance across the anode-to-cathode of a 800 amp device may be 57 kΩ even though the sharing resistor is 80 kΩ.

A failure of an SGCT can be detected by measuring a lower than normal resistance value; one device in the converter may read 15 kΩ whereas the rest of the devices in the converter measured close to 60 kΩ. This indicates a partially shorted device. A fully shorted device will read closer to 0 Ω and will be quickly identified. If the SGCT is found to be out of tolerance, refer to Chapter 5 – Component Definition and Maintenance for detailed instructions on how to replace the SGCT assembly.

Damage to a sharing resistor is easily detected if the SGCT is replaced and the anode-to-cathode resistance remains abnormal. If the resistor is found to be out of tolerance, refer to Chapter 5 – Component Definition and Maintenance for detailed instructions on how to replace the snubber/sharing resistor assembly.

Snubber Resistance (SGCT Device)

Access to the snubber resistor is not required to test the resistance. The snubber circuit test point is located within the PowerCage under the heatsinks. For each device, there is one test point. To verify the resistance, measure the resistance between the test point and the heatsink above.

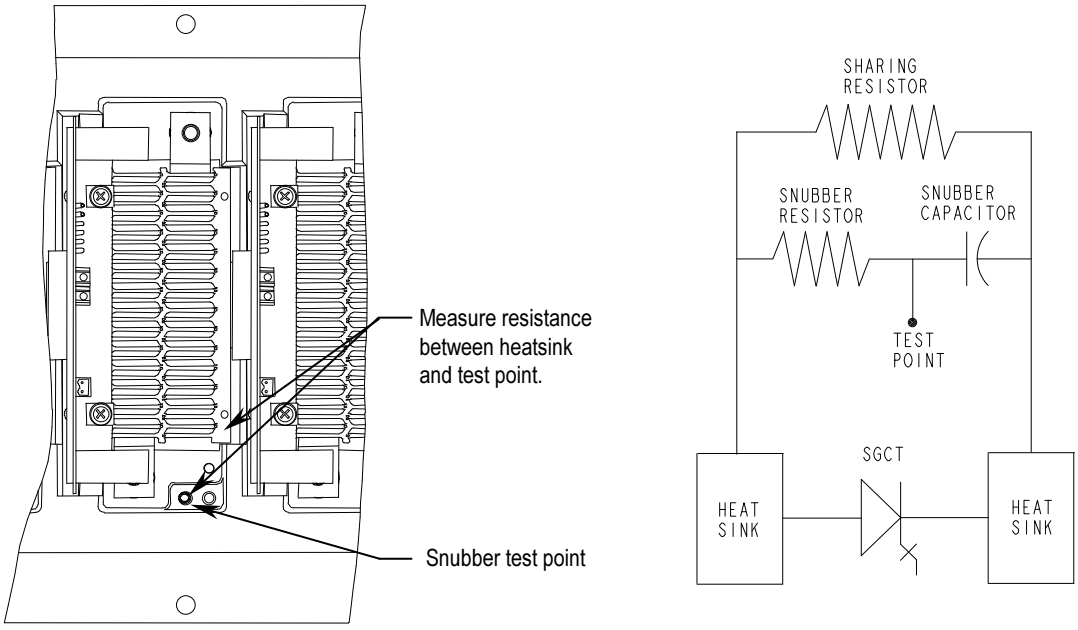

Figure 4.6 – Snubber Resistor Test

Refer to Table 4.A to determine the appropriate snubber resistance value for the current rating of the SGCT used.

If the resistor is found to be out of tolerance, refer to Chapter 5 – Component Definition and Maintenance for detailed instructions on how to replace the snubber resistor assembly.

Resistance Checks (cont.)

Snubber Capacitance (SGCT Device)

Turn the multimeter from the resistance to capacitance measurement mode. Proceed to verify the snubber capacitor by measuring from the test point to the heatsink adjacent to the right.

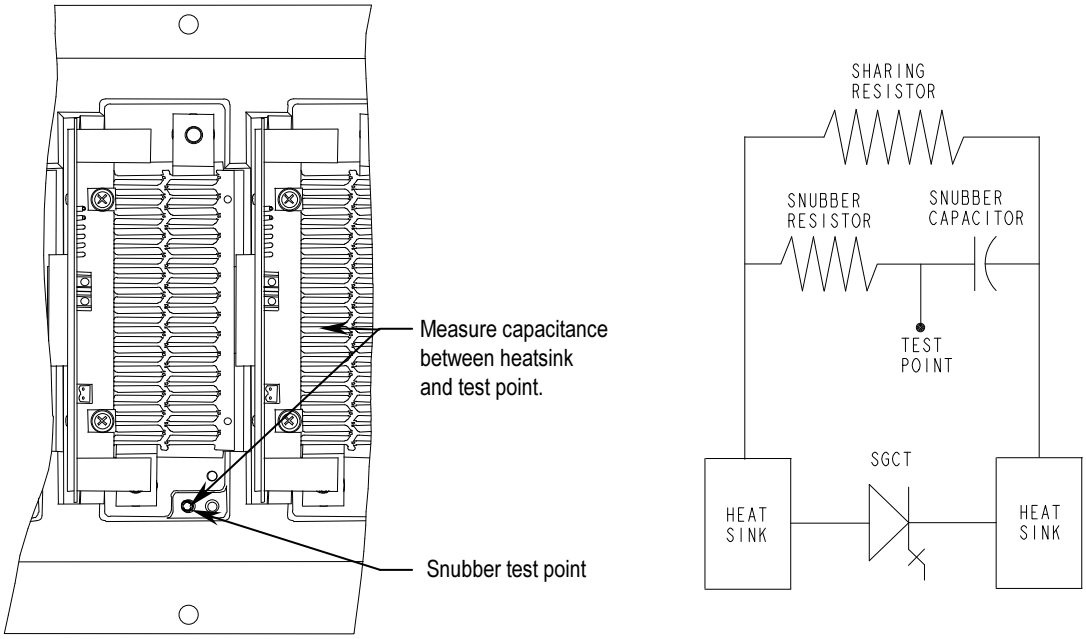

Figure 4.7 – Snubber Capacitor Test

Refer to Table 4.A to determine the appropriate snubber capacitance value for the current rating of the SGCT used.

The capacitance measured is actually affected by the snubber capacitor and other capacitance in the circuit, including capacitance from the Gate Driver circuit. You are actually looking for a consistent reading for all devices.

If the capacitor is found to be out of tolerance, refer to Chapter 5 – Component Definition and Maintenance for detailed instructions on how to replace the snubber capacitor.