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Series DPB Bus System Installation & Operation Manual
March 2013
# TABLE OF CONTENTS

Installation Guide ................................................................................................................. 1

Introduction ............................................................................................................................ 2

Safety Warning ...................................................................................................................... 3

Receiving, Handling, & Storage ............................................................................................ 4

  RECEIVING .......................................................................................................................... 4
  HANDLING ........................................................................................................................... 4
  STORAGE ............................................................................................................................... 4

Installation ............................................................................................................................. 5

  PRE-INSTALLATION REVIEW ........................................................................................... 5
  INSTALLATION HAZARD .................................................................................................... 6
  VERTICAL BUSWAY INSTALLATION .............................................................................. 6
  HORIZONTAL BUSWAY INSTALLATION ......................................................................... 7
  BUSWAY SYSTEM MOUNTING ......................................................................................... 8
  MOUNTING THE END FEED ............................................................................................. 9
    VERTICAL END FEED SUPPORT .................................................................................... 9
    HORIZONTAL END FEED SUPPORT ............................................................................ 9
  MOUNTING THE BUSRAIL ............................................................................................... 10
    SUPPORT ....................................................................................................................... 10
    NEUTRALS ALIGNMENT ............................................................................................... 10
  INSTALLATION OF THE SPLICE CONNECTOR – 160 - 250 AMP ............................... 11
  INSTALLATION OF OPTIONAL "C-CLIPS" FOR 35kAIC RATED 400A BUSWAY .......... 15
  END FEED C-CLIP INSTALLATION ................................................................................. 15
  BUSRAIL AND SPLICE JOINT C-CLIP INSTALLATION .................................................. 15
  INSTALLATION OF THE SPLICE CONNECTOR – 400 AMP ............................................ 17
  INSTALLATION OF THE END CAP CLOSURE PLATE ................................................... 20
  CABLE TERMINATIONS TO THE END FEED BOX ....................................................... 21
  TAP OFF BOX INSTALLATION ....................................................................................... 23
    INSTALLATION WARNING ............................................................................................ 23
    TAP OFF BOX MOUNTING .............................................................................................. 24

Before Energizing The Busway Checklist ............................................................................. 25

Energizing The Busway System ........................................................................................... 26

Maintenance ......................................................................................................................... 27
TABLE OF CONTENTS, CONTINUED

Branch Circuit Monitoring System (BCMS) ................................................................. 29
  Safety Warning .............................................................................................................. 30
  Scope ............................................................................................................................ 31
  System Description ..................................................................................................... 32
  Power Monitoring System Overview ......................................................................... 32
    Option 1 - TAP OFF BOX MONITORING ONLY ....................................................... 33
      SAFETY WARNING .................................................................................................. 33
      END FEED BOX COMPONENTS ........................................................................... 33
      ACCUMULATOR PCB ................................................................................................ 34
      POWER INSERTER PCB .......................................................................................... 34
      SAFETY WARNING .................................................................................................. 35
      TAP OFF BOX MONITORING COMPONENTS ........................................................ 35
      COMMUNICATIONS CABLE CONNECTION ............................................................ 35
    Option 2 - END FEED MONITORING ONLY ............................................................. 36
      SAFETY WARNING .................................................................................................. 36
      END FEED BOX COMPONENTS ........................................................................... 36
      ACCUMULATOR PCB ................................................................................................ 37
      POWER INSERTER PCB .......................................................................................... 37
      INPUT PM PCB ........................................................................................................ 38
    Option 3 - TAP OFF BOX AND END FEED MONITORING CONCURRENTLY .......... 39
      SAFETY WARNING .................................................................................................. 39
      END FEED BOX COMPONENTS ........................................................................... 39
      ACCUMULATOR PCB ................................................................................................ 40
      POWER INSERTER PCB .......................................................................................... 40
      INPUT PM PCB ........................................................................................................ 41
      SAFETY WARNING .................................................................................................. 41
      TAP OFF BOX MONITORING COMPONENTS ........................................................ 41
      COMMUNICATIONS CABLE CONNECTION ............................................................ 42
  Communications .......................................................................................................... 43
    CONNECTING THE END FEED BOX TO LOCAL DISPLAYS OR BMS / DCIM SOLUTIONS ................................................................. 44
    RS 48S FOUR-WIRE CONNECTION .......................................................................... 44
    RS 48S TWO-WIRE CONNECTION ............................................................................ 45
TABLE OF CONTENTS, CONTINUED

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCUMULATOR BOARD CONNECTIONS</td>
<td>46</td>
</tr>
<tr>
<td>BCMS SETUP DOCUMENTATION</td>
<td>47</td>
</tr>
<tr>
<td>REQUIRED MATERIAL</td>
<td>47</td>
</tr>
<tr>
<td>STARTUP</td>
<td>47</td>
</tr>
<tr>
<td>USING THE ACCUMULATOR SETUP PROGRAM</td>
<td>48</td>
</tr>
<tr>
<td>COMMON PROCEDURES</td>
<td>50</td>
</tr>
<tr>
<td>DATA TAB</td>
<td>51</td>
</tr>
<tr>
<td>WINDOW TAB</td>
<td>52</td>
</tr>
<tr>
<td>CUSTOMER CONNECTIONS TO 7&quot; LOCAL DISPLAY</td>
<td>53</td>
</tr>
<tr>
<td>PRODUCT INTRODUCTION</td>
<td>53</td>
</tr>
<tr>
<td>COMPONENT IDENTIFICATION</td>
<td>55</td>
</tr>
<tr>
<td>POWER CONNECTIONS</td>
<td>56</td>
</tr>
<tr>
<td>MODBUS CONNECTION</td>
<td>57</td>
</tr>
<tr>
<td>MODBUS CONNECTIONS ON IX DISPLAY INTERFACE BOARD</td>
<td>58</td>
</tr>
<tr>
<td>MODBUS TO 7&quot; LOCAL DISPLAY WIRING SCHEMATIC</td>
<td>59</td>
</tr>
<tr>
<td>CHANGE MODBUS RTU FROM RS422 TO VIA ETHERNET</td>
<td>60</td>
</tr>
<tr>
<td>Appendix A: Tap Off Box Monitoring Specifications</td>
<td>62</td>
</tr>
<tr>
<td>MONITORED PARAMETERS</td>
<td>62</td>
</tr>
<tr>
<td>ALARM PARAMETERS</td>
<td>63</td>
</tr>
<tr>
<td>PERSONALIZATION</td>
<td>64</td>
</tr>
<tr>
<td>Appendix B: End Feed (Input PM PCB) Monitoring Specifications</td>
<td>65</td>
</tr>
<tr>
<td>MONITORED PARAMETERS</td>
<td>65</td>
</tr>
<tr>
<td>ALARM PARAMETERS</td>
<td>66</td>
</tr>
<tr>
<td>PERSONALIZATION</td>
<td>67</td>
</tr>
<tr>
<td>Appendix C: Bus Monitoring System Schematic Diagrams</td>
<td>68</td>
</tr>
<tr>
<td>BRANCH CIRCUIT MONITORING SYSTEM BOARD INTERCONNECTION</td>
<td>68</td>
</tr>
<tr>
<td>INPUT POWER MONITOR BOARD TO END FEED CURRENT TRANSFORMERS CONNECTIONS</td>
<td>69</td>
</tr>
<tr>
<td>Appendix D: Points List for the End Feed Input PM PCB</td>
<td>71</td>
</tr>
<tr>
<td>Appendix E: Points List for the Tap Of Box IntelliBUS Board</td>
<td>78</td>
</tr>
<tr>
<td>Appendix F: Specifications</td>
<td>86</td>
</tr>
<tr>
<td>GENERAL</td>
<td>86</td>
</tr>
<tr>
<td>INPUT PM BOARD SPECIFICATIONS</td>
<td>86</td>
</tr>
<tr>
<td>INTELLIBUS BOARD SPECIFICATIONS</td>
<td>86</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS, CONTINUED

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>NETWORK COMMUNICATIONS</td>
<td>87</td>
</tr>
<tr>
<td>LISTINGS</td>
<td>87</td>
</tr>
<tr>
<td>Appendix G: Service</td>
<td>88</td>
</tr>
<tr>
<td>STANDARD WARRANTY</td>
<td>88</td>
</tr>
<tr>
<td>START UP</td>
<td>88</td>
</tr>
<tr>
<td>TRAINING</td>
<td>88</td>
</tr>
<tr>
<td>EXTENDED WARRANTY</td>
<td>88</td>
</tr>
<tr>
<td>TIME AND MATERIALS</td>
<td>88</td>
</tr>
<tr>
<td>SPARE PARTS</td>
<td>89</td>
</tr>
<tr>
<td>Appendix H: Quick Install Sheets</td>
<td>90</td>
</tr>
<tr>
<td>160A - 400A SPLICE QUICK INSTALL SHEET</td>
<td>90</td>
</tr>
<tr>
<td>TAP OFF BOX QUICK INSTALL SHEET</td>
<td>92</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 1 - Vertical Busway Installation ................................................................. 6
Figure 2 - Horizontal Busway Installation ............................................................. 7
Figure 3 - Vertical End Feed Support .................................................................. 9
Figure 4 - Horizontal End Feed Support ............................................................... 9
Figure 5 - Busrail Mounting Support around Splice Point .................................... 10
Figure 6 - Busrail Neutrals Alignment .................................................................. 10
Figure 7 - Splice Installation Overview 160 - 250 Amp ....................................... 11
Figure 8 - Splice Installation Detail 160 - 250 Amp .............................................. 12
Figure 8.1 - Cam Spacers in Locked Position ..................................................... 13
Figure 8.2 - Dowel Pin ......................................................................................... 13
Figure 8.5 - Dowel Pin O-Ring Inside "E" Clip ..................................................... 14
Figure 8.3 - Positioning of Dowel Pins ................................................................. 14
Figure 8.4 - Insertion of Dowel Pin ..................................................................... 14
Figure 9 - End Feed C-Clip Installation - 400 Amp ............................................ 15
Figure 10 - Busrail C-Clip Installation - 400 Amp ............................................... 15
Figure 11 - Busrail C-Clip Profile View - 400 Amp ............................................. 16
Figure 12 - Busrail Cam Spacers ...................................................................... 16
Figure 13 - Busrail C-Clip Splice and E-Clip Location - 400 Amp ....................... 16
Figure 14 - Splice Installation Overview - 400 Amp........................................... 17
Figure 15 - Splice Installation Detail 400 Amp .................................................... 18
Figure 15.1 - Cam Spacers in Locked Position .................................................... 18
Figure 15.2 - Dowel Pin ....................................................................................... 19
Figure 15.3 - Positioning of Dowel Pins ............................................................... 19
Figure 15.4 - Insertion of Dowel Pin ................................................................. 19
Figure 15.5 - Dowel Pin O-Ring Inside "E" Clip ................................................. 20
Figure 16 - Busrail End Cap Installation .............................................................. 20
Figure 17 - Standard End Feed Cable Terminations ............................................ 21
Figure 18 - Branch Circuit Monitoring (BCMS) End Feed Cable Terminations .... 21
Figure 19 - End Feed Current Transformer (CT) Orientation ......................... 22
Figure 20 - Tap Off Box Connections ................................................................. 24
Figure 21 - Tap Off Box Mounting and Energizing ........................................... 24
Figure 22 - Branch Circuit Monitoring System Overview .................................... 32
Figure 23 - Option 1 - Branch Circuits via BCMS-Equipped Tap Off Boxes ....... 33
Figure 24 - Option 1 - End Feed Box Monitoring Components ....................... 33
Figure 25 - Accumulator PCB ........................................................................... 34
LIST OF FIGURES, CONTINUED

Figure 26 - Power Inserter PCB ............................................................... 34
Figure 28 - Tap Off Box Communication Interface Into Busrail ......................... 35
Figure 27 - Tap Off Box with Branch Circuit Monitoring Installed ...................... 35
Figure 29 - Option 2 - Busway Input Feeder Monitoring .................................. 36
Figure 30 - Option 2 - End Feed Box Bus Monitoring Components ..................... 36
Figure 31 - Accumulator PCB .................................................................... 37
Figure 32 - Power Inserter PCB .................................................................. 37
Figure 33 - Input PM Board ........................................................................ 38
Figure 34 - Option 3 - End Feed Power and Tap Off Branch Circuits Monitoring ...... 39
Figure 35 - Option 3 - End Feed Box Monitoring Components .......................... 39
Figure 36 - Accumulator PCB .................................................................... 40
Figure 37 - Power Inserter PCB .................................................................. 40
Figure 38 - Input PM PCB .......................................................................... 41
Figure 39 - Tap Off Box with Branch Circuit Monitoring Installed .................... 41
Figure 40 - Tap Off Box Communication Interface Into Series DPB Busrail .......... 42
Figure 41 - RS485 Four-Wire Connection Scheme .......................................... 44
Figure 42 - RS485 Two-Wire Connection Scheme ........................................... 45
Figure 43 - End Feed Accumulator Board ..................................................... 46
Figure 44 - BCMS Setup Startup Screen ....................................................... 47
Figure 45 - BCMS Setup Tab ...................................................................... 48
Figure 46 - BCMS Setup Tab Detail ............................................................... 49
Figure 47 - BCMS Setup Data Tab Window ..................................................... 51
Figure 48 - 7” Series DPB Bus Systems Local Display ...................................... 53
Figure 49 - 7” Local Display End Feed Screenshot ......................................... 54
Figure 50 - 7” Local Display Tap Off Box Screenshot .................................... 54
Figure 51 - 7” Series DPB Local Display Primary Components .................... 55
Figure 52 - IX Display Interface Board ......................................................... 56
Figure 53 - Modbus Wiring Diagram ........................................................... 57
Figure 54 - Connections on IX Display Interface Board .................................. 58
Figure 55 - Modbus to 7” Local Display Wiring Schematic ............................. 59
Figure 56 - Branch Circuit Monitoring System Board Interconnection .............. 68
Figure 57 - Input Power Monitor Board to End Feed Current Transformers Schematic .... 69
Figure 59 - End Feed Current Transformer (CT) Orientation ......................... 70
Figure 58 - End Feed Input Power Monitor Board ......................................... 70
INSTALLATION GUIDE
160, 225, 250, 400 AMP
INTRODUCTION

This manual details the fundamental instructions required for the proper handling, storage, installation and maintenance of the Series DPB Busway manufactured by GE Critical Power.

Installers shall familiarize themselves with this document and become familiar with the design and specific characteristics of each Series DPB Busway component and run. Proper planning and coordination between trades is important for an efficient installation.

Every component shall be tested, inspected and packaged at the assembly plant. Manufacturing details are checked and tested regarding the mechanical and electrical specification of the system. After factory inspection, the busway is boxed and crated for shipment to the job site. The catalogue number and job number will be clearly marked on each shipping package and individual item.
SAFETY WARNING

DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION

Only qualified electrical maintenance personnel should install, operate, service and maintain this busway system and associated equipment. This document should not be viewed as sufficient for those who are not otherwise qualified to operate, service, or maintain the equipment discussed.

Turn off power to the busway before installing, removing, or working on this equipment.

CONFIRM THAT ALL POWER IS OFF

Always use a properly rated voltage sensing device to confirm that all power is off. Always wear proper protection.

The accurate operation of this equipment depends upon proper handling, installation, operation, and maintenance.

Failure to follow these instructions may result in serious injury or death
RECEIVING, HANDLING, & STORAGE

WARNING

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION

Protect this equipment from containments such as water, salt, concrete dust and other corrosive environments before and during installation.

Equipment and packing are not weather resistant and shall not be stored outside or exposed to the environment.

Do not sit, walk or stand on this equipment.

Failure to follow these instructions may result in equipment damage, serious injury or death.

RECEIVING

Upon receipt, check the packing list against the equipment received to ensure the order and shipment are complete. Claims for shortages or other errors must be made in writing to GE Corp within 30 days after the receipt of your shipment.

Upon receipt, inspect the busway packaging components and sections for any damage that may have occurred during shipping. If damage is found, immediately make a claim with the carrier and notify GE Critical Power.

HANDLING

Cut the banding that secures the package with band cutters.

Exercise care when unpacking.

Handle these products with care, avoid damage to the components, do not drop, bend, pierce or mishandle in any manner the system as this may lead to a faulty installation.

Avoid denting or mishandling that may cause damage. Ensure the handling personnel and equipment at the job site is adequate for handling the busway.

Use the correct tools to remove the packing at each busway end. Take care not to damage the housing, which could result in a failure of the busway. Avoid using objects with sharp edges to lift the busway.

Most packaging is recyclable dispose of all packing appropriately.

STORAGE

If the busway is not installed and energized immediately, store the busway in its original packaging in a clean, dry space.

**Busway should not be stored outdoors.**

**Busway should not be stored in a moist environment.**

Protect against moisture.
INSTALLATION

PRE-INSTALLATION REVIEW

PROPER INSTALLATION OF THE SERIES DPB BUSWAY IS ESSENTIAL TO THE BUSWAY OPERATION.

Before installing the busway:

1) Conduct an insulation resistance test on each busway device to check for possible damage during shipment or storage. Ensure the phase-to-phase, phase-to-neutral, and phase-to-ground isolation.

2) Confirm that the ambient temperature range is within acceptable limits –10°C through +40°C. If not, please consult the factory for possible de-rating.

3) Ensure that there is sufficient clearance from the walls, ceilings, and load devices.

4) Ensure that the factory-manufactured mounting supports will conform to the recommended spacing guidelines as detailed in the section titled “Mounting the Busrail”.

5) Ensure that all splice connections, end feed units, and tap off boxes will be accessible after installation.

6) After determining the clearances and the mounting method (vertical or horizontal) for the busway system, level and align the end feeds and busrails before the final tightening and alignment of all supporting members.

7) Align the busbar ends of adjoining sections, verifying proper busbar alignment, phasing, and spacing.

8) Verify that the incoming system phasing, and voltage match the busway system phasing and rated voltage.
INSTALLATION HAZARD

Depending on the installation orientation of the busways, the following WARNING should always be considered.

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAZARD OF EQUIPMENT DAMAGE</td>
</tr>
<tr>
<td>Always maintain the minimum required clearance distance as shown below.</td>
</tr>
<tr>
<td>Failure to follow these instructions may result in equipment damage or personal injury.</td>
</tr>
</tbody>
</table>

VERTICAL BUSWAY INSTALLATION

See Figure 1. For busways installed vertically with channel opening down, always maintain:

A minimum clearance distance of 6 inches (153 mm) from the top of the busways to the ceiling and 1 inch (26 mm) from the wall.

Parallel runs for two systems mounted in the same area shall have the following clearances between the systems.

A minimum clearance distance of 6 inches (153 mm) from the center-point of busway run A to the next run B.

Figure 1 - Vertical Busway Installation
HORIZONTAL BUSWAY INSTALLATION

See Figure 2. For busways installed flat wise or horizontally, maintain the following clearances.

A minimum clearance of 6 inches (153 mm) from top of bus to ceiling.

A minimum clearance distance of 1 inch (26 mm) from the back of the busways to the edge of the wall.

A minimum clearance distance of 6 inches (153 mm) from the center-point of one busway run to the next when mounted in a stacked configuration, one above the other.

Figure 2 - Horizontal Busway Installation

Example A/B Horizontal Busway Installation
BUSWAY SYSTEM MOUNTING

SPECIFIED AND SAFE OPERATION OF THE SERIES DPB BUSWAY IS DEPENDENT ON ITS PROPER INSTALLATION. MISALIGNMENT OF THE BUSWAY COMPONENTS, (END FEEDS, BUS RAILS, AND SPLICES) WILL COMPROMISE ITS PERFORMANCE.

1) End Feed enclosures must be securely mounted so that they are completely level (side-to-side and front-to-back).

2) Bus Rails must be securely installed so that they are level and completely aligned to the End Feed enclosures and with adjoining Bus Rail sections.

3) When each Busway run is properly supported / mounted, leveled, and aligned, all Splices must be verified to be “un-cammed” (not actuated with Cam Actuator Tool).

4) The Splice units must be able to move freely and fully into both sections of adjoining sections of bus before the Splices can be “cammed” (actuated).

5) Once the free movement of the Splice units is verified, the Splice can be actuated. The installation of Dowel Pins completes the correct installation of the Splices.
MOUNTING THE END FEED

VERTICAL END FEED SUPPORT
Series DPB End Feed enclosures can be mounted in a number of ways. The recommended method for mounting Series DPB End Feed enclosures is as shown in Figure 3. Four 3/8" threaded rods (see Figure 3A) secure the enclosure to the ceiling or to Unistrut™, and a standard busway hanger supports the Splice Extension. These need to be aligned and leveled to each other so that the End Feed is completely level after installation.

HORIZONTAL END FEED SUPPORT
Series DPB End Feed enclosures can be horizontally mounted. The recommended method is similar to the vertical mounting method and is shown in Figure 4 below. The enclosure is supported by four 3/8" threaded rods (see Figure 4A) secure the enclosure to the ceiling or to Unistrut™, and a standard busway hanger supports the Splice Extension. These need to be aligned and leveled to each other so that the End Feed is completely level after installation.
MOUNTING THE BUSRAIL

SUPPORT

When mounting the bus rail please use the supplied hangers that are designed to fit into the top and or side channels found on each section of bus rail. Each section of bus rail should have at least one hanger and threaded rod assembly with the maximum span being 5’ on centers. 10’ and 12’ bus rail sections should have a minimum of two hanger and threaded rod assemblies. Bus Rail lengths longer than 12’ should have a minimum of three hangers and threaded rod assemblies. The span of the hanger and threaded support at a Splice point should be a maximum of 6’ on center. Each section of bus rail needs to be aligned and level. See Figure 5.

NEUTRALS ALIGNMENT

Our busway system is designed so that it is NOT possible to mount the busways if the neutral conductor is not in phase with one another from section to section. The neutral conductor of each element MUST be aligned on the same side of the system. Clear markings are also made on the busway system to ensure proper phasing. See Figure 6.

Figure 5 - Busrail Mounting Support around Splice Point

Figure 6 - Busrail Neutrals Alignment
INSTALLATION OF THE SPLICE CONNECTOR – 160 - 250 AMP

All busway sections are shipped from the factory with one splice pack assembly. As each busway section is mounted on its hanger supports, the abutting end of the splice section can be installed to the adjoining busway section.

Connection of Busway Sections and Fittings: (See Figure 7)

1) Each section of busway will come with one Splice Pack assembly (D) and two “E” Clips (E) one at each end of the bus section. Make sure the “E” Clips are always installed on each end of each rail.

2) Bus sections are phase-keyed to maintain proper circuit phasing of the run.

3) Section 2 (with the splice) and Section 1 (without splice) will be aligned on their respective supports. Slide Section 1 forward on the splice pack.

4) Slide Splice Joint Covers (B & C) and “E” Clip (E) into place positioning them equally across the bus.

5) Slide Grounding Plate (A) into place and secure the four grounding screws to the busway. Torque values for the set screws is 60 in-lbs minimum and a maximum of 85 in-lbs.

6) Slide the Splice Pack Assembly so that it is positioned equally on either side of the bus section joint.

7) Starting from one end of the Splice Pack (Figure 8), only use the steel cam-actuator tools supplied to expand the splice joint contact assemblies into contact with bus sections bus bars.
   i) Insert one tool into the first cam port #1; the second cam-actuator tool into the adjacent cam port #2. Rotate each tool ¼ turn to expand the contact plates.
   ii) Rotate the adjacent, non-metallic cam spacers (a & b), ¼ turn to hold the expanded contact plate in place. **DO NOT ATTEMPT TO USE THE NON-METALLIC CAMSPACERS TO EXPAND THE CONTACT PLATE ASSEMBLIES.**
   iii) Rotate and remove the cam actuator tool in cam port #1, and insert it into cam port #3. Rotate the steel tool in cam port #3, ¼ turn clockwise to expand the contact plates.
   iv) Rotate the adjacent, non-metallic cam spacers (c & d), 1/4 turn clockwise.
   v) Rotate and remove the cam actuator tool in cam port #2, and insert it into cam port #4. Rotate the steel tool in cam port #4 to expand the contact plates.
   vi) Rotate the adjacent, non-metallic cam spacers (e & f), 1/4 turn clockwise.
   vii) Rotate and remove the cam actuator tools.

Figure 7 - Splice Installation Overview 160 - 250 Amp
Figure 8 - Splice Installation Detail 160 - 250 Amp

Step 1: Cam Port #1
- Cam Port #1 clockwise
- Cam Port #2 clockwise
- Cam Port #3 clockwise
- Cam Port #4 clockwise

Step 2: Insert tool into Cam 1 & 2
- 1/4 turn clockwise

Step 3: Rotate Spacers a & b
- 1/4 turn clockwise
- 1/4 turn clockwise

Step 4: Move from Cam 2 to Cam 4
- Rotate Spacers c & d
- 1/4 turn clockwise

Step 5: Remove Cam tools
- Rotate Spacers e & f
- 1/4 turn clockwise

Step 6: Cam Port #1
- Cam Port #2
- Cam Port #3
- Cam Port #4

Step 7: Cam Port #1
- Cam Port #2
- Cam Port #3
- Cam Port #4

Cam spacer alignment before installation

Cam Spacer Position - Splice Installation Complete as seen from bottom
8.) **CAUTION:** **DO NOT proceed to 9) Installation of the Dowel Pin Devices until the Cam Spacers are verified to be in the locked position.** A properly installed Splice, when viewed from the bottom (open channel) of the joined bus sections will show the Cam Spacers in the Locked Position as show in Figure 8.1 below.

- Cam Spacer
- Cam Actuator Tool Port
- Cams in Locked Position

![Figure 8.1 - Cam Spacers in Locked Position](image)

9.) **Installation Of The Dowel Pin Devices**

The Dowel Pins are used to secure open Cam Actuator Tool ports and add Cam Spacer functionality. Material Required for Initial Installation (before busway is energized*):

- Four Dowel Pin Devices

10.) Inspect the busway, and verify that the splice connections of the busway have been installed correctly per INSTALLATION OF THE SPLICE CONNECTOR – 160 to 250 AMP.

1. Verify no gaps between the bus connections
2. Verify the E-clips are positioned properly.
3. Verify the Cam Spacers (white-tipped, slotted lock pins) are positioned properly.

*please contact factory service for dowel pin installation procedure when working on an energized busway (800-225-4838)

11.) Each Dowel Pin has an O-ring set into a small groove on the insertion end of the dowel pin. (See Figure 8.2).

![Figure 8.2 - Dowel Pin](image)
12.) Position the Dowel Pin into the round port between the first pair (viewed left-to-right, or right-to-left) of installed white-tipped, slotted Cam Spacers. The conical pointed end is inserted first, and the end with the O-ring inserted last. (See Figure 8.3)

13.) Using pressure push the Dowel Pin so that it is inserted completely into the Cam Actuator Tool Hole. (See Figure 8.4)

14.) Make sure that the O-ring on the dowel is inside the E-clip. (See Figure 8.5)

15.) Repeat Step 13 until all four (4) vacant Cam-Actuator Tool Ports have Dowel Pins in them.

16.) Repeat the process for each splice in the bus run until complete.
INSTALLATION OF OPTIONAL "C-CLIPS" FOR 35kAIC RATED 400A BUSWAY

The 35 kAIC rated 400A Busway utilizes a C-Clip to control tolerances in the busrail channel opening. Detailed below are the modified installation instructions to install these C-Clips on End Feeds and Busrails.

END FEED C-CLIP INSTALLATION

See Figure 9 - End Feed C-Clip Installation - 400 Amp

1.) Locate the C-clip
2.) Remove E-clip by sliding it off the bus rail of the End Feed
3.) Install the C-clip by sliding into place between the walls of the open channel.
4.) Reinstall the E-clip.
5.) Position C-clip so that it butts up against the E-clip.
6.) Tighten screws on C-clip.

NOTE: Loosen, do not remove, the two screws of the C-clip assembly.

BUSRAIL AND SPLICE JOINT C-CLIP INSTALLATION

Install C-clips at the prescribed locations on the bus rail. (See Figure 10 - Busrail C-Clip Installation - 400 Amp).

1.) A C-clip should be placed approximately every 31.5" along the busrail or 2 x 31.5" (63") Pitch Location For Clip. If Tap Off Boxes are installed in the busrail and meet the 31.5" requirement then a C-clip is not required. If a 31.5" opening exists along the busrail then a C-clip will need to be installed.

NOTE: Loosen, do not remove, the two screws of the C-clip assembly.
2.) Slide the C-clip into bus rail positioning the C-clip as shown in (Figure 11 - Busrail C-Clip Profile View - 400 Amp). **NOTE:** Do not tighten the screws yet.

3.) Position a Splice Connector into the bus rail that has been properly mounted and supported (leveled, aligned).

**NOTE:** When the busway is mounted horizontally, make sure the Cam Spacers are flush with the top of the Splice Connector before positioning the assembly. (See Figure 12 - Cam Spacers)

4.) Bring the ends of busrails to be spliced together, position the Splice Pack equally across the joint, position the E-clips, Side Support Plates, and Grounding plate ready for Splice cam actuation. (See Figure 13 - Busrail C-Clip Splice and E-Clip Location - 400 Amp).

5.) Install the Splice per section "INSTALLATION OF THE SPLICE CONNECTOR - 400 AMP".

6.) Position and tighten the two screws of each C-clip.
INSTALLATION OF THE SPLICE CONNECTOR – 400 AMP

All busway sections will come from the factory with one splice connection. As the busways section is mounted on its hanger supports, the abutting end of the splice section can be installed to the adjoin busway section.

Connection of Busway Sections and Fittings: (See Figure 14)

1) Each section of busway will come with one Splice Pack assembly (D) and two "E" Clips (E) one at each end of the bus section. Make sure the "E" Clips are always installed on each end of each rail.

2) Bus sections are phase-keyed to maintain proper circuit phasing of the run.

3) Section 2 (with the splice) and Section 1 (without splice) will be aligned on their respective supports. Slide Section 1 forward on the splice pack.

4) Slide Splice Joint Covers (B & C) and "E" Clip (E) into place positioning them equally across the bus.

5) Slide Grounding Plate (A) into place and secure the four grounding screws to the busway. Tighten each nut to a torque value of 85 in-lbs.

6) Slide the Splice Pack Assembly so that it is positioned equally on either side of the bus section joint.

7) See Figure 8 for Splice Installation reference. Starting from one end of the Splice Pack (Figure 15), only use the steel cam-actuator tools supplied to expand the splice joint contact assemblies into contact with bus sections bus bars.
   i) Insert one tool into the first cam port #1; the second cam-actuator tool into the adjacent cam port #2. Rotate each tool ¼ turn to expand the contact plates.
   ii) Rotate the adjacent, non-metallic cam spacers (a & b), ¼ turn to hold the expanded contact plate in place. **DO NOT ATTEMPT TO USE THE NON-METALLIC CAMSPACERS TO EXPAND THE CONTACT PLATE ASSEMBLIES.**
   iii) Rotate and remove the cam actuator tool in cam port #1, and insert it into cam port #3. Rotate the steel tool in cam port #3, ¼ turn to expand the contact plates.
   iv) Rotate the adjacent, non-metallic cam spacers (c & d), ¼ turn.
   v) Rotate and remove the cam actuator tool in cam port #2, and insert it into cam port #4. Rotate and remove the cam actuator tool in cam port #3, and insert it into cam port #5. Rotate the steel tools in cam ports #4 and #5 to expand the contact plates.
   vi) Rotate the adjacent, non-metallic cam spacers (e & f), ¼ turn.

Figure 14 - Splice Installation Overview - 400 Amp
vii) Rotate and remove the cam actuator tool in cam port #4, and insert it into cam port #6. Rotate the steel tool in cam port #6 to expand the contact plates.
viii) Rotate the adjacent, non-metallic cam spacers (g & h), ¼ turn.
ix) Rotate and remove the cam actuator tools.

8.) **CAUTION: DO NOT** proceed to 9) Installation of the Dowel Pin Devices until the Cam Spacers are verified to be in the locked position. A properly installed Splice, when viewed from the bottom (open channel) of the joined bus sections will show the Cam Spacers in the Locked Position as show in Figure 15.1 below.

9.) **Installation Of The Dowel Pin Devices**

The Dowel Pins are used to secure open Cam Actuator Tool ports and add Cam Spacer functionality. Material Required for Initial Installation (before busway is energized)*:

- Six Dowel Pin Devices

10) Inspect the busway, and verify that the splice connections of the busway have been installed correctly per INSTALLATION OF THE SPLICE CONNECTOR – 400 AMP.

1. Verify no gaps between the bus connections
2. Verify the E-clips are positioned properly.
3. Verify the Cam Spacers (white-tipped, slotted lock pins) are positioned properly.

*please contact factory service for dowel pin installation procedure when working on an energized busway (800-225-4838)
11.) Each Dowel Pin has an O-ring set into a small groove on the insertion end of the dowel pin. (See Figure 15.2).

12.) Position the Dowel Pin into the round port between the first pair (viewed left-to-right, or right-to-left) of installed white-tipped, slotted Cam Spacers. The conical pointed end is inserted first, and the end with the O-ring inserted last. (See Figure 15.3)

13.) Using pressure push the Dowel Pin so that it is inserted completely into the Cam Actuator Tool Hole. (See Figure 15.4)
14.) Insert another Dowel into the next empty port on the splice. (Six empty tool ports per 400A splice connection). Make sure that the O-ring on the dowel is inside the black bracket (E-clip) (See Figure 15.5)

![Figure 15.5 - Dowel Pin O-Ring Inside "E" Clip](image)

15.) Repeat Step 13 until all the vacant Cam-Actuator Tool ports have Dowel Pins in them.
16.) Repeat the process for each splice in the bus run until complete.

**INSTALLATION OF THE END CAP CLOSURE PLATE**

Always terminate each busway run with an end cap in order to prevent any contact with live conductors or internal components inside the extruded aluminum busrail housing. See Figure 16.

To install, align side and top tabs with channels on busrail and tap in using a rubber mallet until flush.

The method of installation of the end caps is common for all mounting positions.

![Figure 16 - Busrail End Cap Installation](image)
CABLE TERMINATIONS TO THE END FEED BOX

STANDARD END FEED

Run all conduit fittings and supports; attach cable to the listed lugs on the termination pad.

Ensure that phasing is correct (see Figure 17).

Once complete, torque all connections with a torque wrench to the values specified on the label located inside the End Feed Box.

BRANCH CIRCUIT MONITORING (BCMS) END FEED

Run all conduit fittings and supports; attach cable to the listed lugs on the termination pad.

Ensure that phasing is correct (see Figure 18) and that Current Transformers (CT) are facing in the correct direction (see Figure 19). The H1 notation on the CT should be facing the input power source.

Once complete, torque all connections with a torque wrench to the values specified on the label on the End Feed Box.
Figure 19 - End Feed Current Transformer (CT) Orientation
TAP OFF BOX INSTALLATION

INSTALLATION WARNING

Depending on the installation orientation of the busways, the following WARNING should always be exercised when mounting and energizing the Tap Off Boxes:

---

CAUTION

HAZARD OF EQUIPMENT DAMAGE

- Always maintain the minimum required clearance distance as shown below.
- Ensure sufficient clearance for the doors of the Tap Off Units to open or close without obstruction.
- Ensure sufficient access to the switch or circuit breaker of the tap off units.
- Failure to follow these instructions may result in equipment damage or personal injury.

---
TAP OFF BOX MOUNTING

Busway Tap Off Boxes have cam-actuated connections to the busway system as shown in Figure 20. As a safety feature the insertion of the Tap Off Box cannot be made into the busway system if the cam knob is in the ON position and the tap off contacts are extended. In the same way a Tap Off Box cannot be removed from the busway system while it is in the ON position. The contacts will not pass through the opening until fully retracted and the bus insulation will keep the contacts from passing through the bus until they are fully disengaged and closed. As a further safety feature the contacts are spring activated to the OFF position to ensure that they fully retract.

Insertion and phase control are part of the safety built into every Tap Off Box. A lip is designed into the busrail that will not allow the Tap Off Box to be inserted backwards. The Tap Off Box is inserted to the busway as shown in Figure 21. The ground connection will be made and the phasing will be aligned in step 3 when the Tap Off Box is fully seated against the busrail, and hold-down screws are screwed in over top of the side channel lip. NOTE: Do not tighten the hold down screws so that they penetrate the busrail. To energize the Tap Off Box, slide the cam knob to the ON position engaging the Contacts to the bus Phasing and Neutral bus bars. As a safety feature the ground connection is always made first.
BEFORE ENERGIZING THE BUSWAY CHECKLIST

Before energizing the busway, some precautionary inspections and reviews are necessary.

1. Perform a complete visual inspection of all end feed connections (See Figure 12 (Standard) and 13 (BCMS)), splice couplings (See Figure 8 (160-250A) and Figure 10 (400A)) and tap off boxes (See Figure 16).

2. Ensure that all protective devices are correctly rated with respect to the loads supplied, or in accordance with project specifications, and that they are in the OFF position.

3. Check that all the Tap Off Boxes protective devices are in the OFF position.

4. Conduct a Resistance Test between A: busrail-to-busrail assembly, and B: busrail-to-tap off box.
   A: Value shall be < 0.005 ohms
   B: Value shall be < 0.006 ohms

5. Check the grounding connections of all devices are secure and tightened. Note: A Torque Specification label can be found inside each End Feed.
   Lug Torque (End Feed) Record: ______________________

6. Verify the phase of the busway matches the system phasing before re-connecting.
   a) Verify that all Tap Off Units are facing forward to the front (neutral) of the busway
   b) Verify that all connection phasing is correct
   c) Verify that all incoming power feeds are phased correctly to the bus system
ENERGIZING THE BUSWAY SYSTEM

DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION

Only qualified electrical technicians or personnel should install, operate, service or maintain the structured busway system and connected devices. This document is not sufficient for those who are not qualified to operate, service, or maintain the electrical equipment.

The successful operation of this equipment depends upon proper handling, installation, operation, and maintenance.

Failure to follow these instructions may result in serious injury or death

When the equipment is energized for the first time, qualified personnel should be present. Care should be taken because if there are any short-circuits and/or ground faults caused by damage or poor installation practices that are not detected during the “BEFORE ENERGIZING” checklist procedures, serious damage can result when the power is applied.

The busway should have no electrical load connected or in the ON position when initially energized. Prior to energization ensure that all devices connected to the busway system are in their OFF position.

Energize the equipment in sequence by starting at the source end and working towards the load. Energize the main devices, and then the branch-circuit devices. Turn the devices to the ON position.

After all protective devices have been turned on, loads may be turned on.

Occurrence of sparking at any point along the busway is not normal condition. De-energize the busway immediately. Correct the cause of the sparking condition. Then, conduct an insulation resistance test before attempting to energize again.
MAINTENANCE

DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION

Only qualified electrical maintenance personnel should install, operate, service or maintain this equipment. This document should not be viewed as sufficient for those who are not otherwise qualified to operate, service, or maintain the equipment discussed.

Turn off power to the busway before installing, removing, or working on this equipment.

Always use a properly rated voltage sensing device to confirm power is off.

The successful operation of this equipment depends upon proper handling, installation, operation, and maintenance.

Failure to follow these instructions may result in serious injury or death.

CAUTION

CLEANING - HAZARD OF EQUIPMENT DAMAGE

Wipe down busway with a dry cloth.

Spray propellants and cleaning or compounds may cause degradation of certain components of the busway system. Ensure that all cleaning liquids are rated for use on electrical equipment.

Before using products to clean, dry or lubricate components during installation or maintenance, consult GE.

Failure to follow these instructions may result in equipment damage or personal injury.
MAINTENANCE

Series DPB Bus Systems™ require only nominal maintenance. Inspect the busway annually or after any short circuit or ground fault. Perform the following maintenance procedures:

Carefully inspect all the system. Verify that all Splice Cams (See Figure 8 (160-250A) and Figure 15 (400A)) and are properly installed and in the locked position. Using a thermal scanning device to record the thermal rise of each termination in each end feed (See Figure 17 (Standard) and 18 (BCMS)). Record this information for comparison for year over year reviews. Changes in excess of 5°C should be inspected more carefully; however the monitoring of more than 5 degrees could be due to change on the loads and not the performance of the busway components.

Check the torque on all power connections using a torque wrench. The tightening torque is specified on the label found in the End Feed Box (See Figures 17 & 18).

If any busrails, splices, end feed terminations or tap off box contacts are badly discolored, corroded or pitted the devices must be replaced with new devices.

Ensure that all mechanisms and mechanical interlocks are in satisfactory operational condition.

Check the insulation resistance before re-energizing the busway. Keep a permanent record of resistance readings. Conduct the insulation resistance test according to the section "Before Energizing the Busway Checklist".

Energize the equipment again following the instructions in the section "Energizing the Busway System".

After performing all the above inspections and necessary repairs, it may be desirable to perform an infrared temperature test on all the electrical connections. Conduct this test after the busway is re-energized and reaches a stabilized operating temperature.

For additional maintenance services please see Appendix H: Service.
BRANCH CIRCUIT MONITORING SYSTEM (BCMS)

INSTALLATION GUIDE
SAFETY WARNING

DANGER

SEVERE INJURY OR DEATH CAN RESULT FROM ELECTRICAL SHOCK DURING CONTACT WITH HIGH VOLTAGE CONDUCTORS, MONITORING PCBs, OR RELATED EQUIPMENT.

DISCONNECT AND LOCK OUT ALL POWER SOURCES DURING INSTALLATION AND SERVICE.

APPLICATIONS SHOWN AND DESCRIBED ARE SUGGESTED MEANS OR INSTALLATION. IT IS THE RESPONSIBILITY OF THE INSTALLER TO ENSURE THAT THE INSTALLATION IS IN COMPLIANCE WITH ALL NATIONAL AND LOCAL CODES.

INSTALLATION SHOULD BE ATTEMPTED ONLY BY INDIVIDUALS FAMILIAR WITH CODES, STANDARDS, AND PROPER SAFETY PROCEDURES FOR HIGH-VOLTAGE INSTALLATIONS.

TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, INSTALL IN A TEMPERATURE AND HUMIDITY CONTROLLED INDOOR AREA FREE OF CONDUCTIVE CONTAMINANTS.

THE PRODUCT IS NOT INTENDED FOR INSTALLATION IN HAZARDOUS LOCATIONS.

READ INSTRUCTIONS THOROUGHLY PRIOR TO INSTALL.
SCOPE

This manual includes user operation and installation information for the GE Series DPB Busway Branch Circuit Monitoring System. It is intended to aid the user in the safe handling and use of the system. It is recommended that a copy of this document be kept in a safe place for easy review. Each section of this manual may contain bold type notes in a rectangle box, warnings and cautions that pertain to your Series DPB Busway Branch Circuit Monitoring system.
SYSTEM DESCRIPTION

This monitoring system is designed for use with the GE Series DPB Busway to provide detailed power parameter information for the busway input feeders (End Feed Boxes) and branch circuits of the power distribution boxes (Tap Off Boxes). The system consists of a Communications Hub module located on the End Feed Box which can acquire power information from the busway input feeders and the branch circuits of Tap Off Boxes equipped with the Branch Circuit Monitoring System (BCMS). The system is capable of monitoring the power infrastructures of Mission Critical, Industrial and Commercial facilities.

The Series DPB Busway busrail is equipped with an integrated communication cable inside a channel along the bottom of the rail section. Communication connectors (see Figure 22) are distributed equally along the span of a bus rail to enable interconnection to each Tap Off Box. This allows a BCMS-equipped Tap Off Box to communicate with the Input PM / Accumulator PCBs of the communication hub via a communication receptacle and the interface cable. (see Figure 22 - Series DPB Branch Circuit Monitoring System Overview)

Information collected by the Input PM / Accumulator is outputted via Modbus™ RTU through a serial port which can be routed to a local display as well as via an Ethernet gateway and/or to a customer-supplied monitoring system.

There are two different levels of firmware available – BCMS Basic -Current only, and BCMS Plus – Current Plus Voltage. See Appendix A, TAP OFF BOX MONITORING SPECIFICATIONS, and Appendix B, END FEED (INPUT PM BOARD) MONITORING SPECIFICATIONS.

POWER MONITORING SYSTEM OVERVIEW

The power monitoring capabilities of the system may be configured as follows,

- **Option 1** - Tap Off Box Monitoring Only (see pages 30-32)
- **Option 2** - End Feed Monitoring Only (see pages 33-35)
- **Option 3** - Tap Off Box and End Feed Monitoring Concurrently (see pages 36-39)
Option 1 - TAP OFF BOX MONITORING ONLY

SAFETY WARNING

**CAUTION**

SEVERE INJURY OR DEATH CAN RESULT FROM ELECTRICAL SHOCK DURING CONTACT WITH HIGH VOLTAGE CONDUCTORS, MONITORING PCBs, OR RELATED EQUIPMENT. DISCONNECT AND LOCK OUT ALL POWER SOURCES DURING INSTALLATION AND SERVICE.

END FEED BOX COMPONENTS

The OPTION 1 configuration (Figure 23) enables power monitoring of the branch circuit loads connected to each BCMS-Equipped Tap Off Box. Busway source power input monitoring is not available since the Input Power Monitor board is not installed in the End Feed.

The Option 1 configured End Feed Box contains the data acquisition system consisting of an Accumulator PCB, and a Power Inserter PCB (Figure 24). The power disconnects for the circuit boards are the readily accessible fuses mounted on the outside of the End Feed Box. Ingress to these circuit boards is by removing the cover on the restricted-access Bus Monitor Housing. **This should only be done by a qualified electrical technician as removing the cover will expose high voltage connections on the circuit boards.** If the system logic PCBs have been purchased separately, they must be mounted in an access-restricted, grounded metal box and a readily accessible appropriate upstream power disconnect must be provided. For details on the circuit board parameters reference Appendix A: Tap Off Box Monitoring Specifications.

![Figure 23 - Option 1 - Branch Circuits via BCMS-Equipped Tap Off Boxes](image)

![Figure 24 - Option 1 - End Feed Box Monitoring Components](image)
Option 1 - TAP OFF BOX MONITORING ONLY

ACCUMULATOR PCB

All communications (power data) from the Tap Off Boxes are transmitted through the Accumulator Board (Figure 25). The board is equipped with a RS-485 serial Modbus communications serial interface capable of two-wire or four-wire communications. Refer to Section "Communications" for details on how to interface with the serial port for connection to Building Management Systems (BMS), Data Center Infrastructure Solutions (DCIM) or Local Displays.

POWER INserter PCB

DC power for all related circuit boards of the Bus Monitoring System is supplied through the Power Inserter Board (Figure 26) located inside the BCMS Monitoring Module on the End Feed Box. The Power Inserter Board acquires AC power via a readily accessible disconnect device directly from the End Feed main AC input bus. It provides a 24 VDC source along the bus rail communications cable to power the intelliBUS (Branch Monitoring) circuit boards in Tap Off Boxes. It is important that the Power Inserter be configured for the correct AC input voltage. See Table 1. For the correct jumper configuration for jumper J2 and J5 located on the Power Inserter Board.

The input power inserter is always fused with Type KTK-R fuses rated at 0.5A.

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Table 1 - Power Supply Input Voltage Configuration
Option 1 - TAP OFF BOX MONITORING ONLY

SAFETY WARNING

CAUTION

ALL VOLTAGE CONNECTIONS MUST BE FUSED!

TAP OFF BOX MONITORING COMPONENTS

Each Tap Off Box is BCMS-equipped (Figure 27) and interconnected with the Accumulator Board via the Communications Cable Connection scheme (Figure 23).

Branch Monitor Sensor Board (intelliBUS): This board monitors 3-phase current (phases A, B, C) for each branch circuit. Depending on the configuration of the system, not all current sensors may be employed.

Fusing: The Branch Circuit Monitoring system uses three fuses (one per phase) to protect the voltage sensing circuits. Fuses are located on the side of the Tap Off Box (Figure 27) in screw-type safety fuse holders. Fuses are Type KTK-R rated at 0.5A. Note that the state of a fuse on the sensing circuit will not affect the electrical performance of the Series DPB Bus System™.

COMMUNICATIONS CABLE CONNECTION

The intelliBUS PCB is located inside the Tap Off Box. Once the Tap Off Box has been secured to the bus rail, (refer to section Tap Off Box Installation) insert the communications cable from the Branch Monitor Connector on the Tap Off Box into the nearest open connector on the busrail (Figure 28). Ensure that the barbed connector lock is in place to maintain connection integrity.

In the event all communication connectors are utilized where a Tap Off Box is located, longer cables or connector splitters are available from the factory. Once energized, the Status LED will NOT be lighted as it is used for Alarm purposes only. Note that the source power for the branch monitor is via the communications cable link.
Option 2 - END FEED MONITORING ONLY

SAFETY WARNING

CAUTION

SEVERE INJURY OR DEATH CAN RESULT FROM ELECTRICAL SHOCK DURING CONTACT WITH HIGH VOLTAGE CONDUCTORS, MONITORING PCBS, OR RELATED EQUIPMENT. DISCONNECT AND LOCK OUT ALL POWER SOURCES DURING INSTALLATION AND SERVICE.

END FEED BOX COMPONENTS

The Option 2 configuration (Figure 29) is intended for monitoring of the busway power input only. Only the data acquisition boards located in the End Feed are utilized for the Busway Input Feeder monitoring.

The End Feed Box contains the main data acquisition system consisting of an Accumulator PCB, a Power Inserter PCB, and an Input PM PCB (Figure 30). The power disconnects for the circuit boards are the readily accessible fuses mounted on the outside of the End Feed Box. Ingress to these circuit boards is by removing the cover on the restricted-access Bus Monitor Housing. **This should only be done by a qualified electrical technician as removing the cover will expose high voltage connections on the circuit boards.** If the system logic PCBs have been purchased separately, they must be mounted in an access-restricted, grounded metal box and a readily accessible appropriate upstream power disconnect must be provided. For details on the circuit board parameters reference Appendix B: End Feed (Input PM Board) Monitoring Specifications.

![Diagram of Busway Input Feeder Monitoring](image)

**Figure 29 - Option 2 - Busway Input Feeder Monitoring**

![Diagram of End Feed Box Bus Monitoring Components](image)

**Figure 30 - Option 2 - End Feed Box Bus Monitoring Components**
Option 2 - END FEED MONITORING ONLY

ACCUMULATOR PCB

All communications (power data) from the End Feed Input PM PCB are transmitted through the Accumulator Board (Figure 31). The board is equipped with a RS-485 serial Modbus communications serial interface capable of two-wire or four-wire communications. Refer to Section “Communications” for details on how to interface with the serial port for connection to Building Management Systems (BMS), Data Center Infrastructure Solutions (DCIM) or Local Displays.

POWER INSUMER PCB

DC power for all related circuit boards of the Bus Monitoring System is supplied through the Power Inserter Board (Figure 32) located inside the Bus Monitor Housing on the End Feed Box. The Power Inserter Board acquires AC power via a readily accessible disconnect device directly from the End Feed main AC input bus. It is important that the Power Inserter be configured for the correct AC input voltage. See Table 2. For the correct jumper configuration for jumper J2 and J5 located on the Power Inserter Board.

The input power inverter is always fused with Type KTK-R fuses rated at 0.5A.

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Table 2 - Power Supply Input Voltage Configuration
Option 2 - END FEED MONITORING ONLY

INPUT PM PCB

Input Power Monitor (PM) Board: (Figure 33): this board monitors two separate 3-phase power sources including voltage, phase current and neutral, and ground current as well as four contact alarm inputs.

Figure 33 - Input PM Board
Option 3 - TAP OFF BOX AND END FEED MONITORING CONCURRENTLY

SAFETY WARNING

CAUTION

SEVERE INJURY OR DEATH CAN RESULT FROM ELECTRICAL SHOCK DURING CONTACT WITH HIGH VOLTAGE CONDUCTORS, MONITORING PCBs, OR RELATED EQUIPMENT. DISCONNECT AND LOCK OUT ALL POWER SOURCES DURING INSTALLATION AND SERVICE.

END FEED BOX COMPONENTS

The Option 3 configuration (Figure 34) combines monitoring of the busway power input and power monitoring of the branch circuit loads connected to each BCMS-Equipped Tap Off Box.

The End Feed Box contains the main data acquisition system consisting of an Accumulator PCB, a Power Inserter PCB, and an Input PM PCB (Figure 35). The power disconnects for the circuit boards are the readily accessible fuses mounted on the outside of the End Feed Box. Ingress to these circuit boards is by removing the cover on the restricted-access Bus Monitor Housing. This should only be done by a qualified electrical technician as removing the cover will expose high voltage connections on the circuit boards. If the system logic PCBs have been purchased separately, the PCBs must be mounted in an access-restricted, grounded metal box and a readily accessible appropriate upstream power disconnect must be provided. For details on the circuit board parameters reference Appendix A: Tap Off Box Monitoring Specifications and Appendix B: End Feed (Input PM Board) Monitoring Specifications.

![Figure 34 - Option 3 - End Feed Power and Tap Off Branch Circuits Monitoring](image)

![Figure 35 - Option 3 - End Feed Box Monitoring Components](image)
**Option 3 - TAP OFF BOX AND END FEED MONITORING CONCURRENTLY**

**ACCUMULATOR PCB**

All communications (power data) from the Tap Off Boxes and End Feed Input PM PCB are transmitted through the Accumulator Board (Figure 36). The board is equipped with a RS-485 serial Modbus communications serial interface capable of two-wire or four-wire communications. Refer to Section “Communications” for details on how to interface with the serial port for connection to Building Management Systems (BMS), Data Center Infrastructure Solutions (DCIM) or Local Displays.

![Accumulator PCB](image)

**POWER INserter PCB**

DC power for all related circuit boards of the Bus Monitoring System is supplied through the Power Inserter Board (Figure 37) located inside the Bus Monitor Housing on the End Feed Box. The Power Inserter Board acquires AC power via a readily accessible disconnect device directly from the End Feed main AC input bus. It provides a 24 VDC source along the bus rail communications receptacles to power the intelliBUS (Branch Monitoring) circuit boards in Tap Off Boxes. It is important that the Power Inserter be configured for the correct AC input voltage. See Table 3. For the correct jumper configuration for jumper J2 and J5 located on the Power Inserter Board.

![Power Inserter PCB](image)

The input power inserter is always fused with Type KTK-R fuses rated at 0.5A.

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Table 3 - Power Supply Input Voltage Configuration
Option 3 - TAP OFF BOX AND END FEED MONITORING CONCURRENTLY

INPUT PM PCB

Input Power Monitor (PM) Board: (Figure 38): this board monitors two separate 3-phase power sources including voltage, phase current and neutral, and ground current as well as four contact alarm inputs.

SAFETY WARNING

CAUTION

ALL VOLTAGE CONNECTIONS MUST BE FUSED!

TAP OFF BOX MONITORING COMPONENTS

Each Tap Off Box is BCMS-equipped (Figure 39) and interconnected with the Accumulator Board via the Communications Cable Connection scheme (Figure 40).

Branch Monitor Sensor Board (intelliBUS): This board monitors 3-phase current (phases A, B, C) for each branch circuit. Depending on the configuration of the system, not all current sensors may be employed.

Fusing: The Branch Circuit Monitoring system uses three fuses (one per phase) to protect the voltage sensing circuits. Fuses are located on the side of the Tap Off Box (Figure 34) in screw-type safety fuses holders. Fuses are Type KTK-R rated at 0.5A. Note that the state of a fuse on the sensing circuit will not affect the electrical performance of the Series DPB Bus System.
**Option 3 - TAP OFF BOX AND END FEED MONITORING CONCURRENTLY**

**COMMUNICATIONS CABLE CONNECTION**

The intelliBUS PCB is located inside the Tap Off Box. Once the Tap Off Box has been secured to the bus rail, (refer to section Tap Off Box Installation) insert the communications cable from the Branch Monitor Connector on the Tap Off Box into the nearest open connector on the busrail (Figure 23). Ensure that the barbed connector lock is in place to maintain connection integrity.

In the event all communication connectors are utilized where a Tap Off Box is located, longer cables or connector splitters are available from the factory. Once energized, the Status LED will NOT be lighted as it is used for Alarm purposes only. Note that the source power for the branch monitor is via the communications cable link.

![Figure 40 - Tap Off Box Communication Interface Into Series DPB Busrail](image-url)
COMMUNICATIONS

The Series DPB Busway BCMS is capable of providing remote communications information in four-wire or two-wire serial configurations via Modbus™ RTU protocol. It is always suggested to use a shielded twisted pair cable for the communications interface.

The standard communication setup is through RS422/RS485, four-wire interface with the Tx and Rx on separate pairs due to the ability to have increased speed on the communications with the Tx and Rx separated. However, it is possible to connect the Remote Communications to a two-wire network.

The default communications parameters for the interface are 9600 baud, 8 bit, even parity, and 1 stop bit.

There are two different levels of firmware available – **BCMS Basic** -Current only, and **BCMS Plus** – Current Plus Voltage. See Appendix A: TAP OFF BOX MONITORING SPECIFICATIONS, and Appendix B: END FEED (INPUT PM BOARD) MONITORING SPECIFICATIONS.
CONNECTING THE END FEED BOX TO LOCAL DISPLAYS OR BMS / DCIM SOLUTIONS

Practical operational limits of Modbus are thirty-two devices on a chain which means thirty-two Accumulators can be connected together. Each device has its own address that limits the number of Accumulators you can have on any Modbus chain.

There are two communications ports on the Accumulator Board in the End Feed Box for customer communications, J5 and J6. They are both in parallel, so the End Feeds can be connected in a Modbus daisy chain up to the limits detailed above. The first port (J6) is dedicated to supplying data to an upstream device acquiring the information. The second port (J5) is used to link additional acquisition circuit boards to allow a single communications port for multiple boards. Refer to Figure 38 for the location of the serial port terminal blocks. Be sure to observe polarities and connection points marked on the circuit board when connecting to the serial port.

The Input Power Monitoring Board in the End Feed and the iBus Board in the Tap Off Boxes have the capability to monitor multiple sources. The End Feed can monitor two independent three phase sources so designed for a dual bus End Feed. The iBus Board can monitor 6 currents, two of each phase.

The USB communications port is reserved for factory programming and customization of module parameters. Consult the External Interface Manual for details.

RS 485 FOUR-WIRE CONNECTION

The four-wire configuration is connected as shown in Figure 41. When daisy chaining additional accumulator boards, the output from the first board (J5) is connected to the input of the second board (J6). The output going to the serial port of the external acquisition device, i.e. Modbus™ gateway, is always connected to J5 of the last board in the series of boards.

Note(s): Up to 18 boards may be connected on one string. Jumpers on J9 and J10 must be removed.

If you require a Ground connection, then you can hook up the Ground connection, but it is not required.
RS 485 TWO-WIRE CONNECTION

The two-wire configuration is connected as shown in Figure 42. Jumpers placed across J10 and J9 on the Accumulator PCB.

Figure 42 - RS485 Two-Wire Connection Scheme
ACCUMULATOR BOARD CONNECTIONS

MODBUS CONNECTION

Upstream connections (connects to customer’s Building Monitoring System). See Figure 43 - End Feed Accumulator Board.

a. Transmit + is J5 OR J6 pin 1
b. Transmit - is J5 OR J6 pin 2
c. Receive + is J5 OR J6 pin 3
d. Receive - is J5 OR J6 pin 4
e. Ground is J5 OR J6 pin 5
BCMS SETUP DOCUMENTATION

REQUIRED MATERIAL

1. USB cable (Male A to Male B)
2. Accumulator_Setup.exe application
3. FTDI Drivers for USB (www.ftdichip.com)

STARTUP

Connect the USB cable to the Accumulator PCB. Wait for it to connect, and then open the Accumulator_Setup.exe file. You should get a screen that looks similar to Figure 44.

Figure 44 - BCMS Setup Startup Screen

Note: you will not have the same devices listed in the main part of the screen.

If you do not see “USB <-> Accumulator” in the top box, This means you have not connected. Press the “Search” button. If the name appears press the “Open” button. If not, you need to make sure you have the FTDI drivers installed.

If you get any DLL error, Make sure you have Microsoft DotNet installed.
USING THE ACCUMULATOR SETUP PROGRAM

Main Window (See Figure 45):

Search – Will search for the Accumulator board. When you open the program it will automatically search for an Accumulator board. If the search is successful “USB <-> Accumulator” should appear in the box beside the search button.

Open – This will open the connection to the Accumulator board. It will automatically open a connection on startup if the Accumulator board is found.

Close – This will close the connection to the Accumulator board. It will automatically close the connection when the program is closed.

Version – This is the version of the software in the Accumulator board. This may be helpful if you have issues and need to contact GE for assistance.

Setup Tab:

The Setup tab is where most of the setup steps will be done. Pressing the “Update” button on the right column will update the data on this page.

At the top is the Modbus setup. You can change the address, parity and baud rate. The addresses are sequential starting with the base address. To change the address put the desired address in the box and press “Set”. You will see the addresses of the devices change in the list below. Use the pull-down box beside parity to change it. You can select even, odd or none. Press “Set” to set the parity. Use the pull-down box beside baud to change it. You can select 9600 or 19200. Press “Set” to set the parity.
In the main part of the window is where the connected devices are shown. In Figure 40 there is one “INP PM” and two “IBUS” boards. INP PM is short for Input Power Monitor, which is the monitoring for the End Feed Box. IBUS is the monitoring in the Tap Off boxes. Each device has a Unique Identification Number. This number is shown after the ID tag. Next is the Modbus address for the device. The Comm: Good/Bad indicates if the Accumulator board is communicating with the device.

It is important when you setup up the busway to know which box is which. Since all the devices are on a bus, it is impossible to know one from another. It is recommended that you plug them in one at a time. This will allow you to put them in the order you desire. Each device has a unique identification number, so once the devices are known, they will remain in the order you put them in. When a device is found, it will be placed in the next available address shown by “No Device”, not necessarily at the end of the list.

Figure 46 image shows some more options when setting up the devices:

Figure 46 - BCMS Setup Tab Detail

In Figure 41 we added two more devices. The second device is a reserved spot. The fourth device is a “No Device” or free device. If another device were added it would be placed in the fourth spot, since the second is reserved. If there were not free devices, it would be added to the end of the list.

Note: You can have a maximum of 32 devices connected to an Accumulator. This includes free or reserved devices.

The following are a list of the buttons on the right which are used to set up the devices in the list.

Update – This button will get the latest update from the Accumulator. There is a check box under it, when if checked, will automatically update the data every two seconds.

Find Device – This will go out on the bus and search for new devices. The is done automatically every thirty seconds, but during setup this will find them faster if needed.

Add – This will Add a reserved device. If you know you will be adding more Tap Off Boxes in the future, or want to leave a gap for another reason, you can add a reserved spot. No new device will be added in this address. If you want to remove the reserve, you can use the remove feature.

Remove – To use Remove you must use the check boxes beside the device you wish to remove. This will remove the device from the list, and put a “No Device” in its place. If you remove the last device on the list it will not add a no device. It will remove the device all together.

Swap – To use Swap you must use the check two boxes beside the devices you wish to swap. It swaps the locations and addresses of the two devices.

Reserve – To use Reserve you must use the check box beside the device you wish to reserve. Only a “No Device” spot can be reserved. This will reserve the spot so new devices will not use this spot. It can be un-reserved by using the remove on the reserved spot.

Insert – To use Insert you must use the check box beside the device you wish to insert. Insert will insert a “No device” spot before the selected item. Note: this will change the addresses of every device including and after the checked box.
LED Control – This is used to help find devices on the chain. To use led control you must use the check box beside the iBus device you wish to find. The “Selected On” will turn the led on the box on solid for the allotted time in the box below (in minutes). The “All Off” will turn all the lights back to their current state. Blinking for alarm and off for no alarm.

Default – This will Default the board. Defaulting the board will remove all the setup and convert back to a default state. You will lose all the Modbus setup, device setup and locations. This is not recommended unless you are moving or reconfiguring the entire busway.

COMMON PROCEDURES

Removing a Tap Off Box:
If you wish to remove a Tap Off Box you must physically disconnect the Communications Cable from the Tap Off Box and Busrail Connector. Use “Remove” to remove it from the list. It should now be a “No Device” and the Accumulator will not look for it anymore. If you do not plan to use this location anymore, you may want to use the “Reserve” and reserve this spot so any new boxes will be added to the end and not the spot where this box was.

Replacing a Tap Off Box:
If you wish to replace a Tap Off Box and put a new one in its place you must disconnect the old Tap Off Box - see section Tap Off Box Mounting. Use “Remove” to remove it from the list. Install the new Tap Off Box - see section Tap Off Box Mounting. As long as it is the first “No Device” in the list is where you want it, it will be added back to the same address. If not, use the “Swap” command to move it to the previous location.

Adding a Tap Off Box:
If you wish to add a Tap Off Box in the first “No Device” spot or at the end, install the new Tap Off Box - see section Tap Off Box Mounting. Connect the Communications Cable to the Tap Off Box and an available Busrail Communications Connector. If you wish to add it to a reserved spot, you will need to remove the reserved by using the “Remove” command before installation.
DATA TAB

The Data tab can be used to see the data for any connected device. It can also be used to setup the parameters for any specific device.

The Pull-Down box at the top-left of the page can be used to change the device you wish to see. The Update box will get the current data from the device. Any time you change devices it will automatically update the data.

All of the points in the Points List are shown on the main window. You can scroll down to see all of them. The selected point can be seen on the right side in the “Write to Modbus” area.

In the “Write to Modbus” area you will see the data for the selected point on the left. If you can change the data, the set button will be active. If it is an alarm register the set button will be replaced by a clear button.

In the “Unit Name” area is the name. This is derived from the last 8 points in the points list. You can change the name of the device, up to 16 characters, to make it easier to identify. The ‘Set” button will change the registers for the name.

Under the “Unit Name” area is a box which will decode several of the alarm and setup registers. It will not show up until you have selected one of these registers. Alarm registers will show you a list of the current alarms. Setup boxes will show a list of setup options which you can check or uncheck. Changing the setup will change the data in the box at the top of the page. This will not be set unless you press the “Set” button in the “Write to Modbus” area.

At the Bottom of the page are the “Save Memory”, “Load Memory”, and “Load Default” buttons. Making changes to the setup will make these changes on the board, but will not save them in the on board EEPROM. The “Save Memory” will save any changes you have made to the on board EEPROM. “Load Memory” will read the values from EEPROM into the board in case you make unwanted changes. “Load Default” will load default values, which should only be done on initial program.

Figure 47 - BCMS Setup Data Tab Window
On the right of the page are several buttons which will take you to alarm and setup parameters. All they do is change the location of the points on the left of the page.

WINDOW TAB

This window is just a direct link into the USB commands. This window does not need to be used by the customer. All the commands on this page can be done on the previous pages with buttons to make it easier to do.
CUSTOMER CONNECTIONS TO 7" LOCAL DISPLAY

PRODUCT INTRODUCTION

The 7” Local Monitor Display is a high-performance, 800 x 480 pixel LED backlit color LCD display with a resistive touch screen interface.

It is used with the Series DPB Busway to provide a graphic display of the detailed power parameter data for the busway power source input (End Feed Boxes) and the branch circuits of the power distribution units (Tap Off Boxes).

The local monitor can be configured to display the power parameters of up to six End Feeds each with up to fifteen Tap Off Boxes – a total of 96 device addresses.

POWER PARAMETERS MONITORED

End Feeds: (See Figure 49)

Voltage - (L-L, L-N, THD%, Freq.)
Current – (3 phases, N, G, Max., Demand, Crest Factor)
Power – (kW, kVA, kVAR, PF, kWh[A], kWh[B], kWh[C])
Percent Load – (3 phases)

Tap Off Boxes: (See Figure 50)

Voltage - (L-L, L-N, THD%, Freq.)
Current – (3 phases, N, G, Max., Demand, Crest Factor, for all poles)
Power – (kW, kVA, kVAR, PF, kWh[A], kWh[B], kWh[C] for all poles)
Percent Load – (3 phases for all poles)
Figure 49 - 7” Local Display End Feed Screenshot

Figure 50 - 7” Local Display Tap Off Box Screenshot
COMPONENT IDENTIFICATION

See Figure 51 - 7” Series DPB Local Display Primary Components

The 7” Series DPB Local Display has the following primary components:

1.) Wall Mountable Housing
2.) 7” Touchscreen Display
3.) Power Supply Board
4.) IX Display Interface Board

Figure 51 - 7” Series DPB Local Display Primary Components
POWER CONNECTIONS

See Figure 52 - IX Display Interface Board for connection points.

120Vac

1.) Phase Voltage connects to TB1 pin 3
2.) Neutral Voltage connects to TB1 pin 1
3.) Ground connects to TB2 pin 3

24Vdc

1.) +24V connects to TB2 pin 1
2.) 24V return connects to TB2 Pin 2
3.) Ground connects to TB2 pin 3

Figure 52 - IX Display Interface Board
MODBUS CONNECTION

Connecting the Local Display to the busway is achieved by daisy-chaining up to 6 End Feed Accumulator PCBs via Connection TB3 (see Figures 53). A total of 15 Tap Off Boxes per End Feed can be addressed on the display providing a maximum of 96 power points that can be monitored. Connecting the Series DPB Local Display to a building management system utilizes Connector TB4.

![Diagram of MODBUS Connection](image)

Figure 53 - Modbus Wiring Diagram
MODBUS CONNECTIONS ON IX DISPLAY INTERFACE BOARD

See Figure 54 for MODBUS Connections on IX Display Interface Board

Downstream Connection utilize Connector TB3 - Connects to End Feed Daisy Chain

1.) Transmit + is TB3 pin 1
2.) Transmit - is TB3 pin 2
3.) Receive + is TB3 pin 3
4.) Receive - is TB3 pin 4
5.) Ground is TB3 pin 5

Upstream Connections utilize Connector TB4 - Connects to customer’s building management system.

1.) Transmit + is TB4 pin 1
2.) Transmit - is TB4 pin 2
3.) Receive + is TB4 pin 3
4.) Receive - is TB4 pin 4
5.) Ground is TB4 pin 5
MODBUS TO 7” LOCAL DISPLAY WIRING SCHEMATIC

Figure 55 - Modbus to 7” Local Display Wiring Schematic
CHANGE MODBUS RTU FROM RS422 TO VIA ETHERNET

1.) On the SETUP screen press the “Modbus Setup” button.
2.) Enter User ID and Password, and press the “Modbus Setup” button again.
3.) From the CHANGE ACTIVE CONTROLLER screen, select “ModbusMaster” so it is highlighted, and press “Settings” button.
4.) The settings should look like the following:

<table>
<thead>
<tr>
<th>MODBUS MODE</th>
<th>VIA RS422</th>
<th>VIA ETHERNET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Communication Mode</td>
<td>Serial</td>
<td></td>
</tr>
<tr>
<td>- Default Station</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>- Modbus Protocol</td>
<td>RTU</td>
<td></td>
</tr>
<tr>
<td>- 32bit Work Mapping</td>
<td>Motorola</td>
<td></td>
</tr>
<tr>
<td>- Addressing</td>
<td>Decimal</td>
<td></td>
</tr>
<tr>
<td>- Start Address</td>
<td>1-based</td>
<td></td>
</tr>
<tr>
<td>- Max Block Size (words)</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>- Force Function Code 0x10</td>
<td>Disabled</td>
<td></td>
</tr>
<tr>
<td>- String Swap</td>
<td>Disabled</td>
<td></td>
</tr>
<tr>
<td>- Silent Time (ms)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>- Clock Register</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>- Serial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Port</td>
<td>Com2</td>
<td></td>
</tr>
<tr>
<td>- Baud</td>
<td>9600</td>
<td></td>
</tr>
<tr>
<td>- Parity</td>
<td>Even</td>
<td></td>
</tr>
<tr>
<td>- Data bits</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>- Stop bits</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Advanced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Enable Unicode</td>
<td>False</td>
<td></td>
</tr>
<tr>
<td>- Byte Order</td>
<td>Intel</td>
<td></td>
</tr>
<tr>
<td>- Timeout</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>- Retries</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>- Offline station retry time</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>- Hide Comm. Error</td>
<td>False</td>
<td></td>
</tr>
<tr>
<td>- Command Line Option</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modbus Mode</td>
<td>Via RS422</td>
<td>Via Ethernet</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------</td>
<td>--------------</td>
</tr>
<tr>
<td>Routing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Communication</td>
<td>Serial</td>
<td>TCP</td>
</tr>
<tr>
<td>- Mode</td>
<td>Transparent</td>
<td>Transparent</td>
</tr>
<tr>
<td>- Timeout</td>
<td>5s</td>
<td>5s</td>
</tr>
<tr>
<td>- Serial Port</td>
<td>Com4</td>
<td>Com4</td>
</tr>
<tr>
<td>- Baud</td>
<td>9600</td>
<td>9600</td>
</tr>
<tr>
<td>- Parity</td>
<td>Even</td>
<td>Even</td>
</tr>
<tr>
<td>- Data bits</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>- Stop bits</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>- Ethernet Port</td>
<td>502</td>
<td>502</td>
</tr>
</tbody>
</table>

5.) To change from RS422 to Ethernet, change the “Communication” box under Routing from “Serial” to “TCP” or vice versa.
6.) Press “OK” on the PROPERTIES box. You may need to drag the box up to see the “OK” button.
7.) Press “OK” on the CHANGE ACTIVE CONTROLLER box.
8.) Press “OK” on the PROJECT MUST RESTART box.
9.) Press the “Reset” button. The reset button is recessed in a small hold on the left side of the bottom of the enclosure.
10.) Wait for the unit to reboot.
# APPENDIX A: TAP OFF BOX MONITORING SPECIFICATIONS

BCMS Basic = Current Only  
BCMS Plus = Current + Voltage

## MONITORED PARAMETERS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>DESCRIPTION</th>
<th>RESOLUTION</th>
<th>NOTES</th>
<th>BCMS BASIC</th>
<th>BCMS PLUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current (A):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2)¹</td>
<td>0.1 A</td>
<td>Input source current</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Maximum Current (A):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2)¹</td>
<td>0.1 A</td>
<td>Maximum input current detected</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Minimum Current (A):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2)¹</td>
<td>0.1 A</td>
<td>Minimum input current detected</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Percent Load (% Max):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2)¹</td>
<td>0.1%</td>
<td>Requires personalization of circuit breaker current rating</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Voltage (VAC):</td>
<td>A, B, C Phase (L-L, L-N)</td>
<td>0.1 VAC</td>
<td>Input source voltage</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Crest Factor (Peak A RMS):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2)¹</td>
<td>0.001 A</td>
<td>Peak waveform current divided by RMS current of the waveform</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Real Power (kW):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2)¹</td>
<td>0.01 kW</td>
<td>kW (real power) per circuit breaker</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Apparent Power (kVA):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2)¹</td>
<td>0.01 kVA</td>
<td>kVA (apparent power) per circuit breaker</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Reactive Power (kVAR):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2)¹</td>
<td>0.01 kVAR</td>
<td>kVAR (reactive power) per circuit breaker</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Power Factor (PF):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2)¹</td>
<td>0.01 PF</td>
<td>Load Power Factor per circuit breaker</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Energy Usage (kWh):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2)¹</td>
<td>1 kW</td>
<td>Energy consumption per circuit breaker</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Total Harmonic Distortion (%THD):</td>
<td>A, B, C Phase</td>
<td>0.1%</td>
<td>Total Harmonic Distortion (load) per phase measured to 3rd, 5th, 7th, 9th, 11th, 13th harmonics.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Frequency (Hz):</td>
<td>A phase (40 – 70 Hz)</td>
<td>0.1 Hz</td>
<td>Source frequency as measured from phase A.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Circuit Temperature Range (°C):</td>
<td>Circuit Board Temperature (Min. / Max.)</td>
<td>1°C</td>
<td>Utilizes on board sensor</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bus Junction Temperature Range (°C):</td>
<td>Temperature Sensors Min. / Max. (1, 2, 3, 4)</td>
<td>1°C</td>
<td>Utilizes remote sensors located on bus junction; may not be present in all cases.</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

¹Neutral and Ground currents may be monitored in addition to phase currents; see note on neutral and ground current monitoring
### ALARM PARAMETERS

| ALARM                        | DESCRIPTION                                                      | NOTES                                                                 | BCMS BASIC | BCMS PLUS |
|------------------------------|------------------------------------------------------------------|                                                                     |            |           |
| Current Loss / Zero Current: | A,B,C (circuit breaker 1), A,B,C (circuit breaker 2)            | Activated when current goes above 1.5 A then to zero Amps; can signify tripped or open circuit breaker or loss of input current | ✓           | ✓         |
| Current Warning Alarm:       | A,B,C (circuit breaker 1), A,B,C (circuit breaker 2)            | User defined based on a percentage of circuit breaker rating; default is 70% | ✓           | ✓         |
|                              |                                                                  | Alarms when current exceeds threshold after time delay (default is zero seconds) | ✓           | ✓         |
| Current High Alarm:          | A,B,C (circuit breaker 1), A,B,C (circuit breaker 2)            | User defined based on a percentage of circuit breaker rating (default is 85%); alarms when current exceeds threshold after time delay; default is 10 seconds | ✓           | ✓         |
|                              |                                                                  | Typically used to indicate when circuit approached trip threshold      | ✓           | ✓         |
| Global Alarms:               |                                                                  |                                                                     | ✓           | ✓         |
|                              | Current Warning Alarm                                             | Indicates if any current warning alarm is active                      | ✓           | ✓         |
|                              | High Current Alarm                                                | Indicates if any high current alarm is active                          | ✓           | ✓         |
|                              | Zero Current Alarm                                                | Indicates if any zero current alarm is active (indicates breaker trip or breaker open or loss of source) | ✓           | ✓         |
|                              | Overvoltage Alarm                                                 | Indicates if any over voltage alarm is active                          | ✓           |           |
|                              | Undervoltage Alarm                                                | Indicates if any under voltage alarm is active                         | ✓           |           |
|                              | Over Temperature Alarm                                            | Indicates if any over temperature alarm is active                      | ✓           |           |
|                              | Under Temperature Alarm                                           | Indicates if any under temperature alarm is active                     | ✓           |           |
| Overvoltage Alarm:           | (L-N Voltage)                                                     | User defined; default is 200 VAC; no time delay                        | ✓           |           |
| Undervoltage Alarm:          | (L-N Voltage)                                                     | User defined; default is 120 VAC                                      | ✓           |           |
### PERSONALIZATION

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>DESCRIPTION</th>
<th>RESOLUTION</th>
<th>NOTES</th>
<th>BCMS BASIC</th>
<th>BCMS PLUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit Breaker Size:</td>
<td>Output circuit breaker rating</td>
<td>1 A.</td>
<td>Defines output circuit breaker ratings; default is 20 A; (20-100 A range)</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Warning Time Delay:</td>
<td>Time (seconds) before warning alarm activates</td>
<td>0-60 seconds</td>
<td>Defines duration current must exceed threshold before activating a current warning alarm; default is 0 seconds</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Alarm Time Delay:</td>
<td>Time (seconds) before alarm activates</td>
<td>0-60 seconds</td>
<td>Defines duration current must exceed threshold before activating a high current alarm; default is 10 seconds</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Demand Average Time:</td>
<td>Time (seconds) to determine average current</td>
<td>1 second</td>
<td>Defines time by which average current is determined; default is 15 seconds. Range is 15 - 60 seconds</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Current Warning Alarm:</td>
<td>Circuit breaker current first level alarm</td>
<td>40-100%</td>
<td>Defines threshold based on a percentage of circuit breaker rating (default is 70%) to activate current warning alarm after a time delay (default is zero seconds)</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Current High Alarm:</td>
<td>Circuit breaker current second level alarm</td>
<td>50-100%</td>
<td>Defines threshold based on a percentage of circuit breaker rating (default is 85%) to activate high current alarm after a time delay (default is 10 seconds)</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Voltage Range:</td>
<td>Source voltage</td>
<td>0.1 V</td>
<td>Defines monitored voltage (208, 480, 600 VAC)</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Frequency:</td>
<td>Source frequency</td>
<td>0.1 Hz</td>
<td>Defines frequency (60 Hz or 50 Hz)</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Board Name Personal-</td>
<td>User defined device name</td>
<td>Alphanumeric</td>
<td>Device name; 16 Character maximum</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Overvoltage Alarm:</td>
<td>High voltage detected on source</td>
<td>0.1V</td>
<td>Defines voltage to activate over voltage alarm. (default is 200 VAC)</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Undervoltage Alarm:</td>
<td>Low voltage detected on source</td>
<td>0.1V</td>
<td>Defines voltage to activate under voltage alarm (default is 60 VAC)</td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B: END FEED (INPUT PM PCB) MONITORING SPECIFICATIONS

BCMS Basic = Current Only
BCMS Plus = Current + Voltage

<table>
<thead>
<tr>
<th>MONITORED PARAMETERS</th>
<th>DESCRIPTION</th>
<th>RESOLUTION</th>
<th>NOTES</th>
<th>BCMS BASIC</th>
<th>BCMS PLUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current (A):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2);</td>
<td>0.1 A</td>
<td>Input source current(s); neutral and ground current optional</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Maximum Current (A):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2);</td>
<td>0.1 A</td>
<td>Maximum input current detected per phase</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Minimum Current (A):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2);</td>
<td>0.1 A</td>
<td>Minimum input current detected per phase</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Current (A):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2);</td>
<td>0.1 A</td>
<td>Average input current monitored over 15-60 minutes rolling average (user defined)</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Percent Load Utilization (%)</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2);</td>
<td>0.1%</td>
<td>Percentage of maximum circuit breaker current utilization. Requires personalization of circuit breaker current rating</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Voltage Source 1 and 2 (VAC):</td>
<td>A, B, C Phase (L-L, L-N) – source 1; A, B, C Phase (L-L, L-N) – source 2</td>
<td>0.1 VAC</td>
<td>Input source voltage(s)</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Crest Factor (Peak A RMS):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2);</td>
<td>0.001 A</td>
<td>Peak waveform current divided by average RMS current of the waveform; per phase</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Real Power (kW):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2);</td>
<td>0.01 kW</td>
<td>kW (real power) per phase</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Apparent Power (kVA):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2);</td>
<td>0.01 kVA</td>
<td>kVA (apparent power) per phase</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Reactive Power (kVAR):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2);</td>
<td>0.01 kVAR</td>
<td>kVAR (reactive power) per phase</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Power Factor (PF):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2);</td>
<td>0.01 PF</td>
<td>Load Power Factor per phase</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Energy Usage (kWh):</td>
<td>A, B, C (circuit breaker 1); A, B, C (circuit breaker 2);</td>
<td>0.01 kW</td>
<td>Energy consumption per phase</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Total Harmonic Distortion (%THD):</td>
<td>A, B, C Phase (source1); A, B, C Phase (source2);</td>
<td>0.1%</td>
<td>Total Harmonic Distortion (load) per phase measured to 3rd, 5th, 7th, 9th, 11th, 13th harmonics</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Frequency (Hz):</td>
<td>A phase (40 – 70 Hz)</td>
<td>0.1 Hz</td>
<td>Source frequency as measured from phase A</td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>

1Neutral and Ground currents may be monitored in addition to phase currents; see note on neutral and ground current monitoring.
### ALARM PARAMETERS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>DESCRIPTION</th>
<th>NOTES</th>
<th>BCMS BASIC</th>
<th>BCMS PLUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Warning Alarm:</td>
<td>A, B, C (circuit breaker 1), A, B, C (circuit breaker 2)</td>
<td>Indicates current exceeds user defined threshold (expressed as a percentage of circuit breaker rating). Default rating is 70% of breaker capacity. Alarm activates after a user defined time limit (default is 0 seconds)</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Current High Alarm:</td>
<td>A, B, C (circuit breaker 1), A, B, C (circuit breaker 2)</td>
<td>Indicates current exceeds user defined threshold (expressed as a percentage of circuit breaker rating). Default rating is 85% of breaker capacity. Alarm activates after a user defined time limit (default is 10 seconds)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Global Alarms:</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Current Warning Alarm</td>
<td></td>
<td>Indicates if any current warning alarm is active.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>High Current Alarm</td>
<td></td>
<td>Indicates if any high current alarm is active</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Overvoltage Alarm</td>
<td></td>
<td>Indicates if any over voltage alarm is active</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Undervoltage Alarm</td>
<td></td>
<td>Indicates if any under voltage alarm is active</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Overvoltage Alarm:</td>
<td>IL-N Voltage</td>
<td>Indicates voltage exceeds user defined threshold</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Undervoltage Alarm:</td>
<td>IL-N Voltage</td>
<td>Indicates voltage is below user defined threshold</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Digital Input Alarm:</td>
<td>Digital inputs 1, 2, 3, 4</td>
<td>Indicates closed status of dry contact digital inputs (for customer use)</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
### BCMS Basic = Current Only

### BCMS Plus = Current + Voltage

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>DESCRIPTION</th>
<th>RESOLUTION</th>
<th>NOTES</th>
<th>BCMS BASIC</th>
<th>BCMS PLUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit Breaker Size:</td>
<td>Source circuit breaker rating</td>
<td>1 A</td>
<td>Defines source circuit breaker rating; default is 250 A (1 A increments); 50-600 A range</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Warning Time Delay:</td>
<td>Time (seconds) before warning alarm activates</td>
<td>0-60 seconds</td>
<td>Defines duration current must exceed threshold before activating a current; default is 0 seconds warning alarm;</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Alarm Time Delay:</td>
<td>Time (seconds) before alarm activates</td>
<td>0-60 seconds</td>
<td>Defines duration current must exceed threshold before activating a high current alarm; default is 10 seconds</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Demand Average Time:</td>
<td>Time (seconds) to determine average current</td>
<td>1 second</td>
<td>Defines time by which average current is determined; default is 15 seconds; range is 15-60 seconds</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Current Warning Alarm:</td>
<td>Circuit breaker current first level alarm threshold</td>
<td>40-100%</td>
<td>Defines threshold based on a percentage of circuit breaker rating (default is 70%) to activate current warning alarm after a time delay (default is zero seconds).</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Current High Alarm:</td>
<td>Circuit breaker current second level alarm threshold</td>
<td>50-100%</td>
<td>Defines threshold based on a percentage of circuit breaker rating (default is 85%) to activate high current alarm after a time delay (default is 10 seconds).</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Frequency:</td>
<td>Source frequency</td>
<td>0.1 Hz</td>
<td>Defines frequency (60 Hz or 50 Hz)</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Board Name Personalization</td>
<td>User defined device name</td>
<td>16 Char</td>
<td>Device name; 16 Character maximum</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Overvoltage Alarm:</td>
<td>High voltage detected on source</td>
<td>0.1 V</td>
<td>Defines voltage to activate over voltage alarm</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Undervoltage Alarm:</td>
<td>Low voltage detected on source</td>
<td>0.1 V</td>
<td>Defines voltage to activate under voltage alarm</td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX C: BUS MONITORING SYSTEM SCHEMATIC DIAGRAMS

BRANCH CIRCUIT MONITORING SYSTEM BOARD INTERCONNECTION

Figure 56 - Branch Circuit Monitoring System Board Interconnection
INPUT POWER MONITOR BOARD TO END FEED CURRENT TRANSFORMERS CONNECTIONS

See Figure 57 - Input Power Monitor Board to End Feed Current Transformers Schematic
See Figure 58 - End Feed Input Power Monitor Board for Connector Locations.

J10 Connector

Figure 57 - Input Power Monitor Board to End Feed Current Transformers Schematic
The Black wire goes to X1 on CT. The White wire to other CT terminal (X2).

H1 marking on CT faces customer power source (See Figure 59 Below).
## APPENDIX D: POINTS LIST FOR THE END FEED INPUT PM PCB

All Modbus variables are stored in 16-bit integer format.

<table>
<thead>
<tr>
<th>#</th>
<th>R/W</th>
<th>NV</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>R/W</td>
<td>Main</td>
<td>Voltage1, phase AB</td>
</tr>
<tr>
<td>2</td>
<td>R/W</td>
<td>Main</td>
<td>Voltage1, phase BC</td>
</tr>
<tr>
<td>3</td>
<td>R/W</td>
<td>Main</td>
<td>Voltage1, phase CA</td>
</tr>
<tr>
<td>4</td>
<td>R/W</td>
<td>Main</td>
<td>Voltage1, phase AN</td>
</tr>
<tr>
<td>5</td>
<td>R/W</td>
<td>Main</td>
<td>Voltage1, phase BN</td>
</tr>
<tr>
<td>6</td>
<td>R/W</td>
<td>Main</td>
<td>Voltage1, phase CN</td>
</tr>
<tr>
<td>7</td>
<td>R/W</td>
<td>Main</td>
<td>Voltage2, phase AB</td>
</tr>
<tr>
<td>8</td>
<td>R/W</td>
<td>Main</td>
<td>Voltage2, phase BC</td>
</tr>
<tr>
<td>9</td>
<td>R/W</td>
<td>Main</td>
<td>Voltage2, phase CA</td>
</tr>
<tr>
<td>10</td>
<td>R/W</td>
<td>Main</td>
<td>Voltage2, phase AN</td>
</tr>
<tr>
<td>11</td>
<td>R/W</td>
<td>Main</td>
<td>Voltage2, phase BN</td>
</tr>
<tr>
<td>12</td>
<td>R/W</td>
<td>Main</td>
<td>Voltage2, phase CN</td>
</tr>
</tbody>
</table>

An Over Voltage Alarm occurs if the Any L-N voltage is greater than this threshold register at any time and is given in tenths of a volt (1200 = 120.0 Volts). For Defaults see the Voltage Type register.

| 13 | R/W | NV | Over Voltage Alarm Threshold Main |

An Under Voltage Alarm occurs if the Any L-N voltage is less than this threshold register at any time and is given in tenths of a volt (1200 = 120.0 Volts). For Defaults see the Voltage Type register.

| 14 | R/W | NV | Under Voltage Alarm Threshold Main |

Frequency is measured from the phase A voltage input. Range is 40.0-70.0Hz: This register will read as 0xFFFF if frequencies outside of this range or if sufficient voltage is not present on phase A for an accurate determination.

| 15 | R   | Frequency |

These registers show Total Harmonic Distortion (THD) calculations and are given in tenth of a percent (01 = 0.1%).

| 16 | R   | Main | Voltage1, phase A THD |
| 17 | R   | Main | Voltage1, phase B THD |
| 18 | R   | Main | Voltage1, phase C THD |
| 19 | R   | Main | Voltage2, phase A THD |
| 20 | R   | Main | Voltage2, phase B THD |
| 21 | R   | Main | Voltage2, phase C THD |
This register shows what Voltage values that are being read by this board.

Note: Maximum Minimum Default Limits for each Voltage Type are:

<table>
<thead>
<tr>
<th>Voltage Type</th>
<th>Phase to Phase High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>208</td>
<td>239</td>
<td>177</td>
</tr>
<tr>
<td></td>
<td>138</td>
<td>102</td>
</tr>
<tr>
<td>380</td>
<td>437</td>
<td>323</td>
</tr>
<tr>
<td></td>
<td>252</td>
<td>186</td>
</tr>
<tr>
<td>400</td>
<td>460</td>
<td>340</td>
</tr>
<tr>
<td></td>
<td>265</td>
<td>196</td>
</tr>
<tr>
<td>415</td>
<td>518</td>
<td>383</td>
</tr>
<tr>
<td></td>
<td>299</td>
<td>221</td>
</tr>
<tr>
<td>480</td>
<td>552</td>
<td>408</td>
</tr>
<tr>
<td></td>
<td>319</td>
<td>236</td>
</tr>
<tr>
<td>600</td>
<td>690</td>
<td>510</td>
</tr>
<tr>
<td></td>
<td>398</td>
<td>295</td>
</tr>
</tbody>
</table>

If your voltage is between the limits, pick the Higher Limit.

22. R/W NV Voltage Type (208, 380, 400, 415, 480, 600)

This register shows the setting for the Voltage monitoring setup. A set bit indicated active value.

23. R/W NV Voltage Option Setting

- bit 0: Voltage option side 1 set
- bit 1: Voltage option side 2 set
- bit 2: Set for 50 Hz
- bit 3: Auto Adjust Gain
- bits 4 – 15: Not Used Always read as 0

These registers show the phase currents and are given in tenth of amps (100 = 10.0 Amps)

Note: For Neutral and Ground options see Current Options and read the note with these options.

24. R/W Current, Phase 1A
25. R/W Current, Phase 1B
26. R/W Current, Phase 1C
27. R/W Current, Side 1 Neutral (option)
28. R/W Current, Side 1 Ground (option)
29. R/W Current, Phase 2A
30. R/W Current, Phase 2B
31. R/W Current, Phase 2C
32. R/W Current, Side 2 Neutral (option)
33. R/W Current, Side 2 Ground (option)
34. R Current, Phases 1A & 2A
35. R Current, Phases 1B & 2B
36. R Current, Phases 1C & 2C

These registers show the minimum phase currents and are in tenth of amps (100 = 10.0 Amps)

37. R Minimum Current, Phase 1A
38. R Minimum Current, Phase 1B
39. R Minimum Current, Phase 1C
40. R Minimum Current, Phase 1N
41. R Minimum Current, Phase 1G
42. R Minimum Current, Phase 2A
43. R Minimum Current, Phase 2B
44. R Minimum Current, Phase 2C
45. R Minimum Current, Phase 2N
46. R Minimum Current, Phase 2G
47. R Minimum Current, Phases 1A & 2A
48. R Minimum Current, Phases 1B & 2B
49. R Minimum Current, Phases 1C & 2C

These registers show the maximum phase currents and are in tenth of amps (100 = 10.0 Amps)

| 50. R | Maximum Current, Phase 1A |
| 51. R | Maximum Current, Phase 1B |
| 52. R | Maximum Current, Phase 1C |
| 53. R | Maximum Current, Phase 1N |
| 54. R | Maximum Current, Phase 1G |
| 55. R | Maximum Current, Phase 2A |
| 56. R | Maximum Current, Phase 2B |
| 57. R | Maximum Current, Phase 2C |
| 58. R | Maximum Current, Phase 2N |
| 59. R | Maximum Current, Phase 2G |
| 60. R | Maximum Current, Phases 1A & 2A |
| 61. R | Maximum Current, Phases 1B & 2B |
| 62. R | Maximum Current, Phases 1C & 2C |

Writing this register will reset the current Min and Max registers to the current value.

63. W Min/Max Reset

These registers set the capacity of full load allowed for the alarms. Units are in Amps (125 = 125 Amps). The Values that are written must be between 100 and 650. The Default is 250 Amps

| 64. R/W | NV Full Load Side One |
| 65. R/W | NV Full Load Side Two |

These registers show current demand per phase and are in tenth of amps (262 = 26.2 Amps). Values are the average current over the time given in the Demand Register.

| 66. R | Demand phase 1A |
| 67. R | Demand phase 1B |
| 68. R | Demand phase 1C |
| 69. R | Demand phase 2A |
| 70. R | Demand phase 2B |
| 71. R | Demand phase 2C |

The Demand Register is time that the demand is averaged over in minutes. It must be between 10 to 60 minutes. The Default is 15 minutes.

| 72. R/W | NV | Demand time |

These registers show Percent load and is given in tenth of a percent (753 = 75.3%). These percents are the Amps per phase divided by the full load of that side.

| 73. R | Percent load phase 1A |
| 74. R | Percent load phase 1B |
| 75. R | Percent load phase 1C |
| 76. R | Percent load phase 2A |
| 77. R | Percent load phase 2B |
78. R Percent load phase 2C

These registers show crest factor per phase. Values are peak current/rms current with three decimal places (1412 = 1.412).

79. R Crest Factor phase 1A
80. R Crest Factor phase 1B
81. R Crest Factor phase 1C
82. R Crest Factor phase 2A
83. R Crest Factor phase 2B
84. R Crest Factor phase 2C

The following Warning Register sets a bit for every channel, which reads a current above the Warning Threshold for at least the Warning Time-Delay. All warnings are latching and must be reset by the controller. To reset any alarm, read the register and then write the register with the desired alarm bit cleared.

85. R/W NV Warning Register (Latching)
   bit 0: Phase 1A
   bit 1: Phase 1B
   bit 2: Phase 1C
   bit 3: Phase 2A
   bit 4: Phase 2B
   bit 5: Phase 2C
   bits 6 – 15: Not Used Always read as 0

The following Alarm Register sets a bit for every channel, which reads a current above the Alarm Threshold for at least the Alarm Time-Delay. All alarms are latching and must be reset by the controller. To reset any alarm, read the register and then write the register with the desired alarm bit cleared.

86. R/W NV Alarm Register (Latching)
   bit 0: Phase 1A
   bit 1: Phase 1B
   bit 2: Phase 1C
   bit 3: Phase 2A
   bit 4: Phase 2B
   bit 5: Phase 2C
   bits 6 – 15: Not Used Always read as 0

The following Warning Threshold register sets the thresholds for the Warning alarms. A Warning alarm is given in percent of the Full load registers (75 = 75%). A Warning alarm will occur if the measured current is above the Warning Threshold for at least the Warning Time Delay. Default for the Warning thresholds is 70%. The Values that are written to the Warning Threshold must be between 40 and 100 and always below the corresponding Alarm Threshold.

87. R/W NV Warning Threshold

The following Alarm Threshold registers set the thresholds for the Alarms. An Alarm Threshold register is given in percent of the Full Load registers (85 = 85%). An Alarm will occur if the measured current is above the Alarm Threshold for at least the Alarm Time Delay. Default for the Alarm thresholds is 80%. The Values that are written to the Alarm Threshold must be between 50 and 100 and always above the corresponding Warning Threshold.

88. R/W NV Alarm Threshold
The Warning Time Delay register set the minimum time required for the current to exist above the Warning Threshold before the Warning alarm is set. Units are in seconds. The Values that are written to the Warning Time Delays must be between 0-60. The Default is 0 (zero) which means that there is no delay for the Warning alarm.

89. R/W NV Warning Time Delay

The Alarm Time Delay register set the minimum time required for the current to exist above the alarm Threshold before the Alarm is set. Units are in seconds. The Values that are written to the Alarm Time Delays must be between 0-60. The Default is 10 which means that there is ten seconds before an Alarm is given.

90. R/W NV Alarm Time Delay

This register provides a quick status of alarms for the unit. A bit in this register is set if any bit in the indicated register is set.

91. R NV Global Warning/Alarm Register
   bit 0: Warning Register
   bit 1: Alarm Register
   bit 2: Over Voltage Side 1
   bit 3: Under Voltage Side 1
   bit 4: Over Voltage Side 2
   bit 5: Under Voltage Side 2
   bits 4 – 15: Not Used Always read as 0

These alarms are latching and must be cleared by the user. To reset any alarm, read the register and then write the register with the desired alarm bit cleared. Writing a 1 to any bit has no effect.

92. R/W NV Meter Alarm Status (Latching)
   bit 0: Over Voltage Phase A Side 1
   bit 1: Over Voltage Phase B Side 1
   bit 2: Over Voltage Phase C Side 1
   bit 3: Under Voltage Phase A Side 1
   bit 4: Under Voltage Phase B Side 1
   bit 5: Under Voltage Phase C Side 1
   bit 6: Over Voltage Phase A Side 2
   bit 7: Over Voltage Phase B Side 2
   bit 8: Over Voltage Phase C Side 2
   bit 9: Under Voltage Phase A Side 2
   bit 10: Under Voltage Phase B Side 2
   bit 11: Under Voltage Phase C Side 2
   bits 10 – 15: Not Used Always read as 0

This register is the four Digital alarm that can be used by the customer.

93. R Digital alarm status
   bit 0: Digital alarm 1
   bit 1: Digital alarm 2
   bit 2: Digital alarm 3
   bit 3: Digital alarm 4
   bits 4 – 15: Not Used Always read as 0
129. $R$ Power Factor, Phase 1B & 2B
130. $R$ Power Factor, Phase 1C & 2C

These registers are circuit Phase Kilowatt Hours per phase. Values are in kilowatts hours (90 = 90kwh) For KWH 32-bit value multiply High-word integer by $2^{16}$ (65536) and add Low-word integer.

131. $R$ NV KWH High-word integer, Phase 1A
132. $R$ NV KWH Low-word integer, Phase 1A
133. $R$ NV KWH High-word integer, Phase 1B
134. $R$ NV KWH Low-word integer, Phase 1B
135. $R$ NV KWH High-word integer, Phase 1C
136. $R$ NV KWH Low-word integer, Phase 1C
137. $R$ NV KWH High-word integer, Phase 2A
138. $R$ NV KWH Low-word integer, Phase 2A
139. $R$ NV KWH High-word integer, Phase 2B
140. $R$ NV KWH Low-word integer, Phase 2B
141. $R$ NV KWH High-word integer, Phase 2C
142. $R$ NV KWH Low-word integer, Phase 2C
143. $R$ NV KWH High-word integer, Phase 1A & 2A
144. $R$ NV KWH Low-word integer, Phase 1A & 2A
145. $R$ NV KWH High-word integer, Phase 1B & 2B
146. $R$ NV KWH Low-word integer, Phase 1B & 2B
147. $R$ NV KWH High-word integer, Phase 1C & 2B
148. $R$ NV KWH Low-word integer, Phase 1C & 2C

Writing this register will reset all KWH registers to zero.

149. $W$ KWH Reset
150. $R$ Board Voltage

This register shows whether this Modbus address is communicating.

151. $R$ Communication Error

These registers show the PM Input Board name as sixteen characters long and are compacted into eight integers or two characters per integer.

152. $R/W$ NV PM Input Board Name
   bit 0-7 Char 2
   bit 8-15 Char 1
153. $R/W$ NV PM Input Board Name
   bit 0-7 Char 4
   bit 8-15 Char 3
154. $R/W$ NV PM Input Board Name
   bit 0-7 Char 6
   bit 8-15 Char 5
155. $R/W$ NV PM Input Board Name
   bit 0-7 Char 8
   bit 8-15 Char 7
156. $R/W$ NV PM Input Board Name
   bit 0-7 Char 10
   bit 8-15 Char 9
157. $R/W$ NV PM Input Board Name
   bit 0-7 Char 12
   bit 8-15 Char 11
158. R/W NV PM Input Board Name  
    bit 0-7 Char 14  
    bit 8-15 Char 13

159. R/W NV PM Input Board Name  
    bit 0-7 Char 16  
    bit 8-15 Char 15

Note: The value of any option that is not selected will be given as a -1 (65535)
## APPENDIX E: POINTS LIST FOR THE TAP OF BOX INTELLIBUS BOARD

All Modbus variables are stored in 16-bit integer format.

### #  
<table>
<thead>
<tr>
<th></th>
<th>R/W</th>
<th>NV</th>
<th>Description</th>
</tr>
</thead>
</table>

These registers show the Main voltages and are in tenths of a volt (1215 = 121.5 Amps)

1. R/W Main Voltage, phase A-B
2. R/W Main Voltage, phase B-C
3. R/W Main Voltage, phase C-A
4. R/W Main Voltage, phase A-N
5. R/W Main Voltage, phase B-N
6. R/W Main Voltage, phase C-N

An Over Voltage Alarm occurs if the Any L-N voltage is greater than this threshold register at any time and is given in tenths of a volt (1200 = 120.0 Volts). Default is 200.0 VAC

7. R/W NV Over Voltage Alarm Threshold Main

An Under Voltage Alarm occurs if the Any L-N voltage is less than this threshold register at any time and is given in tenths of a volt (1200 = 120.0 Volts) Default is 60.0 Volts.

8. R/W NV Under Voltage Alarm Threshold Main

Frequency is measured from the phase A voltage input. Range is 40.0-70.0Hz. This register will read as 0xFFFF if frequencies outside of this range or if sufficient voltage is not present on phase A for an accurate determination.

9. R Frequency

These registers show Total Harmonic Distortion (THD) calculations and are given in tenth of a percent (01 = 0.1%).

10. R Main Voltage1, phase A THD
11. R Main Voltage1, phase B THD
12. R Main Voltage1, phase C THD

This register shows what Voltage values that are being read by this board.

<table>
<thead>
<tr>
<th>Voltage Type</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>208 Phase to Phase Neutral</td>
<td>239</td>
<td>177</td>
</tr>
<tr>
<td>380 Phase to Phase</td>
<td>437</td>
<td>323</td>
</tr>
<tr>
<td>400 Phase to Phase Neutral</td>
<td>252</td>
<td>186</td>
</tr>
<tr>
<td>415 Phase to Phase Neutral</td>
<td>518</td>
<td>383</td>
</tr>
<tr>
<td>480 Phase to Phase Neutral</td>
<td>552</td>
<td>408</td>
</tr>
<tr>
<td>600 Phase to Phase Neutral</td>
<td>690</td>
<td>510</td>
</tr>
</tbody>
</table>

Note Maximum Minimum Default Limits for each Voltage Type are:
If your voltage is between the limits, pick the Higher Limit.

13. 

| R/W | NV | Voltage Type (208, 380, 400, 415, 480, 600) |

This register shows the setting for the Voltage monitoring setup. A set bit indicated active value.

14. 

| R/W | NV | Voltage Option Setting |

bit 0: Voltage option set  
bit 1: Set for 50 Hz  
bit 2: External LED blink  
bit 3: Auto Adjust Gain.  
bits 4 – 15: Not Used Always read as 0

These registers show the phase currents and are given in tenth of amps (100 = 10.0 Amps)  
NOTE: If there are three two phase breakers, the center breaker’s current will be showed as Current, Breaker 1C & 2A.

15. 

| R/W | Current, Breaker 1A |
16. 

| R/W | Current, Breaker 1B |
17. 

| R/W | Current, Breaker 1C |
18. 

| R/W | Current, Breaker 2A |
19. 

| R/W | Current, Breaker 2B |
20. 

| R/W | Current, Breaker 2C |
21. 

| R | Current, Breakers 1A & 2A |
22. 

| R | Current, Breakers 1B & 2B |
23. 

| R | Current, Breakers 1C & 2C |

These registers show the minimum phase currents and are in tenth of amps (100 = 10.0 Amps). For three two phase breakers, see Note on the Current Points above.

24. 

| R | Minimum Current, Breaker 1A |
25. 

| R | Minimum Current, Breaker 1B |
26. 

| R | Minimum Current, Breaker 1C |
27. 

| R | Minimum Current, Breaker 2A |
28. 

| R | Minimum Current, Breaker 2B |
29. 

| R | Minimum Current, Breaker 2C |
30. 

| R | Minimum Current, Breakers 1A & 2A |
31. 

| R | Minimum Current, Breakers 1B & 2B |
32. 

| R | Minimum Current, Breakers 1C & 2C |

These registers show the maximum phase currents and are in tenth of amps (100 = 10.0 Amps). For three two phase breakers, see Note on the Current Points above.

33. 

| R | Maximum Current, Breaker 1A |
34. 

| R | Maximum Current, Breaker 1B |
35. 

| R | Maximum Current, Breaker 1C |
36. 

| R | Maximum Current, Breaker 2A |
37. 

| R | Maximum Current, Breaker 2B |
38. 

| R | Maximum Current, Breaker 2C |
39. 

| R | Maximum Current, Breakers 1A & 2A |
40. 

| R | Maximum Current, Breakers 1B & 2B |
41. 

| R | Maximum Current, Breakers 1C & 2C |

Writing to this register will reset all Min and Max registers to currents present value.
The following Breaker Size Registers set the capacity of each breaker for the alarms. Units are in Amps (20 = 20 Amps). The values that can be written are between 15 and 100. The Default value is -1 (65535). If the breaker is -1 (65535) then no alarm for this breaker will be given. This can be done by giving the breaker a size 0. For three two phase breakers, see Note on the Current Points above.

Writing to this register will set all the Breakers size registers to the value written. The Values that are written to the Breaker sizes must be either zero or between 15 and 100. To remove all breakers, give a value of 0. This register should always read 0.

These registers show current demand per phase and are in tenth of amps (260 = 26.0 Amps). Values are the average current over the time given in the Demand Register.

The Demand Register is time that the demand is averaged over in minutes. It must be between 15 to 60 minutes. The Default is 15 minutes.

These registers show Percent load and is given in tenth of a percent (753 = 75.3%). These percents are the Amps per phase divided by the breaker size of the same phase.

These registers show crest factor per phase. Values are peak current/rms current with three decimal places (1412 = 1.412).
The following Zero Current Registers set a bit for every channel, which reads a current that has gone to zero. All alarms are active until reset by the controller, or the current returns to the channel. To reset any alarm, read the register and then write the register with the desired alarm bit cleared.

Note: Current Loss is when the current goes above 1.5 Amps and then goes to zero an alarm is set for that branch breaker. If bit 15 on the Current Option Setting is set the alarm will be active on the loss of current.

69. **R/W NV** Zero Current Register
   - bit 0: Breaker 1A
   - bit 1: Breaker 1B
   - bit 2: Breaker 1C
   - bit 3: Breaker 2A
   - bit 4: Breaker 2B
   - bit 5: Breaker 2C
   - bits 6 – 15: Not Used Always read as 0

The following Warning Register sets a bit for every channel, which reads a current above the Warning Threshold for at least the Warning Time-Delay. All warnings are latching and must be reset by the controller. To reset any alarm, read the register and write the register with the desired alarm bit cleared.

70. **R/W NV** Warning Register (Latching)
   - bit 0: Breaker 1A
   - bit 1: Breaker 1B
   - bit 2: Breaker 1C
   - bit 3: Breaker 2A
   - bit 4: Breaker 2B
   - bit 5: Breaker 2C
   - bits 6 – 15: Not Used Always read as 0

The following Alarm Register sets a bit for every channel, which reads a current above the Alarm Threshold for at least the Alarm Time-Delay. All alarms are latching and must be reset by the controller. To reset any alarm, read the register and then write the register with the desired alarm bit cleared.

71. **R/W NV** Alarm Register (Latching)
   - bit 0: Breaker 1A
   - bit 1: Breaker 1B
   - bit 2: Breaker 1C
   - bit 3: Breaker 2A
   - bit 4: Breaker 2B
   - bit 5: Breaker 2C
   - bits 6 – 15: Not Used Always read as 0

The following Warning Threshold register sets the thresholds for the Warning alarms. A Warning alarm is given in percent of the breaker size registers for each phase (75 = 75%). A Warning alarm will occur if the measured current is above the Warning Threshold for at least the Warning Time Delay. Default for the Warning thresholds is 70%. The Values that are written to the Warning Threshold must be between 40 and 100 and always below the corresponding Alarm Threshold.

72. **R/W NV** Warning Threshold

The following Alarm Threshold registers set the thresholds for the Alarms. A Alarm Threshold register is given in percent of the breaker size registers for each phase (85 = 85%). An Alarm will occur if the Series
measured current is above the Alarm Threshold for at least the Alarm Time Delay. Default for the Alarm
thresholds is 80%. The Values that are written to the Alarm Threshold must be between 50 and 100 and
always above the corresponding Warning Threshold.

73. R/W NV Alarm Threshold

The Warning Time Delay register set the minimum time required for the current to exist above the Warning
Threshold before the Warning alarm is set. Units are in seconds. The Values that are written to the Warning
Time Delays must be between 0-60. The Default is 0 (zero) which means that there is no delay for the Warning
alarm.

74. R/W NV Warning Time Delay

The Alarm Time Delay register set the minimum time required for the current to exist above the alarm
Threshold before the Alarm is set. Units are in seconds. The Values that are written to the Alarm Time Delays
must be between 0-60. The Default is 10 which means that there is ten seconds before an Alarm is given.

75. R/W NV Alarm Time Delay

This register provides a quick status of alarms for the unit. A bit in this register is set if any bit in the indicated
register is set.

76. R NV Global Alarm Register

bit 0: Warning Register
bit 1: Alarm Register
bit 2: Zero Current Register
bit 3: Over Voltage
bit 4: Under Voltage
bit 5: Over Temperature
bit 6: Under Temperature
bits 7 – 15: Not Used Always read as 0

These alarms are latching and must be cleared by the user. To reset any alarm, read the register and then
write the register with the desired alarm bit cleared. Writing a 1 to any bit has no effect.

77. R/W NV Meter Alarm Status (Latching)

bit 0: Over Voltage Phase A
bit 1: Over Voltage Phase B
bit 2: Over Voltage Phase C
bit 3: Under Voltage Phase A
bit 4: Under Voltage Phase B
bit 5: Under Voltage Phase C
bit 6: Over Temperature Board
bit 7: Over Temperature 1
bit 8: Over Temperature 2
bit 9: Over Temperature 3
bit 10: Over Temperature 4
bit 11: Under Temperature Board
bit 12: Under Temperature 1
bit 13: Under Temperature 2
bit 14: Under Temperature 3
bit 15: Under Temperature 4

This register shows the setting for the Temperature and Current monitoring setup. A set bit indicated active value.

78. R/W NV Current Option Setting
    bit 0: Flip Current for Strip 1
    bit 1: Flip Current for Strip 2
    bit 2: Temperature in Fahrenheit
    bits 3 – 14: Not Used Always read as 0
    bit 15 Current Loss

These registers show the KW and are in hundredth of KW (500 = 5.00 KW)
79. R KW, Breaker 1A
80. R KW, Breaker 1B
81. R KW, Breaker 1C
82. R KW, Breaker 2A
83. R KW, Breaker 2B
84. R KW, Breaker 2C
85. R KW, Breakers 1A & 2A
86. R KW, Breakers 1B & 2B
87. R KW, Breakers 1C & 2C

KVA Registers 88-96 are in hundredth of KVA (500 = 5.00 KVA)
88. R KVA, Breaker 1A
89. R KVA, Breaker 1B
90. R KVA, Breaker 1C
91. R KVA, Breaker 2A
92. R KVA, Breaker 2B
93. R KVA, Breaker 2C
94. R KVA, Breakers 1A & 2A
95. R KVA, Breakers 1B & 2B
96. R KVA, Breakers 1C & 2C

KVAR Registers 97-105 are in hundredth of KVAR (500 = 5.00 KVAR)
97. R KVAR, Breaker 1A
98. R KVAR, Breaker 1B
99. R KVAR, Breaker 1C
100. R KVAR, Breaker 2A
101. R KVAR, Breaker 2B
102. R KVAR, Breaker 2C
103. R KVAR, Breakers 1A & 2A
104. R KVAR, Breakers 1B & 2B
105. R KVAR, Breakers 1C & 2C

Power Factor Registers 106-114 are in hundredth of PF (98 = 0.98 PF)
106. R Power Factor, Breaker 1A
107. R Power Factor, Breaker 1B
108. R Power Factor, Breaker 1C
109. R Power Factor, Breaker 2A
110. R Power Factor, Breaker 2B
111. R Power Factor, Breaker 2C
112. R Power Factor, Breaker 1A & 2A
Power Factor, Breaker 1B & 2B
Power Factor, Breaker 1C & 2C

These registers are circuit Phase Kilowatt Hours per phase. Values are in kilowatts hours (90 = 90kwh) For KWH 32-bit value multiply High-word integer by $2^{16}$ (65536) and add Low-word integer.

115. R NV KWH High-word integer, Breaker 1A
116. R NV KWH Low-word integer, Breaker 1A
117. R NV KWH High-word integer, Breaker 1B
118. R NV KWH Low-word integer, Breaker 1B
119. R NV KWH High-word integer, Breaker 1C
120. R NV KWH Low-word integer, Breaker 1C
121. R NV KWH High-word integer, Breaker 1A & 2A
122. R NV KWH Low-word integer, Breaker 1A & 2A
123. R NV KWH High-word integer, Breaker 1B & 2B
124. R NV KWH Low-word integer, Breaker 1B & 2B
125. R NV KWH High-word integer, Breaker 1C & 2C
126. R NV KWH Low-word integer, Breaker 1C & 2C

Writing this register will reset all KWH registers to zero.

133. W KWH Reset

Bus connection temperature given in degrees Celsius (24 = 24 ºC) or Fahrenheit (75 = 75 ºF).

134. R Temperature Board
135. R Temperature 1
136. R Temperature 2
137. R Temperature 3
138. R Temperature 4
139. R Max Temperature Board
140. R Max Temperature 1
141. R Max Temperature 2
142. R Max Temperature 3
143. R Max Temperature 4
144. R Min Temperature Board
145. R Min Temperature 1
146. R Min Temperature 2
147. R Min Temperature 3
148. R Min Temperature 4

This register gives the over temperature threshold for the board given in degrees Celsius (24 = 24 ºC) or Fahrenheit (75 = 75 ºF). Default for Temperature threshold for board is 80 ºC and for the Bus Temperature thresholds is 120 ºC.

149. R/W Over Temperature threshold
150. R/W Under Temperature threshold
This register shows the IBus board sources voltage
151.  R   IBus Board Voltage

This register shows whether this Modbus address is communicating.
152.  R   Communication Error

These registers show the IBus unit name as sixteen characters long and are compacted into eight integers or two characters per integer.

153.  R/W  NV   IBus Board Name
      bit 0-7  Char 2
      bit 8-15 Char 1
154.  R/W  NV   IBus Board Name
      bit 0-7  Char 4
      bit 8-15 Char 3
155.  R/W  NV   IBus Board Name
      bit 0-7  Char 6
      bit 8-15 Char 5
156.  R/W  NV   IBus Board Name
      bit 0-7  Char 8
      bit 8-15 Char 7
157.  R/W  NV   IBus Board Name
      bit 0-7  Char 10
      bit 8-15 Char 9
158.  R/W  NV   IBus Board Name
      bit 0-7  Char 12
      bit 8-15 Char 11
159.  R/W  NV   IBus Board Name
      bit 0-7  Char 14
      bit 8-15 Char 13
160.  R/W  NV   IBus Board Name
      bit 0-7  Char 16
      bit 8-15 Char 15

Note: The value of any option that is not selected will be given as a -1 (65535)
APPENDIX F: SPECIFICATIONS

GENERAL

Operating Temp. Range: -10° to 60° C at 95% Relative Humidity (Non-Condensing)
Storage Temp. Range: -40° C to 70° C
Input Power (Power Supply Input): Maximum Ratings @ 50/60 Hz

<table>
<thead>
<tr>
<th>Input VAC</th>
<th>Input Amps</th>
</tr>
</thead>
<tbody>
<tr>
<td>480</td>
<td>220 mA</td>
</tr>
<tr>
<td>380</td>
<td>270 mA</td>
</tr>
<tr>
<td>240</td>
<td>430 mA</td>
</tr>
<tr>
<td>208</td>
<td>500 mA</td>
</tr>
<tr>
<td>120</td>
<td>860 mA</td>
</tr>
</tbody>
</table>

Output Power (Power Supply Output): Maximum Output Ratings - 3A @ 24 VDC

INPUT PM BOARD SPECIFICATIONS

AC Current Channels: 2 X 3 Phase (A,B,C,N,G); CT determines current
AC Voltage Channels: 2 X 3 Phase (A,B,C,) 480 VAC max input
Frequency: 50 / 60 Hz
Outputs: 2 X Form C Contacts (5A)

INTELLIBUS BOARD SPECIFICATIONS

Current Channels: 1 X 3 Phase (A,B,C)
Frequency: 50 / 60 Hz
Temperature Inputs: 4 remote temperature probes
Current Accuracy: 1%
Voltage Measurement Range: 0 – 480 VAC
Voltage Accuracy: 1%
NETWORK COMMUNICATIONS

**Type:** Modbus™ RTU (RS 485 4 Wire)

**Upstream Connection:** 1 Terminal Block (16-22 AWG)

**Downstream Connection:** 1 Terminal Block (16-22 AWG)

**Device Address:** Selectable via Commission Software (1 To 247)

**Baud Rate:** 9600 Baud

**Parity:** Even

**Communication Format:** 8 Data Bits, 1 Start Bit, 1 Stop Bit

LISTINGS

**ETL Listings:**

UL/CSA C22.2 – #60950-1, Issue: 03/27/2007, Ed: 2nd

EN 60950-1, Issued: 04/01/2006, Ed: 2, AMD 11 2009/03/01, AMD 1 2010/03/01

EN -61000-6-4-2007, Emission Standard for Industrial Environments

EN-61000-6-2-2005, Immunity Standard for Industrial Environments
APPENDIX G: SERVICE

The GE Service Department is proud to provide support for its broad range of power quality products. Our commitment to servicing these products begins with our START UP service, and continues with our factory Warranty and is continuously maintained through our Preventative Maintenance Contracts.

GE’s STANDARD WARRANTY

GE’s Standard Warranty is good for all products for 18 months following shipment or 12 months after START UP, whichever comes first. After the warranty period is over, customer is on Time & Material basis unless a Preventative Maintenance contract is in effect.

- U.S. – Full Coverage of Parts and Labor
- International – Parts Only Coverage

START UP

GE START UP is recommended for all Series DPB Bus purchased, and is a sure way of getting your power quality equipment up and running as you need it. By following our standard START UP procedures, you can be assured that your power quality equipment will perform to your requirements. Some of the features and benefits are:

- GE START UP services provide a factory-trained customer support engineer to oversee visual inspection of the installation and system calibration.
- Start up timing available
  One Week Normal Business Hours
  (M-F 8AM-5PM) – U.S.
  One Week Overtime Business Hours
  (M-F 5PM-8AM) – U.S.

TRAINING

GE Training is recommended for every installation and is an optional service that can be provided as an introduction to the Series DPB Bus. The training class will encompass installation, configuration of BCMS and maintenance of the Series DPB Bus in a classroom setting and hands on field demonstrations.

EXTENDED WARRANTY

GE extended warranty program provides several benefits for the Series DPB Bus.

- U.S. – Full Coverage of Parts and Labor; 24 hour phone support; preferred customer rates
- International – Parts Only Coverage; 24 hour phone support; preferred customer rates

TIME AND MATERIALS

In most cases the customer will be covered by START UP service or Maintenance Contracts, however, there may be times when the customer needs GE service and lacks the benefits that these two packages provided. Therefore, GE provides Time and Material coverage for those in need of our customer support engineers. These rates will be at a preferred rate for contract customers and include GE trained technicians and engineering support.
**SPARE PARTS**

GE provides a spare parts list based upon customer replaceable units and field replaceable units for each Series DPB Bus solution. GE considers a spare parts inventory a vital component to the sustainability of the Series DPB Bus solution.

<table>
<thead>
<tr>
<th>Qty</th>
<th>Spare Parts Kit Components</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Side Plate</td>
<td>A</td>
</tr>
<tr>
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A. No BCMS

B. BCMS in End Feed Only

C. BCMS in Tap off Box Only

D. BCMS in End Feed and Tap Off Box
APPENDIX H: QUICK INSTALL SHEETS
160A - 400A SPLICE QUICK INSTALL SHEET
TAP OFF BOX QUICK INSTALL SHEET

STEP 1 - Product Identification

STEP 2 - Product Inspection

STEP 3 - Mechanical Installation

Backout Set Screws (2)
Use phillips head screwdriver to back out Set Screws.

Neutral Sticker (Top of Rail)
Front of Tap Off Box

Align Tap Off Box with Bus Rail
Align Front of Tap Off Box with Neutral Side of Bus Rail
NOTE: Place Tap Off Boxes a minimum of 6" from ends of Splices.

Install Tap Off Box
Align Tap Off Box Mast with center channel of Bus Rail and insert until it is firmly seated against the Bus Rail. Check both sides.

Set Actuation Knob to OFF
Ensure the Actuation Lever is in the OFF position on the far left.

Turn Breaker to OFF
Ensure the Breakers are in the OFF position.

Continued Other Side
**STEP 3 - Mechanical Installation (con't)**

- Install Set Screws
  - Screw in Set Screws with phillips head screwdriver to secure Tap Off Box to Bus Rail.

**STEP 4 - Energize Tap Off Boxes**

1. Set Actuation Knob to On
   - Ensure Contact Actuation Lever is in the On position on the far Right. Turn Knob Clockwise to tighten and insert into Keyhole.
   - Turn Breaker to On
   - Switch Breaker to On when ready to test.

**STEP 5 - Tap Off Box Removal**

1. Turn Breaker to Off
   - Ensure the Breaker(s) are in the Off position.
2. Set Actuation Knob to Off
   - Ensure Contact Actuation Lever is in the Off position on the far Left. Turn Knob Counter-Clockwise to loosen and release Knob from Keyhole.
3. Backout Set Screws (2)
   - Use phillips head screwdriver to back out set screws.
4. Remove Tap Off Box
   - Pull down on Tap Off Box to remove.

**If Defective or Damaged**

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**GE Factory Use Only:**

1) Test at GE:
2) Notify GEEngineering:
3) Return Part to Vendor for Assessment:
4) Return Part to Vendor for Credit:

**Ship To:**
RMA - General Electric
Attn: c/o PDI, Nate Carroll
4200 Oakleys Court
Richmond, VA 23223

**NOTES:**

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