Allen Bradley Motor Controls Centers
Advanced Intelligent Motor Control and Protection
IAS/IES Chicago Technical Meeting

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Wesco-Englewood Electric

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AC Drives Considerations
Available Fault Current

- Drives have a limited fault current they can withstand.
- The larger the supply transformer - the greater the available fault current.
- A line reactor or isolation transformer can be used to reduce the available fault current.

If your utility transformer is greater than 10 times drives KVA rating the drive could see a very high current surge on a momentary interruption without adequate impedance.
If your utility transformer is greater than 10 times drives KVA rating the drive could see a very high current surge on a momentary interruption without adequate impedance.
### Line Impedance Recommendations

#### Table 12 - AC Line Impedance Recommendations for PowerFlex 753/755 Drives (continued)

<table>
<thead>
<tr>
<th>Drive</th>
<th>Drive Catalog Number</th>
<th>Volts</th>
<th>kW (Hp)</th>
<th>Max Supply A @ 60Hz</th>
<th>3% Line Reactor Open Style 112t</th>
<th>Reactor Inductance (mH)</th>
<th>Reactor Current Rating (amps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PowerFlex 753</td>
<td>ZOG_D5P0</td>
<td>480</td>
<td>2.2 (3)</td>
<td>500</td>
<td>R4B-B</td>
<td>6.5</td>
<td>4</td>
</tr>
<tr>
<td>For PowerFlex</td>
<td>ZOG_D6P0</td>
<td>480</td>
<td>4.0 (5.5)</td>
<td>500</td>
<td>R4B-B</td>
<td>6.5</td>
<td>8</td>
</tr>
<tr>
<td>755</td>
<td>ZOG_D011</td>
<td>480</td>
<td>5.5 (7.5)</td>
<td>750</td>
<td>R112t-B</td>
<td>2.5</td>
<td>12</td>
</tr>
<tr>
<td>replace 20G</td>
<td>ZOG_D014</td>
<td>480</td>
<td>2.5 (3.3)</td>
<td>750</td>
<td>R112t-B</td>
<td>1.5</td>
<td>10</td>
</tr>
<tr>
<td>with 20R</td>
<td>ZOG_D022</td>
<td>480</td>
<td>11 (15)</td>
<td>750</td>
<td>R5B-5</td>
<td>1.2</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>ZOG_D027</td>
<td>480</td>
<td>15 (20)</td>
<td>750</td>
<td>R5B-5</td>
<td>0.6</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>ZOG_D034</td>
<td>480</td>
<td>18.5 (25)</td>
<td>1000</td>
<td>R5B-5</td>
<td>0.8</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>ZOG_D040</td>
<td>480</td>
<td>22 (30)</td>
<td>1000</td>
<td>R5B-5</td>
<td>0.7</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>ZOG_D052</td>
<td>480</td>
<td>30 (40)</td>
<td>1000</td>
<td>R5B-5</td>
<td>0.5</td>
<td>55</td>
</tr>
<tr>
<td>ZOG_D065</td>
<td>480</td>
<td>37 (50)</td>
<td>1000</td>
<td>R5B-5</td>
<td>0.4</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ZOG_D077</td>
<td>480</td>
<td>45 (60)</td>
<td>1000</td>
<td>R5B-5</td>
<td>0.4</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>ZOG_D096</td>
<td>480</td>
<td>55 (75)</td>
<td>1000</td>
<td>R5B-5</td>
<td>0.3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>ZOG_D10T</td>
<td>480</td>
<td>75 (100)</td>
<td>1000</td>
<td>R5B-5</td>
<td>0.2</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>ZOG_D110</td>
<td>480</td>
<td>75 (100)</td>
<td>1000</td>
<td>R5B-5</td>
<td>0.15</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>ZOG_D156</td>
<td>480</td>
<td>90 (125)</td>
<td>1500</td>
<td>R5B-5</td>
<td>0.15</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>ZOG_D160</td>
<td>480</td>
<td>110 (150)</td>
<td>2000</td>
<td>R5B-5</td>
<td>0.11</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>ZOG_D340</td>
<td>480</td>
<td>150 (200)</td>
<td>3000</td>
<td>R5B360-B</td>
<td>0.075</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>ZOG_D380</td>
<td>480</td>
<td>187 (250)</td>
<td>5000</td>
<td>R5B360-B</td>
<td>0.075</td>
<td>120</td>
</tr>
</tbody>
</table>

#### Table 9 - AC Line Impedance Recommendations for PowerFlex 520-Series Drives

<table>
<thead>
<tr>
<th>Drive</th>
<th>Drive Catalog Number</th>
<th>Volts</th>
<th>kW (Hp)</th>
<th>Max Supply A @ 60Hz</th>
<th>3% Line Reactor Open Style 112t</th>
<th>Reactor Inductance (mH)</th>
<th>Reactor Current Rating (amps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>520D114</td>
<td>480</td>
<td>480</td>
<td>0.6 (0.7)</td>
<td>150</td>
<td>R4B-B</td>
<td>7.5</td>
<td>2</td>
</tr>
<tr>
<td>520D115</td>
<td>480</td>
<td>480</td>
<td>1.2 (1.5)</td>
<td>150</td>
<td>R4B-B</td>
<td>7.5</td>
<td>2</td>
</tr>
<tr>
<td>520D117</td>
<td>480</td>
<td>480</td>
<td>1.5 (1.8)</td>
<td>150</td>
<td>R4B-B</td>
<td>7.5</td>
<td>2</td>
</tr>
<tr>
<td>520D404</td>
<td>480</td>
<td>480</td>
<td>3.2 (4)</td>
<td>150</td>
<td>R4B-B</td>
<td>7.5</td>
<td>2</td>
</tr>
<tr>
<td>520D405</td>
<td>480</td>
<td>480</td>
<td>3.7 (4.5)</td>
<td>150</td>
<td>R4B-B</td>
<td>7.5</td>
<td>2</td>
</tr>
<tr>
<td>520D410</td>
<td>480</td>
<td>480</td>
<td>3.7 (4.5)</td>
<td>150</td>
<td>R4B-B</td>
<td>7.5</td>
<td>2</td>
</tr>
<tr>
<td>520D411</td>
<td>480</td>
<td>480</td>
<td>3.7 (4.5)</td>
<td>150</td>
<td>R4B-B</td>
<td>7.5</td>
<td>2</td>
</tr>
<tr>
<td>520D414</td>
<td>480</td>
<td>480</td>
<td>5.5 (7)</td>
<td>150</td>
<td>R4B-B</td>
<td>7.5</td>
<td>2</td>
</tr>
<tr>
<td>520D417</td>
<td>480</td>
<td>480</td>
<td>5.5 (7)</td>
<td>150</td>
<td>R4B-B</td>
<td>7.5</td>
<td>2</td>
</tr>
<tr>
<td>520D430</td>
<td>480</td>
<td>480</td>
<td>11.5 (15)</td>
<td>300</td>
<td>R5B-5</td>
<td>7.5</td>
<td>18</td>
</tr>
<tr>
<td>520D431</td>
<td>480</td>
<td>480</td>
<td>11.5 (15)</td>
<td>300</td>
<td>R5B-5</td>
<td>7.5</td>
<td>18</td>
</tr>
<tr>
<td>520D434</td>
<td>480</td>
<td>480</td>
<td>15.0 (20)</td>
<td>300</td>
<td>R5B-5</td>
<td>7.5</td>
<td>18</td>
</tr>
<tr>
<td>520D437</td>
<td>480</td>
<td>480</td>
<td>15.0 (20)</td>
<td>300</td>
<td>R5B-5</td>
<td>7.5</td>
<td>18</td>
</tr>
<tr>
<td>520D439</td>
<td>480</td>
<td>480</td>
<td>17.0 (22)</td>
<td>300</td>
<td>R5B-5</td>
<td>7.5</td>
<td>18</td>
</tr>
<tr>
<td>520D440</td>
<td>480</td>
<td>480</td>
<td>17.0 (22)</td>
<td>300</td>
<td>R5B-5</td>
<td>7.5</td>
<td>18</td>
</tr>
<tr>
<td>520D443</td>
<td>480</td>
<td>480</td>
<td>17.0 (22)</td>
<td>300</td>
<td>R5B-5</td>
<td>7.5</td>
<td>18</td>
</tr>
</tbody>
</table>
# Understanding Load Requirements

<table>
<thead>
<tr>
<th>Normal Duty Applications</th>
<th>Heavy Duty Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Include all variable torque loads</td>
<td>May require a significant amount of overload current for a significant period of time</td>
</tr>
<tr>
<td>Include some constant torque loads</td>
<td></td>
</tr>
<tr>
<td>May require limited overload current or a significant amount of overload current, but only for a short period of time</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Normal Duty Sizing can provide 110% overload for 60 seconds</th>
<th>Heavy Duty Sizing can provide 150% overload for 60 seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>or 150% overload for 3 seconds</td>
<td>or 180% overload for 3 seconds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable Torque Loads</th>
<th>“Constant” Full Start Torque Loads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typically have no overload current requirements. (e.g. fans and pumps)</td>
<td>Usually have overload current requirements, but not always the same amount of current or the same amount of time</td>
</tr>
</tbody>
</table>

Remember to make sure the motor FLC is less than or equal to the drive unit’s continuous current rating!
Typically the Heavy Duty Drive is one HP size larger than a Normal Duty Drive.
E300 Electronic Overload
E300 Electronic Overload Features

Module Specifications

<table>
<thead>
<tr>
<th>Communication Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>193-ECM*</td>
</tr>
<tr>
<td>Features</td>
</tr>
<tr>
<td>- EtherNet/IP</td>
</tr>
<tr>
<td>- DeviceNet</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>193-EIO*</td>
</tr>
<tr>
<td>Control Voltage</td>
</tr>
<tr>
<td>I/O</td>
</tr>
<tr>
<td>I/O and Protection</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Inputs</td>
</tr>
<tr>
<td>110…120V AC 50/60 Hz</td>
</tr>
<tr>
<td>220…240V AC 50/60 Hz</td>
</tr>
<tr>
<td>24V DC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensing Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>592/193-ESM*</td>
</tr>
<tr>
<td>Sensing Options:</td>
</tr>
<tr>
<td>- Voltage/Current/Ground Fault</td>
</tr>
<tr>
<td>- Current/Ground Fault</td>
</tr>
<tr>
<td>- Current</td>
</tr>
<tr>
<td>Current Range:</td>
</tr>
<tr>
<td>- 0.5…30 A</td>
</tr>
<tr>
<td>- 6…60 A</td>
</tr>
<tr>
<td>- 10…100 A</td>
</tr>
<tr>
<td>- 20…200 A</td>
</tr>
</tbody>
</table>
**E300 Overview**

**Top Section**
- Ethernet
- DeviceNet
- Modbus

**Middle Section PLC**
- Overload
- I/O Module
- PLC (DeviceLogix)
- 24VDC and 120V Control
- Zero Sequence CT input (option)
- PT Inputs (Medium Voltage)

**Bottom Section Sensing**
- Current
- Current and Ground Fault Current
- Current, Ground Fault and Voltage
- NEMA Contactor Spade Connectors
- Terminal Block
- IEC Contactor Connectors
Pilot Devices and Control Stations
Motor Control Center Basics
Example of Multiple Combination Starter each one is separate and each one has its own power feed.
What if we could have one source of power that the motor starters could plug in to like a power strip?
Motor Control Center Basics

Plug in an Electrical Device

Plug in a MCC unit
Motor Control Center Basics
Motor Control Center Basics
Motor Control Center Basics
MCC Power Distribution

Before Splicing

Splices

After Splicing
MCC Power Distribution

Dedicated plug-in ground bus is part of a solid grounding system

- Helps assure units are securely grounded
- Provides first make, last break connection for plug-in unit ground connection
- Continuous horizontal ground bus
- Optional vertical ground bus with motor ground terminal
MCC Power Distribution

**Horizontal Power Bus**
Rating
- 600 A; 800 A; 1200 A; 1600 A; 2000 A; 2500 A or 3000 A
SCCR Withstand Rating
- 42 kA; 65 kA or 100 kA
Material
- Aluminum Tin-plated; Copper Tin-plated or Copper Silver-plated

**Vertical Power Bus**
Rating
- 300 A (600 A effective) or 600 A (1200 A effective)
Material
- Copper Tin-plated or Copper Silver-plated (matches horizontal power bus plating)
Dimensions

- Section Height: 90” standard
- Sections Width: 20” standard; wider sections available
- Section Depth
  - 15” standard; 20” available
  - 30” or 40” for back-to-back
- Vertical Wireway
  - 4” standard; 9” available

NEMA Enclosure Type

- 1 (IP20, IP30, IP40)
- 1G with gasketing around perimeter of unit doors (IP20, IP30, IP40)
- 12 (IP54)
- 3R non walk-in (IP44)
- 4 Stainless Steel, non walk-in (IP65)
Unit Features
Unit Features

Superior fault containment helps minimize downtime

- Units have top and bottom plates
- Stab housing is designed to extinguish arcing faults by segregating three phases

- Pull-apart terminal blocks & power terminal block
- Free-floating stabs self-align to bus

Dedicated ground stab is part of a solid grounding system
Unit Features

- Rugged, flange-mounted handle
- Through the door handle for operating with door closed
- Accepts multiple padlocks for easy implementation of lockout/tag-out procedure

- Handle position easily identified when looking down the line-up
  - ON / OFF/ Tripped
- Unit cannot be inserted or withdrawn when the disconnect handle is ON
Unit Features

- NEMA Starters
- Space Saving NEMA Starters
- Safety Components
- Molded Case Circuit Breakers
- Soft Starters
- Overload Relays
- AC Drives
- Disconnect Switches
Engineered to increase industrial safety and mitigate risk

Industry-leading MCC is built with a foundation of standard design and materials that provide the first level of protection

1. **Automatic shutters** – Immediately isolates and minimizes exposure to energized vertical power bus when unit is removed

2. **Sheet metal thickness** – 10...16-gauge steel used for all structural components

3. **Horizontal and vertical bus** – Reduces periodic maintenance and minimizes exposure to hazardous voltages

4. **Structural isolation** – Help prevent faults from propagating to adjacent sections

5. **Standard vertical power bus** – Effective 600 A capacity per section.

6. **Unit isolation** – Limit equipment damage by helping prevent a fault from cascading throughout the enclosure

7. **Interlocks** – Unit cannot be inserted or withdrawn when the disconnect handle is ON
Centerline 2100 Safety Features
Connect and disconnect unit stabs with MCC unit door closed to prevent exposure to live electrical parts.
**CENTERLINE 2100 SecureConnect™ technology user experience**

1. **Power Stabs and Stab Shutter Status Port**
   Multi-point validation system that helps confirm the unit is disconnected from the vertical power bus.

2. **Lockout Mechanism**
   Lockout mechanism can prevent the power stabs from being connected and the unit being placed back into service.

3. **SecureConnect Access Port**
   With the disconnect handle in the off position, use a standard ¼” hex tool to...

   - Rotate a **quarter turn counter-clockwise** to disconnect stabs.
   - Rotate a **quarter turn clockwise** to connect stabs.

**CENTERLINE 2100 – 1.0 space factor unit with SecureConnect**
SecureConnect™ technology Remote Operators

Wired Pendant Control (Std.)

SecureConnect MCC Unit

Optional Status Indicator

Remote Operator Available as:
Wired Only (Std.) or Wired & Wireless (Optional)

Wireless Control
CENTERLINE 2100 MCC with ArcShield helps reduce arc flash hazard

• Offers improved personnel protection against internal arcing faults when all doors and covers are closed and secured

• Provides Type 2 accessibility as defined by IEEE C37.20.7-2007
  • Helps protect personnel at front, sides and rear of enclosure from the effects of an internal arcing fault
## Arc Flash Rated (Arc Shield) Motor Control Centers

<table>
<thead>
<tr>
<th>Duration Limited</th>
<th>Device Limited</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Designed to contain an arcing fault for up to 100ms in duration</td>
<td>• Designed to contain an arcing fault for the time it takes a pre-tested main protective device to clear the fault</td>
</tr>
<tr>
<td>• Ventilated units are not allowed (e.g., 10HP or greater drives and soft starters)</td>
<td>• Ventilated units are allowed (with arc resistant baffles)</td>
</tr>
<tr>
<td>• Allowable HBUS ratings: 600-3000A (up to 600V)</td>
<td>• Allowable HBUS Ratings: 600-3000 (up to 600V)</td>
</tr>
<tr>
<td>• Limited to 65kA SCCR</td>
<td>• Limited to 65kA SCCR</td>
</tr>
<tr>
<td>• It includes doors with spring latches</td>
<td>• Two spring latches per door</td>
</tr>
<tr>
<td>• Requires a top-plate pressure relief system</td>
<td>• No top-plate pressure relief system required</td>
</tr>
<tr>
<td><strong>Centerline 2100 ArcShield Design Features</strong></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td></td>
</tr>
</tbody>
</table>
| **Arc-Resistant Latches** | Provide pressure relief  
Helps keep the door latched to the MCC during an arcing fault  
Two latches per door for Device Limited ArcShield MCCs  
All latches for Duration Rated ArcShield MCCs |
| **Pressure Relief System** | Vents and redirects arc blasts out the top and away from personnel  
Required for Duration Rated ArcShield MCCs only |
| **Arc-Resistant Baffles** | Vented units with arc-resistant baffles are available to allow for a wider range of MCC equipment  
Maintains Type 2 Accessibility  
Only allowed for Device Limited ArcShield MCCs |
| **Reinforced End Plates** | Adds an insulating covers on horizontal bus closing plates  
Helps prevent “burn through” which may result from arcing faults in the horizontal bus compartment |
| **Horizontal Ground Bus** | Available at top of MCC, bottom of MCC or both for Device Limited ArcShield MCCs  
Required at top and bottom of MCC for Duration Rated ArcShield MCCs |
Additional Arc Flash Safety Options

**Maintenance Mode Selector Switch**

- For MCC Feed by and Electronic Circuit breaker a maintenance mode selector switch can be installed.
- Can be installed in the upstream switchgear or a the MCC.
- Reduces the current setting of the short time (instantaneous) trip setting of the main circuit breaker.
- Meets the requirement of article 240.87 in the NEC Handbook as a method of reducing clearing time.

**Current Limiting Fuses**

- Current Limit Fuses, e.g., Class J, clear fast enough to limit the let through current.
- Fuses can be supplied in the following:
  - Main
  - Feeders
  - Starters
  - Drives
  - Soft-Starts
CENTERLINE 2100 – Insulated Bus

Horizontal bus is insulated with a factory-installed polypropylene flame-retardant wrap

• Increases equipment longevity
• Help prevent an arc caused by foreign objects
• Help prevent propagation if an arc does occur
• Helps provide protection for the bus in facilities with air pollutants
IntelliCENTER® technology

Intelligent MCC offering from Rockwell Automation

- Intelligent motor control connectivity
- Built-in EtherNet/IP network
  - Ethernet switch quantity and port capacity customized for your MCC
  - Multiple Ethernet connection and cable routing options
  - Exclusive Allen-Bradley® UL Listed, PLTC rated 600V Ethernet cabling
- IntelliCENTER® Software customized to your MCC

Leverage IntelliCENTER® to enable and strengthen enterprise solutions
IntelliCENTER is assembled and validated

Firmware is normalized across like end-devices

Customers can get a jump start on their Control system design
IntelliCENTER® software

System Level Dashboard
• Virtual view of the MCC
• Simple dashboard presentation
• Customer configurable

Monitoring & Diagnostics
• Parameter access
• Device monitoring
• Remote diagnostic support
• Trending and event logging
Asset Management

Key Customer Documentation

- Manuals
- Unit Wiring Diagrams
- Spare Parts List
Integration Assistant

Add the IMC devices to your Logix Program

IntelliCENTER® Energy

Real time Energy usage of the intelligent motor control devices within your MCC
2100 Centerline Specification Checklist
# Common Mistakes and Best Practices

## Common Mistakes
- Not including line reactor or output filtering
- Mixing up top and bottom fed
- Not being aware or confirming shipping splits
- Not being aware of the power system the MCC is going to be connected to
- Not being aware of the environment the MCC going to be place in – people and cleanliness
- Wiring connections, e.g., over sized wire, lug connections for incoming wiring.
- Not specifying heavy duty drives for constant torque applications
- Not specifying the correct overload to measure voltage
- Including a neutral when it is not needed

## Best Practices
- Going through the MCC specification checklist.
- Making the incoming section its own shipping split
- Providing a Cable and Conduit Schedule when getting a MCC quoted
- Working with your favorite MCC provider to align the requirements of the project with the possible features of their MCC.
- Leverage typical drawings of MCC
- Place the larger loads towards the direction the cables will be exiting
- Place the larger starters and drive towards the bottom of the MCC to lower the center of gravity
- Inspect the MCC as soon as it arrives for damage – remover packing material
- Order MCC FOB destination
Helpful Tools and Links

- Centerline 2100 Low Voltage MCC Selection Guide

- Centerline 2100 Low Voltage MCC Program Guide

- Centerline 2100 Speciation Checklist

- Centerline 2100 Installation Manual

- Centerline 2100 Joining Splicing Bus Connections

- Wiring and Grounding Guidelines for Pulse Width Modulated Drives

- Transcoil Harmonic Analysis Tool
  https://www.transcoil.com/solution-center/
Contact Information

• Adan Corral Manager, LVMCC & MV Products ACORRAL@eescodist.com Cell 331-575-1027

• Robert McDonough Senior Specialist Industrial Automation rmcdonough@eescodist.com Cell 773-359-7217

If you would like us to come out and present a “Deep-Dive” on any of this material, please us know.
Questions