Miter Core Transformers = Lower Operating Cost = Lower Energy Cost = Quicker Payback!

Miter vs. Butt Lap Transformer Cores

A dry-type transformer consists of four main parts: the coils, the core, the structural frame and the terminals. The purpose of the core is to provide a path for the magnetic flux with which the windings are linked. The core is used to transfer energy from the primary winding to the secondary winding. When voltage is applied to the primary, current flows producing a magnetic field (flux). Secondary voltage is induced due to the coupling of the secondary to the magnetic field.

Energy is required to magnetize the core. The amount of energy required depends on the composition of the core material, joints or air gaps within the core and the type of core construction. The four main types of core construction are wound cores, stamped laminations, butt-lapped cores and step-lapped miter cores.

In a typical butt lap core, (Figure 1) the core steel is cut with square ends and stacked at right angles. This means the flux must cross the grain orientation of the core steel at the corners, (Figure 2) resulting in higher losses, more noise and more heat that must be dissipated.

In a step-lapped miter core, (Figures 3 and 4) the core steel is miter cut and step stacked in groups of 5 to 7 laminations at a time. In this arrangement, the grain orientation of the core steel lines up with the direction of the flux (Figure 6). The flux then flows parallel with the direction of the grain orientation.
Cost Savings
Along with less heat to dissipate and lower sound, the greatest benefit of using step-lapped, miter core transformers is in the energy savings. In a typical mining power center with a 2500 KVA transformer, the annual savings can be as much as $2235, based on an average electricity cost per kilowatt hour (KWH) of $.08. Your actual savings could be more or less depending on cost per KWH and actual usage of the equipment. The chart below (Figure 7) illustrates some typical cost savings based on individual transformer KVA ratings.

Less Heat and Noise Means Longer Component Life
Heat and vibration can be the two main causes of component failure in any electrical equipment. With step-lapped miter cut transformer cores, the amount of heat produced is reduced and also the amount of noise (vibration). Reducing both the amount of heat and vibration can help extend the life of other components in the equipment.

<table>
<thead>
<tr>
<th>KVA</th>
<th>Core Weight (Pounds)</th>
<th>Losses in Watts</th>
<th>Difference in Watts</th>
<th>Annual Savings Based on $0.08 per KWH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Butt Lap</td>
<td>Miter</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>2800</td>
<td>3265</td>
<td>2202</td>
<td>1063</td>
</tr>
<tr>
<td>750</td>
<td>3389</td>
<td>3942</td>
<td>2659</td>
<td>1283</td>
</tr>
<tr>
<td>1000</td>
<td>4200</td>
<td>4898</td>
<td>3304</td>
<td>1594</td>
</tr>
<tr>
<td>1500</td>
<td>5700</td>
<td>6647</td>
<td>4484</td>
<td>2163</td>
</tr>
<tr>
<td>2000</td>
<td>7100</td>
<td>8280</td>
<td>5585</td>
<td>2695</td>
</tr>
<tr>
<td>2500</td>
<td>8400</td>
<td>9796</td>
<td>6607</td>
<td>3189</td>
</tr>
</tbody>
</table>

Figure 7 - Typical Cost Savings Butt-Lap vs Step-Lapped Miter Core
Parts & Rebuild Division

At Line Power . . . Rebuilding means much more than repair.

Line Power Manufacturing Corporation’s Parts and Rebuild Division, a portion of Electro-Mechanical Corporation, has been a leader for over 30 years in re-engineering and rebuilding electrical apparatus. Now located in its own modernized 50,000 square foot facility in Bristol, Virginia, with a competent staff of electrical engineers, application specialists and factory technicians, Line Power’s Parts and Rebuild Division looks forward to assisting you with your replacement parts and rebuild needs.

Rebuild Service

A large, constantly changing selection of rebuilt electrical equipment is always available from the Rebuild Division.

When capital funds are not available for new equipment purchases, Line Power’s Rebuild Division offers an economical alternative.

Damaged or outdated equipment can be modified to meet your requirements and rebuilt to current industry standards which extends its useful service.

The Line Power Rebuilding Cycle:

- Picked up on your site by our truck
- Inspected prior to disassembly
- Complete disassembly
- Component parts cleaned, inspected, tested, repaired and retested
- Enclosure is cleaned, repaired, modified for additional circuits if required and painted. If damage is severe, a new enclosure is fabricated
- Assembled to meet the customer’s specifications
- Tested to the same standards as a new unit
- Delivered back to your site by our truck

Step 1

Step 2

Step 3

Step 4
**Parts Service**

Line Power offers a wide selection of parts and components, ready for immediate shipment from our large inventory. The Parts Department will help you select the correct part, cross reference when necessary, and supply it promptly. Our stock includes high voltage switches, vacuum circuit breakers, high voltage couplers, low voltage couplers, transformers, etc., all manufactured by Line Power. Components from Westinghouse, General Electric, DAC, Joy and McGraw Edison as well as other manufacturers are also included in our inventory.

For additional information and/or ordering instructions for Line Power products, or information on other divisions, please contact your local Line Power Representative or the factory at the address and phone number listed below.
Longwall Control Systems

Protect Your Longwall Investment With LINE POWER Controls

Line Power sales engineers are available to discuss your longwall electrical requirements.

Line Power provides total electrical systems from the power center to the face. Our power centers ranging from 1000 KVA to 5500 KVA have been supplying power to longwall mining faces for years.

Line Power explosion tested electrical controls are custom designed and "MSHA" certified for each longwall application. Special attention is given to provide the best layout for operation and maintenance.

All components are selected for maximum motor protection, performance and reliability.

4160 VAC in-by, 2300 VAC in-by, 995 VAC in-by, or combinations of these depending on your motor requirements, longwall controls can be supplied.

Complete systems include the power center, explosion tested motor starters and master controls with intrinsically safe voice communication, signaling, conveyor lockouts, pull-cord switches and pre-start warning.

Immediate assistance is available during start-up and operation by our team of sales engineers located in the mining areas throughout the United States.
Genuine Line Power Component Parts

Switches

Vacuum Circuit Breakers

Low and High Voltage Coupler, Flange Terminators

Ground Monitors and Ground Fault Relays

High Voltage Splice Boxes

Mine-Duty Transformers
High Capacity Longwall Power Center

Ratings: 5,500 KVA (5.0 MVA)
Impedance: 3.6%
Incoming: 12,470 Volts
Connected Load: Approximately 5,000 HP
Utilization Voltage: 2,300 Volts and 575 Volts
Outputs: 3 @ 2,300 Volts, 8 @ 575 Volts
Circuit Breakers: 2,300 volt Vacuum, Toshiba KV, 1,200 A continuous, 29,000 AIC
Mounting: 42” rail, with articulated trucks to facilitate panel moves
Frame: "Lo-Boy" to increase the available height for the transformer
Outside Dimensions: 27” - 0” Long, 6’ - 0” Wide, 4’ - 8” High, 0’ - 6” Rail Clearance
Weight: 40,000 Pounds

Custom Configurations Available
Genuine Line Power Component Parts

Switches

Vacuum Circuit Breakers

Low and High Voltage Couplers, Flange Terminators

Ground Monitors and Ground Fault Relays

High Voltage Splice Boxes

Mine-Duty Transformers
Line Power originated the concept of Portable Mining Electrical Substations. These substations give the mine operator the advantage of mobility and ease of installation. In many instances, these substations have been de-energized, moved and re-energized in one day, allowing minimum down time during the move from one mining location to another. All Line Power substations are custom designed to meet the customer’s needs. They may have one or two high voltage outputs to feed underground mines and as many low voltage outputs as are required to provide surface power. Some may also include the starters to operate the belt conveyor and fan or a 120/240 volt utility circuit for an office or supply building.
Outdoor Substations

Line Power manufactures portable and permanent, electrical substations and switchgear for all types of surface mining. Our capability, gained through many years of experience, extends from small pump substations to large multi-skid power substations with walk-in switchgear. Each skid is individually designed, combining the customers special requirements with Line Power’s heavy duty construction and attention to detail.

If you are considering new electrical equipment, contact your Line Power Sales-Service Engineer, or call our factory.
High Voltage Grounding Resistors

General
In designing the Line Power High Voltage Neutral Grounding Resistor we went beyond "Industrial Duty", even beyond what has been thought of for years as "Mining Duty".

The resistor design meets or exceeds IEEE Standard 32-1978 and is based on our years of experience in the mining industry. Resistor components are routinely subjected to conditions that exceed their design rating and the resistor design is rated for continuous duty. The Line Power High Voltage Neutral Grounding Resistor assembly uses edge wound stainless steel resistor elements with 100% stainless steel terminals and interconnections, porcelain insulators, galvanized steel frame and high strength/high dielectric station type main frame insulators to assure a rugged design for outdoor use.
For a metal resistor enclosure for padmount application please consult our factory.

** This dimension remains the same on all resistors.

<table>
<thead>
<tr>
<th>Part Number</th>
<th>System Voltage</th>
<th>Specification Line to Neutral</th>
<th>Box Qty</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>89-0037-01</td>
<td>2400</td>
<td>15 Amps, 1387 Volts, 92 Ohms</td>
<td>1</td>
<td>27-1/2 46 35 37-1/2 26-1/2</td>
</tr>
<tr>
<td>89-0037-02</td>
<td>4160</td>
<td>15 Amps, 2400 Volts, 160 Ohms</td>
<td>1</td>
<td>36-1/2 49-1/2 35 37-1/2 26-1/2</td>
</tr>
<tr>
<td>89-0037-03</td>
<td>7200</td>
<td>15 Amps, 4160 Volts, 272 Ohms</td>
<td>1</td>
<td>45-1/2 46 35 37-1/2 26-1/2</td>
</tr>
<tr>
<td>89-0037-04</td>
<td>12470</td>
<td>15 Amps, 7200 Volts, 476 Ohms</td>
<td>2</td>
<td>36-1/2 &amp; 45-1/2 49-1/2 35 37-1/2 26-1/2</td>
</tr>
<tr>
<td>89-0037-05</td>
<td>13200</td>
<td>15 Amps, 7620 Volts, 508 Ohms</td>
<td>2</td>
<td>45-1/2 &amp; 45-1/2 46 35 37-1/2 26-1/2</td>
</tr>
<tr>
<td>89-0037-06</td>
<td>13800</td>
<td>15 Amps, 7960 Volts, 532 Ohms</td>
<td>2</td>
<td>45-1/2 &amp; 45-1/2 49-1/2 35 37-1/2 26-1/2</td>
</tr>
<tr>
<td>89-0038-01</td>
<td>2400</td>
<td>15 Amps, 1387 Volts, 56 Ohms</td>
<td>1</td>
<td>27-1/2 46 35 38-1/4 26-1/2</td>
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<tr>
<td>89-0038-02</td>
<td>4160</td>
<td>15 Amps, 2400 Volts, 96 Ohms</td>
<td>1</td>
<td>27-1/2 46 35 38-1/4 26-1/2</td>
</tr>
<tr>
<td>89-0038-03</td>
<td>7200</td>
<td>15 Amps, 4160 Volts, 168 Ohms</td>
<td>1</td>
<td>45-1/2 46 35 38-1/4 26-1/2</td>
</tr>
<tr>
<td>89-0038-04</td>
<td>12470</td>
<td>15 Amps, 7200 Volts, 288 Ohms</td>
<td>2</td>
<td>27-1/2 &amp; 45-1/2 46 35 38-1/4 26-1/2</td>
</tr>
<tr>
<td>89-0038-05</td>
<td>13200</td>
<td>15 Amps, 7620 Volts, 306 Ohms</td>
<td>2</td>
<td>36-1/2 &amp; 45-1/2 49-1/2 35 38-1/4 26-1/2</td>
</tr>
<tr>
<td>89-0038-06</td>
<td>13800</td>
<td>15 Amps, 7960 Volts, 318 Ohms</td>
<td>2</td>
<td>36-1/2 &amp; 45-1/2 49-1/2 35 38-1/4 26-1/2</td>
</tr>
</tbody>
</table>

Specifications subject to change without notice.

LPMS-HVGR-0607
**High Voltage Splice Box**

**Application**
The Line Power High Voltage Splice Box (HVSB) is intended for use to splice 8kV and 15kV cable. It is particularly useful in mining for the repair of damaged cable and cable length extension.

**Features**
- Two Lid Switches (for Pilot Circuit)
- Lifting Eyes
- Barriers Between Splices on the 15kV Design
- Skid Plate (Optional)
- Yellow Color
- Padlock Provision

**Part Number**

**HVSB - 8 - S - A**

<table>
<thead>
<tr>
<th>Cable Diameter Range</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - 1.15” to 1.3” Cable</td>
<td>HVSB - 8 - S - A</td>
</tr>
<tr>
<td>B - 1.31” to 1.45” Cable</td>
<td></td>
</tr>
<tr>
<td>C - 1.46” to 1.60” Cable</td>
<td></td>
</tr>
<tr>
<td>D - 1.61” to 1.75” Cable</td>
<td></td>
</tr>
<tr>
<td>E - 1.76” to 1.90” Cable</td>
<td></td>
</tr>
<tr>
<td>F - 1.91” to 2.10” Cable</td>
<td></td>
</tr>
<tr>
<td>G - 2.11” to 2.30” Cable</td>
<td></td>
</tr>
<tr>
<td>S - Skid*</td>
<td></td>
</tr>
<tr>
<td>N - No Skid*</td>
<td></td>
</tr>
<tr>
<td>8 - 8kV*</td>
<td></td>
</tr>
<tr>
<td>15 - 15kV*</td>
<td></td>
</tr>
</tbody>
</table>

*Available in the Lightning Fast Delivery Program
### Available Replacement Parts

<table>
<thead>
<tr>
<th>Part</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrier Kit to Convert an 8kV Unit to a 15kV Unit</td>
<td>20-9230</td>
</tr>
<tr>
<td>Lid Switch Replacement</td>
<td>20-9231</td>
</tr>
<tr>
<td>HV Termination Kit</td>
<td>20-9232</td>
</tr>
<tr>
<td>Skid Plates (Set of 2)</td>
<td>22-0513</td>
</tr>
<tr>
<td><strong>Cast Metal Cable Flanges</strong></td>
<td></td>
</tr>
<tr>
<td>1.15&quot; to 1.3&quot; Cable</td>
<td>02-2503</td>
</tr>
<tr>
<td>1.31&quot; to 1.45&quot; Cable</td>
<td>02-2504</td>
</tr>
<tr>
<td>1.46&quot; to 1.60&quot; Cable</td>
<td>02-2505</td>
</tr>
<tr>
<td>1.61&quot; to 1.75&quot; Cable</td>
<td>02-2506</td>
</tr>
<tr>
<td>1.76&quot; to 1.90&quot; Cable</td>
<td>02-2507</td>
</tr>
<tr>
<td>1.91&quot; to 2.10&quot; Cable</td>
<td>02-2508</td>
</tr>
<tr>
<td>2.11&quot; to 2.30&quot; Cable</td>
<td>02-2509</td>
</tr>
<tr>
<td>2.31&quot; to 2.50&quot; Cable</td>
<td>02-2510</td>
</tr>
<tr>
<td>2.51&quot; to 2.70&quot; Cable</td>
<td>02-2511</td>
</tr>
<tr>
<td>2.71&quot; to 2.90&quot; Cable</td>
<td>02-2512</td>
</tr>
<tr>
<td>2.91&quot; to 3.10&quot; Cable</td>
<td>02-2513</td>
</tr>
<tr>
<td>3.11&quot; to 3.30&quot; Cable</td>
<td>02-2514</td>
</tr>
<tr>
<td>3.31&quot; to 3.50&quot; Cable</td>
<td>02-2515</td>
</tr>
</tbody>
</table>

Prices and specifications subject to change without notice
**Application**

House electrical components in areas where permissible equipment is required with Line Power’s MSHA Certified, Commonwealth of Pennsylvania approved enclosures. Typical devices requiring such enclosures include:

- Circuit breakers for power distribution
- Disconnect switches for power distribution
- Starters for motor control
- Relays and timers for motor control

**Sizes**

A large variety of MSHA Certified enclosures are available, or Line Power will custom design an enclosure to fit your dimensional requirements and will acquire the necessary certifications and approvals.

**Complete Controller**

Line Power will also design and manufacture a complete control system incorporating traditional relays and timers, a programmable controller, or a computer to perform the control functions. Line Power will work with you to acquire the necessary MSHA machine approval.

**Features**

Line Power enclosures may include:

- Removable aluminum covers
- Hinged aluminum doors
- Polycarbonate windows
- Permissible electrical connectors
- Cable entrance glands
- Circuit breaker operators
- Door-mounted push buttons, selector switches and lights.
Genuine Line Power Component Parts

Switches

Vacuum Circuit Breakers

Low and High Voltage Couplers, Flange Terminators

Ground Monitors and Ground Fault Relays

High Voltage Splice Boxes

Mine-Duty Transformers
Distribution Vacuum Circuit Breaker

Optional Features and Accessories Include:

- Remote Control for Trip and Close
- Extra Creep Bushings
- NEMA 12 Enclosure
- Pad-mount Enclosure
- Stainless-Steel Cabinet and Hardware
- Extra CTs for Relaying and Metering
- Internal or External VTs for Phase Sequence Relaying and/or Control Power
- SCADA Terminal Points
- Zone 4 Seismic Duty
- Lightning Arresters
- Cabinet Options: Colors, Powder Paint, Stainless Steel
- Customized Protection and Control Schemes

Standard Ratings

<table>
<thead>
<tr>
<th></th>
<th>15.5 kV</th>
<th>15.5 kV</th>
<th>27 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Voltage</td>
<td>95 kV</td>
<td>95 kV</td>
<td>125 kV</td>
</tr>
<tr>
<td>BIL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous Current</td>
<td>600A</td>
<td>1200A</td>
<td>600A</td>
</tr>
<tr>
<td>Interrupting Rating</td>
<td>12.5 kA</td>
<td>18.0 kA</td>
<td>12.5 kA</td>
</tr>
<tr>
<td>(Sym)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Standard Features

- Operations Counter
- One Relay Accuracy CT Per Phase
- Selector Switch (TRIP, CLOSE)
- DC Capacitor Tripping with Fail Safe Trip Circuit
- Heavy-Duty Gear Motor with Spring Charging Mechanism That is Electrically and Mechanically TRIP FREE
- Control Voltage: 120 VAC
- Electronic Overcurrent Relay with ANSI/IEC Time-Current Curve Selections, Ground Fault Sensing, and Time-Delay Settings
- 14-gauge NEMA 3R Cabinets
- Adjustable Height Base
- Swingout Control Panel for Maintenance
- Number Markers on All Control Wiring
- Durable ANSI #61 Gray Paint
- Thermostatically Controlled Heaters
- Visible Bottle Wear Indication
- Visible Load Side Disconnect with Automatic Grounding

The Line Power Three-Phase Distribution Vacuum Circuit Breaker is a rugged and servicable DVCB utilizing a simple straight line operator and stored energy spring mechanism. Line Power includes the following standard and optional features. Additionally, Line Power specializes in accessories and ratings to meet special application requirements.
Genuine Line Power Component Parts

Switches

Vacuum Circuit Breakers

Low and High Voltage Couplers, Flange Terminators

Ground Monitors and Ground Fault Relays

High Voltage Splice Boxes

Mine-Duty Transformers
**Line Power High Voltage Couplers**

**LINE POWER ... the outstanding difference is the insulating system**

- A solid, heavy, rigid insulator to prevent contact misalignment when cable is moved.
- A firm insulator tube of high track resistance EPDM rubber to prevent folding during coupling.
- Two positive O-Ring Seals between insulator and housing, one to prevent compound leakage, the other to prevent outside moisture from entering.
- LINE POWER high voltage couplers mate with other high voltage couplers.

Series 19 15kV Gear Mount Receptacle / Series 96 15kV Line Coupler

The Line Power Insulating System

Teflon Insulating System Also Available
**Line Power High Voltage Couplers Feature:**
- Plated electrical terminals
- Full strength starting threads
- Rigid insulator
- Couplers are interchangeable with other couplers

**Optional Equipment for Line Power High Voltage Couplers:**
- Quick thread (double acme)
- Interlocking dust covers
- Beryllium split male contacts
- Additional ground check contacts
- Kirklock drilling
- Teflon tubes
- No-thread couplers

**Recommended High Voltage Couplers**
- PMG19AA0  Gear mounted plug (input)
- SFG19AA0  Gear mounted socket w/standard dust cap (output)
- SFG19AC0  Gear mounted socket w/standard interlocking dust cap (feed-thru)
- SFG19AE0  Gear mounted socket w/insulated interlocking dust cap (feed-thru)
- PML96AA0  Line mounted plug w/4" end bell
- SFL96AA0  Line mounted socket w/4" end bell
- PML97AA0  Line mounted plug w/5" end bell
- SFL97AA0  Line mounted socket w/5" end bell

**When Ordering Please Specify:**
- Catalog number
- System voltage
- Size of phase conductors
- O.D. of jacket over cable
- Copper or aluminum wire
- Optional equipment

Line Power high voltage couplers, up to 15kV, 500 amperes, can solve your coupler problems.

Complete Catalog Available

Specifications Subject To Change Without Notice.
64-Series Coupler with Sliding Cover
600 Amp - 600 Volt - AC Application

**Application**
Suitable for cable with 3 power wires, ground and ground check.
For cable sizes up to 500 MCM Round and 1/0 Flat, Types W, G and G-GC.

**Receptacle Part Numbers**

<table>
<thead>
<tr>
<th>LP Part Number</th>
<th>Application</th>
<th>Dust Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG40DFC64D</td>
<td>Gear Mounted Receptacle (Output)</td>
<td>Integral</td>
</tr>
</tbody>
</table>
**Plugs**

**64-Series Plug**

Sliding Covers and Large Terminating Compartments Make Cable Installation and Inspection Convenient.

**Application**
Suitable for cable with 3 power wires, ground and ground check. For cable sizes up to 500 MCM Round and 1/0 Flat, Types W, G and G-GC.
Overall dimensions: 7” H x 7.5” W x 20” L.

**Plug Part Numbers**

<table>
<thead>
<tr>
<th>LP Part Number</th>
<th>Application</th>
<th>Dust Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL40DFC64S</td>
<td>Line Mounted Plug (Output and Line Splice)</td>
<td>10-6100</td>
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</tbody>
</table>

**PIN ARRANGEMENT**

EN - AC 600A
Line Power Low Voltage Couplers -
The Mining Industry Standard for Couplers!

67-Series Coupler with Sliding Cover
300 Amp - 1000 Volt - AC Application

Application
Suitable for cable with 3 power wires, ground and ground check.
For cable sizes up to 4/0 Round and No. 1 Flat, Types W, G and G-GC.

Receptacle Part Numbers

<table>
<thead>
<tr>
<th>LP Part Number</th>
<th>Application</th>
<th>Dust Cap</th>
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<tbody>
<tr>
<td>RG30DNC67D</td>
<td>Gear Mounted Receptacle (Output)</td>
<td>Integral</td>
</tr>
</tbody>
</table>
**Plugs**

67-Series Plug

**Application**
Suitable for cable with 3 power wires, ground and ground check. For cable sizes up to 4/0 Round and No. 1 Flat, Types W, G and G-GC. Overall dimensions: 6” H x 6.25” w x 15” L.

**Plug Part Numbers**

<table>
<thead>
<tr>
<th>LP Part Number</th>
<th>Application</th>
<th>Dust Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL30DNC67S</td>
<td>Line Mounted Plug</td>
<td>10-6300</td>
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<tr>
<td></td>
<td>(Output and Line Splice)</td>
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</tbody>
</table>

**Sliding Covers and Large Terminating Compartments Make Cable Installation and Inspection Convenient.**

**PIN ARRANGEMENT**

K - AC 300A
Line Power Low Voltage Couplers -
The Mining Industry Standard for Couplers!

68-Series Coupler with Sliding Cover
300 Amp - 1000 Volt - AC Application

Application
Suitable for cable with 3 power wires, ground and ground check.
For cable sizes up to 4/0 Round and No. 1 Flat, Types W, G and G-GC.

Receptacle Part Numbers

<table>
<thead>
<tr>
<th>LP Part Number</th>
<th>Application</th>
<th>Dust Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG30DNC68D</td>
<td>Gear Mounted Receptacle (Output)</td>
<td>Integral</td>
</tr>
</tbody>
</table>
Plugs

68-Series Plug

Sliding Covers and Large Terminating Compartments Make Cable Installation and Inspection Convenient.

Application
Suitable for cable with 3 power wires, ground and ground check.
For cable sizes up to 4/0 Round and No. 1 Flat, Types W, G and G-GC.
Overall dimensions: 6” H x 6.25” w x 15” L.

Plug Part Numbers

<table>
<thead>
<tr>
<th>LP Part Number</th>
<th>Application</th>
<th>Dust Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL30DNC68S</td>
<td>Line Mounted Plug (Output)</td>
<td>Integral</td>
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</table>

PIN ARRANGEMENT

K - AC 300A
**Line Power Low Voltage Couplers - The Mining Industry Standard for Couplers!**

**69-Series Coupler with Sliding Cover**

**300 Amp - 1000 Volt - AC Application**

---

**Application**

Suitable for cable with 3 power wires, ground and ground check. For cable sizes up to 4/0 Round and No. 1 Flat, Types W, G and G-GC.

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**Receptacle Part Numbers**

<table>
<thead>
<tr>
<th>LP Part Number</th>
<th>Application</th>
<th>Dust Cap</th>
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</thead>
<tbody>
<tr>
<td>RG30DNC69D</td>
<td>Gear Mounted Receptacle (Output)</td>
<td>Integral</td>
</tr>
</tbody>
</table>

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**MOUNTING DIMENSIONS**

**PIN ARRANGEMENT**

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**69-Series Receptacle**
Plugs

69-Series Plug

Sliding Covers and Large Terminating Compartments Make Cable Installation and Inspection Convenient.

Application

Suitable for cable with 3 power wires, ground and ground check.

For cable sizes up to 4/0 Round and No. 1 Flat, Types W, G and G-GC.

Overall dimensions: 5.5” H x 6.25” w x 12.75” L.

Plug Part Numbers

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PIN ARRANGEMENT

K - AC 300A
**107-Series Coupler with Sliding Cover**

**600 Amp - 1000 Volt - AC Application**

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**Application**

Suitable for cable with 3 power wires, ground and ground check. For cable sizes up to 500 MCM Round and 1/0 Flat, Types W, G and G-GC.

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**Receptacle Part Numbers**

<table>
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<tr>
<th>LP Part Number</th>
<th>Application Description</th>
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<td>RG40DFC107D</td>
<td>Gear Mounted Receptacle (Output)</td>
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**Application**

Suitable for cable with 3 power wires, ground and ground check.

For cable sizes up to 500 MCM Round and 1/0 Flat, Types W, G and G-GC.

Overall dimensions: 7” H x 7.5” w x 20” L.

**Plug Part Numbers**

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<thead>
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<th>LP Part Number</th>
<th>Application</th>
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<tbody>
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<td>PL40DFC107S</td>
<td>Line Mounted Plug (Output and Line Splice)</td>
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**PIN ARRANGEMENT**

1-KV AC 600A
Line Power Low Voltage Couplers - The Mining Industry Standard for Couplers!

300-Series Coupler with Sliding Cover
700 Amp - 1000 Volt - AC Application

Application
Suitable for cable with 3 power wires, ground and ground check.
For cable sizes up to 500 MCM Round and 4/0 Flat, Types W, G and G-GC.

Receptacle Part Numbers

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<thead>
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<th>LP Part Number</th>
<th>Application</th>
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<td>RG70DNC300D</td>
<td>Gear Mounted Receptacle (Output)</td>
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Plugs

300-Series Plug

Application
Suitable for cable with 3 power wires, ground and ground check.
For cable sizes up to 500 MCM Round and 4/0 Flat, Types W, G and G-GC.
Overall dimensions: 7” H x 7.5” w x 20” L.

Plug Part Numbers

<table>
<thead>
<tr>
<th>LP Part Number</th>
<th>Application</th>
<th>Dust Cap</th>
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<tbody>
<tr>
<td>PL70DNC300S</td>
<td>Line Mounted Plug (Output &amp; Line Splice)</td>
<td>10-6100</td>
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PIN ARRANGEMENT

1-KV AC 700 A
15.5 kV 600 Amp Vacuum Circuit Breaker

General Information
Specifications

Application
Line Power Manufacturing’s Vacuum Circuit Breaker, 3-phase, 15.5 kV power interrupting device, is designed to provide protection for all types of electric feed circuits within its ratings.

Ratings (600 Amp Model)
Continuous Current ......................... 600 Amperes*
Maximum Voltage .......................... 15.5 kV
Symmetrical Interrupting Capacity ....... 12,500 Amperes per IEEE Std. C37.60
Lightning Impulse Withstand (BIL) ....... 95 kV
Switching Current ......................... 630Amps, perIEEEStd. C37.60

Features
• Mechanically interlocked visible disconnect.
• Independent bottle wear indicators.
• Each bottle assembly can be independently adjusted for proper contact pressure to insure that adequate interrupting capacities are met.
• Optional Accessories
  - Load side grounding of visible disconnect
  - Non-isolated
  - Isolated
  - Shunt Trip
  - Undervoltage release
  - Motor operation
  - Key interlocks

* Consult factory for 630 amp applications.
**15.5kV, 600 Amp Vacuum Circuit Breaker with VisibleDisconnect and Grounding Profile**

**SELECTION CHART**

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<tr>
<th>DESCRIPTION</th>
<th>PART NO.</th>
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<tbody>
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<td>BASIC</td>
<td>20-2116-01</td>
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<tr>
<td>VISIBLE DISCONNECT</td>
<td>20-2116-02</td>
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<td>20-2116-07</td>
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<tr>
<td>48Vdc - 175Vdc, 120Vac</td>
<td>20-2116-08</td>
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<tr>
<td>CAP TRIP (120-375Vdc)*</td>
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<td>UNDERVOLTAGE</td>
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<td>120 VAC</td>
<td>20-2116-12</td>
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<td>240 VAC</td>
<td>20-2116-13</td>
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<td>G Output Grounding (Non-Isolated)</td>
<td>20-2116-14</td>
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<tr>
<td>IG Output Grounding (Isolated)</td>
<td>20-2116-15</td>
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<tr>
<td>K Kirklock Provision</td>
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<tr>
<td>KK 2 Key Kirklock Provision</td>
<td>20-2116-17</td>
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* Drawing is based on Vacuum Breaker part number 20-2116-05.
* A series of two auxiliary contacts are recommended for tripping with DC voltage over 170V DC.
15.5 kV 600 Amp
Front Operated Vacuum Circuit Breaker

Application
Line Power Manufacturing’s Vacuum Circuit Breaker, 3-phase, 15.5 kV power interrupting device, is designed to provide protection for all types of electric feed circuits within its ratings.

Ratings (600 Amp Model)
Continuous Current ....................... 600 Amperes*
Maximum Voltage ....................... 15.5 kV
Symmetrical Interrupting Capacity ....... 12,500 Amperes per IEEE Std. C37.60
Lightning Impulse Withstand (BIL) ........ 95 kV
Switching Current .......................... 630Amps, per IEEE Std. C37.60

Features
- Integral operator handle for front operation.
- Mechanically interlocked visible disconnect.
- Independent bottle wear indicators.
- Each bottle assembly can be independently adjusted for proper contact pressure to insure that adequate interrupting capacities are met.
- Optional Accessories
  - Load side grounding of visible disconnect
    - Non-isolated
    - Isolated
  - Shunt Trip
  - Undervoltage release
  - Motor operation
  - Key interlocks

* Consult factory for 630 amp applications.
15.5kV, 600 Amp Vacuum Circuit Breaker with Visible Disconnect and Grounding Profile

Drawn is based on Vacuum Breaker part number 20-2121-19IGP.

* A series of two auxiliary contacts are recommended for tripping with DC voltage over 170VDC.
15.5 kV 600 Amp Vacuum Circuit Breaker (left hand version)

Application
Line Power Manufacturing’s Vacuum Circuit Breaker, 3-phase, 15.5 kV power interrupting device, is designed to provide protection for all types of electric feed circuits within its ratings.

Ratings (600 Amp Model)
Continuous Current ......................... 600 Amperes*
Maximum Voltage .............................. 15.5 kV
Symmetrical Interrupting Capacity ........... 12,500 Amperes per IEEE Std. C37.60
Lightning Impulse Withstand (BIL) ........... 95 kV
Switching Current ............................. 630Amps, per IEEE Std. C37.60

* Consult factory for 630 amp applications.

Features
- Mechanically interlocked visible disconnect.
- Independent bottle wear indicators.
- Each bottle assembly can be independently adjusted for proper contact pressure to insure that adequate interrupting capacities are met.
- Optional Accessories
  - Load side grounding of visible disconnect
  - Non-isolated
  - Isolated
  - Shunt Trip
  - Undervoltage release
  - Motor operation
  - Key interlocks
**15.5kV, 600 Amp Vacuum Circuit Breaker (left hand version) With Visible Disconnect and Grounding Profile**

**SELECTION CHART**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>PART NO.</th>
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<tbody>
<tr>
<td>BASIC</td>
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<tr>
<td>VISIBLE DISCONNECT</td>
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<td>20-2116LS-03</td>
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<td>SHUNT TRIP (OPTIONAL)</td>
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<td></td>
<td>20-2116LS-02</td>
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</tbody>
</table>

**UVR (OPTIONAL)**

- 120V Shunt Trip
- 48Vdc - 175Vdc, 120Vac
- CAP TRIP (120-375Vdc)*
- UNDERVOLTAGE

**SUFFIX LETTERS**

- G Output Grounding (Non-Isolated)
- IG Output Grounding (Isolated)
- K Kirklock Provision
- KK 2 Key Kirklock Provision

Drawing is based on Vacuum Breaker part number 20-2116LS-05.

*A series of two auxiliary contacts are recommended for tripping with DC voltage over 170VDC.*
**Application**

Line Power Manufacturing’s Vacuum Circuit Breaker, 3-phase, 15.5 kV power interrupting device, is designed to provide protection for all types of electric feed circuits within its ratings.

**Ratings (1200 Amp Model)**

- Continuous Current ......................... 1200 Amperes
- Maximum Voltage ............................. 15.5 kV
- Symmetrical Interrupting Capacity ....... 18,000 Amperes
- Lightning Impulse Withstand (BIL) ........ 95 kV
- Switching Current ............................ 1200A

**Features**

- Mechanically interlocked visible disconnect.
- Independent bottle wear indicators.
- Each bottle assembly can be independently adjusted for proper contact pressure to insure that adequate interrupting capacities are met.
- Optional Accessories
  - Load side grounding of visible disconnect
  - Non-isolated
  - Isolated
  - Shunt Trip
  - Undervoltage release
  - Motor operation
  - Key interlocks
# 15.5kV, 1200 Amp Vacuum Circuit Breaker with Visible Disconnect and Grounding Profile

## Selection Chart

<table>
<thead>
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*A series of two auxiliary contacts are recommended for tripping with dc voltage over 170Vdc.*
27 kV 600 Amp Vacuum Circuit Breaker

Application
Line Power Manufacturing’s Vacuum Circuit Breaker, 3-phase, 27kV power interrupting device, is designed to provide protection for all types of electric feed circuits within its ratings.

Ratings (600 Amp Model)
Continuous Current .........................600 Amperes*
Maximum Voltage ..........................27 kV
Symmetrical Interrupting Current ........12,500 Amperes
Lightning Impulse Withstand (BIL) ........125 kV
Switching Current ..........................600 Amperes

* The VCB is rated 600 amps continuously in a 40°C environment with one square foot of total ventilation or a 35°C environment with no ventilation.

Derating to 580 amps is required if the VCB is operated at 40°C environment without ventilation.

Features
- Mechanically interlocked visible disconnect.
- Independent bottle wear indicators.
- Each bottle assembly can be independently adjusted for proper contact pressure to insure that adequate interrupting capacities are met.
- Optional Accessories
  - Load side grounding of visible disconnect
  - Non-isolated
  - Isolated
  - Shunt Trip
  - Undervoltage release
  - Motor operation
  - Key interlocks

(Some optional accessories shown)
# 27kV, 600 Amp Vacuum Circuit Breaker with Visible Disconnect and Grounding Profile

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Drawing is based on Vacuum Breaker part number 20-2119-05.

*A series of two auxiliary contacts are recommended for tripping with DC voltage over 170V DC.

LPMS-27KVVCB-1008
**DTS-VCB® Draw-Out Vacuum Circuit Breaker**

**General Information**

**Specifications**

**Benefits**
- Greatly reduced down time for maintenance and repair.
  - Automatic high voltage connection
  - Reliable and fast screw together low voltage connections
- Uses existing Line Power breaker and plug technology

**Application**
Line Power Manufacturing’s DTS Vacuum Circuit Breaker, 3-phase, 15.5 kV power interrupting device, is designed to provide protection for all types of electric feed circuits and rapid service.

**Ratings**
- Continuous Current ......................... 600 Amperes*
- Maximum Voltage ........................... 15.5 kV
- Symmetrical Interrupting Capacity ........ 12,500 Amperes per IEEE Std. C37.60
- Lightning Impulse Withstand (BIL) .......... 95 kV
- Switching Current .................... 630 Amps, per IEEE Std. C37.60

**Features**
- Mechanically and electrically interlocked visible disconnect.
- Independent bottle wear indicators.
- Each bottle assembly can be independently adjusted for proper contact pressure to insure that adequate interrupting capacities are met.
- Optional Accessories
  - Load side grounding of visible disconnect
    - Non-isolated
    - Isolated
  - Shunt Trip
  - Undervoltage release
  - Motor operation
  - Key interlocks
- Automatic high voltage plugs are the same as used in time tested Line Power high voltage couplers.
- Hinged front panel for barriered access to low voltage compartments.
- Rack out tray is interlocked with the integral visible disconnect switch to prohibit extraction under load.

* Consult factory for 630 amp applications.
15.5kV, 600 Amp DTS-VCB® Vacuum Circuit Breaker with Visible Disconnect and Grounding Options

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Drawing is based on Vacuum Breaker part number 20-2316-19G.
**Benefits of DTS® II**

- Smaller Power Centers
- Better Access To Components
- 30% Smaller
- 25% Lighter
- Red and Green ‘Ready’ Indication
- Safety Shutter
- Drawer-In-A-Drawer Control Compartment

Line Power is proud to introduce the second generation of the Down Time Saver DTS® II for medium voltage feeder and motor protection.

The benchmark DTS® II design continues to serve the needs of our customers by saving them time and money. Traditional feeder circuit protection designs involve numerous components separately mounted in a fixed environment with numerous cables and wires connecting the circuits together. The more circuits, components and wires involved, the greater the probability of system failure, and time and money lost troubleshooting.

<table>
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<tr>
<th>Feature:</th>
<th>Benefits:</th>
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<tr>
<td>Completely Removable</td>
<td>All components are assembled to a drawout tray that disconnects the circuit for repair either underground or above ground, saving time and money.</td>
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<tr>
<td>Visible Disconnect</td>
<td>The sliding contactor disconnect is designed so that it cannot be opened unless the drawout tray is locked in place for safety.</td>
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<tr>
<td>Drawer-In-A-Drawer Control Compartment</td>
<td>The control compartment slides out in its own drawer and is easily removable for replacement or repair. It has a hinged cover, it slides out, it tilts down, its removable.</td>
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<tr>
<td>Proven Load and Feed Connections</td>
<td>Self-aligning pin and socket load and feed connections utilizing proven industry technology.</td>
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<tr>
<td>Open Layout</td>
<td>Open and uncluttered layout that aids in inspection, troubleshooting and servicing.</td>
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<tr>
<td>Ratings</td>
<td>100/300 Amp., 5 kV (For ratings up to 7.2 kV contact factory)</td>
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<tr>
<td>Built-In Safety Features</td>
<td>Drawer is mechanically locked when in closed position. Drawer cannot be racked out unless disconnect switch is open and grounded. Drawer cannot be racked in unless disconnect switch is open and grounded.</td>
</tr>
<tr>
<td>Proven Reliability, Hundreds in Service</td>
<td>Cost improvement, less downtime.</td>
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</tbody>
</table>
Hinged Cover For Panel Access

Control Panel

Tilt Down Face

Easy Viewing

3Ø Current Sensing CTs

Ball Bearings For Smooth Sliding

Drawout Handles

Disconnect Operating Handle (Inter-Locked With Contactor and Drawer)

Optional Automated Components

Slide Out Tray (Patent Pending)

Space For Front and Rear Control Components and Relays

Ground Monitor and Ground Fault

Relay (Per Users Request)

Local Control As Required

Local Control

As Required
Engaged Contactor (Lit Red)  
(Patent Pending)

Disengaged and Grounded Contactor  
(Lit Green)
Genuine Line Power Component Parts

Switches

Vacuum Circuit Breakers

Low and High Voltage Couplers, Flange Terminators

Ground Monitors and Ground Fault Relays

High Voltage Splice Boxes

Mine-Duty Transformers
**Line Power LP-2600 Circuit Protector**

**General**
The LP-2600 vacuum circuit protector is designed to replace 1000V, 600 amp mechanical circuit breakers now used by the mining industry. The accuracy and flexibility in the LP-2600 design provides the electrical engineer (or electrician) the means to monitor actual circuit load conditions and “fine tune” the circuit to reduce “nuisance tripping” while maintaining cable protection. The unit can also be used as a belt or pump controller - replacing the mechanical circuit breaker, control contactor and overcurrent relay. The modeling technique used by the LP-2600 provides dynamic protection for loads operating at their design limit.

**Features and Options**
- I²T thermal-overload protection
- Instantaneous overcurrent protection
- Phase-loss protection
- Stuck vacuum bottle indication with audible alarm
- Undervoltage protection
- Ground-fault protection
- Ground-monitoring protection
- Current limiting protection and blown fuse detection
- Temperature sensing and over temperature protection
- Front-panel programming
- Program-change lockout
- Nonvolatile memory for programmed values and values at trip
- Digital display of:
  - Load Current
  - Meter values-at-trip
- -20°C to 40°C operating temperature
- Optional parameter-selectable, isolated analog output
**LP-2600 Description**

The LP-2600 is rated for 1000 volts AC at 600 amperes continuous. The Full Load Amps (FLA) can be adjusted from 600 amps down to 60 amps in 6.0 amp steps. This, plus other adjustments, gives the LP-2600 the flexibility to meet the majority of load and cable requirements found in the mining industry.

The LP-2600 has all of the necessary components mounted on a slide-in panel that will fit into a 16.625" H by 18" W cutout - allowing for easy retrofit of existing power centers that contain mechanical circuit breakers. In most cases, the only electrical connections are phase power, control voltage and ground. Custom packaging is also available - consult factory.

The LP-2600 contains the following components and/or provisions:

- **LP-2600 circuit protection unit** - provides the protection and monitoring features listed.
- **Vacuum Bottle Contactor** - switches three-phase power to load and provides the primary means for interrupting three-phase fault currents.
- **Current Limiting Fuses** - one per phase, limits three-phase fault currents and disconnects the load under extreme fault currents. Each fuse is fitted with NC contact to indicate blown fuse.
- **Provisions for customer-specified ground fault in substitution of ground fault protection provided by the LP-2600 circuit protection relay.**
- **Provisions for customer-specified ground monitor** - provides ground monitoring protection.
- **Close Push-button** - Closes contactor.
- **Open Push-button (Maintained)** - Opens contactor.
- **Control Circuit Breaker** - Removes control voltage to the LP-2600 components.
- **Power Receptacle** - Provides means for quick disconnect of three-phase power cable.
- **Phase CTs** - 600 amps nominally rated, one transformer for each phase housed in a three phase block, provides proportional phase current levels to the LP-2600 circuit protection relay, nominal secondary current is 5 amps.
- **Ground-Fault CT** - provides the LP-2600 circuit protection relay ground conductor current levels when the unit is used for ground-fault protection; phase conductor to ground conductor fault current detection for other ground-fault devices.
- **Front Panel View Window** - provides visible means to inspect the current limiting fuses for blown fuses and to insure proper fuse installation.
LP-2600 Construction

Emergency Stop
Indicator Lights
Blown Fuse Indicator Window
Polarity Switch
Electrical Control Unit
Over-Current Relay
GE MIIF-II
Control Power Circuit Breaker
Horn
Pull Handle
Options Panel for Ground Fault Relay and MSHA-Approved Ground Monitor

Front View

Ground Connection
Isolated Neutral Connection
Sealed, Harsh-Environment Cooling Fan
Contactor
Fuses With Blown Fuse Indication

Top View
**LP-2600 Investigation**

The LP-2600 investigation was conducted by the Electrical Safety Division at the MSHA approval and certification center. It was determined that the LP-2600 VCB is a suitable circuit breaker for compliance with 30 CFR 75.900 and 75.902 and can be used as a “no less effective” device for the purposes of 30 CFR 75.601, acceptance No. 100407LP.

Front View

Side View
**Line Power LP-2600-300 Circuit Protector**

**General**

The LP-2600-300 vacuum circuit protector is designed to replace 1000V, 300 amp mechanical circuit breakers now used by the mining industry. The accuracy and flexibility in the LP-2600-300 design provides the electrical engineer (or electrician) the means to monitor actual circuit load conditions and “fine tune” the circuit to reduce “nuisance tripping” while maintaining cable protection. The unit can also be used as a belt or pump controller - replacing the mechanical circuit breaker, control contactor and overcurrent relay. The modeling technique used by the LP-2600-300 provides dynamic protection for loads operating at their design limit.

**Features and Options**

- I²T thermal-overload protection
- Instantaneous overcurrent protection
- Phase-loss protection
- Stuck vacuum bottle indication with audible alarm
- Undervoltage protection
- Ground-fault protection
- Ground-monitoring protection
- Current limiting protection and blown fuse detection
- Front-panel programming
- Program-change lockout
- Nonvolatile memory for programmed values and values at trip
- Digital display of: Load Current Meter values-at-trip
- -20°C to 40°C operating temperature
- Optional parameter-selectable, isolated analog output
**LP-2600-300 Description**

The LP-2600-300 is rated for 1000 volts AC at 300 amperes continuous. The Full Load Amps (FLA) can be adjusted from 300 amps down to 30 amps in 6.0 amp steps. This, plus other adjustments, gives the LP-2600-300 the flexibility to meet the majority of load and cable requirements found in the mining industry.

The LP-2600-300 has all of the necessary components mounted on a slide-in panel that will fit into a 16.625” H by 18” W cutout - allowing for easy retrofit of existing power centers that contain mechanical circuit breakers. In most cases, the only electrical connections are phase power, control voltage and ground. Custom packaging is also available - consult factory.

The LP-2600-300 contains the following components and/or provisions:

- **LP-2600-300 circuit protection unit** - provides the protection and monitoring features listed.
- **Vacuum Bottle Contactor** - switches three-phase power to load and provides the primary means for interrupting three-phase fault currents.
- **Current Limiting Fuses** - one per phase, limits three-phase fault currents and disconnects the load under extreme fault currents. Each fuse is fitted with NC contact to indicate blown fuse.
- **Provisions for customer-specified ground fault in substitution of ground fault protection provided by the LP-2600-300 circuit protection relay.**
- **Provisions for customer-specified ground monitor - provides ground monitoring protection.**
- **Close Push-button - Closes contactor.**
- **Open Push-button (Maintained) - Opens contactor.**
- **Control Circuit Breaker - Removes control voltage to the LP-2600-300 components.**
- **Power Receptacle - Provides means for quick disconnect of three-phase power cable.**
- **Phase CTs - 300 amps nominally rated, one transformer for each phase, provides proportional phase current levels to the LP-2600-300 circuit protection relay, nominal secondary current is 5 amps.**
- **Ground-Fault CT - provides the LP-2600-300 circuit protection relay ground conductor current levels when the unit is used for ground-fault protection; phase conductor to ground conductor fault current detection for other ground-fault devices.**
- **Front Panel View Window - provides visible means to inspect the current limiting fuses for blown fuses and to insure proper fuse installation.**
**LP-2600-300 Construction**

![Diagram of LP-2600-300 Construction](image)

**Front View**

- Close Contactor Push Button
- Ground Fault Relay
- Options Panel for Ground Fault Relay and MSHA-Approved Ground Monitor
- Emergency Stop
- Indicator Lights
- Blown Fuse Indicator Window
- Polarity Switch
- Coupler
- Control Power Circuit Breaker
- Horn
- Pull Handle
- Electronic Control Unit Over-Current Relay GE MIF-II

**Rear View**

- Fuses With Blown Fuse Indication
- Contactor
- Terminal Block
- Ground Connection
**LP-2600-300 Investigation**

The LP-2600-300 investigation was conducted by the Electrical Safety Division at the MSHA approval and certification center. It was determined that the LP-2600-300 VCB is a suitable circuit breaker for compliance with 30 CFR 75.900 and 75.902 and can be used as a “no less effective” device for the purposes of 30 CFR 75.601, acceptance No. 100407LP.
Line Power Manufacturing is the leading specialist in design and manufacturing of mine duty transformers. Our people, knowledge and experience can provide a reliable, cost-effective transformer that will provide years of trouble free service.

Line Power vacuum pressure impregnated (VPI) transformers combine a performance proven dry-type transformer design with the environmental protection of a polyester coil encapsulation process. This combination ensures reliable transformer operation in hostile environments containing moisture, dust, dirt, chemicals and other contaminants.

The VPI process fully penetrates and seals the coils into a high strength composite unit for complete environmental protection. Since the coil protection is created using vacuum pressure impregnation rather than molding, maximum design flexibility is achieved to allow conformance to the most stringent application requirements.

The vacuum impregnation of the varnish eliminates winding voids to reduce corona generation due to insulation voids.

Benefits
Line Power vs. Cast Coil

- Lower initial cost
- Flexibility of design
- Elimination of cracking concerns
- Higher thermal overload available
  Cast = 17% @ 80 / 115° C rise
  VPI = 30% @ 80 / 150° C rise
- Less weight for easier handling and installation
- Smaller dimensions to save valuable floor space
- Outstanding environmental protection
The Material
Line Power uses a polyester solvent varnish class H 220° C. The transformer is first baked to remove any traces of water, dipped in the varnish, baked, dipped and baked again.

Coil Construction
Coil construction is used to assure proper ventilation and maximum strength. Coils are constructed using a 220° C Nomex® insulation system that for many years has had proven performance in dielectric strength, temperature stability and long life. The high voltage coils are wound directly over the low voltage coils to form a complete assembly. The coil assembly is completely insulated and mechanically braced to pass all ANSI standard tests.

Epoxy Shielded Transformer
Take one high quality Line Power VPI transformer, add 1-2 mils or more of modified epoxy varnish and the result is a premium transformer ready to handle the really tough environments. The Line Power Epoxy Shielded transformer is ideal for environments polluted with refrigerants, askarel, mineral oil, acids, alkalis, salt water and high humidity. Even greater dielectric strength, mechanical integrity, and thermal endurance than VPI is now achievable.

Line Power uses high viscosity (40 - 60 sec. #4 Ford cup) insulating epoxy. This specially formulated epoxy is designed for greater film dry thickness than most epoxies in use today. The epoxy used has a high percentage of solids, 50% by weight, yet has a relatively low cure weight. This unique combination allows high mechanical bond strength (7 lbs. helical coil) and a low overall unit weight.

Where your environmental concerns are the greatest, specify the best epoxy transformer on the market today - Line Power’s Epoxy Shielded Transformer.

Vacuum Pressure Impregnated Process

1. Transformer coils preheated for improved resin penetration into coils
2. Coils placed into special pressure vessel
3. Apply dry vacuum to remove trapped moisture from coils
4. Polyester resin is pumped into pressure vessel to completely submerge coils
5. Vacuum broken followed by application of high pressure forcing the resin to penetrate into the transformer coils thereby removing air voids
6. Resin evacuated from pressure vessel and returned to storage tank
7. Coils allowed to drain
8. Coils baked in oven to cure resin forming a barrier to airborne contaminants and enhancing the dielectric strength of the insulation system
**Specification Guide**

The transformer(s) shall be dry-type with both primary and secondary coils encapsulated with polyester resin using a vacuum pressure impregnation (VPI) process (optional VPI with epoxy shield). The transformer shall be fire resistant, and cooled by the natural circulation of air through the windings.

The transformer will be designed, manufactured and tested in accordance with applicable ANSI, NEMA and IEEE standards.

**Conductor Material**

The conductor shall be electrical grade copper.

**Insulation Material**

All insulation materials for the primary and secondary coils shall be rated for continuous 220°C operation.

**Coil Assembly**

The high and low voltage coils shall be concentrically wound as an integral assembly. The insulated coil assembly shall be capable of passing all standard ANSI and NEMA tests, including impulse test, before the coils are encapsulated.

**High Voltage Taps**

Taps shall be terminated at the coils and equipped with provisions for changing taps under de-energized conditions.

**Encapsulation System**

The coil assembly shall be encapsulated utilizing a vacuum pressure impregnation process to completely seal and bind the windings. The encapsulating material shall be solventless polyester (optional VPI with epoxy shield).

**Core Structure**

The core structure shall be of nonaging, cold rolled, grain oriented, high permeability silicon steel. All core laminations shall be free of burrs and stacked without gaps. The core framing structure shall be of rigid construction to provide full clamping pressure upon the core and provide support points for the coils.

**Enclosure**

The enclosure and/or skid shall be designed for maximum safety protection against electrical shock hazard and to assure proper cooling for long transformer life.

**Sound Level**

The transformer shall be designed to meet or exceed the standards for dry-type transformers per NEMA ST20.

**Test**

Each transformer shall be tested in accordance with ANSI C57.12.91.

---

**Definition**

A mitered core is similar to a butt lap core arrangement made from cold rolled, grain-oriented silicon steel laminations with joints configured at 45° angles for purposes of reducing core losses and sound levels. (See diagram below.)

**Purpose**

To better control flow of magnetic flux and reduce eddy currents.

**Benefits**

- Eliminate flux in cross grain directions which reduces core loss and exciting current values.
- Permits larger KVA rating for a given constrained size.

**Types**

- Hybrid Miter - Achieves better losses than butt-lap construction, however v-notching core machine not required. Some 90° angle configurations still exist. (See diagram below).
- Full Miter - All angles at 45° for maximum reduction of flux. “V-notcher” required to achieve center cut. (See diagram below).

*Line Power, the only manufacturer of mining electrical equipment that can offer this exclusive feature.*
Mining Transformer BIL’s

Line Power’s experience with the electrical system requirements associated with power center transformers, indicates a strong emphasis by the coal companies toward lower height, lower impedance, and higher KVA’s. We are confident that suitable surge protection (arrester plus surge capacitor) is available to fully protect these transformers which are designed in accordance with ANSI C57.12.01 and C57.12.91.

Where the coal company is particularly concerned with having the highest possible BIL withstand, we encourage the specifications to include a production line impulse test from which the manufacturer is required to furnish the oscillograms. If the transformer is designed properly, the production line impulse test is not a destructive test, nor a design limit test, but rather another quality assurance activity performed at the factory to enhance the reliability of the transformer in the field.

Impulse Tests

Impulse tests are dielectric tests that consist of the application of a high-frequency voltage wave of a specified shape applied between windings and between winding and ground.

The primary purpose of production-line impulse test is to weed out transformers with “weak links” in their impulse dielectric make-up, a deficiency not discovered by any other standard test.
Application
Line Power Manufacturing’s Vacuum Loadbreak Switch is designed for rugged-duty, mining applications. The low profile, compact design makes this switch well suited for mine applications.

Ratings
Continuous Current......................... 600 Amperes
Maximum Voltage............................ 15 kV
Symmetrical Interrupting Current........ 2000 Amperes
Lightning Impulse Withstand (BIL)....... 60 kV
Switch Current.................................. 600 Amperes

Features
• Each bottle assembly can be independently adjusted for proper contact pressure to insure that adequate interrupting capacities are met.

• Visible disconnect switch grounds the output terminals when in the fully-opened position.

• Switch can be tripped manually, or through an optional shunt trip and/or undervoltage release.

• Optional electrical closing and auxiliary switches are available.
### Switch Mounting Profile

![Top View Partial Side View](image)

#### SELECTION CHART

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</table>

*A series of two auxiliary contacts are recommended for tripping with dc voltage over 175Vdc.
7.2kV 1200 Amp
No-Load Vacuum Reversing Switch

Application
Line Power Manufacturing’s No-Load Vacuum Reverser is designed to switch two deenergized phases of a 7.2kV circuit. The most common application is to change the direction of motor rotation.

Ratings
Continuous Current .......................... 1200 Amperes
Maximum Voltage ................................ 7.2 kV
Lightning Impulse Withstand (BIL) .............. 60 kV
Maximum Operations Before Adjustment ...... 6000 Full Cycles
Transfer Speed ........................................ Less than 2 seconds
Continuous Transition Rate* ..................... 1 Full cycle/min
Withstand Current ..................................... 12,500 Amps

Features
- The most secure interlocking possible. The same motion opens and closes a fixed assembly of four (4) vacuum bottles
- Wear indicators are standard for vacuum bottles
- 120V control power**
- Forward or reverse transition is accomplished with a momentary contact closure.

*Intermittent duty of 1/2 cycle every 3 seconds
**Consult factory for other control voltages.
7.2kV, 1200 Amp No-Load Reversing Switch

Model: NLVR-1200

Part Number: 44-7031

REVERSING CONTACTOR
P/N 44-7031

TERMIONAL BLOCK

WHITE

BLACK

GREEN

RED

MOTOR

LINE POWER
5kV, 15kV and 27kV, 600 Amp Auto-Jet® II Mining Duty Air Break Switch

Application
Line Power Manufacturing’s 3-phase, 5kV, 15kV and 27kV Auto-jet®II Air Break Switch, is designed to provide load break switching and visible isolation for all types of electric circuits within its ratings.

Ratings
Continuous Current ......................... 600 Amperes
Voltage .......................................... 5kV, 15kV, 27kV
Momentary and Fault Close................. 40kA Asym
Lightning Impulse Withstand (BIL) ........ 60 kV (5kV Switch)
                                      95 kV (15kV Switch)
                                      125kV (27kV Switch)
Manual Operations ......................... 1,000 +
Transformer Magnetizing ................. 21 Amps

Features
• Quick-Make and Quick Break Independent of Operator Handle Speed
• Reliable Switch
  - Widely Used in Mining
  - Simple and Effective Mechanism
• Automatic Load Side Grounding of visible disconnect
• Optional Accessories (Consult Factory)
  - Shunt Trip
  - Auxiliary Contacts
  - Key interlocks

Ordering Information

<table>
<thead>
<tr>
<th>Voltage Class</th>
<th>Left or Right Hand</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>5kV</td>
<td>RH</td>
<td>0042-4-53152</td>
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<tr>
<td>5kV</td>
<td>LH</td>
<td>0042-4-53154</td>
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<td>15kV</td>
<td>RH</td>
<td>0042-4-53152 and 20-3043-1</td>
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<tr>
<td>15kV</td>
<td>LH</td>
<td>0042-4-53154 and 20-3043-1</td>
</tr>
<tr>
<td>27kV</td>
<td>RH</td>
<td>0038-4-53152-01</td>
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<tr>
<td>27kV</td>
<td>LH</td>
<td>0039-4-53152-01</td>
</tr>
</tbody>
</table>

Misc. Parts:
Lever Arm 20-4188
Handle Extension 20-0165
Wide Gap Easy to View
Opens Into Grounded Position
Load Side Terminals
Line Side Terminals
Puffer
Toggle Mechanism
Heavy-Duty Frame

Open

Closed
27kV Left Hand Switch
15kV Right Hand Switch
ZCT High Voltage Alert Device Offers the Benefit of Seeing and Hearing When High Voltage is Present!

**Features**

The ZCT® Audible and Visual Alarm device is connected to three sensors which are fitted onto each phase. All voltage sensing options are available for the full range of rated voltages!

The combination of brightly flashing neon lights and beeping “ZCT® Audible Alarm”, alert maintenance and operation personnel to the presence of high voltage.

The ZCT® is ideal for reducing downtime by indicating where voltage is lost.

Zero corona cable sensors - voltage sensors fit snugly on unshielded cables with no voltage partial discharge for long life and no damage to cable insulation due to corona.¹ No downtime!

One Zero Corona Sensor Kit works on all cable sizes.

**Application**

**Self power:** Does not require separate power supply.

**Comprehensive:** Responds to phase-to-ground voltages on each of the three phases independently.

**Effective and Economical:** Can be applied in circuit locations where alternative indicators would be impractical or too costly.

**Reliable:** No adjustment or calibration required, low maintenance.

**Easy Installation:** Installed without disconnecting cable. You are not required to slide it over the cable from one end!

¹ Cables must be appropriately rated for system voltage.
Flush Mounted Indicator With Cable Sensor

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Catalog No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2 kV - 15kV</td>
<td>17-0300-15F-C</td>
<td>Cable Style Sensor</td>
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<tr>
<td>17 kV - 25kV</td>
<td>17-10300-25F-C</td>
<td>Cable Style Sensor</td>
</tr>
</tbody>
</table>

**WARNING**

Voltage can be present without the ZCT® warning lights visible or audible alarm. The ZCT® should never be used as a device to make decisions to access high voltage areas, or determining if circuits are energized for operation, access or maintenance. Safety procedures that do not rely on this product must be followed.
High Voltage Ground Monitor

Application

The Line Power Manufacturing High Voltage Ground Monitor is an impedance-type ground monitor that can operate in either of two modes: UVR Mode or Non-UVR mode. Mode selection is made by changing the position of the “C1” lead on the rear of the unit. The unit is normally shipped wired in the UVR Mode. The UVR mode is fail-safe where the Non-UVR mode is not fail-safe.

In the UVR Mode, the monitor relay will energize when control power is present and the pilot-ground loop is complete with normal continuity. If the ground loop is “lost” (impedance increases 3 ohms or more after proper initial adjustment of the unit) the monitor relay will trip (de-energize) and the face plate indicator will indicate “Tripped”. The monitor is shipped wired for manual (“lockout” or “hand reset mode”) and can be wired for automatic reset by the addition of a jumper on the rear terminals. When this jumper is added, the trip indicator continues to function, but the relay will automatically reset when the ground loop is restored.

In the Non-UVR Mode, the relay is normally de-energized. The relay energizes to perform a trip function only when control power is present and the ground loop is open. To utilize the advantages of the monitor in the Non-UVR mode, the associated circuit breaker must employ a potential trip device. As with the UVR mode, the lock-out function can be defeated with a jumper. With this jumper (while in the Non-UVR mode) the relay states are reversed (lock-out puts the relay into an energized state instead of de-energized.)
**Features**

A 0.25 second time delay is incorporated into the monitor to prevent relay trip from occurring when power is removed and re-applied in the Non-UVR mode.

**Initial Adjustment**

The monitor must be adjusted for the particular installation with its cable at the time it is commissioned into service. Full adjustment instructions are printed on the face plate of the monitor. Also at this time, the polarity switch position should be set according to the instructions on the monitor face plate. The monitor can be adjusted for operation with up to 15 ohms total pilot-ground loop impedance.

**Specifications**

- **Control Power:** 115 VAC, +/- 15% Continuous¹
- **Pilot Output:** Maximum 16 VAC, 50/60 Hz. Maximum 1.5 Amps.
- **Operating Temperature:** +10° F to +120° F

¹ Allowed dip will vary from installation to installation. However, generally a 30% dip will not cause problems. Should dips greater than 30% be anticipated, the addition of a constant voltage transformer (50/60 Hz, 100 VA Minimum) is recommended.
Ground Fault Relay GT-137

Electrical Components are Protected by the Design of the Enclosure
Easy to Read, Easy to Operate Front Panel

Application
This Line Power Manufacturing Ground Fault Relay is a compact and rugged ground fault relay designed for the harsh environment of underground mining. Referred to as GT-137, this unit has become the standard in ground fault relays for the mining industry.

In conjunction with its current transformer, a primary current injection, push-to-test ground fault is standard. This test, or an actual ground fault, will result in the trip of the manual reset breaker located on the ground fault relay and the trip of the associated output breaker, if closed. The manual reset breaker must be in a non-tripped position before the output breaker can close.

Specifications
The Line Power Manufacturing GT-137 Ground Fault Relay is factory set at 5 amps, instantaneous, requires no field adjustment, and is designed for undervoltage or shunt trip applications.

Control Power: 115VAC, +/- 15% Continuous
Operating Temperature: +10° F to +120° F

Features
The GT-137 Ground Fault Relay requires the use of one of the following types of current transformers (see reverse side):

95-0060 - Window-type current transformer. Maximum of 3 #2/0 cables; No mounting feet.
95-0060-01 - Window-type current transformer. Maximum of 3 #2/0 cables; For cable smaller than #1; Use with mounting feet.

Inside window diameter for either 95-0060 or 95-0060-01: 1.5 inches.

95-0069 - Window-type current transformer. For three single #4/0 cables; No mounting feet.
95-0069-01 - Window-type current transformer. For dual #2/0 cable; With mounting feet.

Inside window diameter for 95-0069 or 95-0069-01: 2.0 inches.

95-0061-01 - Window-type current transformer for high current circuits when dual cable per phase is required.

Inside window diameter for 95-0061 or 95-0061-01: 3.375 inches.
Ground Fault Relay GT-137

Typical Current Transformers

Part Number 95-0061-01

Part Number 95-0060

Mounting Profile


Manufacturer reserves the right to make changes or modifications without notification.
Application

Impedance-type ground monitoring combined with ground fault protection is conveniently packaged in the Groundkeeper 1 Series of Line Power Ground Monitors. Easy to understand indication lights and adjustments put all the information up front to show at a glance the condition of the circuit.

Ground Monitor Protection

The Groundkeeper 1 Series features easy to see lights on the front panel. The yellow “Control Power On” light shows when power is available to the unit. Next to it is the green “GM Picked Up” light which indicates the ground circuit is complete and the monitor is operational.

Also on the front cover are the “Test” button, “Polarity Switch” and “Adjust” knob. The “Test” button is provided to assist in initially setting the monitor and later to periodically check the operation of the monitor. When the test button is depressed, the “GM Picked Up” light should go out to indicate the monitor has been tripped. Next to the “test” button is the “Polarity Switch”. This switch reverses the polarity of the monitor current with respect to the induced voltages in the pilot wire/ground wire loop. Located in the center of the cover is the “Adjust” knob, for initially calibrating the monitor to trip as required by MSHA. (If desired, this knob can be easily relocated to an alternate position behind the front cover.) A simple set of instructions for ground monitor adjustment is printed on the front cover for operational convenience. The Groundkeeper 1 Series is MSHA accepted, B.T.S. #021177LPMC (1) - R3.

Easily Accessible Interior

The interior of the monitor is accessible from the front of the panel. The front cover may be taken off by removing two screws. This provides convenient access to the transformer taps used in adjusting the monitor and also to the relay, should replacement ever be necessary. The monitor may be used to operate either shunt trip or under-voltage release devices by moving a wire from one terminal to another.

Part Number: 16-7015-03-01
Rapid Change Out
A complete change out of the monitor can be made from the front of the panel in five minutes or less. The same two screws that secure the front cover also secure the monitor to the panel. When these screws are removed, the monitor can be tipped forward and pulled out of the panel opening. Two plugs disconnect it from the electrical circuit.

Ground Fault Protection
Several ground fault relay cards are available, each providing different features. Refer to the chart below to select the relay with the features required for your application. These can be easily changed at any time by replacing the ground fault card and the cover.

The ground fault relay features available are Ground Fault Instantaneous Trip, Ground Fault Time Delay Trip, Ground Fault Tripped Light, and Ground Fault Test Pushbutton. The Ground Fault Tripped Light remains on after a ground fault condition occurs until it is manually reset. The Ground Fault Test Pushbutton tests the system by imposing a simulated fault current on the sensor through a separate test winding.

Additional Features
The -04 and -06 models of the Groundkeeper 1 Series contains the features listed above plus a “Ground Monitor Tripped” light and a “Power to Trip Coil” light.

Ordering Information
For a complete Groundkeeper 1, first determine the application and select the Monitor Part Number. Then:

1. Determine if a GF Sensor is required for your application.
   If it is, request "with GF Sensor" on your monitor order.
2. Determine if a Panel Wiring Harness is required for your application. If it is, specify "with Shunt Trip wiring harness" or "with Undervoltage Release wiring harness" on your monitor order.

Groundkeeper 1
Impedance Type Ground Monitor

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-0105-01</td>
<td>Output Circuit - Separate GF          (imp. GM, no GF)</td>
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<tr>
<td>17-0105-03</td>
<td>Output Circuit                                (imp. GM, inst. GF, no indicator)</td>
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<tr>
<td>17-0105-02</td>
<td>Output Circuit                                (imp. GM, inst. GF, w/indicator)</td>
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<tr>
<td>17-0105-04</td>
<td>Output Circuit                                (imp. GM, inst. GF, w/indicators, GF test)</td>
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<tr>
<td>17-0105-05</td>
<td>Output Circuit Feeding a Distribution Box or Starter (imp. GM, TD GF, w/indicator)</td>
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<tr>
<td>17-0105-06</td>
<td>Output Circuit Feeding a Distribution Box or Starter (imp. GM, TD GF, w/indicators, GF test)</td>
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Specifications subject to change without notice.
Groundkeeper 143
Continuity Type Ground Monitor

Fail-Safe Operation with Constant Ground Monitoring
Machine Remote Control

Application
Fail-safe control of machines stop and start operations and ground wire monitoring at the same time, is provided in a convenient package with the Line Power Groundkeeper 143. It can be used on remotely controlled machines or operator attended machines in achieving fail safe operation with freedom from nuisance tripping. The Groundkeeper 143B (P/N 17-0143B) is available for use up to 5kV applications.

System Operation
The Groundkeeper 143 Ground Monitor System is designed to monitor the continuity of both the pilot-conductor and ground-conductor in an equipment trailing cable. These cables are normally connected between a power source (i.e.: power distribution center) and a load (i.e.: motor), using a cable designed for power, safety ground, and pilot wire operation.

This type of ground monitor requires that a semiconductor diode be connected between the pilot wire terminal and the ground wire terminal at the load end of the trailing cable. A low voltage, D.C. signal current circulates in the pilot-wire/ground-conductor loop; the Groundkeeper 143 system continually monitors this circulating signal.

If this pilot-wire/ground-conductor loop is connected properly and is not open, shorted, or presenting a high impedance, the Groundkeeper 143 will continually provide permissive contact closure for electrical interlocking of the control system...

The monitor’s control contact will OPEN if any one of the following conditions are present:

- The semiconductor diode at the load end is absent
- The semiconductor diode at the load end is open
- The semiconductor diode at the load end is shorted
- The pilot-wire or ground-conductor is open at any location
- The pilot-wire and ground-conductor are shorted together at any location
- The total D.C. resistance in the pilot-wire/ground-conductor loop (in the trailing cable and/or pilot diode circuits) is greater than 50 ohms

Ground Wire Device (G.W.D.)
System interconnection of the Groundkeeper 143 requires that a G.W.D. be connected between the ground-wire return at the power source and the frame-ground of the power source. This device may be either a pair of back-to-back, high-current semiconductor diodes, or a high-current inductor, depending on the application. The purpose of the G.W.D. is to effectively isolate the pilot-wire/ground-conductor loops from each other while providing a ground to enclosure. This ground is used in the event of a problem resulting in significant ground-conductor current. In this way, the individual (separate) signals being monitored by each ground monitor system and its associated pilot-wire/ground-conductor loop are effectively prevented from interfering with each other.
### GROUND KEEPER 143

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<th>Monitoring System Component Part Numbers</th>
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### GROUND KEEPER 143B

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</table>

Specifications subject to change without notice.

P/N: 17-0144
L.V. Pilot Diode

P/N: 92-1004
Inductor Ground Wire Device

P/N: 08-0362
Current Transformer

P/N: A2596-A
Back-to-Back Diode
Ground Wire Device
Groundkeeper 145
Continuity Type Ground Monitor

Fail-Safe Operation with Constant Ground Monitoring

Front Panel Design

Machine Remote Control

Application
Fail-safe control of machines stop and start operations and ground wire monitoring at the same time, is provided in a convenient package with the Line Power Groundkeeper 145. It can be used on remotely controlled machines or operator attended machines in achieving fail safe operation with freedom from nuisance tripping. The Groundkeeper 145B (P/N 17-0145B) is available for use up to 5kV applications.

System Operation
The Groundkeeper 145 Ground Monitor System is designed to monitor the continuity of both the pilot-conductor and ground-conductor in an equipment trailing cable. These cables are normally connected between a power source (i.e.: power distribution center) and a load (i.e.: motor), using a cable designed for power, safety ground, and pilot wire operation.

This type of ground monitor requires that a semiconductor diode be connected between the pilot wire terminal and the ground wire terminal at the load end of the trailing cable. A low voltage, D.C. signal current circulates in the pilot-wire/ground-conductor loop; the Groundkeeper 145 system continually monitors this circulating signal.

If this pilot-wire/ground-conductor loop is connected properly and is not open, shorted, or presenting a high impedance, the Groundkeeper 145 will continually provide permissive contact-closure for electrical interlocking of the control system.

The monitor's control contact will OPEN if any one of the following conditions are present:

- The semiconductor diode at the load end is absent
- The semiconductor diode at the load end is open
- The semiconductor diode at the load end is shorted
- The pilot-wire or ground-conductor is open at any location
- The pilot-wire and ground-conductor are shorted together at any location
- The total D.C. resistance in the pilot-wire/ground-conductor loop (in the trailing cable and/or pilot diode circuits) is greater than 50 ohms

Ground Wire Device (G.W.D.)
System interconnection of the Groundkeeper 145 requires that a G.W.D. be connected between the ground-wire return at the power source and the frame-ground of the power source. This device may be either a pair of back-to-back, high-current semiconductor diodes, or a high-current inductor, depending on the application. The purpose of the G.W.D. is to effectively isolate the pilot-wire/ground-conductor loops from each other while providing a ground to enclosure. This ground is used in the event of a problem resulting in significant ground-conductor current. In this way, the individual (separate) signals being monitored by each ground monitor system and its associated pilot-wire/ground-conductor loop are effectively prevented from interfering with each other.
## GROUND KEEPER 145

<table>
<thead>
<tr>
<th>Item</th>
<th>Monitoring System Final Part Number</th>
<th>Electronic Assembly</th>
<th>Current Transformer</th>
<th>Pilot Diode</th>
<th>Ground Wire Device</th>
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## GROUND KEEPER 145B

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<td>B2054-4</td>
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</table>

### Specifications subject to change without notice.
Line Power 17-0043
Low Voltage Impedence Ground Monitor

GMS ADJUSTMENT PROCEDURE
1. Make certain ground and pilot wires are intact and properly wired.
3. Turn potentiometer fully clockwise.
4. Decrease test button.
5. Slowly turn potentiometer counterclockwise until the relay drops out. The dropout point is identified by a “mizing” of the relay.
6. Release test button. The adjustment is complete.

NOTE: If relay fails to pick up, select a higher tap. The IR5 tap is invariable.

Line Power
329 Williams Street • Bristol, VA 24201 • Phone (276) 466-8200 • Fax (276) 645-8887 • www.linepower.com
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Flange Terminators

General
The Line Power Flange Terminator is a rugged combination of a strain relief mechanism and a water tight seal which is designed for use on all types of electrical equipment. It will accept a wide range of high and low voltage cable sizes. The Line Power Flange Terminator is superior to so called "cord grips" in that it provides mechanical strain relief through cable gripping aluminum clamps and a water tight seal through a rubber grommet. Conventional "cord grips" providing mechanical gripping with their grommet and do not use cable gripping clamps.

Selection

<table>
<thead>
<tr>
<th>Flange Terminator Part Number</th>
<th>Cable Range</th>
<th>Item 3 Cable Seal Part Number</th>
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<tbody>
<tr>
<td>02-2566-01</td>
<td>.875 - 1.000</td>
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<td>1.001 - 1.125</td>
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<td>02-2566-03</td>
<td>1.126 - 1.250</td>
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<td>02-2566-04</td>
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<td>1.626 - 1.750</td>
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<td>02-2566-08</td>
<td>1.751 - 1.875</td>
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<td>02-2566-16</td>
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Line Power Flange Terminators are available in four types of mountings. The 02-2567 Series uses six (6) mounting holes on a 7 - 7/8" diameter circle, the same mountings as all PMG and SFG High Voltage Couplers (except SFG08). The 02-2568 Series mounts like the SFG08 High Voltage Coupler, six (6) holes on an 8 - 5/8" diameter circle. 02-2503 thru 02-2524 Flange Terminators use six (6) holes on a 6 - 1/8" diameter circle. The 02-2566 Series uses four (4) mounting holes in a 4 - 1/4" square pattern as found PG39, 59, 60, 67, 68, 69, 79 and 85 Low Voltage Couplers.
### MOUNTING HOLE DIAMETER

<table>
<thead>
<tr>
<th>7-7/8&quot; Part Number</th>
<th>8-5/8&quot; Part Number</th>
<th>6-1/8&quot; Part Number</th>
<th>Cable Range</th>
<th>Item 3 Seal Gasket</th>
<th>Item 4 Comp. Ring</th>
<th>Item 6 Cable Clamp</th>
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### MOUNTING HOLE DIAMETER

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<td>See Chart</td>
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* Replaces Items (8) and (11) at switchgear.

** For use with all PMG and all SFG *(except Series 08) Coupler mounting holes.

° For use with SFG Series (08) Coupler mounting holes only.

---

Other Line Power Products

- Substations
- Power Centers
- Rectifiers
- Starters
- Switchhouses
- Motor Test Centers
- Vacuum Circuit Breakers
- High Voltage Switches
- High Voltage Couplers
- Transformers
- Low Voltage Couplers
- Ground Monitors
- Bolted Pressure Switches
- Grounding Resistors

Note: Specifications subject to change without notice.
The Model 12-1017 Slip Switch is a self-contained belt control switch designed to protect your conveyor system from slip, sequence and gob-off conditions.

**Description**

The Model 12-1017 Slip Switch has all the electronic sensing and control circuitry contained in an encapsulated enclosure. This procedure assures that the Slip Switch is not affected by moisture or dust. To install the unit, mount the Slip Switch near a suitable roller, add targets to the roller and connect the cable to the belt control box. The Slip Switch has a surface mounted adjustment for speed control and indicator lights for power and speed set up.

**Features**

- Adjustable Speed Set Up
- Indicator Lights
- Environmentally Sealed
- Easy Installation

**Specifications**

- Size: 6" Long x 2" Round
- Power: 120 VAC.
- Speed: 140 to 4000 Targets Per Minute
- No Moving Parts
- Part Number: 12-1017
**Model 12-1015 Spill Switch**

**Description**

The Model 12-1015 Spill Switch is shipped complete and ready to use. Designed to be mounted vertically, the solid state sealed switch breaks the control or sensing circuit when tilted more than 30° in any direction. An attached chain makes mounting a snap.

The heavy-duty, grounded housing is completely sealed from the environment with epoxy resin compound. All control voltages are well insulated from the user for safety.

- Normally-closed contacts
- Normally-open contacts
- 30° omni-directional deflection angle
- 120 VAC., 20 amp. or 240 VAC, 10 amp.
- Mounting Chain
- Grounded housing
- Easy to install.

**Applications**

- Detects clogged conveyor transfer points or chutes
- Detects high or low levels in bins, hoppers, crushers
- Detects presence of materials and indicates flow
- Detects spills
- Part Number 12-1015

LPMS-S/TS-0903
Another new and innovative product from Line Power Manufacturing — the leader in mine power distribution.

Test Summary
A heat run test was performed in accordance to ANSI/IIEEE C57.12.91, Section 11, on a 4500 KVA Longwall Power Center with all covers, top and side, in place and fastened. The top covers over the transformers were of the Vent-A-Lid design. Ambient temperature was 23.2°C. The highest surface temperature recorded (during a short-circuit test) was on a Vent-A-Lid cover over a transformer. This cover was within 2” of the core steel of the transformer. This temperature was 66°C, a rise of 42.8°C.

Note 1: ANSI/IIEEE C57.12.01, Section 5.11.3.5 Temperatures of external parts accessible to operations shall not exceed the following temperature rises over ambient temperature at maximum rated load: Readily Accessible: 65°C Rise; Not Readily Accessible: 80°C Rise.

Note 2: “Not Readily Accessible” is considered to apply to equipment parts located at heights greater than 6.5 feet (1.96 m) above floor level, or otherwise located to make accidental contact unlikely.

Heat Run Test

<table>
<thead>
<tr>
<th>Possible Without Vent-A-Lid</th>
<th>ANSI Max. - See Note 1</th>
<th>Vent-A-Lid</th>
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</thead>
<tbody>
<tr>
<td>Ambient 23.2°C</td>
<td>Temperature Rise</td>
<td></td>
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</tbody>
</table>

Vent-A-Lid
With the ever-increasing KVA requirements for underground Power Centers, and in particular, Longwall Power Centers, many undesirable features were presenting themselves. For example:

1. “Skin” temperature, especially the top cover lid over transformer bays can reach 140°C, a definite hazard to workers.

2. Excessive heat within the Power Center enclosure can adversely affect electrical components.

3. Excessive heat within the Power Center enclosure reduces the efficiency and life expectancy of the transformer.

4. The use of thermocouples and relays to reduce the incidence of the above conditions can result in unscheduled shutdowns.

These undesirable features can be essentially resolved with Line Power’s new Vent-A-Lid incorporated into the design of your Power Center.

There is no trade-off, as the Vent-A-Lid is structurally more robust than a flat sheet top cover, sheds debris and water as well as a flat sheet top cover and uses no forced air ventilation to meet a KVA requirement.

The Vent-A-Lid’s tortuous air path design also meets the requirement of retarding flame emissions from the enclosure in case of an internal fire.

Line Power Manufacturing has noted the concern the mining industry has expressed with the inherent problems associated with large KVA units in underground mines. With the new Vent-A-Lid design, we feel that this concern has been successfully and safely addressed.
Another new and innovative product from Line Power Manufacturing — the leader in mine power distribution.
Series 10 & 20
High Voltage Fuses

- **Wide Range of Ampere Sizes**
- **Two Types Cover 4 Thru 24 kV**
- **High Interrupting Capacity**
- **Direct Replacement for Similar Types by Other Manufacturers**
- **Built-in Indicator/Plunger for Auxiliary Tripping (Striker Pin)**

**General**

Line Power fuses are indoor type, automatic, selectively acting high voltage protection devices for the 4-24 kV voltage range. By rapid action, these fuses reliably protect transformers, cables, capacitors and switching installations from thermal and dynamic effects of short circuits. The Line Power fuses are direct replacements for similar types now in service. They are readily applicable for protection of high voltage equipment of all types.

**Striker Pin**

A spring loaded plunger (called a striker pin) is standard on all Line Power High Voltage Fuses. This striker operates immediately when the fuse is blown and not only gives a visual indication but can be used to operate tripping or signaling mechanisms.

**Double Fusing**

In special cases, a rated current may be required exceeding that which is available in a single fuse; such rated current can be realized by parallel connection of several fuses per pole.

**Fuse Mounting Assembly**

Line Power manufactures a mounting assembly for use with these fuses. Each assembly is for one phase and includes fuse clips, insulators and a channel with adjustment holes for either Series 8 or Series 24 length fuses. Mounting assemblies are available for single or double fuses.
Fuse Protection of Transformers

Various criteria must be observed in selecting fuses for the short circuit protection of transformers:

1. The rated current of the fuse must not be less than a certain value so as to prevent operation of the fuse by the transformer inrush current.

2. The rated current of the fuse must not be too high in order to prevent the current flowing through the fuse due to a short circuit on the low voltage side of the transformer, being below the minimum breaking current of the fuse (taking account of cable impedance and arc resistance).

3. The rated current of the high voltage fuse must be sufficiently high to assure discrimination between high voltage and low voltage transformer fuses.

4. The rated current of the fuse must be as low as possible so that their time/current characteristic is below the operating characteristics of the relay in the supply feeder.

Taking the above mentioned points into account, selection of the fuses in accordance with the diagram below is recommended.
### Selection Data

**Fuse Mounting Assemblies**

#### Voltage Class

**Series 10** (use on 4kV through 10kV systems)

<table>
<thead>
<tr>
<th>Current Rating</th>
<th>Part Number</th>
<th>MVA Rating</th>
<th>Dimensions - Inches (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>13-0011-01</td>
<td>400</td>
<td>A: 11.5 (292) B: 3.23 (82)</td>
</tr>
<tr>
<td>125</td>
<td>13-0014-01</td>
<td>400</td>
<td>A: 11.5 (292) B: 3.23 (82)</td>
</tr>
<tr>
<td>160</td>
<td>13-0015-01</td>
<td>400</td>
<td>A: 11.5 (292) B: 3.23 (82)</td>
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<tr>
<td>200</td>
<td>13-0016-01</td>
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</table>

**Series 20** (use on 12kV through 24kV systems)

<table>
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<th>Part Number</th>
<th>MVA Rating</th>
<th>Dimensions - Inches (mm)</th>
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<td>75</td>
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<td>400</td>
<td>A: 17.4 (442) B: 3.23 (82)</td>
</tr>
<tr>
<td>100</td>
<td>13-0029-01</td>
<td>400</td>
<td>A: 17.4 (442) B: 3.23 (82)</td>
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<td>125</td>
<td>13-0030-01</td>
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<td>160</td>
<td>13-0031-01</td>
<td>400</td>
<td>A: 17.4 (442) B: 3.23 (82)</td>
</tr>
</tbody>
</table>

#### Part Number Description

- **13-2035-01**: Mount for single fuse
- **13-2035-02**: Mount for double fuse
**Time Current Characteristics**

The diagram below shows the pre-arcing time/fault current characteristics of Line Power fuses, rated currents 6 to 200 amps.

For additional information and/or ordering instructions, please contact your local Line Power Representative or the factory at the address and phone number below.

**IMPORTANT**

The information contained herein is general in nature and is intended FOR REFERENCE ONLY. It is the responsibility of the designer to select the fuse for a specific application. All pertinent design criteria must be considered.

Specifications subject to change without notice.

LPMS-F20-11/10