Low Voltage Power Circuit Breakers
Types DSII and DSLII
Class 6035
# Table of Contents

## Introduction
- Safety Features ........................................... 1
- Safety Practices ......................................... 2
- Qualified Personnel ..................................... 3
- Precautions ............................................... 3
- Other Publications and Documentation ................. 3

## Receiving, Handling, and Installation
- Unpacking the Circuit Breaker .......................... 4
- Storing the Circuit Breaker .............................. 4
- Lifting the Circuit Breaker .............................. 5
- Circuit Breaker Inspection .............................. 6
- Levering Device Positions ................................ 7

## Equipment Description
- Type DSII Circuit Breaker ................................ 9
- Type DSLII (Limiter) Circuit Breaker .................. 10
- Basic Circuit Breaker Assembly ....................... 11
- Pole Units ................................................ 12
- Primary Moving Contact Assembly .................... 13
- Primary Stationary Contact Assembly ............... 14
- Interphase Barriers ...................................... 14
- DE-ION Arc Chutes (Interrupter Assemblies) ....... 14
- Electronic Tripping System .............................. 16
- Electronic Trip Unit .................................... 16
- Sensors .................................................... 16
- Trip Actuator ............................................ 17
- Operating Mechanism .................................... 18
- Manually Operated Circuit Breaker ................... 19
- Power Operated Circuit Breaker ....................... 19

## Movable Primary and Secondary Contacts
- Standard and Optional Devices ......................... 20
- Motor Cut-Off Switch (LS) ............................ 20
- Spring Release Device (SR) ......................... 20
- Anti-Pump Relay (Y) .................................. 21
- Shunt Trip Attachment (ST) .......................... 21
- Latch Check Switch ................................... 22
- Auxiliary Switch ....................................... 22
- Undervoltage Trip Attachment (UVR) ............... 23
- Overcurrent Trip Switch ............................... 24
- Miscellaneous Details ................................ 25
- Interference Interlock ................................ 25
- Ground Contact ......................................... 25
- Close Bar Guard ......................................... 25
- Operation Counter ..................................... 25
# BASIC OPERATING INSTRUCTIONS

- Manual Circuit Breaker Operation .............................................. 26
  - Spring Charge Mechanism for Manually Operated Circuit Breakers .......... 27
- Power Circuit Breaker Operation .............................................. 29
  - Spring Charge Mechanism for Power Operated Circuit Breakers .......... 29
  - Power Operation ................................................................. 35
- Closing Mechanism ................................................................. 36
- Opening (Tripping) Mechanism ................................................. 37
- Mechanical Interlocking System Description .................................. 38
  - REMOVE Position ................................................................. 38
  - DISCONNECT Position .......................................................... 39
  - TEST Position ........................................................................ 39
  - CONNECT Position ................................................................. 39
  - Mechanical Interlocking System Operation ................................... 40
  - Spring Discharge Interlock ...................................................... 42
  - Connected Circuit Breaker Manual Close Interlock ......................... 44
  - Electric Lockout Equipped Circuit Breaker .................................. 44
  - Closed Circuit Breaker Interlock ............................................. 44
  - Padlocking Provision .............................................................. 45
- DSLII Circuit Breaker and Fuse Truck .......................................... 47
  - DSLII Current Limiters ........................................................... 47
  - Blown Limiter Indicator .......................................................... 48
  - Fuse Truck ............................................................................. 49
  - Fuse Truck Installation and Use ................................................ 49
  - Fuse Replacement ................................................................. 50
  - Blown Fuse Indicator .............................................................. 50

# INSPECTION AND MAINTENANCE

- General ...................................................................................... 51
- General Cleaning Recommendations .......................................... 51
- When To Inspect ......................................................................... 51
- What To Inspect ......................................................................... 52
  - DSII-308 Through DSII-840/850 Inspection .................................. 52
  - Additional Inspections for DSII-632 and DSII-840/850 ...................... 54
  - DSII-632 and DSII-840/850 Inspection ......................................... 54
  - DSII-516 Through DSII-840/850 Contact Replacement .................... 55
  - Arc Chutes .............................................................................. 56
  - Power Operated Mechanism ...................................................... 56
- Factory Adjustments ................................................................... 56
  - Trip Latch Overlap Adjustment .................................................. 57
  - Circuit Breaker Open Position Stop Adjustment (DSII-632 Only) ........ 57
  - Moving Contact Adjustment ..................................................... 58
  - Levering Mechanism Adjustment ............................................... 59
- Lubrication .................................................................................. 59
  - Lubrication Frequency ............................................................. 60
  - Lubricant Location ................................................................. 60

# RENEWAL PARTS ...................................................................... 63
**LIST OF FIGURES**

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Typical DSII Circuit Breaker Nameplate</td>
<td>2</td>
</tr>
<tr>
<td>Figure 2</td>
<td>DSII 840 Circuit Breaker with Lifting Adapter Installed</td>
<td>5</td>
</tr>
<tr>
<td>Figure 3</td>
<td>DSII Circuit Breaker with One Interphase Barrier Removed</td>
<td>6</td>
</tr>
<tr>
<td>Figure 4</td>
<td>DSII Circuit Breaker with One Arc Chute Removed</td>
<td>7</td>
</tr>
<tr>
<td>Figure 5</td>
<td>DSII Circuit Breaker Levering Arm Shown in REMOVE Position</td>
<td>8</td>
</tr>
<tr>
<td>Figure 6</td>
<td>Type DSII Circuit Breaker</td>
<td>9</td>
</tr>
<tr>
<td>Figure 7</td>
<td>Type DSLII Circuit Breaker</td>
<td>10</td>
</tr>
<tr>
<td>Figure 8</td>
<td>Typical DSII Circuit Breaker Faceplate</td>
<td>11</td>
</tr>
<tr>
<td>Figure 9</td>
<td>Type DSII-308 Pole Unit Assembly (Front View)</td>
<td>12</td>
</tr>
<tr>
<td>Figure 10</td>
<td>Type DSII-308 Pole Unit Assembly (Rear View)</td>
<td>12</td>
</tr>
<tr>
<td>Figure 11</td>
<td>Type DSII-516 Pole Unit Assembly (Front View)</td>
<td>13</td>
</tr>
<tr>
<td>Figure 12</td>
<td>Type DSII-516 Pole Unit Assembly (Rear View)</td>
<td>13</td>
</tr>
<tr>
<td>Figure 13</td>
<td>Removing the DSII Interface Barriers</td>
<td>14</td>
</tr>
<tr>
<td>Figure 14</td>
<td>Removing the DSII Arc Chute</td>
<td>15</td>
</tr>
<tr>
<td>Figure 15</td>
<td>Typical Type DSII Tripping System Diagram</td>
<td>16</td>
</tr>
<tr>
<td>Figure 16</td>
<td>Type DSII Trip Actuator</td>
<td>17</td>
</tr>
<tr>
<td>Figure 17</td>
<td>Front and Rear Views of Manual Spring Charge Mechanism</td>
<td>18</td>
</tr>
<tr>
<td>Figure 18</td>
<td>Front and Rear Views of Power Operated Spring Charge Mechanism</td>
<td>18</td>
</tr>
<tr>
<td>Figure 19</td>
<td>Type DSII Circuit Breaker (Bottom View)</td>
<td>20</td>
</tr>
<tr>
<td>Figure 20</td>
<td>Anti-Pump Relay Shown Unmounted</td>
<td>21</td>
</tr>
<tr>
<td>Figure 21</td>
<td>Power Operated DSII Circuit Breaker (Front Cover Removed)</td>
<td>21</td>
</tr>
<tr>
<td>Figure 22</td>
<td>Latch Check Switch Operation</td>
<td>22</td>
</tr>
<tr>
<td>Figure 23</td>
<td>Undervoltage Trip Attachment Operation</td>
<td>23</td>
</tr>
<tr>
<td>Figure 24</td>
<td>Overcurrent Trip Operation</td>
<td>24</td>
</tr>
<tr>
<td>Figure 25</td>
<td>Close Bar Guard Shown Installed</td>
<td>25</td>
</tr>
<tr>
<td>Figure 26</td>
<td>Manual Charging of Circuit Breaker Closing Springs</td>
<td>26</td>
</tr>
<tr>
<td>Figure 27</td>
<td>Principal Parts in Manually Charged Spring Operated Mechanism</td>
<td>27</td>
</tr>
<tr>
<td>Figure 28</td>
<td>Manually Operated Spring-Charging Mechanism Details</td>
<td>28</td>
</tr>
<tr>
<td>Figure 29</td>
<td>Principal Parts in Power Operated Mechanism (Close Spring Shown in Charged Position)</td>
<td>29</td>
</tr>
<tr>
<td>Figure 30</td>
<td>Crank Shaft Assembly Front View</td>
<td>31</td>
</tr>
<tr>
<td>Figure 31</td>
<td>Power Operated Spring-Charge Details</td>
<td>32</td>
</tr>
<tr>
<td>Figure 32</td>
<td>Four Basic Positions of Circuit Breaker and Linkage (Enlarged View of Trip Shaft)</td>
<td>33</td>
</tr>
<tr>
<td>Figure 33</td>
<td>Manual Spring-Charge on Power Operated Mechanism</td>
<td>34</td>
</tr>
<tr>
<td>Figure 34</td>
<td>Basic Schematic and Connection Diagrams for Power Operated Circuit Breaker</td>
<td>35</td>
</tr>
<tr>
<td>Figure 35</td>
<td>Drawout Unit Position Indicator</td>
<td>38</td>
</tr>
<tr>
<td>Figure 36</td>
<td>Shutter, Trip Plate and Trip Shaft Relationship</td>
<td>40</td>
</tr>
<tr>
<td>Figure 37</td>
<td>Shutter, Interlock Cam and Levering Device Arms Relationship</td>
<td>42</td>
</tr>
<tr>
<td>Figure 38</td>
<td>Close-Release Interlock to Discharge Springs on Levering Out</td>
<td>43</td>
</tr>
<tr>
<td>Figure 39</td>
<td>Close Interlock Preventing Efforts to Close an Already Closed Circuit Breaker</td>
<td>45</td>
</tr>
</tbody>
</table>
LIST OF FIGURES (CONT.)

Figure 40: Padlock Device (Locked Trip-free with Shutter Raised) . . 46
Figure 41: DSLII-516 Circuit Breaker (Side View) . . . . . . . . . . 48
Figure 42: Blown Fuse Indicator . . . . . . . . . . . . . . . . . . . . . . . 48
Figure 43: DSII-FT32 Fuse Truck (Front View) . . . . . . . . . . . . . . . . 49
Figure 44: DSII-FT32 Fuse Truck (Rear View) . . . . . . . . . . . . . . . . 49
Figure 45: DSII-FT32 Truck (Front Cover Removed) . . . . . . . . . . . . 50
Figure 46: DSII-308 Contacts and Adjustments . . . . . . . . . . . . . . . . 53
Figure 47: DSII-516/620 Contacts and Adjustments . . . . . . . . . . . . 53
Figure 48: DSII-632 Contacts and Adjustments . . . . . . . . . . . . . . . . 54
Figure 49: DSII-840 Contacts and Adjustments . . . . . . . . . . . . . . . . 55
Figure 50: Shunt Trip Details Showing Trip Shaft Adjustment . . . . 57
Figure 51: Open Position Stop and Anti-Rebound Latch . . . . . . . . . 58
Figure 52: Levering Mechanism . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 59
Figure 53: Left Side of Mechanism Lubrication Points . . . . . . . . . . 61
Figure 54: Right Side of Mechanism Lubrication Points . . . . . . . . . 61
Figure 55: Shunt Trip Device Lubrication Points . . . . . . . . . . . . . . . . 62
Figure 56: Spring Release Device Lubrication Points . . . . . . . . . . . 62
Figure 57: Trip Shaft Lubrication Points . . . . . . . . . . . . . . . . . . . . . . . 62

LIST OF TABLES

Table 1: Type DSII Circuit Breaker Ratings . . . . . . . . . . . . . . . . . . . . 2
Table 2: Type DSLII Circuit Breaker and Combination Ratings . . . . . 2
Table 3: Circuit Breaker and Fuse Truck Weights . . . . . . . . . . . . . . . . 5
Table 4: Sensor and Limiter Ratings . . . . . . . . . . . . . . . . . . . . . . . . 47
Table 5: Lubrication Frequency . . . . . . . . . . . . . . . . . . . . . . . . . . . . 60
INTRODUCTION

Read and understand these instructions before unpacking, assembling, operating, or maintaining Type DSII and DSLII circuit breakers.

If problems are experienced during installation, operation, or maintenance contact Square D Field Service Division at the following number: 1-800-634-2003.

NOTE: The DSII circuit breaker is not interchangeable with the DS circuit breaker. Square D DSII circuit breakers are not interchangeable with Cutler-Hammer DSII circuit breakers.

|
|---|
|**DANGER**|
|**HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION**|
|  • Type DSII and DSLII circuit breakers are protective devices. They are maximum current devices.  
  • These circuit breakers should not be applied outside of their nameplate ratings.  
  **Failure to follow these instructions will result in death or serious injury.**|

Safety Features

Type DSII and DSLII circuit breakers and POWER-ZONE® III Series 2 switchgear are manufactured with built-in interlocks and safety features. These are provided to reduce the hazard associated with installing, maintaining, and operating power circuit breakers and metal-enclosed low-voltage switchgear. Interlocks and other safety features are provided for the user's safety and should never be altered or disabled.

|
|---|
|**DANGER**|
|**HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION**|
|  Do not disable, remove, or modify any mechanical interlock, electrical interlock, or safety feature.  
  **Failure to follow this instruction will result in death or serious injury.**|
Safety Practices

Operate Type DSII and DSLII circuit breakers within the voltage, current, and short circuit interrupting capacity shown on the nameplate. Do not apply this equipment in systems with voltages, current levels, or available short circuit current in excess of these limits.

Table 1: Type DSII Circuit Breaker Ratings

<table>
<thead>
<tr>
<th>Circuit Breaker Type</th>
<th>Frame Size (A)</th>
<th>Interruption Ratings, RMS Symmetrical Amperes</th>
<th>With Instantaneous Trip</th>
<th>With Short Delay Trip</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>208-240 V</td>
<td>480 V</td>
<td>600 V</td>
</tr>
<tr>
<td>DSII-308</td>
<td>800</td>
<td>42,000</td>
<td>30,000</td>
<td>30,000</td>
</tr>
<tr>
<td>DSII-508</td>
<td>800</td>
<td>65,000</td>
<td>50,000</td>
<td>42,000</td>
</tr>
<tr>
<td>DSII-608</td>
<td>800</td>
<td>65,000</td>
<td>50,000</td>
<td>42,000</td>
</tr>
<tr>
<td>DSII-516</td>
<td>1600</td>
<td>65,000</td>
<td>50,000</td>
<td>42,000</td>
</tr>
<tr>
<td>DSII-616</td>
<td>1600</td>
<td>65,000</td>
<td>65,000</td>
<td>50,000</td>
</tr>
<tr>
<td>DSII-620</td>
<td>2000</td>
<td>65,000</td>
<td>65,000</td>
<td>50,000</td>
</tr>
<tr>
<td>DSII-632</td>
<td>3200</td>
<td>85,000</td>
<td>65,000</td>
<td>65,000</td>
</tr>
<tr>
<td>DSII-840</td>
<td>4000</td>
<td>130,000</td>
<td>85,000</td>
<td>85,000</td>
</tr>
<tr>
<td>DSII-850</td>
<td>5000</td>
<td>130,000</td>
<td>85,000</td>
<td>85,000</td>
</tr>
</tbody>
</table>

1 Maximum voltages at which the interrupting ratings apply are:

- System Voltage 208 or 240 V: 254
- Maximum Voltage 480 V: 508
- Maximum Voltage 600 V: 635

2 Also short-time ratings.

3 Short circuit ratings of non-automatic circuit breakers except the DSII-840/850 which is 65,000.

Table 2: Type DSLII Circuit Breaker and Combination Ratings

<table>
<thead>
<tr>
<th>Type</th>
<th>Frame Size (A)</th>
<th>Max. Interrupting Rating, RMS Sym. (A), System 600V or Below</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSLII-308①</td>
<td>800</td>
<td>200,000</td>
</tr>
<tr>
<td>DSLII-516①</td>
<td>1600</td>
<td>200,000</td>
</tr>
<tr>
<td>DSLII-632②</td>
<td>3200 ⑥</td>
<td>200,000</td>
</tr>
<tr>
<td>DSLII-840③</td>
<td>4000</td>
<td>200,000</td>
</tr>
</tbody>
</table>

1 Limiter Integral with drawout circuit breaker element.

2 DSII-632 circuit breaker and DSII-FT32 drawout fuse truck in separate interlocked compartments.

3 DSII-840 circuit breaker and DSII-FT40 drawout fuse truck in separate interlocked compartments.

4 Maximum continuous rating limited to 3000 A when fuse truck compartment is above circuit breaker compartment.
Qualified Personnel

Install, inspect, operate, and maintain Type DSII and DSLII circuit breakers by qualified electrical personnel according to OSHA standard 1910.331 through 1910.335. This OSHA standard contains information and requirements on training, selection and use of work practices, use of equipment, and safeguards for personal protection.

Precautions

It is important to be familiar with and understand all of the information presented in this instruction manual. Remember to NEVER work alone.

⚠️ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION

- Turn off all power supplying this equipment before working on or inside equipment.
- This equipment must be installed, operated, and serviced only by qualified electrical personnel according to OSHA 1910.331 through 1910.335.
- Always practice lock-out tag-out procedures according to OSHA requirements.
- Always use a properly rated voltage sensing device to confirm all power is off.
- Never work on an energized circuit.
- Never work in the vicinity of an energized circuit without using proper safety equipment.
- Circuit breaker and switch contacts must be open and all springs discharged before performing maintenance work.
- Never insert a circuit breaker into a cell that is not complete and functional according to its nameplate.
- Ensure that drawout circuit breakers are in one of their designed cell positions, such as CONNECT, TEST, DISCONNECT, or REMOVE.

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

Other Publications and Documentation

In addition to this instruction manual, other printed information and documentation is available and supplied as appropriate. Additional documentation may include POWER-ZONE® III Series 2 switchgear instruction bulletin, 44021-995-01, or DIGITRIP® RMS Trip Units instruction bulletin, 6035-510A.
RECEIVING, HANDLING, AND INSTALLATION

Types DSII and DSLII circuit breakers, when supplied as part of a metal-enclosed switchgear assembly, will be shipped separately. Receiving and handling of this equipment is addressed in an assembly instruction manual supplied with the assembled equipment. This instruction manual still applies, however, to all other aspects of the circuit breakers.

Before unpacking new DSII circuit breakers, read and understand these directions. Following the directions will ensure that you have caused no damage.

Every effort is made to ensure that DSII circuit breakers arrive at their destination undamaged and ready for installation. Care should be exercised to protect the circuit breakers from impact at all times. Do not remove protective packaging until the circuit breakers are ready for inspection, testing, and/or installation. Inspect shipping containers for obvious signs of rough handling and/or external damage that may have occurred during transportation. Record any observed damage for reporting to the transportation carrier and Square D. All reports and claims should be as specific as possible and include shop order and general order information.

When ready to inspect and install the DSII circuit breaker, carefully open the shipping container and remove any packing material and any internally packed documentation. The circuit breaker is designed and balanced to be easily lifted from the shipping container using the appropriate lifting adapter and travelling lifter or portable lifting device.

**WARNING**

HAZARD OF FALLING EQUIPMENT

- Do not connect crane hook, ropes, chains, etc., directly to circuit breaker.
- Always use accessory lifting adapter to lift the circuit breaker.
- Never walk, stand, or work under a suspended load.
- Follow all precautions and instructions of the lifting device being used.

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

Storing the Circuit Breaker

If it is necessary to store a circuit breaker before installation, do so in its original shipping container. Keep the circuit breaker in a clean dry place. Ensure there is ample air circulation and heat to prevent condensation. It is very important that the insulation used in the circuit breaker not be exposed to dirt or moisture.

**NOTE:** A circuit breaker that has been stored for any length of time should be operated a minimum of five times before it is placed into service.
Lifting the Circuit Breaker

When handling the circuit breaker, carefully lift and place the circuit breaker on a solid work surface capable of handling the circuit breaker’s weight (see Table 3) or on the extension rails of the circuit breaker compartment. This is accomplished by using the appropriate lifting adapter and lifter. The lifting adapter consists of a spreader bar with two sheet steel hooks specially shaped to hook under the top edges of the large openings on each circuit breaker side sheet (see Figure 2).

Figure 2: DSII 840 Circuit Breaker with Lifting Adapter Installed

Table 3: Circuit Breaker and Fuse Truck Weights

<table>
<thead>
<tr>
<th>Type</th>
<th>lbs/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSII-308</td>
<td>150/68</td>
</tr>
<tr>
<td>DSII-508</td>
<td>195/88</td>
</tr>
<tr>
<td>DSII-608</td>
<td>200/91</td>
</tr>
<tr>
<td>DSII-516</td>
<td>195/88</td>
</tr>
<tr>
<td>DSII-516</td>
<td>200/91</td>
</tr>
<tr>
<td>DSII-620</td>
<td>200/91</td>
</tr>
<tr>
<td>DSII-632</td>
<td>300/136</td>
</tr>
<tr>
<td>DSII-840</td>
<td>400/181</td>
</tr>
<tr>
<td>DSII-850</td>
<td>400/181</td>
</tr>
<tr>
<td>DSLII-308</td>
<td>200/91</td>
</tr>
<tr>
<td>DSLII-516</td>
<td>260/118</td>
</tr>
<tr>
<td>DSII-FT32</td>
<td>325/147</td>
</tr>
<tr>
<td>DSII-FT40</td>
<td>430/195</td>
</tr>
</tbody>
</table>
Circuit Breaker Inspection

If the circuit breaker is to be lifted onto the compartment’s extension rails, ensure the rails are fully extended before the circuit breaker is lifted. Ensure that the four rollers (two on either side of the circuit breaker) are seated properly on the extension rails before removing the lifting device.

Visually inspect all circuit breakers for damage after removing them from their shipping containers.

Remove the glass polyester interphase barriers. Note any cautions or instructions printed directly on the barriers. These instructions will assist you in properly positioning the barriers in the circuit breaker once the barriers are replaced (see Figure 3).

![Figure 3: DSII Circuit Breaker with One Interphase Barrier Removed](image)

**WARNING**

**HAZARD OF EQUIPMENT FAILURE**

Verify interphase barriers and arc chutes are in place and secured before placing the circuit breaker into service.

Failure to follow this instruction can result in death or serious injury.
Remove the three arc chutes which are mounted on top of the pole units. Each arc chute is held in place by one top inserted screw (see Figure 4).

Figure 4: DSII Circuit Breaker with One Arc Chute Removed

⚠️ WARNING

HAZARD OF EQUIPMENT FAILURE
Verify interphase barriers and arc chutes are in place and secured before placing the circuit breaker into service.
Failure to follow this instruction can result in death or serious injury.

Inspect the primary contact structure to be sure no damage has occurred during shipment. Replace all interphase barriers and arc chutes.

Check the electrical and/or manual operation of each circuit breaker following the instructions in “BASIC OPERATING INSTRUCTIONS” on page 26.

Levering Device Positions

⚠️ WARNING

HAZARD OF EQUIPMENT FAILURE
Do not apply torque in excess of 25 lb-ft (33.9 N•m) to the levering shaft.
Failure to follow this instruction can result in death or serious injury.

The circuit breaker drawout element has four normal positions in its compartment as determined by the levering device:

• REMOVE Position (see Figure 5 on page 8)
• DISCONNECT Position
• TEST Position
• CONNECT Position
The REMOVE position is the first position in the compartment as the circuit breaker element is pushed directly by hand as far as it will go. The DISCONNECT, TEST, and CONNECT positions are reached only by means of the levering mechanism assembly. The levering mechanism assembly is hand operated with a removable crank handle. The handle is placed on the levering mechanism assembly worm shaft, which is exposed by pushing and holding the Push-to-Trip button on the front of the circuit breaker and depressing the shutter (see Figure 8 on page 11).

With the circuit breaker sitting on the extension rails, verify that the circuit breaker levering arms are in the REMOVE position (see Figure 5). If they are not, turn the levering mechanism crank in the direction required to get the levering arms in the REMOVE position. Carefully push the circuit breaker into the circuit breaker compartment until it physically stops. Begin turning the levering mechanism crank in a clockwise direction. Initially, push on the front of the circuit breaker while turning the levering mechanism crank to get the lever mechanism engaged and started. A continued clockwise rotation of the levering mechanism crank will move the circuit breaker to the DISCONNECT, TEST, and the CONNECT positions. When the CONNECT position is reached, the levering mechanism crank becomes hard to turn. At this point, stop turning the crank. As the circuit breaker is cranked and the different positions are reached, a position indication is given in the position indicator window on the front of the circuit breaker (see Figure 8 on page 11).

Rotation of the levering mechanism crank counterclockwise will turn the levering arms so as to withdraw the circuit breaker from the compartment. The procedure is basically the same as just described except in the opposite direction.

Figure 5: DSII Circuit Breaker Levering Arm Shown in REMOVE Position

NOTE: If the circuit breaker is levered out from the TEST position to the REMOVE position with the closing springs charged, a trip free closing operation automatically takes place, but the circuit breaker contacts do not close.
EQUIPMENT DESCRIPTION

Type DSII Circuit Breaker

Type DSII circuit breakers are designed specifically for use in metal-enclosed low voltage switchgear assemblies (see Figure 6).

The controls and indicators are functionally grouped on the front of the circuit breaker. To gain access to the stored energy mechanism and control devices, remove the circuit breaker faceplate. Inspection, minor maintenance, and many replacement functions involving the mechanism, control, and/or accessory devices can be easily accomplished.

DSII circuit breakers are available with either a manually operated or electrically operated two-step stored energy mechanism.

Six continuous current frame sizes, 800 through 5000 A, are covered by three physically different circuit breaker sizes. A variety of optional accessories are available and common to all circuit breaker frames.

Figure 6: Type DSII Circuit Breaker

The frame width and height are the same for the DSII-308 through the DSII-620 circuit breakers. Interference interlocks are provided to prevent insertion of circuit breakers with mismatching disconnects or insufficient interruption ratings into compartments capable of carrying higher current.

Circuit protection is supplied by an electronic, micro-processor based tripping system. True RMS sensing is provided for proper correlation with thermal characteristics of conductors and equipment.
Type DSLII (Limiter) Circuit Breaker

Type DSLII circuit breakers are coordinated combinations of standard DSII circuit breakers and series connected current limiters. The primary purpose of the current limiters is to extend the interrupting rating of the DSII circuit breaker up to 200,000 A (see Figure 7).

DSLII circuit breakers are intended for applications requiring the overload protection and switching functions of air circuit breakers on systems whose available fault currents exceed the interrupting ratings of the circuit breakers alone and/or exceed the withstand and interrupting ratings of downstream circuit components.

Figure 7: Type DSLII Circuit Breaker

The 800–1600 A frame DSLII circuit breakers have the limiters integrally mounted on the drawout circuit breaker elements. On 3,200 and 4,000 A frame combinations, the limiters are mounted on separate drawout trucks. They fit into compartments of equal size to their compatible circuit breakers and are normally positioned adjacent to one another.

On overloads and faults within the circuit breaker interrupting rating, the circuit breaker protects the limiters. On higher fault currents exceeding the circuit breaker rating, the limiters protect the circuit breaker.

Interlock arrangements trip the circuit breaker whenever any limiter blows. The circuit breaker cannot be reclosed on a live source unless there are three unblown limiters on the circuit. The blown indicator provides a visual indication when a current limiter in any phase has interrupted a short circuit. In addition, it is the device that ensures a circuit breaker will be tripped when any current limiter has blown, preventing single phasing.

DSLII-308 through DSLII-516 circuit breakers must be completely withdrawn from the compartment, thus ensuring complete isolation, before the integral fuses are accessible.
Fuses for types DSLII-632 and DSLII-840 circuit breakers are mounted on a separate fuse truck. The fuse truck is key interlocked with the circuit breaker to prevent withdrawing or insertion unless the circuit breaker is disconnected.

**NOTE:** Refer to “BASIC OPERATING INSTRUCTIONS” on page 26 for additional information concerning limiter ratings, limiter replacement, blow fuse indicator operation, and fuse truck installation.

---

**WARNING**

**HAZARD OF EQUIPMENT FAILURE**

Verify circuit breaker faceplate, interphase barriers, and arc chutes are correctly installed before putting circuit breaker into cell.

**Failure to follow this instruction can result in death or serious injury.**

---

**Basic Circuit Breaker Assembly**

The basic circuit breaker assembly includes a chassis, a control panel, an operating mechanism, a tripping system, a levering-in device, various required interlocks, and three insulated pole unit assemblies.

The control items needed for proper operation of the circuit breaker are located on the front panel. Controls are functionally grouped for convenience. All operating personnel should be familiar with their locations and functions (see Figure 8).

Access to the operating mechanism and internally mounted auxiliary devices is gained by removing the circuit breaker faceplate. The faceplate is held in place by front accessible bolts.

---

**Figure 8: Typical DSII Circuit Breaker Faceplate**
Pole Units

The pole unit assembly is a molded base of high-strength insulating material in which is mounted one to three sets of primary contact assemblies. The exact design configuration depends upon the frame size of the circuit breaker.

A DSII-308 pole unit assembly consists of a single-molded base and three sets of primary contact assemblies. The primary contact assembly is made up of two parts, the stationary contact assembly and the movable contact assembly, each mounted individually in the insulating base (see Figures 9 and 10).

![Figure 9: Type DSII-308 Pole Unit Assembly (Front View)](image)

![Figure 10: Type DSII-308 Pole Unit Assembly (Rear View)](image)
Pole unit assemblies for other DSII circuit breaker frame sizes are similar to the DSII-308 in design configuration, except each of the three poles are mounted on individual insulating bases (see Figures 11 and 12).

**Figure 11:** Type DSII-516 Pole Unit Assembly (Front View)

**Figure 12:** Type DSII-516 Pole Unit Assembly (Rear View)

**Primary Moving Contact Assembly**

The primary moving contact assembly for all ratings consists of moving arms hinged at the bottom to the lower main terminal through controlled pressure rotating contacts. At the upper end of the primary moving assembly are the main and arcing contacts. The arcing contacts of all frame sizes are essentially the same design. The number of moving arms, the number of main contacts, and the number of main disconnect contact fingers vary with the frame size. A strong and rigid insulating link operates the moving contact blade assembly.
Primary Stationary Contact Assembly

The stationary contact assembly consists of butt-type main contacts which carry the main continuous load current. It is comprised of a multiplicity of individual fingers. Each finger is hinged at the upper end under controlled pressure. The stationary arcing contacts are similar for all frame sizes and consist of two parallel fingers, one on each side of the upper main terminal. They are spring loaded toward each other by compression springs and have arc resisting tips. The previously described moving arcing contact wedges the stationary contact fingers apart as the circuit breaker closes. In addition, the parallel action of the magnetic fields of the currents in each arcing contact finger causes the fingers to be attracted toward each other when closing against fault currents. This results in a “blow-on” action on the arcing contacts.

Interphase Barriers

Glass polyester interphase barriers assist in maintaining proper clearances and must be in place at all times during circuit breaker operation within its compartment. Each barrier is held firmly in place by its positioning in the circuit breaker, with no fastener of any type required (see Figure 13).

To remove a barrier, carefully but firmly grasp the top of the barrier and pull upward until it clears the circuit breaker chassis. Note all cautions and instructions printed directly on the barriers during removal or replacement. These notes help to ensure proper positioning of the barriers in the circuit breaker. In addition, the barriers are designed such that proper seating of the barriers cannot be accomplished, if the barriers are not replaced correctly.

DE-ION Arc Chutes (Interrupter Assemblies)

The arc chutes mount on top of the pole units over the arcing contacts (see Figure 6 on page 9). This position and design of the arc chutes confines the electrical arcs inside the chutes at all times and for all values of current.

Each arc chute contains crosswise, vertical steel splitter plates having an inverted “V” notch to attract the arc and interrupt it, by essentially cooling and stretching the arc. In addition to steel plates, the larger arc chutes include hard, arc-resistant glass polyester plates. These plates produce turbulence in the exhaust gases above the steel plates, and prevent electrical breakdown over the top of the arc chute or to ground. The arc chute components are all assembled in an insulating jacket.
Each arc chute is held in position by one screw mounted on top of the arc chute. To remove an arc chute, remove the mounting screw and lift the arc chute out of the circuit breaker (see Figure 14).

Figure 14: Removing the DSII Arc Chute
The electronic trip unit contains the intelligence for the three part, flux transfer tripping system. The integrally mounted sensors and the trip actuator make up the rest of the system (see Figure 15). For more detailed information about the specific trip unit used with Types DSII and DSLII circuit breakers, refer to DIGITRIP® RMS Trip Units instruction bulletin, 6035-510A.

Electronic Tripping System

Types DSII and DSLII circuit breakers, whether manually or electrically operated, are supplied with a state-of-the-art electronic, microprocessor-based trip units. True RMS sensing is provided for proper correlation with thermal characteristics of conductors and equipment.

In addition to circuit protection, electronic trip units provide information and integral testing functions. Optional remote communications and energy monitoring functions are also available.

The electronic trip units are completely self-contained. When the circuit breaker is closed, no external power is required to operate their protection systems. They operate from current signal levels and the control power is derived from current sensors integrally mounted in the circuit breaker.

When the circuit breaker is shipped from the factory, the trip unit's protective functions are normally set at nominal values. The purchaser, consultant, or Square D Coordination Group must provide specific overload tripping characteristics to coordinate with the load or system.

Three current sensors are installed at the rear of the circuit breaker on the lower studs, directly behind the main disconnecting contacts (see Figure 6 on page 9 and Figure 7 on page 10). The sensors produce an output current proportional to the load current. Under preselected conditions of current magnitude and time, the sensors furnish the electronic trip unit with a signal and the energy required to trip the circuit breaker.

Since the continuous current rating for any frame size circuit breaker is associated with both the sensors and the trip unit itself, a complete tabulation of available current sensors is presented in DIGITRIP® RMS Trip Units instruction bulletin, 6035-510A.
Trip Actuator

The electronic trip unit provides a pulse to the trip actuator, which produces a mechanical force to trip the circuit breaker (see Figure 16). The actuator is comprised of a permanent magnet, a disc held by the magnet, a rod acted on by a spring, a lever for tripping the circuit breaker, and a lever for mechanically resetting the actuator. The trip unit's tripping pulse counteracts the effect of the permanent magnet, allowing the spring to separate the disc from the magnet pole piece, while moving the rod to actuate the trip shaft lever. The device is reset when the circuit breaker opens, since the reset lever causes the disc to contact the magnet. If the disc is not fully reset, the trip shaft lever will hold the circuit breaker mechanism in the trip-free condition, and the circuit breaker cannot be reclosed.

Figure 16: Type DSII Trip Actuator
Operating Mechanism

The operating mechanism is a spring-charged stored energy type. It consists of two major parts:

1. Stored energy or spring-charging mechanism
2. Mechanism for closing and opening circuit breaker

The basic parts of these mechanisms are combined into one sub-assembly. Two varieties of the mechanism, manual and power operated spring charge, cover the entire line of DSII and DSLII circuit breakers (see Figures 17 and 18).

Figure 17: Front and Rear Views of Manual Spring Charge Mechanism

Figure 18: Front and Rear Views of Power Operated Spring Charge Mechanism
Manually Operated Circuit Breaker

On manually operated circuit breakers, the closing springs can be charged only by hand. This is accomplished with the front-mounted, spring-charge handle. The spring-charge handle used with manually operated circuit breakers is significantly longer than the handle used with power operated circuit breakers. An optional electrical spring release, normally supplied only on power operated circuit breakers, can be supplied on the manually operated version.

The circuit breaker can be tripped open manually by pushing the trip plate on the front control panel. Tripping will also occur if the trip plate on the circuit breaker compartment door is pushed while the circuit breaker is in the CONNECT position.

Electrical tripping of a manually operated circuit breaker can take place through the following devices:

- Optional shunt trip device
- Trip actuator energized from the electronic trip unit
- Optional undervoltage trip device
- Blown limiter indicator on DSLII type circuit breakers

The drawout manually operated circuit breaker has four normal positions in its compartment, determined by the levering device: REMOVE, DISCONNECT, TEST, and CONNECT. Refer to “Levering Device Positions” on page 7 for additional information.

Power Operated Circuit Breaker

On power operated circuit breakers, the closing springs can be charged both electrically and manually. Normally, the springs are automatically charged by a universal type electric motor, which is part of the mechanism. If necessary, the springs can be charged manually through the use of a front mounted manual charge handle. The manual charge handle used with power operated circuit breakers is significantly shorter than the handle used with manually operated circuit breakers. Closing is accomplished electrically by an electromagnet which lifts the closing spring release latch. Like the manually operated circuit breaker, the power operated circuit breaker can also be closed manually by pushing on the front control panel close bar (see Figure 8 on page 11), unless defeat screws are installed.

Like the manually operated version, the power operated circuit breaker can also be tripped open manually by pushing the trip plate on the front control panel or the trip plate on the circuit breaker compartment door.

Power operated circuit breakers can be electrically tripped through the following devices:

- Standard shunt trip device
- Trip actuator energized from the electronic trip unit
- Optional undervoltage trip device
- Blown limiter indicator on DSLII type circuit breakers
Movable Primary and Secondary Contacts

The primary connection of a drawout circuit breaker to the primary stabs in the circuit breaker compartment is provided by six primary disconnect finger clusters (see Figure 6 on page 9 and Figure 7 on page 10). Each finger cluster is comprised of a number of spring loaded fingers. The number of fingers varies, depending on the current rating of the circuit breaker. Finger clusters attach to the primary studs of the circuit breaker's pole unit assembly. Finger clusters can be easily removed using a finger cluster removal tool.

The secondary connection of a drawout circuit breaker is provided by contact blocks mounted on the rear upper frame of the circuit breaker. They are mounted, as required, in two rows of two blocks per row. Each block consists of 12 spring loaded contacts. Protective covers over the top row of contacts protect them from damage (see Figure 6 on page 9 and Figure 7 on page 10).

Standard and Optional Devices

Motor Cut-Off Switch (LS)

The motor cut-off switch is standard on all power operated circuit breakers. It disconnects the motor when the closing springs are fully charged, and is operated by the motor cut-off switch lever on the operating mechanism (see Figure 19).

Spring Release Device (SR)

The spring release device is standard on power operated circuit breakers and optional on manually operated circuit breakers. It permits a circuit breaker to be closed electrically. A close signal is applied to the spring release device to begin the closing operation. The spring release coil is energized through the anti-pump relay, the motor cut-off switch, and a normally closed "b" auxiliary switch contact, which operates the spring release latch to release the closing springs.

Figure 19: Type DSII Circuit Breaker (Bottom View)
Power operated circuit breakers have an anti-pump relay mounted in the upper left front portion of the circuit breaker just behind the faceplate. It disconnects the spring release device after the circuit breaker has been closed (see Figure 20 on page 21). This prevents the circuit breaker from trying to close immediately after being tripped open (pumping) on concurrent close and trip signals.

The shunt trip attachment is standard on power operated circuit breakers and optional on manually operated circuit breakers (see Figure 21). It is an electromechanical device of the clapper type. A trip signal to the shunt trip device energizes a coil which causes its armature to be attracted to the core. The armature pushes the trip lever on the circuit breaker trip shaft, causing the circuit breaker to trip. As the circuit breaker trips, a normally open “a” auxiliary switch contact, in series with the shunt trip attachment coil, deenergizes the coil.
The optional latch check switch consists of a switch mounted on the inside of the left hand circuit breaker side sheet. It is located such that when the circuit breaker trip shaft is in the “reset” position, a normally closed contact of the switch is closed (see Figure 22). When the switch is supplied, the contact is usually connected in the closing circuit of the circuit breaker to ensure that the tripping system is reset before the circuit can be energized to close the circuit breaker.

As many as two auxiliary switches can be mounted on a circuit breaker (see Figure 21 on page 21). They are stacked units located in the right front portion of the circuit breaker chassis. Each switch has ten contacts which may be normally open “a” or normally closed “b” contacts. Auxiliary switch contacts are rated 10 A at 120/240 Vac, 10 A at 125 Vdc, and 2 A at 250 Vdc. Five normally open and five normally closed contacts are available for use on both manually and power operated circuit breakers.
Undervoltage Trip Attachment (UVR)

The undervoltage trip attachment is optional on both manually or power operated circuit breakers. The undervoltage trip attachment is an electromechanical device that trips the circuit breaker when the voltage on its coil falls to between 30–60% of nominal. To close the circuit breaker, the proper voltage must first be applied to the undervoltage trip attachment. Failure to apply the proper voltage to the undervoltage trip attachment prevents the circuit breaker from being closed.

In operation, a moving core is magnetically held against a stationary core and spring. This is linked to a latch carrying a roller which restrains the main tripping lever of this assembly (see Figure 23). When the coil voltage is sufficiently reduced, the spring overcomes the magnetic attraction between the two cores. The moving core travels upward and rotates the latch counterclockwise. The roller moves from beneath the tail of the main tripping lever. A torsion spring around the pivot pin of the tripping lever then rotates it counterclockwise, causing a projection on right side of the lever to strike a pin in the mechanism trip shaft. The result is that the trip shaft rotates clockwise and trips the circuit breaker.

As the circuit breaker opens, a pin on the left pole unit shaft strikes a vertical leg (reset arm) of the undervoltage tripping lever and rotates it counterclockwise against its torsion spring. Another arm on the tripping lever resets the roller latch and moving core. A slight amount of overtravel on the trip latch ensures positive resetting under all conditions.

The undervoltage trip attachment is bolted in place in the lower circuit breaker chassis. Always connect the undervoltage coil on the line side of the circuit breaker unless the attachment is equipped with a time delay device. In this case, the time delay will delay tripping of the circuit breaker long enough to permit energization of the undervoltage coil from the load side. Do not use an auxiliary switch contact in the undervoltage circuit.

Figure 23: Undervoltage Trip Attachment Operation
Overcurrent Trip Switch

The overcurrent trip switch is optional on both manually and power operated circuit breakers. Its function is to provide a signal to indicate that the circuit breaker has tripped open by action of the electronic trip unit due to phase or ground overcurrent. Tripping by the trip plate, shunt trip device, or undervoltage trip device does not cause it to operate.

It is mounted on and operates from the trip actuator of the circuit breaker. Three standard contact arrangements are available:

1. Two normally open
2. Two normally closed, or
3. One normally open and one normally closed.

These are independently wired to the circuit breaker secondary disconnect contacts. Special units may have one additional contact.

The device is latch-type and must be manually reset by means of a pushbutton mounted on the circuit breaker front panel. An electric reset type is available for remote operation (see Figure 24).

![Figure 24: Overcurrent Trip Operation](image_url)
### Miscellaneous Details

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interference Interlock</td>
<td>A “Z” shaped bracket prevents a circuit breaker with an insufficient interrupting rating from being inserted into the wrong compartment (see Figure 19 on page 20). The circuit breaker mounted bracket has to properly key with a bracket mounted on the compartment floor to permit circuit breaker insertion. An interference interlock bracket is standard on all drawout circuit breakers from 800–2000 A.</td>
</tr>
<tr>
<td>Ground Contact</td>
<td>The standard circuit breaker ground contact engages a corresponding contact on the compartment floor and provides positive grounding of the circuit breaker frame (see Figure 19 on page 20).</td>
</tr>
<tr>
<td>Close Bar Guard</td>
<td>The optional close bar guard covers the close bar to prevent unintentional manual closing of the circuit breaker (see Figure 25). In the case of emergency, the circuit breaker can be closed by pushing the close bar through the small hole in the close bar guard.</td>
</tr>
<tr>
<td>Operation Counter</td>
<td>The operation counter is used to provide a record of the number of circuit breaker operations. The mechanical counter is connected by linkage to the pole shaft.</td>
</tr>
</tbody>
</table>

![Close Bar Guard](image)
BASIC OPERATING INSTRUCTIONS

HAZARD OF FALLING EQUIPMENT
When charging the circuit breaker on extension rails or a workbench, firmly secure the circuit breaker to prevent it from tilting forward. 
Failure to follow this instruction can result in death or serious injury.

Manual Circuit Breaker Operation
On manually operated circuit breakers, the closing springs can only be charged by hand. The circuit breaker cannot be in the REMOVE position when manually charging the springs. The springs are not allowed to fully charge before discharging (trip-free close operation). If a circuit breaker has been removed from its compartment to a remote location for maintenance and charging of the closing springs is required, the levering device arms on the sides of the circuit breaker must be rotated away from the REMOVE position to the TEST position (see Figure 5 on page 8). This is accomplished through the use of the levering crank as described in “Levering Device Positions” on page 7.

When the circuit breaker is in the CONNECT or TEST position, as indicated on the front control panel indicator, the closing springs can be charged by a single stroke downward of the manual charge handle. The position of the manual charge handle will be nearly 90 degrees from its normal upright rest position (see Figure 26). When the springs are charged, the handle becomes very easy to move, and a metallic “click” is heard as the over-center, closing springs stop is reached. The spring charge indicator on the front control panel will indicate “Spring Charged.”

Figure 26: Manual Charging of Circuit Breaker Closing Springs
Standard manually operated circuit breakers can only be closed by hand using the close bar (see Figure 8 on page 11). An optional closing spring release device can be supplied for the same purpose. Refer to “Spring Release Device (SR)” on page 20 for additional information.

Standard manually operated circuit breakers can be opened manually by using the trip plate on the front control panel or the trip plate on the compartment door. Automatic opening of the circuit breaker can be accomplished through the use of several standard and/or optional devices. Refer to “Manually Operated Circuit Breaker” on page 19 for details.

The mechanism in a manually operated circuit breaker is illustrated in Figure 27. The actuator is omitted for clarity.

<table>
<thead>
<tr>
<th>HAZARD OF MOVING PARTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Do not release the charging handle before charging operation is complete.</td>
</tr>
<tr>
<td>• Releasing the charging handle before the charging operation is complete will cause the handle to return to its normal position at a high velocity.</td>
</tr>
<tr>
<td>Failure to follow these instructions can result in injury or equipment damage.</td>
</tr>
</tbody>
</table>

Spring Charge Mechanism for Manually Operated Circuit Breakers

Figure 27: Principal Parts in Manually Charged Spring Operated Mechanism
Figure 28 shows the details of the spring-charging device. It is located between the mechanism right-hand side frame and the right crank arm. A part of this assembly is the manual charge cam. It is rigidly fixed to the crank shaft, as are the main close cam and crank arms.

The other parts are the front crank assembly. It is pivoted to a bracket fastened to the main frame base, and has a socket for the manual charge handle. The rear crank is pivoted to the front portion, and has a cross-wise pin on the end. A spring forces this pin against the cam. Another spring holds the front crank assembly in a clockwise direction against a stop, so that the manual charge handle socket is normally upright in the unused position.

The manual charge cam is mounted on the crank shaft so that the crank pin hooks behind the hook-shaped surface of the manual charge cam, when the handle is upright and the springs discharged (see Figure 28). The springs are fully charged by moving the charging handle down almost 90 degrees, as previously detailed in “Manual Circuit Breaker Operation” on page 26.

It is possible to manually recharge the closing springs immediately after closing the circuit breaker and before it has been tripped open. This results in the springs loading the associated bearings and latches for long periods. In addition, an extra close operation or trip-free operation will be necessary on levering the circuit breaker to the DISCONNECT and REMOVE positions. Therefore, it is recommended that the springs be charged just prior to closing the circuit breaker.
Power Circuit Breaker Operation

On power operated circuit breakers, the closing springs are normally charged automatically through the use of an electric motor. In the case of an emergency or lack of control power, the springs can be charged manually.

Closing springs can be charged manually by using the short, front mounted manual charging handle. The length of this charging handle is significantly shorter than its manual version. This is one way to quickly identify a manually or power operated circuit breaker. The manual charging mechanism on a power operated circuit breaker operates on a ratchet principle, requiring 10 to 12 handle pumping operations to completely charge the springs. When charged, a definite metallic “click” is heard and the spring charge indicator on the front control panel will show “Spring Charged.” Do not try to force the charging handle beyond this point.

Closing of the circuit breaker is accomplished electrically by an electromagnet (spring release device) which lifts the closing spring release latch. Like the manually operated circuit breaker, the power operated circuit breaker can also be closed manually by pushing the front control panel close bar (Figure 8 on page 11).

Power operated circuit breaker can be opened manually or electrically. Refer to “Power Operated Circuit Breaker” on page 19 for details.

Spring Charge Mechanism for Power Operated Circuit Breakers

The mechanism in a power operated circuit breaker is graphically illustrated in Figure 29.
Figure 30 on page 31 is a front view drawing showing the principal parts of the spring-charging portion of this mechanism. Some parts are omitted for clarity. Figure 31 on page 32 shows in greater detail the major parts of the spring-charge mechanism in two positions:

1. Closing springs charged as viewed looking into right end of crankshaft (see Figure 31a)
2. Closing springs discharged partial view

Refer to Figure 30 on page 31. The basic elements are mounted on the crank shaft. This is a straight shaft with four flats machined on it, and a crank arm attached to each end. Each crank arm connects to its closing spring by a formed spring end in Figure 31b. The rear of the springs anchor to the rear of the mechanism frame. The crank arms, motor cutoff switch cam, close cam and two drive plates have matching flats, and are thus anchored to the crank shaft. The spring charge indicator ratchet wheel, oscillator, and manual charge device do not have internal flats, but are mounted on separate bushings and are free to rotate on the crank shaft.

The motor crank shaft assembly, carrying a roller for driving the oscillator, is pivoted in the right hand mechanism side frame. The hold pawl is mounted by means of a pin on the mechanism side frame.

In operation, rotation of the motor crank pushes the oscillator arm counterclockwise to make the oscillator pawl push a tooth in the ratchet wheel, and rotate the ratchet wheel slightly more than one tooth in the counterclockwise direction. The holding pawl snaps behind the corresponding advanced tooth, and holds it against the torque of the closing springs while the oscillator arm rotates back clockwise to catch another ratchet tooth. Thus the ratchet wheel is rotated counterclockwise until the ratchet wheel pin engages the two drive plates, which in turn rotate the crank shaft and crank arms in the same direction until the arms are slightly past horizontal dead center. Since the close cam is rigidly mounted on the crank shaft like the drive plates, it has rotated the same amount as the plates. The close cam carries as stop roller as shown in Figure 32b. Just after horizontal dead center of the crank arms is reached, the torque of the closing springs starts to rotate the crank independently of the driving motor. However, the stop roller on the closing cam quickly stops the movement of the crank at only a few degrees over center, and holds it there by coming against the spring release latch. This is the "spring charged" position. The motor cut-off switch cam operates the switch through a lever at this time, and the motor stops.

At the instant the springs snap over dead center, the lobes of the drive plates raise the pawl lifters, and prevent the oscillator pawl from engaging the next tooth in the ratchet wheel. Thus the oscillator is free and renders the exact stopping point of the motor not critical.

When the spring release latch is moved below the level of the stop roller, the close cam is free to rotate; and the two closing springs rotate the crankshaft counterclockwise to close the circuit breaker contacts. They assume the position shown in Figure 31b and the cam as shown in Figure 32c. During rotation, the drive plates move away from the ratchet wheel pin. The ratchet wheel does not rotate during the closing operation, thus preventing excessive wear on the teeth and paws.
Power operated circuit breakers are also equipped for manual hand charging of the closing springs (see Figure 33 on page 34). This operation is similar to that of the motor and oscillator except a separate manual charge pawl is used to advance the ratchet wheel several teeth on each stroke of the charge handle. This device also pivots on the crankshaft.

Figure 30: Crank Shaft Assembly Front View
(Some Parts Omitted for Clarity)
Figure 31: Power Operated Spring-Charge Details

a. Spring Charged

b. Spring Discharged
Figure 32: Four Basic Positions of Circuit Breaker and Linkage
(Enlarged View of Trip Shaft)

- **a. Circuit Breaker Open – Springs Discharged**
- **b. Circuit Breaker Closed – Springs Discharged**
- **c. Circuit Breaker Closed – Springs Charged**
- **d. Trip Latch Held**
- **d. Trip Latch Released**

**Circuit Breaker Open – Springs Charged**

- Pole lever pin
- Center pole lever
- Pole shaft
- Trip shaft
- Trip shaft latching surface
- Pivot pin
- Trip latch
- Roller constraining link
- Close cam
- Stop roller
- Spring release latch
- Moving contact arm
- Stationary arcing contact
- Insulating link adjusting stud and lockout
- Moving contact pivot pin
- Insulating link
- Main drive link
- Main roller
- Mechanism side frame

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Figure 33: Manual Spring-Charge on Power Operated Mechanism
Power Operation

Refer to Figure 34 for the basic schematic and connection diagrams.

With the circuit breaker open and springs discharged, the motor is energized through the limit switch (LS) and the “b” contact. The green indicating light (G) is controlled by a separate “b” contact, and when lit indicates the circuit breaker is open.

The motor runs and charges the closing springs. When the springs are fully charged, the limit switch (LS) opens in the motor circuit and closes in the spring release coil (SR) circuit.

When the close contact (CS-C) makes, the spring release coil (SR) is energized through the normally closed “Y” contact, the limit switch (LS), and the circuit breaker “b” contacts. This releases the latch holding the stop roller on the close cam.

The springs are released to close the circuit breaker. When the circuit breaker closes, the “b” contact opens to cut off the spring release coil (SR) and motor (MOT), and the limit switch (LS) contacts reset.
If the close contact (CS-C) is maintained, the anti-pump relay (Y) will be picked up by the current through the spring release coil (SR), and will open its “Y” contact in the spring release (SR) circuit. This allows only one close operation until the close contact (CS-C) has been reset. The “Y” coil has a very low drop-out voltage.

On some circuit breakers a special closing circuit may be provided which permits the closing springs to be automatically recharged immediately after the circuit breaker is closed, instead of only after the circuit breaker is opened. This is accomplished by separating the motor and limit switch from the “b” contact so the motor operation is independent of the position of the circuit breaker contacts. This arrangement makes the circuit breaker suitable for use with instantaneous reclosing relays or in special operating sequences.

Standard control uses ac or dc control power. For 240 Vac or 120 Vac equipment, the control power can be taken directly from the source through fuses. For 480 Vac and 600 Vac operation, a suitable control power transformer is used. The transformer is optional for 240 Vac systems. Control voltages are 48, 125 or 250 Vdc.

When the circuit breaker closes, the “a” contact in the shunt trip (ST) coil circuit also closes to complete this trip circuit. The red indicator lamp (R) supervises the shunt trip circuit to show that it is in working order. It also indicates that the circuit breaker is closed.

When control power is turned on, any power operated circuit breaker in the TEST or CONNECTED positions with its springs discharged will have its motor energized until the closing springs are charged.

The mechanism is of the general variety of mechanically trip free mechanisms. This means that the circuit breaker can be opened or tripped free from the closing mechanism at any point in its closing stroke. It also means that if the trip latch is held in the “trip” position while the spring release latch is released, the closing springs will make a trip-free operation but the circuit breaker contacts will not close or move appreciably toward the closed position.

Based on this construction, the circuit breaker close and trip linkage can have four steady state conditions. The arrangements of the basic close and trip linkage for these four conditions are shown in Figure 32 on page 33.

The angular position of the close cam in Figure 32 on page 33 corresponds to the angular position of the drive plates and closing spring crank arms shown in Figure 31 on page 32. The trip latch is in the tripped position and it will reset to the latched position at the end of the spring charging stroke. The closing springs are charged by counterclockwise rotation of the ratchet and drive plates until the close cam stop roller meets the spring release latch, as shown in Figure 32b on page 33.

Note in Figure 32b on page 33 that the lower end of the main drive link with the main roller has swung upward and toward the left, pushing the trip latch constraining link so as to rotate the trip latch back to the reset position. This occurs at the same time that the spring charge is complete and just before the close cam stop roller strikes the spring release latch. The position of the cam in Figure 32b on page 33 corresponds to the position of the drive plates in Figure 31a on page 32 with the spring charged and circuit breaker open.

The circuit breaker is now ready to be closed. Closing is started by counterclockwise rotation of the spring release latch (see Figure 32b on page 33). This removes the hold on the close cam stop roller, and allows the force of the closing springs to rotate the close cam counterclockwise and close the
The linkage is then in the position shown in Figure 32c on page 33. The close cam has rotated approximately 180 degrees.

The spring release latch can be rotated by two methods:

1. Spring Release Device (see “Spring Release Device (SR)” on page 20, Figure 29 on page 29, and Figure 39 on page 45).
2. Close Bar (through linkage shown in Figure 39b on page 45).

The circuit breaker is tripped open by counterclockwise rotation of the trip shaft (see Figure 32c on page 33). The trip shaft extends across the left hand part of the circuit breaker, from the left hand mechanism side sheet to the left hand circuit breaker side sheet.

Rotation of the trip shaft accomplishes circuit breaker opening as follows (see Figure 32c on page 33): The main contacts (not shown) produce a clockwise twisting force or torque on the pole shaft. This is transmitted by the center pole lever downward through the main drive link to the main roller. The main drive link at the main roller is connected to the trip latch by the roller constraining link. This force tends to rotate the trip latch counterclockwise, but the trip latch is kept from rotating by overlap of the latch surface of the trip shaft. A very small rotation of the trip shaft thus releases the trip latch to rotate counterclockwise to the position shown in Figure 32a on page 33. The enlarged views of the trip shaft and trip latch tip in Figure 32d show in detail the rotation of the trip shaft for release of the trip latch. The entire linkage collapses under the force of the main contacts and comes to rest with the circuit breaker open (see Figure 32a on page 33). Note that the trip latch is still in the released position (not reset).

If the circuit breaker stands open with springs charged as in Figure 32b on page 33, and if the trip shaft is held in the rotated or trip position, an attempt to close results in a trip-free operation. This occurs because with the trip shaft in the trip position, there is no restraint on the trip latch. Therefore, no force is applied to the main link to close the circuit breaker.

Although certain interlocking operations cause trip-free operation of the circuit breaker, it also causes excessive mechanical shock on the mechanism parts. Therefore, trip-free operations should be avoided.

The trip shaft can be rotated to trip the circuit breaker in a number of ways:

1. Circuit Breaker Trip Plate (see Figure 8 on page 11) — Pushing the trip plate will trip the circuit breaker. This item has a tab which pushes against a pin on the trip shaft, which applies a direct rotating force on the shaft in the tripping direction (Figure 36 on page 40).
3. Trip Actuator. Refer to “Trip Actuator” on page 17.
4. Compartment Door Trip Flap — If the circuit breaker is in the CONNECTED position in its compartment, pushing the trip linkage that extends through the door will trip the circuit breaker. It operates through a sliding link and lever fastened to the drawout cradle floor. When pushed, it engages linkage, extending from the bottom of the circuit breaker, to cause tripping (see Figure 19 on page 20).
5. Undervoltage Trip Attachment. Refer to “Undervoltage Trip Attachment (UVR)” on page 23.
6. Blown Limiter Indicator. Refer to “Type DSLII (Limiter) Circuit Breaker” on page 10 and Figure 41 on page 48.
To increase safety to personnel and the circuits to which the circuit breaker is connected, the complete unit is equipped with an automatic mechanical interlocking system. This interlocking system is effective in various ways in the four circuit breaker positions: REMOVE, DISCONNECT, TEST and CONNECT (see Figure 35).

In the REMOVE position, the circuit breaker is nearest to the front of the compartment. It is also where the circuit breaker must be placed when being installed, after having been completely outside the compartment.

In this position, the following conditions exist:

- The circuit breaker is open.
- The closing springs are discharged. If an attempt is made to charge the springs, a trip-free operation will result.
- The circuit breaker cannot be closed electrically or manually.
- The circuit breaker can be withdrawn from the compartment by direct pull. The levering device is not engaged with the cradle at this point.
- The levering device arms are in a horizontal position with their rollers pointing toward the rear (see Figure 5 on page 8).
DISCONNECT Position

In the DISCONNECT position, the circuit breaker has moved only a fraction of an inch into its compartment. This position is indicated by the position indicator on the front of the circuit breaker (see Figure 8 on page 11).

In this position, the following conditions exist:

- The circuit breaker is held in its compartment, since the levering rollers lowered into the slots in the compartment's cradle arms.
- The shutter closes over the levering device hex shaft.
- The shutter may be locked closed and the circuit breaker held trip-free with a padlock, thus locking it in its compartment. Padlocking provisions are described later in this section.
- Both primary and secondary disconnect contacts are separated.
- The circuit breaker is open.

TEST Position

In the TEST position, the circuit breaker is at a point that is in between the DISCONNECT and CONNECT positions, as indicated the drawout position indicator. The main disconnecting contacts are sufficiently separated to permit safe operation of the circuit breaker. The secondary contacts are now made up.

In this position, the following conditions exist:

- The circuit breaker arrives in this position, whether being inserted or withdrawn, with its contacts open. Its closing springs can be either charged or discharged when coming from the CONNECTED position.
- After the levering crank is removed, it is possible to close and trip the circuit breaker both manually and electrically.
- Just before the circuit breaker arrives in the TEST position from the DISCONNECT position, the secondary contacts make up and the spring-charge motor on power operated circuit breakers automatically runs and charges the closing springs.
- The circuit breaker can be closed manually or electrically after the springs are charged.
- The circuit breaker can be opened (tripped) manually or electrically through a shunt trip device.
- The trip flap on the circuit breaker compartment door will not trip the circuit breaker.
- The circuit breaker must be opened before further levering can be done.
- Overload tripping characteristics and other tripping system functions can be visually checked and/or changed in this position. All trip unit testing can be carried out in this position.

CONNECT Position

In the CONNECT position, the circuit breaker’s primary and secondary disconnecting contacts are both engaged with their stationary counterparts in the circuit breaker compartment.

This is the farthest position from the front of the compartment into which the circuit breaker can be levered. The CONNECT position is indicated by:

- The drawout position indicator on the front of the circuit breaker.
- A sudden mechanical stop is felt in the form of an increase in load on the levering crank handle.

**NOTE:** When levering in from the TEST position, an increase in load on the crank handles is felt as the main disconnecting contacts are engaged. As cranking is continued, the load will decrease some and then suddenly increase, as the final connected position stop is reached.
In this position, all the conditions listed for the TEST position exist, except:

- In this position, do not attempt to electrically check the electronic trip device with a test kit or any other method, since the circuit breaker will be tripped and cause a disruption of service.
- The trip flap on the circuit breaker compartment door is operative, and can be used to trip the circuit breaker with the door closed.

Figure 36 on page 40 shows that part of the interlock system which prevents closing of the circuit breaker while being driven in either direction by the levering device, or while it is standing in any intermediate position between TEST and CONNECT or DISCONNECT. Figure 36a shows the shutter and trip plate for normal operation, such as in the DISCONNECT, TEST, or CONNECT positions. The circuit breaker can be closed and tripped open by all available devices in the latter two positions, except for the trip flap on the circuit breaker compartment door.

**Mechanical Interlocking System Operation**

![Diagram of Shutter, Trip Plate and Trip Shaft Relationship](image-url)

**Figure 36**: Shutter, Trip Plate and Trip Shaft Relationship
In Figure 36a on page 40, the shutter prevents the levering device crank handle from being pushed onto the worm shaft. If the shutter alone is pushed downward, it will rotate slightly about its pivot pin and its lower projection strikes the hook on the trip plate. The worm shaft will not be cleared. Therefore, it is necessary to push the trip plate in, which moves the hook back out of the way of the shutter lower projection. This permits the shutter to be pushed downward to clear the worm shaft for the levering device crank (see Figure 36b on page 40).

It should be noted that pushing the trip plate in also pushes the trip shaft pin to rotate the trip shaft counterclockwise. This trips the circuit breaker open. If closing is attempted with the linkage in the position as shown in Figure 36b on page 40, a trip-free operation will occur.

Movement of the shutter is also controlled by the interlock cam which is mounted on the levering device shaft to the left of the worm gear. The interlock cam has a fixed relationship to the levering device arms. Figure 37 on page 42 shows the relationship between the shutter, interlock cam, and levering device arms for the four basic positions of the drawout unit in the compartment.

Figure 37a on page 42 shows the CONNECT position. The cam is in a position to allow free travel of the shutter interlock pin. Therefore, the shutter can be pushed downward, but only after pushing in the trip plate (see Figure 36 on page 40). This trips the circuit breaker and prevents levering out with the circuit breaker closed.

Figure 37b on page 42 shows the TEST position. Note that between the CONNECT and TEST positions the cam will rotate so as to block the shutter interlock pin. If the levering crank is removed, this prevents the shutter from returning to its closed position and releasing the trip plate. Therefore, if a closing operation is attempted during this part of the travel, a trip-free operation occurs and the circuit breaker contacts do not close. This occurs for either direction of circuit breaker travel so that no load is made or broken at the disconnecting contacts.

When the circuit breaker gets to the TEST position, a slot in the interlock cam allows free movement of the shutter interlock pin, and the shutter returns to its closed position when the levering crank is removed. The levering device arms are now almost vertically downward.

Figure 37c on page 42 shows the DISCONNECT position. The cam rotates to block the shutter interlock pin while the circuit breaker is between positions. The shutter is held open. When the exact position, as shown on the indicator, is reached, the shutter closes when the levering crank is removed. The levering arms will be approximately 40 degrees below the horizontal.

Figure 37d on page 42 shows the REMOVE position. The interlock cam stops with the shutter interlock pin blocked. The shutter stays down and the circuit breaker stays tripped when the levering crank is removed. The circuit breaker is held trip-free and cannot be closed. In addition, another interlock, described later, stops the close-release latch from being released.
The spring discharge interlock operates the close-release latch as the circuit breaker is moved out beyond the TEST position. This causes a trip-free operation of the closing mechanism because it occurs while the levering crank is still on the worm shaft, and the closing springs are charged on a power operated circuit breaker. This is because the levering crank is still being used to move the circuit breaker in the final part of its travel to the DISCONNECT position. The trip plate is still pushed in and the circuit breaker is trip-free.

Figure 38 on page 43 shows the essential parts of the spring discharge interlock. Figures 38a and b on page 43 show the levering device in the REMOVE position. The interlock plate has two horizontal pins extending from it, as shown in Figure 38 on page 43. The upper one is designated Pin “A” and the other Pin “B”. In levering the circuit breaker out to the REMOVE position, the levering shaft turns counterclockwise until the levering device arms are horizontal to the rear (see Figures 38a and b on page 43). As it rotates, the close bar cam is rotated counterclockwise by Pin “B” to the CLOSE position. This releases the spring release latch through the linkage.
shown in Figure 38. This results in a trip-free operation of the circuit breaker if the closing springs are charged. This occurs because the levering crank has the trip plate held in the TRIP position. If the circuit breaker is manually operated, levering out can be stopped at the TEST position. Remove the levering crank, close the circuit breaker and trip the circuit breaker. This will discharge the springs so that, when the REMOVE position is reached, there will not be a trip-free operation. The close bar is merely pulled into the CLOSE position.
Connected Circuit Breaker Manual Close Interlock

The purpose of the connected breaker manual close interlock is to provide a choice between being able to close the circuit breaker by pushing on the close bar and not being able to, with the circuit breaker in the CONNECT position. Referring to Figure 38a on page 43, the interlock plate assembly is loosely keyed to the levering device shaft by a drive pin. If the interlock screw is omitted, the interlock plate can be rotated freely on the shaft about 10 degrees. This occurs because the wide slot is considerably wider than the drive pin. If the interlock screw is in place in the narrow slot, the interlock plate has practically no play and is forced to rotate exactly as much as the levering device rotates.

Figure 38c on page 43 shows the standard arrangement without the interlock screw and with the levering device arms in the CONNECT position. Note that there is a clearance between the back of the hook and Pin “A”. This permits the close bar to be pushed to the CLOSE position and the circuit breaker to close.

All parts in Figure 38d on page 43 are in the same position as in Figure 38c on page 43, except that the interlock screw is placed in the narrow slot. This forces the interlock plate to rotate about 10 degrees further than in Figure 38c on page 43. In this case, there is almost no clearance between Pin “A” and the back of the hook. Consequently, the close bar cannot be pushed to the CLOSE position. The circuit breaker can, however, be remotely closed by supplying control voltage to the spring release coil through a control switch or other circuit making device.

Electric Lockout Equipped Circuit Breaker

Manually operated circuit breakers can be equipped for electric lockout. This means that closing an unenergized circuit is prevented. This can be the main circuit or any other desired circuit. It is accomplished by making it impossible for the required spring release device to release the spring release latch unless the monitored circuit is energized. The spring release coil (SR) is wired through the contact on the auxiliary switch, a front panel closing pushbutton switch, and to the terminals of the circuit being monitored. When the monitored circuit is energized properly, the circuit breaker can be closed through the panel pushbutton switch, provided that the closing springs are charged.

As an additional safeguard against undesired closing under an electric lockout condition, all such circuit breakers are provided with the interlock screw described in the previous paragraph. This prevents hand closing of the circuit breaker in the CONNECT position.

Closed Circuit Breaker Interlock

Figure 39 on page 45 shows how operating of the spring release latch is prevented when the circuit breaker is already closed. The close bar is connected to the spring release latch by a link and bell crank. The link is pivoted on the lower end of the close bar cam by a pin. As the close bar is pushed, the pin and latch link move to the right along with the lower end of the cam. The lower end of the link is facing a knife edge pivot on the vertical arm of the bell crank. The upper end of the link is facing the “Open-Close” indicator pin. This pin is at the left end of its slot in the mechanism side frame with the circuit breaker open and at the right end with the circuit breaker closed. As the close bar is pushed, the link as two possible end pivots. If the circuit breaker is open, the upper end of the link will swing to the right until it touches the indicating pin. The lower end of the link will then swing to the right and push the vertical arm of the bell crank to the right. The horizontal arm of the bell crank moves downward and presses directly on the spring release latch, allowing the circuit breaker to close.
If the circuit breaker is already closed and the close bar is pushed, the upper end of the spring release latch link swings free to the right because the indicator pin is not there to stop it. Consequently, no force is applied to the vertical arm of the bell crank and nothing else happens.

Figure 39: Close Interlock Preventing Efforts to Close an Already Closed Circuit Breaker

Padlocking Provision

Figure 40 shows the essential parts of the padlock interlock. The circuit breaker is padlocked in the trip-free condition (Figure 8 on page 11). In this condition, the circuit breaker cannot be closed nor can it be moved with the levering device. Figure 40 shows the parts relationship for padlocking in the trip-free shutter up condition. The three major parts are interleaved and assembled on the left hand side of the levering device assembly.

1. Shutter
2. Trip Plate
3. Padlock Interlock Lever

The padlock interlock lever is located between the trip plate and padlock plate. It is pivoted on a fixed center toward the rear of the circuit breaker. The front part of this lever has a sloping slot in which a projection from the trip plate extends. Horizontal movement of the trip plate by cam action of the projection against the walls of the slot causes the front of the interlock lever to move up or down. The interlock lever is pushed upward by a spring. This lever also has a short pin extending outward, normally into a curved notch in the bottom edge of the padlock plate.

To padlock the circuit breaker with the shutter closed, push the trip plate in and pull the padlock plate forward. This exposes the padlock slot in the padlock plate. Insert the padlock and lock.
Movement of the trip plate pushes the front end of the padlock interlock lever down, moving its pin downward and out of the notch in the padlock plate. Forward movement of the padlock plate and backward movement of the trip plate places the pin in the padlock interlock lever behind the notch in the padlock plate. With the padlock plate held forward, the padlock interlock lever cannot move. Consequently, the projection from the trip plate is held in the slot in the padlock interlock lever. This holds the circuit breaker locked in the trip-free condition until the padlock is removed and the members are returned to their normal positions by return springs. While locked, the shutter is prevented from downward travel by a horizontal projection striking a bent over tab on the padlock plate.

Figure 40: Padlock Device (Locked Trip-free with Shutter Raised)
An overall description of Type DSLII circuit breakers and fuse trucks is provided in “EQUIPMENT DESCRIPTION” (Figure 7 on page 10). More detailed information is provided here relative to application, operation, replacement and installation. Table 4 outlines the available limiters recommended for use with DSLII circuit breakers.

If current limiters are sized in keeping with Table 4 recommendations, the circuit breaker will function and interrupt routine fault currents. Infrequent high faults are cleared by the limiters. The limiters protect the circuit breaker on faults above the rating of the circuit breaker. The limiters will blow below the circuit breaker short-time rating, if the fault currents equal the system maximum capacity.

In some applications the current limiters are sized smaller than necessary for protection of the DSLII circuit breaker in order to provide protection for downstream equipment. When this is done, the current limiters will blow on fault currents which could have been satisfactorily interrupted by the basic circuit breaker.

Type DSII-FT32 and DSII-FT40 fuse trucks provide for separate mounting of current limiting fuses on drawout trucks. They are used in series with DSII-632 and DSII-840 circuit breakers respectively. This separate mounting is made necessary by the size of the fuses and their high temperature characteristics.

### Table 4: Sensor and Limiter Ratings

<table>
<thead>
<tr>
<th>Circuit Breaker Type</th>
<th>Sensor Rating</th>
<th>Limiter Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>① Recommended</td>
</tr>
<tr>
<td>DSLII-308</td>
<td>800 A</td>
<td>1600 A</td>
</tr>
<tr>
<td>DSLII-308</td>
<td>600 A</td>
<td>1200 A</td>
</tr>
<tr>
<td>DSLII-308</td>
<td>Less than 600 A</td>
<td>1200 A</td>
</tr>
<tr>
<td>DSLII-516</td>
<td>1600 A</td>
<td>3000 A</td>
</tr>
<tr>
<td>DSLII-516</td>
<td>1200 A</td>
<td>2500 A</td>
</tr>
<tr>
<td>DSLII-516</td>
<td>Less than 1200 A</td>
<td>2000 A</td>
</tr>
</tbody>
</table>

① Minimizes nuisance blowing of limiters
② Use only when current limiting is required for downstream equipment. If long delay pickup is set above 100%, minimum limiter ratings should not be used.
③ Highest rating that will protect the circuit breaker.

### DSLII Current Limiters

Do not replace limiters with sizes other than permitted by Table 4. DSLII current limiters have been tested and approved by Underwriters Laboratories, Inc. for use in DSLII circuit breakers when applied according to Table 4. They are not electrically or physically interchangeable with current limiting fuses of any other design.

The current limiters are held in place in an extension provided on the back of the circuit breaker (see Figure 41 on page 48). This extension makes the DSLII circuit breaker eight inches deeper than the corresponding DSII circuit breaker. The current limiters can only be removed from the circuit breaker and replaced when the circuit breaker is removed from its associated compartment.
Figure 41: DSLII-516 Circuit Breaker (Side View)

The blown limiter indicator provides a visual indication on the front of the DSLII circuit breaker when a current limiter in any phase has interrupted a short circuit. It also ensures that the circuit breaker will be tripped when any current limiter has blown. This prevents single phase power from being applied to a three-phase load (see Figure 42).

The indicator device consists of three solenoids, each connected in parallel with one of the limiters. When a limiter is blown, the resulting voltage across the open limiter causes the associated solenoid to operate. Operation of the solenoid trips the circuit breaker mechanically and extends an indicator through the front cover of the circuit breaker (see Figure 7 on page 10). The indicator will remain extended and the circuit breaker will be held trip-free until the reset button is pushed. If the device is reset and the circuit breaker reclosed on an energized circuit before the blown limiter is replaced, the circuit breaker will immediately be reopened and held trip-free. The solenoids are isolated from the primary circuit voltage by three transformers located above the limiters (see Figure 7 on page 10 and Figure 41 on page 48).

Figure 42: Blown Fuse Indicator
DSII-FT32 and DSII-FT40 fuse trucks provide drawout mounting for current limiting fuses when installed in low voltage switchgear. These drawout trucks physically fit in the same compartment as the DSII-632 and DSII-840 circuit breakers respectively. They are moved in and out of the compartment using a similar levering mechanism as provided on DSII circuit breakers (see Figures 43 and 44).

**Figure 43: DSII-FT32 Fuse Truck (Front View)**

**Figure 44: DSII-FT32 Fuse Truck (Rear View)**

The fuse truck is normally installed in series with a circuit breaker of the same current rating. When this is done, the fuse truck should be in the circuit ahead of the circuit breaker in order to maximize protection of the equipment. The fuse truck must never be permitted to close the current circuit or to open it when levering the truck in or out of the compartment, because the primary disconnect contacts are not designed for this service. For this reason, a key interlocking system is always provided which prevents opening of the fuse truck compartment door unless the associated circuit breaker has been opened, pulled out and held in the DISCONNECT position. This key interlock is installed on the fuse truck compartment door, not the fuse truck itself.
DSII-FT32 and DSII-FT40 fuse truck fuses are normally provided when the fuse truck is manufactured. The fuse trucks are interlocked to prevent the use of maximum current rated fuses other than the Square D truck fuse. Class L current limiting fuses up to 3000 A maximum can be used on the DSII-FT32 and up to 4000 A maximum on the DSII-FT40.

After the fuse truck has been withdrawn from its compartment, the fuses can be removed by unbolting them from the conductors on the fuse truck. This is a relatively uncomplicated procedure on the DSII-FT40 fuse truck, because there is sufficient working space within the truck. Since the DSII-FT32 fuse truck is more space restricted, it is necessary to first remove the front cover, levering device assembly and bracket (see Figure 45).

After replacing the fuses, be sure that all connection bolts are tight and that all truck parts removed during the processed are replaced.

The same blown fuse indicator is provided on fuse trucks as previously described on DSLII circuit breakers. However, since there is no opening mechanism on fuse trucks, it cannot serve directly as an anti-single phase device. In order to perform this function, the blown fuse indicator is arranged to mechanically operate a switch, which is wired to secondary contacts on the fuse truck. The switchgear assembly wiring must be arranged to connect this switch into the tripping circuit of the associated circuit breaker (see Figure 44 on page 49). Again, the indicator must be reset after being operated to reset the switch, or its contact will prevent the circuit breaker from being closed.
INSPECTION AND MAINTENANCE

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HAZARD OF EQUIPMENT FAILURE</strong></td>
</tr>
<tr>
<td>• This equipment must be installed, operated, and serviced only by qualified electrical personnel according to OSHA 1910.331 through 1910.335.</td>
</tr>
<tr>
<td>• To ensure proper operation inspect, clean, and maintain circuit breakers as described in this section.</td>
</tr>
<tr>
<td><strong>Failure to follow these instructions can result in death or serious injury.</strong></td>
</tr>
</tbody>
</table>

**General**

Design tests and actual installation experience show DSII circuit breakers to have durability well beyond minimum standards requirements. However, because of the variability of application conditions and the great dependence placed upon these circuit breakers for protection and the assurance of service continuity, inspection and maintenance activities should take place on a regularly scheduled basis.

Since maintenance of these circuit breakers consists mainly of keeping them clean, the frequency of scheduled inspection and maintenance depends to some degree on the cleanliness of the surroundings. Cleaning and preventive measures are a part of any good program. Plant operating and local conditions can vary to such an extent that the actual schedule should be tailored to the conditions. When the equipment is subject to a clean and dry environment, cleaning is not required as frequently as if the environment is humid with a significant amount of dust and other foreign matter.

It is recommended that maintenance record sheets be completed for the equipment. Careful and accurate documentation of all maintenance activities provides a valuable historical reference on equipment condition over time.

**General Cleaning Recommendations**

Circuit breaker cleaning activities should be a part of an overall activity that includes the assembly in which the circuit breaker is installed. Loose dust and dirt can be removed from external surfaces using an industrial quality vacuum cleaner and/or lint free cloth. Unless otherwise indicated, never use high pressure blowing air, since dirt or foreign objects can be driven into areas, such as the circuit breaker mechanism, where additional friction sources could create problems. Never use a wire brush to clean any part of the circuit breaker.

**When To Inspect**

Do not wait for specific scheduled periods to visually inspect the equipment, if there are earlier opportunities. If possible, make a visual inspection each time a circuit breaker compartment door is opened, and especially when a circuit breaker is withdrawn on its compartment extension rails. This preventive measure could help to avoid future problems.

Industry standards for this type of equipment recommend a general inspection and lubrication after the number of operations listed in “General”. This should also be conducted at the end of the first six months of service, if the number of operations has not been reached.

After the first inspection, inspect at least once a year. If these recommended inspections show no maintenance requirements, the period may be extended to a more economical point. Conversely, if the recommended inspection shows, for instance, a heavy accumulation of dirt or other foreign matter that might cause mechanical, insulation or other electrical damage, the inspection and maintenance interval should be decreased.
What To Inspect

First withdraw the circuit breaker from its compartment. Remove its barriers and arc chutes. If there is a deposit of dust, use a vacuum, as previously mentioned, to remove it from the circuit breaker. Clean compressed air, if available, can be used to blow dust and dirt away from the arc chutes and barriers, as long as it is done out of the immediate vicinity of the circuit breaker. Wipe accessible areas with a clean and dry lint-free cloth. Carefully inspect the contacts.

**NOTE:** Switching, fault interruptions, and the making of motor inrush currents will cause some pitting of the circuit breaker contact parts. A large accumulation of operations will give the contacts, especially the arcing contacts a mottled, dirty eroded appearance. This appearance is the normal result of arc burning and in itself is no cause for concern.

During any inspection, cleaning, part adjustment or part replacement, be certain to look over all visible parts for missing pin retainers, loose hardware, bent, worn or damaged parts. Be especially alert for foreign matter that should be removed. Make appropriate corrections to anything found out of order.

After any such activity, make sure that all parts are properly installed on the circuit breaker, especially the arc chutes and all four barriers. Take the time to double check all work against provided drawings and written instructions.

**DSII-308 Through DSII-840/850 Inspection**

**NOTE:** DSII-516 adjustments and maintenance apply to the DSII-508. DSII-620 adjustments and maintenance apply to the DSII-608 and DSII-616.

Remove the barriers and arc chutes to expose the contacts. With the circuit breaker open, examine the contact tips of the moving and stationary arcing and main contacts (see Figures 46 and 47 on page 53). If the tips are burned or worn more than 0.030 in (0.76 mm) the contacts must be replaced. Also check the dimension (C) between the stationary arcing contacts. It should be 0.420 in (10.67 mm) plus or minus 0.08 in (2.03 mm). If this dimension is not maintained, the stationary arcing contacts must be replaced.

Close the circuit breaker and check the contact engagement (see Figures 46 and 47 on page 53). The main stationary contact fingers should be parallel (B) to the fixed contact cage. If not, adjust the contacts according to parameters outlined in “Moving Contact Adjustment” on page 58. Also check the dimension (A) between the stationary arcing contacts and the center section of the cage. If this dimension is not 0.02 in (0.51 mm) or greater, the stationary arcing contacts should be replaced.

**WARNING**

**HAZARD OF EQUIPMENT FAILURE**

Verify circuit breaker faceplate, interphase barriers, and arc chutes are correctly installed after inspection is complete.

Failure to follow this instruction can result in death or serious injury.
Figure 46: DSII-308 Contacts and Adjustments

Figure 47: DSII-516/620 Contacts and Adjustments
Additional Inspections for DSII-632 and DSII-840/850

The lower main fixed contacts should be inspected to ensure that they have adequate contact pressure. This is determined by Pin “X” being free to slide in the contact cage. Unlike the DSII-308 through DSII-620 circuit breakers, the top row of fixed main contacts are compressed beyond the parallel position to assure adequate contact pressure for the lower row of fixed main contacts.

Figure 48: DSII-632 Contacts and Adjustments
To replace the stationary contacts, remove the rear mounted disconnect finger contacts (see Figure 6 on page 9), followed by the two bolts holding the upper contact assembly to the molded base. Withdraw the contact assembly from the front. Replace the removed contact assembly with a new contact assembly. Be certain that all bolts are tightened securely. Close the circuit breaker and check all contact dimensions as outlined in “DSII-308 Through DSII-840/850 Inspection” on page 52.

Both the main moving and arcing contacts are held between the two moving arms by two bolts with self-locking nuts. Removal of the two bolts permits the replacement of the moving contacts. These bolts must be securely tightened after replacement.

The fixed arcing contacts are held by a single bolt passing through the contacts and their pressure springs. On reassembly, the self-locking nut is tightened so that a dimension of 3.12 in (79.25 mm) is obtained between the inside surfaces of the flat washers on the spring ends.

The moving arcing and main contacts are secured to the moving contact assembly by two bolts. Removal of these bolts permits the replacement of the moving contacts (see Figure 47 on page 53 and Figures 48 and 49 on page 54).

To change the fixed arcing and main contacts, the fixed contact assembly must first be removed from the pole unit. Remove the rear mounted disconnect finger contacts (see Figure 6 on page 9). Remove the screws holding the contact assembly to the pole unit base and withdraw the contact assembly.
Reassemble a new contact assembly in the pole unit with the holding screws finger tight. Close the circuit breaker and check “A” dimensions. The “A” dimensions should be approximately equal. If not, trip the circuit breaker and adjust the fixed contact system until alignment is obtained. Tighten the screws and contacts as described in “Circuit Breaker Open Position Stop Adjustment (DSII-632 Only)” on page 57.

Arc Chutes

The V-shaped slots in the arc chutes will undergo slow erosion with arc interruptions. Switching operations will give them a pitted and sooty appearance. This is normal. Heavy fault interruptions will cause a greater amount of erosion.

If the steel splitter plates have more than 0.25 in (6.35 mm) of material eroded away at the top of the V-shaped slots, the arc chutes should be replaced. This can be determined by comparing a plate near the center with a plate near the end.

Power Operated Mechanism

Examine the driving face of the oscillator pawl (see Figure 29 on page 29 and Figure 30 on page 31). Normal operation of the spring charging mechanism will result in the removal of plating from the face of the pawl. If the face is chipped, distorted or broken, it should be replaced.

Factory Adjustments

NOTE: These adjustments are required only when a major overhaul has been performed, not during normal maintenance procedures.

Type DSII circuit breakers are designed and built with very few adjustable parts. The operating parts and frame mounting parts are accurately tool made for automatic and accurate assembly relationships. The parts are made of material that are affected to the minimum by repeated operations and normally encountered atmospheric temperature and contaminant conditions.

There are a few adjustments made at the factory and are subjected to quality control inspection and test. These factory settings can normally be expected to hold for the life of the circuit breaker.

Factory settings adjustments should only be necessary when parts are reassembled after dismantling, as described in "Trip Latch Overlap Adjustment” on page 57 and “Circuit Breaker Open Position Stop Adjustment (DSII-632 Only)” on page 57.

Maintenance adjustments should be made as indicated on maintenance inspections and are described in “Moving Contact Adjustment” on page 58.
Trip Latch Overlap Adjustment

Figure 50a shows a composite view of the shunt trip lever and the trip latch, as described in “Opening (Tripping) Mechanism” on page 37. The angular position of the trip shaft latch surface is adjustable in relation to the trip latch surface. This adjustment is made possible by a screw located in the top of the actuator frame (see Figure 50b).

The proper adjustment procedure is as follows:
1. Close the circuit breaker.
2. Slowly rotate the adjusting screw clockwise until the circuit breaker trips. This is the “no overlap” position.
3. Conclude by rotating the adjusting screw four turns in a counterclockwise direction.

Circuit Breaker Open Position Stop Adjustment (DSII-632 Only)

The proper adjust procedure is as follows:
1. Refer to Figure 51 on page 58.
2. Open the circuit breaker and loosen the open position stop bolt nuts so that the eccentric cylinders can be turned by hand but will stay put.
3. Rotate the cylinders to obtain a clearance of approximately 0.005 inch between the cylinders and the stop levers.
4. Tighten the nuts on the bolts.
Figure 51: Open Position Stop and Anti-Rebound Latch

The contact assemblies are adjustable for the amount of engagement only. The lead of the arcing contacts over the main contacts is fixed. The correct engagement of the contacts is achieved when the vertical faces of the main fixed contacts and the fixed contact cage are parallel.

For the DSII-308, this is obtained by the adjusting nuts located on the insulating link stud above and below the pivot block (see Figures 9 and 10 on page 12). These nuts are self-locking and must be tight when the adjustment is complete.

The moving pole of the DSII-516/620 is adjusted by rotating the insulating link after the locknut has been loosened (see Figure 11 on page 13). Tighten the locknut securely after the adjustment has been completed.

The DSII-632 and DSII-840/850 have two adjusting studs on each pole. Both adjusting studs must be moved together to retain the parallelism. Refer to the Renewal Parts Data Book if a pictorial reference is needed to make the adjustment. A spring type locking clip holds the adjustment for the DSII-632. For the DSII-840/850, locking nuts similar to those used with the DSII-516/620 hold the adjustments.
Levering Mechanism Adjustment

The complete levering mechanism is shown in Figure 52. If the traveling stop nut on the rear of the worm shaft has been removed, it must be replaced in the exact position with respect to the worm gear position for proper interlock operation. This is achieved when the threaded worm shaft bottoms in the stop nut and the interlock cam is in the connected position (see Figure 37a on page 42). The shutter interlock pin will then drop to its normal position beneath the lobe of the cam. The retaining clamp ring also operates the position indicator and may be slipped into its groove in the stop nut. The stop nut is prevented from rotating by having a “flat” against the bottom of the circuit breaker horizontal top pan.

During reassembly, care must be taken to ensure that the two guide spacers are located in the slots of the top pan. This permits the mechanism to float. Screws should be tightened and then backed off one half turn to allow the mechanism to float.

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Lubrication

In general, the circuit breaker requires only moderate lubrication at regular intervals. The use of a special lubricant is required in a few places, and must be applied with care. Only small quantities are needed. All excess must be removed with a clean cloth to prevent any accumulation of dust or dirt. Avoid getting any lubricant on insulation or other electrical parts. Care must be taken to prevent any of the molybdenum lubricant from reaching any current carrying contact surface.
Lubrication Frequency

Under normal operating conditions, refer to Table 5 for the recommended lubrication frequency for DSII circuit breakers by frame size. Special conditions, such as contaminated environments, high temperatures and excessive humidity, might dictate that a different schedule be considered.

Table 5: Lubrication Frequency

<table>
<thead>
<tr>
<th>Circuit Breaker Type</th>
<th>Interval(^1) (Circuit Breaker Cycles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSII-308, DSII-508, DSLII-308</td>
<td>1750</td>
</tr>
<tr>
<td>DSII-608, DSII-516, DSII-616, DSII-620, DSLII-516</td>
<td>500</td>
</tr>
<tr>
<td>DSII-632, DSII-840/850</td>
<td>250</td>
</tr>
</tbody>
</table>

\(^1\) Circuit Breaker Cycle - one no load open/close operation.

NOTE: Any circuit breaker that has been stored should be operated a minimum of five times before it is placed in service.

Lubricant Location

NOTE: All parts of the levering mechanism have sufficient lubrication, and should not require any further attention (see Figure 52 on page 59).

Molykote BR-2 Plus by Dow Corning (Molybdenum Disulphide in Lithium Grease) or equivalent should be used sparingly on the following lubrication points (refer to Figures on pages 61 and 62):

- Spring-charge indicator surface engaging with the cut-off switch link
- Cam surface operating the cut-off switch
- Pins on both ends of constraining link
- Shunt trip moving armature surface
- Curved surface of trip latch
- Spring release moving armature surface
- Several trip shaft points
- Surface of cut-off switch link
- Main spring pins on each end of crankshaft and fixed ends
- Rear face of oscillator

⚠️ WARNING

HAZARD OF EQUIPMENT FAILURE

Verify circuit breaker contacts are open and closing springs discharged after completing maintenance activities.

Failure to follow this instruction can result in death or serious injury.
Figure 53: Left Side of Mechanism Lubrication Points

Figure 54: Right Side of Mechanism Lubrication Points
Figure 55: Shunt Trip Device Lubrication Points

Figure 56: Spring Release Device Lubrication Points

Figure 57: Trip Shaft Lubrication Points
RENEWAL PARTS

All renewal parts and/or spare parts recommendations for Type DSII circuit breakers are supplied in the Renewal Parts Data Book, not this instruction bulletin. Refer to the most recent version of the Renewal Parts Data Book for specific assistance.

When ordering parts, always specify, if known, the part name and style number. The Renewal Parts Data Book provides this kind of detailed information. If the style number is not known, refer to a pictorial and/or graphic reference, name and item number as shown in the Renewal Parts Data Book. Also include the circuit breaker type, factory order number or style number as shown on the nameplate on the front cover of the circuit breaker.

Some of the detailed parts shown in the figures in this instruction bulletin will be available only as a part of a sub-assembly. Certain parts, due to manufacturing or installation procedures, are only recommended in this form. In some instances, the detailed parts in the figures are illustrated just to show their function and location in the assembly. The Renewal Parts Data Book indicates which parts are available as individual items or in a sub-assembly.