Remote Controlled Circuit Breaker (RCCB)

Qualified
Qualified to demanding performance parameters of MIL-PRF-83383 standard.

Use as a Relay, Circuit Breaker, Or Both
RCCBs combine the best attributes of a circuit breaker and a relay. Automatically protects the wires and the load device during circuit/load breakdown, but allows the flight deck control of the load during normal operation.

Weight and Cost Savings
In distributed-load applications, RCCBs are a more efficient power distribution solution promoting cost and weight savings through the elimination of long runs of heavy cables associated with the conventional relay - flight deck circuit protector method. Control of the RCCB requires only one #22 AWG control wire from the ICU on the flight deck to the RCCB.

Cockpit Space Savings
An RCCB system removes the presence of large circuit breakers from the cockpit while permitting remote On/Off operation from the flight deck. Combine Eaton RCCB with Indicator Control Unit (ICU) model #1500-052-05.

PERFORMANCE DATA

Rupture Levels
3600 A (115 VAC or 28VDC for 1Pole and 115VAC for 3 Pole)

Endurance (Resistive & Inductive(Motor))
50,000 Cycles

Endurance (Motor)
5-50A: 50,000 cycles; 60-100A: 25,000 cycles

Endurance (Lamp)
5-25A: 50,000 cycles; 35-50A: 25,000 cycles; 60-100A: no rating

Dielectric Strength
1500V, 60Hz, MILSTD-202, method 301, 0.5 MA max

Insulation Resistance
100 mega ohm min, MILSTD-202, method 302

Thermal Temperature Range
-54°C to 71°C (-65°F to 160°F). MILSTD-202, Method 107

Vibration
10G’s to 2000 Hz. Exceeds MILSTD-202, Method 204, Condition C, 10 microseconds max. chatter

Shock
25G’s. MILSTD-202, Method 213, 10 microseconds max. chatter

Altitude
50,000 ft.

EMI Requirements
MILSTD-461, Requirements CS114 and RE102 over the frequency range of 14 KHz to 400 MHz and RE102 limits for Aircraft and Space Systems.

EMI/RFI Susceptibility and Generation
MILSTD-461, Class 1D

Moisture Resistance
MILSTD-202, method 106

Salt Spray Resistance
MILSTD-202, method 101, Condition B

Sand and Dust Resistance
MILSTD-202, method 110, Condition A

Fungus Resistance
MILHDBK-454, Guideline 4

Explosion Proof
MILSTD-202, method 109

Weight (Single Pole)
5-25A: 318 grams (0.703 lbs.); 35-50A: 325 grams (0.719 lbs.); 60-100A: 346 grams (0.766 lbs.)

Weight (w/ Auxiliary Contacts)
5-25A: 332 grams (0.734 lbs.); 35-50A: 339 grams (0.750 lbs.); 60-100A: 346 grams (0.766 lbs.)

Weight (Three Phase)
2.0 lbs. max.

OVERLOAD CALIBRATION DATA

<table>
<thead>
<tr>
<th>Specification</th>
<th>MIN</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Must Hold</td>
<td>115%</td>
<td>115%</td>
</tr>
<tr>
<td>Must Trip</td>
<td>138%</td>
<td>150%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature</th>
<th>25°C</th>
<th>+71°C</th>
<th>-54°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN</td>
<td>MAX</td>
<td>MIN</td>
<td>MAX</td>
</tr>
<tr>
<td>% for 1 Hour</td>
<td>% Within 1 Hour</td>
<td>% for 1 Hour</td>
<td>% Within 1 Hour</td>
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</tbody>
</table>
### Engineering Data

#### Single Pole Single Throw (Double Break Contacts)

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>Rated Contact Load (Amperes)</th>
<th>Part Number</th>
<th>Maximum Weight Oz/gm</th>
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</thead>
<tbody>
<tr>
<td>SM600BA5A1</td>
<td>5 5 5 5 5</td>
<td>M83383/02-01</td>
<td>11.75/332</td>
</tr>
<tr>
<td>SM600BA10A1</td>
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<td>11.75/332</td>
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<tr>
<td>SM600BA35A1</td>
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<td>M83383/02-07</td>
<td>12.00/339</td>
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<tr>
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</table>

#### Three Pole Single Throw (Double Break Contacts)

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<th>Catalog Number</th>
<th>Rated Contact Load (Amperes)</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>SM601BA10A1</td>
<td>10 10 10 10 10</td>
<td>M83383/04-03</td>
</tr>
<tr>
<td>SM601BA15A1</td>
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<td>35 35 35 35</td>
<td>M83383/04-07</td>
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<tr>
<td>SM601BA60A1</td>
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</tr>
</tbody>
</table>

© Contact factory on alternate amperage, trip times, control configurations, grounding, auxiliary switches, and mounting systems.
## Remote Controlled Circuit Breaker (RCCB)

### Ordering Information

<table>
<thead>
<tr>
<th>AMPERE RATING</th>
<th>MS P/N</th>
<th>EATON P/N</th>
<th>AMPERE RATING</th>
<th>MS P/N</th>
<th>EATON P/N</th>
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</thead>
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<tr>
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<td>M83383/01-01</td>
<td>SM600BASN1</td>
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<td>SM600BA10N1</td>
<td>15</td>
<td>M83383/02-03</td>
<td>SM600BA10N1</td>
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<td>SM600BA100N1</td>
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</table>

* All Ampere Ratings equal to Rated Contact Loads (Resistive, Inductive, Motor, and Lamp) except as noted.
* * No Lamp Load Rating
* ** Contact Factory

Note: Contact factory for alternate amperage, trip times, control configurations, grounding, auxiliary switches, mounting systems, etc.

### Single Pole

#### Overload Calibration Data

<table>
<thead>
<tr>
<th>Ratings</th>
<th>Percent Current</th>
<th>Ambient Temperature Degrees C. ± 5°</th>
<th>Tripping Time</th>
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</thead>
<tbody>
<tr>
<td>All</td>
<td>115%</td>
<td>25°C &amp; 71°C</td>
<td>No Trip 1 Hour Max.*</td>
</tr>
<tr>
<td></td>
<td>138%</td>
<td></td>
<td>**</td>
</tr>
<tr>
<td></td>
<td>150%</td>
<td>-54°C</td>
<td>No Trip 1 Hour Max.*</td>
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</table>

* Must trip in one hour.

#### Overload Calibration Data — Single Pole

<table>
<thead>
<tr>
<th>AMPERE RATING</th>
<th>200% Trip Times -54°C to +71°C</th>
<th>400% Trip Times -54°C to +71°C</th>
<th>1000% Trip Times -54°C to +71°C</th>
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<tr>
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</table>

#### Trip Curve

Contact business unit for trip curve.

### Triple Pole

#### Overload Calibration Data

<table>
<thead>
<tr>
<th>Ratings</th>
<th>Percent Current</th>
<th>Ambient Temperature Degrees C. ± 5°</th>
<th>Tripping Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>115%</td>
<td>25°C &amp; 71°C</td>
<td>No Trip 1 Hour Max.*</td>
</tr>
<tr>
<td></td>
<td>138%</td>
<td>-54°C</td>
<td>No Trip 1 Hour Max.*</td>
</tr>
<tr>
<td></td>
<td>150%</td>
<td>**</td>
<td>**</td>
</tr>
</tbody>
</table>

* Must trip in one hour.

#### Overload Calibration Data — Triple Pole

<table>
<thead>
<tr>
<th>AMPERE RATING</th>
<th>200% Trip Times -54°C to +71°C</th>
<th>400% Trip Times -54°C to +71°C</th>
<th>1000% Trip Times -54°C to +71°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MIN SECONDS</td>
<td>MAX SECONDS</td>
<td>MIN SECONDS</td>
</tr>
<tr>
<td>10</td>
<td>12</td>
<td>80</td>
<td>2.8</td>
</tr>
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<td>2.9</td>
</tr>
<tr>
<td>60</td>
<td>13</td>
<td>80</td>
<td>2.4</td>
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</table>
Remote Controlled Circuit Breaker (RCCB)

**Engineering Data Application Note**

**Without RCCB**

![Wiring Diagram Without RCCB]

**With RCCB**

![Wiring Diagram With RCCB]

**Distributed Load Concept**

![Wiring Diagram Distributed Load Concept]

**Typical Wiring Diagrams**

**Integrated Wire Termination Module (MIL-STD-1549)**

![Integrated Wire Termination Module Diagram]

**Contacts and Coil Circuits Only**

- **Single Pole**
  - Intermittent Duty Coils Current Cut-Off Controlled Electronically

**Wiring for Multiple Line Protection**

- **Contacts and Coil Circuits Only**
  - Intermittent Duty Coils Current Cut-Off Controlled Electronically

**NOTE:** Terminals 5A and 5B internally grounded to the mounting leg(s). Integrated Wire Termination (IWT) module accepts pin contacts P/N M39029/-100 or -101. Use with insertion/extraction tool M81969/-14-02.
Remote Controlled Circuit Breaker (RCCB) — 1 Pole and 3 Pole

Engineering Data

Approximate Dimensions - 1 Pole

Options
- Special application auxiliary switches
- Unique grounding
- Power sources
- Other current ratings
- Control via systems other than I/CU
- Low level auxiliary contacts available
- Data Bus/Interface capability available
- Electronically held coil
- Moisture resistant sealing

Three Pole

Typical Placement of Rating on Top Plane

<table>
<thead>
<tr>
<th>Circuits</th>
<th>Nominal System Voltage</th>
<th>I/CU Set Current @ Nom Voltage (Mulliamp)</th>
<th>Set Coil Current @ Nom Voltage Pulse</th>
<th>MAX. Set Time</th>
<th>°I/CU. Trip Current Nominal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Pole</td>
<td>28 Vdc (18 Volts MIN.)</td>
<td>2</td>
<td>3.0 AMP MAX</td>
<td>20 Millisec</td>
<td>35 Millisec</td>
</tr>
<tr>
<td></td>
<td>115 Vdc 115 Vac</td>
<td>2</td>
<td>10 AMP MAX</td>
<td>15 Millisec</td>
<td>30 Millisec</td>
</tr>
<tr>
<td>3 Pole</td>
<td>28 Vdc (18 Volts MIN.)</td>
<td>2</td>
<td>70 AMP MAX</td>
<td>20 Millisec</td>
<td>35 Millisec</td>
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<tr>
<td></td>
<td>400 Hz (104 V MIN.)</td>
<td>2</td>
<td>13.0 AMP MAX</td>
<td>15 Millisec</td>
<td>30 Millisec</td>
</tr>
</tbody>
</table>

* MAX. I/CU. Line Impedance 75
** Average Half-Wave Rectified DC Current
*** Absolute Min. Value from -54°C to +71°C

Coil Operate Current/Set And Trip Time RCCB

EATON CORPORATION Aerospace TF300-0 January 2005
Remote Controlled Circuit Breaker (RCCB) — 1 Pole and 3 Pole

Engineering Data

Description
The Remote Control Circuit Breakers (RCCB) concept, as load controllers in distributed-load applications, provides for a more efficient power distribution system with less line loss at a lower cost and with less weight than the conventional relay-flight deck circuit protector method.

Designed to meet the requirements of MIL-PRF-83383, the RCCB's capability and advantages include:

- Fusible link fail safe
- Remote on/off operation from the flight deck
- Visual indicators for open (green) and closed (red) on top surface
- Substantial reduction in weight and size
- Most direct route from power source to load
- Single wire control line from I/CU to RCCB
- Double-break power contact assembly
- Indication of trip or set by position of the ½ ampere circuit breaker on the flight deck
- Elimination of long runs of heavy and costly cables
- Magnetically latched coils (low power consumption)
- Use as a relay or circuit breaker or both
- Flanges mate for in-line or side-by-side mounting
- 1PST FOR DC OR SINGLE PHASE AC
- 3PST FOR THREE PHASE AC ONLY

Application
The Remote Control Circuit Breaker (RCCB) is a combination relay and circuit breaker which can be released or set by applying a release or set coil current electronically controlled by a command from the Indicator/ Control Unit (I/CU) (a ½ ampere fast trip, thermal circuit breaker). With power available to terminal #4 and/or terminal A1 (28 Vdc or 115V 400 Hz) on 1PST RCCB; to terminal #4 (28 Vdc) and/or both terminals B1 and C1 (115V 400 Hz) on 3PST RCCB, the RCCB will assume the state requested/indicated by the I/CU. If power is removed from terminal #4 and A1 on 1PST or from terminal #4 and both B1 and C1 on 3PST, the RCCB will remain in the state it was in prior to power removal. When power is reapplied to the terminals, the RCCB will assume the state indicated by the I/CU.

With the RCCB closed, an overload or fault current on any line or series will cause the RCCB to trip and in turn will cause a controlled overload of the I/CU, causing it to trip also. A fault or overload on any power contact will cause the RCCB to trip open within the time limits specified regardless of the availability of coil power. To reclose the RCCB, the I/CU line (line 3 to ground) must be opened by the I/CU or series switch and reconnected to ground.

Other Performance Parameters For MIL-PRF-83383

- Coordination. An overload applied to two devices in series with a 2 to 1 current rating will result in only the lower rated device opening.
- Rupture capability to 3600A (115 Vac rms or 28 Vdc for SM600BA and 115 Vac rms for SM601BA series)
- Dielectric. 1500 V, 60 Hz, MIL-STD-202, Test Method 301, 0.5 MA maximum
- Thermal Temperature Range. -54°C to 71°C (-65°F to 160°F). MIL-STD-202, Test Method 107
- Insulation Resistance. MIL-STD-202, Test Method 302, 100 Megohms minimum
- Aircraft Electrical Power. MIL-STD-704
- Shock. 25 g's. MIL-STD-202, Test Method 213. Maximum duration of contact transfer to uncommanded state: 10x10^-6 seconds.
- Altitude. 50,000 feet
- EMI, MIL-STD-461, Class 1D
- Fungus Resistance. MIL-STD-454, Guideline 4
- Sand and Dust Resistance. MIL-STD-202, Test Method 110, Test Condition A
Remote Controlled Circuit Breaker (RCCB)

**Single Pole**
- 28 VDC
- 115/200 VAC 400 Hz

**Three Phase**
- 115/200 VAC 400 Hz
- Three Phase Only

**Qualified**
Meets MIL-PRF-83383

**Weight and Cost Savings**
Saves fuel by eliminating long runs of heavy, costly cables

**Space Savings**
Keeps larger breakers out of cockpit

**RCCB System for Remote Operation**
To form an RCCB system enabling remote On/Off operation from the flight deck, combine the Eaton RCCB with Indicator Control Unit (ICU) model #1500-053-05 on pg. 13.

**Single Wire from Flight Deck**
Control of the RCCB requires only one #22 AWG control wire from the ICU on the flight deck to the RCCB.

**Use as a Relay, Circuit Breaker, or Both**
Combines the best attributes of a circuit breaker and a relay. Automatically protects the wires and the load device during circuit/load breakdown, but allows flight deck control of the load during normal operation.

**Design Concept**

**Introduction**
Part of the weight of the modern jet aircraft comes from the electrical wires and power control systems needed to distribute the electrical energy. As these aircraft increase their passenger carrying capability, the electrical power management system becomes more complex and could become heavier. Wire runs of more than 300 feet from the flight deck circuit breakers to the load become common.

Utilization of Eaton’s Remote Controlled Circuit Breakers (RCCB) close to the load or power source will eliminate much of these long, heavy, and expensive wire/cable. Control of the RCCB requires only one #22 AWG control wire from the flight deck to the RCCB.

Weight reduction, directly from wire use and indirectly from (generator) line heat loss, and installation and maintenance cost reductions becomes significant.

The RCCB combines the best attributes of a circuit breaker and a relay. The RCCB automatically protects the wires and the load device during circuit/load breakdown, but allows flight deck control of the load during normal operation.

**Operation**
The RCCB is basically a relay and a circuit breaker and allows the utilization of each identity singularly or in combination, depending upon the application. All of the RCCB’s capabilities apply in either application.

It can be employed as a relay located adjacent to its load and remotely operated much like relays are today through control wiring and a switching device in the flight deck.

It can also be utilized as a circuit breaker and mounted adjacent to the load, the power source, or even the flight deck.

**Single Pole RCCB**

**Motor Operation**
Figure 1 depicts a simplified presentation of the RCCB.

Figure 2 describes the “motor”, which when “energized”, will result in typical armature transfer operation.

The magnetic circuit utilizes a permanent magnet as a fulcrum and latch for the rocking armature and uses electro-magnets (coils) at each end of the armature stroke for transfer purpose. In the set position (Figure 2), the flux generated by the permanent magnet follows a path from the top of the permanent magnet through the armature, through the left leg of the electro-magnet and back to the permanent magnet.

When the coil T1 - T2 is energized, the flux generated is such that it "flows" through the permanent magnet in the same direction as the flux generated by the permanent magnet itself. Its path now, however, is through the right leg of the electro-magnet. The flux generated by the electro-magnet increases in magnitude as power is applied, and as the flux builds up in the path through the right leg of the electro-magnet, the flux tending to latch the armature in the left leg of the electro-magnet becomes very small in comparison. The armature then "transfers" and seals at the pole face of the right leg of the electro-magnets.
The cutthroat contact B in series with coil T1 - T2 is opened by mechanical actuation due to the armature movement. In Figure 2, a “dotted extension” of the armature represents the mechanical actuator of the cutthroat contacts. In actual design, this is accomplished more conveniently through only one armature extension and an appropriate actuator which drives both contacts B and A.

The opening of contact B occurs in the last several thousandths of an inch travel of the armature movement. After coil opening, the armature movement continues (until it seats i.e. seals), due in some degree to the inertia of the armature, but mostly due to the magneto-motive force of the permanent magnet in conjunction with the decreasing air gap at the right pole face.

The device now is again in a stable position, but the armature has transferred and the following conditions exist:

Contact A is closed and contact B is open, and the armature is sealed and latched at the right leg of the electro-magnet. To transfer the armature to its original position, energizing the coil S1-S 2 allows the process described above to occur in the opposite direction.

There are a number of advantages to this design approach of the "motor."

1. The coils open upon transfer of the armature; hence, the actual "on time" or duty cycle approximates equals the operate time of the relay. Accordingly, the coil can be driven hard without fear of burnout. The "hot coil" with the low timer constant results, in turn, in fast operation times.
2. Using intermittent duty coils (smaller coils with less copper) results in less weight and smaller sizes.
3. Power is conserved. This is important for two reasons.

If a relay is to use power, it must be available. In some of the present day and future vehicles, power remains an expensive commodity, and elimination of coil power drawing (10-35 watts) in power devices can add up especially when vehicles sophistication requires use of a significant number of these devices. Also, it must be remembered that power utilized by relay coils generates heat which must be dissipat-ed. The necessary elimination of this heat, in turn, requires the use of additional energy from the main power source.

4. As indicated, the cutthroat contacts are opened by the armature mechanically during the last several thousandths of an inch travel of armature movement. Note: In actual RCCB, the cutthroat contacts function is replaced by electronic control of coil on time.

**RCCB Operation As A Relay**

To examine the RCCB operation as a relay, refer to Figure 3 and 4. The device is shown in the set position in Figure 3 and in the tripped position in Figure 4. The circuit path is from L2 through the bimetal to one of the stationary contacts. L1 is connected directly to the other stationary contact.

The movable bridge closes the circuit by bridging between the two stationary contacts.

As can be seen, movement of the armature about its fulcrum will determine the position of the contacts. When coil S1-S 2 has been energized such that the armature seals on the left-hand pole face (Figure 3), the mechanical linkage system closes the contacts. Conversely, when coil T1-T 2 has been energized, such that the armature seals on the right-hand pole face (Figure 4), the relay contacts will open due to the spring forces exerted by compression spring K.
Note that the coil U1-U2 is connected in parallel with T1-T2. It is wound on the left-hand core of the electro-magnet such that when energized along with T1-T2, the force it generates will be in a direction opposing the latching force generated in that core by the permanent magnet.

The utilization of a permanent magnet and intermittent duty coils, in conjunction with cutthroat contacts, allows a considerable reduction in copper and iron from that normally required in electro-magnets for continuous duty operation.

**RCCB Operation as a Circuit Breaker**

To examine the operation of the device as a breaker, refer to Figures 3, 4, and 5.

In Figure 3, the device is shown in the closed contact position (presumably) carrying rated current. Should an overload occur, currents greater than rated currents now “flow” through the device ‘entering’ through L2, passing through the bimetal, through the connection of the bimetal to one stationary contact, through the bridging moveable contact structure, to the other stationary contact, and ‘out’ through L1.

Depending upon the size of the overload, the bimetal will begin to deflect as shown in Figure 5 until the actuating end of the bimetal engages latch H at point J.

Motion and force due to the deflection of the bimetal moves latch H such that it rotates in a counter-clockwise direction around its pivot point E.

When latch H has moved an adequate distance, the upward force of lever L, applied at point C to latch bar I, will rotate latch bar I counter-clockwise around its pivot point G. This allows the main lever L to rotate clockwise around point D (where it is engaged with the armature) due to the “contact return” spring (compression spring) force K acting upon the moveable contact bridge.

Note that when this overload occurs, the armature is not transferred to the “off” (tripped) position, but instead remains in the latched position normally associated with the “on” (set) position of the device.

To "reset" the device after the fault or overload clears could be readily accomplished by energizing the "trip" coil (T1-T2) through a toggle or push-button switch (see Figure 1) located in the flight deck. The armature would then transfer and seal on the right-hand core of the electro-magnet, which is the "open" position shown in Figure 4. At that time, springs M and N (tension springs) would reposition latch bar I and latch H to the position shown in Figure 4, providing that the bimetal has now cooled sufficiently and returned to its original position as shown in Figure 4. At this stage, the RCCB is still in an "open position" i.e. (the contacts are open), but as outlined above, the fault or overload has been cleared through action and operation of the device through bimetallic activity, i.e. "Circuit Breaker" operation.

To re-close the contacts, it is now only necessary to energize coils S1-S2 and re-establish a mechanism position similar to that shown in Figure 3. If the fault of overload condition is still in existence, the device would again trip through bimetallic activity as just described.
Three Pole RCCB

The design principles employed in the 3-pole RCCB have followed many of the same paths utilized in the 1-pole RCCB. Differences other than the obvious, such as size, weight, shape, etc., are explained below.

Motor Operation

The principles of motor operation and construction of the three pole devices are similar to those employed in the single pole RCCB. In the 3-pole device, the AC operating power is drawn from two of the three phases. The "off" time between current pulses during coil energization is approximately 0.4 milliseconds. In comparison, the "off" time for single-phase power is approximately 1.25 milliseconds. See Figure 6.

The timing circuit establishes a coil "on" time longer than the actual transfer time of the armature. The operation of the 3-pole RCCB is identical to the 1-pole.

Control Circuit

Refer to Figure 7. There is one minor difference in operating principles and parameters from the single pole devices.

The difference is the addition of a power junction area in the electronics. (see Figure 7). The 3-pole RCCB is designed for use in 3-phase circuits and is a 400 Hz AC load controller. The power junction is designed to use AC power only. DC operate (coil) power may be used even though AC loads are to be controlled. This connection is made at terminal 4 of the IWT5S connector. In Figure 7, two separate power junctions are shown: one for AC and one for DC. In the event both AC and DC are connected to the RCCB, only AC would be utilized by the logic circuit. Should AC power be lost, the DC connection would automatically take over the control function.

The other differences between 1-phase and 3-phase control circuitry, i.e. timer addition, is directly related as described in the above Motor Operation section.

Figure 7

*Indicates In 3 Phase Electronics