Installation Instructions for ND, HND, NDC, CND, CHND, CNDC Circuit Breakers with Digitrip OPTIM Trip Unit and Powernet, and/or Zone Interlock

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1.0 INTRODUCTION

General Information

The N-frame OPTIM Series C circuit breaker (Figure 1-1) types ND, HND, and NDC are 600 VAC maximum rated devices with Digitrip OPTIM Models 550, 750 or 1050 trip units rated 800A or 1200A maximum continuous current. They are for AC applications only and can be reverse fed. They are listed in accordance with Underwriters Laboratories, Inc. Standard UL 489 and satisfy the requirements of International Electrotechnical Commission Recommendations No. IEC 947-2. OPTIM 750 and 1050 N-Frame circuit breakers are equipped with zone interlocking and an auxiliary switch and alarm (signal)/lockout switch for customer usage. Other internal accessories are available but must be factory installed since they are factory sealed. Model 550 is not sealed and can accommodate field installed accessories, including an IMPACC communications kit. Contact Eaton for the following information and user manuals:

- N-Frame and Accessories Selection Data 29-120N
- Instructions and Overview of OPTIM Trip Units 29C89C
- Instructions on the Operation of Digitrip OPTIMIZER Hand Held Programmer 29C892
- Instructions on the Operation of Digitrip Breaker Interface Module 29C893
- Instructions on the Operation of Digitrip OPTIM Trip Units 29C891
- Digitrip OPTIM Wiring Diagrams 29C894
- Application Data 29-167N

100 Percent Rated N-frame Circuit Breakers

CND, CHND, and CNDC circuit breakers are suitable for continuous operation at 100 percent of the frame rating in an enclosure which measures at least 42” height, 22.75” width and 11.5” depth. The 800A version requires no ventilation. The 1200A version requires 224 sq. in. of ventilation on the front face of the enclosure (72 sq. in. top, 72 sq. in. bottom, 40 sq. in. left and 40 sq. in. right). The 1200A version has to be used with the supplied conductor extensions and terminal barriers as shown in Figure 2-2. Use only 90°C rated wire with ampacity based on 75°C rated conductors. Use Copper only or AL9CU terminals only.
2.0 INSTALLATION

The installation procedure consists of inspecting the circuit breaker and, as applicable, installing the rating plug and terminals; mounting the circuit breaker; connecting the line and load conductors; torquing terminals; and attaching terminal covers. Circuit breaker frames, rating plugs, accessories, mounting hardware, and unmounted terminals may be supplied in separate packages. To install the circuit breaker, perform the following steps.

2.1 Compare nameplate data with existing equipment ratings and system requirements to make sure that the circuit breaker is suitable for the intended installation. Prior to mounting, confirm that the circuit breaker has not been damaged during transit or initial handling.

2.2 Remove line and load end covers. Mount wire connecting terminals as shown in Figure 2-1. Secure the terminals to the circuit breaker using two cap screws and lockwashers. Torque to 40 to 50 lb-ft. (54.2 to 67.8 N·m). With the circuit breaker mounted and before the conductors are installed and conductor clamping screws inserted, the terminal mounting screws may be checked for correct torque.

THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE DEATH OR SEVERE PERSONAL INJURY. BEFORE MOUNTING THE CIRCUIT BREAKER IN AN ELECTRICAL SYSTEM, MAKE SURE THERE IS NO VOLTAGE PRESENT WHERE WORK IS TO BE PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT.

WARNING

CAUTION

WHEN ALUMINUM CONDUCTORS ARE USED, THE APPLICATION OF A SUITABLE JOINT COMPOUND IS RECOMMENDED TO REDUCE THE POSSIBILITY OF TERMINAL OVERHEATING. OVERHEATING CAN CAUSE NUISANCE TRIPPING AND DAMAGE TO THE CIRCUIT BREAKER.

NOTICE

Depending on the equipment configuration, the circuit breaker can be mounted using different styles of hardware. The following steps describe how to mount the circuit breaker using standard hardware. When special hardware is needed (for example, with the motor operator), the instruction leaflet describing the accessory also describes the special mounting arrangements.

2.3. To mount the circuit breaker, perform the following steps:

a. For individual surface mounting, drill mounting panel using the drilling plan shown in Figure 2-3. For dead-front cover applications, cut out cover to correct escutcheon dimensions, see Figure 2-4. Make sure accessory wiring is accessible when the circuit breaker is mounted.

b. Position circuit breaker on mounting surface.

c. Install circuit breaker mounting screws and washers. Torque mounting screws to 30-35 lb-ft. (41-47 N·m).

2-4. Connect line and load conductors and accessory leads.

2-5. Install the supplied neutral current sensor in the neutral pole of a four-wire system, see Figure 2-7 and wiring diagram 29C894.

2-6. After the circuit breaker is installed, check all mounting hardware and terminal connecting hardware for correct torque loading. Torque values for line/load terminals are given on the circuit breaker nameplate.

2-7. Re-install load end and line end covers and secure with pan head screws provided. Torque large screws to 35-45 lb-in. (4.0-5.0 N·m) and small screws to 24-30 lb in. (2.7-3.4 N·m). When using the terminals TA700NB1 or T700NB1, or when prospective fault currents of cabled installations exceed 65kA (such as NDC applications) the conductors are to be braced in accordance with Figure 2-5.
Figure 2-2 Conductor Extensions and Terminal Installation for 100% Rating

Note: Conductor extensions increase breaker length by 3.75° on each end.

Figure 2-3 Circuit Breaker Mounting Bolt Drilling Plan

Table 2.1

<table>
<thead>
<tr>
<th>Trip Unit Rating</th>
<th>Available Rating Plugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>800A</td>
<td>400A, 450A, 500A, 550A, 600A, 630A, 700A, 800A</td>
</tr>
<tr>
<td>1200A</td>
<td>500A, 700A, 300A, 900A, 1000A, 1200A</td>
</tr>
</tbody>
</table>
HAZARDOUS VOLTAGE CONDITIONS CAN CAUSE DEATH OR SEVERE PERSONAL INJURY. MAINTAIN ORIGINAL ELECTRICAL CLEARANCE AND CREEP-AGE SPACINGS AT TERMINATIONS.

2-8 Connect the control wires and power wires to their appropriate locations on the male plug of the terminal block, see Figure 2-6. Control power is necessary if IMPACC communication is required.

2-9 Install an appropriate rating plug, see Table 2.1.

2-10. Plug in the hand held Digitrip OPTIMIZER into the programming port and set the INCOM address. Then set the various trip unit current settings using the OPTIMIZER, or use the Breaker Interface Module when INCOM is available. If IMPACC Series III software is part of the system, this too can be used to set the trip unit settings. Refer to the user manuals for details.

3.0 MANUAL OPERATION

Manual operation of the circuit breaker is controlled by the circuit breaker handle and the PUSH-TO-TRIP button in the trip unit. The circuit breaker handle has three positions, two of which are shown on the cover with raised lettering to indicate ON and OFF. On the handle, ON, OFF, and trip are also shown by a color-coded strip for each circuit breaker handle position: red for ON, white for tripped, and green for OFF (see Figure 3-1).

Circuit Breaker Reset

After a trip operation, the circuit breaker is reset by moving the handle to the Reset (extreme OFF) position. It is not necessary to press the reset button before resetting the breaker. The reset button affects only the cause of trip indicator LED’s and trip information in the trip’s memory. It does not affect the operation of the circuit breaker itself.

NOTICE

No circuit breaker should be reclosed until the cause of trip is known and the situation rectified.

PUSH-TO-TRIP Button

The PUSH-TO-TRIP button operates the circuit breaker tripping function and may be used to periodically exercise the operating mechanism. The button is designed to be operated by a small screwdriver.

4.0 INSPECTION AND FIELD TESTING

Series C molded case circuit breakers are designed to provide years of almost maintenance-free operation. The following procedure describes how to do a limited amount of field inspection and testing of a circuit breaker.

Inspection

Circuit breakers in service should be inspected periodi-
## OPTIM Terminal Block 1050 Only

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Terminal</th>
<th>Wire Color</th>
<th>Description</th>
<th>OPTIM 550 Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>550 ICK</td>
</tr>
<tr>
<td>1</td>
<td>GF AL</td>
<td>White/Brown</td>
<td>GF Alarm</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>Zone OUT</td>
<td>White/Black</td>
<td>Short Delay/Ground Output</td>
<td>Zone Select Interlock</td>
</tr>
<tr>
<td>3</td>
<td>Zone IN</td>
<td>White/Rec</td>
<td>Short Delay/Ground Input</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>COM</td>
<td>(jmp)</td>
<td>Common</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>NEG</td>
<td>Black*</td>
<td>24V Neg*</td>
<td>Control Power</td>
</tr>
<tr>
<td>6</td>
<td>+24 Vdc</td>
<td>Orange*</td>
<td>24 Vdc* Power Supply*</td>
<td>Power</td>
</tr>
<tr>
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<td>X</td>
</tr>
<tr>
<td>8</td>
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<td>9</td>
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<td>PT</td>
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<td>Yellow</td>
<td>β B</td>
<td>Module</td>
</tr>
<tr>
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<td>Red</td>
<td>β A</td>
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</tr>
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<td>Violet</td>
<td>INCOM</td>
<td>PowerNT</td>
</tr>
<tr>
<td>13</td>
<td>INCOM</td>
<td>Violet</td>
<td>INCOM</td>
<td>PowerNT</td>
</tr>
<tr>
<td>14</td>
<td>Shield</td>
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<td>Blue</td>
<td>Bell Alarm N.O.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Bell N.C.</td>
<td>Red</td>
<td>Bell Alarm N.C.</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Com</td>
<td>Black</td>
<td>Sell/Aux Common</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Aux N.O.</td>
<td>Red</td>
<td>Aux Switch N.O.</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Aux N.C.</td>
<td>Blue</td>
<td>Aux Switch N.C.</td>
<td></td>
</tr>
<tr>
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<td>Spare</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Spare</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Spare</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**NOTICE**

1. It is crucial to connect the +24 VDC power supply to the correct terminal. Improper connection can destroy the electronic protection functions of the circuit breaker. The trip unit imposes a load of 45 ma.

2. The Optim 550 Ground Fault Trip and Ground Fault Alarm units have “NS and NS*” wires. The Non-Ground Fault Optim 550 units have no wires.

3. Customer wiring connections are made on the removable male plug of the terminal block.

4. If the customer requires the interlock feature in their system, then the removal of the jumper between positions 2 & 3 is required. Breaker is shipped as self interlocked from the factory.

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*The combination Bell Alarm / Auxiliary Switch is only available on the OPTIM 1050 units.*

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*Figure 2-6 OPTIM Wiring Terminations*
The inspection should include the following checks 4-1 through 4-7.

**WARNING**

THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. BEFORE INSPECTING THE CIRCUIT BREAKER IN AN ELECTRICAL SYSTEM, MAKE SURE THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THAT THERE IS NO VOLTAGE PRESENT WHERE WORK IS TO BE PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT.

**CAUTION**

SOME COMMERCIAL CLEANING AGENTS WILL DAMAGE THE NAMEPLATES OR MOLDED PARTS. MAKE SURE THAT CLEANING AGENTS OR SOLVENTS USED TO CLEAN THE CIRCUIT BREAKER ARE SUITABLE FOR THE JOB.

4-1. Remove dust, dirt, soot, grease, or moisture from the surface of the circuit breaker using a lint-free dry cloth, brush, or vacuum cleaner. Do not blow debris into circuit breaker. If contamination is found, look for the source and eliminate the problem.

4-2. Switch circuit breaker to ON and OFF several times to be sure that the mechanism linkages operate freely and do not bind. If mechanical linkages do not operate freely, replace circuit breaker.

4-3. With the circuit breaker in the ON position, press the PUSH-TO-TRIP button to mechanically trip the circuit breaker. Trip, reset, and switch circuit breaker ON several times. If mechanism does not reset each time the circuit breaker is tripped, replace the circuit breaker.

4-4. Check base, cover, operating handle, and handle barrier for cracks, chipping, and discoloration. Circuit breaker should be replaced if cracks or severe discoloration is found.

4-5. Check wire connecting terminals and other type bus bar connectors for looseness or signs of overheating. Overheating will show as discoloration, melting, or blistering of conductor insulation, or as pitting or melting of conductor surfaces due to arcing. If there is no evidence of overheating or looseness, do not disturb or tighten the connections. If there is evidence of overheating, terminations should be cleaned or replaced. Before re-energizing the circuit breaker, all terminations and cable should be refurbished to the originally installed condition.

4-6. Check circuit breaker mounting hardware, and tighten if necessary.

4-7. Exposure to certain types of chemicals can cause
deterioration of electrical connections. Check area where circuit breaker is installed for any safety hazards, including personal safety and fire hazards and take required precautionary actions.

**Field Testing**

Any field testing should be done in accordance with applicable NEMA Standard. The operation of circuit breakers with Digitrip OPTIM RMS trip units can be field tested periodically using the hand held OPTIMIZER. (See user manuals.)

**Performance Testing for Ground Fault Trip Units**

**Code Requirements**

The National Electrical Code under Article 230-95-C requires that any ground-fault protection system be performance tested when first installed. The test shall be conducted in accordance with approved instructions provided with the equipment. A written record of this test shall be made and shall be available to the authority having inspection jurisdiction.

**Standards Requirements**

As a follow-up to the basic performance requirements stipulated by the N.E.C. as stated above, UL Standard No. 1053 requires that certain minimum instructions must accompany each ground fault protection system. These following statements plus a copy of the test record form illustrated in Figure 4-1 are shipped with each Digitrip OPTIM RMS trip unit.

**General Test Instructions**

The interconnected system shall be evaluated in accordance with the equipment assembler’s detailed instructions by qualified personnel.

The polarity of the neutral sensor connections (if used) must agree with equipment assembler’s detailed instructions to avoid improper operations following apparently correct simulated test operations. Where a question exists, consult the specifying engineer and/or equipment assembler.

The grounding points of the system shall be verified to determine that ground paths do not exist that would bypass the sensors. The use of high-voltage testers and resistance bridges may be used.

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**WARNING**

THERE IS A HAZARD OF ELECTRICAL SHOCK OR BURN WHENEVER WORKING IN OR AROUND ELECTRICAL EQUIPMENT. ALWAYS TURN OFF POWER SUPPLYING BREAKER BEFORE CONDUCTING TESTS.
NOTICE

Since the Digitrip OPTIM RMS trip units derive their operating power from the phase currents, and not from the neutral current, passing current through the neutral sensor only will not properly test the ground fault feature.

Using a low-voltage (0-24 volt), high current, ac source, apply a test current of 125% of the Digitrip OPTIM RMS Ground Fault Trip Unit pick-up setting through one phase of the circuit breaker, as shown in Figure 4-2. This should cause the breaker to trip in less than 1 second, and if an alarm indicator is supplied, it should operate. Reset the breaker and the alarm indicator. Repeat the test on the other two phases.

If the system is a 4-wire system with a neutral current sensor, apply the same current as described above through one phase of the breaker, returning through the neutral sensor, as shown in Figure 4-3. The breaker should not trip, and the alarm indicator, if supplied, should not operate. Repeat the test on the other two phases.

If the system is a 3-wire system with no neutral current sensor, apply the same current as described above through any two phases of the breaker, with the connections exactly as shown in Figure 4-4. The breaker should not trip, and the alarm indicator, if supplied, should not operate. Repeat the test using the other two combinations of breaker phases.

CAUTION

FIELD TESTING SHOULD BE USED FOR FUNCTIONAL TESTING AND NOT FIELD CALIBRATION OF THE DIGITRIP OPTIM RMS GROUND FAULT TRIP UNIT.

ANY TEMPORARY CONNECTION MADE FOR THE PURPOSE OF CONDUCTING TESTS SHOULD BE RESTORED TO PROPER OPERATING CONDITIONS BEFORE RETURNING THE BREAKER TO SERVICE.

The results of the test are to be recorded on the test form provided with the equipment.

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**Figure 4-3** Connections for Ground Fault No-Trip Test with a Four-Wire System

**Figure 4-4** Connections for Ground Fault No-Trip Test with a Three-Wire System
Installation Instructions for ND, HND, NDC, CND, CHND, CNDC Circuit Breakers with Digitrip OPTIM Trip Unit and Powernet, and/or Zone Interlock
The instructions for installation, testing, maintenance, or repair herein are provided for the use of the product in general commercial applications and may not be appropriate for use in nuclear applications. Additional instructions may be available upon specific request to replace, amend, or supplement these instructions to qualify them for use with the product in safety-related applications in a nuclear facility.

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