Catalog

05

Power-Zone® 4

Low Voltage, Metal-Enclosed, Drawout Switchgear with Masterpact® NW and NT Low Voltage Power Circuit Breakers

Class 6037

CONTENTS

a brand of Schneider Electric

SQUARE D

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Product Description

INTRODUCTION

Power-Zone® 4 low voltage, metal-enclosed, drawout switchgear is designed to provide superior electrical distribution, protection, and power quality management for the entire facility. The prime components of the switchgear are the Masterpact® NW and Masterpact NT ANSI-rated circuit breakers. Power-Zone 4 switchgear is designed to maximize the functionality of the Masterpact NW and NT circuit breakers, which, in turn, deliver maximum uptime, system selectivity, ease of maintenance and circuit protection. All of this in the smallest footprint available for low voltage drawout switchgear.

Features and Benefits

Figure 1: Power-Zone 4 Switchgear

- Power-Zone 4 is designed and built to ANSI® C37.20.1 and is listed to UL® 1558.
- Masterpact NW and NT drawout low voltage power circuit breakers are designed and built to ANSI C37.13 and C37.16., and are listed to UL1066.
- Short-circuit current rating up to 200 kA without fuses.
- High short-time withstand ratings up to 100 kA for 30 cycles.
- Family of field installable and upgradeable Micrologic® trip units with optional Powerlogic® data communications features.
- Smallest equipment footprint available in this product class.
- Front access to control and communications wire connections.
- Bolted copper bus provided as standard (up to 5000 A maximum).
- Large rear cable compartment pull area allows maximum room for power cables.
- Bus provision for future equipment expansion.
- System designed for maximum uptime with low maintenance.
- Modular circuit breaker design for easy addition of control accessories.

Figure 2: Through-the-Door Access

Figure 3: Circuit Breaker Compartment with Secondary Horizontal and Vertical Wireways

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Compartmentalization

Structures are compartmentalized and are built with barriers as required by ANSI C37.20.1. The structure has large conduit space within the main and feeder sections.

UL Listing

Power-Zone 4 switchgear is designed and engineered to comply with UL1558 requirements. Masterpact NW and NT circuit breakers are UL1066 listed. A UL label can be affixed where UL coverage exists for all component material, parts, and devices in a switchgear section.

Functional Capacity

High current carrying capacity frame sizes and high withstand rating make the Masterpact NW and NT circuit breakers ideal for application on today's high capacity distribution systems.

Maximum Uptime

Drawout construction allows quick and simple replacement of circuit breaker elements. If an emergency occurs, circuit breakers may be removed from low-priority circuits and re-installed to serve high-priority circuits.

Ease of Maintenance

Masterpact NW and NT circuit breakers provide disconnecting and overload protection for the circuit they control. Each is contained in an individual compartment and can be easily isolated from the energized circuit and withdrawn from the compartment for quick inspection, maintenance, or replacement. The entire switchgear or any other feeder circuits need not be shut down during this operation, thus minimizing production downtime.

Auxiliary Instrument Compartments

Optional control power transformers, meters, and other control devices can be mounted in the auxiliary instrument compartments. These compartments are furnished with hinged doors for easy access.

Secondary Horizontal and Vertical Wireways

The secondary wiring design allows for front access to circuit breaker control and communications wiring without removing the circuit breaker from its compartment. The vertical wireway is located on the right side of the circuit breaker for easy access and wiring installation. The horizontal wireway is located directly above the circuit breaker, providing direct access to control and communication terminations.

ANSI Interrupting and Short-Time (Withstand)

Power-Zone 4 switchgear with Masterpact NW and NT circuit breakers has the highest interrupting and short-time (withstand) ratings for low voltage switchgear in the smallest physical size. The elimination of limiter fuses for high interrupting Masterpact NW circuit breakers reduces space and cost. The ANSI rated circuit breaker's improved coordination with downstream devices increase system uptime.

Through-the-Door Construction

Masterpact NW and NT circuit breakers provide clear access to all circuit breaker controls, indicators, and trip unit functionality without opening the compartment door. Circuit breaker racking is also achieved with the compartment door closed.

Disconnecting Contacts

The main disconnecting contacts (power plug-on fingers) on the rear of the circuit breaker are spring loaded and self-aligning to ensure positive electrical contact when the circuit breaker is in the connected position. The secondary disconnecting contacts are located on the top front of the circuit breaker element and are used for connecting the accessories to the control power source, other control circuits, or communication circuits.

Micrologic® Enhanced Functionality

A new family of Micrologic electronic and programmable trip units provide a choice of expanded information, power quality readings, and communication capabilities. Micrologic trip units can be integrated into the optional Powerlogic system.

Powerlogic® Monitoring System

Power-Zone 4 switchgear is available with the Powerlogic metering, data acquisition, and control system. The optional Powerlogic system is used in addition to, or in lieu of, the Type A, Type P, and Type H Micrologic® trip units for the Masterpact NW and NT circuit breakers. Powerlogic functions are included in Micrologic high-end trip units. Several highly accurate circuit monitors are available to work in conjunction with the Powerlogic System Manager Software to manage and control the electrical distribution system.

Equipment Standards

All Power-Zone® 4 switchgear are 100% rated and are assembled and tested in an ISO 9001 facility to applicable standards including:

Standard	Description
ANSI C37.20.1	Metal-enclosed low voltage circuit breaker switchgear
ANSI C.37.51	Testing of metal-enclosed low voltage ac circuit breaker switchgear
NEMA SG-5	Power switchgear assemblies
CAN/CSA C22.2 No. 31-M89	Switchgear assemblies
UBC and CBC	Zone 4 seismic applications
UL 1558	Switchgear assemblies

All Masterpact NW and NT circuit breakers are 100% rated and are assembled and tested in an ISO 9001 facility to applicable standards including:

Standard	Description
ANSI C37.13	Low voltage ac power circuit breakers used in equipment
ANSI C37.16	Preferred rating, related requirement and application recommendations for low voltage power circuit breakers and ac power circuit breakers
ANSI C37.17	Trip devices for ac and general-purpose dc low voltage power circuit breakers
ANSI C37.50	Testing of low voltage ac circuit breakers
NEMA SG-3	Low voltage circuit breakers
UL 1066	Low voltage circuit breakers

Equipment Ratings

Application Voltage Systems	Ampacities
600 Vac Maximum	1600 A–5000 A (main circuit breaker or main lugs only)
1Ø3W, 3Ø3W, 3Ø4W	
50/60 Hz	

Short-Circuit Current Ratings			Short-Time Withstand Ratings
240 V	480 V	600 V	
42 kA	42 kA	42 kA	42 kA
65 kA	65 kA	65 kA	65 kA
85 kA	85 kA	85 kA	85 kA
200 kA	200 kA	130 kA	100 kA (maximum)

SECTION 2 : GENERAL AND APPLICATION INFORMATION

SECTION CONTENTS

INTRODUCTION

Power-Zone® 4 switchgear with Masterpact® NW and NT circuit breakers provides the optimal switchgear solution in an industrial environment. The switchgear is designed for ease of use, system selectivity, system uptime, and low maintenance. The switchgear is easy to operate and maintain because of the technological advances in communications, power quality monitoring, and measuring capabilities.

The switchgear with drawout Masterpact NW and NT circuit breakers provides overload, short-circuit, and ground fault protection for circuits up to 600 volts. All trip unit and circuit breaker functions are operational from the front without opening the circuit breaker compartment door. Masterpact NW circuit breakers carry the highest interruption ratings without fuses, and require minimal space.

All Masterpact NW and NT circuit breakers can be equipped with Micrologic® electronic and programmable trip units to provide a choice of expanded information, power quality measurement, protection, and communication capabilities. Additionally, the optional high-end Micrologic trip units are compatible with the optional Powerlogic system.

The optional Powerlogic® data communications system can be used in lieu of or in addition to Micrologic trip units. The Powerlogic system uses highly accurate circuit monitors that work in conjunction with its System Manager Software to manage and control the electrical distribution system.

Power-Zone 4 switchgear is commonly found as the electrical service in the following applications:

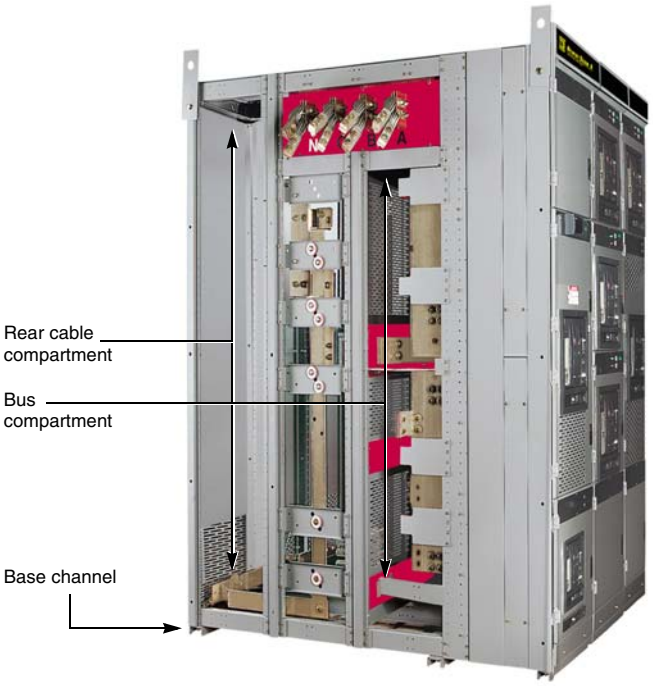
- Chemical refinery
- Manufacturing
- Heavy assembly plants
- Large warehouses
- Semi-conductor manufacturing
- Textile mills
- Large office buildings
- University facilities
- Airports
- Data centers
- Hospitals
- Food and beverage facilities
- Wastewater and water treatment facilities

STRUCTURE

The switchgear assembly is composed of vertical sections arranged according to customer requirements. Each section is divided into a maximum of four compartments when using Masterpact NW circuit breakers, or a maximum of eight compartments when using Masterpact NT circuit breakers. One or more of these compartments can be used as an auxiliary instrument compartment containing potential transformers, meters, relays, and control devices.

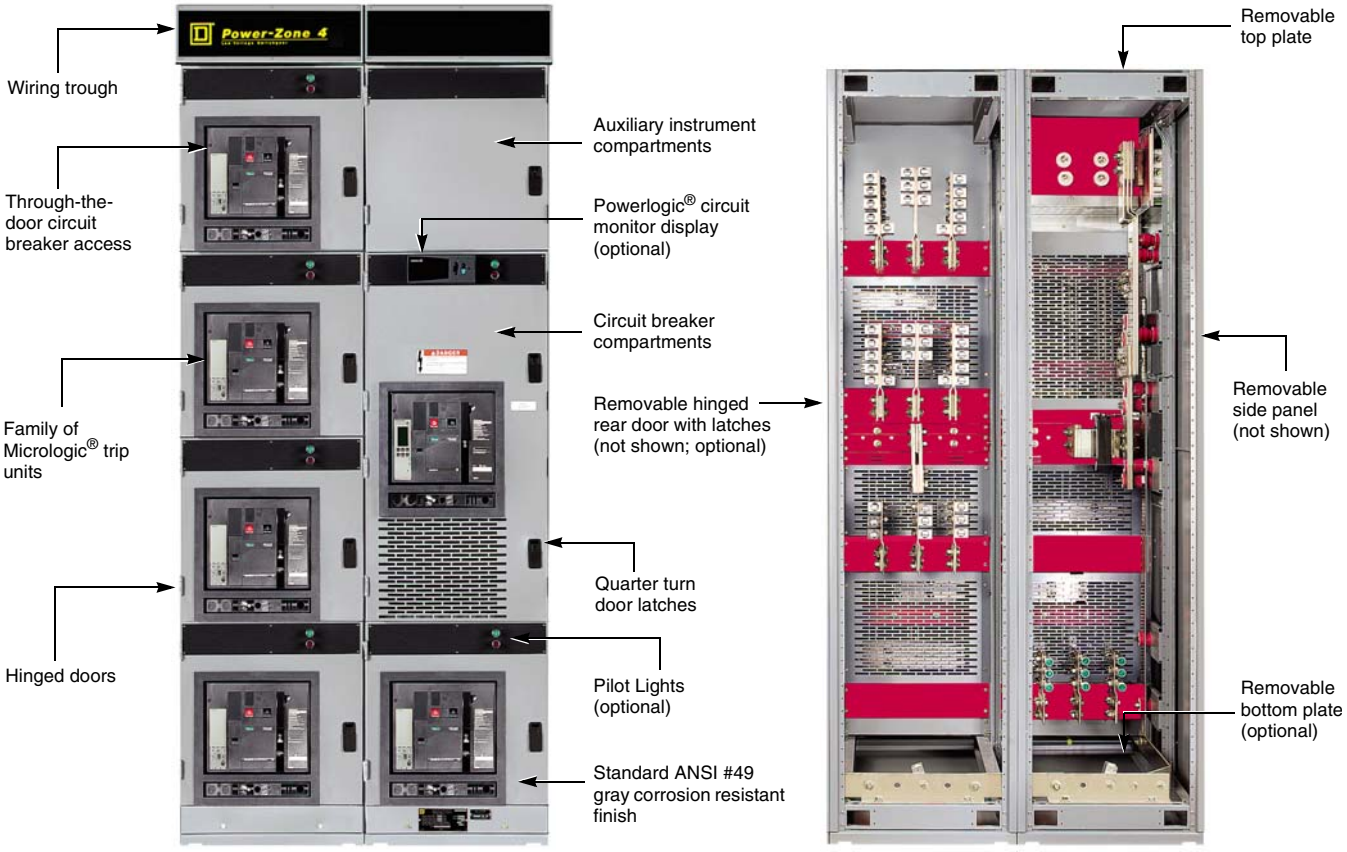
A horizontal secondary wireway, containing the accessory terminal blocks, is directly above each circuit breaker. A spacious vertical wireway is on the right side of each circuit breaker compartment to allow wire routing through the switchgear.

Figure 3: Switchgear (Side View)



Power-Zone 4 switchgear offers compartmentalized construction. Each vertical section consists of three compartments: a front compartment (including secondary wireway), a bus compartment, and a rear cable compartment. The front compartment is divided into a maximum of four or eight compartments that can contain Masterpact NW or NT circuit breakers or auxiliary equipment. If desired, all compartments may be used for auxiliary equipment, circuit breakers, or a combination. The circuit breaker is positioned to allow ample room for control and communications wiring. Hinged doors on the auxiliary instrument compartment are available for mounting meters, relays, or other control equipment when it does not contain a circuit breaker. A circuit monitor display may be mounted on the hinged door of a compartment containing a main circuit breaker.

The examples below depict a typical Power-Zone 4 switchgear assembly.



Switchgear (Front View)

Switchgear (Rear View)

ENCLOSURES

NEMA Type 1 Indoor Enclosures

The standard Power-Zone 4 switchgear enclosure is NEMA Type 1, general purpose. NEMA Type 1 enclosures are dead front, metal-enclosed structures. All sheet steel parts of the enclosure, inside and out, are painted using an electro-deposition process.

Figure 4: POWER ZONE 4 Switchgear, NEMA Type 1, Indoor Enclosure

Standard Features:

- Secondary wiring areas
- Removable, steel top plates over conduit entrance
- Hinged front doors with latches
- Circuit breaker or instrument compartment
- Bus compartment
- Cable compartment
- Capability for future expansion
- Two-piece removable side and back plates
- 1 1/2-inch-high base channels
- Electro-deposition paint process on structural parts
- ANSI #49 paint color
- Customer nameplates for each compartment
- White instrument mounting pans

Available Options:

- Vertical bus barriers
- Strip heaters in circuit breaker, bus, and cable compartments
- Overhead circuit breaker lifting device or floor crane
- Gasketing around doors and between sections
- Filtering of doors and vents
- Lockable, hinged rear doors
- Lockable, hinged front doors
- 18-inch-high pull box
- Bottom plates
- Rodent barriers

NEMA Type 3R Walk-In Enclosures

Power-Zone 4 switchgear is also available in a NEMA Type 3R walk-in enclosure for outdoor installation.

Figure 5: NEMA Type 3R, Walk-In Outdoor Enclosure

NEMA Type 3R, Walk-In Outdoor Enclosure

Available Options:

- Exhaust fan ventilation/inside temperature control
- Exterior lighting
- Undercoating
- Inside emergency lighting
- Top entry/exit for incoming and outgoing cables

Standard Features:

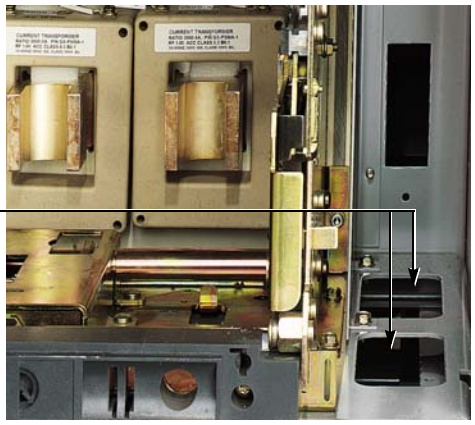
- Front aisle with steel entrance door equipped with panic hardware
- Lockable, hinged rear doors
- Interior fluorescent lighting
- Three-way light switch and convenience outlets near the entrance door
- Strip heaters in circuit breaker and bus compartments
- Overhead circuit breaker lifting device (traveling lifter assembly)
- Removable gasketed steel cover plates over conduit entrance
- One-piece construction for ease of installation

  NOTE: Assembly may be required if shipped split.

Control and Communications Wiring

Figure 6: Conduit Entrances

Top Control Conduit Entrance



Bottom Control Conduit Entrances

Control and communication wiring is installed and connected from the front of the switchgear. The secondary wiring design allows for circuit breaker compartment wiring without removing the circuit breaker from its compartment.

Control Conduit Entrances

The control wiring conduit entrance is in both the top and bottom of each section for maximum flexibility.

A removable top plate (4-inch by 5-inch) can be punched easily; up to four individual 3/4-inch control conduits per section.

Two bottom conduit entrances in each circuit breaker compartment permit cables to exit through the bottom of the compartment.

Horizontal Wireway

The secondary horizontal wireway (see Figure 7 on page 18) is directly above each circuit breaker compartment, allowing easy access to finger-safe secondary terminals. Each secondary terminal is dedicated to a specific function, allowing standardized wiring.

The secondary disconnecting contacts are on the top front of the circuit breaker element and connect the accessories to the control power source or other control circuits. These contacts are in the connected position when the circuit breaker is in the connect and test positions.

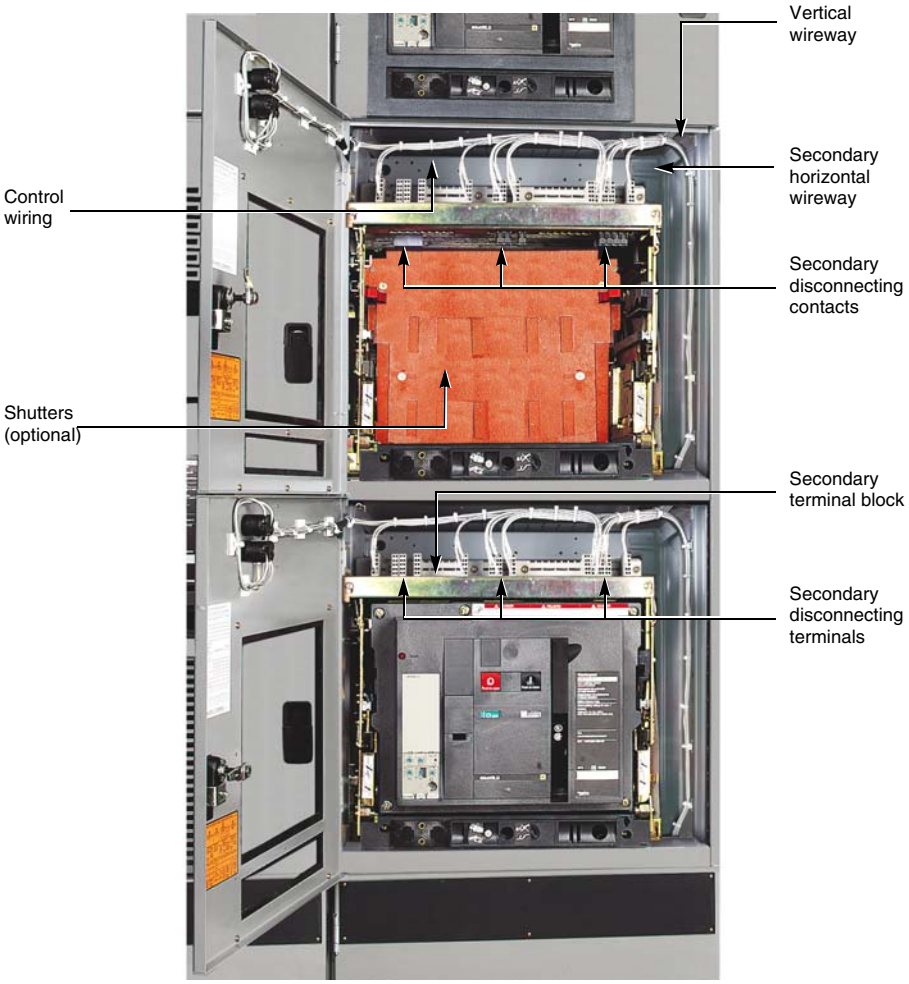
Vertical Wireway

The vertical wireway (see Figure 7 on page 18) is on the right side of the circuit breaker for quick and easy wiring installation.

Control and Communications Terminals

All accessory terminals are on a connecting block on the top front of the circuit breaker cradle and are accessible from the front, even with the circuit breaker in the test or disconnect position. This is particularly useful for field inspection and modification. The field-installable electrical accessories are UL Listed.

Figure 7: Secondary Wiring System



Standard Features:

- Control wires in wiring trough above the circuit breaker compartment
- Secondary terminal block originates directly from the circuit breaker without the use of an intermediate terminal block for factory and customer wiring
- Snap-in wire tie provisions
- Cage clamp terminal blocks locked directly on the circuit breaker cradle
- Control wiring AWG #14 SIS
- Metering CT wiring AWG #10 SIS
- Locking pull-apart terminal blocks at shipping splits
  - — Sleeve type “destination” wire markings
  - — Grommeted holes between circuit breaker compartments

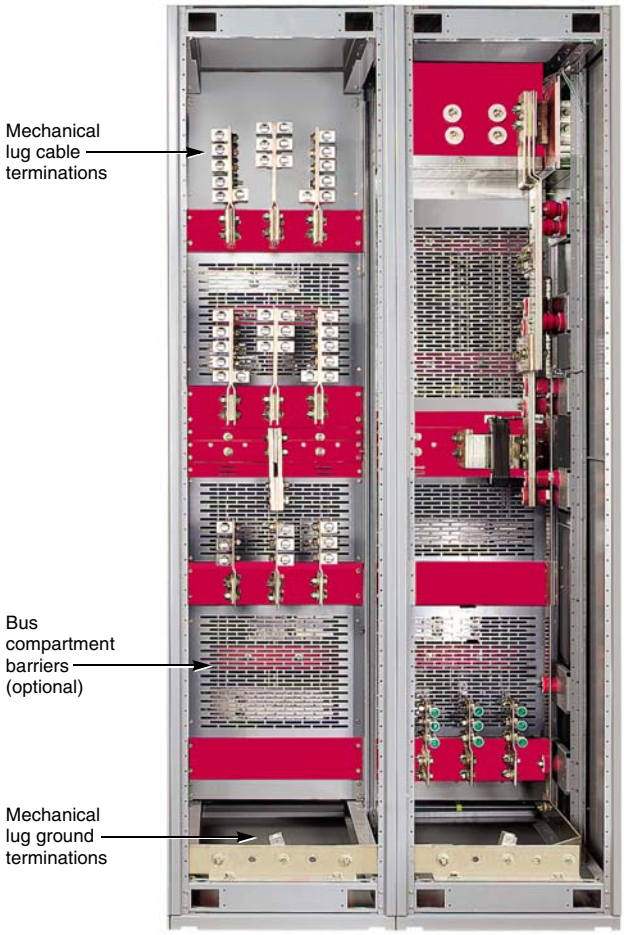
Available Options:

- Ring tongue control wiring
- Communications wiring AWG #22 shielded

Rear Cable Compartment

The rear cable compartment is located behind the bus compartment. It provides room for rear access cable installation. Silver plated copper load bars extend from the load side of the circuit breaker's stationary connecting contacts into the cable compartment. Cable terminations on the load bars permit cables to exit through either the top or bottom of the vertical sections.

Figure 8: Rear Cable Compartment



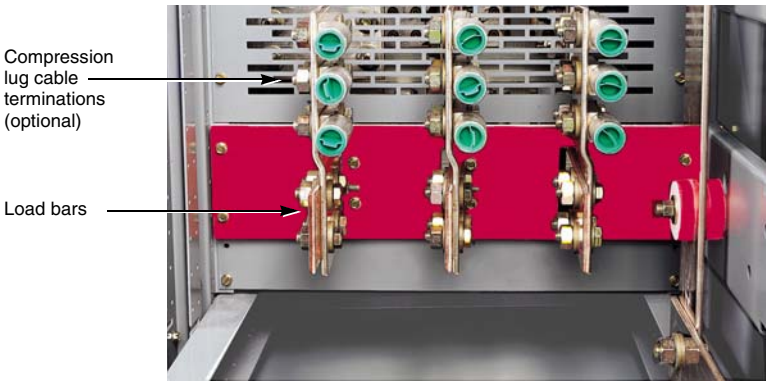
Standard Features:

- Mechanical lugs provided for customer connections
- Largest conduit area in this product class
- Two-piece removable rear covers (not shown)
- 3/0–750 kcmil lugs

Available Options:

- Compression lugs
- Cable supports
- Hinged full height rear door with padlock provisions
- Load connection to I-LINE® busway
- 18-inch pull box

Figure 9: Mechanical Lugs



Mechanical cable lugs are standard for customer cable connections. Optional compression lugs are available with Power-Zone 4 switchgear. Optional cable supports (not shown) provide additional assistance in customer wiring.

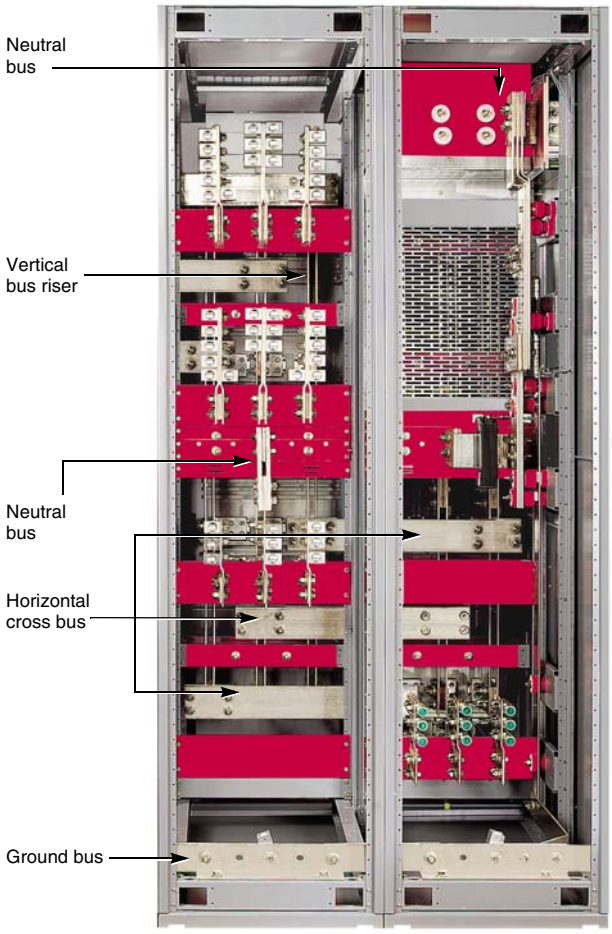
Bus Compartment

The bus compartment contains the horizontal and vertical bus, and is located between the circuit breaker compartment and the cable compartment. The bus compartment is separated from the circuit breaker compartment with grounded steel barriers. The optional side and rear barriers isolate the bus compartment from the rear cable compartment. In addition, service entrance barriers provide isolation around the incoming lines to meet UL and NEC requirements. Optional insulated bus helps protect the bus in harsh environments.

On four-wire systems, a neutral bus extends the length of the line-up and includes taps for the neutral cables in each vertical section. Feeder circuit breaker neutral sensors (current transformers) are provided on these taps when ground fault protection is supplied. A removable link to the ground bus is furnished, but not connected, in the main vertical section for grounded, four-wire systems. The ground bus is a plated copper bus bar that is bolted to the rear bottom of the cable compartment and extends the entire length of the switchgear.

All bus joints use a minimum of two grade-5 bolts and are secured with conical-type spring washers for maximum joint integrity. Bus sizing is based on ANSI/IEEE C37.20.1 continuous current test criteria. Standard bus is plated copper and is fully rated. All vertical and cross bus ratings in Power-Zone 4 switchgear are based on a standard temperature rise of 149 °F (65 °C) above a maximum ambient air temperature of 104 °F (40 °C).

Figure 10: Bus Compartment



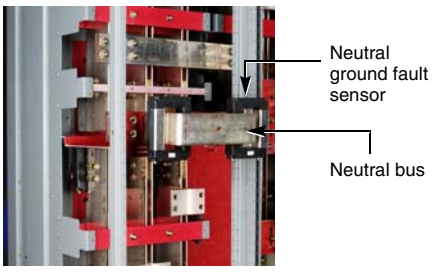
Bus Compartment (Rear View)

Standard Features:

- Silver plated copper bus bars
- Up to 5000 A continuous, 100% rated
- All bus bars are sized for full system capacity
- Minimum of two grade-5 bolt conical washer joints
- Sleeve type insulated runbacks

Available Options:

- Bus compartment barriers
- Side barriers in cable compartment
- Neutral bus center for easy terminations
- Tin plated copper bus
- Bus sized to 1,000 amps/in ^{2}
- Full insulated bus-sleeve type insulated with boots over joints

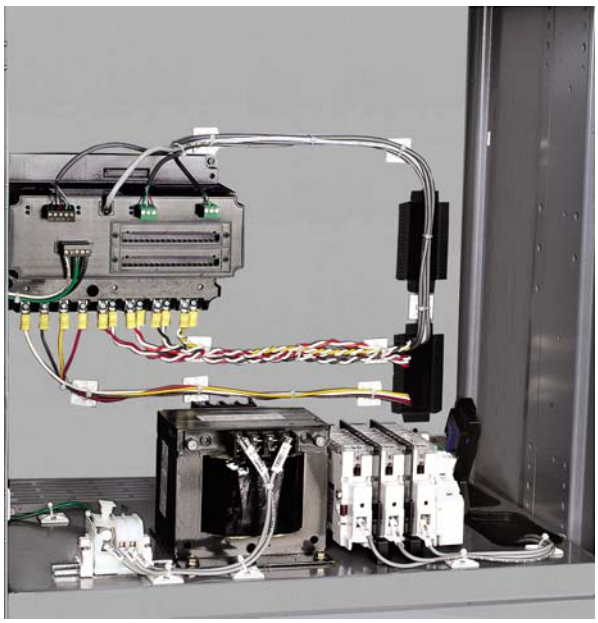


Bus Compartment (Side View)

Auxiliary Instrument Compartments

Auxiliary instrument compartments are the same size as circuit breaker compartments. Typical auxiliary instrument compartments contain control power transformers, control components, meters, relays, and other optional devices. Circuit monitor displays and other metering devices can be mounted on the door.

Figure 11: Typical Auxiliary Instrument Compartment



Auxiliary Sections

Optional, full-height, auxiliary sections with hinged front doors are available that can be bolted to feeder and main switchgear sections. In addition, auxiliary sections can be provided with through bus as needed.

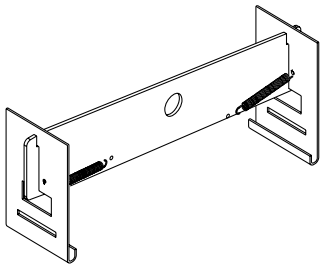
Key Locks and Padlocks

Optional key locks and padlocks can be provided for the door latches on circuit breaker compartments, auxiliary instrument compartments, auxiliary sections, and the rear doors on switchgear sections.

Moving and Handling Options

Whether configured as a single unit or as multiple units assembled together within a shipping group Power-Zone 4 switchgear enclosures are designed to withstand the rigors of lifting, handling, shipping, and setting into place. Maximum sizes are determined by shipping dimensions required for transportation on common carrier trucks and movement through standard equipment location openings (door and portals).

Figure 12: Circuit Breaker Lifter Bar



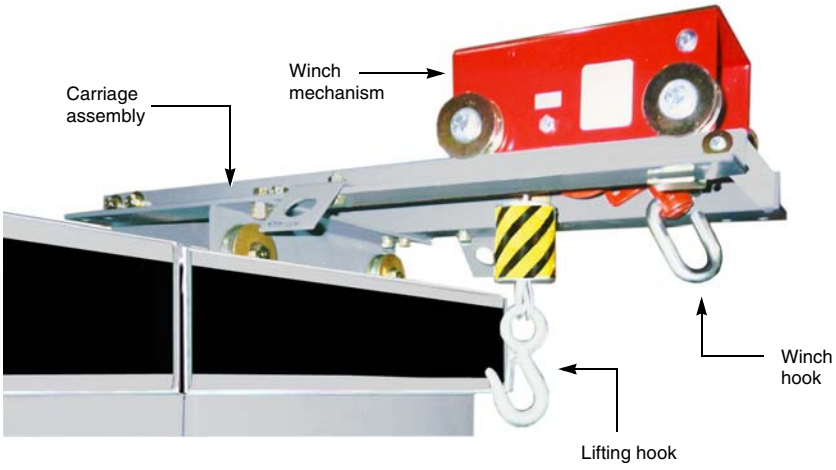
The circuit breaker lifter bar is used with both 3-pole and 6-pole Masterpact NW circuit breakers. The size of the circuit breaker determines whether the inside or outside notches on the lifter bar will be used.

Traveling Lifter Assembly

A rail-mounted, traveling type, circuit breaker lifting device is optionally available with indoor type switchgear. The lifting device is capable of lifting Masterpact NW or NT circuit breakers into and out of any compartment. The circuit breaker is raised or lowered by manually cranking the hoisting mechanism. The manually operated traveling lifter assembly is supplied with outdoor walk-in enclosures as standard.

NOTE: The lifting device is not available on enclosures with drip hoods.

Figure 13: Rail-mounted Circuit Breaker LIfting Device



Floor Crane (Not Pictured)

A floor crane can move into and out of any compartment, and can be used with the lifter bar to move a Masterpact circuit breaker into a dedicated work area.

NOTE: The floor crane can not be used in the outdoor walk-in enclosures.

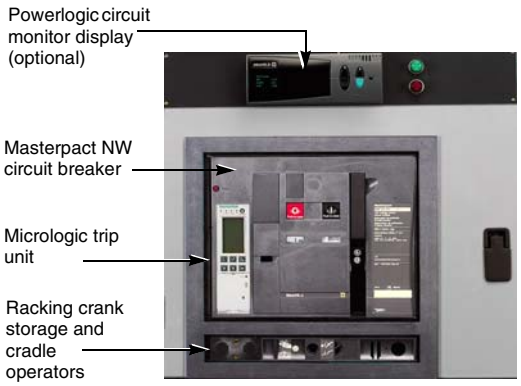
Masterpact Circuit Breakers

The primary component of the Power-Zone 4 switchgear are the Masterpact NW and NT circuit breakers. The drawout circuit breaker design allows easy access to circuit breaker controls, indicators, and the trip unit without opening the circuit breaker compartment door.

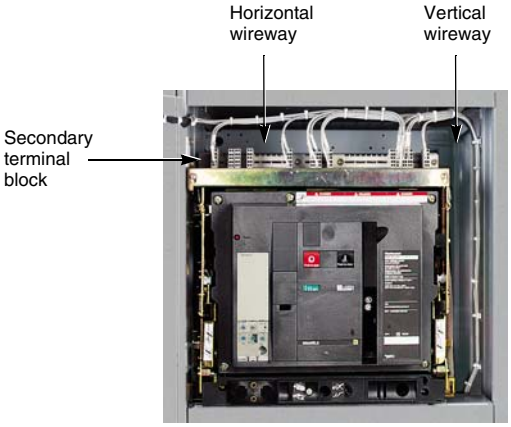
Masterpact NT/NW circuit breaker features and benefits:

- Through-the-door construction with front-accessible key interlocks
- Buttons
- Indicators
- Individually-mounted
- ANSI rated,
- Four-position
- Low voltage power circuit breakers
- Up to 200 kA interrupting rating without fuses (NW)
- 42kA at 480 volts (NT)
- 100% rated, two-step stored energy mechanism
- 800 A–5000 A frame (NW)
- 800 A frame (NT)
- Field-installable, Micrologic trip units with optional Powerlogic, communications and monitoring features
- Enhanced functionality with low maintenance requirements

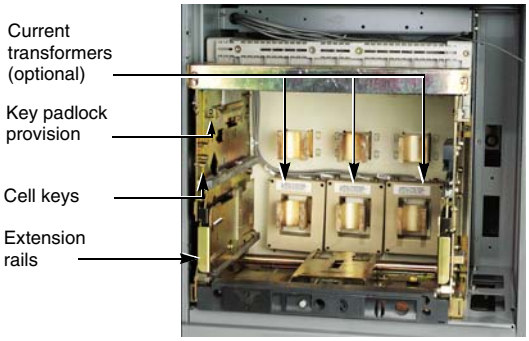
Figure 14: Through-the-Door Construction



Through-the-Door Access



Circuit Breaker Compartment



Circuit Breaker Compartment with Current Transformers

Through-the-Door Construction

The closing and opening push buttons, the racking handle, and racking mechanism are accessible through the front door cutout, allowing circuit breaker operation and disconnection without opening the door. Optional shutters (see "Secondary Wiring System" on page 18) can be provided, covering live parts when the circuit breaker is removed.

Masterpact NW and NT circuit breakers meet ANSI interlock requirements, including closing spring interlocking.

Circuit Breaker Compartment

The circuit breaker compartment consists of the circuit breaker cradle, a horizontal secondary terminal block on top of the cradle, and a vertical wireway on the right side of the compartment allowing for top and bottom customer wiring. The cradle structure is a bolted-in assembly that supports the circuit breaker. Integrated into the cradle are the circuit breaker interference interlocks or cell keys.

Cell keys are steel pins on the left side of the cradle. As the circuit breaker is pushed into the compartment, the bracket on the circuit breaker moves past a corresponding bracket on the cradle. If the circuit breaker is not matched correctly for the compartment, the brackets will interfere and the circuit breaker will not go into the compartment. Cell keying is a standard Power-Zone 4 switchgear feature.

The racking crank storage hole, racking crank hole, and “Push Stop Release” button are on the bottom of the cradle. Circuit breaker racking is achieved with the circuit breaker compartment door closed.

When required for metering, optional current transformers are positioned around the stationary main contacts.

Interrupting and Short-Time (Withstand) Capability

Power-Zone 4 switchgear with Masterpact NW circuit breakers have the highest interrupting (200,000 A at 480 V without using fuses) and short-time (withstand) ratings for low voltage switchgear in the smallest physical size. The small switchgear footprint and the elimination of limiters reduces cost. The Masterpact NW and NT circuit breakers' wide range of coordination with downstream devices increases system uptime.

Masterpact NW circuit breakers are available in various levels of interrupting ratings (AIR). See "Masterpact NW and NT Circuit Breaker Interrupting Rating" on page 39.

NOTE: Circuit breakers of like frame sizes and interrupting ratings are interchangeable.

Circuit Breaker Types

Figure 15: Family of Masterpact Circuit Breakers (800 A–5000 A)

NW08, NW16, NW20, NW32 (800 A–3200 A) N1, H1, H2

NW08, NW16 (800 A–1600 A) L1, L1F

NW20 (2000 A) L1, L1F-Feeder

Number	Amperes
NW08N1 NW08H1 NW08H2 NW08L1 NW08L1F	800
NW16N1 NW16H1 NW16H2 NW16L1 NW08L1F	1600
NW20H1 NW20H2 NW20L1 NW08L1F	2000
NW32H1 NW32H2 NW32L1	3200
NW40H2 NW40L1	4000
NW50H2 NW50L1	5000
NT08N1	800

NW40, NW50 (4000 A–5000 A) H2, L1

NW20, NW32 (2000 A–3200 A) L1

NT08N1 (800 A)

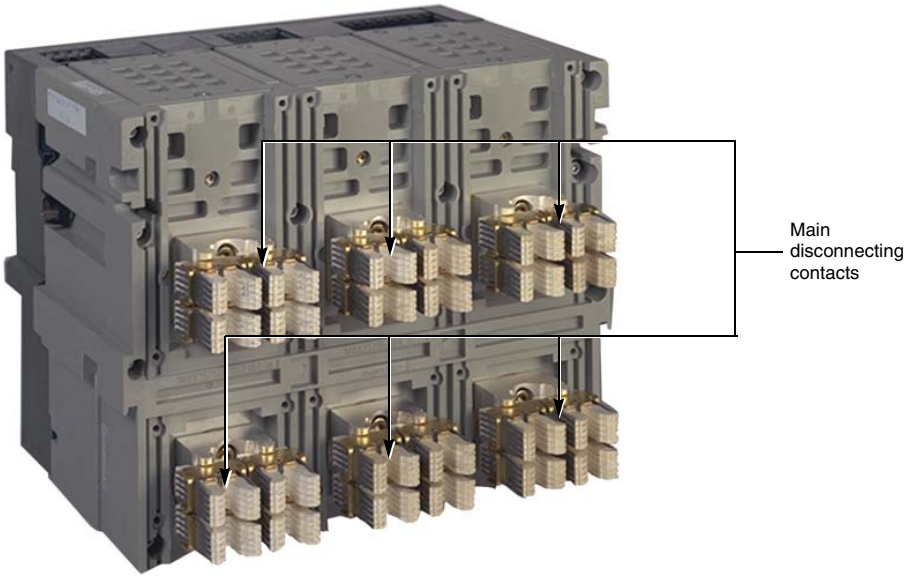
Circuit Breaker Parts

The Masterpact® NW circuit breaker has fewer parts than conventional circuit beakers while performing the same functions.

Figure 16: Masterpact NW Circuit Breaker (Front and Side View)

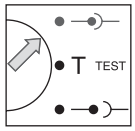
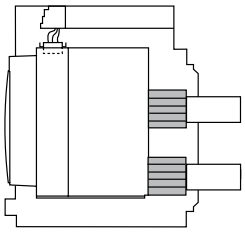
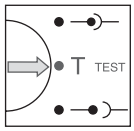
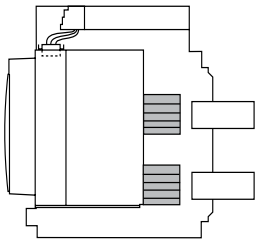
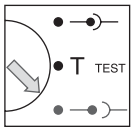
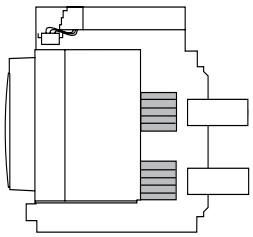
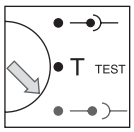
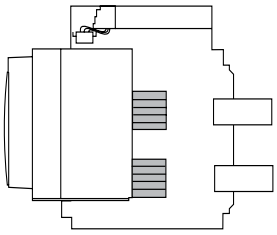
The main disconnecting contacts on the rear of the circuit breaker are spring loaded and self-aligning. These contacts are designed so the pressure at the point of contact on the stationary connectors becomes greater under short-circuit conditions.

Figure 17: Masterpact NW Circuit Breaker (Rear View)



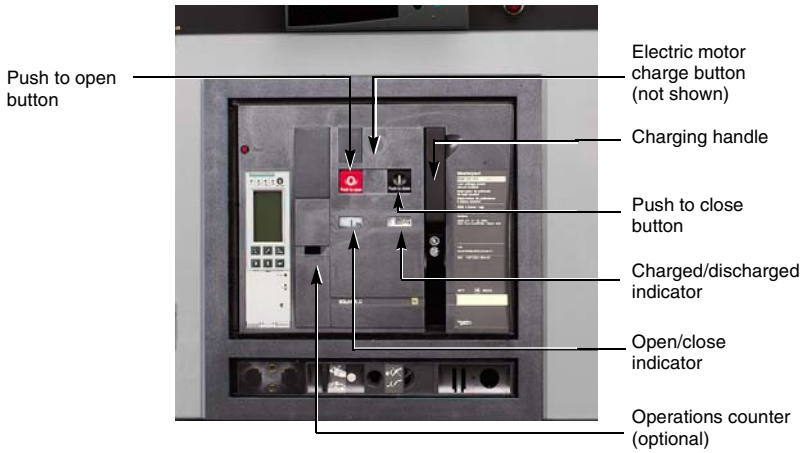
Circuit Breaker Operation

Power-Zone 4 switchgear with Masterpact NW and NT circuit breakers has through-the-door circuit breaker racking. The connect, test, and disconnect positions can be made with the circuit breaker compartment door closed.

Through-the-Door Circuit Breaker Position (side view)		Primary Connectors	Secondary (Control) Connectors	Circuit Breaker Functionality	Circuit Breaker Door Position
Connect 		Engaged	Engaged	a) Can be operated mechanically and electrically. b) Ready for service.	Closed
Test 		Disengaged	Engaged	a) Can be operated mechanically and electrically. b) Can have operation and control systems tested.	Closed
Disconnect 		Disengaged	Disengaged	a) Can not be operated remotely. b) Can not be removed from circuit breaker compartment.	Closed
Remove 		Disengaged	Disengaged	a) Can not be operated remotely. b) Can be removed from circuit breaker compartment.	Open Circuit breaker is fully extended on rails.

Two-Step Stored Energy Mechanism

Figure 18: Charging the Closing Springs



Masterpact NW and NT circuit breakers are stored energy devices with a two-step operating mechanism.

Electrically operated circuit breakers have a motor to charge the stored energy mechanism, electric close feature, and electric open feature.

On manually operated circuit breakers, the closing springs are charged by hand. For electrically operated circuit breakers, the springs are charged by an internal electric motor, but can also be manually charged if no control power is available.

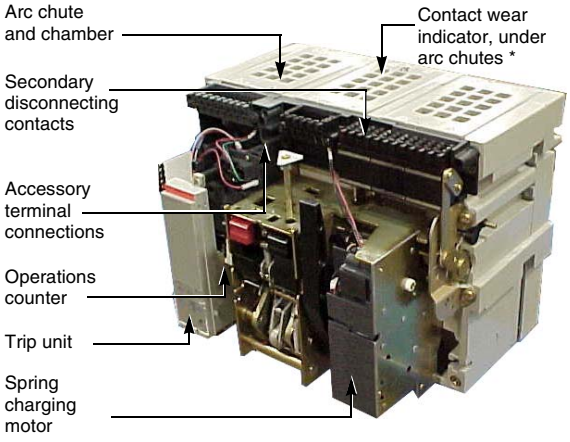
Status indicators on the front of the circuit breaker indicate when the closing springs are charged or discharged.

Circuit Breaker Inspection

When a Masterpact NW or NT circuit breaker is withdrawn on its rails, the circuit breaker is accessible for visual inspection. It is easy to remove the arc chutes and visually inspect the contacts and wear indicator. The operations counter can also indicate when inspections and possible maintenance should be done.

Figure 19: Masterpact NW Circuit Breaker

Masterpact NW Circuit Breaker on Its Rails



Masterpact NW Circuit Breaker Front Plate Removed

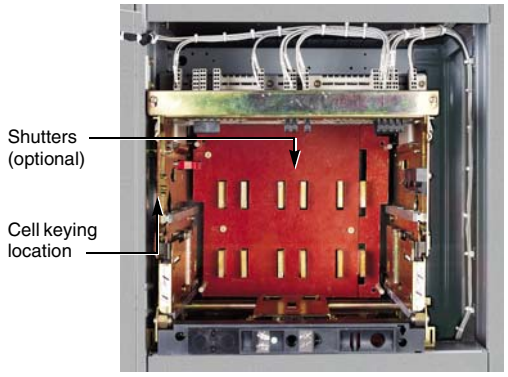
Removable, replaceable, and upgradeable circuit breaker parts include:

- Arc chutes
- Main disconnecting contacts or clusters
- Internal movable contacts
- Spring charging motor
- Trip unit

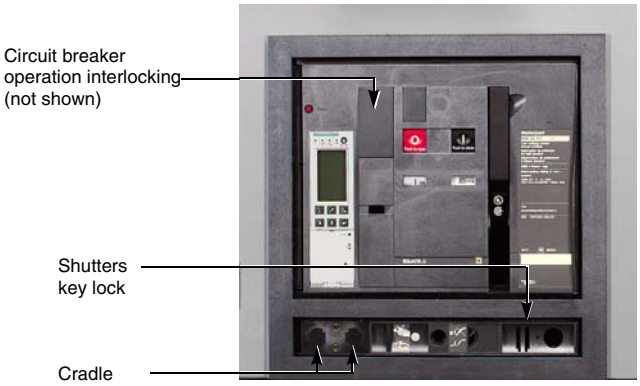
* The contact wear indication is available on Micrologic P and H trip units.

Circuit Breaker and Equipment Accessories

A number of Masterpact NW and NT circuit breaker accessories are available with Power-Zone 4 switchgear. A few of the most common accessories are listed below.



Circuit Breaker Compartment



Masterpact NW Circuit Breaker

NOTE: Refer to the Masterpact® NW and NT circuit breaker catalog for additional information.

Shutters:

Optional shutters in the cradle automatically block access to the main disconnects when the circuit breaker is in the disconnect, test, or remove position. An optional padlock attachment to lock shutters closed is also available.

Key Interlocks, Key Locks, and Padlocks:

Optional key interlocking can be provided with Masterpact NW and NT circuit breakers. Key interlocking capability is available for circuit breaker operation and the cradle.

Key interlock operation is outlined in the Power-Zone 4 switchgear order assembly drawings. To facilitate installation procedures, a key is supplied with each lock. After Installation, only the necessary keys called out on the key interlock diagrams should be present on the switchgear.

Cell Keying:

Cell keying, a standard feature on Power-Zone 4 switchgear, is provided to avoid insertion of circuit breakers with similar dimensions, but insufficient interrupting ratings, or incorrect frame sizes into an inappropriate circuit breaker compartment.

Auxiliary Switches:

A family of auxiliary switches that include:

- Open and close position switches (OF)
- Connected and closed position switches (EF); also known as cell switches
- Cradle position switch (CE, CD, CT)

Field-installable and Upgradeable Options:

A family of field-installable coils, buttons, motors, connectors, and trip units that include, but are not limited to:

- Trip units with or without Powerlogic® monitoring capabilities (see pages 29–30)
- Opening and closing coils (MX, XF)
- Additional shunt trip unit (MX)
- Undervoltage release (MN)
- Spring charging motor (MCH)
- Sensor plug

Micrologic® Trip Units

A new family of field-installable trip units is available with Masterpact® NW and NT circuit breakers. The circuit breaker overcurrent protection consists of a solid-state, microprocessor-based tripping device that requires no external power source. The complete tripping system has three main components: the molded sensors, the trip device (with rating plug), and the trip actuator. The microprocessor-based trip unit uses true RMS current level sensing. For additional information, refer to the trip unit functionality matrix on page 41.

When a Masterpact NW or NT circuit breaker is closed, no external power is required for the protection system. The trip unit is powered by current signal levels and current sensors integrally mounted in the Masterpact NW or NT circuit breaker. All trip units are UL Listed for use in Masterpact NW or NT circuit breakers.

Basic Trip Unit

Micrologic Basic Trip Unit

Standard Trip Features:

- True RMS sensing
- LI trip configuration
- Field interchangeable long-time rating plugs
- LED long-time pickup indication
- Thermal imaging

Available Options:

- LSI trip configuration
- Test kits

Type A (Ammeter) Trip Unit

Micrologic Type A Trip Unit

Standard Trip Features:

- True RMS sensing
- LI trip configuration
- Field interchangeable long-time rating plugs
- LED long-time pickup indication LSIG trip configurations
- Digital ammeter–phase and neutral
- Phase loading bar graph
- LED trip indication
- Zone selective interlocking (ZSI) with short-time and ground fault
- Thermal imaging

Available Options:

- LSI trip configuration
- LSIG (ground fault trip)
- Test kits

Available Powerlogic® Features:

- Amps metering
- Circuit breaker open/close trip status
- Tripping curves

Type P (Power Metering) Trip Unit

Micrologic Type P Trip Unit

Standard Trip Features:

- All standard features of Micrologic Type A trip unit
- LSI trip configuration
- Incremental “fine tuning” of L, S, I, and, when selected, G pickup and delay settings
- LCD dot matrix display and LED trip indication
- Advanced user interface
- Advanced user protection (includes, but not limited to):
  - over/under voltage
  - over/under frequency
- IDMTL: selectable long-time delay bands
- Thermal imaging
- Power measurement
- Contact wear indication
- Temperature indication
- Zone selective interlocking (ZSI) with short-time and ground fault

Available Options:

- LSIG (ground fault trip with programmable ground fault alarm)
- Test kits

Available Powerlogic Features:

- Amps metering
- Volts metering
- Energy accumulation
- Remote operation
- Circuit breaker open/close trip status
- Date/time stamping

Type H (Harmonics) Trip Unit

Micrologic Type H Trip Unit

Standard Trip Features:

- All standard features of Micrologic Type P trip unit
- Advanced power measurements functions
- Fault waveform capture

Available Options:

- LSIG (ground fault trip) with programmable ground fault alarm
- Zone selective interlocking (ZSI) with short-time and ground fault
- Test kits

Available Powerlogic Features:

- Amps metering
- Volts metering
- Energy accumulation
- Remote operation
- Waveform capture
- Data logging
- Circuit breaker open/close trip status
- Power quality measurements
- Harmonics measurements through 51st
- Date/time stamping

NOTE: Refer to the Masterpact® NW/NT circuit breaker catalog for detailed information about the family of Micrologic trip units.

Powerlogic System

Power-Zone 4 switchgear is available with Powerlogic® metering, data acquisition, and control system features. The Powerlogic system is used in conjunction with Micrologic® Type A, Type P, and Type H trip units for the Masterpact NW and NT circuit breakers. The complete system is comprised of several devices including: circuit monitors, power meters, trip units, programmable logic controllers, digital relays, transformer temperature controllers, I/O, lighting control, and more. System Manager Software is available to work in conjunction with these devices to manage and control an electrical distribution system.

Modbus® industry standard data communications allow the Powerlogic system to replace discrete meters, multiple transducers, analog wires, and analog-to-digital conversion equipment. Extensive information can be transmitted over a single communications cable to a Powerlogic system display, a personal computer, programmable logic controller, or other host system.

The following Micrologic trip units are Powerlogic compatible:

- Type A
- Type P
- Type H

Basic circuit information, such as amperes, can be monitored using the Micrologic Type A trip unit. Circuit breaker remote operation is available using the Micrologic types P, and H trip units with Powerlogic functionality. For additional information, see the trip unit functionality matrix on page 41. For more sophisticated metering, power quality monitoring, data acquisition and control, Powerlogic circuit monitors may also be used.

Micrologic Trip Unit System Summary

In addition to its metering capabilities, the Micrologic trip unit system is available with optional status inputs and relay outputs for monitoring discrete contacts and remote control of devices by way of the data communications channel.

Micrologic trip unit metering functions include:

- Amperes and volts
- Frequency
- Power
- Power demand
- Energy
- Energy demand
- Power factor
- Power quality measurements
- Communications
- Fault waveform capture
- Waveform capture
- Data logging
- Programmable contacts

Micrologic trip unit relaying functions include:

- Current unbalance
- Over/under voltage
- Over/under frequency
- Voltage unbalance
- Phase loss
- Phase sequence
- Reverse power

Masterpact NW/NT circuit breaker maintenance information:

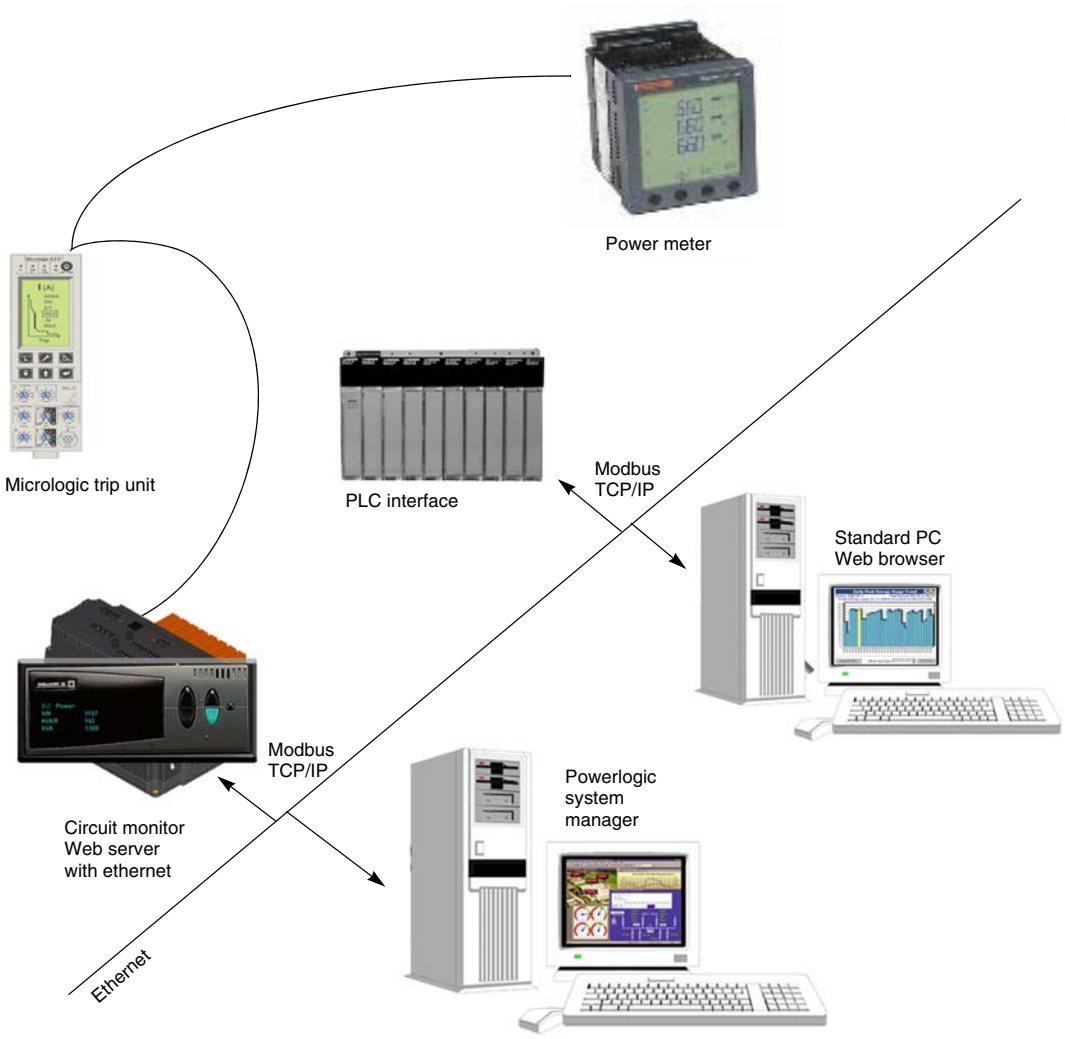
- Thermal imaging
- Contact wear indicator
- Temperature indication

System Communications

The Powerlogic®, monitoring system, as well as Transparent Ready® Web Enabled (TRE) equipment, is available, as an option, with Power-Zone 4 switchgear.

The Powerlogic power monitoring and control systems, and (TRE) systems use a high-performance ethernet backbone with Modbus® communications. Information about the switchgear and its components is passed to and from a local or remote computer system using Powerlogic Modbus data communications.

Figure 20: Powerlogic Data Communications System / TRE



System Components

Powerlogic® system components and additional features are listed below.

Powerlogic System Components:

- System Manager Software
- Powerlogic ethernet gateway
- NOE ethernet card
- TCP/IP Modbus®
- PLCs
- Circuit monitor
- Power meters
- Automatic control
- Digital relay
- Motor protection
- Transformer module
- Micrologic® trip units

Available Powerlogic Features:

- Custom software applications
- Communication interfaces

Circuit Monitors

Powerlogic circuit monitors provide highly accurate meter readings along with disturbance monitoring, analog and digital I/O, onboard logging, and more. Circuit monitors can be mounted on Power-Zone 4 switchgear, auxiliary instrument compartments, and auxiliary sections.

Figure 21: Powerlogic Circuit Monitor Display

Detailed information about the Powerlogic system and components can be found in the Powerlogic monitoring and control system catalogs.

ARC FLASH PROTECTION WITH MASTERPACT NW CIRCUIT BREAKERS

What is an Arc Flash?

An arc flash occurs when insulation or isolation between electrified conductors is breached or can no longer withstand the applied voltage. As employees work on or near energized conductors or circuits, movement near or contact with the equipment (or a failure of the equipment) may cause a phase-to-ground and/or a phase-to-phase fault. Temperatures of more than 5,000 degrees Fahrenheit and a powerful explosion can be produced in an arc flash incident. The Occupational Safety and Hazard Administration (OSHA) has begun to enforce the NFPA 70E safety guidelines for arc flash safety. The guidelines:

- provide analysis detailing arc flash incident energy, boundary distances, and the Personal Protective Equipment (PPE);
- state that PPE must be provided;
- mandate proper worker training;
- provide procedures for safe work practices;
- state that tools for a safe work environment must be provided; and
- state that equipment be installed in accordance with the safety requirements of the *National Electrical Code*.

Masterpact NW Circuit Breaker Technology

Breakthrough technology was used to design the new Masterpact® NW circuit breakers to interrupt large amounts of fault current without being protected by fuses. The same technology and design that allows the Masterpact NW and NT circuit breakers to interrupt large fault currents without fuses also provides very good arc flash limitation. The decision to design the Masterpact NW to eliminate the need for fuse protection is based on the following:

- Requirements for smaller footprints and space-saving installations;
- Avoidance of fuse installation, maintaining supplies, and the need to enter the equipment in order to check and change fuses;
- The need to be adjustable to provide coordination with downstream products and better arc flash protection.

Advantages of using Masterpact breakers and Power-Zone 4 switchgear when there are Arc Flash concerns:

- Arc Flash limiting feeder breakers up to 2000A reduce arc incident energy on downstream equipment such as motor control centers (MCC's) and power distribution panels (PDP's).
- Through-the-door breaker operation allows unit to be operated/racked while door is closed, this reduces NFPA 70E PPE category by one level.
- Optional rear hinged doors allow easy access to cables, this reduces NFPA 70E 2004 PPE category by one level.
- Masterpact arc flash breaker equations are easily inserted into software packages such as SKM Analysis to get these testing results.

For further information on applying Masterpact breakers for arc flash protection, refer to data bulletins 0613DB0202 and 0100DB0402.

Calculating Arc Flash Incident energy using Masterpact NW L1F circuit breakers

Example 1:

Bolted fault currents at MCC is I_b = 17kA, bolted fault current at PDP is I_b = 40kA. Using the following Masterpact NW-LF equations from actual testing, we calculate the incident energy to be 1.15 cal/cm^2 at the MCC and 3.31 cal/cm^2 at the PDP. This allows workers to wear Class 0 and 1 PPE per NFPA 70E when working on or around energized parts. In addition to incident energy, flash protection boundaries can be calculated as well.

To calculate incident energy, use the following equations:

800 A NW-L Masterpact Circuit Breaker

- $E = 0.067 + 0.064 \times I_b$ for $15 \leq I_b \leq 42$ kA
- $E = 2.16 + 0.017 \times I_b$ for $42 < I_b \leq 100$ kA

1600 / 2000 A NW-L Masterpact Circuit Breaker

- $E = 1.43 + 0.047 \times I_b$ for $20 \leq I_b \leq 50$ kA
- $E = 2.70 + 0.020 \times I_b$ for $50 < I_b \leq 65$ kA

800 A NT-L Masterpact Circuit Breaker

- $E = 0.47 + 0.0036 \times I_b$ 0for $10 \leq I_b \leq 100$ kA

Where:

- E is incident energy in calories/cm^2
- I_b is available bolted fault current in kilocamperes at the location of interest
- Working distance is 18 inches (457 mm) from the point of arcing
- Instantaneous trip setting is set at maximum (lower settings may result in lower incident energy values)

To calculate a flash protection boundary, use the following equations:

800 A NW-L Masterpact Circuit Breaker

- $D_b = 245 + 12.5 \times I_b$ for $15 \leq I_b \leq 42$ kA
- $D_b = 667 + 2.63 \times I_b$ for $42 < I_b \leq 100$ kA

1600 / 2000 A NW-L Masterpact Circuit Breaker

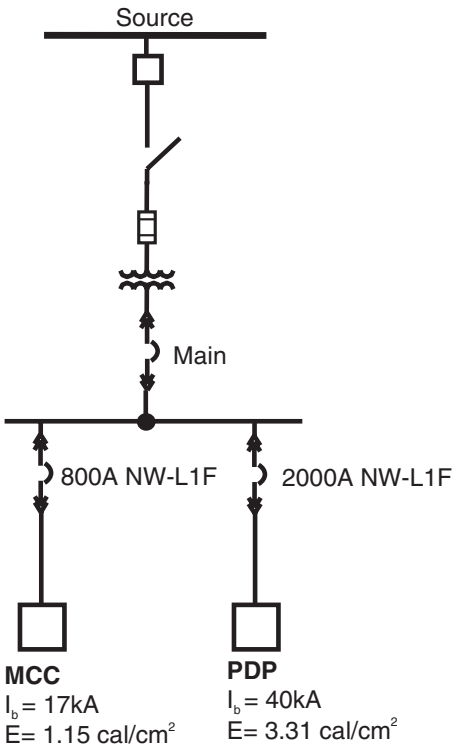
- $D_b = 541 + 7.6 \times I_b$ for $20 \leq I_b \leq 50$ kA
- $D_b = 775 + 2.92 \times I_b$ for $50 < I_b \leq 65$ kA

800 A NT Masterpact Circuit Breaker

- $D_b = 260 + 1.06 \times I_b$ for $10 \leq I_b \leq 100$ kA

Where:

- D_b is the flash protection boundary in millimeters
- I_b is available bolted fault current in kilocamperes at the location of interest
- Working distance is 18 inches (457 mm) from the point of arcing
- Instantaneous trip setting is set at maximum (lower settings may result in lower incident energy values)



Example 1

SECTION 3 : TECHNICAL OVERVIEW

SECTION CONTENTS

INTRODUCTION

This section contains basic technical information pertaining to the Power-Zone 4 switchgear, Masterpact® NW and NT circuit breakers, and Micrologic® trip units.

Power-Zone 4 Switchgear Ratings

Power-Zone 4 switchgear is industrial-duty equipment built to ANSI standards and uses 100% rated Masterpact NW and NT circuit breakers. Switchgear ratings are listed below.

Switchgear
120/208 to 600 Vac, 1Ø3W, 3Ø3W, or 3Ø4W
1600 A – 5000 A
50/60 Hz
up to 200 kA symmetrical short-circuit current

Bus Type	Continuous Amperes	Short-circuit current	Short-time Withstand
Cross	1600, 2000, 3200, 4000, 5000	65 kA, 85 kA, 100 kA, 130 kA, 200 kA	50 kA, 65 kA, 85 kA, 100 kA
Vertical	1600, 2000, 3200, 4000, 5000	65 kA, 85 kA, 100 kA, 130 kA, 200 kA	50 kA, 65 kA, 85 kA, 100 kA
Neutral	1600, 2000, 3200, 4000, 5000 NOTE: 50% ratings available	65 kA, 85 kA, 100 kA, 130 kA, 200 kA	50 kA, 65 kA, 85 kA, 100 kA

Masterpact NW and NT Circuit Breakers

This section contains basic Masterpact NW and NT circuit breaker interrupting, sensor, operating time, control power requirements, and switch ampere ratings. In addition, an overview of key interlock operation is described on page 41.

Ratings

Power-Zone 4 switchgear with Masterpact NW circuit breakers has the highest interrupting and short-time (withstand) ratings for low voltage switchgear in the smallest physical size. The small switchgear footprint and the elimination of limiters reduces cost. The circuit breaker's improved coordination with downstream devices increases system uptime.

Power-Zone 4 switchgear using Masterpact NT circuit breakers allows the use of up to eight (8) 800 A frame breakers in a single, 30-inch wide section. This lets the user maintain a high concentration of power protection devices in a small physical size.

Masterpact NW circuit breakers are available in various levels of interrupting ratings (AIR) as listed in Table 1: on page 39.

Table 1: Masterpact NW and NT Circuit Breaker Interrupting Rating

Trip Current Range	Circuit Breaker Model #	Instantaneous Trip Rating (A)			Short-time Trip Rating (A)		
		208 V–240 V (254 V Max.)	480 V (508 V Max.)	600 V (635 V Max.)	208 V–240 V (254 V Max.)	480 V (508 V Max.)	600 V (635 V Max.)
40–800	NW08N1	42,000	42,000	42,000	42,000	42,000	42,000
40–800	NW08H1	65,000	65,000	65,000	65,000	65,000	65,000
40–800	NW08H2	85,000	85,000	85,000	85,000	85,000	85,000
40-800	NW08H3	100,000	100,000	85,000	85,000	85,000	85,000
40–800	NW08L1[1]	200,000	200,000	130,000	30,000	30,000	30,000
40–800	NW08L1F	200,000	200,000	130,000	22,000	22,000	22,000
320–1600	NW16N1	42,000	42,000	42,000	42,000	42,000	42,000
320–1600	NW16H1	65,000	65,000	65,000	65,000	65,000	65,000
320–1600	NW16H2	85,000	85,000	85,000	85,000	85,000	85,000
320–1600	NW16H3	100,000	100,000	85,000	85,000	85,000	85,000
320–1600	NW16L1[1]	200,000	200,000	130,000	30,000	30,000	30,000
320–1600	NW16L1F	200,000	200,000	130,000	22,000	22,000	22,000
400–2000	NW20H1	65,000	65,000	65,000	65,000	65,000	65,000
400–2000	NW20H2	85,000	85,000	85,000	85,000	85,000	85,000
400–2000	NW20H3	100,000	100,000	85,000	85,000	85,000	85,000
400–2000	NW20L1[1]	200,000	200,000	130,000	30,000	30,000	30,000
400–2000	NW20L1F	200,000	200,000	130,000	22,000	22,000	22,000
640–3200	NW32H1	65,000	65,000	65,000	65,000	65,000	65,000
640–3200	NW32H2	85,000	85,000	85,000	85,000	85,000	85,000
640–3200	NW32H3	100,000	100,000	85,000	85,000	85,000	85,000
640–3200	NW32L1[1]	200,000	200,000	130,000	100,000	100,000	100,000
800–4000	NW40H2	85,000	85,000	85,000	85,000	85,000	85,000
800–4000	NW40H3	100,000	100,000	85,000	85,000	85,000	85,000
800–4000	NW40L1[1]	200,000	200,000	130,000	100,000	100,000	100,000
1000–5000	NW50H2	85,000	85,000	85,000	85,000	85,000	85,000
1000–5000	NW50H3	100,000	100,000	85,000	85,000	85,000	85,000
1000–5000	NW50L1[1]	200,000	200,000	130,000	100,000	100,000	100,000
40-800	NT08N1	42,000	42,000	N/A	42,000	42,000	N/A

[1] Note: L1 circuit breakers cannot be combined with N1, H1, or H2 circuit breakers within the same switchgear lineup.

Table 2: Various Sensor Capacities of Masterpact NW and NT Circuit Breakers.

Circuit Breaker Type		Sensor Rating (Amperes)
NW08N1 NWO8H1 NW08H2	NW08H3 NW08L1 NW08L1F	100, 250, 400, 600, 800
NW16N1 NW16H1 NW16H2	NW16H3 NW16L1 NW16L1F	800, 1200, 1600
NW20H1 NW20H2 NW20H3	NW20L1 NW20L1F	1200, 1600, 2000
NW32H1 NW32H2	NW32H3	1600, 2000, 2500, 3000, 3200
NW32L1		1600, 2000, 2500, 3000, 3200,
NW40H2 NW40H3	NW40L1	2000, 2500, 3000, 3200, 4000
NW50H2 NW50H3	NW50L1	2500, 3000, 3200, 4000, 5000
NT08N1		100, 250, 400, 600, 800

NOTE: Minimum sensor rating is 50% of frame rating (except for 800 A frame).

Table 3: Masterpact NW/NT Circuit Breaker Approximate Operating Time Ratings

Action	Time
Spring charging motor (MCH)	
Response time	70–80 milliseconds
Charging time	3–4 seconds (max)
Shunt trip (MX)	50 milliseconds
Shunt close (XF)	70–80 milliseconds

Table 4: Control Power-NW/NT Circuit Breakers and PZ-4 Switchgear Equipment

Action	Power Consumption
Spring Charging Motor Current (electrically operated circuit breakers)	180 VA
Closing coil (XF)	4.5 VA
Shunt trip coil (MX)	4.5 VA
Time delay under/voltage trip (MN)	20 VA
Status indicating lights (each)	2 VA
Circuit monitor	22 VA
Strip heater (each)	125 VA

Table 5: Approximate Ampere Ratings for Masterpact NW/NT Circuit Breaker Switches

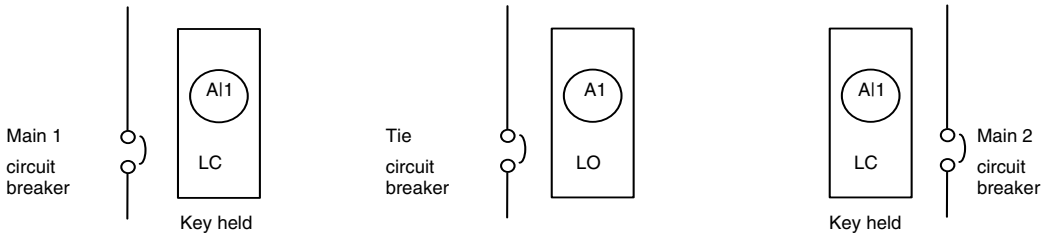
Action	Ampere (240 V)
Auxiliary switch (OF)	10 A
Overcurrent trip switch (SDE)	10 A
Combined (connect/close) switch (EF)	10 A
Cradle cell switch	10 A

Key Interlock Operation

As shown in the example below, a main-tie-main manual key interlock scheme is designed to keep all three circuit breakers from being closed simultaneously. Only two of the three circuit breakers can be closed simultaneously.

NOTE: Spare keys should be removed and kept safely stored and under the control of responsible supervision.

Figure 22: Main-Tie-Main Key Interlocking



Main 1 and main 2 circuit breakers are closed with their keys placed in the lock cylinders. The tie circuit breaker is locked open; a key is required to unlock it and put the circuit breaker into service.

The main 1 circuit breaker is opened and taken out of service. It is locked open, permitting key A1 to be removed to operate the lock associated with the tie circuit breaker. Then the main 1 circuit breaker cannot be put into service and closed until either the tie circuit breaker, or the main 2 circuit breaker, is opened and locked out of service. This would free one key for use in unlocking the main 1 circuit breaker.

Micrologic Trip Units

Micrologic® trip unit ratings, functionality, and curves are listed below.

Ratings

Standard Micrologic adjustable trip settings, including time/current characteristics, pickup settings, pickup points, and time band in seconds are listed below.

Time/Current Characteristic	Pickup Setting	Pickup Point [a]	Time Band, Seconds
Long-time Delay	0.4, 0.45, 0.5, 0.625, 0.7, 0.8, 0.9, 1.0	I_n Times Long-time Delay Setting	0.5, 1, 2, 4, 8, 12, 16, 20, 24 (at 6 times pickup value)
Instantaneous	2, 3, 4, 6, 8, 12, 15, OFF	I_n Times Instantaneous Setting	
Short-time Delay	1.5, 2, 2.5, 3, 4, 5, 6, 8,10	I_r Times Short-time Delay Setting	0.0, 0.1, 0.2, 0.3 (Flat Response) 0.0, 0.1, 0.2, 0.3, 0.4 (I^2t Response)
Ground Fault	A (0.3), B (0.3), C (0.4), D (0.5), E (0.6),F (0.7), G (0.8), H (0.9), J(1.0) (1200 A Max.)	I_n Times Ground Fault Setting	0.0, 0.1, 0.2, 0.3, 0.4 (Flat Response) 0.0, 0.1, 0.2, 0.3, 0.4 (I^2t Response)

[a] I_n = Sensor Plug Value I_r = Long Delay Pickup Setting X I_n

Functionality

The table below lists the standard and optional trip unit features for Micrologic Type A (Ammeter), Type P (Power Metering), and Type H (Harmonics) trip units for use in Power-Zone 4 switchgear.

Functions	Basic	Type A	Type P	Type H
True RMS sensing	X	X	X	X
LI trip configuration	X	X	X	X
LSI	O	O	X	X
LSIG/ground fault trip	–	O	X	X
Ground fault alarm (no trip)	–	–	X	X
Ground fault trip and programming alarm	–	–	O	O
Adjustable rating plugs	X	X	X	X
LED – long–time pickup	X	X	X	X
LED – trip indication	–	X	X	X
Digital ammeter	–	X	X	X
Phase loading bar graph	–	X	X	X
Zone selective interlocking	–	X	X	X
Communications	–	O	X	X
LCD dot matrix display	–	–	X	X
Advanced user interface	–	–	X	X
Protective relay functions	–	–	X	X
Thermal imaging	–	–	X	X
Contact wear indication	–	–	X	X
Temperature indication	–	–	X	X
Incremental fine tuning of settings	–	–	X	X
Selective long-time delay bands	–	–	X	X
Power measurement	–	–	X	X
Waveform capture	–	–	–	X
Data logging	–	–	–	X

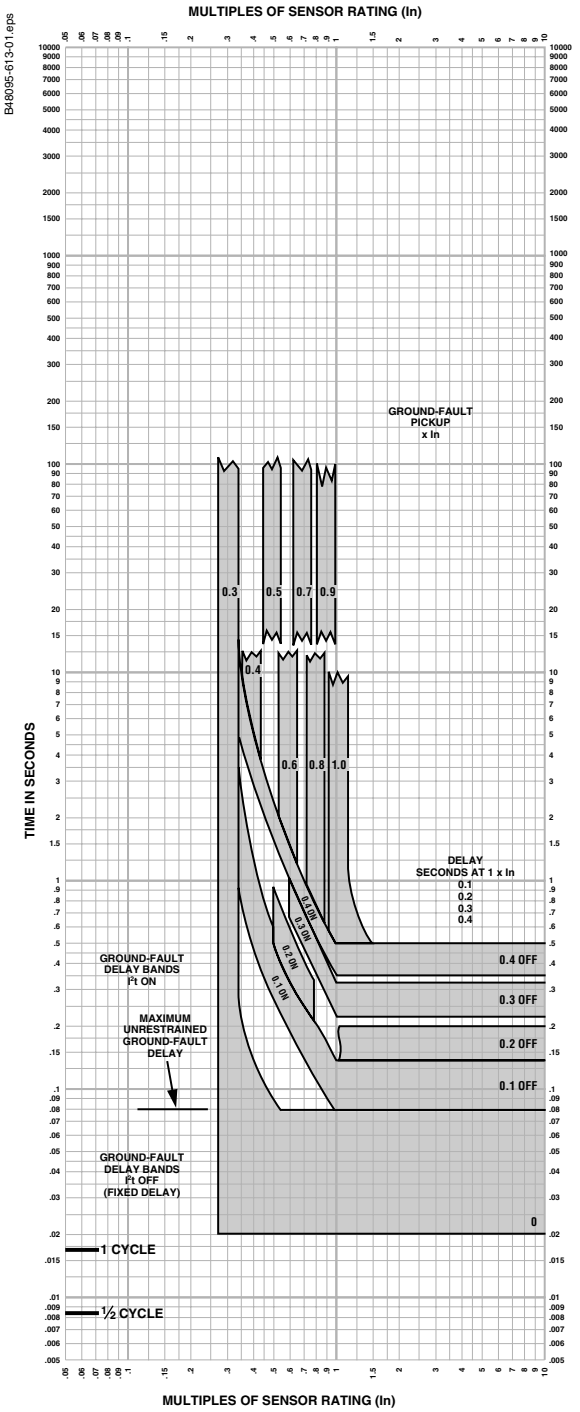
Table Values:

–	Not Applicable
X	Standard Feature
O	Optional Feature

Trip Curves

This section contains typical characteristic trip curves for Micrologic trip units in Power-Zone 4 switchgear. Detailed information about Micrologic trip units can be found in the Masterpact NW circuit breaker catalog.

Figure 23: Typical Micrologic 6.0 A/P/H Trip Units with Adjustable Ground-fault Pickup and Delay (Ground Fault I^2t OFF and ON / $I_n \leq 400$ A)



MICROLOGIC 6.0 A/P/H Trip Units with Adjustable Ground-fault Pickup and Delay

Characteristic Trip Curve No. 613-1

Ground Fault I^2t OFF and ON

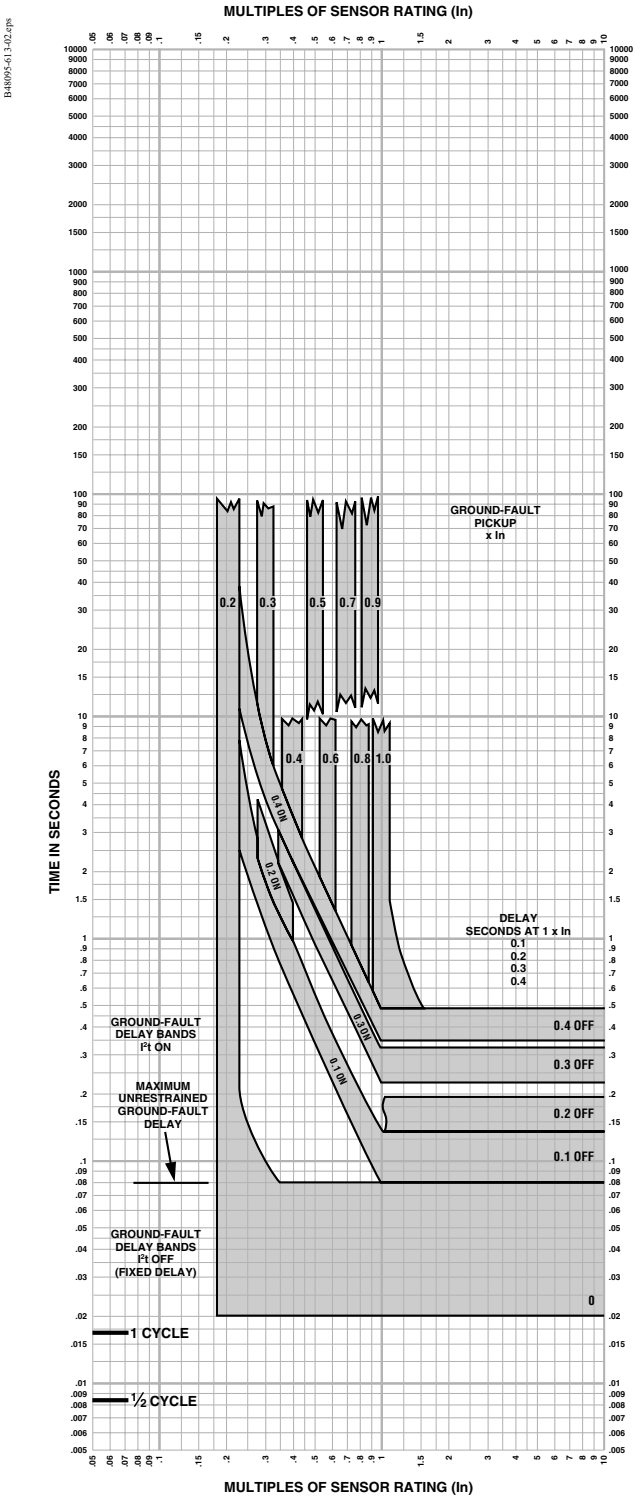
$I_n \leq 400$ A

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C (-22°F to +140°F) ambient temperature.

Curve No. 0613TC0001
Drawing No. B48095-613-01

Figure 24: Typical Micrologic 6.0 A/P/H Trip Units with Adjustable Ground-fault Pickup and Delay (Ground Fault I^2t OFF and ON / 400 A < I_n ≤ 1200 A)



Micrologic 6.0 A/P/H Trip Units with Adjustable Ground-fault Pickup and Delay

Characteristic Trip Curve No. 613-2

Ground Fault I^2t OFF and ON

400 A < I_n ≤1200 A

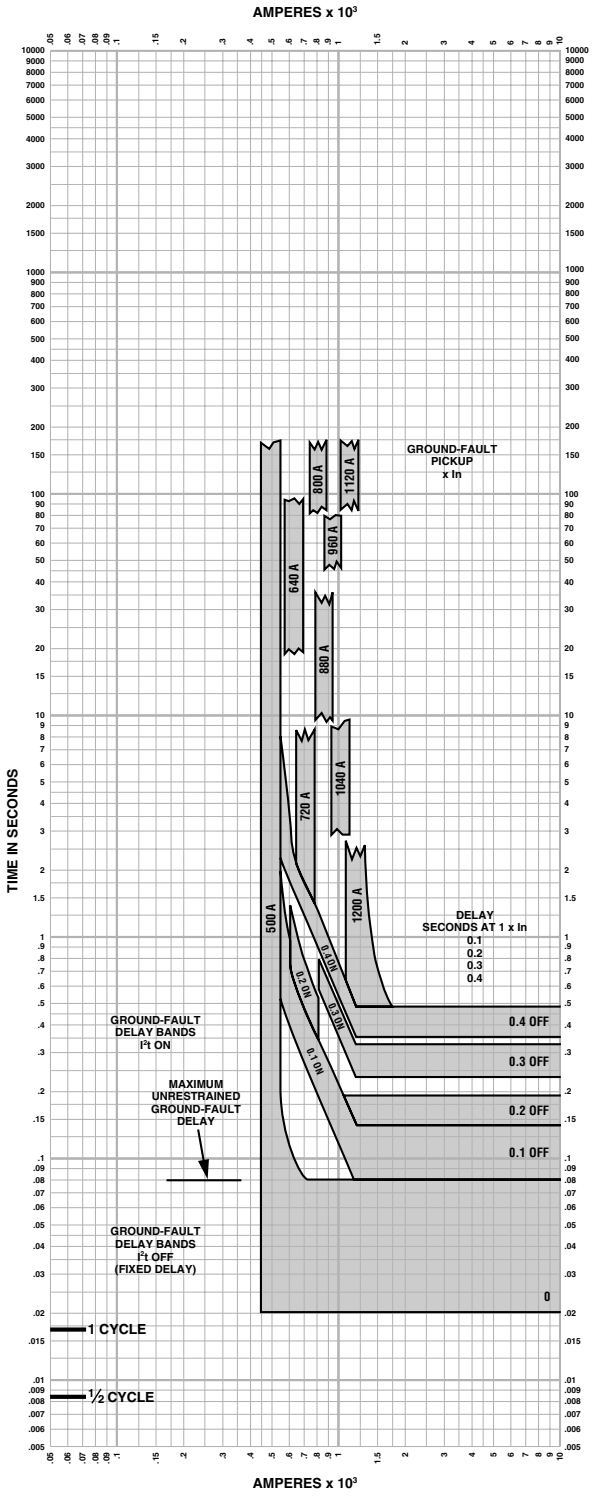
The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C (-22°F to +140°F) ambient temperature.

Curve No. 0613TC0002
Drawing No. B48095-613-02

Figure 25: Typical Micrologic 6.0 A/P/H Trip Units with Adjustable Ground-fault Pickup and Delay (Ground fault I^2t OFF and ON / I_n > 1200A)

B48095-613-03.eps



Micrologic 6.0 A/P/H Trip Units with Adjustable Ground-fault Pickup and Delay

Characteristic Trip Curve No. 613-3

Ground Fault I^2t OFF and ON

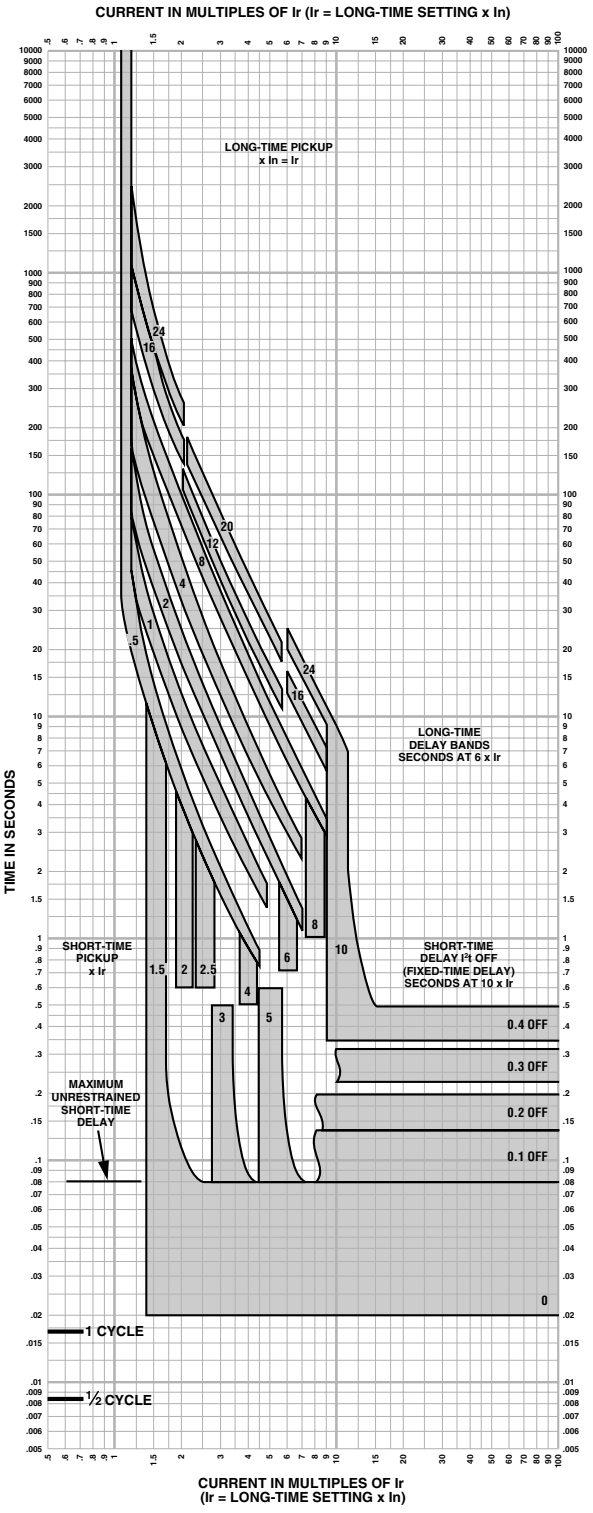
I_n > 1200 A

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C (-22°F to +140°F) ambient temperature.

Curve No. 0613TC0003
Drawing No. B48095-613-03

Figure 26: Typical Micrologic 5.0/6.0 A/P/H Trip Units (Long-time Pickup and Delay / Short-time Pickup and I^2t OFF Delay)



Curve No. 0613TC0004
Drawing No. B48095-613-04

Micrologic 5.0/6.0 A/P/H Trip Units

Characteristic Trip Curve No. 613-4

Long-time Pickup and Delay
Short-time Pickup and I^2t OFF Delay

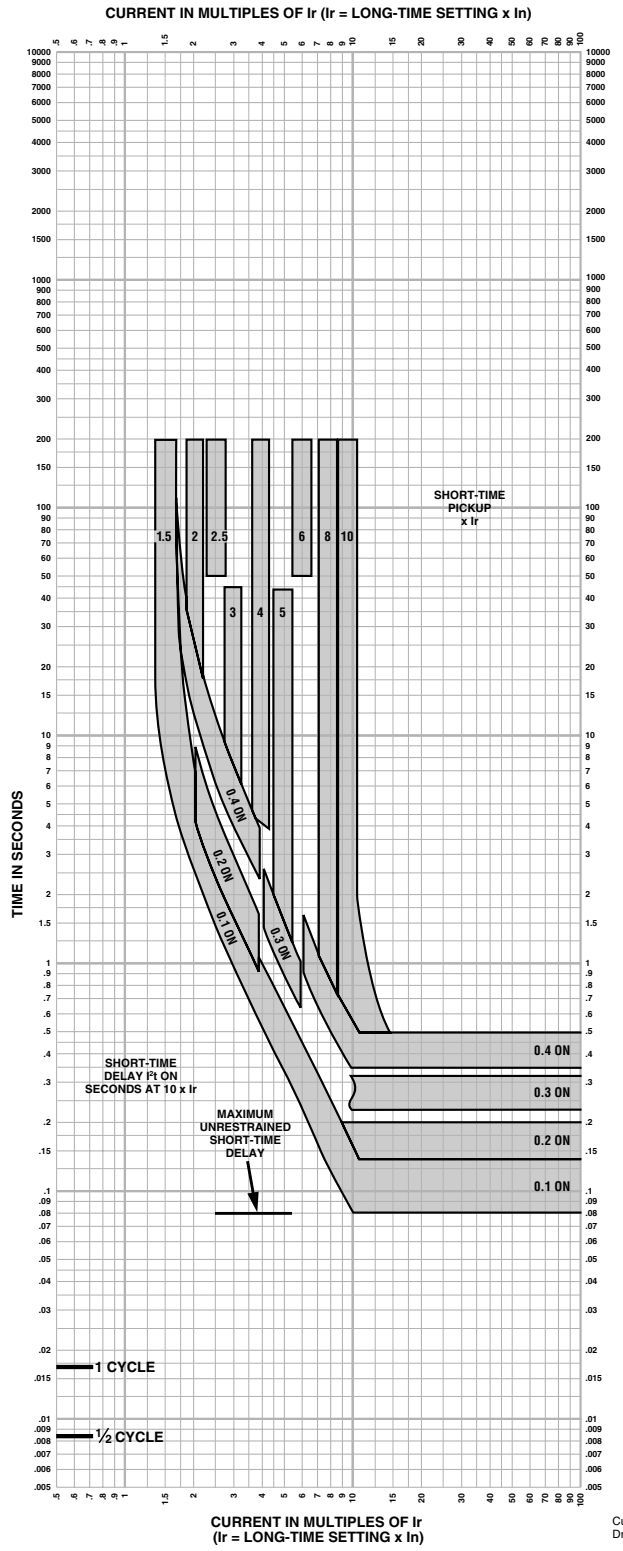
The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C (-22°F to +140°F) ambient temperature.

NOTE:

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately twenty minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the interrupting rating of the circuit breaker.
3. With zone-selective interlocking ON, short-time delay utilized, and no restraining signal, the maximum unrestrained short-time delay time band applies regardless of the setting.
4. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.
5. For a withstand circuit breaker, instantaneous can be turned OFF. See trip curve 613-7 for instantaneous trip curve. See trip curve 613-10 for instantaneous override values.
6. Overload indicator illuminates at 100%.

Figure 27: Typical Micrologic 5.0/6.0 A/P/H Trip Units (Short-time Pickup and I^2t ON Delay)



Micrologic 5.0/6.0 A/P/H Trip Units

Characteristic Trip Curve No. 613-5

Short-time Pickup and I^2t ON Delay

The time-current curve information is to be used for application and coordination purposes only.

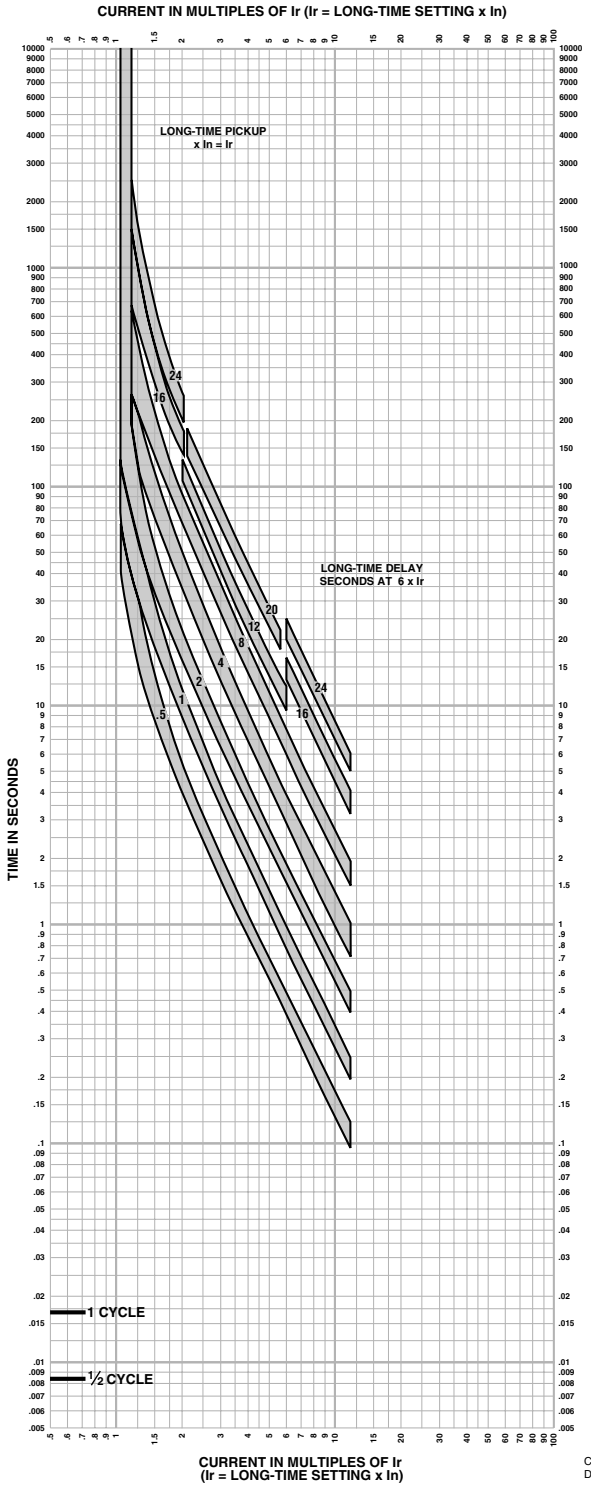
Curves apply from -30°C to +60°C (-22°F to +140°F) ambient temperature.

NOTE:

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately twenty minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the interrupting rating of the circuit breaker.
3. With zone-selective interlocking ON, short-time delay utilized, and no restraining signal, the maximum unrestrained short-time delay time band applies regardless of the setting.
4. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of current.
5. For withstand circuit breaker, instantaneous can be turned OFF. See trip curve 613-7 for instantaneous trip curve. See trip curve 613-10 for instantaneous override values.
6. See Trip Curve 613-4 for long-time pickup and delay trip curve.

Curve No. 0613TC0005
Drawing No. B48095-613-05

Figure 28: Typical Micrologic 3.0 A Trip Unit (Long-time Pickup and Delay)



Curve No. 0613TC0006
Drawing No. B48095-613-06

Micrologic 3.0A Trip Unit

Characteristic Trip Curve No. 613-6

Long-time Pickup and Delay

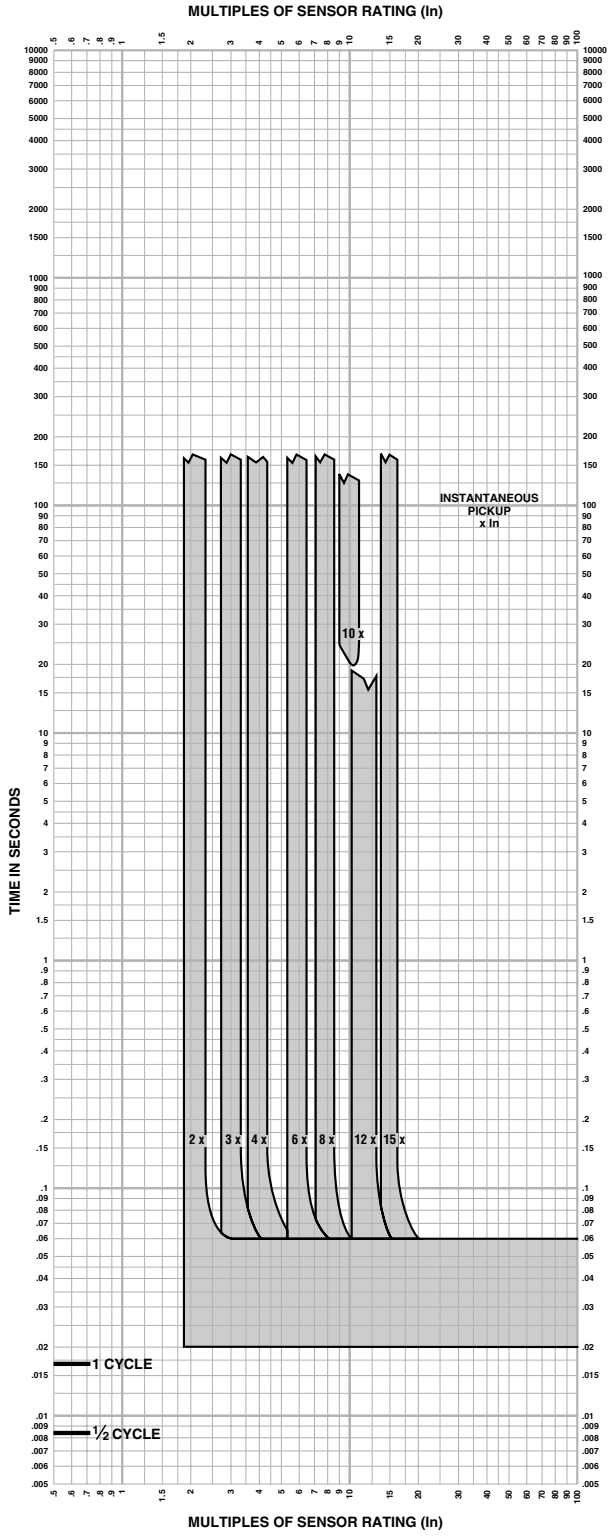
The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C (-22°F to +140°F) ambient temperature.

NOTE:

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately twenty minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the instantaneous setting of the circuit breaker.
3. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of current.
4. See trip curve 613-8 for instantaneous pickup trip curve.

Figure 29: Typical Micrologic 5.0/6.0 Trip Units (instantaneous Pickup, 2X to 15X and OFF)



Curve No. 0613TC0007
Drawing No. B48095-613-07

Micrologic 5.0/6.0 Trip Units

Characteristic Trip Curve No. 613-7

Instantaneous Pickup, 2X to 15X and OFF

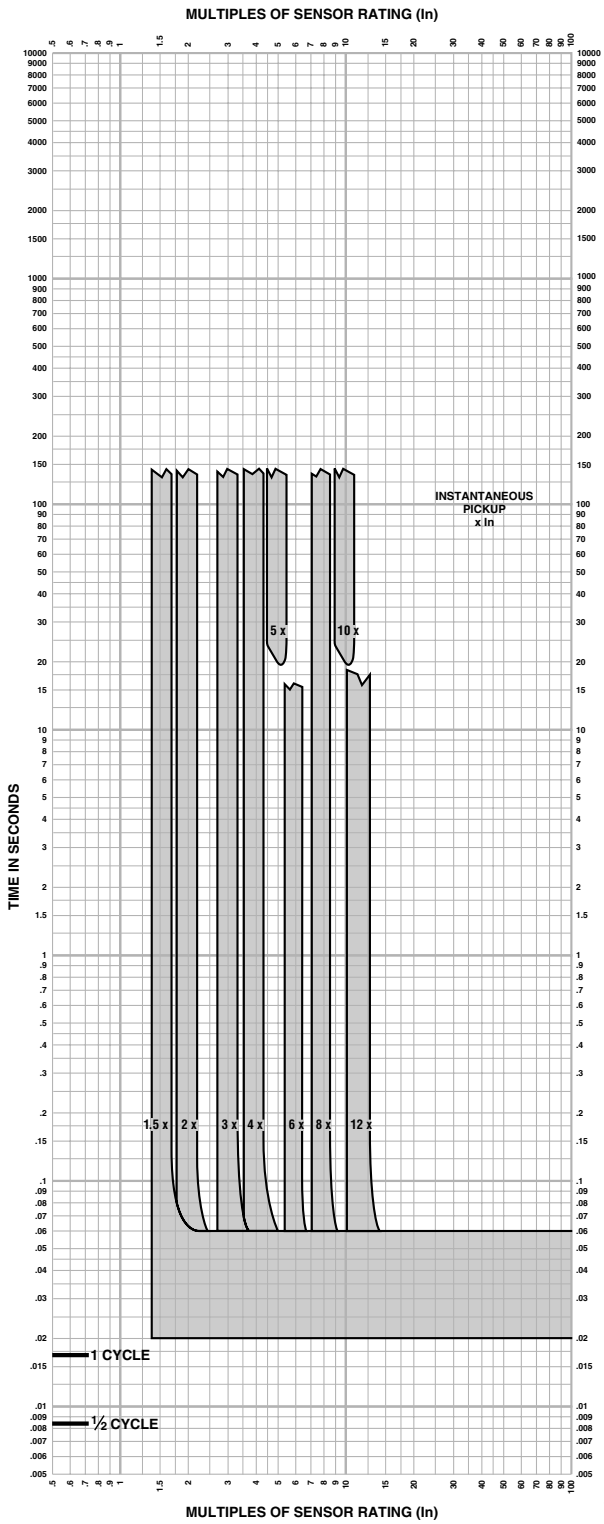
The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C (-22°F to +140°F) ambient temperature.

NOTE:

1. The end of the curve is determined by the interrupting rating of the circuit breaker.
2. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of current.
3. The instantaneous region of the trip curve shows maximum total clearing times. Actual clearing times in this region can vary depending on the circuit breaker mechanism design and other factors. The actual clearing time can be considerably faster than indicated. Contact your local sales office for additional information.
4. For a withstand circuit breaker, instantaneous can be turned OFF. See trip curve 613-7 for the instantaneous trip curve. See trip curve 613-10 for the instantaneous override values.
5. See trip curve 613-4 and trip curve 613-5 for long-time pickup, long-time delay, short-time pickup and short-time delay trip curves.

Figure 30: Typical Micrologic 3.0 A Trip Unit (Instantaneous Pickup, 1.5X to 12X)



Curve No. 0613TC0008
Drawing No. B48095-613-08

Micrologic 3.0A Trip Unit

Characteristic Trip Curve No. 613-8

Instantaneous Pickup, 1.5X to 12X

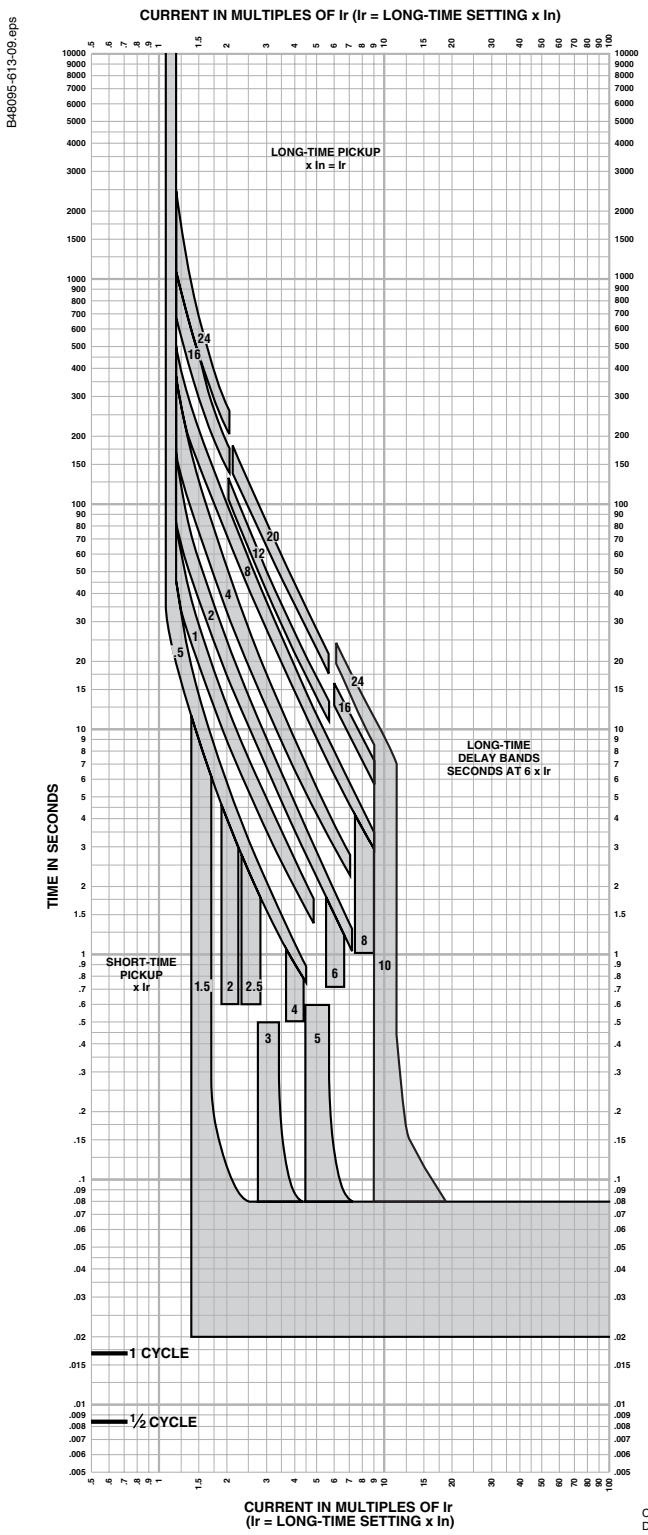
The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C (-22°F to +140°F) ambient temperature.

NOTE:

1. The end of the curve is determined by the interrupting rating of the circuit breaker.
2. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of current.
3. The instantaneous region of the trip curve shows maximum total clearing times. Actual clearing times in this region can vary depending on the circuit breaker mechanism design and other factors. The actual clearing time can be considerably faster than indicated. Contact your local sales office for additional information.
4. See trip curve 613-6 for long-time pickup and delay trip curves.

Figure 31: Typical Micrologic 2.0 A Trip Unit (Long-time Pickup and Delay / Short-time Pickup and Delay)



Micrologic 2.0A Trip Unit

Characteristic Trip Curve No. 613-9

Long-time Pickup and Delay
Short-time Pickup with No Delay

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C (-22°F to +140°F) ambient temperature.

NOTE:

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately twenty minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the short-time setting.
3. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of current.
4. Overload indicator illuminates at 100%.

Curve No. 0613TC0009
Drawing No. B48095-613-09

Figure 32: Micrologic 2.0/3.0/5.0/6.0 A/P/H Trip Unit Instantaneous Override Values

MASTERPACT NW/NT

ANSI CB Model No.	Inst. Override (kA RMS) +/- 10%
NW08N1 ★	24
NW08N1	None
NW16N1	None
NW08H1 ★	24
NW08H1	None
NW16H1	None
NW20H1	None
NW32H1	None
NW08H2 ★	24
NW08H2	None
NW16H2	None
NW20H2	None
NW32H2	None
NW40H2	None
NW50H2	None
NW08H3 ★	24
NW08H3	85
NW16H3	85
NW20H3	85
NW32H3	85
NW40H3	85
NW50H3	85
NW08L1 ★	24
NW08L1	35
NW08L1F	24
NW16L1	35
NW16L1F	24
NW20L1	35
NW20L1F	24
NW32L1	117
NW40L1	117
NW50L1	117
NT08N1 ★	24

★ Maximum sensor plug 250 A

Note:

Faults at or above instantaneous override value will be cleared at 20 msec or less.

Selection Tables with Transformer Ratings

Transformer ratings for Masterpact NW circuit breakers in Power-Zone 4 switchgear are listed below.

Table 6: Application of Masterpact NW Circuit Breakers (with Standard Three-Phase Transformers: Liquid Filled and Ventilated Dry Types)

Transformer Base (100%) Rating		Secondary Short-Circuit Currents RMS Symmetrical Amperes				Minimum Size Circuit Breakers for Selective Trip Systems		
kVA and Percent Impedance	Amperes [a]	Max. Short-circuit kVA Available from Primary System	Through Transformer Only	Motor Contribution	Combined	Main Circuit Breaker Short-time Delay Trip	Feeder Circuit Breaker Short-time Delay Trip	Feeder Circuit Breaker Instantaneous Trip
208 V Three-Phase - 50% Motor Load / xd'' = 25%[b]								
300 5.0%	833	50000	14900	1700	16600	NW16N1	NW08N1	NW08N1
		100000	15700		17400		NW08N1	NW08N1
		150000	16000		17700		NW08N1	NW08N1
		250000	16300		18000		NW08N1	NW08N1
		500000	16500		18200		NW08N1	NW08N1
		Unlimited	16700		18400		NW08N1	NW08N1
							NT08N1	NT08N1
500 5.0%	1389	50000	23100	2800	25900	NW16N1[c]	NW08N1	NW08N1
		100000	25200		28000		NW08N1	NW08N1
		150000	26000		28800		NW08N1	NW08N1
		250000	26700		29500		NW08N1	NW08N1
		500000	27200		30000		NW08N1	NW08N1
		Unlimited	27800		30600		NW08H1	NW08H1
							NT08N1	NT08N1
750 5.75%	2083	50000	28700	4200	32900	NW32H1	NW08N1	NW08N1
		100000	32000		36200		NW08N1	NW08N1
		150000	33300		37500		NW08N1	NW08N1
		250000	34400		38600		NW08N1	NW08N1
		500000	35200		39400		NW08N1	NW08N1
		Unlimited	36200		40400		NW08N1	NW08N1
							NT08N1	NT08N1
1000 5.75%	2778	50000	35900	5600	41500	N32H1[c]	NW08N1	NW08N1
							NT08N1	NT08N1
1000 5.75%	2778	100000	41200	5600	46800	NW32H1[c]	NW08H1	NW08H1
		150000	43300		48900		NW08H1	NW08H1
		250000	45200		50800		NW08H1	NW08H1
		500000	46700		52300		NW08H1	NW08H1
		Unlimited	48300		53900		NW08H1	NW08H1

Table 6: Application of Masterpact NW Circuit Breakers (with Standard Three-Phase Transformers: Liquid Filled and Ventilated Dry Types)

Transformer Base (100%) Rating			Secondary Short-Circuit Currents RMS Symmetrical Amperes			Minimum Size Circuit Breakers for Selective Trip Systems		
kVA and Percent Impedance	Amperes [a]	Max. Short-circuit kVA Available from Primary System	Through Transformer Only	Motor Contribution	Combined	Main Circuit Breaker Short-time Delay Trip	Feeder Circuit Breaker Short-time Delay Trip	Feeder Circuit Breaker Instantaneous Trip
240 V Three-Phase - 100% Motor Load / xd'' = 25%[b]								
300 5.0%	722	50000	12900	2900	15800	NW08N1[c]	NW08N1	NW08H1
		100000	13600		16500		NW08N1	NW08H1
		150000	13900		16800		NW08N1	NW08H1
		250000	14100		17000		NW08N1	NW08H1
		500000	14300		17200		NW08N1	NW08H1
		Unlimited	14400		17300		NW08N1	NW08H1
							NT08N1	NT08N1
500 5.0%	1203	50000	20000	4800	24800	NW16N1[c]	NW08N1	NW08N1
		100000	21900		26700		NW08N1	NW08N1
		150000	22500		27300		NW08N1	NW08N1
		250000	23100		27900		NW08N1	NW08N1
		500000	23600		28400		NW08N1	NW08N1
		Unlimited	24100		28900		NW08N1	NW08N1
							NT08N1	NT08N1
750 5.75%	1804	50000	24800	7200	32100	NW20H1[c]	NW08N1	NW08N1
		100000	27800		35000		NW08N1	NW08N1
		150000	28900		36100		NW08N1	NW08N1
		250000	29800		37000		NW08N1	NW08N1
		500000	30600		37800		NW08N1	NW08N1
		Unlimited	31400		38600		NW08N1	NW08N1
							NT08N1	NT08N1
1000 5.75%	2406	50000	31000	9600	40600	N32H1[c]	NW08N1	NW08N1
							NT08N1	NT08N1
1000 5.75%	2406	100000	35600	9600	45200	NW32H1[c]	NW08H1	NW08H1
		150000	37500		47100		NW08H1	NW08H1
		250000	39100		48700		NW08H1	NW08H1
		500000	40400		50000		NW08H1	NW08H1
		Unlimited	41800		51400		NW08H1	NW08H1

Table 6: Application of Masterpact NW Circuit Breakers (with Standard Three-Phase Transformers: Liquid Filled and Ventilated Dry Types)

Transformer Base (100%) Rating			Secondary Short-Circuit Currents RMS Symmetrical Amperes			Minimum Size Circuit Breakers for Selective Trip Systems		
kVA and Percent Impedance	Amperes [a]	Max. Short-circuit kVA Available from Primary System	Through Transformer Only	Motor Contribution	Combined	Main Circuit Breaker Short-time Delay Trip	Feeder Circuit Breaker Short-time Delay Trip	Feeder Circuit Breaker Instantaneous Trip
480 V Three-Phase - 100% Motor Load / xd" = 25%[b]								
500 5.0%	601	50000	10000	2400	12400	NW08N1[c]	NW08N1	NW08N1
		100000	10900		13300		NW08N1	NW08N1
		150000	11300		13700		NW08N1	NW08N1
		250000	11600		14000		NW08N1	NW08N1
		500000	11800		14200		NW08N1	NW08N1
		Unlimited	12000		14400		NW08N1	NW08N1
							NT08N1	NT08N1
750 5.75%	902	50000	12400	3600	16000	NW16N1	NW08N1	NW08N1
		100000	13900		17500		NW08N1	NW08N1
		150000	14400		18000		NW08N1	NW08N1
		250000	14900		18500		NW08N1	NW08N1
		500000	15300		18900		NW08N1	NW08N1
		Unlimited	15700		19300		NW08N1	NW08N1
							NT08N1	NT08N1
1000 5.75%	1203	50000	15500	4800	20300	NW16N1[c]	NW08N1	NW08N1
		100000	17800		22600		NW08N1	NW08N1
		150000	18700		23500		NW08N1	NW08N1
		250000	19600		24400		NW08N1	NW08N1
		500000	30200		25000		NW08N1	NW08N1
		Unlimited	20900		25700		NW08N1	NW08N1
							NT08N1	NT08N1
1500 5.75%	1804	50000	20600	7200	27800	NW20H1[c]	NW08N1	NW08N1
		100000	24900		32100		NW08N1	NW08N1
		150000	26700		33900		NW08N1	NW08N1
		250000	28400		35600		NW08N1	NW08N1
		500000	29800		37000		NW08N1	NW08N1
		Unlimited	31400		38600		NT08N1	NT08N1
2000 5.75%	2406	50000	24700	9600	34300	NW32H1[c]	NW08N1	NW08N1
		10000	31000		40600		NT08N1	NT08N1
2000 5.75%	2406	150000	34000	9600	43600	NW32H1[c]	NW08H1	NW08H1
		250000	36700		46300		NW08H1	NW08H1
		500000	39100		48700		NW08H1	NW08H1
		Unlimited	41800		51400		NW08H1	NW08H1
2500	3008	50000	28000		40000		NW08N1	NW08N1
							NT08N1	NT08N1
2500 5.75%	3008	50000	28000	12000	40000	NW32H1[c]	NW08H1	NW08H1
		100000	36500		48500		NW08H1	NW08H1
		150000	40500		52500		NW08H1	NW08H1
		250000	44600		56600		NW08H1	NW08H1
		500000	48100		60100		NW08H1	NW08H1
		Unlimited	52300		64300		NW08H1	NW08H1

Table 6: Application of Masterpact NW Circuit Breakers (with Standard Three-Phase Transformers: Liquid Filled and Ventilated Dry Types)

Transformer Base (100%) Rating			Secondary Short-Circuit Currents RMS Symmetrical Amperes			Minimum Size Circuit Breakers for Selective Trip Systems		
kVA and Percent Impedance	Amperes [a]	Max. Short-circuit kVA Available from Primary System	Through Transformer Only	Motor Contribution	Combined	Main Circuit Breaker Short-time Delay Trip	Feeder Circuit Breaker Short-time Delay Trip	Feeder Circuit Breaker Instantaneous Trip
3000 5.75%	3609	50000	30700	14000	44700	NW40H2[C]	NW08H1	NW08H1
		100000	41200		55200		NW08H1	NW08H1
		150000	46600		60600		NW08H1	NW08H1
		250000	51900		65900		NW08H2	NW08H2
		500000	56800		70800		NW08H2	NW08H2
		Unlimited	62800		76800		NW08H2	NW08H2
3750 5.75%	4511	50000	34000	18000	52000	NW50H2	NW08H1	NW08H1
		100000	47500		65500		NW08H2	NW08H2
		150000	54700		72700		NW08H2	NW08H2
		250000	62200		80200		NW08H2	NW08H2
3750 5.75%	4511	500000	69400	18000	87400	NW50H3	NW08H3	NW08H3
		Unlimited	78500		96500		NW08H3	NW08H3

Table 6: Application of Masterpact NW Circuit Breakers (with Standard Three-Phase Transformers: Liquid Filled and Ventilated Dry Types)

Transformer Base (100%) Rating			Secondary Short-Circuit Currents RMS Symmetrical Amperes			Minimum Size Circuit Breakers for Selective Trip Systems		
kVA and Percent Impedance	Amperes [a]	Max. Short-circuit kVA Available from Primary System	Through Transformer Only	Motor Contribution	Combined	Main Circuit Breaker Short-time Delay Trip	Feeder Circuit Breaker Short-time Delay Trip	Feeder Circuit Breaker Instantaneous Trip
600 V Three-Phase - 100% Motor Load / xd'' = 25%[b]								
500 5.0%	481	50000	8000	1900	9900	NW08N1	NW08N1	NW08N1
		100000	8700		10600		NW08N1	NW08N1
		150000	9000		10900		NW08N1	NW08N1
		250000	9300		11200		NW08N1	NW08N1
		500000	9400		11300		NW08N1	NW08N1
		Unlimited	9600		11500		NW08N1	NW08N1
750 5.75%	722	50000	10000	2900	12900	NW08N1[c]	NW08N1	NW08N1
		100000	11100		14000		NW08N1	NW08N1
		150000	11600		14500		NW08N1	NW08N1
		250000	11900		14800		NW08N1	NW08N1
		500000	12200		15100		NW08N1	NW08N1
		Unlimited	12600		15500		NW08N1	NW08N1
1000 5.75%	962	50000	12400	3900	16300	NW16N1	NW08N1	NW08N1
		100000	14300		18200		NW08N1	NW08N1
		150000	15000		18900		NW08N1	NW08N1
		250000	15600		19500		NW08N1	NW08N1
		500000	16200		30100		NW08N1	NW08N1
		Unlimited	16700		20600		NW08N1	NW08N1
1500 5.75%	1443	50000	16500	5800	22300	NW16N1[c]	NW08N1	NW08N1
		100000	20000		25800		NW08N1	NW08N1
		150000	21400		27200		NW08N1	NW08N1
		250000	22700		28500		NW08N1	NW08N1
		500000	23900		29700		NW08N1	NW08N1
		Unlimited	25100		30900			
2000 5.75%	1924	50000	19700	7700	27400	NW20H1[c]	NW08N1	NW08N1
		100000	24800		32500		NW08N1	NW08N1
		150000	27200		34900		NW08N1	NW08N1
		250000	29400		37100		NW08N1	NW08N1
		500000	31300		39000		NW08N1	NW08N1
		Unlimited	33500		41200		NW08N1	NW08N1
2500 5.75%	2406	50000	22400	9600	32000	NW32H1[c]	NW08N1	NW08N1
		100000	29200		38800		NW08N1	NW08N1
		150000	32400		42000		NW08N1	NW08N1
		250000	35600		45200		NW08H1	NW08H1
		500000	38500		48100		NW08H1	NW08H1
		Unlimited	41800		51400		NW08H1	NW08H1
3000 5.75%	2886	50000	24600	11500	36100	NW32H1[c]	NW08N1	NW08N1
		100000	33000		44500		NW08H1	NW08H1
		150000	37300		48800		NW08H1	NW08H1
		250000	41500		53000		NW08H1	NW08H1
		500000	45500		57000		NW08H1	NW08H1
		Unlimited	50200		61700		NW08H1	NW08H1

Table 6: Application of Masterpact NW Circuit Breakers (with Standard Three-Phase Transformers: Liquid Filled and Ventilated Dry Types)

Transformer Base (100%) Rating			Secondary Short-Circuit Currents RMS Symmetrical Amperes			Minimum Size Circuit Breakers for Selective Trip Systems		
kVA and Percent Impedance	Amperes [a]	Max. Short-circuit kVA Available from Primary System	Through Transformer Only	Motor Contribution	Combined	Main Circuit Breaker Short-time Delay Trip	Feeder Circuit Breaker Short-time Delay Trip	Feeder Circuit Breaker Instantaneous Trip
3750 5.75%	3608	50000	27200	14400	41600	NW40H2[C]	NW08N1	NW08N1
		100000	38000		52400		NW08H1	NW08H1
		150000	43700		58100		NW08H1	NW08H1
		250000	49800		64200		NW08H1	NW08H1
		500000	55500		69900		NW08H2	NW08H2
		Unlimited	62800		77200		NW08H2	NW08H2

[a] At transformer base rating.

[b] Subtransient reactance.

[c] Next larger frame size main circuit breaker may be required for 55/65 ×C rise and/or forced air–cooled (FA) transformer. Check Transformer Secondary Ampere Rating.

Distribution Systems

This section contains a brief overview of Wye and Delta distribution systems.

Wye Solidly Grounded Systems

A Wye system is the most common type of three-phase distribution system for low voltage switchgear. Wye systems are either three- or four-wire distribution systems that are grounded, either in the equipment (see “Four-Wire Wye Distribution—Solidly Grounded System - 3 phase, 4 wire”), or at the transformer source (see “Three-Wire Wye Distribution—Solidly Grounded System - 3 phase, 3 wire”).

Figure 33: Four-Wire Wye Distribution—Solidly Grounded System - 3 phase, 4 wire

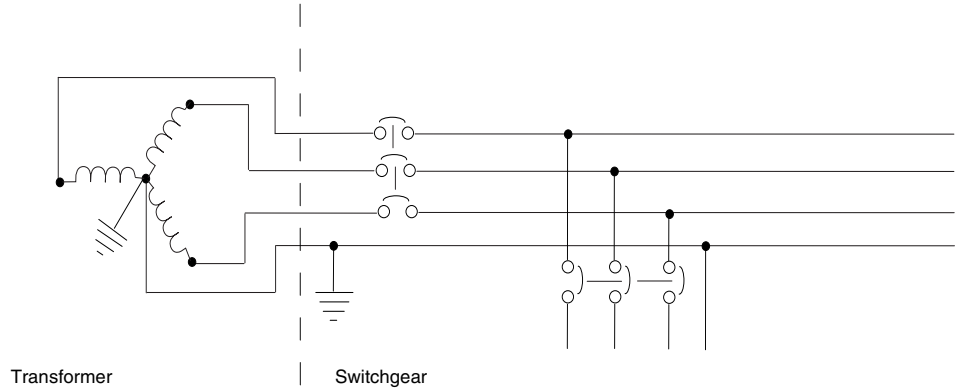
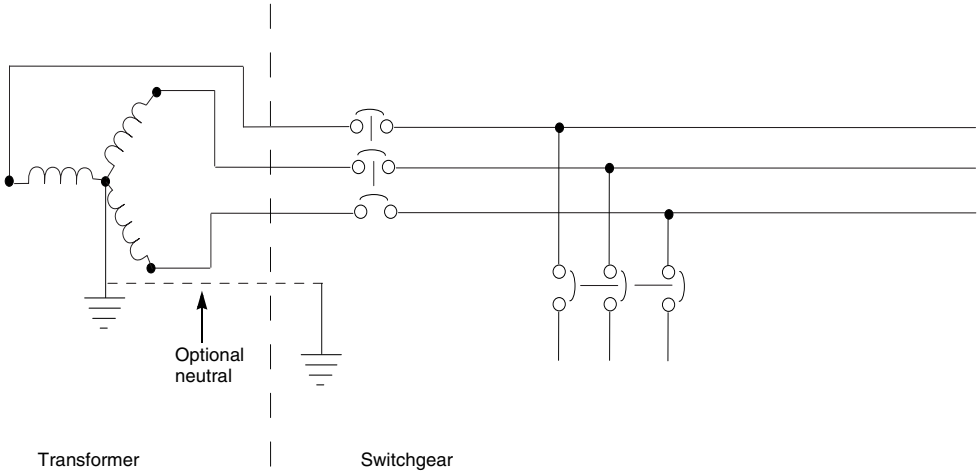


Figure 34: Three-Wire Wye Distribution—Solidly Grounded System - 3 phase, 3 wire



When the system is grounded in the equipment and the neutral phase is carried through the equipment, the system is described as a four-wire solidly grounded system with neutral connections available to supply single phase-to-neutral loads, such as lighting loads.

When the system is grounded at the transformer source and no neutral phase is carried through the equipment, the system is described as a three-wire solidly grounded system. No neutral connections are available; all loads must be three-phase (or single “phase-to-phase”) loads.

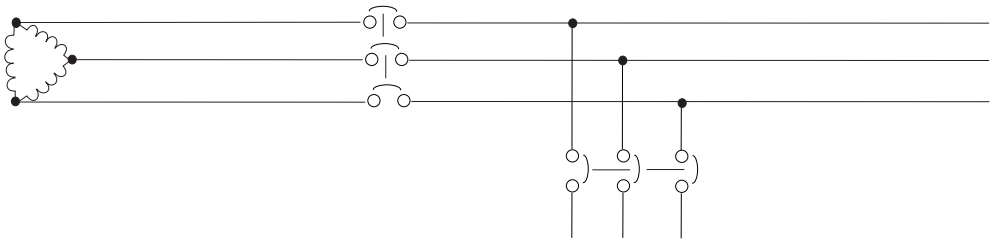
In some cases, the neutral is delivered to the service entrance where it is bonded to ground similar to the four-wire solidly grounded system.

Delta Grounded and Ungrounded Systems

Formerly common, Delta three-wire systems are rarely used in low voltage distribution systems. Delta three-wire distribution systems can be grounded or ungrounded services. Generally, Delta systems are ungrounded. In some cases, they are grounded on the “corner” of the delta or some other point. Ungrounded Delta systems do not have a reference point or ground. Corner or Grounded B Phase Delta distribution systems do provide a reference point but require one phase to be connected to the ground.

Low voltage drawout switchgear with Masterpact NW and NT circuit breakers is designed and built to ANSI C37.20.1 and is tested for single phase-to-phase faults. They can be applied on “corner” grounded Delta distribution systems. Power-Zone 4 switchgear with Masterpact NW and NT circuit breakers is suited for corner grounded or ungrounded systems.

Figure 35: Three-Wire Delta Distribution—Ungrounded - 3 phase, 3 wire



Although ungrounded systems have been used for many years, they are not recommended in newly designed low voltage distribution systems. Ungrounded power systems may be unstable. High resistance grounded systems as shown on pages 65 and 66 are recommended for use in newly designed low voltage distribution systems.

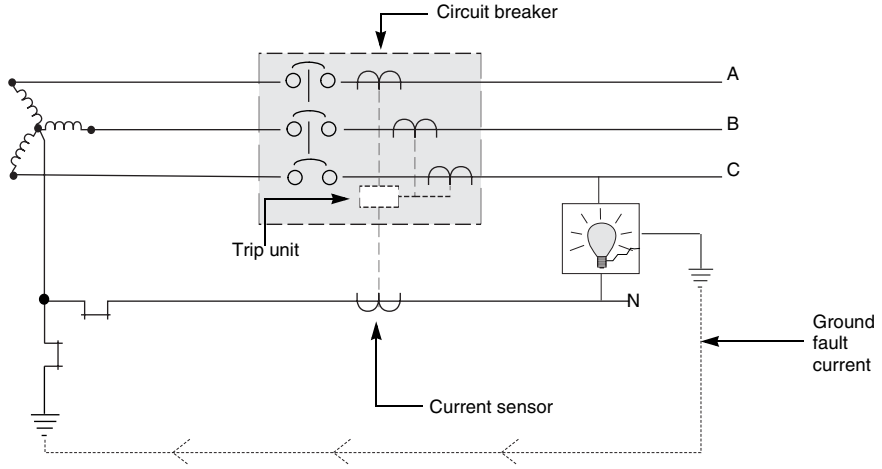
Ground Fault Protection for Wye Systems

The need for ground fault protection in three-phase solidly grounded Wye systems is due to the possibility of low magnitude ground fault currents. Phase-to-phase faults are of such a large magnitude that overcurrent protection devices (trip units) can operate rapidly and positively to signal the circuit breaker to open. Ground faults can be of a much lower magnitude and require specialized elements in the trip unit for detection.

Power-Zone® 4 switchgear with Masterpact® NW and NT circuit breakers equipped with Micrologic® trip units has the capability of providing ground fault sensing (alarm with no tripping) and ground fault protection (tripping) on three-phase, three-wire and three-phase, four-wire solidly-grounded systems. Masterpact NW and NT circuit breakers can be used for overcurrent protection on ungrounded or resistance grounded systems, but are not suitable for ground fault protection on these systems.

Ground faults are an inadvertent flow of current between the normal current-carrying conductors and ground. These ground faults usually start at a low level and, if left undetected, escalate causing significant heat and mechanical damage to the electrical system. Ground faults can escalate to a phase-to-phase fault causing major system damage. The ground fault system in the Masterpact NW and NT circuit breakers monitors the flow of current in the system and detects ground fault currents. The circuit breaker will trip to protect the circuit, or send an alarm through the appropriate interface equipment, depending on the option installed.

Figure 36: Masterpact NW Circuit Breaker Ground Fault System Sensing Capabilities



The National Electrical Code (NEC) requires ground fault protection on solidly grounded Wye electrical services of more than 150 V to ground, but not exceeding 600 V phase-to-phase for each service disconnect rated 1000 A or more. This includes service entrance, feeders and building disconnects. The NEC also requires ground fault alarm (no tripping) on emergency systems and allows ground fault alarm on continuous processes, fire pumps, and other circuits that would be more hazardous if stopped without an orderly shutdown.

Ground Fault Protection with Tripping

Ground fault protection is available as an option on Masterpact NW and NT circuit breakers with Micrologic 6.0A and higher trip units. Masterpact NW and NT circuit breakers offer three different ground fault sensing options: residual, ground-source return and modified differential. The sensing options make it possible to match the number and location of current sensors to the application. The pickup and delay settings for ground fault are adjustable locally with the dial settings or through the key pad. The pickup and delay settings for ground fault are also adjustable remotely over a computer network on Micrologic 6.0 and higher trip units. A neutral current sensor (NCT) must be installed in the neutral if ground fault alarm is used on a three-phase, four-wire system.

Ground Fault Protection without Tripping

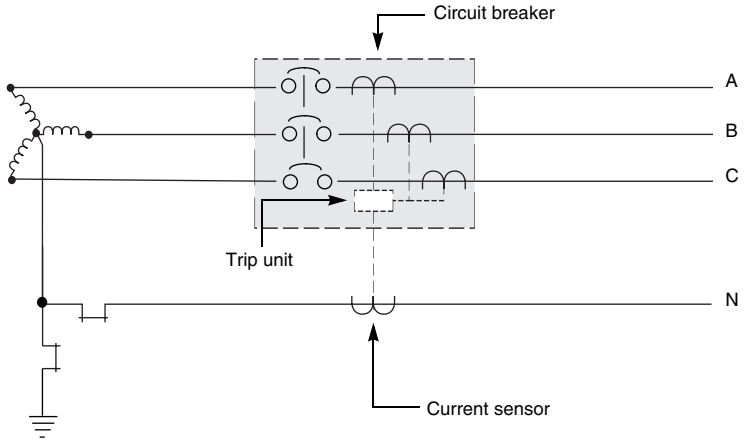
All Masterpact NW and NT circuit breakers with Micrologic 5.0P and higher trip units come standard with the ability to sense and report a ground fault alarm through the optional programmable contact module or communication network. A neutral current sensor (NCT) must be installed in the neutral if ground fault alarm is used on a three-phase, four-wire system.

The pickup and delay settings for the ground fault alarm are adjustable locally through the key pad on the trip unit or remotely over a computer network.

Residual Ground Fault Sensing

Residual ground fault sensing systems use one current sensor for each current-carrying conductor. The trip unit vectorially sums the secondary outputs from each sensor to determine if there is a ground fault and the magnitude of the ground fault. The following diagram shows the current sensors for a three-phase, four-wire system. There is a current sensor on each phase and the neutral.

Figure 37: Typical Residual Ground Fault Sensing System with Phase Conductors

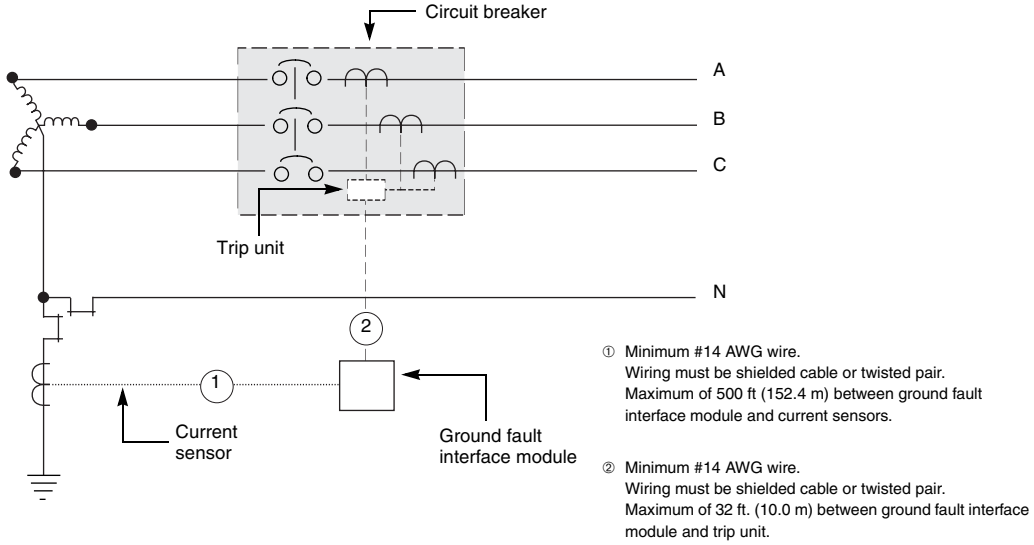


The sensors for the phase conductors A, B and C are inside the circuit breaker. The neutral current transformer is installed in the neutral circuit. If the circuit breaker were used on a three-phase, three-wire system, the neutral current transformer would not be necessary.

Ground Source Return

Ground source return ground fault sensing systems use one current sensor on the ground conductor. The current sensor measures the ground current flow. The following diagram shows the current sensor for a three-phase, four-wire system. Ground source return can also be used on three-phase, three-wire systems.

Figure 38: Typical Ground Source Return Sensing System with Ground Fault Interface Module and Current Sensor



Ground-source return sensing systems require the use of the optional ground fault interface module and a sensor installed in the ground circuit.

The current sensor and ground fault interface module must be wired per the installation and wiring instructions included with the ground fault interface module.

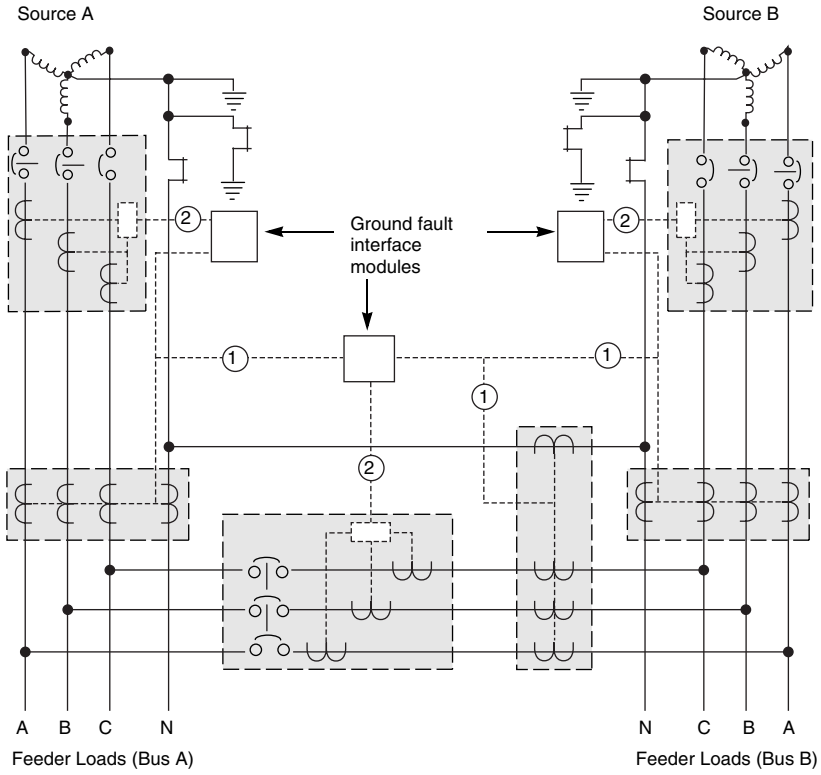
Modified Differential Ground Fault System

A modified differential ground fault system (MDGF) is used for multiple sourced systems. Normal residual and ground-source return systems will not correctly sum all of the circulating currents caused by the multiple neutral paths and multiple grounds. The following diagram shows a typical main-tie-main system. Each source transformer is grounded, and the service entrance neutral is bonded to ground. Multiple neutral paths allow neutral current to circulate and return to the supplying transformer by several different paths. The ground fault system must be capable of correctly summing these circulating currents.

Figure 39: Typical Modified Differential Ground Fault System with Ground Fault Interface Modules

① Minimum #14 AWG wire.
Wiring must be shielded cable or twisted pair.
Maximum of 500 ft (152.4 m) between ground fault interface module and current sensors.

② Minimum #14 AWG wire.
Wiring must be shielded cable or twisted pair.
Maximum of 32 ft. (10.0 m) between ground fault interface module and trip unit.



The modified differential ground fault sensing system requires the use of ground fault interface modules and current sensors installed in all normal current-carrying conductors.

The current sensors and ground fault interface modules must be wired in parallel and the polarity of the current sensors must be maintained per the installation and wiring instructions included with the ground fault interface module.

High Resistance Grounded Systems

When continuance of service for a distribution system is a high priority, high-resistance grounding adds the features of a grounded system on an ungrounded system, while minimizing the risk of service interruptions resulting from ground faults.

High resistance grounding simultaneously provides a system reference point (or ground) to overcome the negative effects of low level ground faults and limits the magnitude of current that can flow during a ground fault. A resistance value is selected to limit the overvoltage during arcing faults. Industry practice has established that the resistance value should be selected relative to the system capacitive charging current.

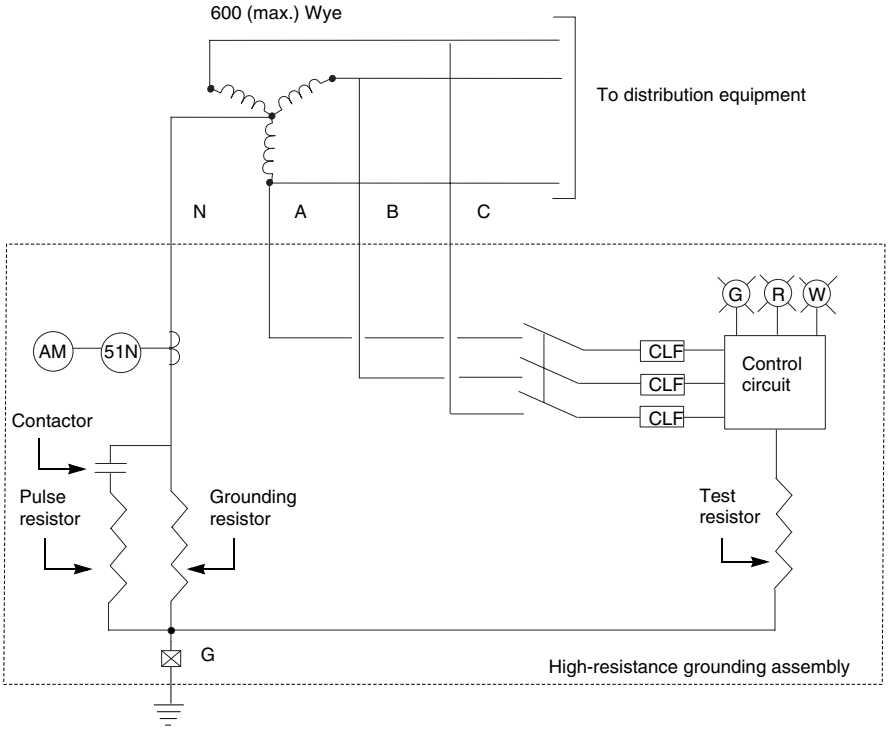
An ammeter, in the circuit of a grounding resistor/grounding transformer assembly, reads the total amount of the ground current flowing through the system. When a current-sensing relay is added, any levels in excess of the capacitive charging current can be monitored. Alternatively, a voltmeter-relay can be connected across ground resistors to monitor the capacitive charging current in a resistor/grounding transformer assembly. The ground current ammeter provides a linear reading of the existent ac ground current present in the system for both the current and voltage detection methods described above.

Circuit breakers rated to C37.13 are recommended for high resistance grounded systems. Power-Zone 4 switchgear with Masterpact NW and NT circuit breakers is rated to C37.13.

Wye Systems Configured

High resistance grounding for Wye-connected systems is established by placing resistors in series with the neutral-to-ground connection of the power source. Grounding resistors are chosen to limit the ground current to a maximum value of five amperes. Line-to-neutral loads cannot be connected to a system where the neutral is resistance-grounded. For additional information, see 2005 NEC 250.36.

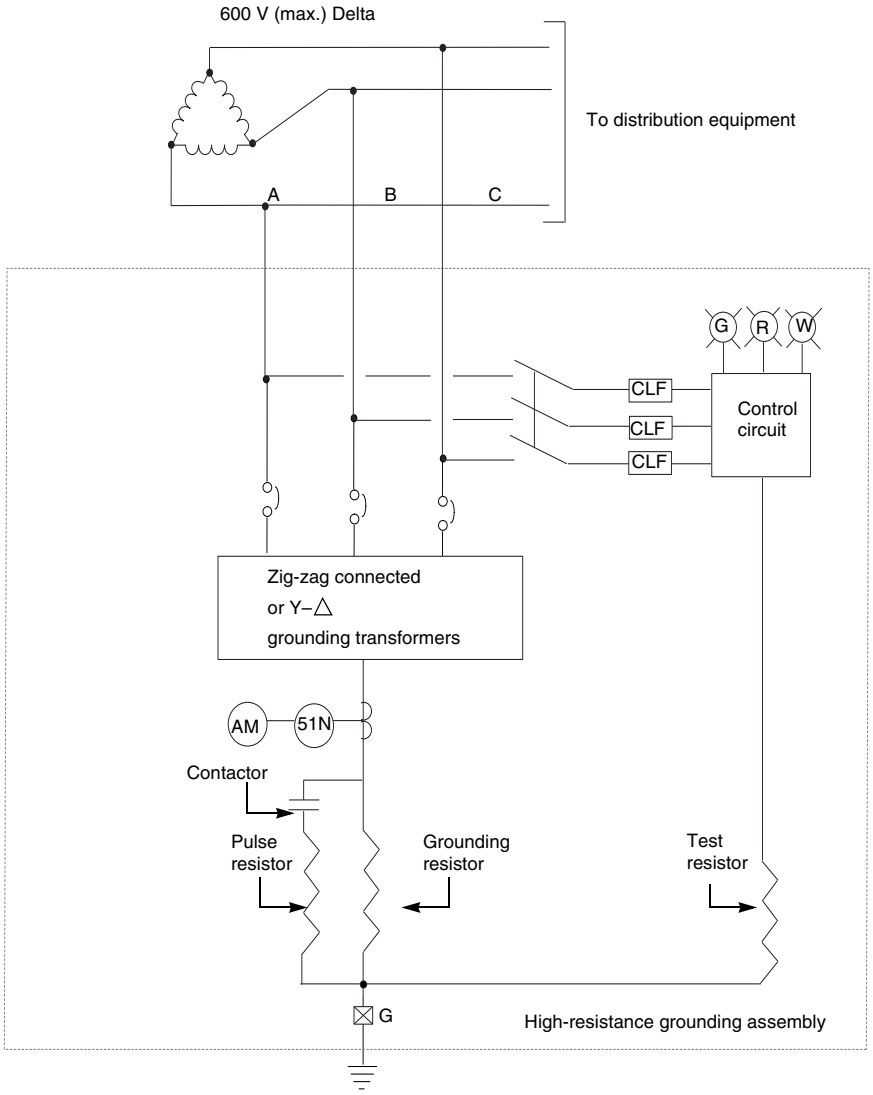
Figure 40: Four-Wire Wye System Fault Detection with Current Relay



Delta Systems Configured

A neutral point must be established in an ungrounded Delta-connected system using three single-phase transformers. Typically, grounding resistors and transformers are chosen to limit the ground current to a maximum value of five amperes. This technique can be applied on Wye-connected sources when the neutral point is not accessible from the service entrance conduit. The neutral point cannot be used to service phase-to-neutral loads.

Figure 41: Three-Wire Delta System with Zig Zag Grounding Transformers



Automatic Transfer Systems

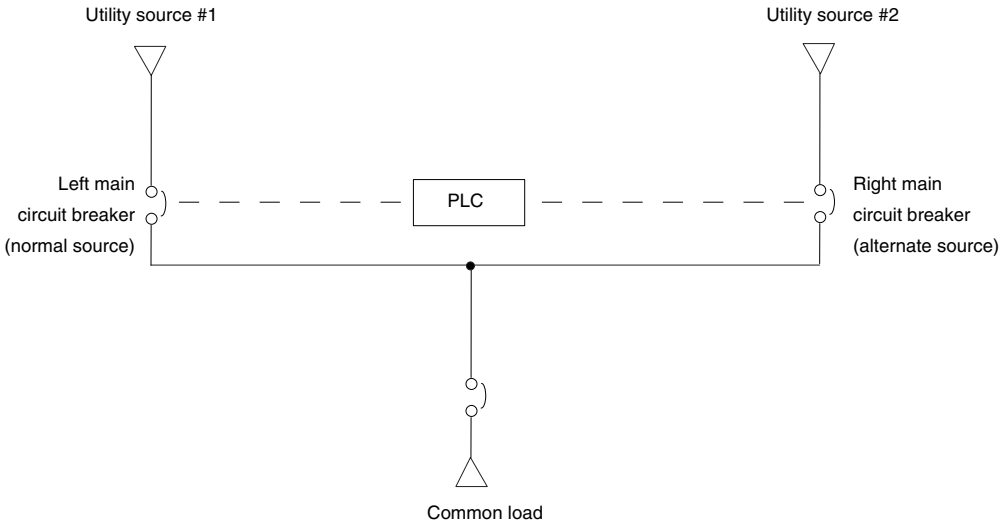
Automatic transfer systems minimize power interruption by transferring the load from the normal source to an alternate source when the normal source is temporarily unavailable. The system uses multiple connections to power sources, usually utility sources, and a programmable logic controller (PLC) to achieve this transfer. These systems also feature redundant supplies of control power. Examples of automatic transfer systems with main-main circuit breakers and main-tie-main circuit breakers are shown in Figure 42: below and Figure 43: on page 68.

Main-Main Circuit Breakers

Each main circuit breaker connects to a utility source. When the normal source becomes unavailable, the system transfers to the alternate. If the system comes equipped with a preferred source selector option, the system reverts to the preferred source automatically once it is available. Without the selector, automatic retransfer does not occur.

Optional listing to UL 1008 for both **closed** and **open** transition transfer schemes is available. When an **open** transition UL 1008 listed transfer scheme is specified, a mechanical interlocking cable is provided between the two main circuit breakers (main-main) to assure that at least one breaker is always open. This way, one circuit breaker is open prior to closing the other main.

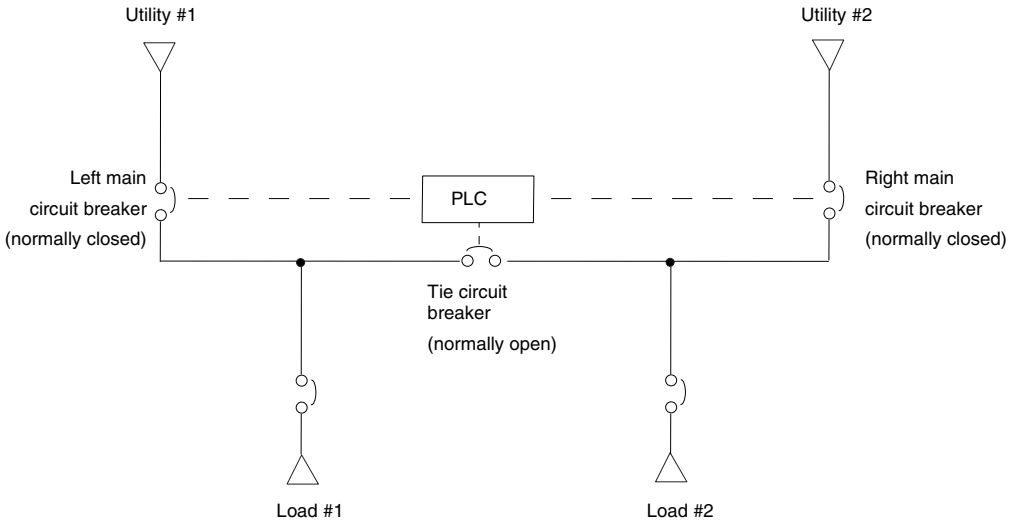
Figure 42: Main-Main Circuit Breaker Configuration



Main-Tie-Main Circuit Breakers

Both main circuit breakers, connected to a utility source, are connected together by means of a normally open tie circuit breaker. Each main circuit breaker feeds independent load buses. Various settings of the preferred source selector switch and the retransfer on/off options determine which circuit breakers are closed during various operating conditions.

Figure 43: Main-Tie-Main Circuit Breaker Configuration



Special Applications

This section contains information regarding low voltage systems in seismic and high altitude applications.

Seismic Applications

Power-Zone 4 switchgear has been tested for applications according to Uniform Building Code (UBC) zone 4 requirements. Equipment must be anchored properly to fully comply with zone 4 installations. Additional information can be found in Bulletin No. 80298-002-05, Power-Zone 4 Low Voltage, Metal-Enclosed, Drawout Switchgear with Masterpact® Low Voltage Power Circuit Breakers.

High Altitude Applications

When Power-Zone 4 switchgear with Masterpact NW and NT circuit breakers is installed at a location greater than 6600 feet above sea level, the ratings must be de-rated.

Altitude	Voltage	Amps
6600 ft (2,000 m) and below	100%	100%
8500 ft (2,600 m)	95%	99%
13000 ft (3,900 m)	80%	96%

NOTE: Ref. ANSI C37.20.1, Table 10.

SECTION 4 : WIRING DIAGRAMS

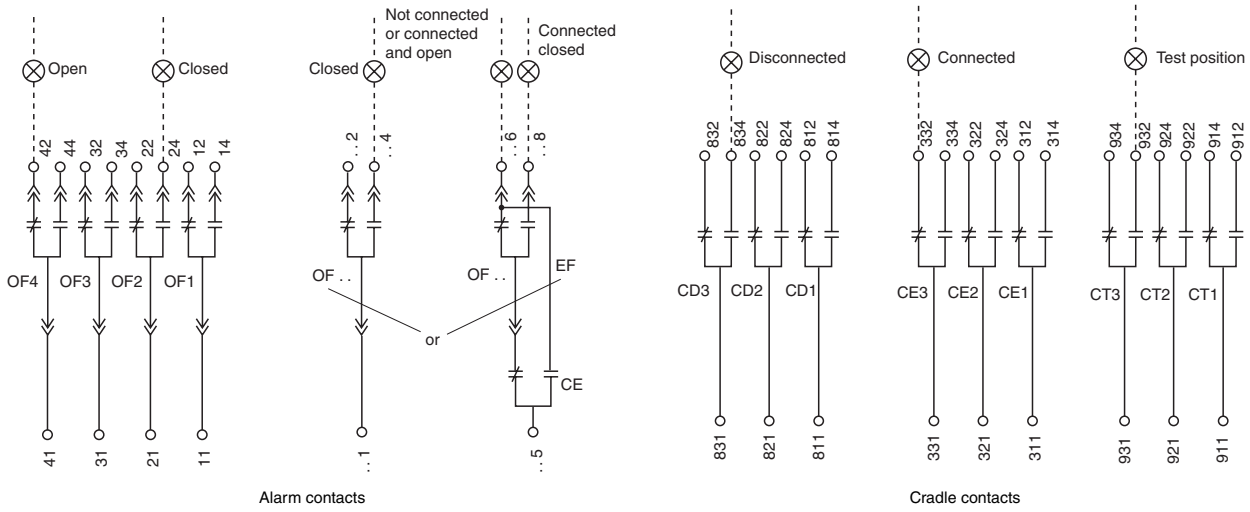
SECTION CONTENTS

BASIC ELECTRICALLY OPERATED CIRCUIT BREAKER DIAGRAMS

This section contains Masterpact® NW and NT circuit breaker diagrams. Refer to the *Masterpact NT/NW Universal Power Circuit Breakers* catalog for additional information.

Masterpact NW/NT Alarm and Cradle Contacts

Figure 44: Masterpact NW Alarm and Cradle Contacts

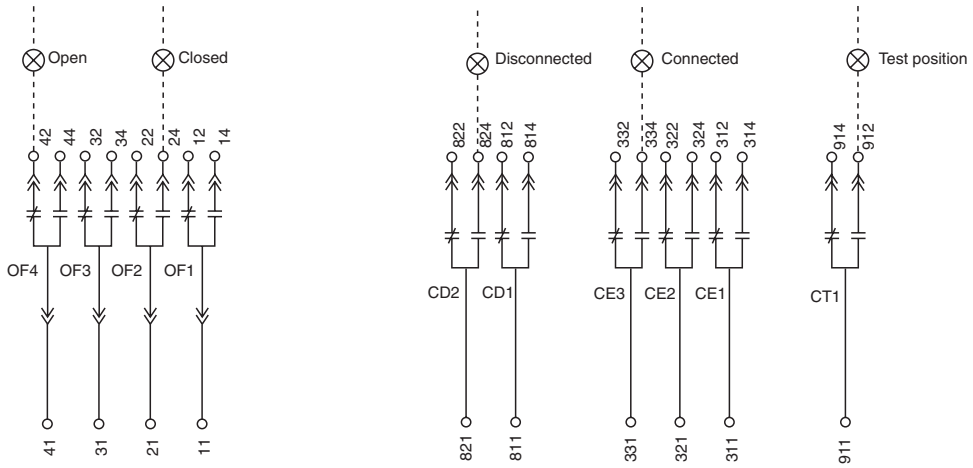


OF4	OF3	OF2	OF1
44	34	24	14
42	32	22	12
41	31	21	11

OF24	OF23	OF22	OF21	OF14	OF13	OF12	OF11
244	234	224	214	144	134	124	114
242	232	222	212	142	132	122	112
241	231	221	211	141	131	121	111
OU	OU	OU	OU	OU	OU	OU	OU
OF24	OF23	OF22	OF21	OF14	OF13	OF12	OF11
248	238	228	218	148	138	128	118
246	236	226	216	146	136	126	116
245	235	225	215	145	135	125	115

CD3	CD2	CD1	CE3	CE2	CE1	CT3	CT2	CT1
834	824	814	334	324	314	934	924	914
832	822	812	332	322	312	932	922	912
831	821	811	331	321	311	931	921	911
OU						OU		
CE6	CE5	CE4				CE9	CE8	CE7
364	354	344				394	384	374
362	352	342				392	382	372
361	351	341				391	381	371

Figure 45: Masterpact NT Alarm and Cradle Contacts



OF4	OF3	OF2	OF1
44	34	24	14
42	32	22	12
41	31	21	11

CD2	CD1	CE3	CE2	CE1	CT1
824	814	334	324	314	914
822	812	332	322	312	912
821	811	331	321	311	911

NW/NT Circuit Breaker Alarm and Cradle Contacts

Table 7: Alarm Contacts

OF4, OF3 OF2, OF1	“Open/close” circuit breaker or switch position contacts	OF24: “Open/close” circuit breaker or switch position contact or EF24: Combined “connected and closed” contact
		OF23 or EF23
		OF22 or EF22
		OF21 or EF21
		OF14 or EF14
		OF13 or EF13
		OF12 or EF12
		OF22 or EF22
		OF11 or EF11

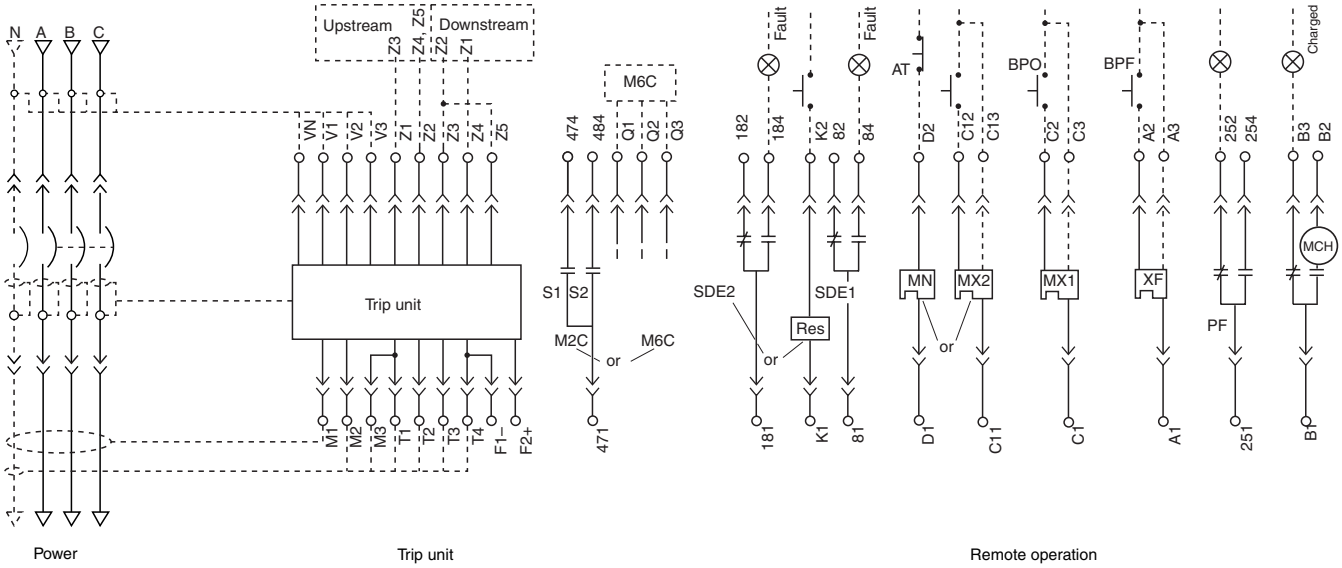
NOTE: OF1, OF2, OF3 and OF4 contacts are standard equipment.

Table 8: Cradle Contacts

CD3, CD2, CD1	“Disconnected” position contacts	CE3, CE2, CE1	“Connected” position contacts	CT3, CT2, CT1	“Test” position contacts
or				or	
CE6, CE5, CE4	“Connected” position contacts			CE9, CE8, CE7	“Connected” position contacts
				or	
				CD6, CD5, CD4	“Disconnected” position contacts

Masterpact NW/NT Power, Trip Unit, and Remote Operation

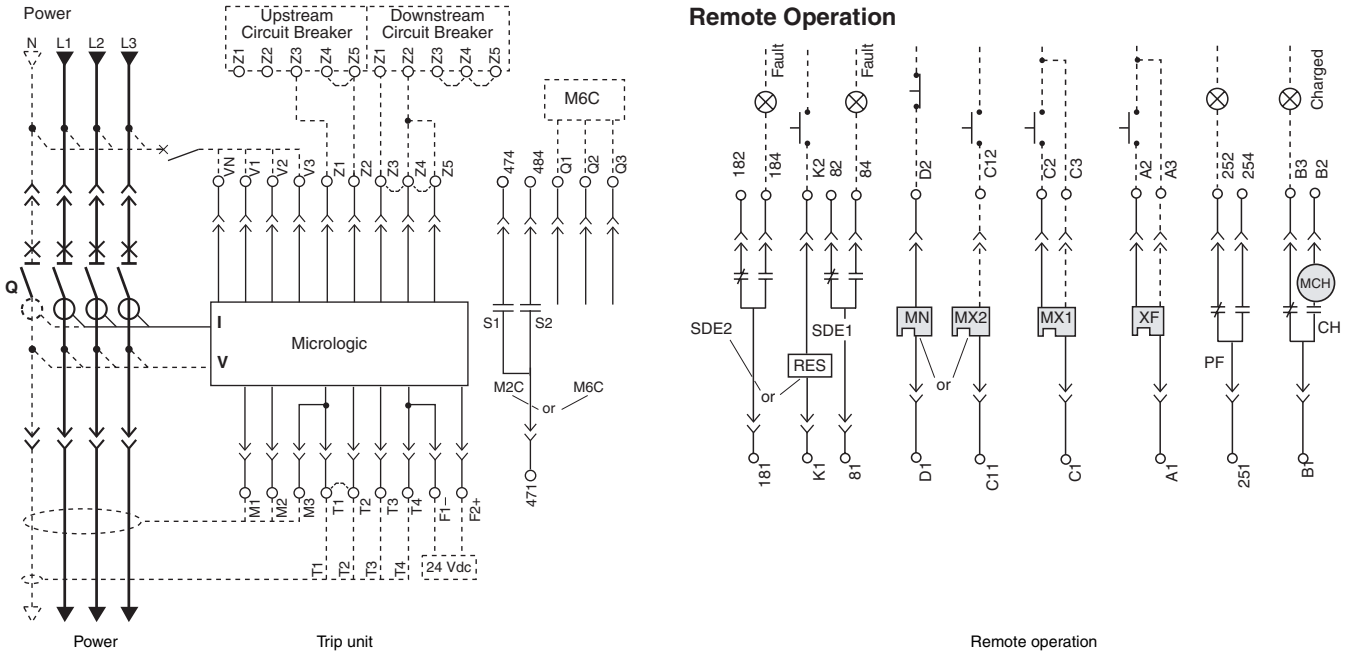
Figure 46: Masterpact NW Power, Trip Unit, and Remote Operation



COM		UC1		UC2		UC 3			M2C / M6C
E5	E6	Z5	M1	M2	M3	F2+		V3	484 / Q3
E3	E4	Z3	Z4	T3	T4	VN		V2	474 / Q2
E1	E2	Z1	Z2	T1	T2	F1-		V1	471 / Q1

SDE2 / Res	SDE1	MN / MX2	MX1	XF	PF	MCH
184 / K2	84	D2 / C12	C2	A2	254	B2
182 /	82	/	C3	A3	252	B3
181 / K1	81	D1 / C11	C1	A1	251	B1

Figure 47: Masterpact NT Power, Trip Unit, and Remote Operation



COM		UC1		UC2		UC3	UC4 / M2C / M6C
E5	E6	Z5	M1	M2	M3	F2+	V3 / 484 / Q3
E3	E4	Z3	Z4	T3	T4	VN	V2 / 474 / Q2
E1	E2	Z1	Z2	T1	T2	F1–	V1 / 471 / Q1

SDE2 / RES	SDE1	MN / MX2	MX1	XF	PF	MCH
184 / K2	84	D2 / C12	C2	A2	254	B2
182	82	C13	C3	A3	252	B3
181 / K1	81	D1 / C11	C1	A1	251	B1

NW/NT Circuit Breaker Trip Units and Remote Operation

Table 9: Basic A/P/H Trip Units

Basic	A	P	H	Trip Unit	
■	■	■	■	Com:	E1–E6 communication
	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	UC1:	Z1–Z5 logical selectivity Z1 = ZSI OUT Z2 = ZSI OUT Com; Z3 = ZSI IN Com Z4 = ZSI IN short-time delay Z5 = ZSI IN ground fault
	■	■	■	UC2:	T1, T2, T3, T4 = external neutral;
	■	■ ■	■ ■	UC3:	F2+, F1– 24 Vdc external power supply External neutral VN plug
		■	■	UC4	
		■	■	M2C	Two programmable contacts (internal relay)
		■	■	or M6C	Six programmable contacts (for connection to external M6C module)

Table 10: Remote Operation

SDE2 or Res	Electrical fault alarm contact Remote reset
SDE1	Electrical fault alarm contact (standard or over current trip switch)
MN or MX2	Undervoltage trip device Shunt trip device
MX1	Shunt trip device (standard or networked)
XF	Closing coil (standard or networked)
PF	Ready-to-close contact
MCH	Spring-charging motor

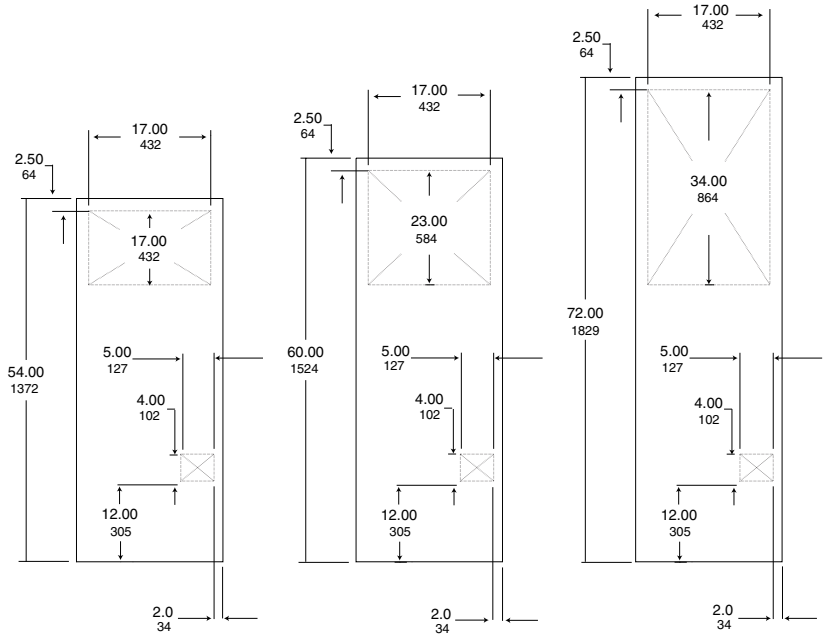
NOTE: When networked MX1 or XF coils are used, the third wire (C3, A3) must be connected even if the communications module is not installed.

SECTION 5 : DIMENSIONS

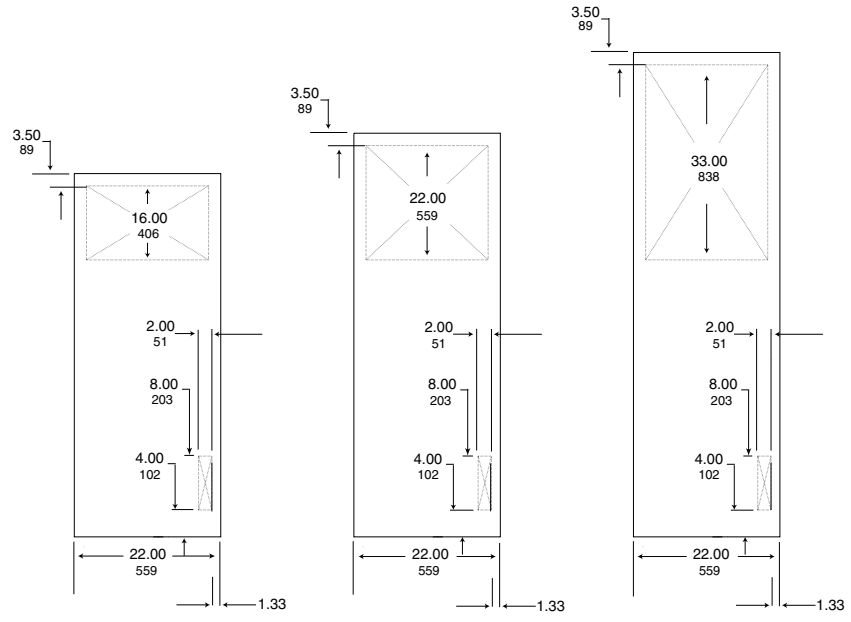
SECTION CONTENTS

TOP AND BOTTOM CONDUIT ENTRANCE LAYOUTS

Figure 48: Top and Bottom Conduit Entrance Dimensions (22-inch wide)– Not for Construction (consult factory drawings)

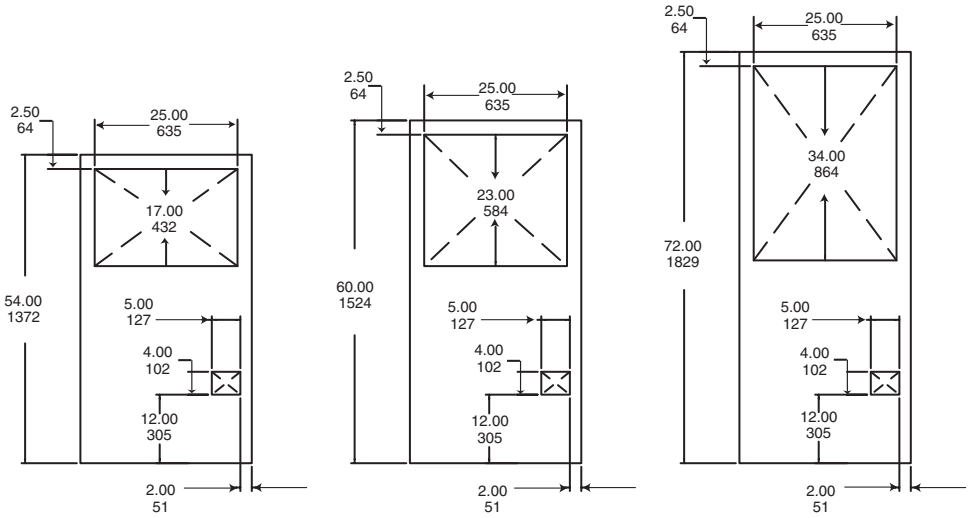


Top Conduit Entrance–Auxiliary Section (22-inch wide)

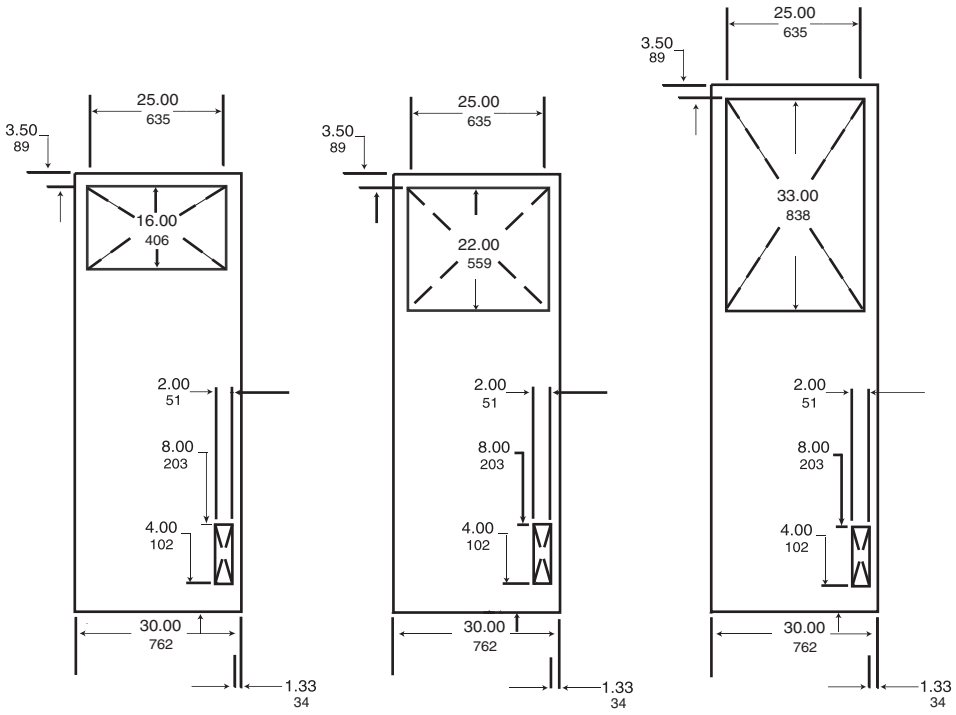


Bottom Conduit Entrance–Auxiliary Section (22-inch wide)

Figure 49: Top and Bottom Conduit Entrance Dimensions (30-inch wide)– Not for Construction (consult factory drawings)

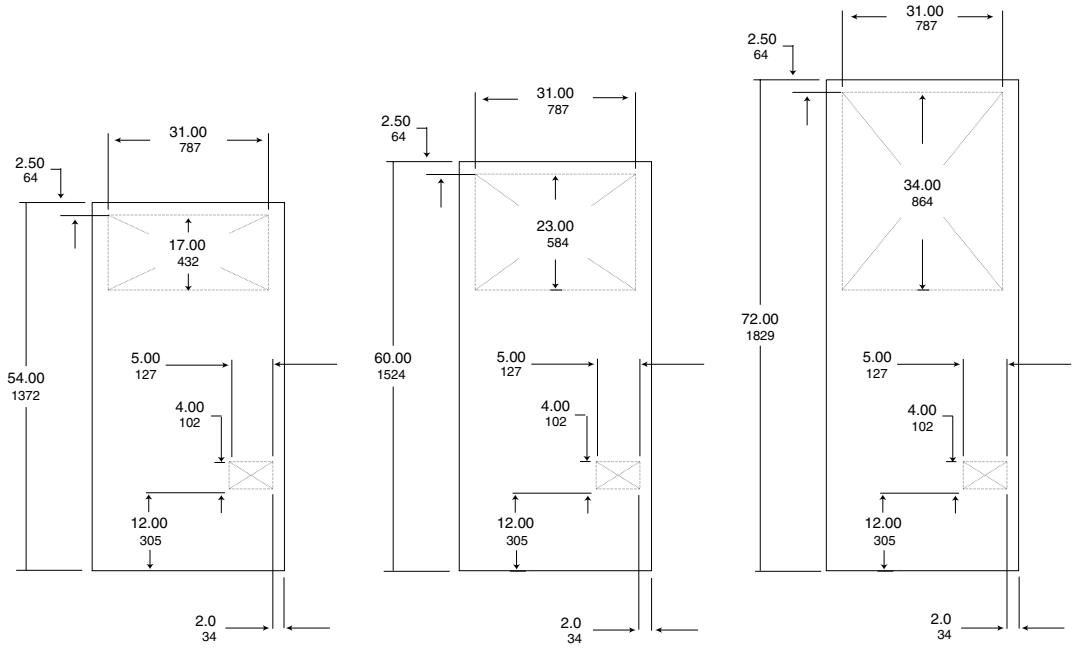


Top Conduit Entrance–Auxiliary Section (30-inch wide)

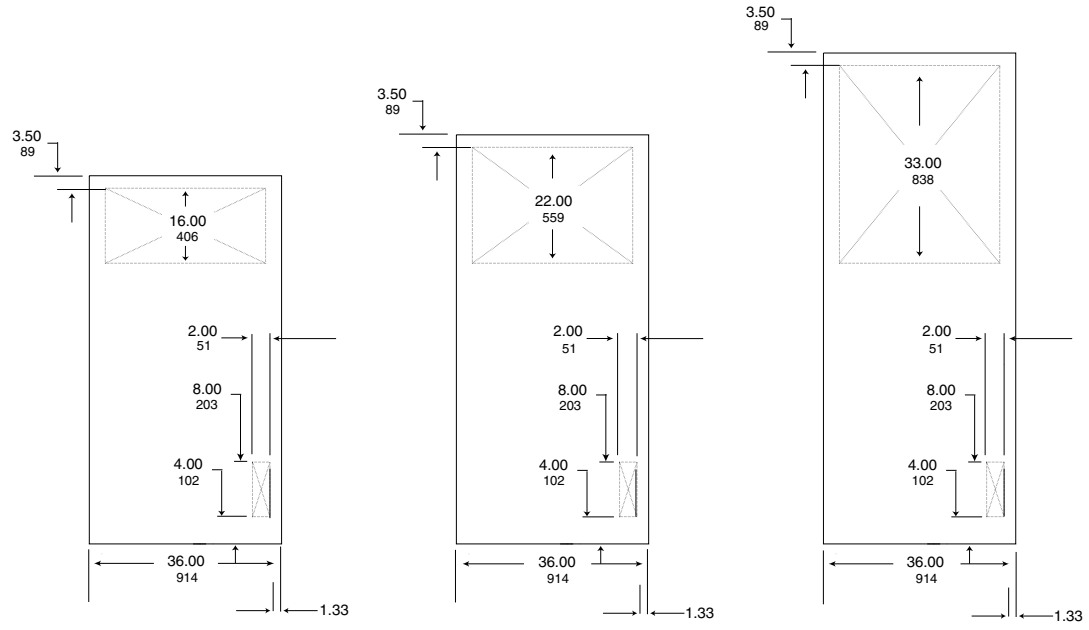


Bottom Conduit Entrance–Auxiliary Section (30-inch wide)

Figure 50: Top and Bottom Conduit Entrance Dimensions (36-inch wide)– Not for Construction (consult factory drawings)

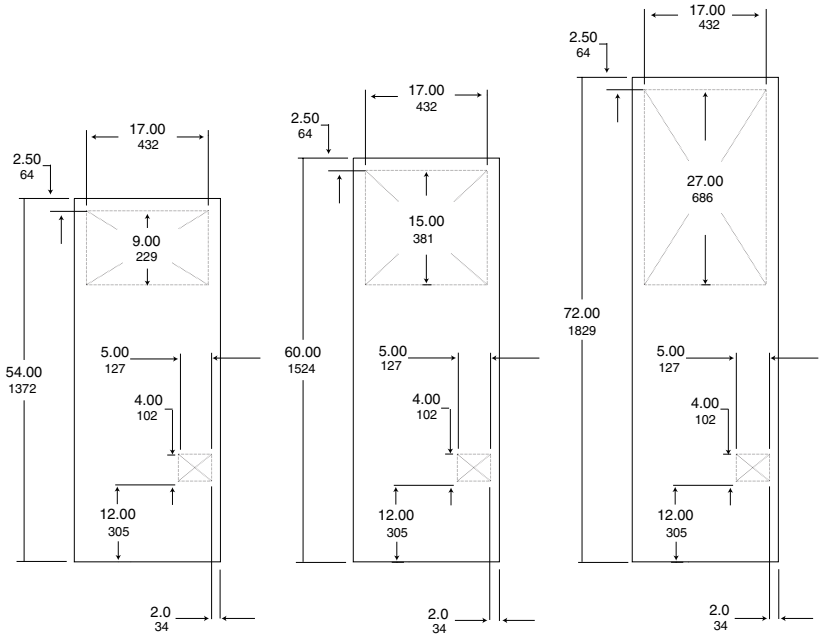


Top Conduit Entrance–Auxiliary Section (36-inch wide)



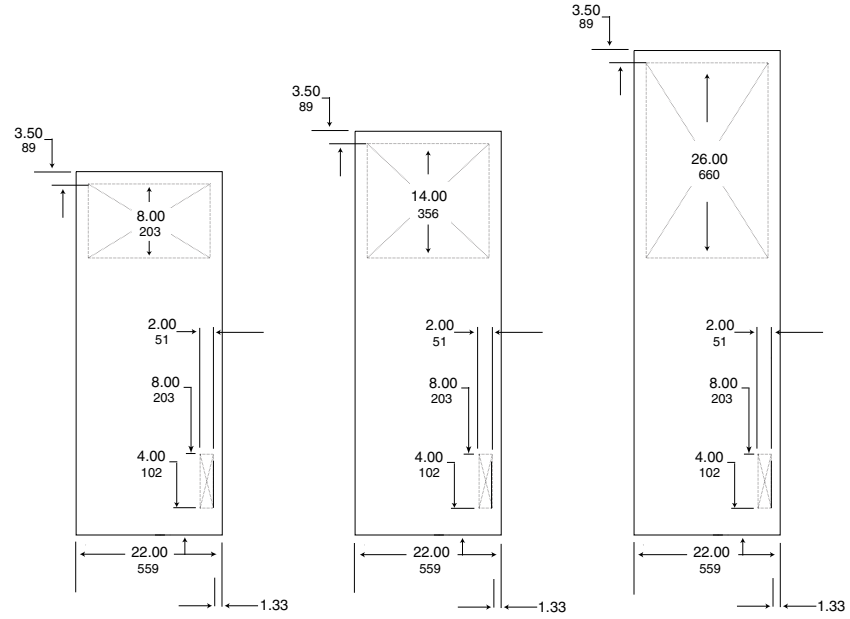
Bottom Conduit Entrance–Auxiliary Section (36-inch wide)

Figure 51: Top and Bottom Conduit Entrance Dimensions (22-inch wide Main, Tie, and Feeder Sections)– Not for Construction (consult factory drawings)



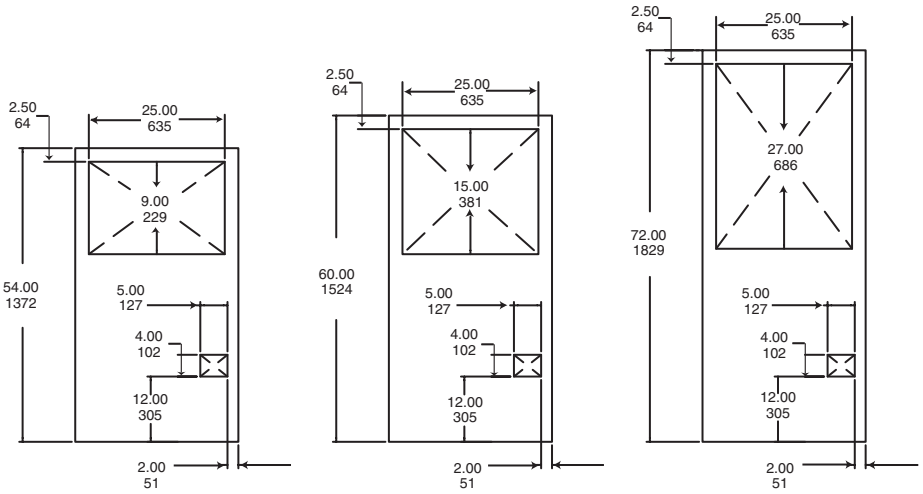
Top Conduit Entrance–Main, Tie, and Feeder Sections (22-inch wide)

NOTE: Top conduit entrance area is reduced when close-coupled with a transformer.



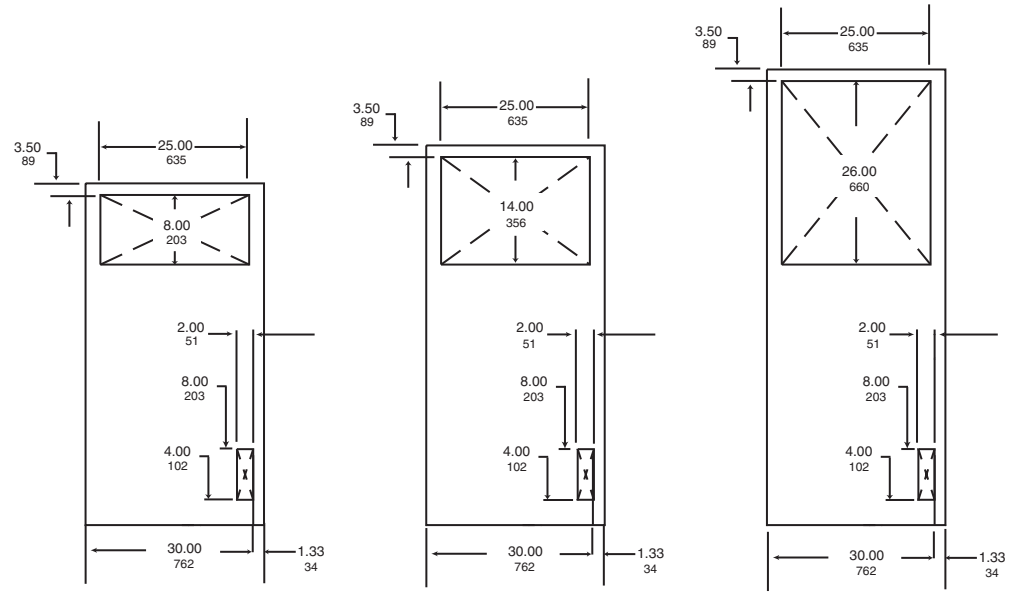
Bottom Conduit Entrance–Main, Tie, and Feeder Sections (22-inch wide)

Figure 52: Top and Bottom Conduit Entrance Dimensions (30-inch wide Main, Tie, and Feeder Sections)– Not for Construction (consult factory drawings)



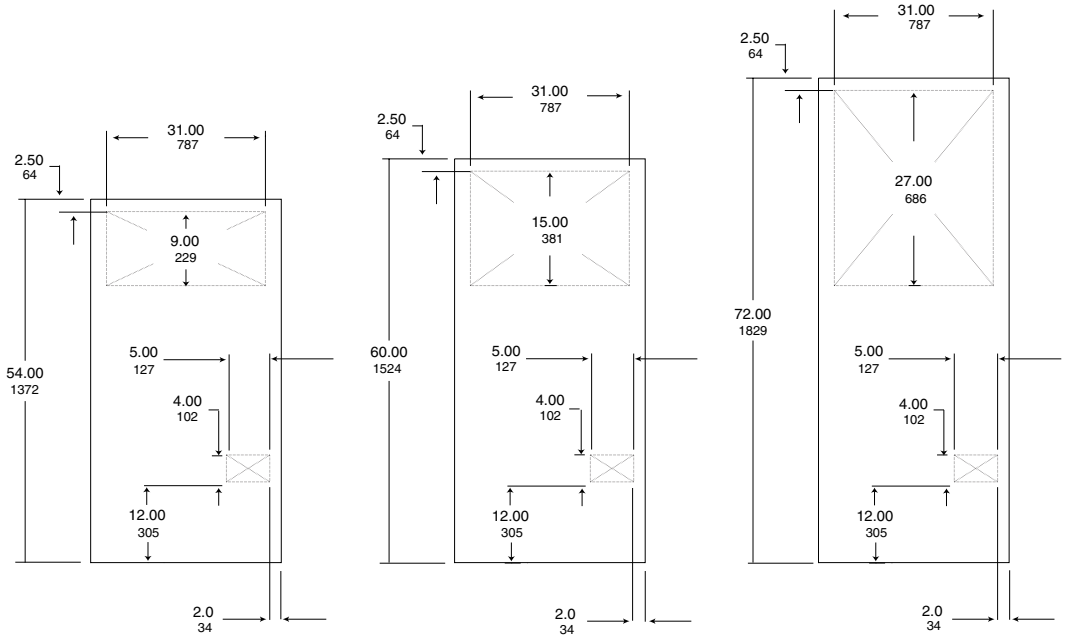
Top Conduit Entrance–Main, Tie, and Feeder Sections (30-inch wide)

NOTE: Top conduit entrance area is reduced when close-coupled with a transformer.



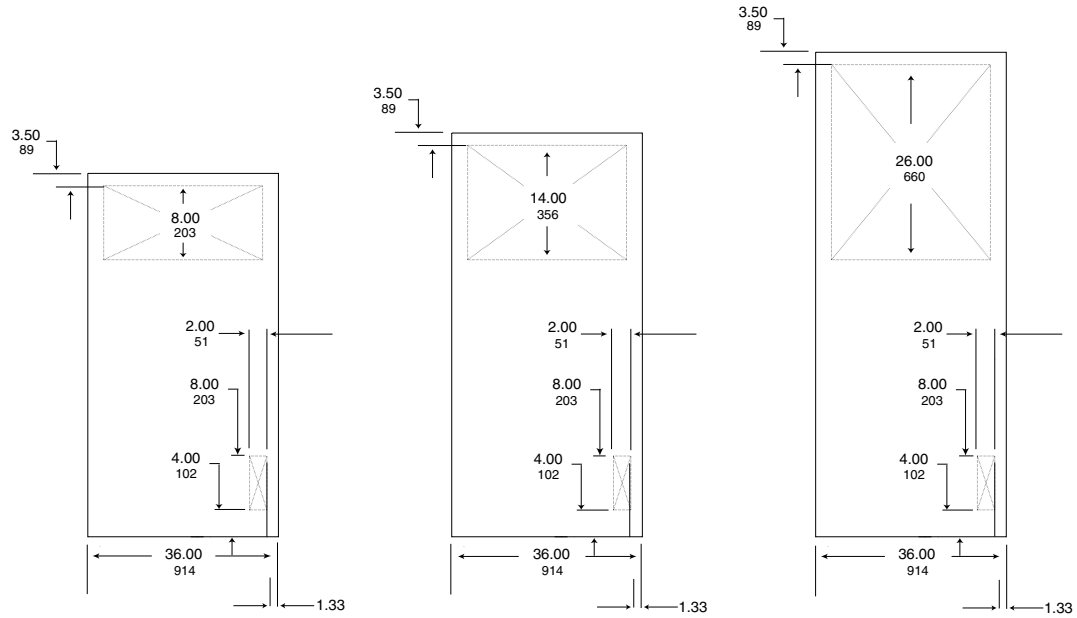
Bottom Conduit Entrance–Main, Tie, and Feeder Sections (30-inch wide)

Figure 53: Top and Bottom Conduit Entrance Dimensions (36-inch wide Main, Tie, and Feeder Sections)– Not for Construction (consult factory drawings)



Top Conduit Entrance–Main, Tie, and Feeder Sections (36-inch wide)

NOTE: Top conduit entrance area is reduced when close-coupled with a transformer.



Bottom Conduit Entrance–Main, Tie, and Feeder Sections (36-inch wide)

Figure 54: NEMA 3R Walk-in Low Voltage Switchboard/Switchgear Top Conduit Entrance Dimensions–Not for Construction (consult factory drawings)

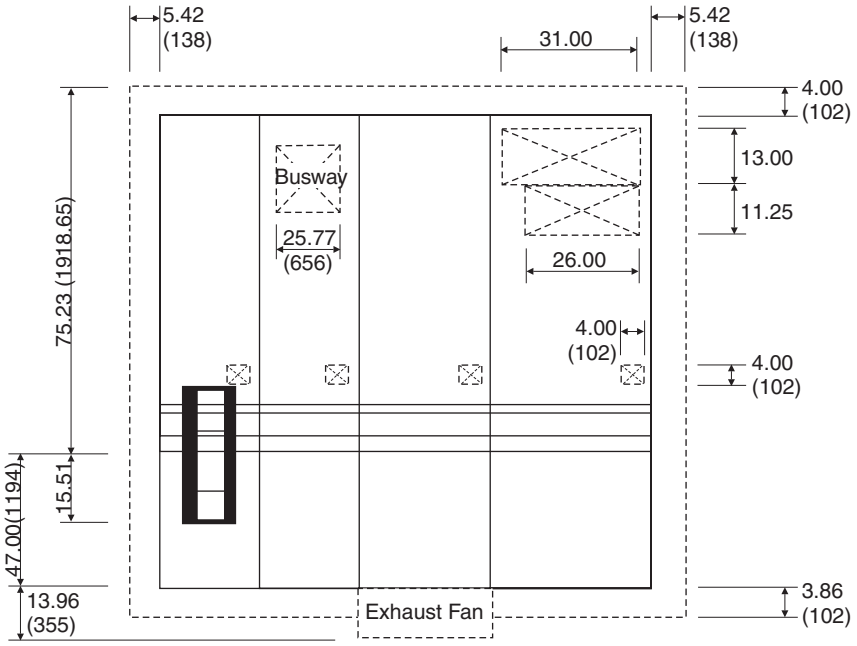


Figure 55: NEMA 3R Walk-in Low Voltage Switchboard/Switchgear Bottom Conduit Entrance Dimensions–Not for Construction (consult factory drawings)

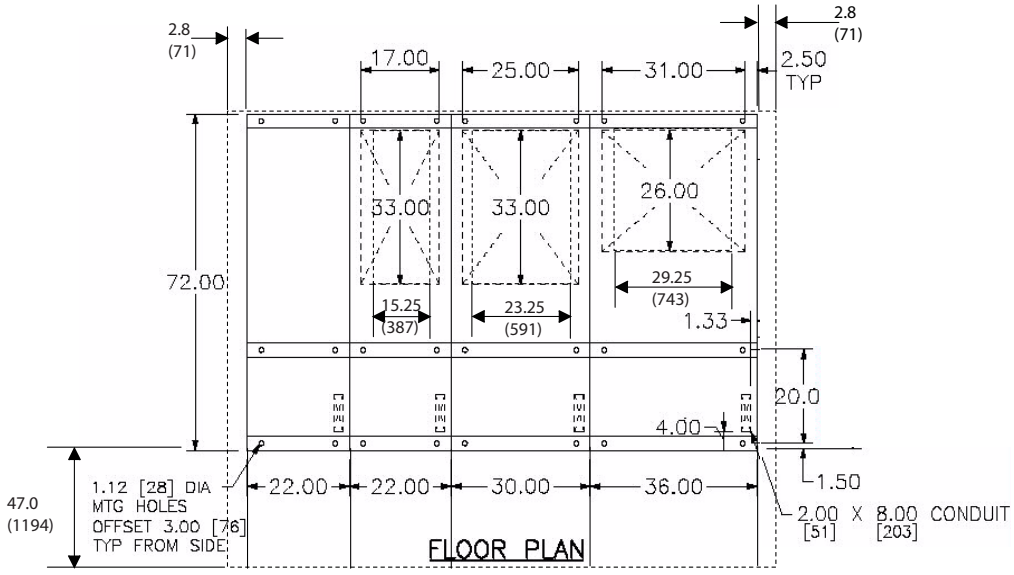
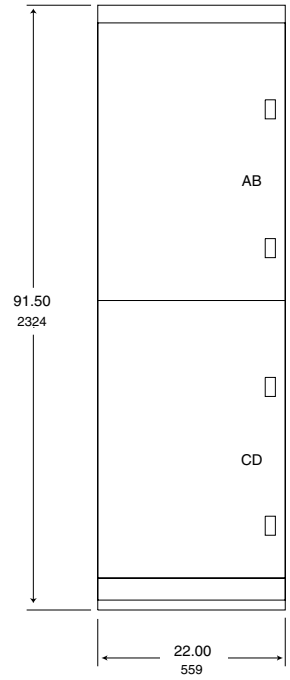


Figure 56: Front Elevation Dimensions–Not for Construction (consult factory drawings)



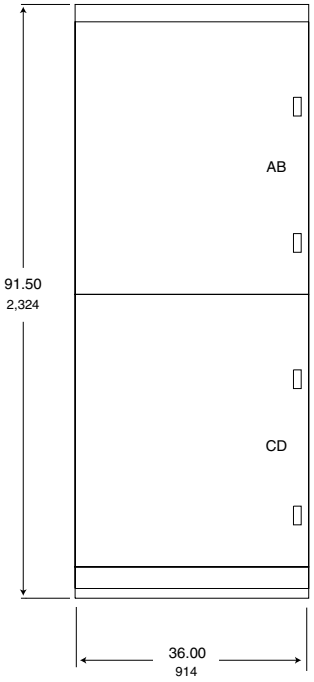
Typical Auxiliary Section–A
(22-inch wide)

Table 11: Typical Auxiliary–A (22-inch wide)

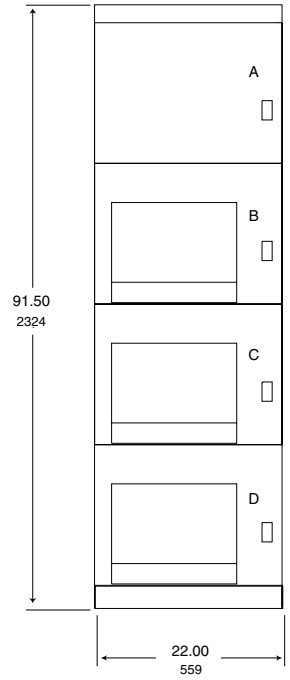
Location	Description
AB	Blank or instrument
CD	Blank or instrument

Table 12: Typical Auxiliary–B (36-inch wide)

Location	Description
AB	Blank or instrument
CD	Blank or instrument



Typical Auxiliary Section–B
(36-inch wide)



Typical Main and Tie Circuit Breakers–A
(22-inch wide)

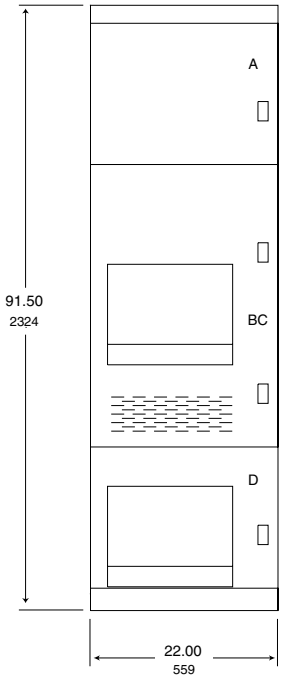
Table 11: Typical Main and Tie–A (22-inch wide)

Location	Description	Frame Size	Frame SCCR
A	Blank or instrument	–	–
B	Main or tie	800 A–2000 A	N1–H2, L1F, NT
C	Feeder	800 A–2000 A	N1–H2, L1F, NT
D	Feeder	800 A–2000 A	N1–H2, L1F, NT

Table 12: Typical Main and Tie–B (22-inch wide)

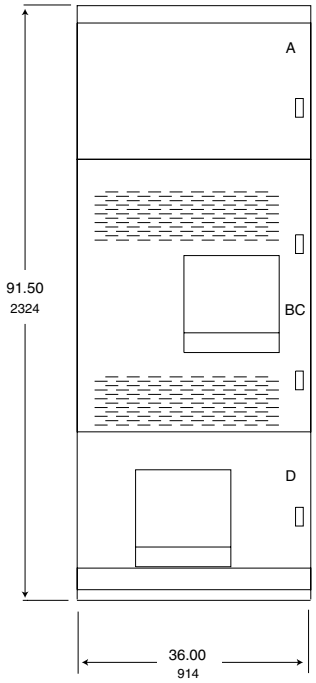
Location	Description	Frame Size	Frame SCCR
A	Blank or instrument	–	–
BC	Main or tie	3200 A	H1–H2
D	Feeder	800 A–2000 A	N1–H2, L1F, NT

NOTE: Any main, tie, or feeder compartment positions may be used as a blank, or instrument compartment. Not convertible for future circuit breaker use. Height including secondary wiring trough compartment is 93.7 inches (2380 mm).



Typical Main and Tie Circuit Breakers–B
(22-inch wide)

Figure 57: Front Elevation Dimensions–Not for Construction (consult factory drawings)



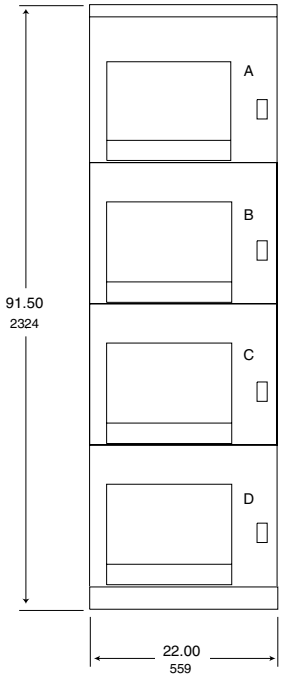
Typical Main and Tie Circuit Breakers–C (36-inch wide)

Table 13: Typical Main and Tie–C (36-inch wide)

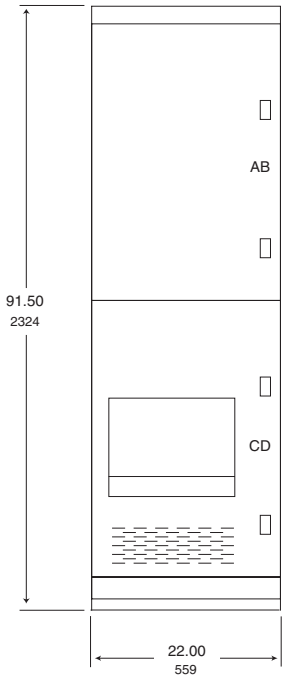
Location	Description	Frame Size	Frame SCCR
A	Blank or instrument	–	–
BC	Main or tie	4000 A–5000 A	H2
D	Feeder	800 A–2000 A	N1–H2

Table 14: Typical Feeder–A (22-inch wide)

Location	Description	Frame Size	Frame SCCR
A	Feeder	800 A–2000 A	N1–H2, L1F, NT
B	Feeder	800 A–2000 A	N1–H2, L1F, NT
C	Feeder	800 A–2000 A	N1–H2, L1F, NT
D	Feeder	800 A–2000 A	N1–H2, L1F, NT



Typical Feeder Circuit Breakers–A (22-inch wide)



Typical Feeder Circuit Breakers–B (22-inch wide)

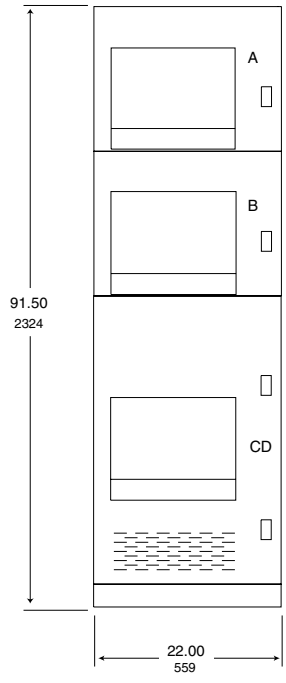
Table 15: Typical Feeder–B (22-inch wide)

Location	Description	Frame Size	Frame SCCR
AB	blank or instrument		
CD	Feeder	3200 A	H1–H2

Table 16: Typical Feeder–C (22-inch wide)

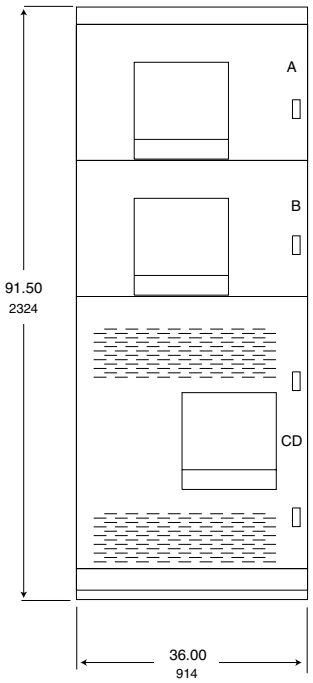
Location	Description	Frame Size	Frame SCCR
A	Feeder	800 A–2000 A	N1–H2, L1F, NT
B	Feeder	800 A–2000 A	N1–H2, L1F, NT
CD	Feeder	3200 A	H1–H2

NOTE: Any main, tie, or feeder compartment positions may be used as a blank, or instrument compartment. Not convertible for future circuit breaker use. Height including secondary wiring trough compartment is 93.7 inches (2380 mm).



Typical Feeder Circuit Breakers–C (22-inch wide)

Figure 58: Front Elevation Dimensions–Not for Construction (consult factory drawings)



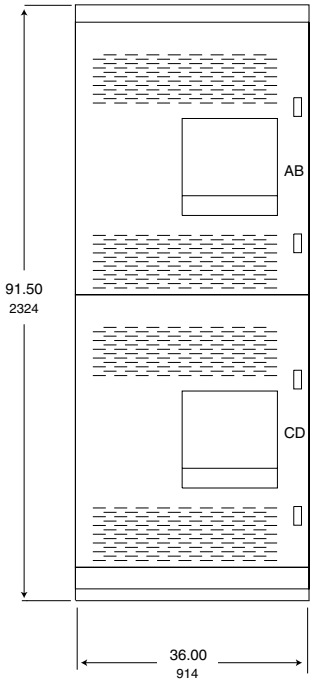
Typical Feeder Circuit Breakers–D (36-inch wide)

Table 17: Typical Feeder–D (36-inch wide)

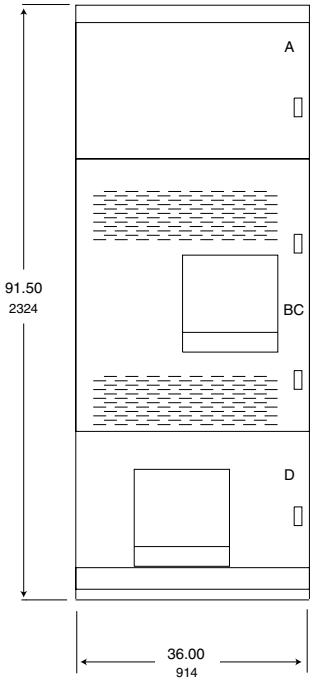
Location	Description	Frame Size	Frame SCCR
A	Feeder	800 A–2000 A	N1–H2, L1F
B	Feeder	800 A–2000 A	N1–H2, L1F
CD	Feeder	4000 A–5000 A	H2

Table 18: Typical Feeder–E (36-inch wide)

Location	Description	Frame Size	Frame SCCR
AB	Feeder	4000 A–5000 A	H2
CD	Feeder	4000 A–5000 A	H2



Typical Feeder Circuit Breakers–E (36-inch wide)



Typical L1 Main and Tie Circuit Breakers–A (36-inch wide)

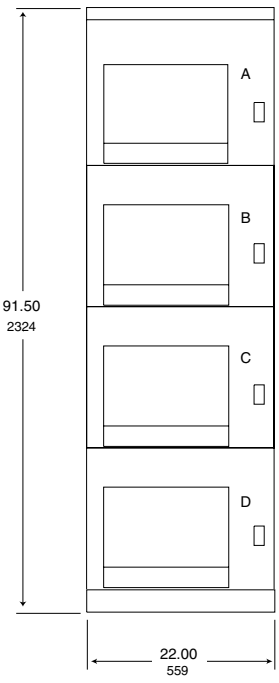
Table 19: Typical L1 Main and Tie–A (200 kA @ 480 V) (36-inch wide)

Location	Description	Frame Size	Frame SCCR
A	Blank or instrument	–	–
BC	Main or tie	2000 A–5000 A	L1
D	Feeder	2000 A	L1, L1F

Table 20: Typical L1 Feeder–A (200 kA @ 480 V) (22-inch wide)

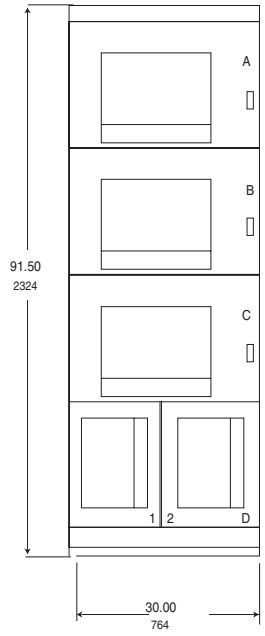
Location	Description	Frame Size	Frame SCCR
A	Feeder	800 A–2000 A	L1, L1F
B	Feeder	800 A–2000 A	L1, L1F
C	Feeder	800 A–2000 A	L1, L1F
D	Feeder	800 A–2000 A	L1, L1F

NOTE: Any main, tie, or feeder compartment positions may be used as a blank, or instrument compartment. Not convertible for future circuit breaker use.Height including secondary wiring trough compartment is 93.7 inches (2380 mm).



Typical L1 Feeder Circuit Breakers–A (22-inch wide)

Figure 59: Front Elevation Dimensions–Not for Construction (consult factory drawings)



Typical Feeder Circuit Breakers
(30-inch wide)

Table 19: Typical Feeder–F (30-inch wide)

Location	Description	Frame Size	Frame SCCR
A	Feeder	800 A–2000 A	N1–H2, L1F
A1/A2	Feeder	800 A NT	N1
B	Feeder	800 A–2000 A	N1–H2, L1F
B1/B2	Feeder	800 A NT	N1
C	Feeder	800 A–2000 A	N1–H2, L1F
C1/C2	Feeder	800 A NT	N1
D	Feeder	800 A–2000 A	N1–H2, L1F
D1/D2	Feeder	800 A NT	N1

NOTE: Dimensions–Not for Construction (consult factory drawings)

Figure 60: Front View, NEMA 3R Walk-in Low Voltage Switchboard/Switchgear

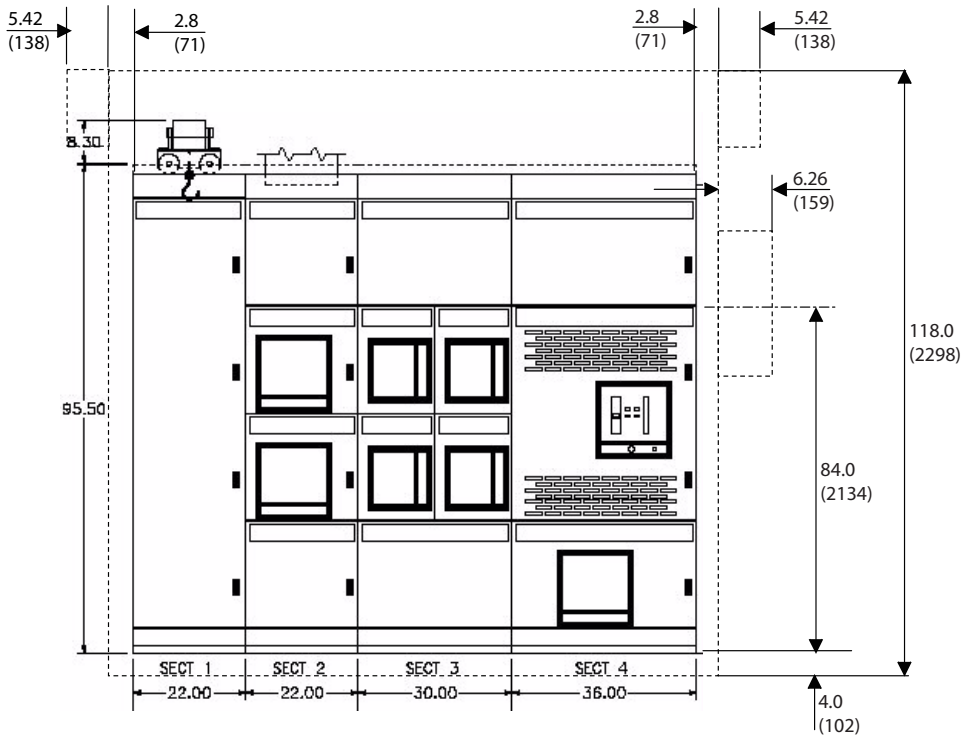
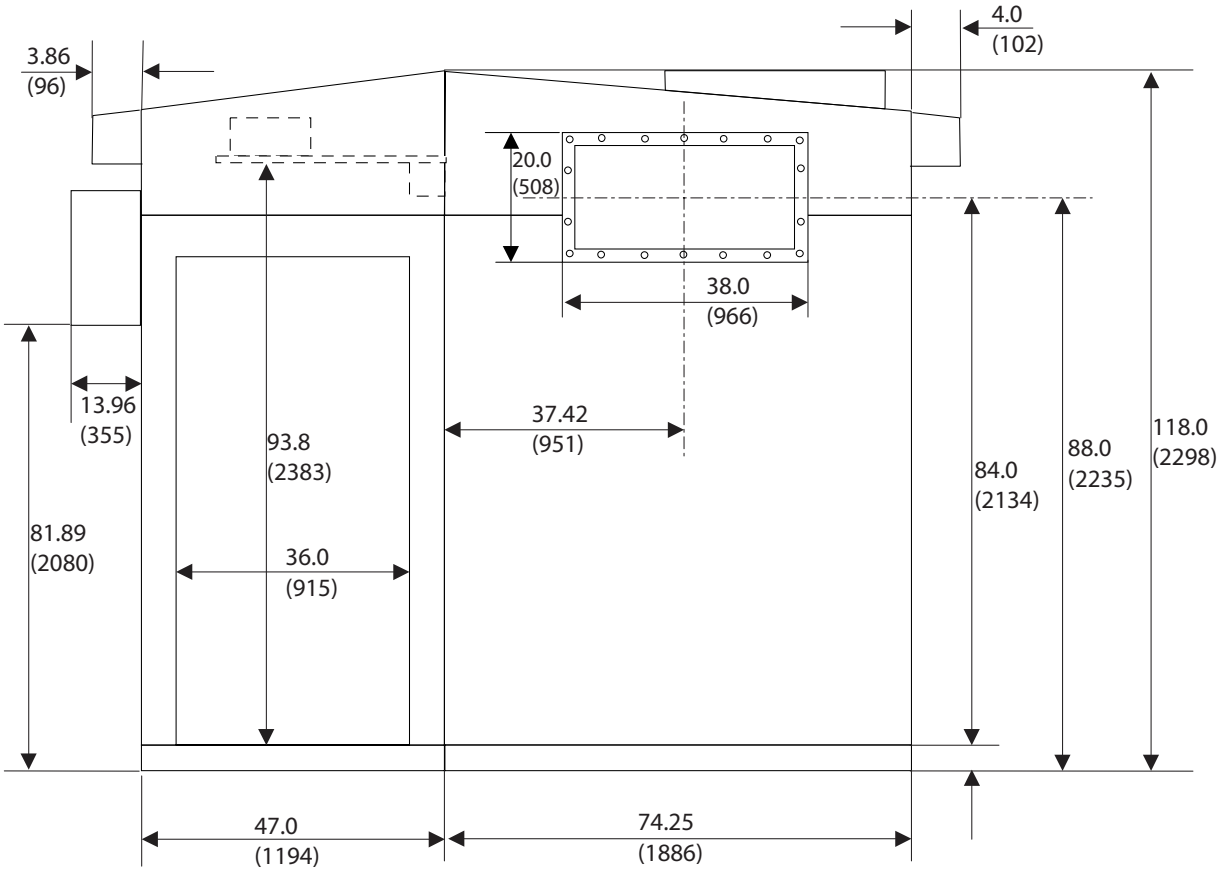
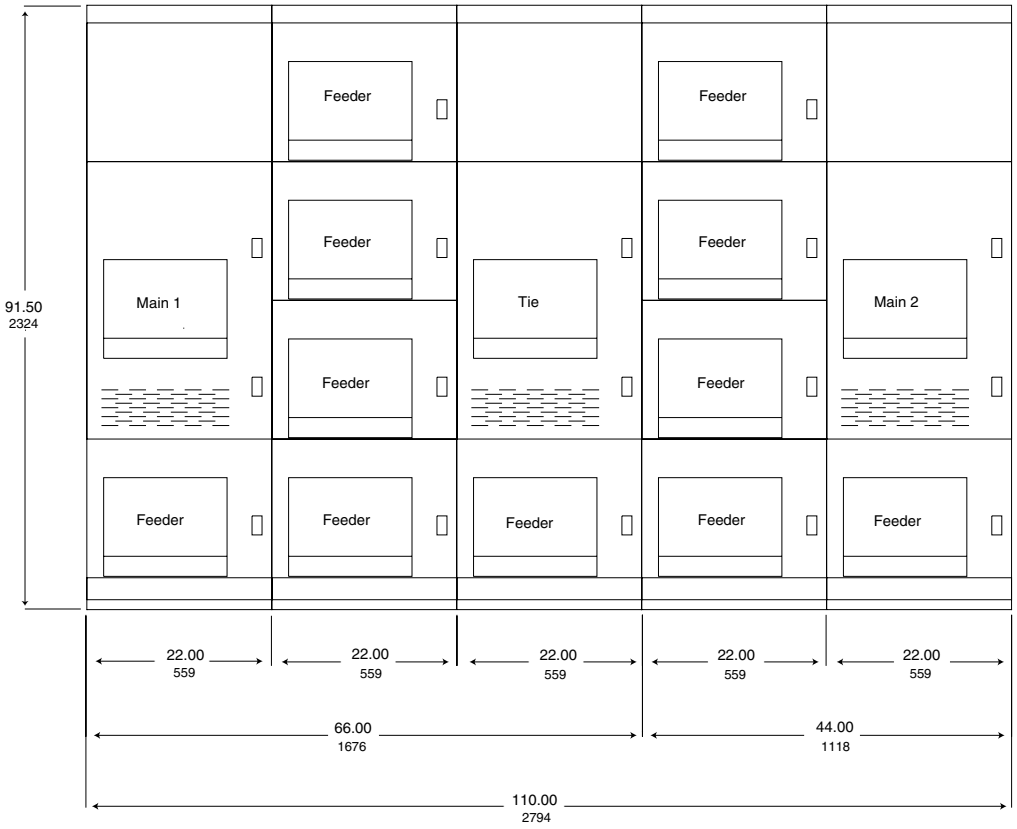


Figure 61: Right Side View, NEMA 3R Walk-in Low Voltage Switchboard/Switchgear



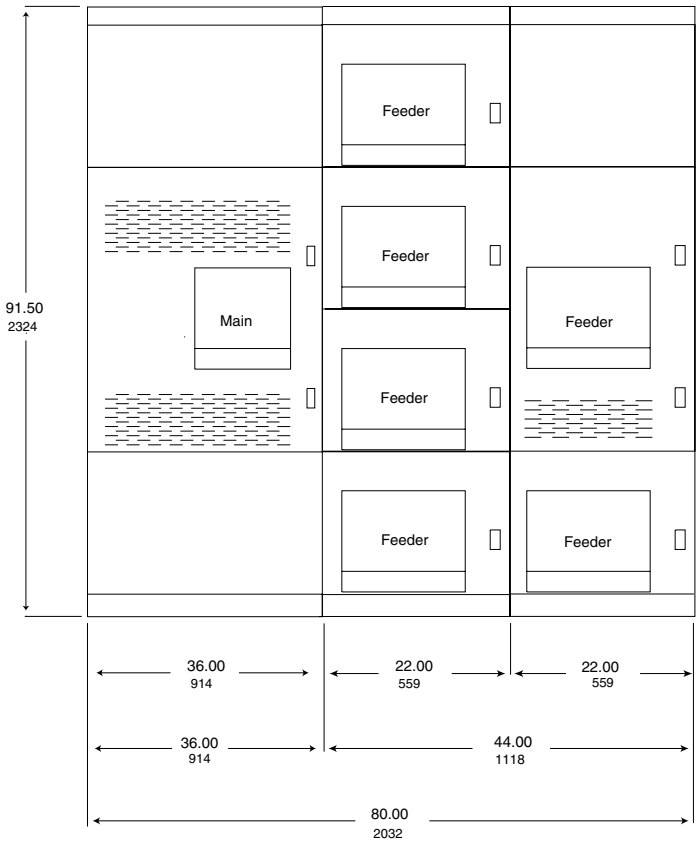
SYSTEM DESIGN

Figure 62: Front Elevation Dimensions–Not for Construction (consult factory drawings)



Typical 5 Bay Representation (22-inch wide) with 3200 A Main-Tie-Main, Double-ended Lineup

Figure 63: Front Elevation Dimensions–Not for Construction (consult factory drawings)



Typical 3 Bay Representation (36-inch and 22-inch wide)

WEIGHTS

Refer to the shipping documents for the correct weights and dimensions. The weights given here are approximate values. Consult shipping documents for actual weights.

Table 20: Switchgear 4 High without Circuit Breakers

Bus Rating	22 Wide		36 Wide	
	lbs	Kg	lbs	Kg
1600 A–2000 A	1200	545	1300	591
3200 A	1400	636	1500	682
40000 A–5000 A	1700	773	1800	818

Table 21: Masterpact NW Circuit Breaker Weights

Amperes	Lbs.	Kg.
800	110	50
1600	110	50
2000	110	50
3200	110	50
2000 ①	230	105
3200 ①	230	105
4000 ①	230	105
5000 ①	230	105
①6 Pole (double-wide)		

Table 22: Masterpact NT Circuit Breaker Weights

Amperes	Lbs	Kg
800	40	18

SECTION 6 : SUGGESTED SPECIFICATIONS

SECTION CONTENTS

GENERAL

This specification and associated drawings describe Power-Zone 4 switchgear constructed to ANSI C37.20.1 industry standards. The main components of the switchgear are Masterpact® NW and NT circuit breakers.

NOTE: Square D Type Masterpact circuit breakers are described in "Square D Specifications, Section 16410-5–Low Voltage Power Circuit Breakers".

Standards

Power-Zone 4 switchgear equipment shall be designed, tested, and manufactured according to the following standards.

Standard	Description
ANSI C37.20.1	Metal-enclosed low voltage circuit breaker switchgear
ANSI C.37.51	Testing of metal-enclosed low voltage ac circuit breaker switchgear
NEMA SG-5	Power switchgear assemblies
CAN/CSA C22.2 No. 31-M89	Switchgear assemblies
UBC and CBC	Zone 4 seismic applications
UL 1558	Switchgear assemblies

Main and feeder Masterpact NW and NT circuit breakers used in Power-Zone 4 switchgear shall be designed, tested, and manufactured to the following standards.

Standard	Description
ANSI C37.13	Low voltage ac power circuit breakers used in equipment
ANSI C37.16	Preferred rating, related requirement and application recommendations for low voltage power circuit breakers and ac power circuit breakers
ANSI C37.17	Trip devices for ac and general-purpose dc low voltage power circuit breakers
ANSI C37.50	Testing of low voltage ac circuit breakers
NEMA SG-3	Low voltage circuit breakers
UL 1066	Low voltage circuit breakers

Ratings

Power-Zone 4 switchgear available ampacity ratings are outlined below.

System Ampacity
1600
2000
3200
4000
5000

The short-circuit current rating of the system shall be determined by the available fault current at the Power-Zone 4 switchgear. All circuit interruption shall be accomplished by the Masterpact circuit breakers without the aid of limiter fuses. The short-time rating shall also be a function on the desired selectivity of the electrical system. Short-time ratings shall be equal to interrupting ratings for systems delivering up to 85 kA available fault current.

Available short-circuit current ratings are outlined below.

Short-Circuit Current Rating			Short-Time	Close and Latch
240 V	480 V	600 V		
42 kA	42 kA	42 kA	42 kA	42 kA
65 kA	65 kA	65 kA	65 kA	65 kA
85 kA	85 kA	85 kA	85 kA	50 kA
200 kA	200 kA	130 kA	30 kA (minimum)	22 kA (minimum)

Powerzone 4 switchgear is designed for use on 50 Hz or 60 Hz electrical systems up to 600 Vac and shall be properly braced to the ratings of the Masterpact NW and NT circuit breakers installed within the switchgear.

PRODUCTS

Manufacturers

Power-Zone 4 switchgear shall be manufactured by Schneider Electric company. The Masterpact NW and NT circuit breakers shall be manufactured by Schneider Electric company.

Structure

Structure specifications for the Power-Zone 4 switchgear are outlined below.

General

A. Each steel section of the switchgear shall contain one or more individual circuit breaker compartments or auxiliary instrument compartments, as well as a bus compartment and rear compartment for outgoing cable connections.
B. A rigid removable steel base channel shall be provided at the front and rear of each section.
C. The exterior and interior switchgear finish shall be medium ANSI #49 gray.

Dimensions

A. Section widths shall be 22-inches, 30-inches, or 36-inches wide, depending on the size of the Masterpact NW and NT circuit breakers being installed in the switchgear.
B. The switchgear lineup shall provide adequate wire bending space for main and feeder Masterpact NW and NT circuit breakers using up to 750 kcmil wires.
C. Section depth shall be 54-inches minimum when using 800 A feeders. Additional depth to the lineup shall be for the sole purpose of additional wire bending and conduit space.
D. Adequate conduit space that allows all conductors to exit the section at the same location.

Moving and Handling

A. The switchgear lineup shall be divided into shipping splits not to exceed 88-inches wide and shall be capable of being lifted overhead or by using a forklift.
B. Each shipping split shall have removable lifting straps.
C. Removable base channels shall be provided with prying slots for ease of final positioning at the job site.
D. For Masterpact NW and NT circuit breakers, an overhead lifter or floor crane shall be provided to ease the installation or removal of circuit breakers in excess of 75 pounds.

Circuit Breaker Compartment

Power-Zone 4 switchgear circuit breaker compartments shall contain Masterpact NW and NT circuit breakers with Micrologic trip units.

Masterpact NW and NT Circuit Breakers

A. Each circuit breaker shall be mounted in its own barriered compartment.
B. Feeder circuit breakers rated 2000 A or less shall be capable of being mounted in the uppermost compartment without de-rating.
C. The front of the circuit breaker shall protrude through the door of the switchgear allowing access to circuit breaker controls, indicators, and the trip unit.
D. The design shall allow for closed door racking in circuit breaker compartments.
E. Circuit breakers of like frames shall be interchangeable, as standard.
F. Prepared circuit breaker compartments shall include the racking mechanism, bussing, and secondary contacts, as necessary.
G. Circuit breaker and prepared circuit breaker compartments shall be “keyed” to avoid insertion of circuit breakers with similar dimensions but insufficient interrupting ratings, or incorrect frame sizes into an inappropriate circuit breaker compartment.
H. Up to eight (8) physically smaller frame circuit breakers (rated 800 A or less) may be mounted in a 30-inch wide section when fault current interrupting ratings permit. When these smaller sized circuit breakers are used, all requirements listed above shall still be met.

Secondary Connections

A. All customer secondary control and communications connections shall be made from the front of the switchgear lineup.
B. A dedicated wiring channel accessible from the front of the switchgear shall allow easy access to all control or communications terminations.
C. Control connections shall be either cage clamp or optional ring tongue terminals. All control wire shall be #14 gauge SIS.
D. Dedicated conduit entry for control wires shall be provided at the top and bottom of each section, capable of landing up to four 3/4-inch conduits and accessible from the front of the switchgear.
E. All interconnections between switchgear sections at shipping splits shall use locking, pull-apart type terminal blocks.
F. All secondary and communication wiring shall be securely fastened to the switchgear with minimal use of adhesive backed wire anchors. Adhesive backed anchors shall be allowed on doors to aid in wire routing.

Instrumentation

A. Where additional space is required for instrumentation, such as CPTs and metering, a barriered auxiliary instrumentation compartment shall be used in the switchgear.
B. The auxiliary instrumentation compartment shall not inhibit the routing of control or communication wires.

Bus Compartment

A. All vertical and cross bus shall be rated for the full ampacity of the switchgear lineup.
B. All bus joints shall consist of grade 5 hardware and conical washers to withstand mechanical forces exerted during short circuits. All bus joints shall consist of a minimum of 2 bolts.
C. Bus shall be plated along its entire length.
D. Bus shall be braced to withstand the instantaneous interrupting rating of the main breaker(s) or 65 kA minimum.
E. Optional barriers shall be available to separate the bus and cable compartments.

Cable Compartment

A. All incoming or outgoing power conductors shall be routed through the rear cable compartment.

B. Feeder circuit breakers shall have adequate wire bending space, regardless of the circuit breaker interrupting rating.

The table below lists the section depth needed to meet wire bending requirements.

Feeder Circuit Breaker	Section Depth (inches)
800 A (max.)	54
4000 A (max.)	60
4000 A (max.)	72 (optional)
4000 A (max.)	80 (optional)

C. The conduit area for each section shall be a minimum of 17-inches wide and provide adequate depth for all section conduits.

D. Select depth based on the table requirements listed below. The dimensions in the table indicate approximate conduit area for cable fed mains and feeders. All dimensions are in inches.

Section Width (inches)	Section Depth			
	54-inches	60-inches	72-inches	80-inches
22	17 W x 8 D	17 W x 14 D	17 W x 26 D	17 W x 34 D
30	25 W x 8 D	25 W x 14 D	25 W x 26 D	25 W x 34 D
36	31 W x 8 D	31 W x 14 D	31 W x 26 D	31 W x 34 D

E. Barriers to separate the cable compartment from the adjacent cable compartment shall be available for the switchgear assembly.

Circuit Breakers and Trip Units

Masterpact NW and NT Circuit Breakers

A. Circuit breakers shall be Masterpact® NW and NT circuit breakers. Listed to UL 1066.

B. Circuit breakers shall be suitable for the required instantaneous rating without the use of external current limiting fuses.

C. All circuit breakers shall have field interchangeable electrical accessories, including shunt trip, auxiliary contacts, electrical operating mechanism, shunt close, and trip unit.

D. All secondary connections shall be made directly to the front of the circuit breaker cradle.

E. Each circuit breaker shall have built-in contact temperature sensors and contact wear indicators.

Micrologic (Basic, Type A, Type P, and Type H) Trip Units

A. All trip units shall be removable to allow for field upgrades.

B. Trip units shall incorporate “true RMS sensing,” and have LED long-time pickup indications.

C. The table on page 95 lists the standard and optional trip unit features for Micrologic Type A (ammeter), Type P (Power Metering), and Type H (Harmonics) trip units for use in Power-Zone 4 switchgear.

Select the appropriate trip unit(s) for the system performance desired.

Functions	Basic	Type A	Type P	Type H
True RMS sensing	X	X	X	X
LI trip configuration	X	X	X	X
LSI	O	O	X	X

Functions	Basic	Type A	Type P	Type H
LSIG/ground fault trip	–	O	X	X
Ground fault alarm (no trip)	–	–	X	X
Ground fault trip and programming alarm	–	–	O	O
Adjustable rating plugs	X	X	X	X
LED – long–time pickup	X	X	X	X
LED – trip indication	–	X	X	X
Digital ammeter	–	X	X	X
Phase loading bar graph	–	X	X	X
Zone selective interlocking	–	X	X	X
Communications	–	O	X	X
LCD dot matrix display	–	–	X	X
Advanced user interface	–	–	X	X
Protective relay functions	–	–	X	X
Thermal imaging	–	–	X	X
Contact wear indication	–	–	X	X
Temperature indication	–	–	X	X
Incremental fine tuning of settings	–	–	X	X
Selective long-time delay bands	–	–	X	X
Power measurement	–	–	X	X
Waveform capture	–	–	–	X
Data logging	–	–	–	X

Table Values:

– Not Applicable

X Standard Feature

O Optional Feature

Metering and Instrumentation

Metering and communication requirements for Power-Zone 4 switchgear are listed below.

Main Metering

A. Metering requirements that exceed the capabilities of the circuit breaker trip units shall use the optional Powerlogic® Power Monitoring System.
B. Three metering current transformers shall be appropriately sized for use on the incoming section.
C. Separate low voltage HMI and circuit monitor display shall be mounted near the incoming section.
D. Optional input/output (I/O) and the Ethernet communications card shall be provided as necessary.

Communications

A. Internal communications in the switchgear shall be Modbus® protocol.
B. Where necessary, an Ethernet gateway shall be located near the switchgear assembly and be capable of accepting inputs from the Micrologic® trip unit(s), Powerlogic circuit monitor(s), and Modicon PLCs.

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P

R

S

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Replaces 6037CT9901R9/02

11/2005