T54 - Short Circuit Protection Device Options

PUBLIC INFORMATION
Why are Disconnect Switches and Circuit Breakers Used

Disconnect Switch and Circuit Breaker Overview

How are Disconnect Switches and Circuit Breakers Applied

Standards and Short Circuit Current Ratings

Summary
Why are Disconnect Switches and Circuit Breakers Used?

- **What is a short circuit?**
  - An over-current fault that exceeds normal full load currents... 10x, 100x, 1,000x of FLC
  - Catastrophic results if short circuit faults are not cleared properly

- **What are short circuit protection devices?**
  - Designed to protect an electrical circuit from damage caused by overload or short circuit
  - Basic function is to detect a fault condition and interrupt current flow
Why are Disconnect Switches and Circuit Breakers Used?

**Short-circuit protection devices can be classified into two groups:**

1. **Fuses (Disconnect Switches)**
   - Operate once and then must be replaced
     - Non-time Delay Fuse
     - Dual Element (Time Delay) Fuse

2. **Circuit Breakers**
   - Can be reset (either manually or automatically) to resume normal operation
     - Instantaneous Trip (Magnetic-only) Circuit Breaker
     - Inverse Time (Thermal-magnetic) Circuit Breaker
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Summary
Disconnect switches and molded case circuit breakers are used for three primary functions in industrial control applications.

1. Isolation
   - Isolation of the control panel from the supply voltage
   - Isolation of the branch circuit from the feeder

2. Short Circuit Protection
   - Protect the feeder wiring against damage from short circuits
   - Protect the branch circuit against damage from short circuits

3. Thermal Protection
   - Provide overcurrent (thermal protection of wires in the feeder)
   - Provide protection of the branch circuit conductors
Circuit Breaker

Definition

- Circuit Breaker
  - Defined by UL 489 and NEMA
    - “A device designed to open (OFF) and close (ON) a circuit by non-automatic means (manual) and to open the circuit automatically on a predetermined overcurrent, without injury to itself when properly applied within its rating.”
  - Defined by (IEEE)
    - “A circuit breaker that is assembled as an integral unit is a supporting and enclosed housing of insulating material.”
Circuit Breaker Terminology

- Molded Case Circuit Breaker - MCCB
  - Feeder Distribution & Branch Circuit Protection (conductors, bus & cable)
    - Short Circuit Protection
    - Overcurrent Protection - calibrated for distribution applications
    - Disconnect Applications

- Molded Case Switch - MCS
  - Isolation Switch - Self-protected on Short Circuit Fault

- Motor Protection Circuit Breaker - MPCB
  - Motor Protection and Short Circuit Protection
    - Short Circuit Protection
    - Overload Protection - calibrated for motor overload applications
    - Manual Controller (ON/OFF)

- Motor Circuit Protector - MCP
  - Branch Circuit Protection Only
    - Short Circuit Protection Only (magnetic trip only)
    - Adjustable settings approximately 6..12 X FLA
    - Motor Overload protection provided with separate overload relay (e.g. 193-E)
Disconnect Switch

Definition

- Disconnect Switch
  - Defined by UL 98, CSA 22.2
    - “A device intended to remove motors, motor controllers and other loads from a supply circuit; may be fused or non-fused type.”
  - Defined by IEC 60947-3
    - “A device that makes, carries and breaks current in an open position satisfying isolating requirements.”
Disconnect Switch Terminology

- Load switch – makes, carries and breaks current
- Disconnect - a switch that makes, breaks and isolates a load
- Fused switch - a disconnect with provisions for fuses
- Disconnector - disconnects inductive loads
- Isolator - switch isolates load from power; cannot break a load
- Control switch - breaks resistive or slightly inductive loads
- At-motor disconnect - a disconnect located at the motor (UL98)
- Safety switch - an inexpensive, enclosed switch
- Service entrance disconnect - a fused disconnect to remove all conductors in a building from the electric supply
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Disconnect Switches & Circuit Breakers

Industrial Control Applications

MCCBs used for Feeder Protection

Fuses used for Feeder Protection
Short Circuit Protective Device Service and Maintenance Comparison

- Molded Case Circuit Breakers
  - Recommended Annual inspection
    - Main breaking parts not replaceable
  - Accessories can be replaced or added in the field
    - Undervoltage Releases
    - Shunt Trip Releases
    - Auxiliary Contacts
      - Standard
      - Alarm contacts
      - Trip indicating contacts

- Disconnect Switches
  - Recommended Annual inspection
    - Remove dirt from switch blades and re-grease as needed
  - Accessories can be replaced or added in the field
    - Auxiliary Contacts
      - Standard
      - Alarm contacts
      - Dry circuit – low level
Short Circuit Protective Device
Technology Comparison

- Molded Case Circuit Breakers
  - Thermal Magnetic
    - Short Circuit and Overcurrent
    - 150kA SCCR
  - Electronic
    - Short Circuit and Overcurrent
    - Trip curves are adjustable
    - Short Circuit and motor overcurrent protection
    - Magnetic short circuit only
      - Used with tested motor controller

- Disconnect Switches
  - Fusible
    - Short Circuit and Overcurrent
    - 200kA SCCR
  - Electronic capability
    - Overcurrent
    - Motor overcurrent protection
    - Provided by overload relays which are downstream from disconnect switch
Short Circuit Protective Device

Applications Comparison

- Molded Case Circuit Breakers
  - Feeder Breakers
    - Short Circuit Protection
    - Thermal Protection
  - Electronic Breakers
    - Provide selectivity between feeder and branch protection
  - Branch Circuit Protection
    - Branch Short Circuit Protection
    - Branch Motor Circuit Protection
    - Branch Short Circuit and overcurrent protection

- Disconnect Switches
  - Feeder Switches
    - Short Circuit Protection
    - Thermal Protection
  - Branch Circuit Protection
    - Branch Short Circuit Protection
    - Branch Motor Circuit Protection
Circuit breakers vs. fused disconnect switch solution?

- **Molded Case Circuit Breakers**
  - Universally accepted
  - Can be manually reset
  - Adjustable or fixed trip
  - Choice of thermal magnetic or electronic trip units
  - Higher initial cost
  - Modular design
  - Provides protection against Undervoltage (with UVT)
  - Inherently provides phase loss protection
  - 150kA SCCR capability

- **Fusible Disconnect Switch**
  - Universally accepted
  - Fuses need to be replaced
  - Fixed trip - fuses
  - Lower initial cost
  - Modular design
  - 200kA SCCR capability
  - Visible blade construction
Circuit breakers vs. fused disconnect switch solution?

- Circuit breakers are generally more expensive than fuses initially
- Fuse availability
  - OEMs shipping to overseas – fuse types used in NA might not be available in Europe
- Circuit breaker can be reset without opening the enclosure door
  - Less exposure to hazardous voltage
- Circuit breaker trip curves can be adjusted
- Circuit breakers open all three phases at once under tripping conditions
- Form size – circuit breaker is typically smaller
- Fuses typically have higher short circuit ratings
- Different functionality and accessories offer more flexibility than fuses
  - Shunt trip opens the circuit breaker remotely
  - Under-voltage trips
  - Alarm and auxiliary contacts provide remote status indication
    - Alarm contacts – mounted internally – monitor trip status of breaker
    - Auxiliary contacts – mounted externally – monitor position of handle mechanism
Molded Case Circuit Breaker Portfolio

Molded Case Circuit Breakers
- 125A
- 125A
- 225A
- 250A
- 400A
- 600/800A
- 1200A
- 3000A

Motor Circuit Protectors
- 125A
- 125A
- 225A
- 250A
- 400A
- 600/800A
- 1200A

Motor Protection Circuit Breakers
- 100A
- 150A
Molded Case Circuit Breaker Portfolio Accessories

Broad Selection of Accessories

Termination Options
- End Cap (Standard)
- Lug
- Extended
- Multitap Lug
- Spreader

Annunciate Options
Internal accessories are quickly and easily field-installed by simply removing the front cover.
- Shunt Trip/Undervoltage Relay
- Auxiliary/Alarm Contacts

Protection Options
- Fixed Thermal/Magnetic
- Adjustable Electronic
  - Long Short Instantaneous (LSI) and
  - Long Short Instantaneous Ground-Fault (LSIG)
- Adjustable Thermal/Adjustable Magnetic

Ease of Installation
With multiple operator options, you can find the right installation for your application needs and safety requirements.
- Variable Depth Rotary Operator – For global application of non-flanged enclosures.
- Flex Cable Operator – Provides flexibility to easily position circuit breakers in a panel when using a flange style handle.
- Motor Operators – Allows for remote electrical operation of the MCCB.
- Direct Rotary Operators – Through the door operation or control with the enclosure door open.
- NFPA Internal Operating Handle – When using a variable depth operator allows for control of the MCCB with the enclosure door open without the use of tools.
- Variable Depth Flange Operating Mechanism – Direct control for a flange style handle.
Global Disconnect Switch Portfolio

Rotary Disconnect Switch
- Bulletin 194R
- Rotary operation of the switch body
- UL & IEC Ratings
- Fused & Non-fused types
- Actuator options
  - Rotary handle, through the door mount
  - Rotary handle, side-mount
  - Flange handle, cable assembly

Visible Blade Disconnect Switch
- Bulletin 1494
- Flange operation of the switch body
- UL & IEC Ratings (IEC Ratings planned)
- Fused & Non-fused types
- Actuator options
  - Flange handle, variable mounting depth
  - Flange handle, fixed mounting depth
  - Flange handle, cable assembly
  - Rotary handle, variable mounting depth
Rotary Disconnect Switch Portfolio
General Features

Installation
- Through-door with rotary operation of handle
- Flange mount available (30A – 200A J fused)
- Side-Mount available (30A – 60A)

NFPA 79 Compliant
- Switch, mechanism and handle are always connected whether the enclosure door is open or closed

Fused Type Construction
- Double break construction
- Fuses are electrically isolated from line & load when the disconnect is in the OFF position

Non-fused Type Construction
- Sweeping contact allows a high short-circuit withstand
- Fast opening and closing, independent from operator, allows the switch to close on short circuit and also to operate high inductive load
Rotary Disconnect Switch Portfolio
Accessories

Terminal Protection
• Line or load side shields available
• Back of hand safe

Actuator Options
• Rotary
• Flange
• NFPA 79

Auxiliary contacts
• 800F aux contacts for fused disconnects
• Form C micro-switch aux for non-fused (100A >)

Electrical Interlock
• Early break contacts
• Operates with the motion of the handle
• Can be used to de-energize the control circuit of a drive before the line power is turned OFF
Visible Blade Disconnect Switch
General Features

Visible Blade Design
• Clearly visible in OFF position
• Can be seen at a distance or through viewing window

Switch Construction
• Quick make/break design
• Reduces arcing
• Prevents handle from being teased between ON and OFF positions

Fusible Switch
• Robust, time proven design
• Can accommodate Class RK5 fuses
• 200kA SCCR

NFPA 79 Compliant
• Switch, mechanism and handle are always connected whether the enclosure door is open or closed
Visible Blade Disconnect Switch Accessories

Line Side Protection
- Line side shield provided as standard
- Clear shield for easy viewing
- Back of hand safe

Load Side Protection
- Optional cover provides added protection for both line and load side
- Fastens to switch and fuse block – no tools
- Back of hand safe

Auxiliary contacts
- Standard 10A contacts
- Low level pentaficated contacts for “dry” circuits
- Snaps onto the archood for ease on installation
- Provides feedback if the switch is ON or OFF

Electrical Interlock
- Early break contacts
- Operates with the motion of the handle
- Can be used to de-energize the control circuit of a drive before the line power is turned OFF
Flange Operating Mechanisms

- **Available for**
  - Visible blade disconnect switches
  - Cable operated rotary disconnect switches
  - Molded case circuit breakers with cable or rod operated mechanism

- **Benefits**
  - Handle, operating mechanism and switch are connected at all times even when the enclosure door is open
  - Metal handle construction is desired
  - For rugged/abusive applications
Rotary Operating Mechanisms

- **Available for**
  - Rotary operated disconnect switches
  - Molded case circuit breakers with variable depth rotary operators

- **Benefits**
  - Ability to use a less expensive enclosure
  - Less space requirements (fuses on top of switch verse the NEMA design)
  - Designed for Global market – variety of fuse options (i.e.: BS88)
  - Multiple placement options
  - Rotary operated handles with visible trip indication
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Understanding North American Electrical Standards for Panel Design

- European OEMs and Panel builders exporting to North America can be faced with difficulties of designing switchboards to North American required standards.

- As a North American company, Rockwell Automation aims to help to understand the differences and applies this knowledge to increase the export business of customers.

- Unique products for UL applications.

- Contact your local sales office for the new UL White Paper and for supporting product selection and sizing in accordance with NEC/UL508A.

- Consult www.rockwellautomation.com for more information on short circuit current ratings as required by NEC art. 409.
SCCR on UL Industrial Control Panels

NEC & UL 508A

NEC Articles:
- 409 – Industrial Control Panels
  “General use, 600V or less”
- 440 – Air Conditioning & Refrigeration
- 610 – Cranes & Hoists
- 670 – Industrial Machinery

409.110 Marking:
(3) Short-circuit current rating of the industrial control panel based on one of the following:
  a. Short-circuit current rating of a listed and labeled assembly
  b. Short-circuit current rating established utilizing an approved method

FPN: UL 508A-2001, Supplement SB, is an example of an approved method

General Use Industrial Control Panels:
- Construction
- Panels
- Power Circuits
- Control Circuits
- Ratings
- Markings
- Specific Use IC Panels
  - Supplement SB:
    “SCCR for IC Panels”
Short Circuit Protective Devices
Industrial Control Applications

Disconnecting Means
Connection Systems
Branch Circuits “Power”
Branch Circuits “Control”
Global Short-Circuit Current Ratings Selection Tool

Provides coordinated high fault branch circuit solutions for motor starters, soft-starters and component drives.

www.rockwellautomation.com/go/globalsccr
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- Short circuit protection solutions:
  - Variety of pretested combinations of devices
  - High Short Circuit Ratings for global application
  - Tools to assist you in selection and applying short circuit protective devices

Motor circuit protection devices tested with combination starters or contactors to provide SCCR coordination to 65 kA.

See our Global SCCR website for more information: www.rockwellautomation.com/support/global-sccr.page

Global portfolio to meet your demands!
Thank you!