Compact® NSF and NSJ
150 to 600 A Circuit Breakers

Class 615

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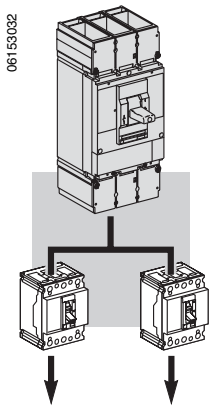
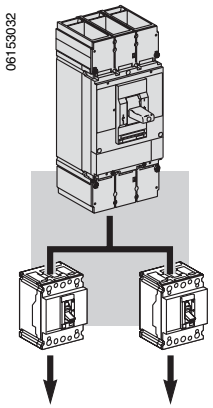
SECTION 1—THE COMPACT® CIRCUIT BREAKER LINE

CIRCUIT BREAKERS—PAGE 8



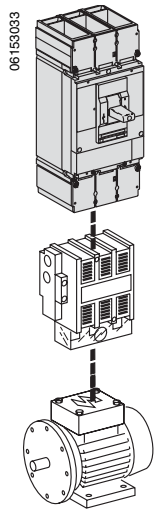
						
Rated Current (A)		15–100	15–250	150–600	400–1200	1250–2500
COMPACT®		NSE100	NSF150 NSF250	NSJ400 NSJ600	CK400–CK1200	CM1250–CM2500
Interrupting Rating at 480 V	**N**	18	35	35	50	—
	H	—	65	65	65	85
	L	—	—	100	150	—

SWITCHES—PAGE 17



Rated Current (A)	70	150, 250	400, 600	800, 1200	1600–2500
COMPACT®	NSE100A	NSF150A NSF250A	NSJ400A NSJ600A	CK800NA	CM1600HA CM2000HA CM2500HA

MOTOR CIRCUIT PROTECTORS—PAGE 19

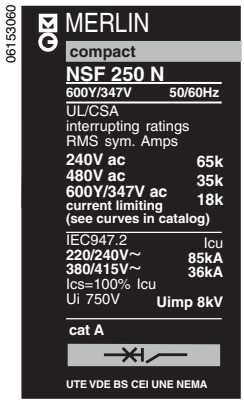


Rated Current (A)	3–75	100–250	400–600	800–1200
COMPACT®	NSE100A	NSF150A NSF250A	NSJ400A NSJ600A	CK800NA

For NSE, CK and CM circuit breakers see appropriate catalog.

SECTION 2—GENERAL CHARACTERISTICS

COMPLIANCE WITH STANDARDS



Compliance with North American Standards

Compact® NS circuit breakers are built in accordance with Underwriters Laboratories Inc. UL 489 Standard and Canadian Standards Association CSA C22.2 No. 5.02 Standard. Circuit breakers, switches and their accessories, except where noted, are Listed under UL files E63335, E103740, E103955, and Certified under CSA files LR69561 and LR88980.

Compliance with International Standards

Compact NS circuit breakers and their accessories comply also with the following international standards:

- IEC 60947-1: general rules
- IEC 60947-2: circuit breakers
- IEC 60947-3: switches, disconnectors, switch disconnectors, etc.

In that these standards are applied in most countries, Compact circuit breakers and their accessories comply with European (EN 60947-1 and EN 60947-2) and the corresponding national standards:

- France NF
- Germany VDE
- U.K. BS
- Australia AS
- Italy CEI

Compliance with the Specifications of Marine Classification Organizations

Compact NS circuit breakers have been approved for marine application by the American Bureau of Shipping, Bureau Veritas, Lloyd's Register of Shipping, Registro Italiano Navale, Germanischer Lloyd's and Det Norske Veritas.

They comply with the following standards:

- UL 489 Supplement SA. Marine use on vessels over 65 feet in length
- US Coast Guard specifications
- IEC 92-504 and marine specifications: inclination, vibrations, insulation resistance
- IEC 803 Electromagnetic Disturbance Immunity

Tropicalization

Compact® NS circuit breakers comply with NF C 63-100 standard level 2 conditions (95% relative humidity at 45° C or 80% at 55° C, hot and humid climate conditions). The materials used in Compact NS circuit breakers will not support the growth of fungus or mold.

They also comply with the following standards:

- IEC 68-2-30 damp heat
- IEC 68-2-2 dry heat
- IEC 68-2-11 salt spray
- IEC 68-2-1 low temperatures

Pollution Degree

Compact NS circuit breakers are certified for operation in pollution degree III environments as defined by IEC standard 947 (industrial environments).

Environmental Protection

Compact NS circuit breakers take into account concerns for environmental protection. Most components are recyclable and parts are marked as specified in applicable standards.

Suitability for Isolation (Positive Contact Indication)

All Compact NS circuit breakers and switches are suitable for isolation as defined in the IEC 947-2 Standard:

- The isolation position corresponds to the O (OFF position).
- The operating handle cannot indicate the OFF position unless the contacts are open.
- Padlocks may not be installed unless the contacts are open

Installation of a rotary handle or a motor mechanism does not alter the functionality of the position indication system.

The isolation function is certified by tests guaranteeing:

- The mechanical reliability of the position indication system
- The absence of leakage currents
- Overvoltage withstand capacity between upstream and downstream connections

06153038 Circuit Breaker Marking

06153039 Switch Marking

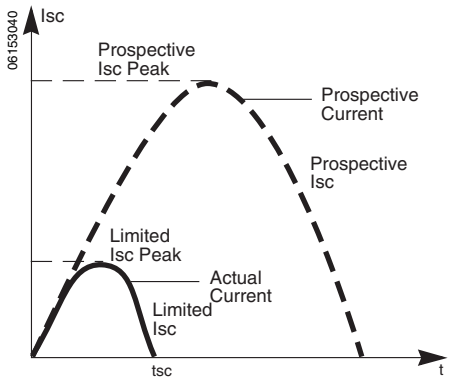
Installation in Class II Switchboards

All Compact NS circuit breakers, even when fitted with a rotary handle or a motor mechanism, can be installed through the door of Class II IEC switchboards (as per IEC 664 Standard). Refer to circuit breaker installation instructions prior to installing circuit breaker.

Installation requires no special insulation because Compact NS circuit breakers provide Class II insulation between the front face and all internal circuits.

Suitability for Isolation (Positive Contact Indication)

The limiting capacity of a circuit breaker is its ability to limit short-circuit currents.



The exceptional limiting capacity of the Compact® NS line is due to the double break technique (rapid natural repulsion of contacts and the appearance of two arc voltages in series with a steep wavefront).

The limiting capacity of the Compact NS line greatly reduces the forces created by fault currents in devices. The result is a major increase in breaking performance. In particular, the service breaking capacity Ics is equal to 100% of Icu.

The Ics value, defined by IEC 947-2, is guaranteed by tests comprising the following operations:

- Breaking a fault current equal to 100% of Icu three times consecutively
- Checking that the device continues to function normally
- Conduction of rated current without abnormal temperature rise
- Protection functions perform within the limits specified by the standard
- Suitability for isolation is not impaired

Longer Service Life of Electrical Installations

Current limiting circuit breakers greatly reduce the negative effects of short circuits on installations.

Thermal Effects

Less temperature rise in conductors, therefore longer service life for cables.

Mechanical Effects

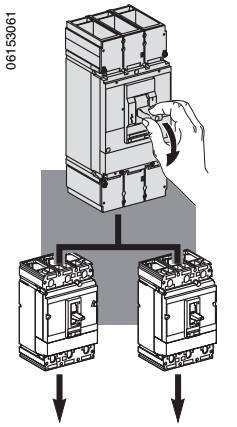
Reduced electrodynamic forces, therefore less risk of electrical contacts or busbars being distorted or broken.

Electromagnetic Effects

Less disturbance for measuring devices located near electrical circuits.

SECTION 3—CIRCUIT BREAKERS

RATINGS AND INTERRUPTING RATINGS



UL 489 Listed Ratings

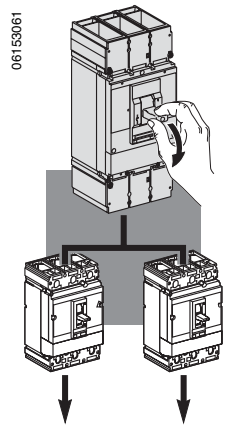
Compact® Circuit Breakers				NSF150		NSF250	
Number of Poles				3, 4, 4 OSN*		3, 4	
Rated Voltage (V)		AC 50/60 Hz		600Y/347		600Y/347	
Rated Current (A)	In	40° C		150		250	
				N	H	N	H
Interrupting Ratings (kA rms)			240 V	65	100	65	100
			480 V	35	65	35	65
			600 Y/ 347 V	18	25	18	25
			600 V	—	—	—	—

*Oversized Neutral Protection: four-pole OSN 125/250N and 150/250N are same ratings as NSF250A.

IEC 947-2 and EN 60947-2 Ratings

Compact® Circuit Breakers				NSF150		NSF250	
Number of Poles				3, 4, 4 OSN*		3, 4	
Rated Insulation Voltage (V)	Ui			750		750	
Rated Impulse Withstand Voltage (kV)	Uimp			8		8	
Rated Operational Voltage (V)	Ue	AC 50/60 Hz		690		690	
		DC		500		500	
Rated Current (A)	In	40° C		150		250	
				N	H	N	H
Ultimate Breaking Capacity (kA rms)	Icu	AC 50/50 Hz	220/ 240 V	85	100	85	100
			380/ 415 V	36	70	36	70
			440 V	35	65	35	65
			500 V	30	50	30	50
			525 V	22	35	22	35
			600/ 690 V	8	10	8	10
		DC	250 V (1 pole)	50	85	50	85
			500 V (2 pole in series)	50	85	50	85
Service Breaking Capacity	Ics	(% Icu)		100%	100%	100%	100%
Utilization Category				A	A	A	A

*Oversized Neutral Protection: four-pole OSN 125/250N and 150/250N are same ratings as NSF250A.



UL 489 Listed Ratings

Compact® Circuit Breakers				NSJ400			NSJ600		
Number of Poles				3, 4, 4 OSN*			3, 4		
Rated Voltage (V)		AC 50/60 Hz		600			600		
Rated Current (A)	In	40° C		400 (100% Rated Circuit Breaker)			600		
				N	H	L	N	H	L
Interrupting Ratings (kA rms)			240 V	65	100	150	65	100	150
			480 V	35	65	100	35	65	100
			600 Y/ 347 V	—	—	—	—	—	—
			600 V	18	25	25	18	25	25

*Oversized Neutral

IEC 947-2 and EN 60947-2 Ratings

Compact® Circuit Breakers				NSJ400			NSJ600		
Number of Poles				3, 4, 4 OSN*			3, 4		
Rated Insulation Voltage (V)	Ui			750			750		
Rated Impulse Withstand Voltage (kV)	Uimp			8			8		
Rated Operational Voltage (V)	Ue	AC 50/60 Hz		690			690		
		DC		500			500		
Rated Current (A)	In	40° C		400			600		
				N	H	L	N	H	L
Ultimate Breaking Capacity (kA rms)	Icu	AC 50/50 Hz	220/240 V	85	100	150	85	100	150
			380/415 V	45	70	150	45	70	150
			440 V	42	65	130	42	65	130
			500 V	30	50	70	30	50	70
			525 V	22	35	50	22	35	50
			600/690 V	10	20	35	10	20	35
		DC	250 V (1 pole)	—	85	—	—	85	—
			500 V (2 pole in series)	—	85	—	—	85	—
Service Breaking Capacity	Ics	(% Icu)		100%	100%	100%	100%	—	100%
Utilization Category				A	A	A	A	—	A

*Oversized Neutral

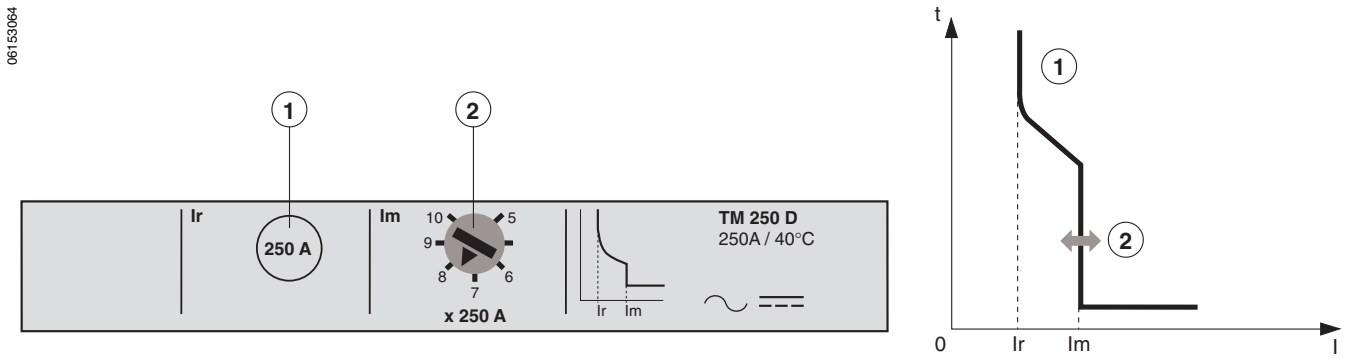
SECTION 4—TRIP UNITS

TRIP UNITS FOR COMPACT® NSF150 AND NSF250 CIRCUIT BREAKERS

Compact NSF150 and NSF250 circuit breakers are equipped with thermal-magnetic (TM) trip units.

Protection

- Against overload **(1)** with a fixed thermal protection
- Against short circuits **(2)** with fixed (on NSF150) or adjustable (on NSF250) magnetic protection



Trip Units for Compact® NSF150–NSF250 Circuit Breakers			TM15DP–TM250DP Trip Units															
Rating (A)	**In**	40° C	15	20	30	40	50	60	70	80	90	100	125	150	175	200	225	250
3P		50° C	14.2	19	28.5	38	47.5	57	66.5	76	85	95	118	142	166	190	213	237
4P3T		60° C	13.5	18	27	36	45	54	63	72	81	90	112	135	158	180	203	225
4P4T		70° C	12.8	17	25.6	34.2	43	51	60	68	77	85	107	128	150	171	192	214
Circuit Breaker	Compact® NSF150 N/H		■	■	■	■	■	■	■	■	■	■	■	■				
	Compact® NSF250 N/H														■	■	■	■

			TM100OSN–TM150OSN Trip Units					
			Phase	**Neutral**	**Phase**	**Neutral**	**Phase**	**Neutral**
Rating (A)	**In**	40° C	100	150	125	250	150	250
4P OSN		50° C	95	142	118	237	142	237
		60° C	90	135	112	225	135	225
		70° C	85	128	107	214	128	214

Overload Protection									
Thermal		3P	Non-adjustable						
		4P3T					Non-adjustable, No Neutral Protection		
		4P4T					Non-adjustable		
		4P OSN*					Non-adjustable		
Short-circuit Protection									
Magnetic			Non-adjustable						Adjustable
	Compact® NSF150		400	500	1000			1250	1500
	Compact® NSF250								5–10 x In
Neutral Protection		4P3T					No Neutral Protection		
		4P4T					1000	1250	1500
		4P OSN*					1000	1250	1500

*Oversized Neutral

TRIP UNITS FOR COMPACT® NSJ400 AND NSJ600 CIRCUIT BREAKERS

Compact NSJ400 and NSJ600 circuit breakers are equipped with current sensors and electronic trip units.

Current Sensors

Four different sizes are available and can be mounted with all trip units:

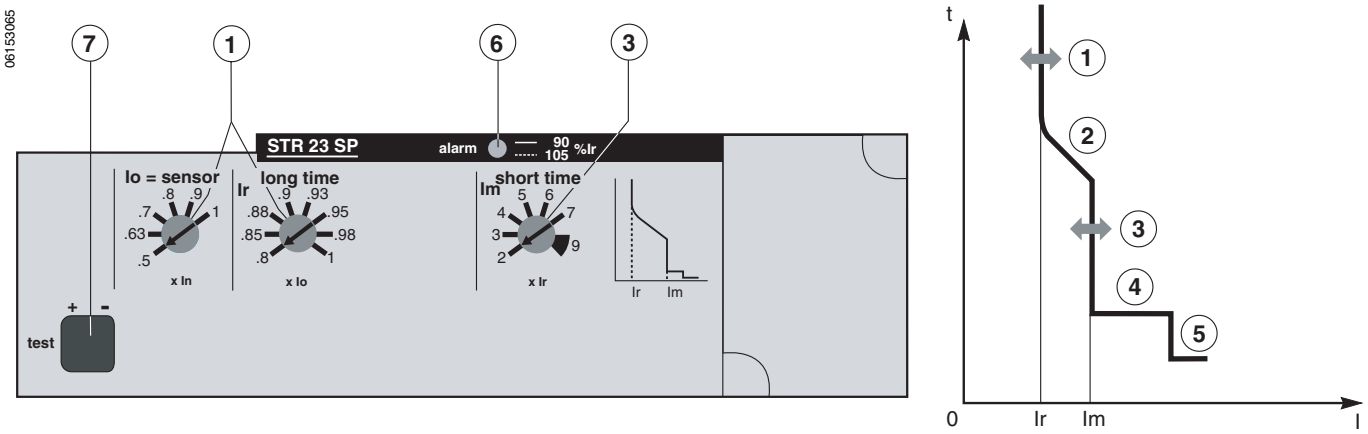
- NSJ400—150, 250 and 400 A
- NSJ600—600 A

Trip Units STR23SP, STR53UP and STR23SP-OSN

- Protection for loads, from 60 to 600 A
  - — STR23SP and STR53UP for standard protection
  - — STR23SP-OSN for oversized neutral protection (factory-installed only)
  - — STR53UP for generator supplied network protection and long cable runs
- Trip units STR23SP and STR53UP can be mounted on all Compact NSJ400 and NSJ600 circuit breaker types N, H and L
- Trip unit STR53UP offers a greater number of optional indication and measurement functions, protection settings and ground-fault protection
- STR23SP and STR53UP available on four-pole circuit breakers with sealable, 3-position neutral protection setting:
  - — 4P 3D (neutral unprotected)
  - — 4P 3D + N/2 (neutral protection at 0.5 x Ir) where Ir is trip unit current setting
  - — 4P 4D (neutral protection at Ir) where Ir is trip unit current setting

Trip Units for Compact® NSJ400 and NSJ600 Circuit Breakers			STR23SP	STR53UP					STR23SP OSN (Oversized Neutral)	
Overload Protection (Long Time)										
Tripping Threshold (A)	**Ir**	20–70° C	Adjustable (48 Settings) 0.4–1 x In							
Tripping Time (s) (Min–Max)			Fixed	Adjustable					Fixed	
		At 1.5 x Ir	120–180	17–25	34–50	69–100	138–200	277–400	120–180	
		At 6 x Ir	5–7.5	0.8–1	1.6–2	3.2–4	6.4–8	12.8–16	5–7.5	
		At 7.2 x Ir	3.2–5.0	0.5–0.7	1.1–1.4	2.2–2.8	4.4–5.5	8.8–11	3.2–5.0	
Short-circuit Protection (Short Time)										
Tripping	**Im / Isd**		Adjustable (7 Settings) 2–9 x Ir	Adjustable (7 Settings) 1.5–7 x Ir					Adjustable (7 Settings) 2–9 x Ir	
	Accuracy		± 15%							
Time Delay (ms)	Max. Overcurrent Time Before Tripping		Fixed ≤40	Adjustable (4 Settings + Constant I^2t Function)					Fixed ≤40	
				≤15	≤60	≤140	≤230			
	Total Breaking Time		≤60	≤60	≤140	≤230	≤350		≤60	
Short-circuit Protection (Instantaneous)										
Tripping Threshold (A)			Fixed ≥ 9 x In	Adjustable (7 Settings) 1.5–9 x In					Fixed ≥ 9 x In	
Adjustable Neutral Protection (Three Position Switch)										
									NSJ250/400N	**NSJ400/600N**
	Switch	**Settings**	**Protection Level**							
	Position 1	4P 3D	No Protection	No Protection					No Protection	No Protection
	Position 2	4P 3D + N/2	0.5 x Ir	0.5 x Ir					0.8 x Ir	0.75 x Ir
	Position 3	4P 4D	1.0 x Ir	1.0 x Ir					1.6 x Ir	1.5 x Ir
Other Functions										
Indication of Fault Type				■ (Standard)						
Equipment Ground-fault Protection (T)				■						
Built-in Ammeter (I)				■						
Zone-selective Interlocking (ZSI)				■						
Communication (COM)				■						

Electronic Trip Unit STR23SP and STR23SP-OSN (Oversized Neutral)



Protection

- Long-time (LT) overload protection, adjustable threshold, based on the actual rms current
  - — Adjustable threshold (1) using six Io base settings (0.5–1) and fine adjustment Ir with eight settings ranging from (0.8–1)
  - — Non-adjustable tripping time (2)
- Short-time (ST) short-circuit protection
  - — Adjustable threshold Im (3)
  - — Fixed time delay (4)
- Instantaneous (I) short-circuit protection, fixed threshold (5)
- Neutral protection available on standard four-pole circuit breakers; protection level controlled using three-position switch
  - — 4P 3D: no protection
  - — 4P 3D + N/2: neutral protection at 0.5 Ir
  - — 4P 4D: neutral protection at Ir
- Neutral protection for STR23SP-OSN (oversized neutral) available on four-pole circuit breakers equipped with oversized neutral protection; protection level controlled using three-position switch

NSJ250/400N:

- — 4P 3D: no protection
- — 4P 3D + N/2: neutral protection at 0.8 x Ir
- — 4P 4D: neutral protection at 1.6 x Ir

NSJ400/600N:

- — 4P 3D: no protection
- — 4P 3D + N/2: neutral protection at 0.75 x Ir
- — 4P 4D: neutral protection at 1.5 x Ir

Indications

Load indication (LED) in front (6):

- Lights solid at 90% of Ir threshold
- Flashes at >105% or greater of Ir threshold

Test

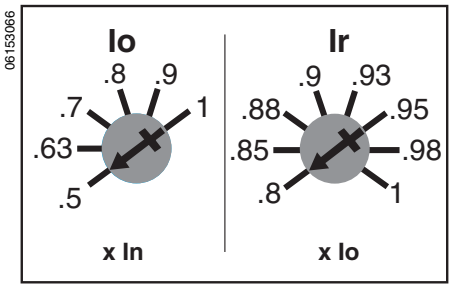
Test connector in front (7) for connection to test kit to check circuit breaker operation after fitting the trip unit or other accessories.

Setting Example

Question: What is the overload protection threshold of a Compact NSJ400 circuit breaker equipped with trip unit STR23SP where Io = 0.5 and Ir = 0.8?

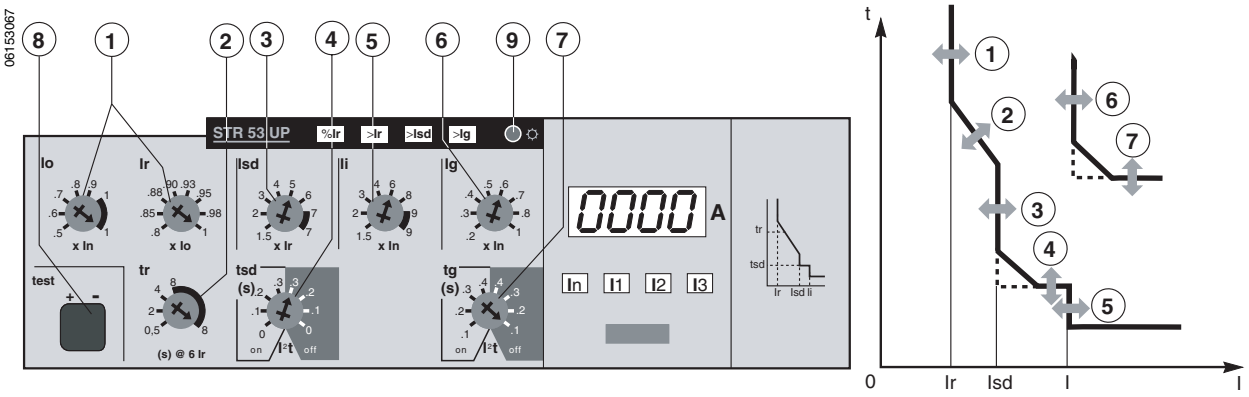
Answer: In x Io x Ir = 400 x 0.5 x 0.8 = 160 A

The same trip unit with the same settings, mounted on an NSJ600 circuit breaker will have the following tripping threshold: In x Io x Ir = 600 x 0.5 x 0.8 = 240 A.



400 x 0.5 x 0.8 = 160 A

Electronic Trip Unit STR53UP



Protection

- Long-time (LT) overload protection, adjustable threshold, based on actual rms current, as defined by IEC 947-2, appendix F
  - — Adjustable threshold (1) using six Io base settings (0.5–1) and fine adjustment Ir with eight settings ranging from (0.8–1)
  - — Adjustable tripping time (2)
- Short-time (ST) short-circuit protection
  - — Adjustable threshold Isd (3)
  - — Adjustable time delay (4), with or without constant I^2t function
- Instantaneous (Ii) short-circuit protection, adjustable threshold (5)
- Neutral protection available on standard four-pole circuit breakers; protection level controlled using three-position switch
  - — 4P 3D: no protection
  - — 4P 3D + N/2: neutral protection at 0.5 Ir
  - — 4P 4D: neutral protection at Ir

Overload Indications (%Ir)

- LED (9) lights solid when current exceeds 0.9 Ir
- LED (9) flashes when current exceeds long-time threshold Ir

Fault Indications

LEDs indicate the type of fault that caused tripping:

- Overload (LT protection) or abnormal component temperature (>Ir)
- Short-circuit (ST or instantaneous protection) (>Isd)
- Ground-fault (if earth-fault protection option is present) (>Ig)
- Microprocessor malfunction—both (>Ir) and (>Isd) LEDs go on, plus the (>Ig) LED, if the ground-fault protection option is present

The LEDs are battery powered with spare batteries supplied in the adapter box. When a fault occurs, the LED indicating type of fault shuts off after approximately 10 minutes to conserve battery power. The fault data is stored in memory and the LED can be re-illuminated by pressing the battery/LED test button (9). The LED automatically goes off and memory is cleared when the circuit breaker is reset.

Test

- Test connector in front (8) for connection to test kit (see page 16); used to check circuit breaker operation after fitting trip unit or other accessories
- Test button (9) for (%Ir), (>Ir), (>Im) and (>Ig) LEDs and battery

Self-monitoring

The circuit breaker trips for both microprocessor faults and abnormal temperatures.

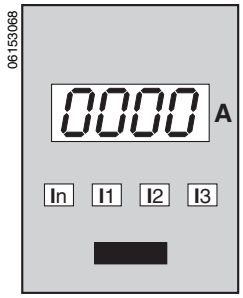
Options for Electronic Trip Unit STR53UP

Equipment Ground-fault Protection (T)—see (6) and (7), page 14

Type		Residual Current
Tripping threshold	Ig	Adjustable (8 Settings) 0.2–1 x In
	Accuracy	± 15%
Tripping time (ms)	Max. overcurrent time before tripping (Tg)	Adjustable (4 Settings + Constant I^2t Function) 60, 140, 230, 350
	Total Breaking Time	-140, -230, -350, -500

Ammeter (I)

A digital display continuously indicates the current of the phase with the greatest load. By pressing a scroll button, it is also possible to display successively the readings of I1, I2, I3 and I neutral. LEDs indicate the phase for which the current is displayed.



Zone-selective Interlocking (ZSI)

A number of circuit breakers are interconnected one after another by a pilot wire. In the event of a short-time or earth fault:

- If a given trip unit STR53UP detects the fault, it informs the upstream circuit breaker which applies the set time delay
- If the trip unit STR53UP does not detect the fault, the upstream circuit breaker trips after its shortest time delay

In this way, the fault is cleared rapidly by the nearest circuit breaker. In addition, thermal stresses on the circuits are minimized and time discrimination is maintained throughout the installation.

Opto-electronic Outputs

The use of opto-transistors ensures total isolation between the internal circuits of the trip unit and the circuits wired by the user.

Communication (COM)

Transmission of the following data to Digipact® distribution monitoring and control modules:

- Settings
- Phase and neutral currents (rms values)
- Highest current of the three phases
- Overload condition alarm

Possible Combinations

- I
- T
- I + T
- I + COM
- I + T + COM
- ZSI
- ZSI + I
- ZSI + T
- ZSI + I + T
- ZSI + I + COM
- ZSI + I + T + COM

ELECTRONIC TRIP UNIT TEST KITS

The test kits presented below are compatible with Compact® and Masterpact® MP/MC/M circuit breakers.

Tests performed by test kits are only functional tests designed to electrically test the operating integrity of the trip unit, the flux shifter and the mechanical operation of the circuit breaker. Tests are not designed to calibrate the circuit breaker.

Mini Test Kit and Hand-held Test Kit

The Mini Test Kit and the new generation Hand-held Test Kit are portable units which require no external power supply. Both are powered by five 9 V alkaline batteries, not supplied. These test kits are used to check operation of the electronic trip unit and circuit breaker tripping. Connection of either test kit is made via the test port on the front of the trip unit.

Mini Test Kit

Hand-held Test Kit

Portable Test Kit and Full-function Test Kit

The Portable Test Kit and the new generation Full-function Test Kit are calibration units. Both require a power supply of 110 or 240 Vac, 50/60 Hz (two-position selector). These test kits are used to check the operation of the trip unit by measuring actual trip times:

- At 1.5 x Ir for long-time protection
- At 15 x Ir for short-time protection
- At 0.8 x In for ground-fault protection

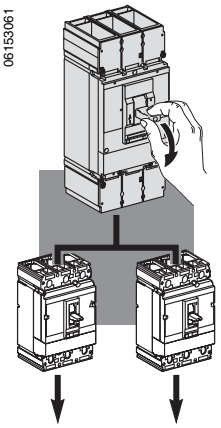
Portable Test Kit

Full-function Test Kit

SECTION 5—SWITCHES

RATINGS AND INTERRUPTING RATINGS

UL 1087 Listed Ratings



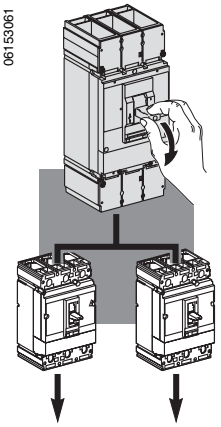
Compact® Switches		NSF150A	NSF250A
Number of Poles		3, 4, 4P OSN*	3, 4
Rated Voltage (V)	AC 50/60 Hz	600Y/ 347	600Y/ 347
Rated Current (A)		150	250

*Oversized Neutral Protection: four-pole OSN 125/250 and 150/250 are same ratings as NSF250A.

IEC 947-3 Ratings

Compact® Switches			NSF150A	NSF250A
Number of Poles			3, 4, 4P OSN*	3, 4
Rated Insulation Voltage (V)	Ui		750	750
Rated Impulse Withstand Voltage (kV)	Uimp		8	8
Rated Operational Voltage (V)	Ue	AC 50/60 Hz	690	690
		DC	500	500
Rated Operational Current (V)	Ie	AC23A 690 V	160	250
		DC23A 250 V	160	250
		DC23A 500 V (2 poles in series)	160	250
Making Capacity (kA peak)			3.6	4.9
Short-time Withstand Current (kA rms)	Icw	Icw (kA rms)	2.5	3.5
		Duration (s)	3	3

*Oversized Neutral Protection



UL 489 Listed Ratings

Compact® Switches		NSJ400A	NSJ600A
Number of Poles		3, 4, 4P OSN*	3, 4
Rated Voltage (V)	AC 50/60 Hz	600	600
Rated Current (A)		400	600

*Oversized Neutral Protection: four-pole OSN 125/250 and 150/250 are same ratings as NSF250A.

IEC 947-3 Ratings

Compact® Switches			NSF150A	NSF250A
Number of Poles			3, 4, 4P OSN*	3, 4
Rated Insulation Voltage (V)	**Ui**		750	750
Rated Impulse Withstand Voltage (kV)	**Uimp**		8	8
Rated Operational Voltage (V)	**Ue**	AC 50/60 Hz	690	690
		DC	500	500
Rated Operational Current (V)	**Ie**	AC23A 690 V	400	630
		DC23A 250 V	400	630
		DC23A 500 V (2 poles in series)	400	630
Making Capacity (kA peak)			7.1	8.5
Short-time Withstand Current (kA rms)	**Icw**	Icw (kA rms)	5	8
		Duration (s)	3	3

*Oversized Neutral Protection

Short-circuit Withstand Current

Molded case switches are identical to molded case circuit breakers, except they are not equipped with trip units and sensors. Molded case switches open when the handle is switched to the OFF position or in response to an auxiliary tripping device such as a shunt trip or an undervoltage release.

These switches open instantaneously at a non-adjustable, factory preset, magnetic trip point calibrated to protect only the molded case switch itself. Magnetic settings:

- NSF150/250 A switches: 2000 A
- NSJ 400/600 A switches: 6000 A

These switches are suitable for use on a circuit capable of delivering not more than:

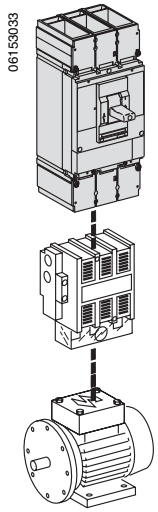
- 240 V: 100 kA for NSF switches and 150 kA for NSJ switches
- 480 V: 65 kA for NSF switches and 100 kA for NSJ switches
- 600 V (600Y/347 for NSF switches): 25 kA

Switches are Listed under UL file E103740 and Certified under CSA file LR 88980.

SECTION 6—MOTOR CIRCUIT PROTECTORS

RATINGS AND INTERRUPTING RATINGS

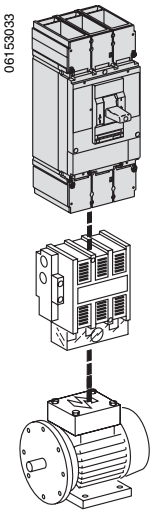
UL 489 Recognized Component



Compact® Circuit Breakers			NSF150HC	NSF250HC	
Number of Poles			3	3	
Rated Voltage (V)		AC 50/60 Hz	600Y/347	600Y/347	
Rated Current (A)	In	40° C	150	200	250
Magnetic Trip Setting	Im		900-1800	1000–2000	1250–2500

IEC 947-2 and EN 60947-2 Ratings

Compact® Circuit Breakers				NSF150HC	NSF250HC	
Number of Poles				3	3	
Rated Insulation Voltage (V)	Ui			750	750	
Rated Impulse Withstand Voltage (kV)	Uimp			8	8	
Rated Operational Voltage (V)	Ue	AC 50/60 Hz		690	690	
		DC		500	500	
Rated Current (A)	In	40° C		150	200	250
				HC	HC	
Ultimate Breaking Capacity	Icu	AC 50/60 Hz	220/240 V	100	100	
(kA rms)			380/415 V	70	70	
			440 V	65	65	
			500 V	50	50	
			525 V	35	35	
			660/690 V	10	10	
		DC	250 V (1 pole)	85	85	
			500 V (2 poles in series)	85	85	
Service Breaking Capacity	Ics	(% Icu)		100%	100%	
Utilization Category				A	A	



UL 489 Recognized Component

Compact® Circuit Breakers			NSJ400HC	NSJ600HC
Number of Poles			3	3
Rated Voltage (V)		AC 50/60 Hz	600	600
Rated Current (A)	**In**	40° C	400 (100% Rated Circuit Breaker)	600
Magnetic Trip Setting	**Im**		2000–4000	3000–6000

IEC 947-2 and EN 60947-2 Ratings

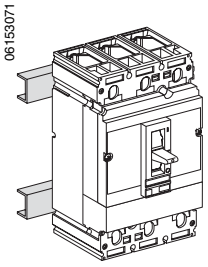
Compact® Circuit Breakers				NSF150HC	NSF250HC
Number of Poles				3	3
Rated Insulation Voltage (V)	**Ui**			750	750
Rated Impulse Withstand Voltage (kV)	**Uimp**			8	8
Rated Operational Voltage (V)	**Ue**	AC 50/60 Hz		690	690
		DC		500	500
Rated Current (A)	**In**	40° C		400	600
				HC	**HC**
Ultimate Breaking Capacity	**Icu**	AC 50/60 Hz	220/240 V	100	100
(kA rms)			380/415 V	70	70
			440 V	65	65
			500 V	30	30
			525 V	35	35
			660/690 V	20	20
		DC	250 V (1 pole)	85	85
			500 V (2 poles in series)	85	85
Service Breaking Capacity	**Ics**	(% Icu)		100%	100%
Utilization Category				A	A

SECTION 7—MOUNTING CONFIGURATIONS

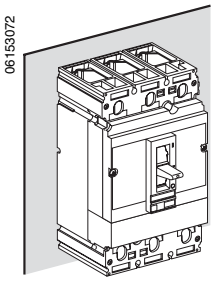
Refer to circuit breaker installation instructions before installing circuit breaker, accessories or wiring.

FIXED MOUNTING

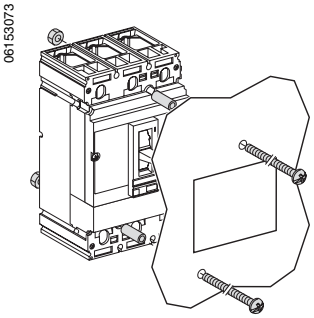
Mounting on Rails



Mounting on Backplate



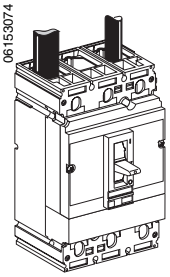
Flush Mounting



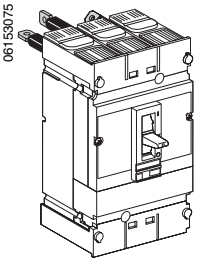
CONNECTIONS

See Section 8—Connections for details. Compact® NSF and NSJ circuit breakers suitable for reverse feeding.

Front Connection

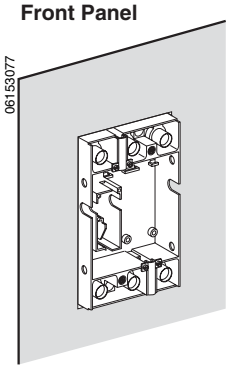


Rear Connection

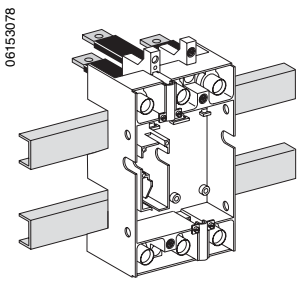


PLUG-IN MOUNTING

Mounting through Front Panel



Mounting on Rails



The plug-in configuration makes it possible to:

- Extract and/or rapidly replace the circuit breaker without having to touch connections
- Allow for addition of future circuits at a later date

When the circuit breaker is in the connected position, the primary voltage is fed through the circuit breaker by means of multiple finger disconnects. Control voltage of internal accessories is provided through secondary disconnects.

Parts of a Plug-in Configuration

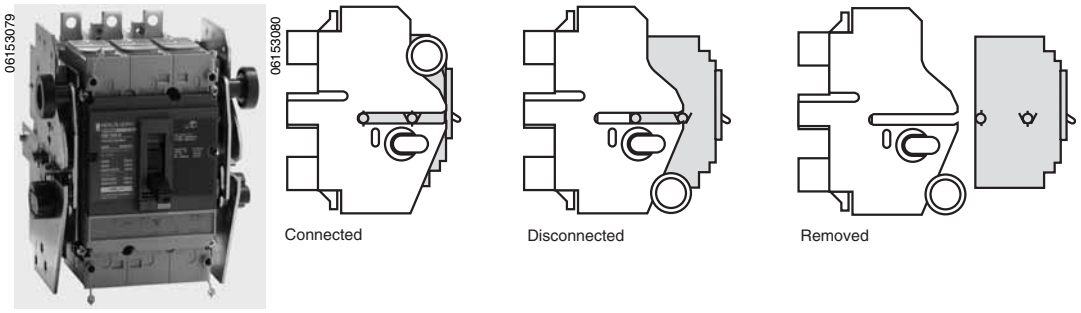
Compact® circuit breaker (fixed mounted)

- Set of power and secondary disconnects that are added to the circuit breaker
- Plug-in base for mounting through a front panel or on rails
- Safety trip, to be installed on the circuit breaker, which causes automatic tripping if the circuit breaker is ON before engaging or withdrawing it; the safety trip does not prevent circuit breaker operation, even when the circuit breaker is disconnected
- Mandatory short terminal shields

The plug-in mounting is Listed under UL file E113555 and Certified under CSA file LR 69561.

DRAWOUT MOUNTING

The chassis is made up of two side plates installed on the base and two other plates mounted on the circuit breaker.



Chassis Functions

All functions of the plug-in base, plus:

- Disconnected position: the power circuits are disconnected, the circuit breaker is simply "withdrawn" and may still be operated (on, off, push-to-trip)
- Circuit breaker may be locked using 1 to 3 padlocks—diameter 0.19 to 0.31 inch (5 to 8 mm)—to prevent connection
- Auxiliaries can be tested using manual auxiliary connector

Mounting

- On a backplate, through a front panel or on rails
- Horizontally or vertically

Accessories

- Auxiliary switches for installation on the fixed part of the chassis, indicating the "connected" and "disconnected" positions
- Toggle collar for circuit breakers with toggle through front panel, intended to maintain the degree of protection whatever the position of the circuit breaker (supplied with a toggle extension)
- Keylock which, depending on the bolt fitted, can be used to:
  - — Prevent insertion for connection
  - — Lock the circuit breaker in connected or disconnected position
- Telescopic shaft for extended rotary handles

Connection of Auxiliaries

Control voltage is provided through automatic secondary disconnects in the connected position only. See Section 8—Connections for more details. Electrical accessories can be tested in the disconnected position with an external wiring harness.

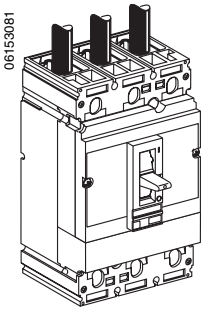
The drawout-mounted chassis is Listed under UL file E113555 and Certified under CSA file LR 69561.

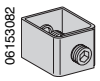
SECTION 8—CONNECTIONS

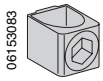
FRONT CONNECTION

Connection to Cables

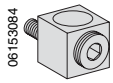
Cable connectors for Compact® NSF150 and NSF250 circuit breakers surround the circuit breaker terminals. They are positioned by an insulating lug pack which is anchored to the circuit breaker case.



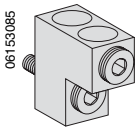




Cable connectors for Compact NSJ400 and NSJ600 circuit breakers bolt onto the circuit breaker terminals or the terminals of the plug-in base.

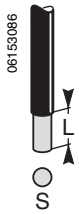


One-wire Cable



Two-wire Cable

Copper or Aluminum Cable

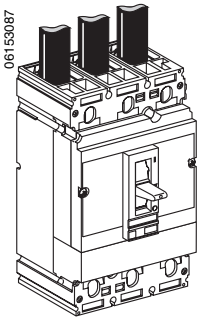
	NSF150		NSF150/250	
	Steel Lug (15–60 A)		Aluminum Lug (70–250 A)	
	S	#14 AWG–#3/0 AWG Cu (Solid or Stranded) #12 AWG–#4/0 AWG Al (Stranded Only) 2.5–95 mm^2 CU/AL	**S**	#2/0 AWG–250 kcmil Cu (Stranded Only) 70–120 mm^2 #4/0 AWG–300 kcmil Al (Stranded Only) 95–150 mm^2
	L	0.79 in. 20 mm	**L**	0.79 in. 20 mm

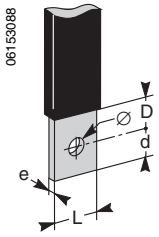
NSJ400		NSJ600	
1 Cable		1–2 Cable	
S	#2 AWG–600 kcmil Cu (Stranded Only) 35–300 mm^2 #2 AWG–500 kcmil Al (Stranded Only) 35–240 mm^2 Cu/AL	**S**	#2/0 AWG–350 kcmil Cu (Stranded Only) 70–185 mm^2 #2/0 AWG–500 kcmil Al (Stranded Only) 70–240 mm^2
L	1.2 in. 31 mm	**L**	1.2–2.4 in. 31–61 mm

Connection to Bars

Compact® NSF150 to NSJ600 circuit breakers are equipped as standard with captive nuts and screws for direct connection to bars:

- Compact NSF150/250 circuit breakers—M8 screws
- Compact NSJ400/600 circuit breakers—M10 screws



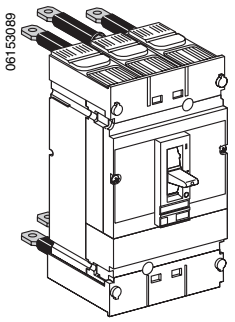


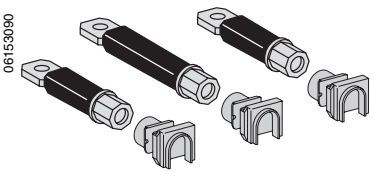
Compact® Circuit Breaker		NSF150/250	NSJ400/600
Pole Pitch	in. / mm	1.4 / 35	1.8 / 45
L	in. / mm	-1 / 25	-1.3 / 32
d	in. / mm	-0.4 / 10	-0.64 / 16
D	in. / mm	< 0.35 / 9	< 0.51 / 13
e	in. / mm	-0.23 / -6	0.11–0.39 / 3–10
∅	in. / mm	< 0.32 / 8	< 0.4 / 10

REAR CONNECTION

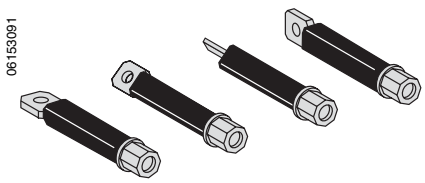
Fixed Mounting

For connection of bars or cables with compression lugs. Rear connections are easily installed on the circuit breaker terminals. The same connection may be installed flat, edgewise or at a 45° angle. All combinations are possible. The circuit breaker is mounted on a backplate.





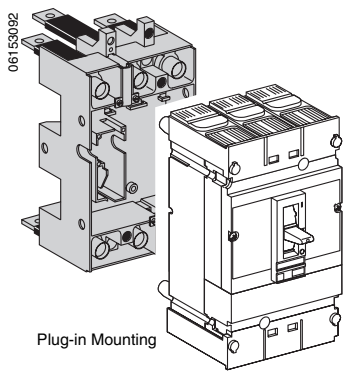
One Long + Two Short



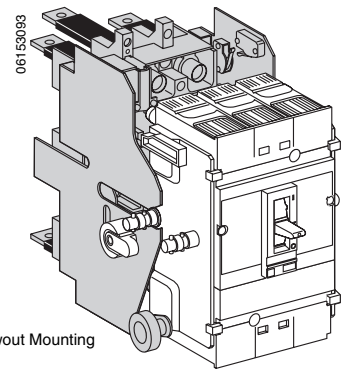
Four Positions

Plug-in Mounting and Drawout Mounting

For connection of bars or cables with compression lugs. Rear connections are installed flat. The plug-in base or the chassis are mounted through a front panel.



Plug-in Mounting

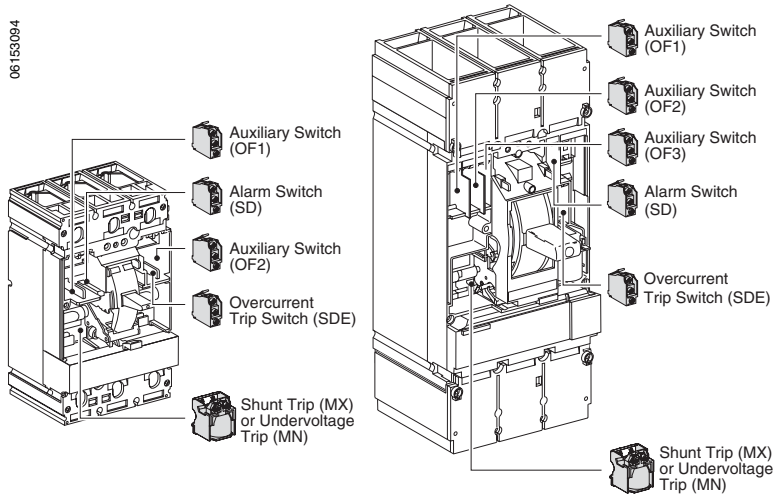


Drawout Mounting

SECTION 9—ACCESSORIES

LOCATION

Internal accessories comply with requirements of Underwriters Laboratories Inc. UL 489 and Canadian Standard Association C22.2 No. 5.1 Standards. All internal accessories are Listed for fixed installation per UL file E103955 and Certified under CSA file LR 69561.



NSF150/250 NSJ400/600

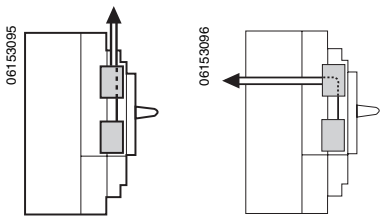
CONNECTIONS

Each electrical accessory is fitted with numbered terminal blocks for wires with the following maximum size:

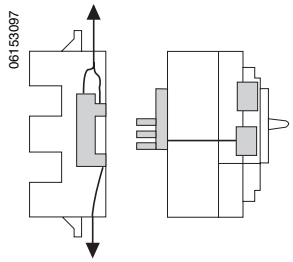
- #16 AWG (1.5 mm^2) for auxiliary switches, undervoltage and shunt trip or undervoltage trip
- #14 AWG (2.5 mm^2) for the motor operator

Fixed Mounting

Auxiliary circuits exit the device through a knock-out in the front cover.



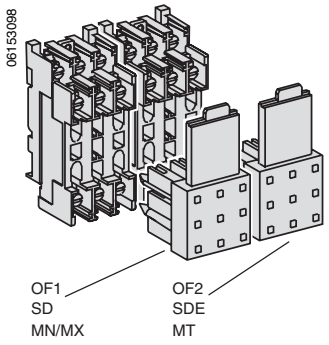
Plug-in and Drawout Mounting



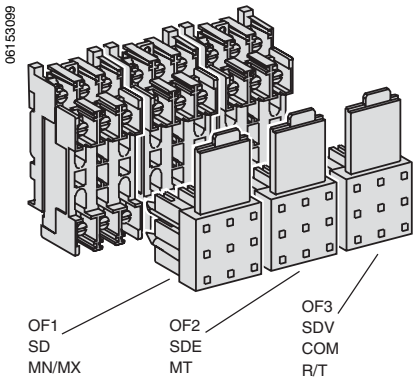
AUTOMATIC SECONDARY DISCONNECTING BLOCKS

Accessory circuits exit the circuit breaker via one to three secondary disconnecting blocks (nine wires each). For Compact® NSJ400/600 circuit breakers connection wires for the options installed with trip unit STR53UP also exit via the automatic secondary disconnecting blocks. These are made up of:

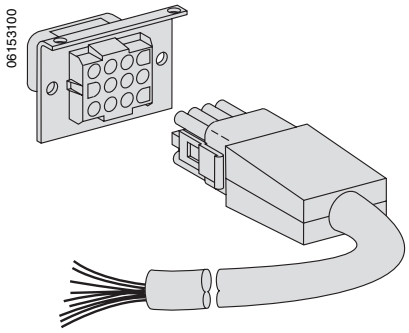
- A moving part connected to the circuit breaker via a support (one support per circuit breaker)
- A fixed part mounted on the plug-in base, equipped with connectors for wires up to #14 AWG (2.5 mm^2)



Compact® NSF150 and NSF250 Circuit Breakers



Compact® NSJ400 and NSJ600 Circuit Breakers



Nine-wire Manual Auxiliary Connector

AUXILIARY AND ALARM SWITCHES

Changeover Switches

Auxiliary switches provide remote information of the circuit breaker status and can thus be used for indications, electrical locking, relays, etc.

Functions

- OF (open/closed): auxiliary switch—indicates position of the circuit breaker contacts
- SD (trip indication): bell alarm—indicates that the circuit breaker has tripped due to
  - — Overload
  - — Short circuit
  - — Ground fault
  - — The operation of a shunt trip or undervoltage trip or the "push-to-trip" button which resets when the circuit breaker is reset
- Operation of a plug-in base or chassis when attempting to withdraw the circuit breaker in ON position; SDE (fault indication): indicates the circuit breaker has tripped due to an overload, short circuit or ground fault; resets when circuit breaker is reset
- CAM (early-make or early-break function): indicates the position of the rotary handle; used in particular for advanced-opening safety trip devices
- Connected/disconnected: indicates the position of a drawout circuit breaker
- Switching of very low loads: all above auxiliary switches are also available in low-level versions capable of switching very low loads (e.g., for controlling PLCs or electronic circuits)

Standards

Auxiliary switches comply with UL 489, CSA C22.2 No. 5.1 and IEC 947-5 Standards. “Low-level" switches are not UL Listed.

Installation

- Functions OF, SD and SDE:
  - — Switches snap into cavities under front accessory cover of the circuit breaker
  - — For Compact® NSF150–NSJ600 circuit breakers, one model serves for all indication functions depending on where it is fitted in the circuit breaker
- SDE function of a circuit breaker equipped with a thermal-magnetic trip unit requires the SDE actuator
- CAM: to be fitted in the rotary handle module; depending on how it is installed, it ensures either the CAO (early-break) or the CAF (early-make) function "Connected/disconnected" function; two parts to be fitted on the chassis and the drawout circuit breaker

Electrical Ratings

UL 489 and CSA C22.2 No. 5.1 Ratings

			Low-level Switches	Regular Switches
Minimum Rating			1 mA–4 V	10 mA–24 V
Maximum Current and Voltage			100 mA–10 V If the maximum voltage and current are exceeded, the low-level characteristics of the switch will be compromised. However, the switch will still function as a standard switch to the following specifications:	6 A–480 V
Maximum Rating	50/60 Hz	240 V	5	6
		480 V	5	6
		600 V	—	3
	DC	48 V	2.5	2.5
		125 V	0.8	0.8
		250 V	0.3	0.3

IEC 947 Ratings

		Low-level Switches				Regular Switches			
Rated Thermal Current (A)		5				6			
Minimum Rating		1 mA–4 V				10 mA–24 V			
Maximum Current and Voltage		100 mA–10 V If the maximum voltage and current are exceeded, the low-level characteristics of the switch will be compromised. However, the switch will still function as a standard switch to the following specifications:				6 A–480 V			
		ac		dc		ac		dc	
Utilization Category (IEC 947-4)		AC12	AC15	DC12	DC14	AC12	AC15	DC12	DC14
Operational Current (A)	24 V	5	3	5	1	6	6	2.5	1
	48 V	5	3	2.5	0.2	6	6	2.5	0.2
	110 V	5	2.5	0.8	0.05	6	5	0.8	0.05
	220/240 V	5	2	—	—	6	4	—	—
	250 V	—	—	0.3	0.03	—	—	0.3	0.03
	380/415 V	5	1.5	—	—	6	3	—	—
	440 V	5	1.5	—	—	6	3	—	—
	660/690 V	—	—	—	—	6	0.1	—	—

SHUNT TRIP AND UNDERVOLTAGE TRIP

A voltage release can be used to trip the circuit breaker via a control signal.

Undervoltage trip (MN)

- Trips circuit breaker when the control voltage drops below a tripping threshold
- Drops out between 35% and 70% of rated voltage
- Circuit breaker closing is possible only if the voltage exceeds 85% of rated voltage
- Permanent type
- If an overvoltage condition exists, operation of circuit breaker closing mechanism will not permit the main contacts to touch, even momentarily

Shunt trip (MX)

- Trips the circuit breaker when control voltage rises above 70% of its rated voltage
- Impulse type ≥ 20 ms or maintained control signals
- AC shunt trips can be operated at 55% of their rated voltage, making them suitable for ground-fault protection when combined with a Class I ground-fault sensing element

Operation

- The circuit breaker must be reset locally after being tripped by shunt trip or undervoltage trip (MN or MX)
- MN or MX tripping has priority over manual (or motor operator) closing; in the presence of a standing trip order such an action does not result in any closing, even temporarily, of the main contacts
- Endurance: 50% of the rated mechanical endurance of the circuit breaker for Compact® NSF150–NSJ600 circuit breakers

Installation and Connection

- Accessories are common to NSF and NSJ circuit breakers and are located within the circuit breaker behind front accessory cover
- Each terminal may be connected by one #18–#14 AWG (1.0–2.5 mm^2) stranded copper wire

Electrical Characteristics

		AC	DC
Rated Voltage (V)		24, 48, 110–130, 208–277, 380–480, 525, 600	12, 24, 30, 48, 60, 125, 250
Consumption	Pickup (MX)	< 10 VA	< 5 W
	Seal-in (MN)	< 5 VA	< 5 W
Clearing Time (ms)		< 50	< 50

MOTOR OPERATOR

The motor operator remotely operates the circuit breaker featuring easy and sure operation:

- All circuit breaker indications and information remain visible and accessible, including trip units settings and circuit breaker connection
- Suitability for isolation is maintained and padlocking remains possible
- Double insulation front face

Applications

- Local motor-driven operation, centralized operation, automatic distribution control
- Normal/standby source changeover or switching to a replacement source to optimize energy costs
- Load shedding and reconnection to optimize energy costs
- Synchrocoupling—less than five cycle closing time

Automatic Operation

- On and off by two impulse type or continuous control signals
- Depending on the wiring, resetting can be done locally, remotely or automatically
- Mandatory manual reset following tripping due to an electrical fault

Manual Operation

- Transfer to manual mode using switch with possibility of remote mode indication
- On and off by two push buttons
- Recharging of stored-energy system by pumping the lever nine times
- Padlocking in off position

Installation and Connection

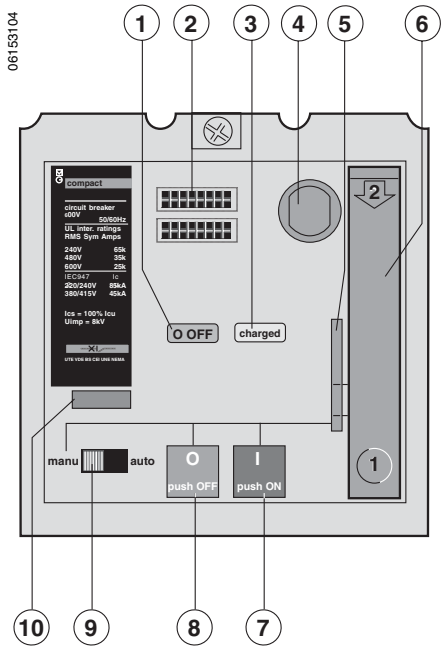
- All installation (fixed, plug-in/drawout mounting) and connection capabilities are maintained
- Connection of the motor operator module behind its front cover to a built-in terminal block, for stranded copper wire #14 AWG (2.5 mm^2)

Accessories for NSJ400/600

- Keylock for locking in OFF position
- Operations counter, indicating the number of ON and OFF cycles; the counter must be installed on the front of the motor operator module.

Characteristics

			NSF	NSJ
Response Time (ms)		Opening	< 500	—
		Closing	< 80	—
Max. Cycles Frequency Per Minute			4	—
Control Voltage (V)	AC 50/60 Hz		48–60	48–60
			110–130	110–130
			208–277	208–277
			380–480	380–415
				440–480
	DC		24–30	24–30
			48–60	48–60
			110–130	110–130
			250	250
Consumption	AC (VA)	Opening	-500	—
		Closing	-500	—
	DC (W)	Opening	-500	—
		Closing	-500	—
Minimum Operating Order			700 ms	—
Operating Voltage			85–110% Rated Voltage	—

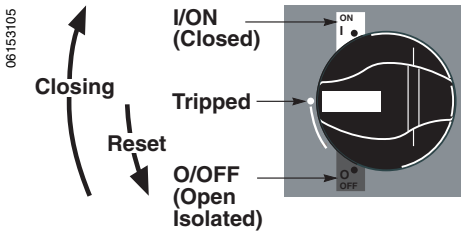


1. Contact position indicator (suitability for isolation)
2. Outgoing circuit identification labels
3. Spring status indicator (charged, discharged)
4. Locking device (keylock) on NSJ400/600
5. Locking device (off position) using one to three padlocks, diameter 0.2–0.32 in. (5–8 mm), not supplied
6. Manual spring-charging handle
7. ON push button
8. OFF push button
9. Manual/auto mode selection switch; the position of the switch can be indicated remotely
10. Operations counter (Compact® NSJ400/600 circuit breaker)

ROTARY OPERATING HANDLES

Operation

- The direct rotary handle maintains
  - — Suitability for isolation
  - — Indication of three positions: O (off), I (on) and tripped
  - — Access to the "push-to-trip" button
  - — Visibility of, and access to, trip unit settings



- The circuit breaker may be locked in the off position by using one to three padlocks, padlock shackle diameter 0.19–0.31 in. (5–8 mm); padlocks are not supplied

Directly Mounted

Installation

Replaces the circuit breaker front accessory cover (secured by screws).

Models

- Standard with black handle
- VDE type with red handle and yellow bezel for machine tool control

Variations for Compact® NSF150–NSJ600 Circuit Breakers

Accessories transform the standard direct rotary handle for the following situations:

- Motor control centers (MCCs)
  - — Opening of door prevented when circuit breaker is on
  - — Closing of circuit breaker inhibited when door is open
- Machine tool control; complies with CNOMO E03.81.501N; degree of protection IP54

The directly-mounted rotary operating handle is Listed under UL file E103955 and Certified under CSA file LR 69561.

Door Mounted

Makes it possible to operate circuit breakers installed inside an enclosure from the front. The handle mechanism can be used in NEMA 3R and 12 enclosure applications. Degree of protection: IP40 as per IEC 529.

Operation

- The unit maintains:
  - — Suitability for isolation
  - — Indication of the three positions: O (off), I (on) and tripped
  - — Visibility of and access to trip unit settings when door is open
- Defeatable interlock prevents opening of door when circuit breaker is on
- Circuit breaker may be locked in the off position by using one to three padlocks, padlock shackle diameter 0.19–0.31 in. (5–8 mm); padlocks are not supplied; locking prevents opening of the switchboard door

Models

- Standard with black handle
- VDE type with red handle and yellow bezel for machine tool control

Installation

The extended rotary operating handle is made up of:

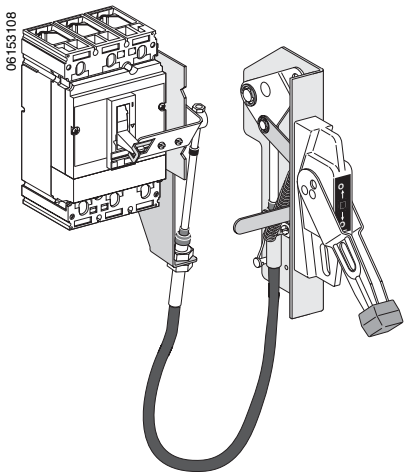
- A unit that replaces the front accessory cover of the circuit breaker (secured by screws)
- An assembly (handle and front plate) on the door that is always secured in the same position, whether the circuit breaker is installed vertically or horizontally
- An extension shaft that must be adjusted; the distances between back of circuit breaker and door are
  - — Compact® NSF150/250 circuit breakers: 7.4–24 in. (185–600 mm)
  - — Compact NSJ400/600 circuit breakers: 8.4–25 in. (210–625 mm)

Variation for Compact® NSF150–NSJ600 Circuit Breakers

For withdrawable configurations, the extended rotary handle is also available with a telescopic shaft containing two stable positions. The extended rotary operating handle is Listed under UL file E103955 and Certified under CSA file LR 69561.

CABLE OPERATING HANDLE

The extended rotary operating handle is Listed under UL file E103955 and Certified under CSA file LR 69561.



Flange-mounted Handle Cable Operating Mechanism

- The cable operator maintains:
  - — Suitability for isolation
  - — Indication of three positions: O (Off), I (On) and tripped
  - — Access to push-to-test
- The circuit breaker may be locked in the off position by one to three padlocks, padlock shackle diameter 0.19–0.31 in. (5–8 mm); padlocks are not supplied
- Door can be locked closed due to interlocking features of handle operator

Installation

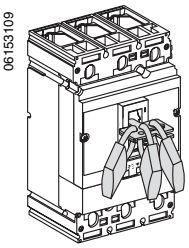
Handle is mounted on flange of enclosure using specified mounting dimensions while circuit breaker and operating mechanism are mounted to inside of enclosure using two screws.

Cable lengths available in 3-, 5- or 10-foot lengths to accommodate a variety of mounting locations. Handles are available in painted Nema 1, 3, 3R, 4 (sheet steel) and 12 ratings or chrome (Nema 4, 4x).

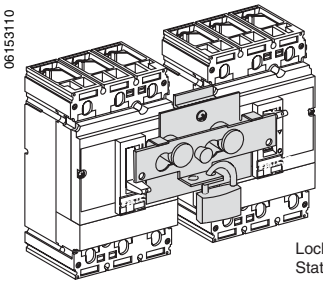
LOCKING SYSTEMS

Padlocking systems can receive up to three padlocks with diameters ranging from 0.19–0.31 in. (5–8 mm) ; padlocks not supplied.

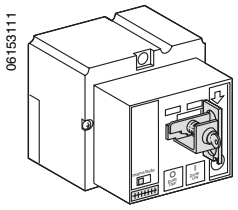
Locking In the Off Position



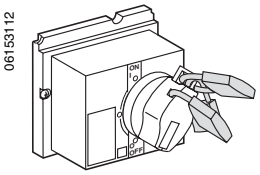
Locking of the Toggle Using a Fixed Device



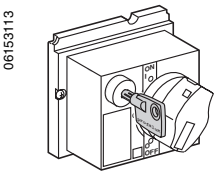
Locking of the Toggle Using a Stationary Device



Locking of the Motor Operator Using a Keylock



Locking of the Rotary Handle Using a Padlock or a Keylock



Locking of the Rotary Handle Using a Keylock

Control Device	Function	Means	Required Accessories	Compact® NSF150/250	Compact® NSJ400/600
Toggle	Lock In Off Position	Padlock	Removable Device	■	■
	Lock In Off or On Position	Padlock	Stationary Device	■	■
Direct Rotary Handle	Lock In Off Position	Padlock	—	■	■
		Keylock	Locking Device + Keylock		
MCC Rotary Operating Handle	Lock In Off Position	Padlock	—	■	■
Extended Rotary Operating Handle	Lock In Off Position, Door Opening Prevented	Padlock	—	■	■
		Keylock	Keylock		
Motor Operator	Lock In Off Position, Motor	Padlock	—	■	■
	Mechanism Locked Out	Keylock	Locking Device (Keylock Incorporated)	■	

INTERLOCKING ACCESSORIES

Interlocking prevents simultaneous closing of two circuit breakers.

Control Device	Means	NSF150–NSJ600
Toggle	Sliding Bar Interlocking Mechanical Device	■
Rotary Handle (Directly or Door Mounted)	Mechanical Interlocking	■
	2 Keylocks and 1 Key	■

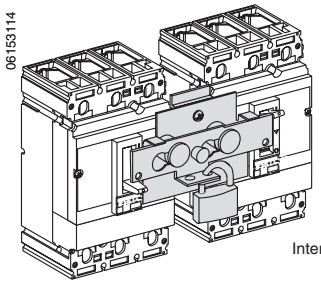
Interlocking of Circuit Breakers with Toggle Control

Two models:

- For Compact® NSF150–NSF250 circuit breakers (three-pole or four-pole)
- For Compact® NSJ400–NSJ600 circuit breakers (three-pole or four-pole)

Padlocking systems can receive one or two padlocks with diameters ranging from 0.19–0.31 inch (5–8 mm). Both interlocked circuit breakers should be fixed version or plug-in version.

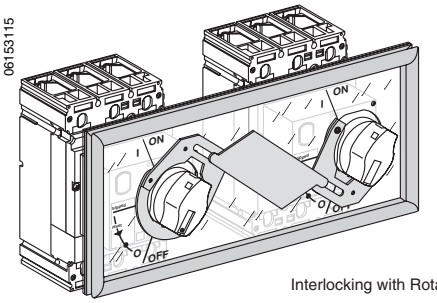
Two sliding interlocking bars can be used to interlock three circuit breakers installed side-by-side, in which case one circuit breaker is in the ON position and the two others in the OFF position.



Interlocking with Toggle Control

Interlocking of Circuit Breakers with Rotary Handles

For Compact® NSF150–NSJ600 circuit breakers



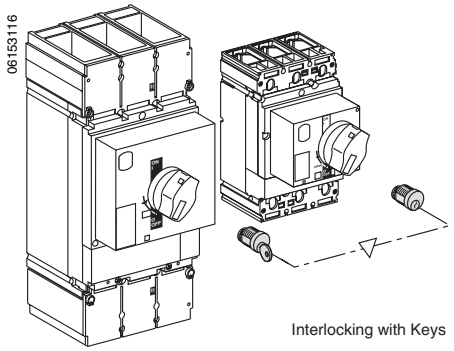
Interlocking with Rotary Handles

Interlocking with Keys

For circuit breakers equipped with rotary handles or a motor mechanism. Interlocking with keys may be easily implemented by equipping each of the Compact® circuit breakers, either fixed or drawout mounted, with a directly mounted rotary operating handle and a standard keylock, but with only one key for the two keylocks. This solution enables interlocking between two circuit breakers that are geographically distant or that have significantly different characteristics.

Use:

- A keylock adapter (different for each device)
- Two identical keylocks with a single key



Interlocking with Keys

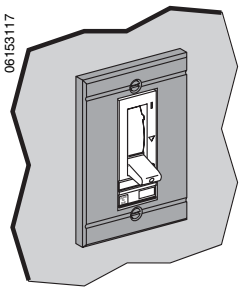
FRONT-PANEL ESCUTCHEONS

For Fixed or Plug-in Mounting

Door escutcheon provides better appearance of the door contact.

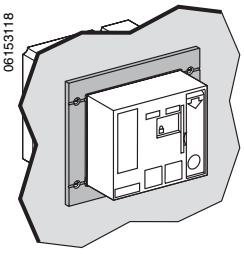
Front-panel Escutcheons for Toggle

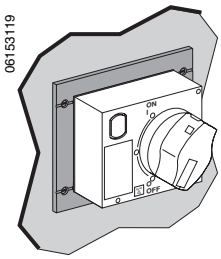
Secures to the panel, from the front.



Front-panel Escutcheon for Motor Operator Module or Rotary-operating Handle

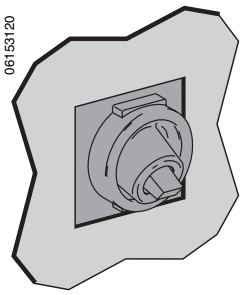
Secures to the panel by four screws, from the front.





Toggle Boot

- Protection up to NEMA 3M
- Fits on front of circuit breaker



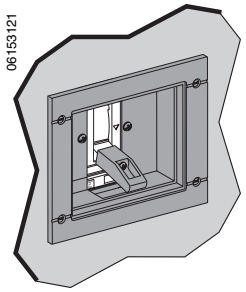
For Drawout Mounting

Toggle Collars

The toggle collars make it possible to maintain degrees of protection regardless of the circuit breaker position (connected, disconnected).

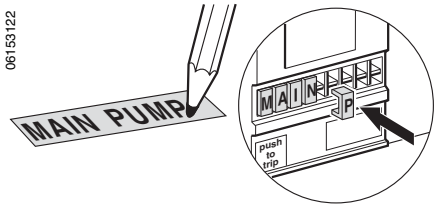
- Front panel escutcheons are obligatory (identical to those for rotary handle and ammeter module)
- Toggle collars secured by two screws on the circuit breaker
- Front panel escutcheons secured on the switchboard
- Toggle extension is supplied with the toggle collar

Front panel escutcheons for motor operator, rotary operating handles are the same as for the fixed-mounted circuit breaker with the same equipment.



Outgoing Circuit Identification

Compact® NS circuit breakers come with labels designed for handwritten indications.

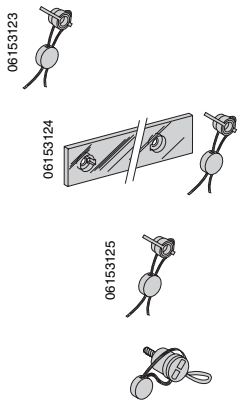


It is also possible to use preprinted Telemecanique labels, catalog No. AB1

- Compact® NSF150–NSF250 circuit breakers: eight characters
- Compact® NSJ400–NSJ600 circuit breakers: sixteen characters

Sealing Accessory

This accessory includes the elements required to fit lead seals to prevent:

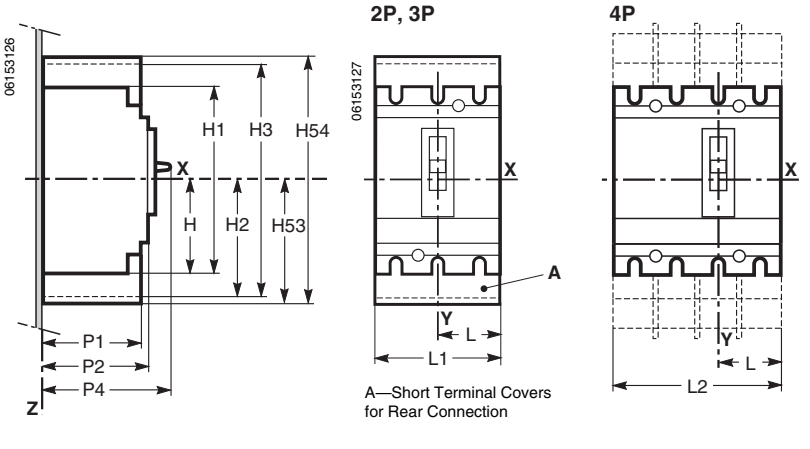


- Front accessory cover removal
- Rotary handle removal
- Opening of the motor operator
- Access to accessories
- Access to trip unit settings
- Access to ground-fault protection settings
- Trip unit removal
- Terminal cover removal
- Access to power connections

SECTION 10—DIMENSIONS

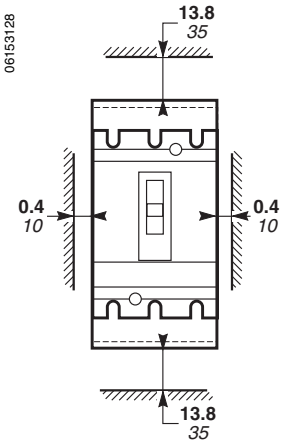
FIXED MOUNTED

Dimensions

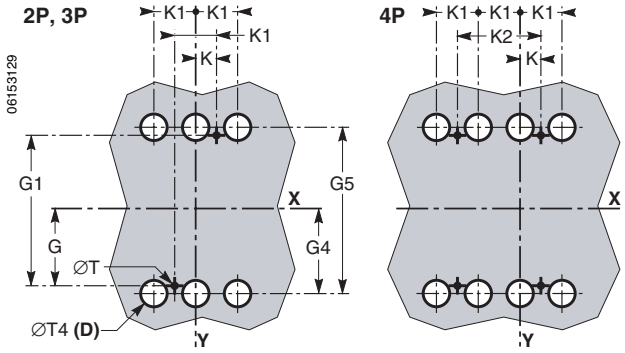


A—Short Terminal Covers for Rear Connection

Electrical Clearances

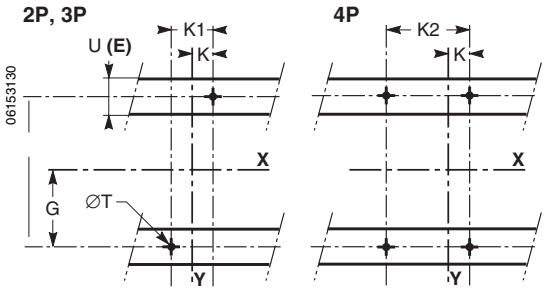


Mounting on Backplate



D—Only For Rear Connected Circuit Breakers

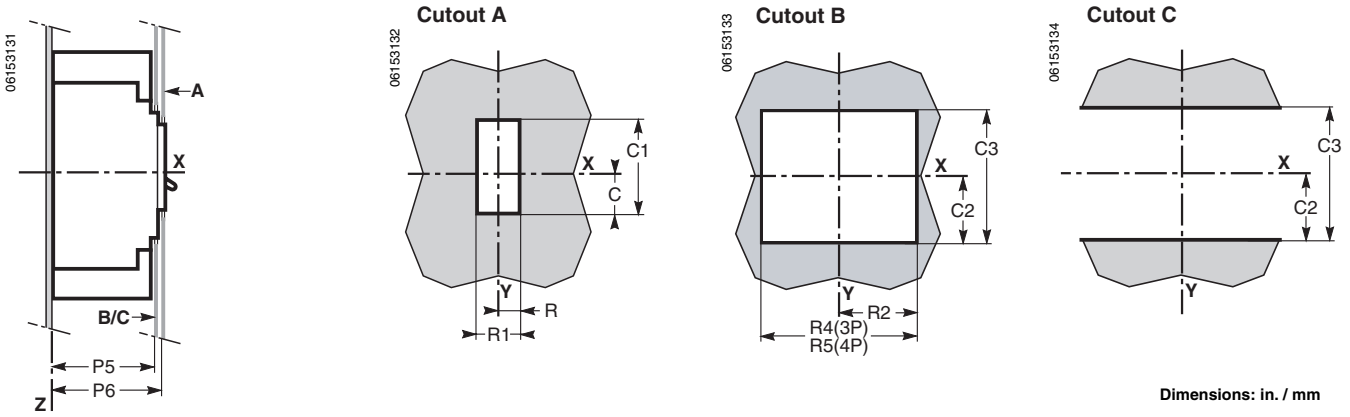
Mounting on Rails



E—U ≤0.78 in. (20 mm) When Using Secondary Disconnecting Blocks (Compact® NSF150 and NSF250 Circuit Breakers)

Front Panel Cutouts

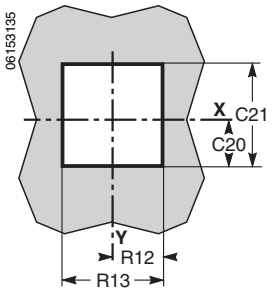
For Fixed or Plug-in Circuit Breakers



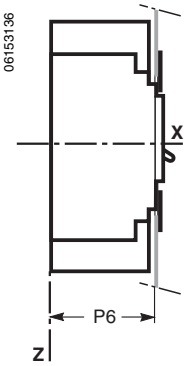
Dimensions: in. / mm

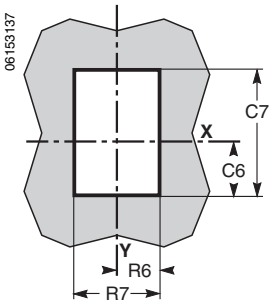
Front-panel Cutouts

With Toggle Boot



With Escutcheon





Front Accessories: See Page 39

Dimensions: in. / mm

		C	C1	C2	C3	C6	C7	C20	C21	G	G1	G4
NSF150/250N/H/L	Inch	1.14	2.99	2.12	4.25	1.69	4.09	1.33	3.38	2.46	4.92	2.75
	mm	29	76	54	108	43	104	34	86	62,5	125	70
NSJ400/600N/H/L	Inch	1.63	4.56	3.64	7.24	2.08	5.74	1.83	4.96	3.93	7.87	4.46
	mm	41.5	116	92.5	184	53	146	46.5	126	100	200	113.5

		G5	H	H1	H2	H3	H53	H54	K	K1	L	L1
NSF150/250N/H/L	Inch	5.51	3.16	6.33	3.70	7.40	3.74	7.48	0.68	1.37	2.06	4.13
	mm	140	80.5	161	94	188	95	190	17.5	35	52.5	105
NSJ400/600N/H/L	Inch	8.93	5.01	10.03	5.61	11.22	6.69	13.38	0.88	1.77	2.75	5.51
	mm	227	127.5	255	142.5	285	170	340	22.5	45	70	140

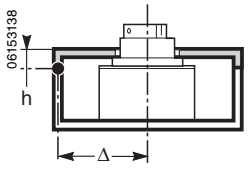
		L2	P1	P2	P4	P5	P6	R	R1	R2	R4	R6
NSF150/250N/H/L	Inch	5.51	3.18	3.38	4.37(*)	3.26	3.46	0.57	1.14	2.12	4.25	1.14
	mm	140	81	86	111(*)	83	88	14.5	29	54	108	29
NSJ400/600N/H/L	Inch	7.28	3.75	4.33	6.61	4.21	4.40	1.24	2.48	2.81	5.62	1.83
	mm	185	95.5	110	168	107	112	31.5	63	71.5	143	46.5

		R7	R12	R13	ØT	ØT4	U**
NSF150/250N/H/L	Inch	2.28	1.69	3.38	0.23	0.86	- 1.25
	mm	58	43	86	6	22	- 32
NSJ400/600N/H/L	Inch	3.66	2.48	4.96	0.23	1.25	- 1.25
	mm	93	63	126	6	32	- 32

* P4 = 4.96 in./126mm for Compact® NSF250N/H/L Circuit Breaker

** U ≤0.78 in./20mm When Using Secondary Disconnecting Blocks (Compact® NSF150 and NSF250 Circuit Breakers)

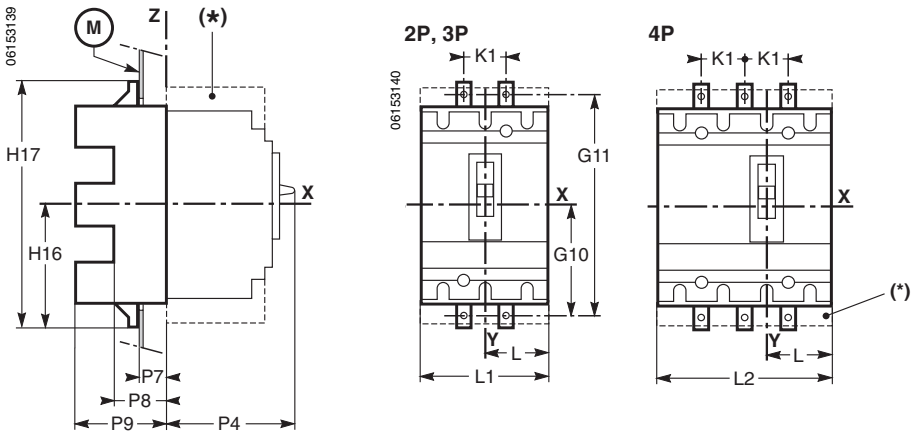
NOTE: Door cutouts require a minimum distance between the center of the circuit breaker and the door hinge point Δ 3.93 in./100 mm + (h x 5).



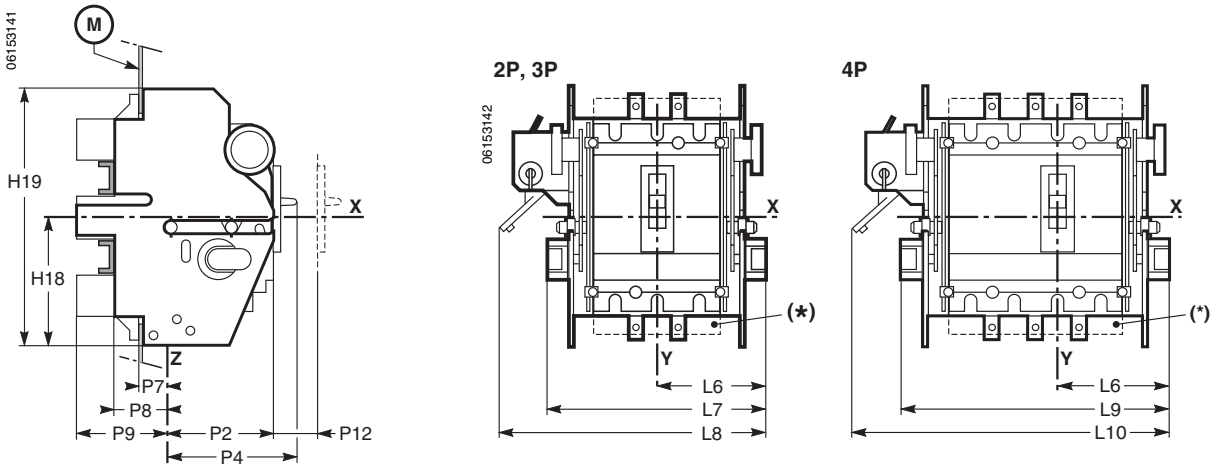
PLUG-IN AND DRAWOUT MOUNTING

Dimensions

Plug-in (On Base)



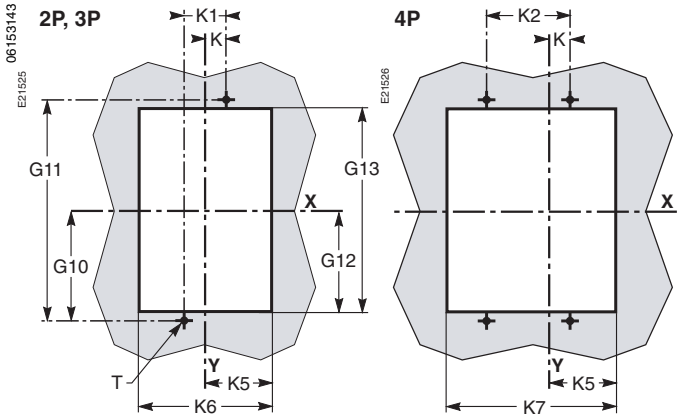
Drawout (On Chassis)



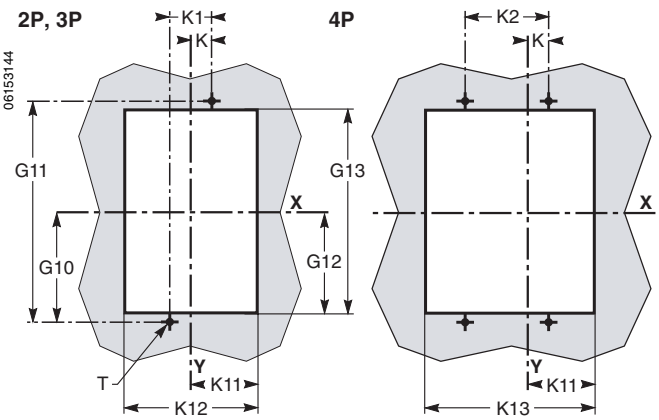
Dimensions: in. / mm

Mounting

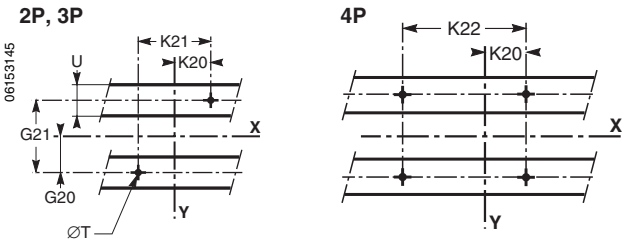
Through a Backplate (Plug-in Base)



Through a Backplate (Chassis)



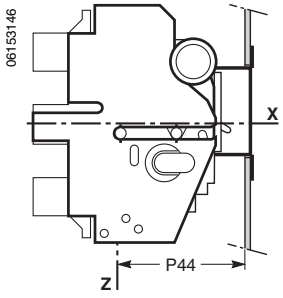
On Rails (Plug-in Base or Chassis)



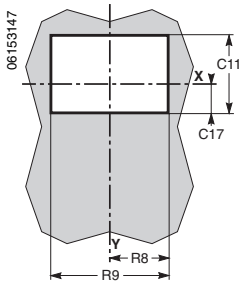
Front-panel Cutouts

Plug-in Mounting

See Fixed-mounted Installation Page 41



Drawout with Extended Front-panel Escutcheons



		C11	C17	G10	G11	G12	G13	G20	G21	H16	H17	H18	H19	K	K1
NSF150/250N/H/L	Inch	4.05	1.67	3.74	7.48	3.42	6.85	1.47	2.95	4.03	8.07	4.07	8.26	0.68	1.37
	mm	103	42.3	95	190	87	174	37.5	75	102.5	205	103.5	210	17.5	35
NSJ400/600N/H/L	Inch	6.10	1.65	5.90	11.8	5.39	10.7	2.95	5.90	6.20	12.40	5.51	11.02	0.88	1.77
	mm	115	42	150	300	137	274	75	150	157.5	315	140	280	22.5	45

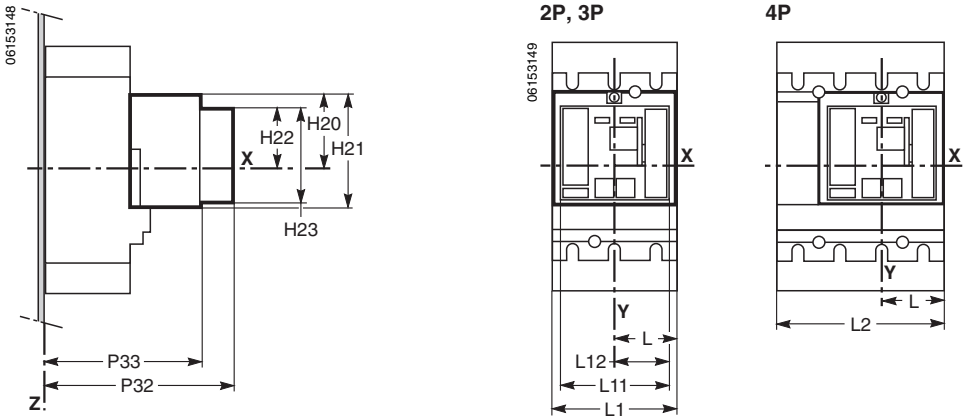
		K5	K6	K11	K12	K13	K20	K21	L	L1	L2	L6	L7	L8	L9
NSF150/250N/H/L	Inch	2.14	4.29	2.91	5.82	7.20	1.37	2.75	2.06	4.13	5.51	3.64	7.28	8.50	8.66
	mm	54.5	109	74	148	183	35	70	52.5	105	140	92.5	185	216	220
NSJ400/600N/H/L	Inch	2.81	2.81	7.40	3.60	7.20	8.97	1.96	2.75	5.51	7.28	4.33	8.66	98.46	10.43
	mm	71.5	143	91.5	183	228	50	100	70	140	185	110	220	250	265

		L10	P2	P4	P7	P8	P9	P12	P44	R8	R9	U**	ØT	
NSF150/250N/H/L	Inch	9.88	3.38	4.37(*)	1.06	1.77	2.95	1.25	4.84	2.91	5.82	≤1.25	0.23	
	mm	251	86	111(*)	27	45	75	32	123	74	148	≤ 32	6	
NSJ400/600N/H/L	Inch	11.61	4.33	6.61	1.06	1.77	3.93	1.25	5.78	3.54	7.08	≤ 1.25	0.11	
	mm	295	110	168	27	45	100	32	147	90	180	≤32	3	

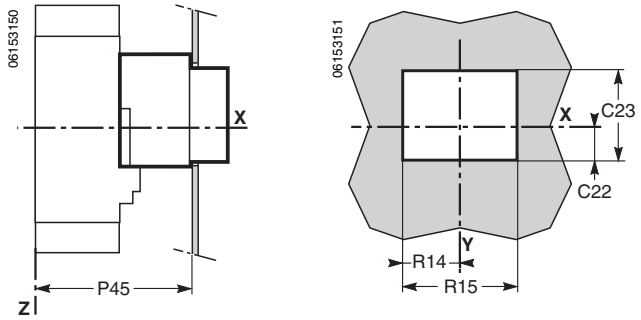
* P4 = 4.96 in./126mm for Compact NSF250N/H/L Circuit Breaker

** U ≤0.78 in./20mm When Using Automatic Auxiliary Connectors (Compact NSF150 and NSF250 Circuit Breakers)

Motor Operators



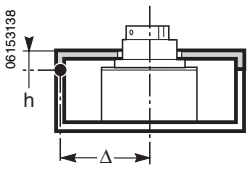
Front-panel Cutouts



Dimension Table

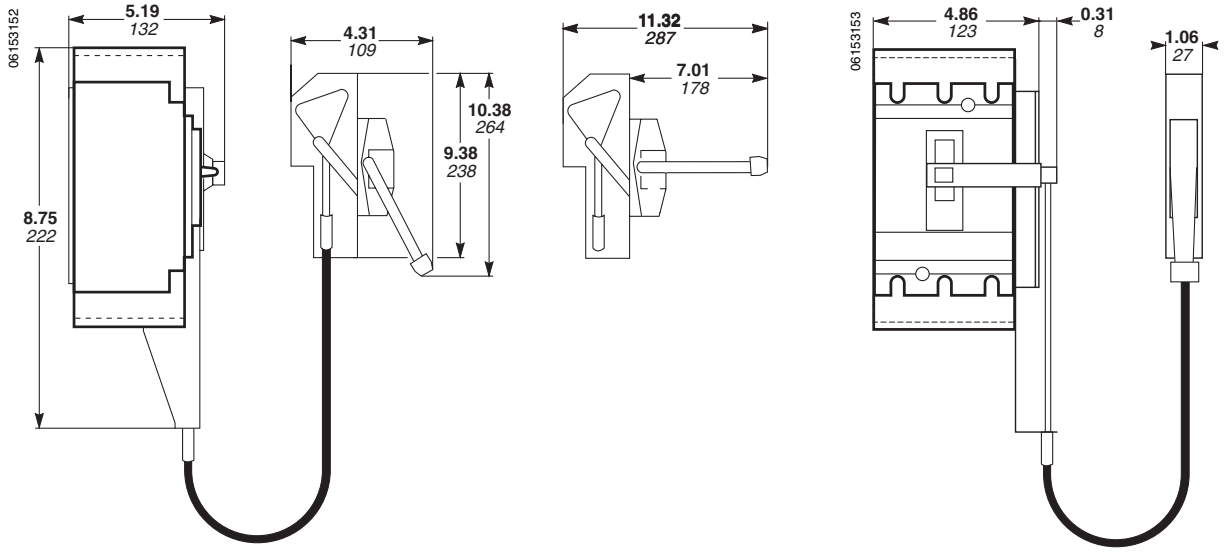
		C22	C23	H20	H21	H22	H23	L	L1	L2	L11	L12	P32	P33	P45	R14
NSF150/250N/H/L	Inch	1.14	2.99	2.46	3.81	1.79	2.87	2.06	4.13	5.51	3.58	1.79	7.00	5.62	5.70	1.90
	mm	29	76	62.5	97	45.5	73	52.5	105	140	91	45.5	178	143	145	48.5
NSJ400/600N/H/L	Inch	1.63	4.96	3.93	5.98	3.26	4.84	2.75	5.51	7.28	4.84	2.42	9.84	8.46	8.54	2.53
	mm	41.5	126	100	152	83	123	70	140	185	123	61.5	250	215	217	64.5

NOTE: Door cutouts require a minimum distance between the center of the circuit breaker and the door hinge point Δ 3.93 in./100 mm + (h x 5).

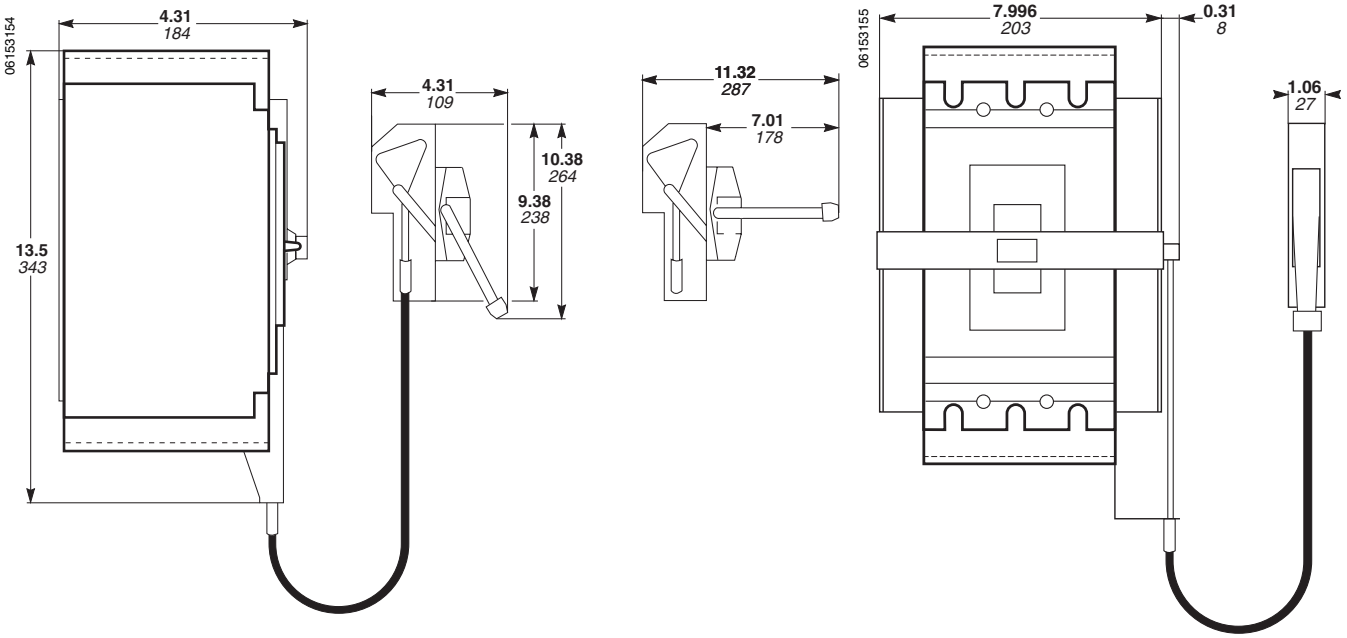


CABLE-OPERATING HANDLES

Compact NSF



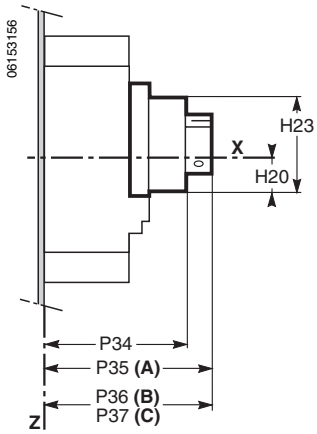
Compact NSJ



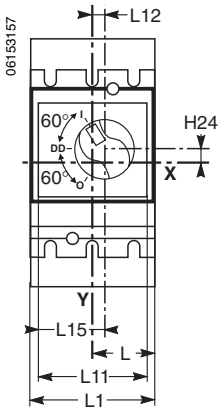
Dimensions: in. / mm

ROTARY-OPERATING HANDLES

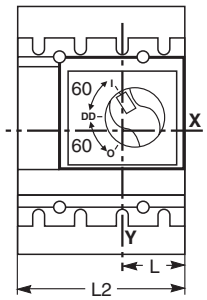
Dimensions



2P, 3P



4P

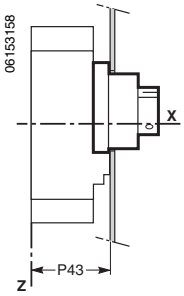


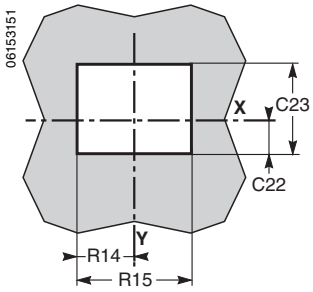
A—Without Keylock
B—With Ronis™ Keylock
C—With Profalux™ Keylock

Ronis and Profalux are trademarks of HF Sécurité

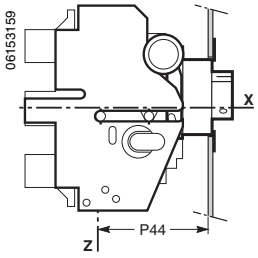
Front-panel Cutouts

Fixed or Plug-in Mounted

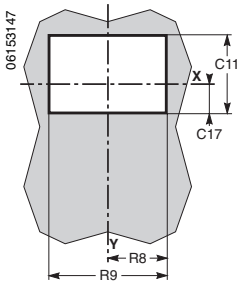




Drawout Mounting

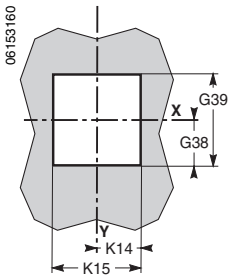


Mandatory to Fit Front Panel Escutcheon

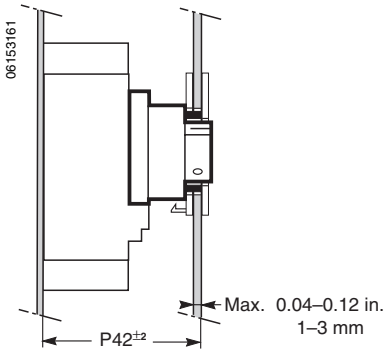


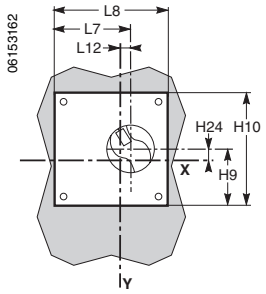
Motor Control Center Type Direct Rotary-operating Handle

Front-panel Cutout



Dimensions

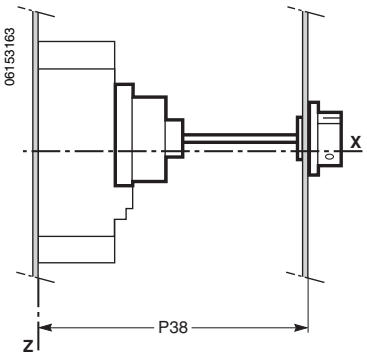




Dimensions

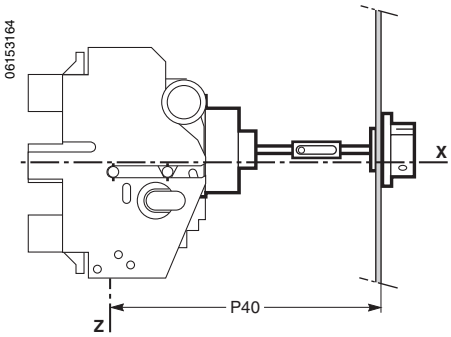
Fixed or Plug-in Mounted

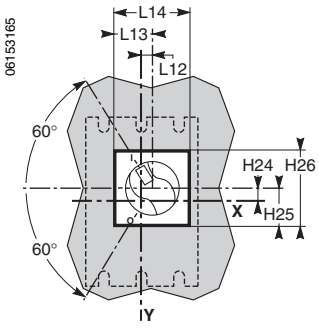
Cut Shaft at Length:
P38—4.96 in. (126 mm) NSF150/250
P38—5.90 in. (150 mm) NSJ400/600



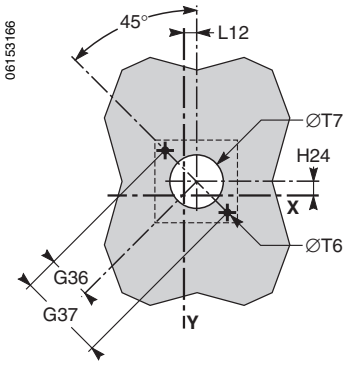
Drawout Mounting

Cut Shaft at Length:
P38—4.80 in. (122 mm) NSF150/250
P40—5.90 in. (150 mm) NSJ400/600

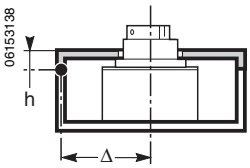




Front-panel Cutout



NOTE: Door cutouts require a minimum distance between the center of the circuit breaker and the door hinge point Δ 3.93 in./100mm + (h x 5)



		C11	C17	C22	C23	G36	G37	G38	G39	H9	H10	H20	H23	H24	H25
NSF150/250N/H	Inch	4.05	1.67	1.14	2.99	1.41	2.83	1.61	3.93	2.36	4.72	1.10	2.87	0.35	1.47
	mm	103	42.5	29	76	36	72	41	100	60	120	28	73	9	37.5
NSJ400/600N/H/L	Inch	6.10	1.65	1.63	4.96	1.41	2.83	2.00	5.70	3.26	6.29	1.47	4.84	0.96	1.47
	mm	155	42	41.5	126	36	72	51	145	83	160	40	123	24.5	37.5

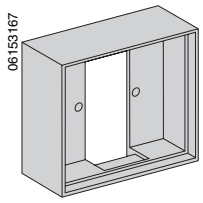
		H26	K14	K15	L	L1	L2	L7	L8	L11	L12	L13	L14	L15	P34
NSF150/250N/H	Inch	2.95	1.96	3.93	2.06	4.13	5.51	2.71	4.72	3.58	0.36	1.47	2.95	2.16	4.76
	mm	75	50	100	52.5	105	140	69	120	91	9.25	37.5	75	55	121
NSJ400/600N/H/L	Inch	2.95	2.85	5.70	2.75	5.51	7.28	3.34	6.29	4.84	0.19	1.47	2.95	2.61	5.70
	mm	75	72.5	145	70	140	185	85	160	123	5	37.5	75	66.5	145

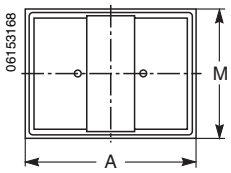
		P35	P36	P37	P38	P40	P42	P43	P44	R8	R9	R14	R15	ØT6	ØT7
NSF150/250N/H	Inch	6.10/7.04	6.14	6.45	7.28 min.	9.76 min.	4.92	3.50	4.84	2.91	5.82	1.90	3.81	0.16	1.96
					23.6 max.	23.6 max.									
	mm	155/179	156	164	185 min.	248 min.	125	89	123	74	148	48.5	97	4.2	50
					600 max.	600 max.									
NSJ400/600N/H/L	Inch	7.08	7.08	7.40	8.22 min.	10.7 min.	5.86	4.40	5.78	3.54	7.08	2.53	5.07	0.16	1.96
					23.6 max.	23.6 max.									
	mm	180	180	188	209 min.	272 min.	149	112	147	90	180	64.5	129	4.2	50
					600 max.	600 max.									

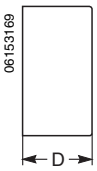
FRONT ACCESSORIES

Extended Escutcheons

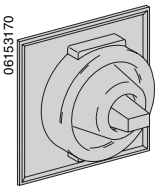
For Toggle

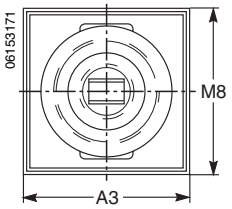


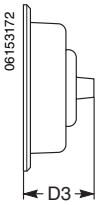




Toggle Boot

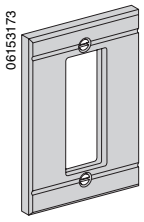


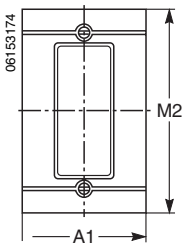


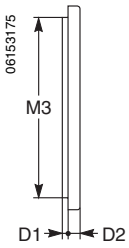


Front-panel Escutcheons

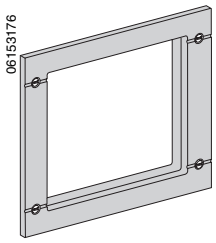
For Toggle

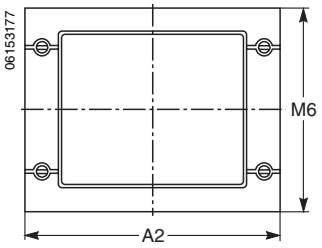


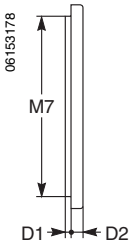




For Extended Escutcheon, Motor Operator Module or Rotary Handle





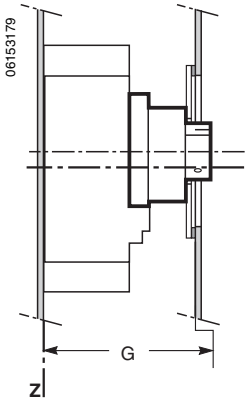


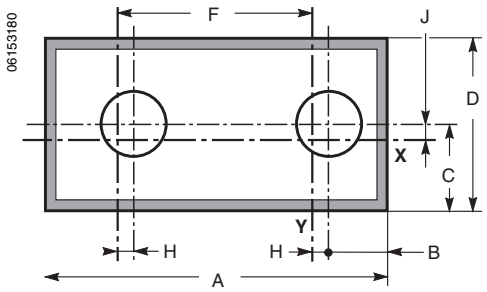
		A	A1	A2	A3	D	D1	D2	D3	M	M2	M3	M6	M7	M8
NSF150/250N/H	Inch	3.58	2.71	6.18	3.70	1.37	0.13	0.25	1.57	2.87	4.52	4.01	4.48	3.97	3.70
	mm	91	69	157	94	35	3.5	6.5	40	73	115	102	114	101	94
NSJ400/600N/H/L	Inch	4.84	4.01	7.44	1.37	5.27	0.13	0.25	2.36	4.84	6.10	5.59	6.45	5.94	5.27
	mm	123	102	189	35	134	3.5	6.5	60	123	155	142	164	151	134

INTERLOCKING SYSTEMS

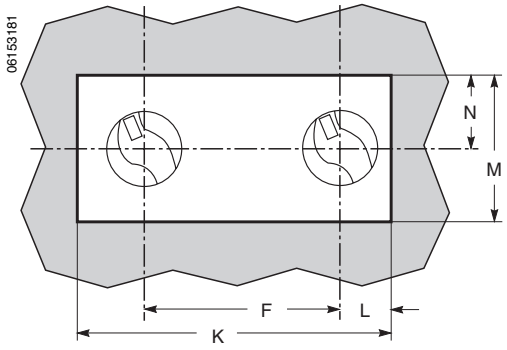
Interlocking Systems with Rotary-operating Handles

Dimensions





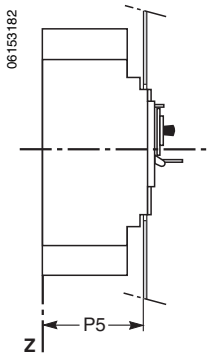
Front-panel Cutout



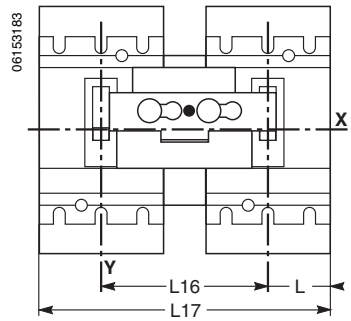
		A	B	C	D	F	G	H	J	K	L	M	N
NSF150/250	Inch	12.79	3.54	3.44	6.89	6.14	5.23	0.36	0.35	11.61	2.97	5.90	2.95
	mm	325	90	87.5	175	156	133	9.25	9	295	75.5	150	75
NSJ400/600	Inch	16.38	4.53	3.94	7.87	8.27	6.18	0.20	0.97	15.20	3.94	6.89	2.93
	mm	416	115	100	200	210	157	5	24.6	386	100	175	74.5

Interlocking Systems with Toggles

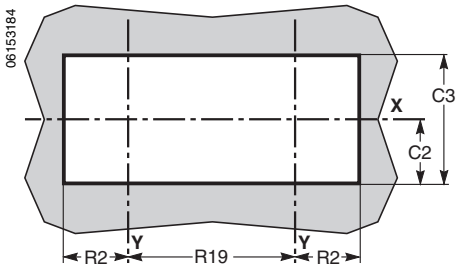
Dimensions



Three-pole



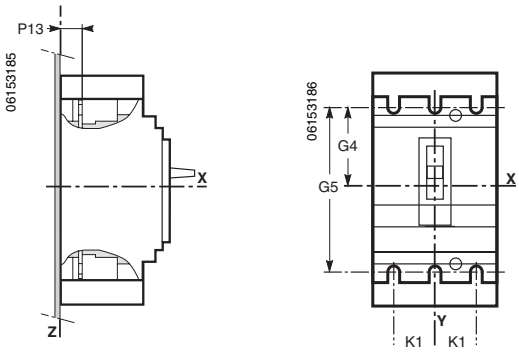
Front-panel Cutout



		C2	C3	L	L16	L17	R2	R19	P5
NSF150/250N/H	Inch	2.12	4.25	2.06	5.51	9.64	2.12	5.51	3.26
	mm	54	108	52.5	140	245	54	140	83
NSJ400/600N/H/L	Inch	3.64	7.24	2.75	7.28	12.79	2.81	7.28	4.21
	mm	92.5	184	70	185	325	71.5	185	107

SECTION 11—CONNECTION DIMENSIONS

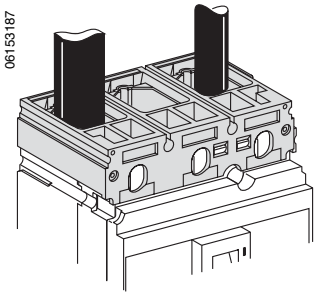
Fixed Mounted



		G4	G5	K1	P13
NSF150/250N/H	Inch	2.75	5.51	1.37	0.76*
	mm	70	140	35	19.5*
NSJ400/600N/H/L	Inch	4.46	8.93	1.77	1.02
	mm	113.5	227	45	526

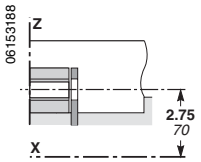
* P13 = 0.84 in./21.5 mm for Compact® NSF250N/H Circuit Breaker

Front Connections

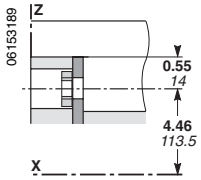


Bar Connection

NSF 150/250 (M8 Screws)

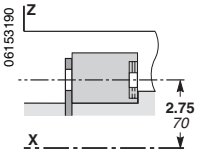


NSJ 400/600 (M10 Screws)

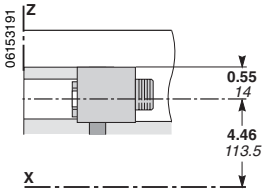


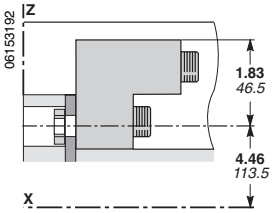
Cable Connection

NSF 150/250

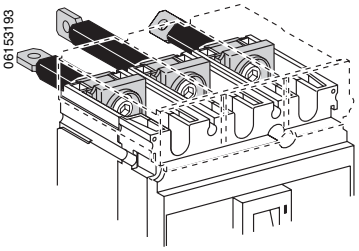


NSJ 400/600

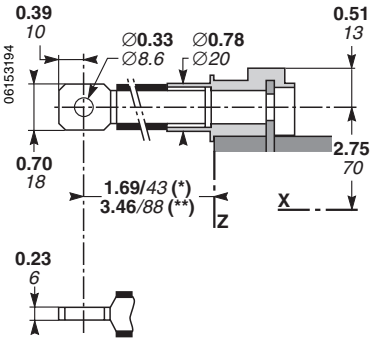




Rear Connections

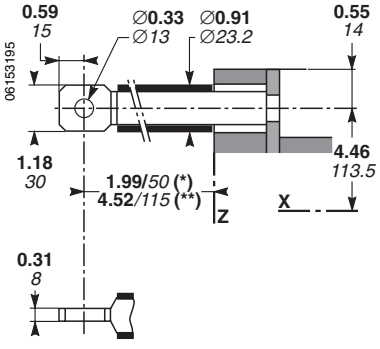


NSF 150/250



(*) Short RC : 1.69/*43*
(**) Long RC : 3.46/*88*

NSJ 400/600

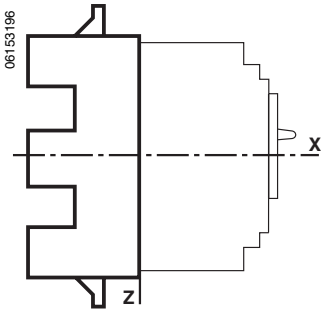


(*) Short RC : 1.96/*50*
(**) Long RC : 4.52/*115*

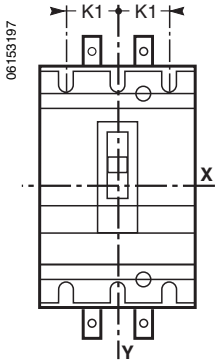
Dimensions of Energized Parts: See Section 8—Connections

Dimensions: in. / mm

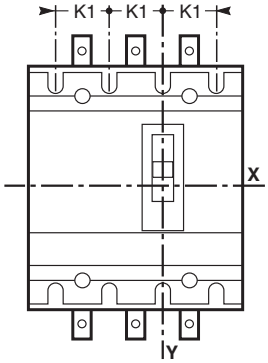
Plug-in or Drawout Mounting



2P, 3P

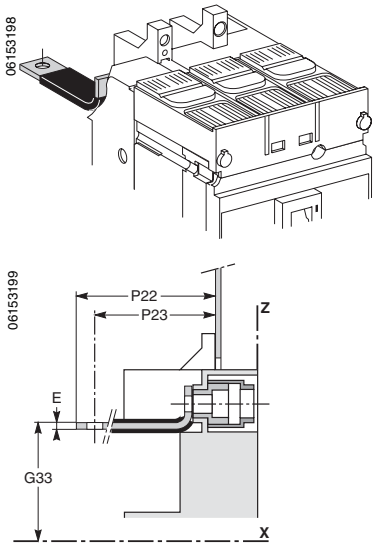


4P

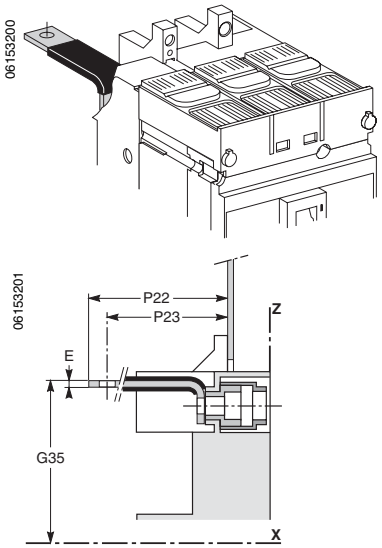


Rear Connections

Rear Connections Fitted at Lower Limit



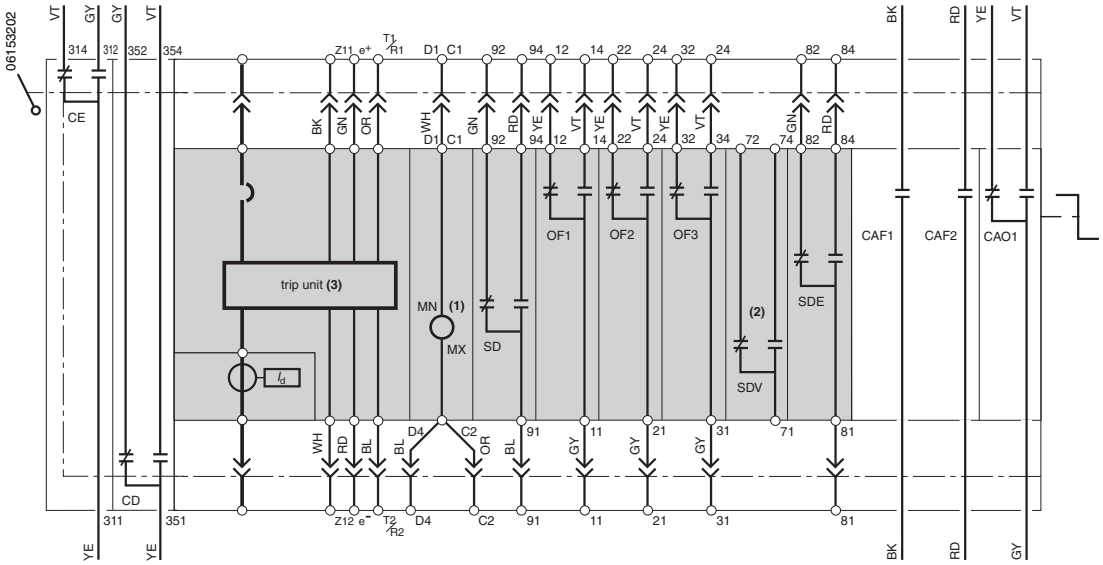
Rear Connections Fitted at Upper Limit



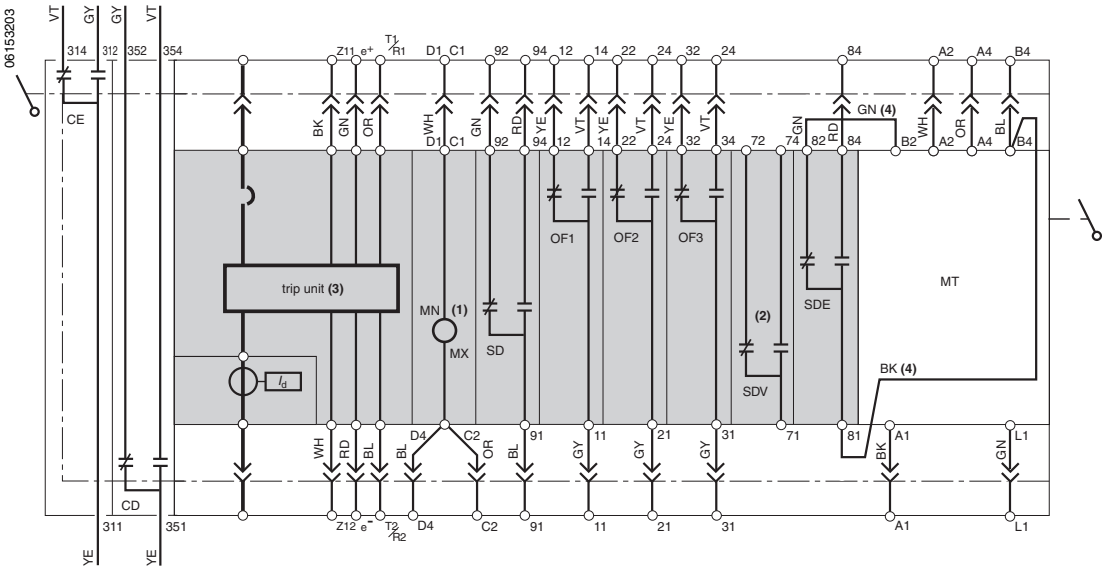
		E	G33	G35	K1	P22		P23	
NSF150/250N/H	Inch	0.15	2.5	3.16	1.37	2.93	4.86	2.59	4.52
	mm	4	63.5	80.5	35	74.5	123.5	66	115
NSJ400/600N/H/L	Inch	0.23	4.09	5.07	1.77	4.50	7.14	3.93	6.57
	mm	6	104	129	45	114.5	181.5	100	167

SECTION 12—WIRING DIAGRAMS

Manually-operated Circuit Breaker



Motor-operated Circuit Breaker



All schemes are shown without the control voltage present, all devices open and relays in the de-energized position.

Switches CD, CE: on drawout chassis.

Switches CAO, CAF: on rotary handle.

Symbols

CAF = early-make switch
CAO = early-break switch
CE = "connected" position indication switch
CD = "disconnected" position indication switch
MN = undervoltage trip
MT = motor operator
MX = shunt trip
OF = position indication switch
SD = trip indication switch
SDE = overcurrent trip switch
SDV = ground-fault indication switch

Legend

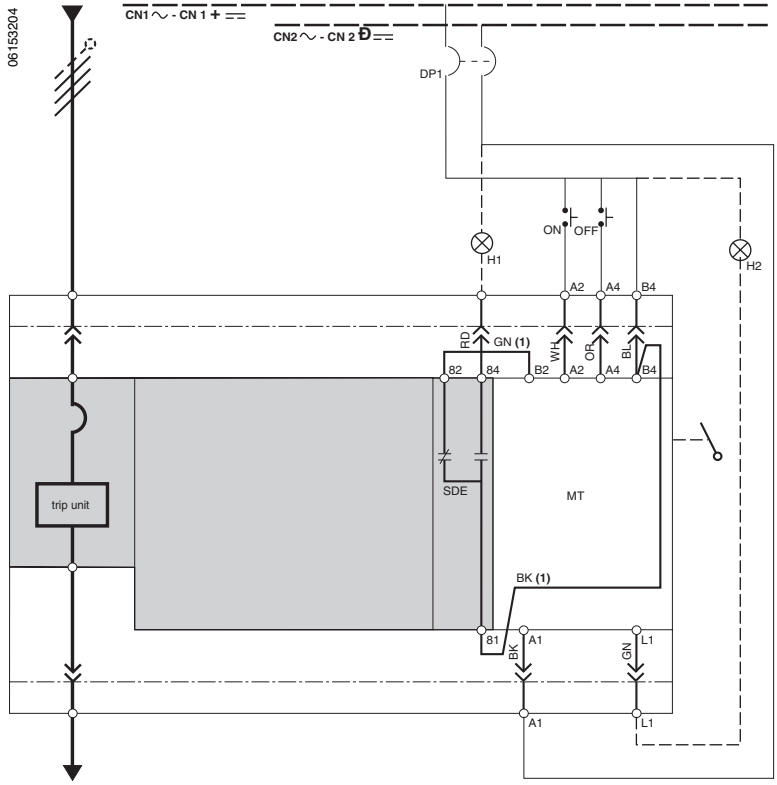
(1) Undervoltage or shunt trip
(2) For plug-in/drawout versions, SDV and OF2 switches can be installed together, but only one of them will be connected through automatic secondary disconnecting blocks
(3) Options are only installed on trip unit STR53UP
(4) Wiring supplied, mandatory to connect

Color code

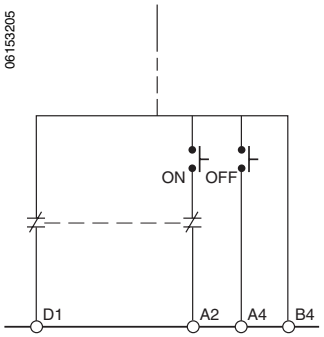
VT: Purple
YE: Yellow
RD: Red
BK: Black
GN: Green
GY: Grey
WH: White
OR: Orange
BL: Blue

Motor Operator—Automatic Resetting After Tripping

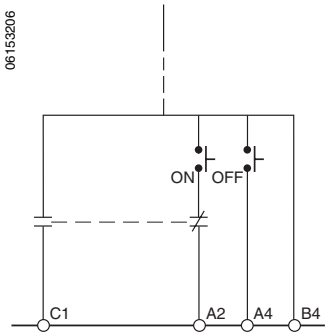
Use of the Motor Operator (Standard Wiring Diagram)



Motor Operator + Undervoltage Trip



Motor Operator + Shunt Trip



Mandatory manual reset after tripping due to an electrical fault.

Symbols

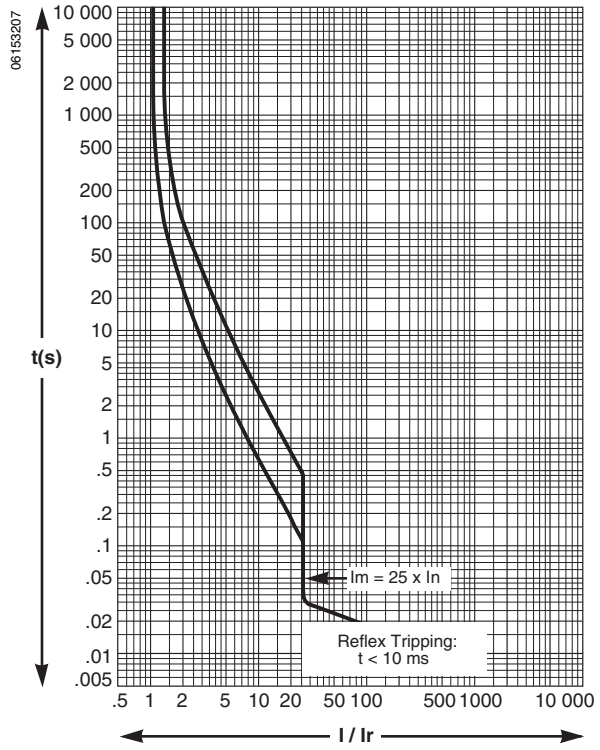
DP1 = protection circuit breakers
OFF = opening push button
ON = closing push button
H2 = "manual" position indication
H1 = electrical fault indication
MT = motor operator
SDE = electrical fault indication switch

(1) Jumper is supplied and must be connected by user. Overcurrent trip switch is strongly recommended to lock remote or automatic resetting after an overcurrent fault.

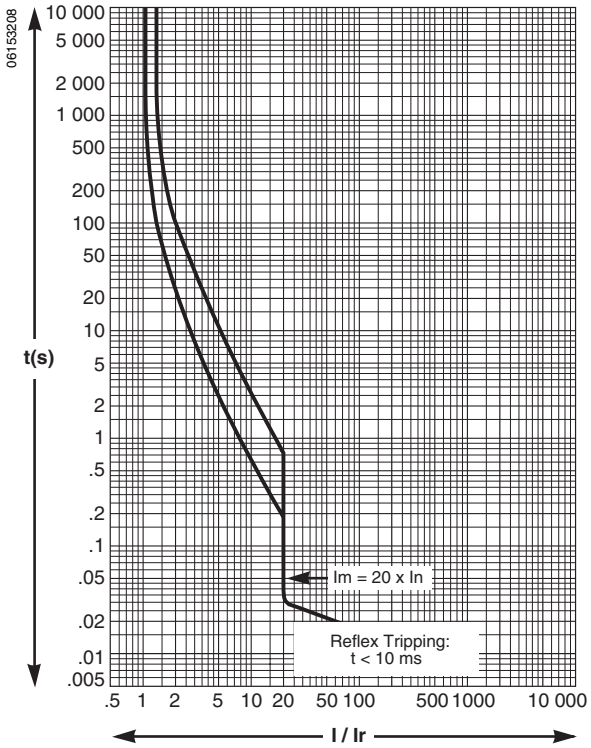
SECTION 13—SUPPLEMENTARY TECHNICAL INFORMATION

TRIP UNITS FOR COMPACT® NSF150–NSF250 CIRCUIT BREAKERS

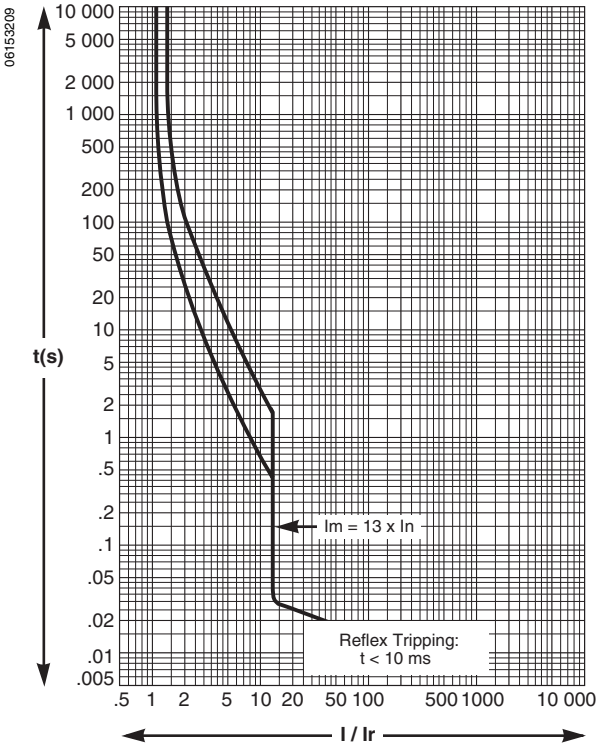
TM15DP



TM20DP

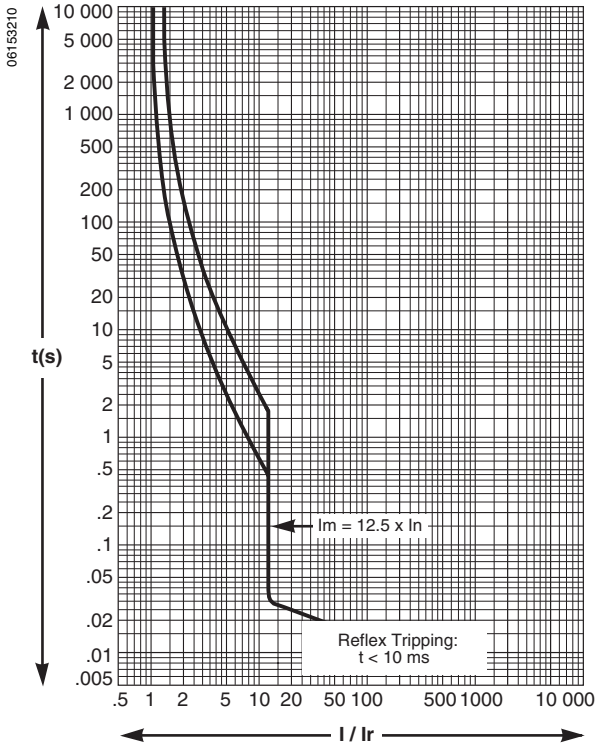


TM30DP

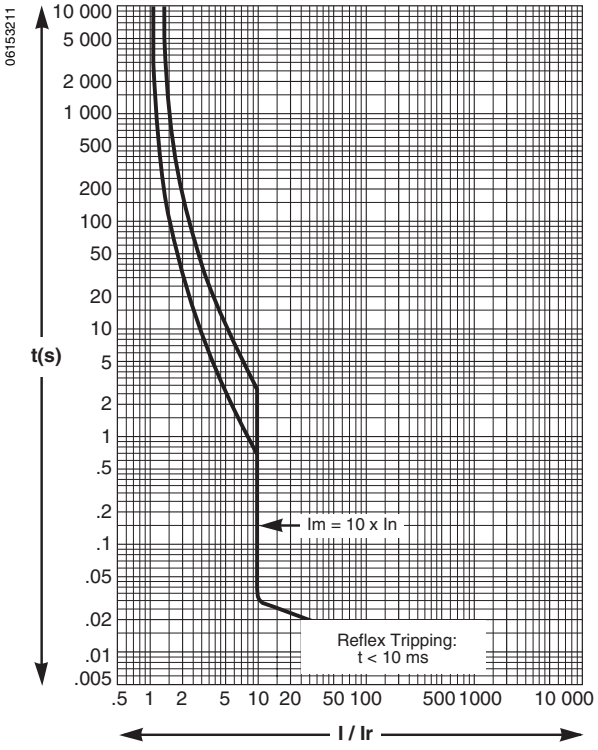


Reflex Tripping: See Page 62

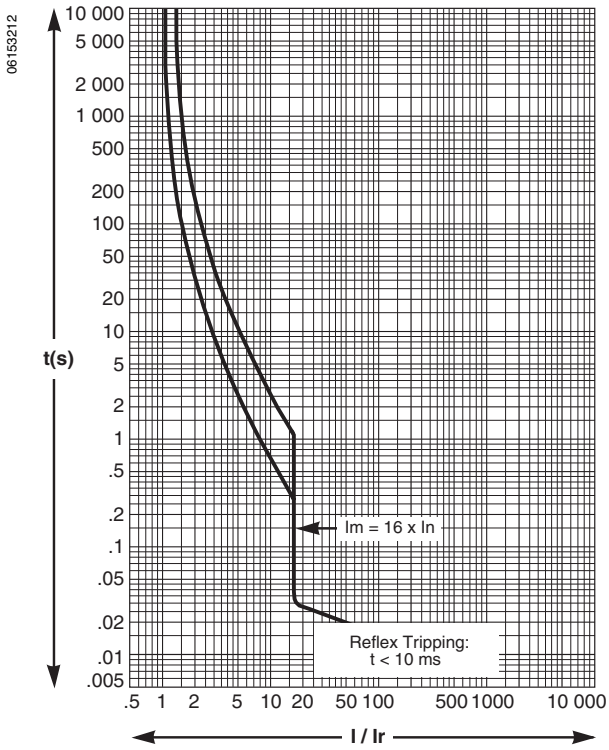
TM40DP



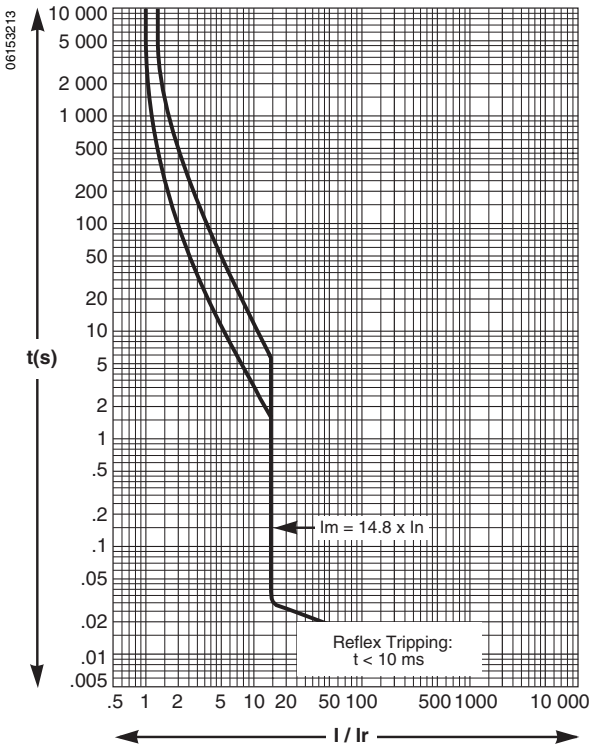
TM50DP



TM60DP

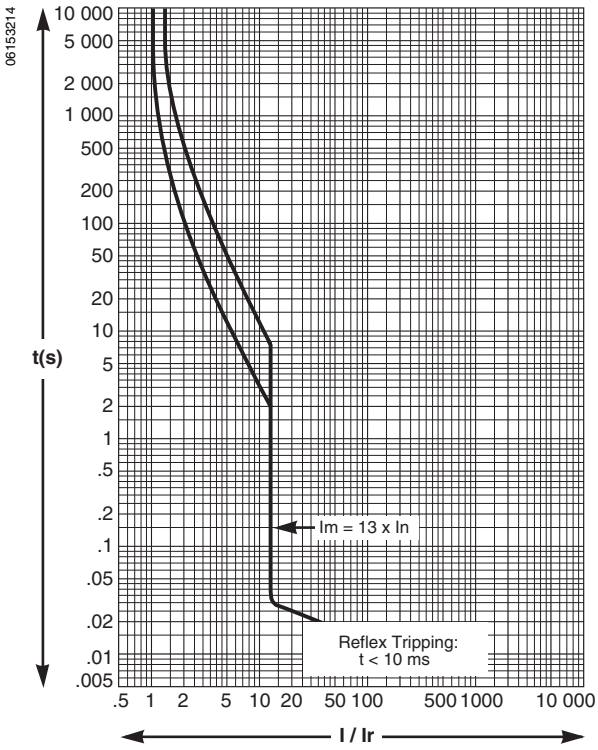


TM70DP

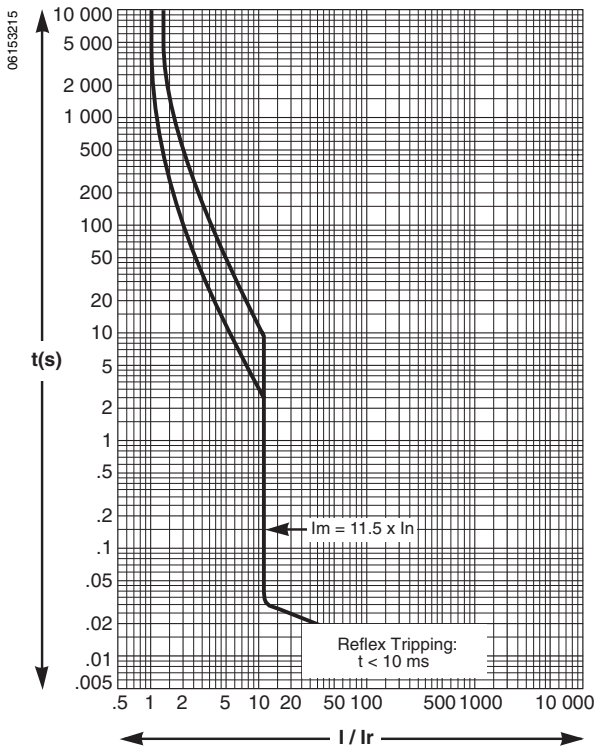


Reflex Tripping: See Page 62

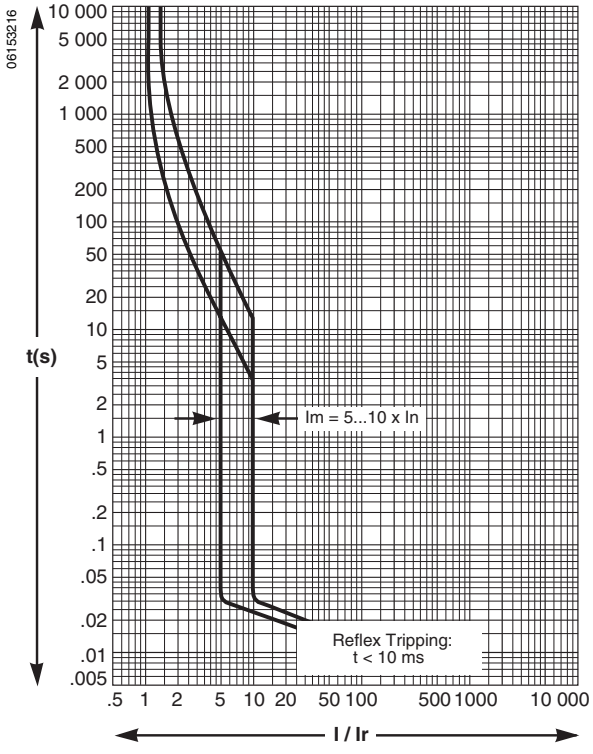
TM80DP



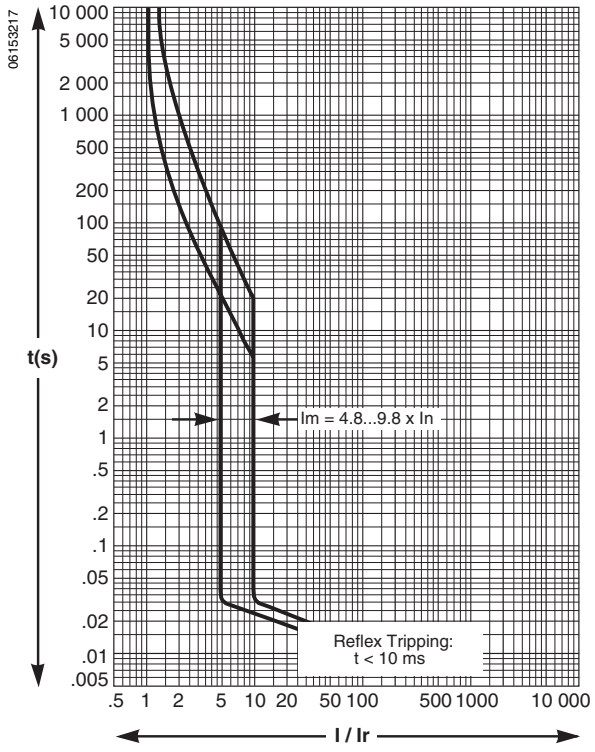
TM90DP



TM100-225DP



TM250DP



Reflex Tripping: See Page 62

EFFECT OF HIGH TEMPERATURES

When the ambient temperature is greater than 40° C, overload protection characteristics are slightly modified. When determining tripping times using time/current curves, the Ir values corresponding to the thermal setting on the circuit breaker must be reduced using the coefficients below:

45° C	50° C	55° C	60° C	65° C	70° C
0.975	0.95	0.925	0.90	0.875	0.85

Example

What is the tripping time for a TM200DP circuit breaker with a 400A fault current and an ambient temperature of 40° C?

- Ir = 200 A
- I/Ir = 400/200 = 2

On the time/current curve, t = 100 s.

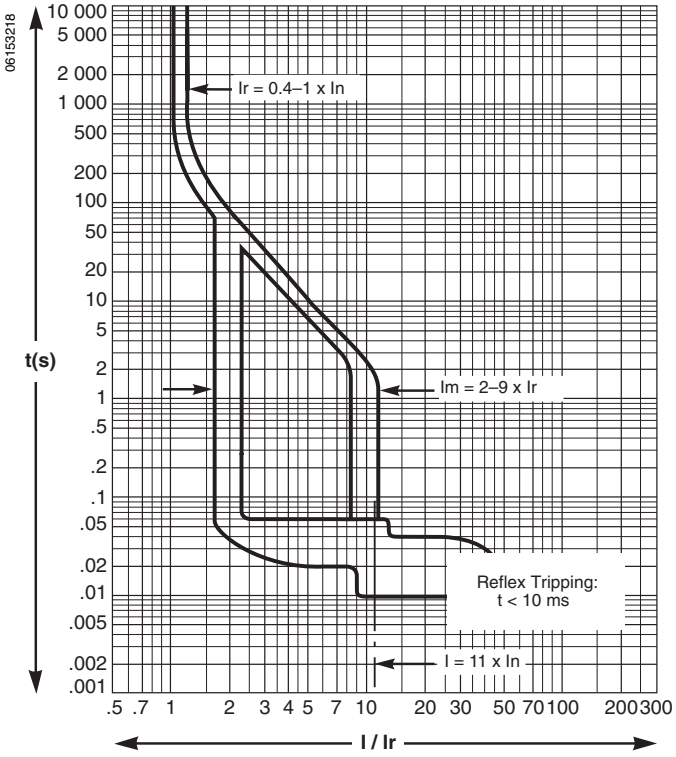
Consider the same conditions, except an ambient temperature of 65° C. What is the tripping time?

- Ir = 200 x 0.875 = 175 A
- I/Ir = 400/175 = 2.28

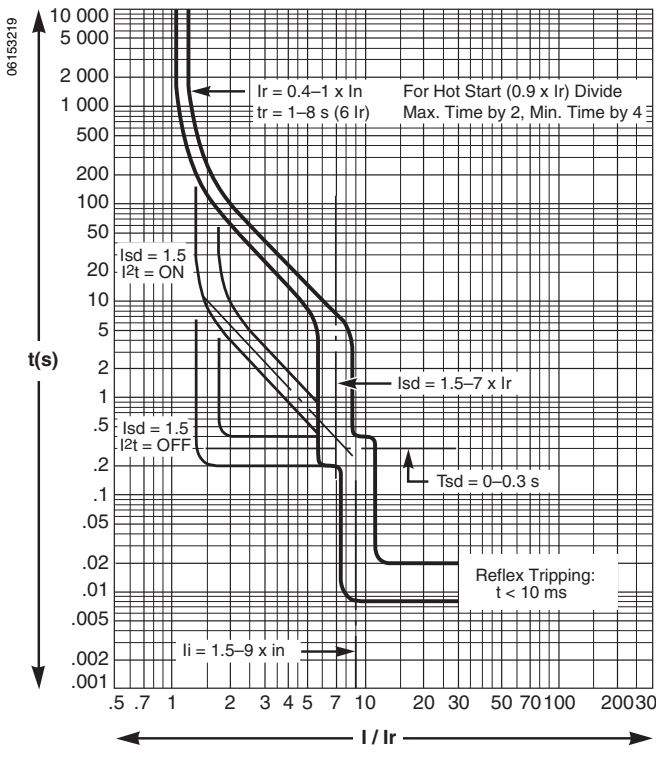
On the time/current curve, ≈ 65 s.

TRIP UNITS FOR COMPACT® NSJ400–NSJ600 CIRCUIT BREAKERS

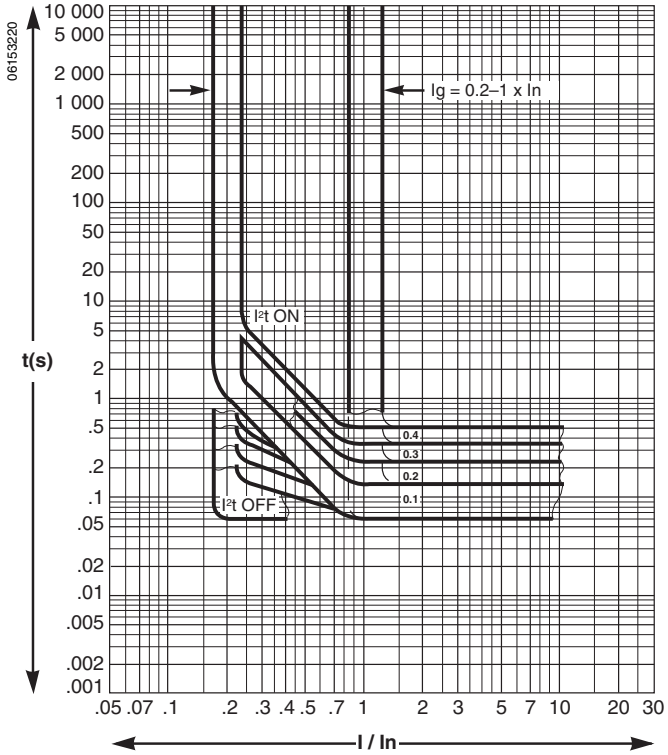
STR23SP



STR53UP



STR53UP Ground-fault Protection



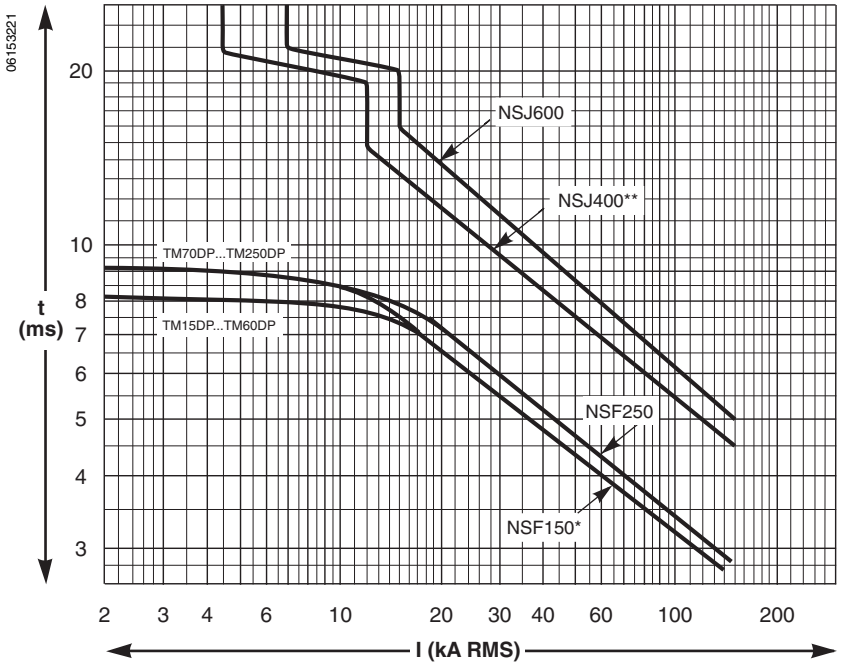
Reflex Tripping: See Page 62

REFLEX TRIPPING

All Compact® NS circuit breakers and switches incorporate the exclusive reflex tripping system.

This extremely simple system breaks very high fault currents by mechanically tripping the device via a "piston" actuated directly by the pressure produced in the breaking units resulting from a short circuit.

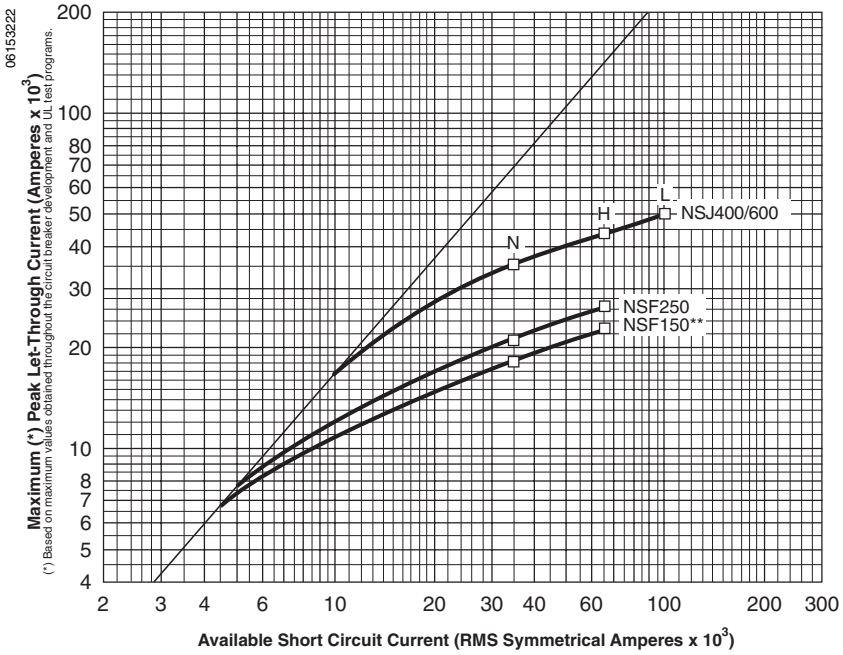
For high short-circuit thermal withstand, this system provides a faster break. Reflex tripping curves are exclusively a function of the circuit breaker rating.



* 4P OSN Compact® NSF125/250N and NSF 150/250N Ratings Are Same As NSF250
** 4P OSN NSJ 400/600N Ratings Are Same As NSJ600

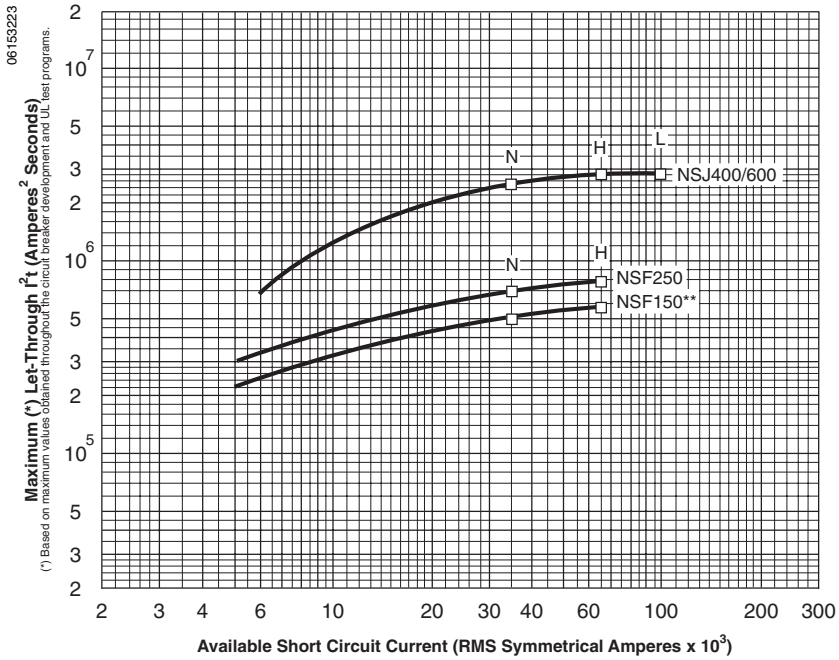
LET-THROUGH CURVES AT 480 V

Maximum Peak Let-through Current (Amperes)



**4P OSN Compact® NSF125/250N and NSF 150/250N Ratings Are Same As NSF250

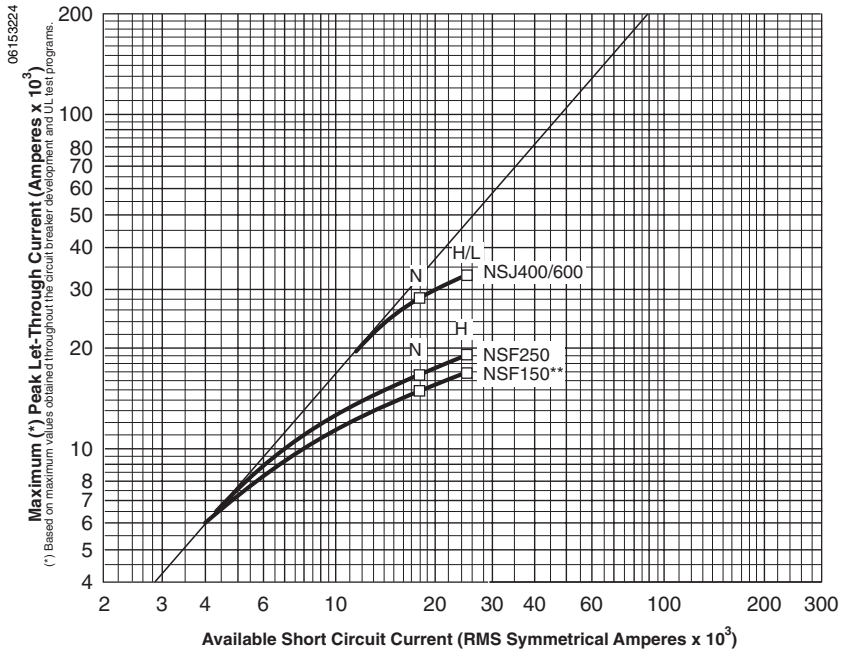
Maximum Let-through I^2t (Amperes^2 Seconds)



**4P OSN Compact® NSF125/250N and NSF 150/250N Ratings Are Same As NSF250

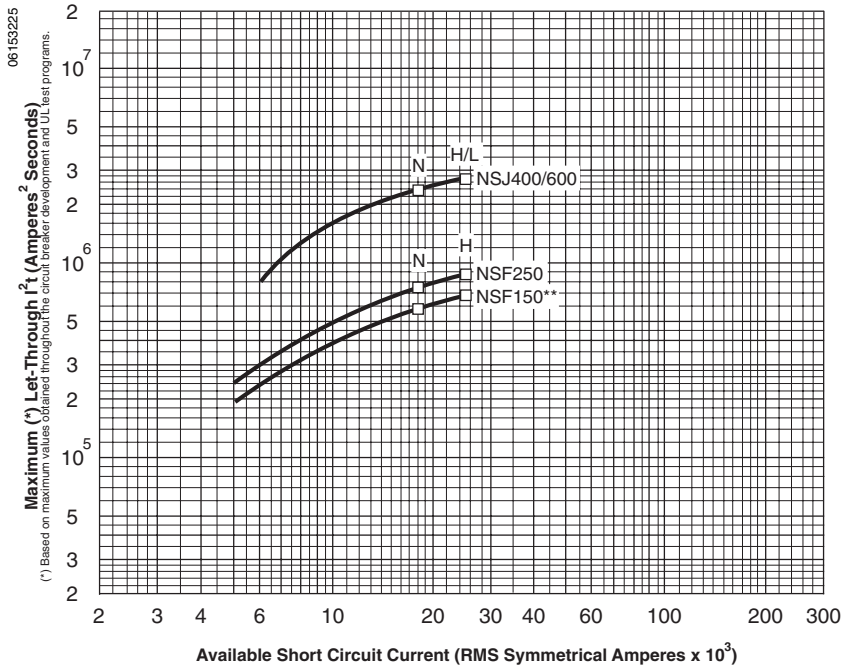
LET-THROUGH CURVES AT 600 V

Maximum Peak Let-through Current (Amperes)



**4P OSN Compact® NSF125/250N and NSF 150/250N Ratings Are Same As NSF250

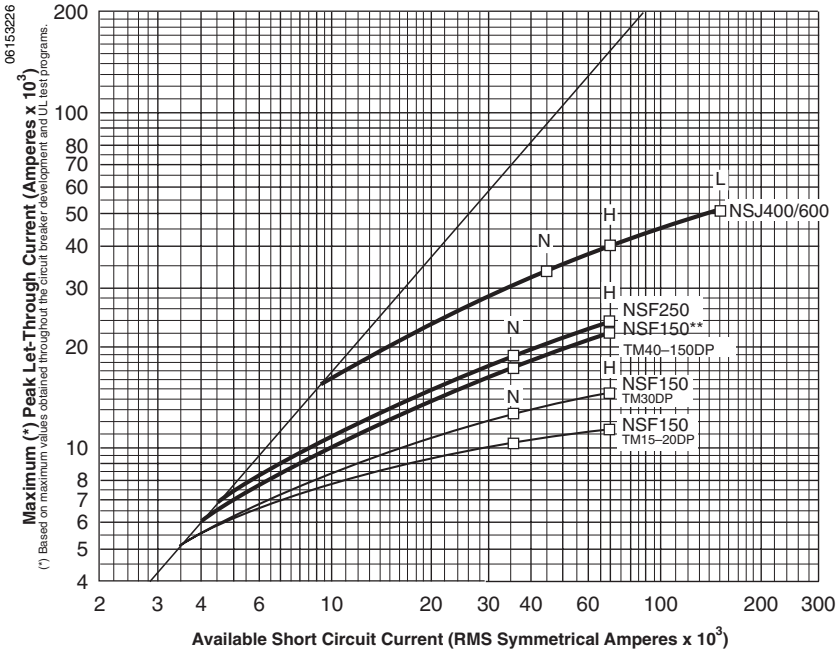
Maximum Let-through I^2t (Amperes^2 Seconds)



**4P OSN Compact® NSF125/250N and NSF 150/250N Ratings Are Same As NSF250

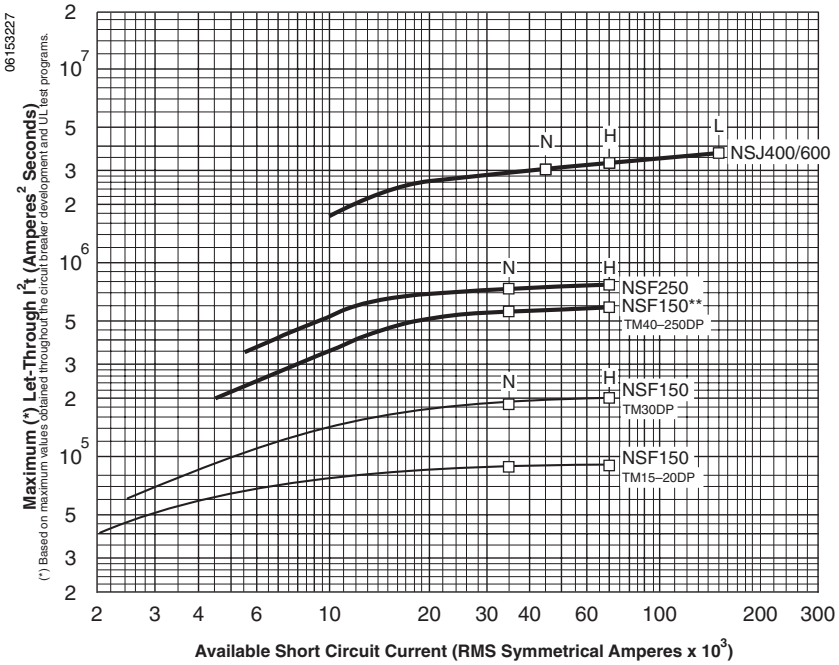
CURRENT-LIMITING CURVES AT 380/415 V

Maximum Peak Let-through Current (Amperes)



**4P OSN Compact® NSF125/250N and NSF 150/250N Ratings Are Same As NSF250

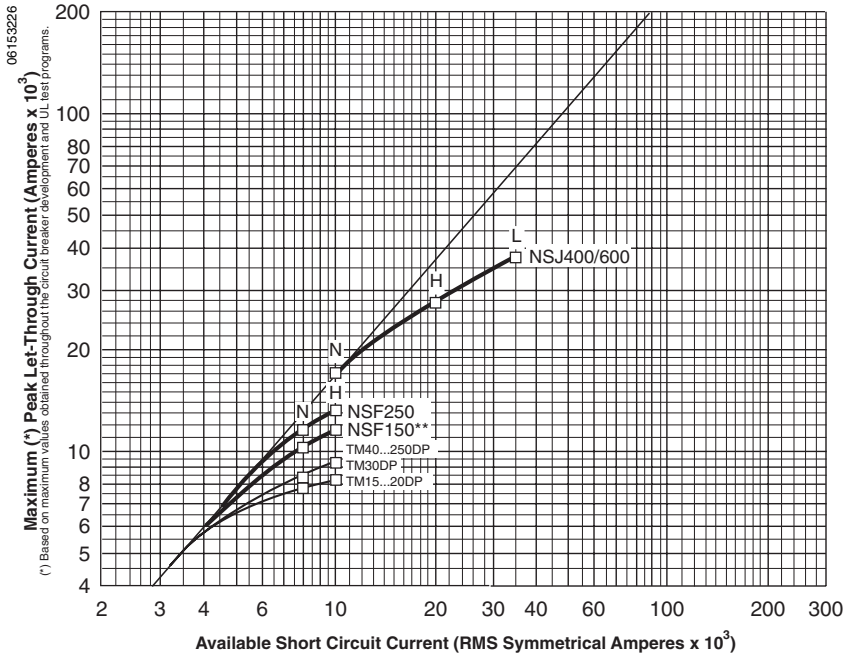
Maximum Let-through I^2t (Amperes^2 Seconds)



**4P OSN Compact® NSF125/250N and NSF 150/250N Ratings Are Same As NSF250

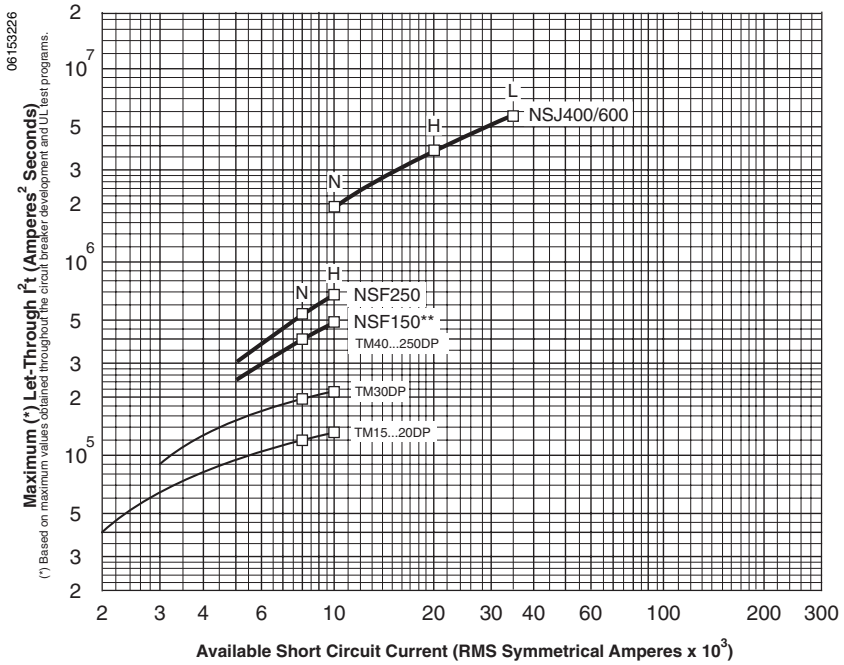
CURRENT-LIMITING CURVES AT 690 V

Maximum Peak Let-through Current (Amperes)



**4P OSN Compact® NSF125/250N and NSF 150/250N Ratings Are Same As NSF250

Maximum Let-through I^2t (Amperes^2 Seconds)



**4P OSN Compact® NSF125/250N and NSF 150/250N Ratings Are Same As NSF250

UL 489 TEST PROCEDURE

Standard Tests

For electronic trip circuit breakers and uncompensated thermal-magnetic circuit breakers rated 40° C, the test sequences are as shown in the table below:

Test	Sequence		
	X	Y	Z
200% Calibration at 25° C (77° F)	■	■	■
135% Calibration at 25° C (77° F)	■		
Calibration of Adjustable Instantaneous Trip	■		
Overload	■		
Tungsten Lamp Load	①		
100% Calibration at 40° C (104° F)	②		
Temperature and 100% Calibration at 25° C (77° F)	■		
Endurance		■	
200% Calibration at 25° C (77° F) Repeated		■	
135% Calibration at 25° C (77° F) Repeated		■	
Interrupting Ability (Y sequence)		■	
Interrupting Ability (Z sequence)			■
200% Trip Out at 25° C (77° F)		■	■
Dielectric Voltage Withstand	■	■	■

① Applies only to circuit breakers rated 50 A or less, and 125 or 125/250 V or less.

② Applies only to thermal-magnetic breakers rated 40° C.

Standard Specifications

Temperature

The temperature rise at the circuit breaker and at its terminals does not exceed specified limits when connected with specified cables or bus bars (see below) and at its rated current.

Examples of specified wires and bus:

- 75° C Copper Wire

Rating	Number	Size
100 A	1	#1 AWG (60° C)
	1	#3 AWG
250 A	1	250 kcmil
400 A	2	3/0 AWG
600 A	2	350 kcmil
800 A	3	300 kcmil
1000 A	3	400 kcmil
1200 A	4	350 kcmil

- Copper Busbar

Rating	Number	Size
1600 A	2	1/4 x 3
2000 A	2	1/4 x 4
2500 A	2	1/4 x 5
	4	1/4 x 2-1/2
3000 A	4	1/4 x4

(1200 A or Less—1000 A / in^2)

Calibration

200% calibration at 25° C—the circuit breaker must trip within time limits which depend on the rating from three minutes for 30 A rated circuit breakers to 30 minutes for over 2000 A rated circuit breakers.

135% calibration at 25° C—the circuit breaker must trip within two hours for circuit breakers rated more than 50 A.

Calibration of adjustable instantaneous trip—the circuit breaker must trip within the range of 80–120% of the maximum marked tripping current and 75–125% of the minimum marked tripping current.

Overload

- Up to 1600 A—50 operations at 600% of rated current
- 2000 and 2500 A—25 operations at 600% of rated current
- 3000–6000 A—three operations at 600% of rated current followed by 25 operations at 200% of rated current

The power factor shall be from to 0.45–0.50 lagging.

Endurance

The circuit breaker must complete an endurance test:

- Operations at rated current and rated voltage
- Followed by no load operation.

The power factor shall be 0.75–0.80 lagging.

Frame Size	Number of Cycles of Operations		
	With Current	Without Current	Total
100 A	6,000	4,000	10,000
225 A	4,000	4,000	8,000
400 A	1,000	5,000	6,000
600 A	1,000	5,000	6,000
800 A	500	3,000	3,500
1200 A	500	2,000	2,500
1600 A	500	2,000	2,500
2000 A	500	2,000	2,500
2500 A	500	2,000	2,500
3000 A	400	1,100	1,500

Interrupting Ability

Interrupting ability (Y sequence)—after endurance tests and calibrations are repeated, the circuit breaker completes an opening (O) followed by a close-open operation (O-t-CO), with specified current.

Frame Rating	RMS Sym. Amperes (3-pole O-and-CO)
100 A ①	3,000
225 A	3,000
400 A	5,000
600 A	6,000
800 A	10,000
1200 A	14,000
1600 A	20,000
2000 A	25,000
3000 A	35,000

① Above 250 V

Interrupting ability (Z sequence)—a three-pole circuit breaker rated 240, 480 or 600 V has to complete an opening operation (O) and a close-open operation (O-and-CO) on each pole, at rated voltage, followed by an opening operation (O) using all three poles.

Frame rating	RMS Sym. Amperes	
	Each Pole	Common
	O-and-CO	O
100 to 800 A	8,660	10,000
1000 to 1200 A	12,120	14,000
1600 A	14,000	20,000
2000 A	14,000	25,000
3000 A	25,000	35,000

Dielectric

After testing, the circuit breaker must withstand for one minute a voltage of 1000 V plus twice the rated voltage between:

- Line and load terminals with circuit breaker in open, tripped and off positions
- Terminals of opposite polarity with circuit breaker closed
- Live parts and the overall enclosure with circuit breaker open and closed

Optional Tests

- High available fault current—circuit breakers having passed all the standard tests may have the UL Listing label applied at higher values than the standard; test sequence is as follows:
  - — 200% calibration
  - — Interrupting capacity: an opening operation followed by a close-open operation (O-and-CO) on all poles are performed on the circuit breaker

  The power factor over 20000 A shall be 0.15–0.2 lagging:

  - — Trip out at 250%
  - — Dielectric at twice the rated test voltage
- 100% rated—circuit breakers having passed all the standard tests may have the UL Listing label applied to use the circuit breaker in an enclosure when carrying 100% of its maximum rating

The circuit breaker is submitted to additional temperature tests performed as standard tests, except that the circuit breaker is installed in an enclosure. The dimensions and possible ventilations shall be recorded and shall be marked on the circuit breaker.

Tests On Accessories

Shunt trip and Undervoltage Trip—these devices are submitted to temperature, overvoltage, operation, endurance and dielectric tests.

Overvoltage Test—the device must be capable of withstanding 110% of its rated voltage continuously without damage (this test does not apply to a shunt trip with an "a" contact connected in series).

Operation:

Shunt Trip—must operate at 75% of its rated voltage (except shunt trip devices for use with ground-fault protection shall operate at 55%).

Undervoltage Trip—must trip the circuit breaker when the voltage is less than 35% and may trip the circuit breaker between 35 and 70% of its rated voltage and shall pick-up and seal when the voltage is at 85% or more of its rated voltage.

Endurance—the device must be capable of performing successfully for 10% of the number of "with current" operations of the circuit breaker.

Auxiliary and Alarm Switches—auxiliary and alarm switches must be submitted to temperature, overload, endurance and dielectric tests.

Overload Test—the test consists of fifty operations making and breaking 150% of rated current at rated voltage, with a 75–80% power factor in ac and non-inductive load in dc.

Endurance—the switch must make and break its rated current at rated voltage, with a 75–80% power factor in ac, and non-inductive load in dc for 100% of the number of operations "with current" for auxiliary switches, and 10% of this number for alarm switches.

Motor Operator—the motor operator shall perform the number of "without current" operations indicated for the circuit breaker endurance tests. The first 25 operations shall be conducted at 85% of the motor operator voltage rating. The circuit breaker is to be tripped during these tests. The next 25 operations shall be conducted at 110% of the motor operator voltage rating. The balance shall be completed at rated voltage without tripping the circuit breaker.

IEC 947-2 TEST PROCEDURE

Standard Tests

Consisting of seven parts, the IEC 947 Standard applies to all low-voltage equipment designed for industrial application.

Three documents are to be consulted for circuit breakers and switches:

- IEC 947-1: general regulations
- IEC 947-2: circuit breakers
- IEC 947-3: switches

Two Categories of Devices

The IEC 947-1 standard defines two categories of devices:

- Category A—devices not specifically designed to carry out chronometric selectivity
- Category B—devices specifically designed to carry out chronometric selectivity; these circuit breakers possess a compulsory additional characteristic: short-time withstand (Icw)

Breaking Capacity

Ultimate Breaking Capacity: Icu

Icu is the value to be taken into account when calculating an installation. The rule remains: Icu > Icc (maximum fault current of the installation).

Breaking Performance During Operation: Ics

This characteristic indicates the ability of the device to eliminate short-circuit currents less than Icc and with a greater likelihood of occurring, generally near the application. Ics is expressed in % of Icu (values retained by the standard IEC 25-50-75-100% of Icu). This test sequence designed to check the Ics performance, groups together on the same device, following the breaking test (O-CO-CO, see page 72), certain checks such as:

- Temperature rise under In
- Calibration at 1.45 In
- Leakage current (for devices suitable for disconnection)

The leakage current should not exceed 2 mA under the application voltage (0.5 mA when new). These checks ensure that the device is able to carry out all its functions after elimination of a fault of Ics value and to be put back in operation; hence the notion of breaking power performance during operation Ics.

Isolation

Function

Recognition and definition of the disconnection capacity for industrial low-voltage equipment:

Until recently, circuit breaker standards have established no regulations concerning the isolation function. Only the installation standards provided some rather vague information. The IEC 947 standard takes this function into account. In the "general regulations" section, it clearly states:

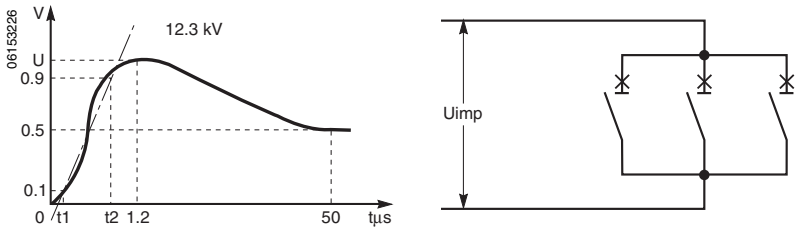
- The manufacturing regulation
- The tests to be performed

The circuit breaker standard should define the manner in which the tests are to be performed (under study). The manufacturing regulations state, for example:

- Both the isolation and the inner contact distances (open > 8 mm)
- A device indicating the true position of the contacts (operating handle if representative of the state of all the contacts)
- When a "locked" position is provided, this should only be possible with "open" contacts

The tests to be performed are as follow:

- Shock wave voltage strength (Uimp)



1.2/50 µs–12.3 kV plus 25% between open contacts in comparison with devices not fitted with the applied isolation function according to the figure below. The test is validated if no triggering occurs between the contacts.

- Measurement of leakage current—under 110% of the device application voltage, maximum leakage currents proposed per pole:
  - 0.5 mA new device
  - 2 mA device after Ics
  - 6 mA device after Icu or after endurance tests, representative of the "end of service life."

Test Sequences

Sequence	Category of Devices	Tests
1–General Characteristics	All Circuit Breakers	• Trip Unit Control • Dielectric Properties • Mechanical and Electrical Endurance • Overload • Dielectric Voltage Withstand • Temperature Rise • 145% Calibration (3 Phases Test)
2–Breaking Capacity During Operation	All Circuit Breakers	• Breaking Capacity During Operation (Ot-CO-t-CO) • Dielectric Voltage Withstand • Temperature Rise • 145% Calibration (3 Phases Test)
3–Ultimate Breaking Capacity (Icu)	A B if Icu > Icw	• 200% Calibration (Each Pole Separately) • Ultimate Breaking Capacity (O-t-CO) • Dielectric Voltage Withstand • 250% Calibration (Each Pole Separately)
4–Admissible Short Duration Current (Icw)	B	• 200% Calibration (Each Pole Separately) • Short-time Current Withstand • Temperature Rise • Breaking Capacity at Admissible Short-time Current (O-t-CO) • Dielectric Voltage Withstand • 200% Calibration (Each Pole Separately)
Combined Sequence	• Icw = Ics Replaces Sequences 2 and 4 • Icw = Ics = Icu Replaces Sequences 2, 3 and 4	• 200% Calibration (Each Pole Separately) • Short-time Current Withstand Icw • Breaking Capacity at Ics (O-CO-CO) at Maximum Relay Temp. • Dielectric Voltage Withstand • Temperature Rise • 200% Calibration (Each Pole Separately)

ROUTINE AND MAINTENANCE GUIDELINES

Recommended Inspection Intervals

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors and covers before turning on power to this equipment.

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

CAUTION

HAZARD OF EQUIPMENT DAMAGE

Molded case circuit breakers contain factory-sealed and calibrated elements. The seal must not be broken and the circuit breaker must not be tampered with. Molded case circuit breakers should not be field adjusted or repaired. In the case of a malfunction, the circuit breaker should be replaced or inspected at the Schneider Electric factory, or by an authorized representative.

Failure to follow this instruction can result in equipment damage.

Merlin Gerin circuit breakers are designed to be maintenance-free. However, all equipment with moving parts requires periodic inspection to ensure optimum performance and reliability. It is recommended that the circuit breakers be routinely inspected six months after installation, followed by annual inspection. Intervals can vary depending on particular usages and environments.

Inspection of Terminals

- Connections to circuit breaker terminals should be inspected. If there is discoloration due to overheating, the connections should be disassembled and the surface cleaned before reinstallation. It is essential that electrical connections be made carefully in order to prevent overheating.
- Check for terminal tightness.

Cleaning

Remove dust and dirt that have accumulated on the circuit breaker surface and terminals.

Mechanical Checks

Even over long periods of time, circuit breakers are not often required to operate on overload or short-circuit conditions. Therefore it is essential to operate the circuit breaker periodically. To trip the circuit breaker, push the push-to-trip button.

Insulation Resistance Tests

When a circuit breaker is subjected to severe operating conditions, an insulation resistance test should be performed as indicated in NEMA standard publication No. AB4-1996. An insulation resistance test is used to determine the quality of the insulation between phases and phase-to-ground. The resistance test is made with a dc voltage higher than the rated voltage to determine the actual resistance of the insulation.

The most common testing method employs a "megger" type instrument. A 1000 V instrument will provide a more reliable test because it is capable of detecting tracking on insulated surfaces. Resistance values below one megohm are unsafe and should be investigated. An insulation test should be made:

- Between line and load terminals of individual poles with the circuit breaker contacts open
- Between adjacent poles and from poles to the metallic supporting structure with the circuit breaker contacts closed. The latter test may be done with the circuit breaker in place after the line and load conductors have been removed, or with the circuit breaker bolted to a metallic base which simulates the in-service mounting.

Electrical Tests

These tests require equipment for conducting pole resistance, overcurrent and instantaneous tripping, in accordance with NEMA Standard publication No. AB4. They are not within the scope of normal field operation.

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