Metal-Enclosed Switchgear
With Types DSII and DSLII Power Circuit Breakers in Drawout Construction

General Standards, Ratings
Type DSII Switchgear is constructed in accordance with ANSI C37.20.1 standards for metal-enclosed low-voltage drawout switchgear. As such, it contains low-voltage power circuit breakers, Type DSII (no limiters) and Type DSLII (with limiters) as the overcurrent protective devices both as main and as feeder protection. The drawout feature of DSII Breakers facilitates testing and maintenance which are important in many applications.

Compartmentalization of the drawout breakers is part of the standard construction and additional safety barriers are available in maintenance areas. DSII and DSLII Breakers are designed to NEMA Standard SG-3; ANSI Standards C37.13, C37.16 and C37.17; and UL 1066 in frame sizes ranging from 800 to 5000 Amperes. Type DSII Switchgear is designed in accordance with NEMA Standard SG-5; ANSI Standards C37.20.1, C37.51 and UL Standard 1558.

Ratings are as follows:

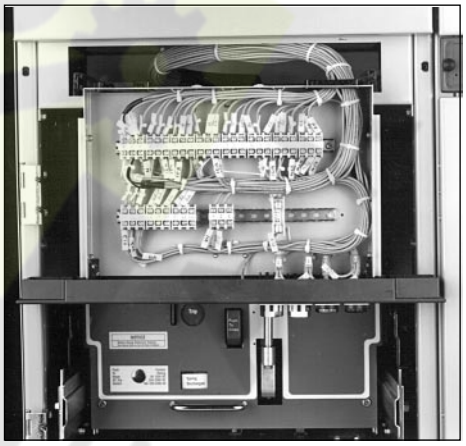
Voltage: 120-600 Volts ac, 3-phase, 3-wire or 4-wire

Main bus ampacity: 800-5000 amperes continuous

Short circuit capability: up to 85 kA with non-current limiting breakers (DSII) interruption and bus rating; up to 200 kA with current limiting type breakers (DSLII) at 480 volts ac.

Features
- Four-Position Drawout
- Double Steel Front Safety Barrier
- Ease of Inspection and Maintenance
- Safety Shutter System for Primary Stationary Contacts (optional).
- Standard 100 kA Bus Bracing
- Front Accessible Terminal Block Trays
- Rugged formed Steel Base With Jacking Provisions
- Doors with Removable Hinge Pins

Construction Details



Breaker Cell Terminal Block Tray Withdrawn and in Inspection Position

Type DSII Switchgear features removable terminal block trays above each circuit breaker. These trays contain fuses for circuit breaker control protection, short circuiting terminal blocks for cts and terminations for circuit breaker secondary wiring and remote control connections. The tray front also provides a location for breaker control and indication devices, and 2% ammeters and switches. Non-adhesive wire anchors are provided to secure factory and field installed wiring. Trays are designed to hang from openings of compartment doors for the clear access to terminal blocks and wiring. Standard wire markers further aid in circuit identification and maintenance.

Cell With Breaker

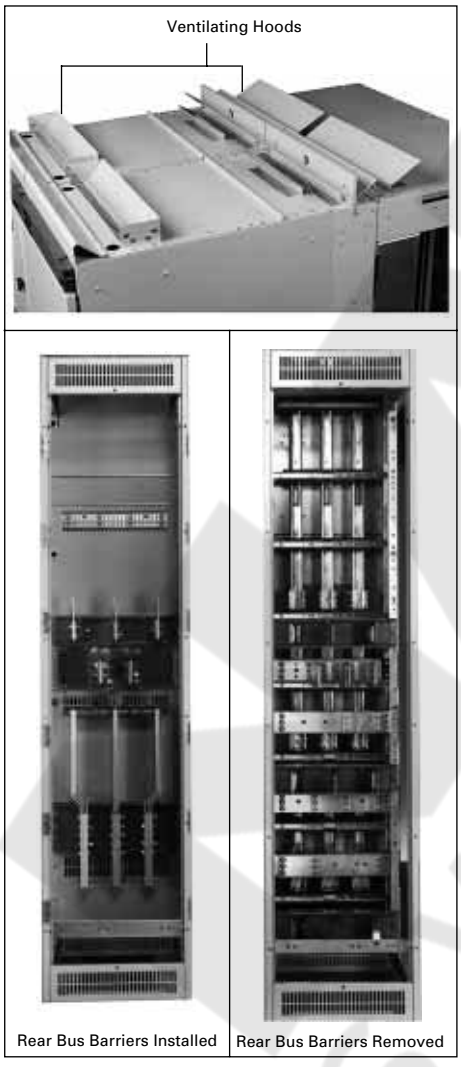
Outer door with quick-opening latches closes compartment completely with breaker in or out. All controls on the face of the breaker are protected from unauthorized or accidental operation. Removable hinge pins allow unrestricted access to the breaker and compartment.

General Description

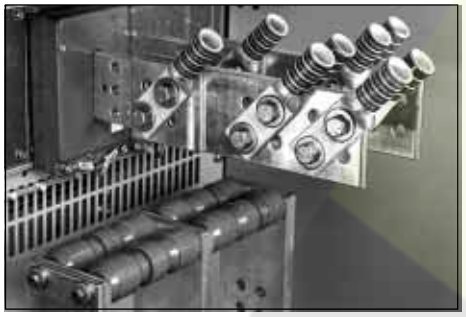
Full sized metal shield on breaker face protects operator from live parts while operating, racking or checking trip unit settings with door open. Interlocking is provided to prevent racking a closed breaker or closing a breaker during racking.

Operating controls for DSII and DSLII Breakers are easily accessible with the cell door open. Charging the stored energy springs, mechanically closing and tripping the breaker, racking the breaker to its 4 positions and making adjustments to the trip settings are all accomplished at the breaker inner front panel. Indicators to show drawout position, contacts open or closed and charging spring condition are also incorporated on this panel.

A microprocessor tripping system provides continuous wide range adjustability. No control power is required for the tripping functions. Adjustable long delay, short delay, instantaneous and ground fault trip characteristics in various combinations are available.



DSII Rear View



Cable lug adaptors are provided which allow either compression lugs (shown) or mechanical lugs to be mounted at a 45° angle (up or down) to facilitate cable termination with a minimum bending radius.

The rear portion of the switchgear houses the bolted main bus connections and terminals. Cable lug adaptors provide for mounting of terminals at a 45° angle (up or down) to facilitate cable terminations with a minimum bending radius. A safety feature is provided which isolates the cable connections. Steel barriers are assembled between the runback supports to provide this full height segregation. Rear covers are bolt-on type, split into two separate sections for ease of handling during installation. Main bus and section bus are silver-plated copper standard and they are bolted at all joints with conical spring type washers as standard. Bus sizing is based on NEMA standard temperature rise criteria of 65°C over 40°C ambient (outside the enclosure).

Types DSII and DSLII Power Circuit Breakers

Types DSII and DSLII Power Circuit Breakers constitute a complete, modern, and rugged line of low-voltage power circuit breakers utilizing the DE-ION principle of arc extinction. The breaker family is distinguished by its similarity of appearance and operation frame to frame. All frame sizes are either manually or electrically operated.

DSLII Current Limiting Breakers
DSLII Circuit Breakers are coordinated combinations of Type DSII Breakers and series connected current limiters. They are commonly applied when available fault currents at their point of application exceed the interrupting rating of the breaker alone. Limiters are mounted integrally with the drawout breaker element and in series with the upper terminals on 800 through 2000 Ampere frames. For 3200 and 4000 Ampere combination, limiters are on a separate drawout carriage from that of the DSII Breaker.

Circuit Breaker Features
- Two-step stored energy closing mechanism
- Closing spring automatic discharge on breaker withdrawal
- Interchangeable current sensors
- Digitrip RMS trip units
- UL label
- Can be applied at 100% of frame rating
- Built in trip unit test provision

Optional Accessories
- Compartment position switch
- Undervoltage trip either instantaneous or time delay
- Bell alarm switch (OTS)
- Electric close release
- Key interlock
- Operation counter
- Capacitor trip (ac)
- Short time delay
- Shunt trip attachments for manually operated breakers
- Auxiliary switch
- Portable test kit
- Integral breaker ground fault tripping (3-wire or 4-wire systems)
- Electric lockout for manual breaker
- Zone interlocking wiring

Complete DSII 3-Pole Breaker

Further Information

CAT.73.01.T.E

Electronic Trip Units

Cutler-Hammer offers the most comprehensive range of electronic trip units in the industry for power circuit breakers. The UL listed OPTIM electronic trip units are true RMS sensing and can be applied in any DSII breakers.

Digitrip electronic trip units are ac devices that employ microprocessor-based technology that provides a true RMS current sensing means for proper correlation with thermal characteristics of conductors and equipment. The primary function of the Digitrip electronic trip unit is to provide circuit protection. This is achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip unit when pre-set current levels and time delay settings are exceeded. By sampling the current waveform at various points on the wave and calculating true RMS current, the Digitrip is able to reduce nuisance tripping events due to non-sinusoidal wave shapes.

Electronic trip units are applied to distribution systems when high standards of protection and coordination are called for. In addition, electronic trip units can provide further enhanced features such as alarming, diagnostics, system monitoring and communications.

Cutler-Hammer RMS sensing trip units for power breakers fall into two main categories:

- Front adjustable trip units: Digitrip RMS 510, 610, 810, 910
- Programmable trip units: Digitrip OPTIM 750, 1050

Digitrip RMS Trip Units

Cutler-Hammer introduced the first microprocessor-based trip unit and has advanced the technology into a new family of UL listed Digitrip RMS trip units that are user friendly and easy to operate.

The Digitrip RMS trip units provide increased circuit protection with true RMS sensing for proper correlation with thermal characteristics of conductors and equipment.

Digitrip RMS trip units afford opportunities to improve systems control, monitoring, and testing while also providing for present and future energy monitoring, power quality monitoring and remote communications requirements.

Along with circuit protection, all Digitrip RMS models include information and self-testing functions. The Digitrip RMS 510 is the basic model. The 610/810/910 units build upon the 510 and each other to provide increased functionality and flexibility to meet specific distribution system requirements.

All Digitrips include LEDs that light to indicate what function initiated a trip (Long Delay, Short Delay, Instantaneous, or Ground). The 610, 810, and 910 trip units have an alphanumeric display window to provide circuit and trip unit status and cause of trip indication. The display uses LEDs and characters are ½ inch high for clear visibility.

Remote communications and energy monitoring functions are provided by the Digitrip 810 and 910 trip units. The 910 includes displays for harmonic content of the waveform being monitored and percent Total Harmonic Distortion for each particular harmonic order. The 910 also features waveform analysis for transmission via IMPACC/PowerNet to a remote PC terminal.

As many as five phase and two ground time-current adjustments, providing increased levels of protection, are available on each Digitrip RMS trip unit to help meet specific system requirements. Units include long time settings and user selected choices of short time, instantaneous and ground protection, each with a wide range of settings adjusted by discretely set dials on the front of the trip unit.

Digitrip RMS trip units are completely self-contained and when the circuit breaker is closed, no external power is required to operate their protection systems. They operate from current signal levels and the control power is derived from the current sensors integrally mounted in the circuit breaker.

Interchangeable rating plugs establish the circuit breaker's continuous ampere rating. Different types and ratings are available to match the desired ampere rating and type of circuit breaker into which a Digitrip RMS trip unit is installed. The rating plugs are suitable for use on either 50 or 60 Hz system applications. Rating plugs may be applied as low as 50% of sensor rating.

A long-life lithium battery is included to provide power to the mode of trip LEDs following an automatic circuit breaker trip and simultaneous loss of control to the power/relay module (when provided). The battery is located in the rating plug and can be easily replaced. A battery check pushbutton and green LED are included to monitor battery status.

OPTIM RMS Trip Units

OPTIM trip units are electronic trip units that have up to ten time-current setting options that are programmed electronically by the use of a programming device. Trip units are readily accessible from the front of the breakers. Programmability means more settings, better accuracy, faster configuration, remote accessibility, higher system security, and the ability to apply limitless software. The application for programmable trip units would be high integrity distribution systems that require superior levels of system coordination coupled with system alarming, diagnostics and monitoring.

Digitrip OPTIM for power breakers are available in three configurations:

- Long time, short time, and instantaneous (LSI)
- Long time, short time, instantaneous and ground fault protection (LSIG)
- Long time, short time, instantaneous and ground fault alarm (LSIA)

For maximum selectability, OPTIM trip units allow the user to disable either short time or instantaneous functions, but not both.

OPTIM 750

- RMS Sensing
- 10 Functions
- Programmable
- Load Monitoring
- Diagnostics
- Communications

OPTIM 1050

- RMS Sensing
- 10 Functions
- Programmable
- Load Monitoring
- Diagnostics
- Communications
- Power and Energy Monitoring
- Harmonics

Rating Plugs

Rating plugs provide a means to establish the breaker's continuous current rating. Rating plugs are unique to a particular breaker type, and are color coded to make it easy to match the correct rating plug with the correct circuit breaker type. Rating plugs are fixed type, and are interchangeable so that amp ratings can be changed simply by changing from one plug to another in a given breaker. The same rating plug can be applied to both 50 and 60 Hz distribution systems.

Rating plugs are available down to an ampere value of half the sensor rating. Sensors are selectable on DSII breakers and are equal to the breaker frame rating. The plug value is referred to as I_n.

Time-Current Curve Shaping

All Digitrip OPTIM settings are continuously adjustable, allowing virtually an infinite number of possibilities within setting ranges. Ranges are based on the plug rating I_n and the long delay pickup setting I_r. For ease of use all pickup values are programmed in amps rather than in multiples of I_n or I_r. Figure 1 illustrates available setting ranges.

For improved system coordination OPTIM features a new setting not available on previous models of Digitrip. The I^4t long delay slope will provide superior coordination with upstream fuses and transformer damage curves.

For additional information see section B3.

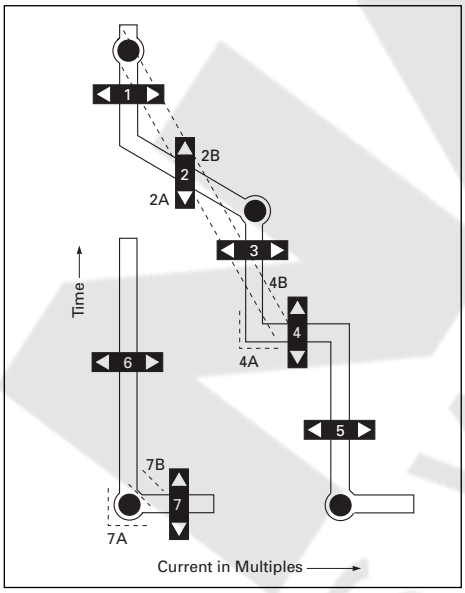


Figure 1.

10 Curve Shaping Adjustments

Function	Multiplier/ Setting	Setting Range
Overload		
1. Long Delay Pickup	XI_n	0.4 - 1.0
2A. Long Delay Time I^2t	@$6I_r$	2 - 24 sec.
2B. Long Delay Time I^4t	@$6I_r$	1 - 5 sec.
Short Circuit		
3. Short Delay Pickup	XI_r	1.5 - S max.*
4A. Short Delay Time Flat Response	XI_r	0.1 - 0.5 sec.
4B. Short Delay Time I^2t Response	XI_r	0.1 - 0.5 sec.
5. Instantaneous	XI_n	2.0 - M max.*
Ground Fault		
6. Ground Fault Pickup	XI_n	0.25 - 1.0 (1200 A max)
7A. Ground Fault Delay Flat Response	XI_n	0.1 - 0.5 sec.
7B. Ground Fault Delay I^2t Response	XI_n	0.1 - 0.5 sec.

I_n = Rating Plug Rating I_r = LDPU Setting

* Varies with Breaker Type and Frame – See small table this page.

Breaker Type	Frame	S max.	M max.
DSII	All	10	12

Low Voltage Trip Unit - Selection Data

	RMS 510	RMS 610	RMS 810	RMS 910	OPTIM 750	OPTIM 1050
						
	9 Functions — **Front Adjustable**	**9 Functions** — **Front Adjustable** — **Load Monitoring** — **Diagnostics**	**9 Functions** — **Front Adjustable** — **Load Monitoring** — **Diagnostics** — **Communications** — **Power and Energy Monitoring**	**9 Functions** — **Front Adjustable** — **Load Monitoring** — **Diagnostics** — **Communications** — **Power and Energy Monitoring** — **Harmonics**	**10 Functions** — **Programmable** — **Load Monitoring** — **Diagnostics** — **Communications**	**10 Functions** — **Programmable** — **Load Monitoring** — **Diagnostics** — **Communications** — **Power and Energy Monitoring** — **Harmonics**
Breaker Type						
Frame(s)	All DSII and DSLII	All DSII and DSLII	All DSII and DSLII	All DSII and DSLII	All DSII and DSLII	All DSII and DSLII
Ampere Range	100A-5000A	100A-5000A	100A-5000A	100A-5000A	100A-5000A	100A-5000A
Interrupting Rating @ 480V	30 thru 200 kA	30 thru 200 kA	30 thru 200 kA	30 thru 200 kA	30 thru 200 kA	30 thru 200 kA
Trip Unit Sensing						
rms Sensing	Yes	Yes	Yes	Yes	Yes	Yes
Protection and Coordination						
Protection — Ordering Options	LI, LS, LSI, LIG LSG, LSIG	LI, LS, LSI, LIG LSG, LSIG	LI, LS, LSI, LIG LSG, LSIG	LI, LS, LSI, LIG LSG, LSIG	LSI(A), LSIG	LSI(A), LSIG
Protection — Fixed Rating Plug (I_n)	Yes	Yes	Yes	Yes	Yes	Yes
Protection — Overtemperature Trip	Yes	Yes	Yes	Yes	Yes	Yes
Long Delay — Adjustable Rating Plug (I_n)	No	No	No	No	No	No
Long Delay — Long Delay Setting	0.5-1.0 (I_r)	0.5-1.0 (I_r)	0.5-1.0 (I_r)	0.5-1.0 (I_r)	0.4-1.0 x (I_n)	0.4-1.0 x (I_n)
Long Delay — Long Delay Time I^2T	2-24 Seconds	2-24 Seconds	2-24 Seconds	2-24 Seconds	2-24 Seconds	2-24 Seconds
Long Delay — Long Delay Time I^4T	No	No	No	No	1-5 Seconds	1-5 Seconds
Long Delay — Long Delay Thermal Memory	Yes	Yes	Yes	Yes	Yes	Yes
Long Delay — High Load Alarm	No	0.85 x I_r	0.85 x I_r	0.85 x I_r	0.5-1.0 x I_r	0.5-1.0 x I_r
Short Delay — Short Delay Setting	200-600% S1 & S2 (I_r)	200-600% S1 & S2 (I_r)	200-600% S1 & S2 (I_r)	200-600% S1 & S2 (I_r)	150-800% x (I_r)	150-800% x (I_r)
Short Delay — Short Delay Time I^2T	100-500 ms	100-500 ms	100-500 ms	100-500 ms	100-500 ms	100-500 ms
Short Delay — Short Delay Time Flat	100-500 ms	100-500 ms	100-500 ms	100-500 ms	100-500 ms	100-500 ms
Short Delay — Short Delay Time ZSI	Yes	Yes	Yes	Yes	Yes	Yes
Instantaneous — Instantaneous Setting	200-600% M1 & M2	200-600% M1 & M2	200-600% M1 & M2	200-600% M1 & M2	200-800% x (I_n)	200-800% x (I_n)
Instantaneous — Discriminator	Yes①	Yes①	Yes①	Yes①	Yes	Yes
Instantaneous — Instantaneous Override	Yes (Not Type DSII)	Yes (Not Type DSII)	Yes (Not Type DSII)	Yes (Not Type DSII)	Yes	Yes
Ground Fault — Ground Fault Alarm	No	No	No	No	20/25-100%②	20/25-100%②
Ground Fault — Ground Fault Setting	25-100%(I_n)②	25-100%(I_n)②	25-100%(I_n)②	25-100%(I_n)②	20/25-100%②	20/25-100%②
Ground Fault — Ground Fault Delay I^2T	100-500 ms	100-500 ms	100-500 ms	100-500 ms	100-500 ms	100-500 ms
Ground Fault — Ground Fault Delay Flat	100-500 ms	100-500 ms	100-500 ms	100-500 ms	100-500 ms	100-500 ms
Ground Fault — Ground Fault ZSI	Yes	Yes	Yes	Yes	Yes	Yes
Ground Fault — Ground Fault Thermal Memory	Yes	Yes	Yes	Yes	Yes	Yes
System Diagnostics						
Cause of Trip LEDs	Yes	Yes	Yes	Yes	Yes	Yes
Magnitude of Trip Information	No	Yes	Yes	Yes	Yes	Yes
Remote Signal Contacts	No	Yes	Yes	Yes	Yes	Yes
System Monitoring						
Digital Display	No	Yes	Yes	Yes	Yes③	Yes④
Current	No	Yes	Yes	Yes	Yes	Yes
Voltage	No	No	No	Yes	No	Yes
Power and Energy	No	No	Yes	Yes	No	Yes
Power Quality - Harmonics	No	No	No	Yes	No	Yes
Power Factor	No	No	Yes⑤	Yes	No	Yes
System Communications						
IMPACC/PowerNet	No	No	Yes	Yes	Yes	Yes
Field Testing						
Testing Method	Integral⑤	Integral⑤	Integral⑤	Integral⑤	OPTIMizer, BIM, IMPACC/PowerNet	OPTIMizer, BIM, IMPACC/PowerNet

① LS/LSG Only.
② Not to exceed 1200 Amperes.
③ By OPTIMizer/BIM.
④ Over IMPACC/PowerNet only.
⑤ Secondary injection testing performed for DSII/DSLII.

BIM = Breaker Interface Module
I_s= Sensor Rating
I_n=Rating Plug
I_r= LDPU Setting x I_n
(A) = GF Alarm

IQ Analyzer

See section B1.

Power Line Analyzer
The IQ Analyzer is a complete solution for users who want to monitor all aspects of their electrical distribution system. Its high performance metering complies with the rigid ANSI C12.16 Class 10 accuracy specification for revenue meters, provides quality true RMS readings through the 50th harmonic, accurately measures nonsinusoidal wave forms up to a 3.0 crest factor, and displays even and odd multiples of the fundamental current and voltage through the 50th harmonic.

Features include:
- Over 150 continuously metered parameters.
- Displays multiple parameters at the same time (up to 7 lines of information on one screen).
- Programming and access to all information via the faceplate.
- Remote communications capability within an IMPACC/PowerNet system.

IQ DP-4000

See section B1.

Incoming Line Metering and Voltage Protection
This microprocessor-based device provides complete metering and system voltage protection. It replaces individually mounted and wired ammeters, voltmeters, ammeter and voltmeter switches, wattmeters, varmeters, and watthour meters.

IQ DP-4000 features include:
- Cost and space savings through replacement of individual meters and switches.
- Direct voltage input of up to 600 volts – no additional PTs required.
- Voltage protection set by customer replaces: undervoltage relay, overvoltage relay, phase loss relay, and phase unbalance relay.
- Nonvolatile memory
- Remote communications capability available within an IMPACC/PowerNet System.

Assemblies Electronic Monitor II

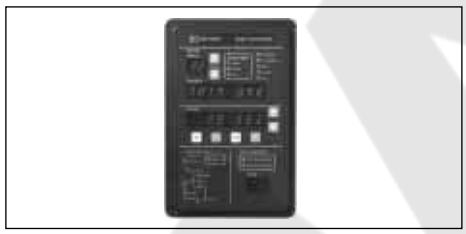
See section B4.

Centralized Monitoring and Information Display
This microprocessor-based device monitors up to 40 circuit breakers with Digitrip RMS 700, RMS 800, RMS 810, and RMS 910 Trip Units; and displays status, cause of trip, and metered values (including current at time of trip) from each circuit breaker. The device can also receive and transmit data from eight IQ Data Plus II and/or IQ Data devices.

Assemblies Electronic Monitor II features include:
- Local or remote monitoring.
- Separate metering transformers are not required.
- Remote communications capability available within an IMPACC/PowerNet System.
- A centralized alternative to ammeters and ammeter switches, circuit breaker position indicating lights, and alarm contacts.
- Nonvolatile memory.

Breaker Interface Module (BIM)

See section B4.



Centralized Monitoring and Information Display
The Breaker Interface Module is a panel-mounted device which performs the following functions:
- Monitors and displays parameters from any combination of Digitrip RMS 810 and 910, Digitrip OPTIM Trip Units, supporting as many as 50 of these devices up to 10,000 feet away.
- Communicates the information from these protective and energy monitoring devices over an IMPACC/PowerNet network to a computer or PLC.

IQ Data™

See section B1.

Voltage and Current Metering
This microprocessor-based device performs only the identical voltage and current metering functions of the IQ Data Plus II and is supplied as standard when incoming line metering is required.

IQ Data features include:
- Separate voltage and ammeter windows. Voltage and current can be stepped through independently.
- Auto ranging between volts and kilovolts, and amps and kiloamps.
- Remote communications capability available within an IMPACC/PowerNet System.

Communications
For remote power monitoring and software see IMPACC/PowerNet section B5.

Addressable Relay II

See section B5.

Direct On/Off Control Capabilities
An industrial control relay with two inputs to monitor the status of external contacts and one output controllable over the communication network. The relay is ac/dc powered with ac/dc contacts rated to directly switch/monitor switchgear breakers, motor starters, etc.

Addressable features include:
- Address assigned by setting three hexadecimal switches.
- LEDs show when the relay is energized and when it is sending reports.
- Two status inputs and a Form C contact output.
- Built in remote communications capability within an IMPACC/PowerNet System.
- Selectable baud rate.

Electrical Characteristics of DSII and DSLII Power Circuit Breakers

Table 1: Ratings of DSII and DSLII Breakers

Breaker Type	Available Ampere Range	Current Sensor Rating, Ampere	Ratings, Symmetrical Amperes (000)					
			Interrupting Rating			Short Time Ratings①		
			240V	480V	600V	240V	480V	600V
DSII-308	50- 800	200, 300, 400, 600, 800	42	30	30	30	30	30
DSII-508	50- 800	200, 300, 400, 600, 800	65	50	42	50	50	42
DSII-608	50- 800	200, 300, 400, 600, 800	65	65	50	65	65	50
DSII-516	50-1600	200, 300, 400, 600, 800, 1200, 1600	65	50	42	50	50	42
DSII-616	50-1600	200, 300, 400, 600, 800, 1200, 1600	65	65	50	65	65	50
DSII-620	50-2000	200, 300, 400, 600, 800, 1200, 1600, 2000	65	65	50	65	65	50
DSII-632	800-3200	2400, 3200	85	65	65	65	65	65
DSII-840	1000-4000	3200, 4000	130	85	85	85	85	85
DSII-850	1600-5000	5000	130	85	85	85	85	85
DSLII-308	50- 800	200, 300, 400, 600, 800	200	200	200	–	–	–
DSLII-516	50-1600	200, 300, 400, 600, 800, 1200, 1600	200	200	200	–	–	–
DSLII-620	500-2000	2000	200	200	200	–	–	–
DSLII-632	800-3200	2400, 3200	200	200	200	–	–	–
DSLII-840	1000-4000	3200, 4000	200	200	200	–	–	–

Table 2: Available Digitrip RMS Rating Plugs Marked 50/60 Hertz②

Sensor Ratings, Amperes	Plug Rating in Amperes (I_n)
200	100, 200
300	200, 250, 300
400	200, 250, 300, 400
600	300, 400, 600
800	400, 600, 800
1200	600, 800, 1000, 1200
1600	800, 1000, 1200, 1600
2000	1000, 1200, 1600, 2000
2400	1600, 2000, 2400
3200	1600, 2000, 2400, 3000⑥, 3200
4000	2000, 2400, 3200, 4000
5000	3200, 4000, 5000

Table 3: Digitrip RMS Adjustable Trip Settings

Time/Current Characteristic	Pick-Up Setting	Pick-Up Point (see note)	Time Band, Seconds
Long Delay	0.5, 0.6, 0.7, 0.8, 0.85, 0.9, 0.95, 1.0	I_n Times Long Delay Setting	2, 4, 7, 10, 12, 15, 20, 24 (at 6 times pick-up value)
Instantaneous	2, 2.5, 3, 4, 5, 6 M_1 = 8 M_2 = 12	I_n Times Instantaneous Setting	
Short Delay	2, 2.5, 3, 4, 5, 6 S_1 = 8 S_2 = 10	I_r Times Short Delay Setting	0.1, 0.2, 0.3, 0.4, 0.5 (Flat Response) 0.1*, 0.3*, 0.5* *(I^2t Response)
Ground Fault	A (.25), B (.3), C (.35), D (.4), E (.5), F (.6), H (.75), K (1.0) (1200A Max.)	I_n Times Ground Fault Setting	0.1, 0.2, 0.3, 0.4, 0.5 (Flat Response) 0.1*, 0.3*, 0.5 *(I^2t Response)
Note: I_n = Rating Plug Value I_r = Long Delay Pickup Setting x I_n			

① Also withstand ratings
② The Rating Plug is for 50 and 60 Hertz applications. Rating Plugs are not interchangeable with 60 Hertz or 50 Hertz only Rating Plugs.
③ For use only when protection of downstream equipment is required. Not completely coordinated with breaker to avoid nuisance blowing.
④ Lowest rating that can be coordinated with breaker to minimize nuisance blowing.
⑤ Highest available ratings, for protection of breaker only.
⑥ Not available on 840 or 850 frame.

Standard Control Voltages
Dc: 48, 125, 250
Ac: 120, 240

Table 4: DSLII Breakers-Limiter Selection

Breaker Type	Sensor Rating Amps	Limiter Rating, Amperes		
		Minimum ③	Recommended ④	Maximum ⑤
DSLII-308	100	150	1200	2000
DSLII-308	150	200	1200	2000
DSLII-308	200	250	1200	2000
DSLII-308	300	400	1200	2000
DSLII-308	400	600	1200	2000
DSLII-308	600	800	1200	2000
DSLII-308	800	1200	1600	2000
DSLII-516	600	800	2000	3000
DSLII-516	800	1000	2000	3000
DSLII-516	1200	2000	2500	3000
DSLII-516	1600	–	3000	–
DSLII-620	2000	–	3000	–

Table 5: DSLII-632 and DSLII-840 Available Limiters

Breaker Type	Available Limiters
DSLII-632	2500, 3000, 4000A
DSLII-840	2500, 3000, 4000, 5000A

Center of Gravity
For seismic calculations, the following dimensions should be used to locate the center of gravity for Type DSII Switchgear.
Vertical ..... 60 inches (1524 mm)
Left to right ..... center of lineup
From the front..... 24 inches (610 mm)
(28 inches for assemblies containing DSLII, DSII-840 and DSII-850 Breakers)

Estimated Heat Loss Per Breaker (watts)
(See Note Below)
DSII-308 (DSLII-308)..... 400 (600)
DSII-516 (DSLII-516)..... 1000 (1500)
DSII-620 (DSLII-620)..... 1500 (2250)
DSII-632..... 2400
DSII-840..... 3000
DSII-850..... 4700
DSII-FT32 3600
DSII-FT40 4500

Note: Add heat loss of structure per the following.
Main bus through 3200 Amps..... 4000
Main bus 4000 Amps maximum..... 5000
Main bus 5000 Amps maximum..... 7000

E

Layout Guide – Indoor – DSII Breakers①②③

DSII Main - Close Coupled to Transformer

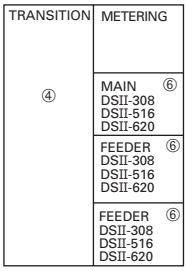


Fig. 1

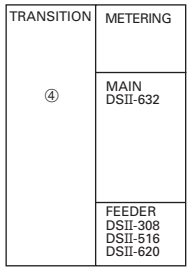


Fig. 2

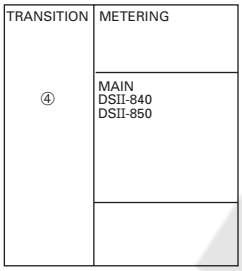


Fig. 3

Ampacity vs. Catalog Number

Frame	Breaker Designation
800A	DSII-308, -508, -608, DSLII-308 *
1600A	DSII-516, -616, DSLII-516 *
2000A	DSII-620, DSLII-620 *
3200A	DSII-632, DSLII-632 **
4000A	DSII-840, DSLII-840 **
5000A	DSII-850

* These breakers have the current limiters mounted on the breaker.
** These breakers have the current limiters mounted separately.

DSII Mains - Cable or Bus Duct Connected

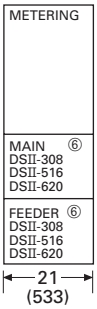


Fig. 4

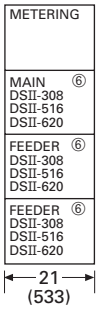


Fig. 5

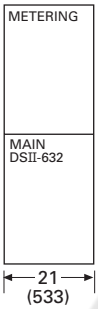


Fig. 6

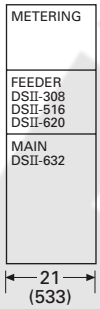


Fig. 7

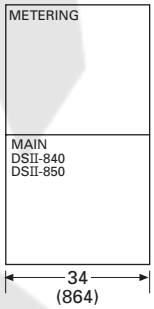


Fig. 8

DSII Ties

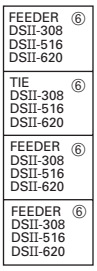


Fig. 9

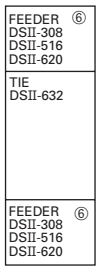


Fig. 10

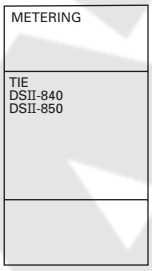


Fig. 11

Miscellaneous

Fig. 12

Fig. 13

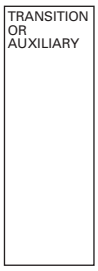


Fig. 14

Fig. 15

DSII Feeders③

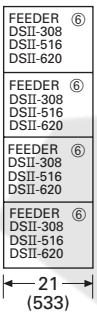


Fig. 16

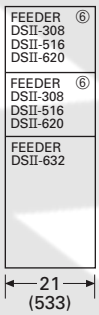


Fig. 17

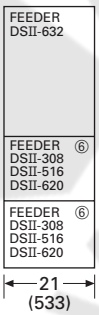


Fig. 18

Note: Blank may be substituted for any breaker position. Auxiliary may be substituted for any transition.

Dimensions are in inches (millimeters).

① Maximum indoor shipping width is 5 vertical sections or 120 inches (3048 mm), whichever is smaller. Maximum outdoor shipping width is 96 inches (2438 mm) including aisle doors, any transformer connections, etc.
② All vertical sections are 92 inches (2339 mm) high plus 4-inch (102 mm) ventilators and non-removable lifting angle. When the top-of-gear breaker lifter is used, height is 104 inches (2642 mm) over the lifter and 97.38 inches (2473 mm) over the lifter rail.
③ When bus ducts out of feeder sections are required, the depth of the lineup may increase and vertical stacking may be affected. Refer to Cutler-Hammer.
④ Transition may be omitted if: standard dry-type transformer is used; auxiliary and metering devices are not located in transition; no fire pump breaker; no zero sequence ground fault.
⑤ Refer to Cutler-Hammer for availability.
⑥ Also DSII-308, DSII-608, DSII-616 (Max. of 2 fully loaded DSII-620 breakers per section).

Layout Guide – Indoor – DSLII Breakers①②③

DSLII Mains - Close Coupled to Transformer

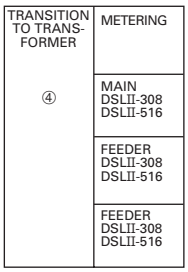


Fig. 1

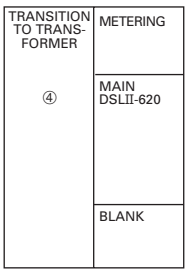


Fig. 2

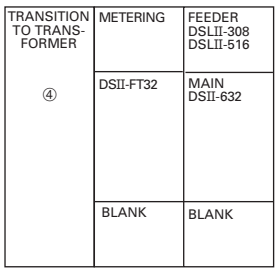


Fig. 3

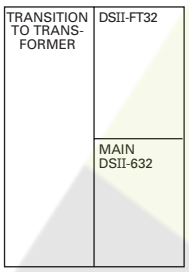


Fig. 4

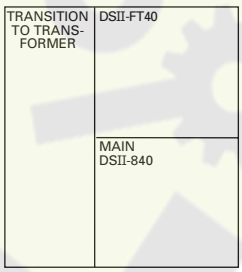


Fig. 5

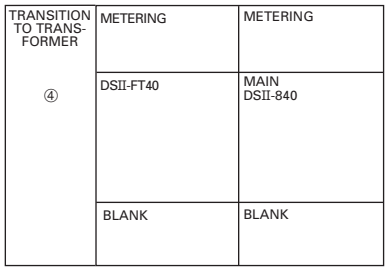


Fig. 6

Ampacity vs. Catalog Number

Frame	Breaker Designation
800A	DSII-308, -508, -608, DSLII-308 *
1600A	DSII-516, -616, DSLII-516 *
2000A	DSII-620, DSLII-620 *
3200A	DSII-632, DSLII-632 **
4000A	DSII-840, DSLII-840 **
5000A	DSII-850

* These breakers have the current limiters mounted on the breaker.
** These breakers have the current limiters mounted

E

DSLII Mains - Cable or Bus Duct Connected

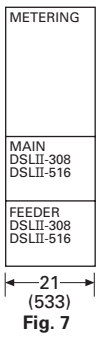


Fig. 7

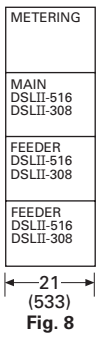


Fig. 8

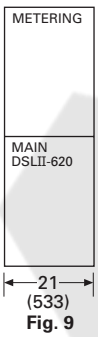


Fig. 9

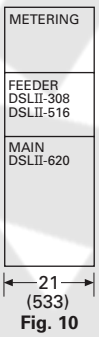


Fig. 10

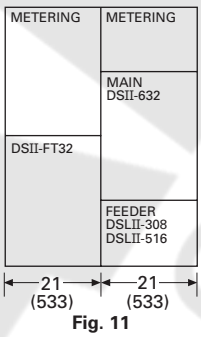


Fig. 11

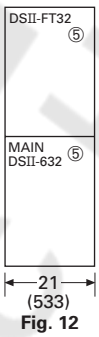


Fig. 12

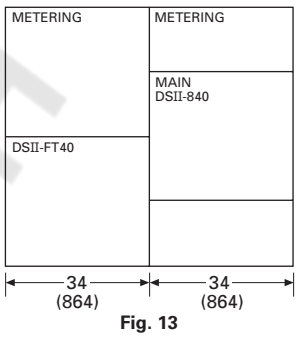


Fig. 13

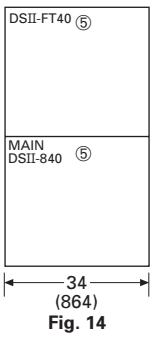


Fig. 14

DSLII Ties

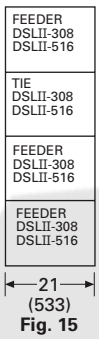


Fig. 15

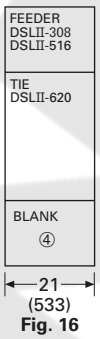


Fig. 16

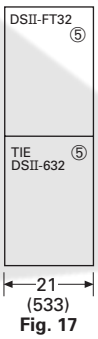


Fig. 17

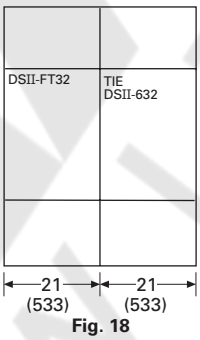


Fig. 18

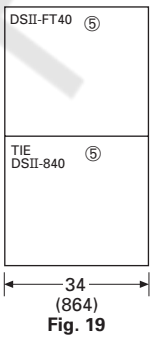


Fig. 19

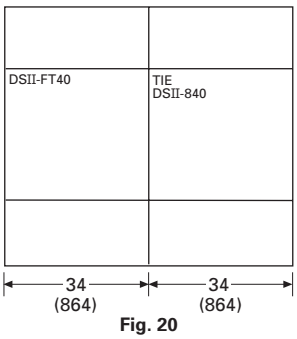


Fig. 20

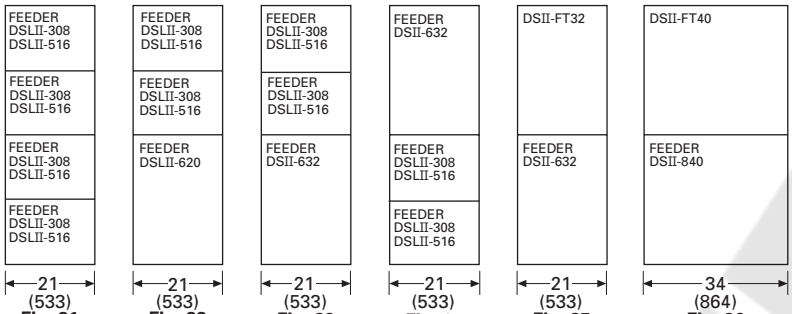
① Maximum indoor shipping width is 5 vertical sections or 120 inches (3048 mm), whichever is smaller. Maximum outdoor shipping width is 96 inches (2438 mm) including aisle doors, any transformer connections, etc.
② All vertical sections are 92 inches (2339 mm) high plus 4-inch (102 mm) ventilators and non-removable lifting angle. When the top-of-gear breaker lifter is used, height is 104 inches (2642 mm) over the lifter and 97.38 inches (2473 mm) over the lifter rail.
③ When bus ducts out of feeder sections are required, the depth of the lineup may increase and vertical stacking may be affected. Refer to Cutler-Hammer.
④ Transition may be omitted if: standard dry-type transformer is used; auxiliary and metering devices are not located in transition; no fire pump breaker; no zero sequence ground fault.
⑤ Refer to Cutler-Hammer for availability.

Note: Blank may be substituted for any breaker position. Auxiliary may be substituted for any transition.

Dimensions are in inches (millimeters).

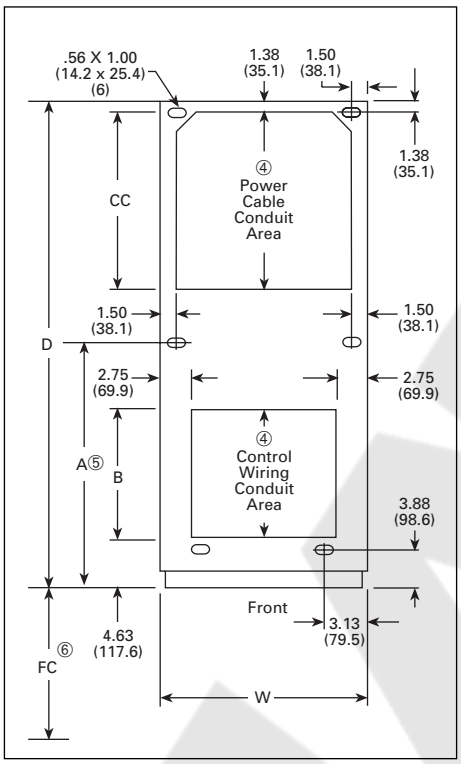
Layout Guide – Indoor – DSLII Breakers①②③

DSLII Feeders



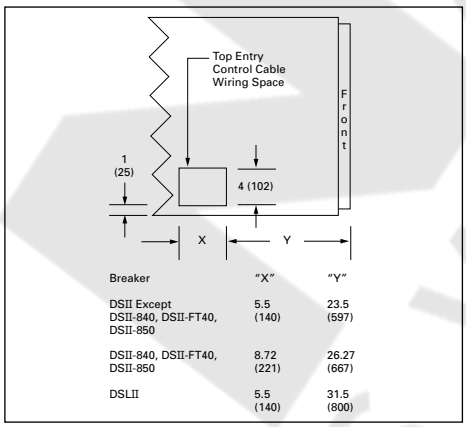
Note: Blank may be substituted for any breaker position. Auxiliary may be substituted for any transition.

Dimensions, in Inches



Floor Plan

Type of Breakers in Section	FC⑥	W	D	CC⑦	A⑤	B	Recommended④ No. of Power Conduits (Max.)	
							3.5 Inches	4 Inches
All DSII, Except DSII-840 DSII-850	36 (914)	21 (533)	60 (1524) 66 (1676) 72 (1829) 78 (1981) 84 (2134) 90 (2286)	10 (254) 16 (406) 22 (559) 28 (711) 34 (864) 40 (1016)	30.50 (775)	1.750 (445)	6 9 12 15 18 21	3 6 9 12 15 18
DSII-840 DSII-850	44 (1118)	34 (864)	72 (1829) 78 (1981) 84 (2134) 90 (2268)	14 (356) 20 (508) 26 (660) 32 (813)	38.50 (978)	23.50 (597)	14 18 23 32	10 15 23 28
DSLII-308 DSLII-516 DSLII-620	44 (1118)	21 (533)	66 (1676) 72 (1829) 78 (1981) 84 (2134) 90 (2286)	8 (203) 14 (356) 20 (508) 26 (660) 32 (813)	38.50 (978)	25.50 (648)	4 8 10 15 18	3 6 9 12 15
DSLII-632 DSII-FT32 (non stacked)	44 (1118)	21 (533)	72 (1829) 78 (1981) 84 (2134) 90 (2286)	14 (356) 20 (508) 26 (660) 32 (813)	38.50 (978)	25.50 (648)	8 10 15 18	6 9 12 15
DSLII-632 DSII-FT32 (stacked)	44 (1118)	21 (533)	72 (1829) 78 (1981) 84 (2134) 90 (2286)	0 (0) 6 (152) 12 (305) 18 (457)	38.50 (978)	25.50 (648)	0 3 6 9	0 3 6 9
DSLII-840 DSII-FT40 (non stacked)	44 (1118)	34 (864)	72 (1829) 78 (1981) 84 (2134) 90 (2286)	14 (356) 20 (508) 26 (660) 32 (813)	38.50 (978)	23.50 (597)	14 18 23 32	10 15 23 28
DSLII-840 DSII-FT40 (stacked)	44 (1118)	34 (864)	72 (1829) 78 (1981) 84 (2134) 90 (2286)	0 (0) 6 (152) 12 (305) 18 (457)	38.50 (978)	23.50 (597)	0 5 10 15	0 5 10 15



Top View

① Maximum indoor shipping width is 5 vertical sections or 120 inches (3048 mm), whichever is smaller. Maximum outdoor shipping width is 96 inches (2438 mm) including aisle doors, any transformer connections, etc.

② All vertical sections are 92 inches (2339 mm) high plus 4-inch ventilators and non-removable lifting angle. When the top-of-gear breaker lifter is used, height is 104 inches (2642 mm) over the lifter and 97.38 inches (2473 mm) over the lifter rail.

③ When bus ducts out of feeder sections are required, the depth of the lineup may increase and vertical stacking may be affected. Refer to Cutler-Hammer.

④ Stub conduit 2 inches (50 mm) maximum in power cable area, 1 inch (25 mm) maximum in control wiring area.

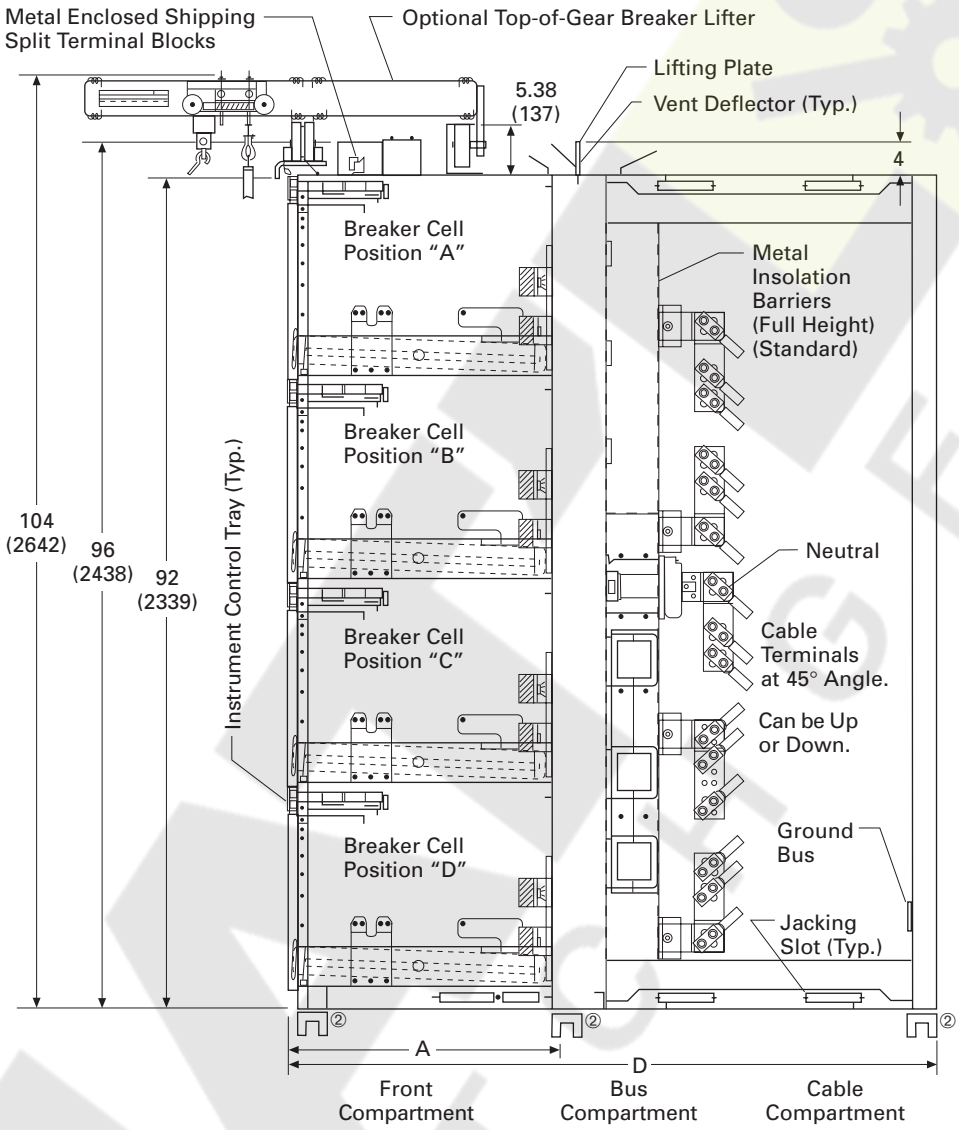
⑤ Bolt hole location for mounting the center floor channel when required. Floor channels not included. Note that when there is an assembly containing structures with different channel locations, a channel must be used for each of the locations.

⑥ FC is the recommended front clearance for breaker removal with top-of-switchgear-mounted breaker lifter. If a portable breaker lifter is to be used, allow at least 60 inches (1624 mm) of aisle space.

⑦ When a zero-sequence ground-fault ct is mounted on line-side or load-side of a breaker, reduce CC dimension by 10 inches (254 mm).

Dimensions are in inches (millimeters).

Section View of Typical Structure



Type DSII Indoor Switchgear Weights — Pounds (Approximate)

Stationary Structures

21 in. (533 mm) wide breaker structure less breakers:	
66 in. (1676 mm) maximum depth	1300
78 in. (1981 mm) maximum depth	1400
90 in. (2286 mm) maximum depth	1500
34 in. (864 mm) wide breaker structure less breaker:	
66 in. (1676 mm) maximum depth	1500
78 in. (1981 mm) maximum depth	1600
90 in. (2286 mm) maximum depth	1700
21 in. (533 mm) wide auxiliary structure less breaker:	
66 in. (1676 mm) maximum depth	1000
78 in. (1981 mm) maximum depth	1100
90 in. (2286 mm) maximum depth	1200
34 in. (864 mm) wide auxiliary structure less breaker:	
66 in. (1676 mm) maximum depth	1100
78 in. (1981 mm) maximum depth	1200
90 in. (2286 mm) maximum depth	1300
13 in. (330 mm) wide Bus Transition structure	700
21 in. (533 mm) Transformer Transition structure	1000

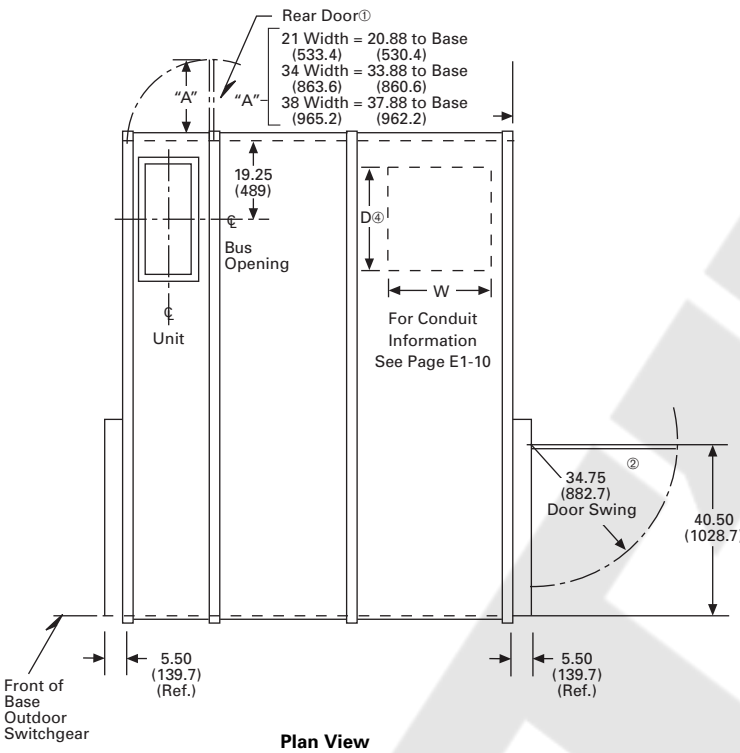
Dimensions are in inches (millimeters).

Drawout Elements①

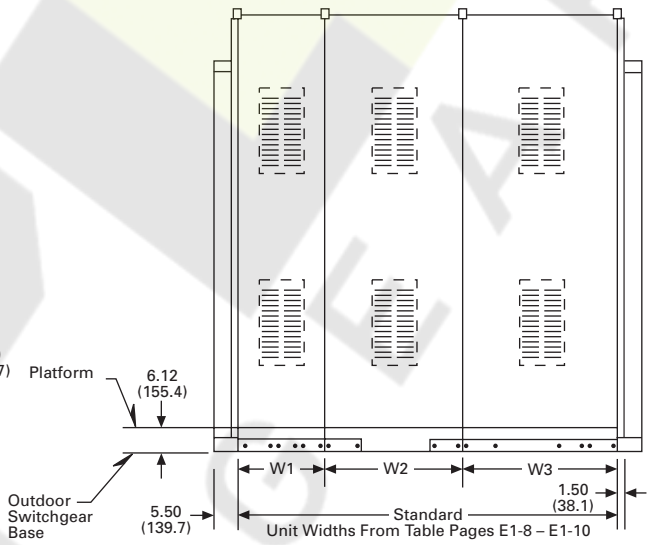
DSII-308 Breaker	150
DSII-508 Breaker	195
DSII-608 Breaker	200
DSII-516 Breaker	195
DSII-616 Breaker	200
DSII-620 Breaker	200
DSII-632 Breaker	300
DSII-840 Breaker	400
DSII-850 Breaker	400
DSLII-308 Breaker	200
DSLII-516 Breaker	260
DSLII-620 Breaker	325
DSII-FT32 Fuse Truck	325
DSII-FT40 Fuse Truck	430

① Manually or electronically operated. For approximate impact weight, add 50% of breaker weight.
② Floor channels not included. See page E1-10 for location of center channel(s).

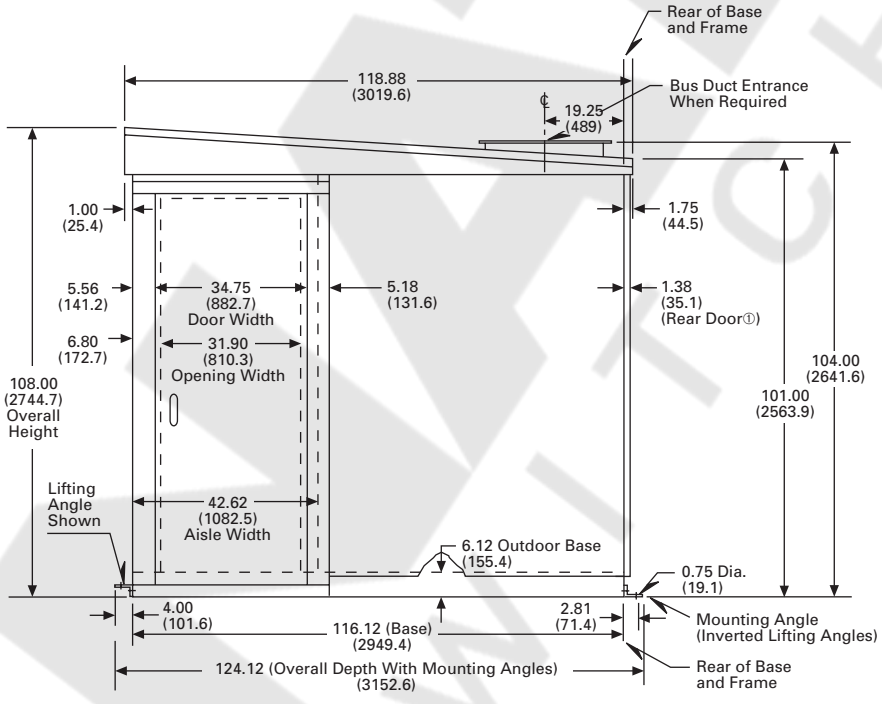
Typical Dimensions - Outdoor Walk-In



Plan View



Front View



Right-Hand End View

Weights of Outdoor Structures

Stationary Structures③	Weight–Lbs. (kg)
End trims (one set per lineup)	1500 (682)
21 in. wide breaker section (533 mm)	2600 (1182)
34 in. wide breaker section (864 mm)	2700 (1227)
21 in. wide auxiliary section (533 mm)	2300 (1045)
34 in. wide auxiliary section (864 mm)	2400 (1091)
38 in. wide utility section (965 mm)	2700 (1227)
50 in. wide utility section (1270 mm)	3200 (1455)
21 in. bus transition section (533 mm)	2500 (1136)
Transformer throat	150 (68)

① Rear doors are standard.
② Enclosures equipped with hinged door on each end of aisle.
③ Weight of structure is less breakers.
④ When a zero-sequence ground-fault ct is mounted on line-side or load-side of a breaker, reduce CC dimension by 10 inches (254 mm).

Dimensions are in inches (millimeters).

Ratings

A. Voltage rating shall be as indicated on the drawings. The entire assembly shall be suitable for 600 volts maximum AC service.

B. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions [of (30,000) (42,000) (50,000) (65,000) (85,000) amperes symmetrical at rated voltage] [as shown on the drawings] per ANSI standard.

C. The bus system shall have a minimum ANSI 4-cycle short-circuit withstand rating of [100,000] [150,000] [200,000] amperes symmetrical.

D. All circuit breakers shall have a minimum symmetrical interrupting capacity of [30,000] [42,000] [50,000] [65,000] [85,000] [200,000] amperes. To assure a fully selective system, all circuit breakers shall have 30-cycle short time withstand ratings equal to their symmetrical interrupting ratings, regardless of whether equipped with instantaneous trip protection or not.

E. Where circuit breakers are equipped with current limiters, the combination shall have short time ratings in accordance with the characteristics of the limiter selected.

F. All ratings shall be tested to the requirements of ANSI C37.20.1, C37.50 and C37.51 and UL 1558.

Construction

A. The Switchgear shall consist of the required number of vertical sections, bolted together to form a rigid assembly. The sides shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide ventilators located on the top of the switchgear over the breaker and bus compartments to ensure adequate ventilation within the enclosure. [The rear covers shall be fabricated in two (2) pieces for ease of handling, and shall be mounted using captive hardware.] [Hinged rear doors, complete with provisions for padlocking, shall be provided.]

B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to [contractor supplied floor sills to be set level in concrete per manufacturer's recommendations] [the floor without the use of floor sills providing the floor is level to 1/8-inch per 3-foot distance in any direction]. Provisions shall be made for jacking of shipping groups, for removal of skids or insertion of equipment rollers. Base of assembly shall be suitable for rolling directly on pipes without skids. The base shall be equipped with slots in the bottom side frame members to accommodate the forks of a lift truck. The base frame member shall be constructed such that the forks can not protrude into the breaker, bus or cable compartments of the assembly.

C. Each vertical steel unit, forming part of the switchgear line-up, shall be a self-contained housing having one or more individual breaker or instrument compartments, a centralized bus compartment, and a rear cabling compartment. Each individual circuit breaker compartment, or cell, shall be segregated from adjacent compartments and sections, including the bus compartment, by means of steel barriers. It shall be equipped with drawout rails and primary and secondary disconnecting contacts. Removable hinge pins shall be provided on the breaker compartment door hinges. Current transformers for feeder instrumentation, where shown on the plans, shall be located within the appropriate breaker cells.

D. The stationary part of the primary disconnecting devices for each power circuit breaker, shall consist of a set of contacts extending to the rear, through a glass polyester insulating support barrier; corresponding moving finger contacts suitably spaced shall be furnished on the power circuit breaker studs which engage in only the connected position. The assembly shall provide multiple silver-to-silver full floating high-pressure point contacts with uniform pressure on each finger maintained by springs. Each circuit shall include the necessary three-phase bus connections between the section bus and the breaker line side studs. Load studs shall be equipped with insulated copper load extension busses terminating in solderless type terminals in the rear cable compartment of each structure. Bus extensions shall be [silver-plated] [tin-plated] where outgoing terminals are attached.

E. The secondary disconnecting devices shall consist of floating fingers mounted on the removable unit and engaging flat contact segments at the rear of the compartment. The secondary disconnecting devices shall be silver-plated and sliding contact engagement shall be maintained in the CONNECTED and TEST positions.

F. The removable power circuit breaker element shall be equipped with disconnecting contacts, wheels and interlocks for drawout application. It shall have four positions, CONNECTED, TEST, DISCONNECTED, and REMOVED all of which permit closing the compartment door. The breaker drawout element shall contain a worm gear levering “in” and “out” mechanism with removable lever crank. Mechanical interlocking shall be provided so that the breaker is in the tripped position before levering “in” or “out” of the cell. The breaker shall include a provision for padlocking open to prevent manual or electric closing. The padlocking shall also secure the breaker in the connected, test or disconnected position by preventing levering.

G. An insulating flash shield shall be mounted above each circuit breaker to prevent flashover from the arc chutes to ground.

H. Provide a rear compartment steel barrier between the cable compartment and the main bus to protect against inadvertent contact with main or vertical bus bars.

I. The switchgear shall be Cutler-Hammer type DSII low-voltage metal-enclosed switchgear, utilizing type DSII or DSLII power air circuit breakers as herein specified.

J. Provide in the cell, when the circuit breaker is withdrawn, a safety shutter which automatically covers the line and load stabs and protects against accidental contact.

K. [Provide a metal barrier full height and depth between adjacent vertical structures in the cable compartment.]

L. Provide a glass polyester full height and depth barrier between adjacent vertical structures in the bus compartment with appropriate slots for main bus.

M. The switchgear shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

Bus

A. All bus bars shall be [silver-plated copper] [tin-plated copper]. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on ANSI standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).

   1. In addition to full UL air clearances, the bus shall be insulated with a minimum of 5 mill thickness of epoxy resin coating. Removable non-PVC boots shall be provided to give access to the cross bus joints for inspection and maintenance.

B. Provide a [half] [full] capacity neutral bus where a neutral bus is indicated on the drawings.

C. A copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchgear. The ground bus short time withstand rating shall meet that of the largest circuit breaker within the assembly.

D. All hardware used on conductors shall be high-tensile strength and zinc plated. All bus joints shall be provided with Belleville-type washers.

Wiring/Terminations

A. Small wiring, necessary fuse blocks and terminal blocks within the switchgear shall be furnished as required. Control components mounted within the assembly shall be suitably marked for identification corresponding to the appropriate designations on manufacturer's wiring diagrams.

B. All control wire shall be type SIS. Wire bundles shall be secured with nylon ties and anchored to the assembly with the use of prepunched wire lances or nylon non-adhesive anchor. All current transformer secondary leads shall first be connected to conveniently accessible short circuit terminal blocks before connecting to any other device. Four (4) shorting screws with provisions for storage shall be provided. All groups of control wires leaving the switchgear shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring. Plug-in terminal blocks shall be provided for all shipping split wires. Terminal connections to remote devices or sources shall be front accessible via removable trays above each circuit breaker. Control fuses for each electrically operated circuit breaker shall also be located in these trays.

C. NEMA 2-hole [mechanical-] [crimp-] type lugs shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the size indicated on the drawings.

D. A termination system shall be provided such that no additional cable bracing, tying or lashing is required to maintain the short circuit withstand ratings of the assembly through 85 kA.

E. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.

Circuit Breakers

A. All protective devices shall be drawout low-voltage power air circuit breakers, Cutler-Hammer type "DSII" or approved equal. Frame ratings shall be 800, 1600, 2000, 3200, 4000, or 5000 amperes. All breakers shall be UL listed for application in their intended enclosures for 100% of their continuous ampere rating.

B. Breakers shall be manually operated (MO) unless electrically operated (EO) is indicated on the drawings.

C. Electrically operated breakers shall be complete with [120-Vac] [48-Vdc] [125-Vdc] [250-Vdc] operators, [OPEN/CLOSE pushbuttons] [control switch], plus red and green indicating lights to indicate breaker contact position. [DC source shall be supplied from a remote battery system] [AC source shall be taken from a (remote source) (control power transformer internal to the switchgear assembly)].

D. Main power circuit breakers shall be provided with trip units as specified in paragraph [__.__ through __].

E. Tie power circuit breakers shall be provided with trip units as specified in paragraph [__.__ through __].

F. Feeder power circuit breakers shall be provided with trip units as specified in paragraph [__.__ through __].

Utilize the applicable paragraphs for the type trip unit(s) desired, and delete the remaining non-applicable paragraphs.

Mains, tie, and feeders may utilize different types of trip units depending on features desired for the specific application. Suggested format as follows:

Digitrip RMS510 – Basic protection and curve shaping
Trip Units (Digitrip) Paragraphs A through J

Digitrip RMS610 – Same as 510 plus local current display
Trip Units (Digitrip) Paragraphs A through N

Digitrip RMS810 – Same as 610 plus energy monitoring/display, and remote communications
Trip Units (Digitrip) Paragraphs A through R

Digitrip RMS910 – Same as 810 plus voltage, power factor and harmonic analysis and display
Trip Units (Digitrip) Paragraphs A through S

Digitrip OPTIM 750 – Programmable curve shaping, load monitoring, and communications
Programmable Trip Units (Digitrip OPTIM) Paragraphs A through O

Digitrip OPTIM 1050 – Same as 750 plus power and energy monitoring; harmonic monitoring and analysis.
Programmable Trip Units (Digitrip OPTIM) Paragraphs A through Q

G. [Main] [Tie] [and Feeder] power circuit breakers (where indicated on the drawings) shall include current limiters. Limiters shall be integrally mounted on 800-, 1600- and 2000-ampere breakers. For 3200-ampere and 4000-ampere breakers, limiters shall be mounted on a separate draw-out limiter truck. Current limiters shall be coordinated with the breaker trip device, so as to avoid unnecessary blowing of the current limiters. Breakers shall include an anti-single-phase device that will trip the breaker in the event of a blown limiter, indicate from the front of the breaker which limiter is blown, and prevent the breaker from being re-closed on a single-phase condition due to missing or blown limiters.

1. Current limiters which are integrally mounted with breaker shall be inaccessible until the breaker is completely withdrawn from its compartment assuring complete isolation. Current limiters mounted on a separate truck shall be key interlocked with the breaker to prevent withdrawing or insertion unless the breaker is locked open.

2. Power circuit breakers with current limiting fuses shall have a 200,000-ampere RMS symmetrical interrupting capacity at 600 volts and below.

Trip Units (Digitrip)

A. Each draw-out low-voltage power circuit breaker shall be equipped with a solid-state tripping system consisting of three (3) current sensors, microprocessor-based trip device and flux-transfer shunt trip. Current sensors shall provide operation and signal function. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection functions. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached.

B. Interchangeable rating plugs shall establish the maximum continuous trip ratings of each circuit breaker. Rating plugs shall be fixed type as indicated. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.

C. Complete system selective coordination shall be provided by the addition of the following individually adjustable time/current curve shaping solid-state elements:

1. All breakers shall have adjustments for long delay pick-up and time.

2. [Main] [Tie] [and Feeders] shall have individual adjustments for short delay pick-up and time, and include selective flat or I^2t curve shaping.

3. [Main] [Tie] [and Feeders] shall have an adjustable instantaneous pick-up.

4. Breakers where indicated on the drawings, shall have individually adjustable ground fault current pick-up and time, and include selective flat or I^2t curve shaping.

D. The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.

E. Trip units to include zone interlocking capability for the short time delay and ground fault delay trip functions for improved system coordination. The zone interlocking system shall restrain the tripping of an upstream circuit breaker and allow the circuit breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after the pre-set time delay. [Factory wire zone interlocking system for breakers within the switchgear.]

F. For trip units that do not have an instantaneous adjustment, a discriminator circuit shall be provided to prevent the breaker being closed and latched on to a faulted circuit.

G. Internal ground fault protection settings shall not exceed 1200 amperes. Provide neutral ground fault sensor for four-wire loads.

H. The trip unit shall have an information system that utilizes battery backed-up LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A trip reset button shall be provided to turn off the LED indication after an automatic trip. A test pushbutton shall energize an LED to indicate battery status.

I. The trip unit shall be provided with a representation of the time-current curve on the trip unit that indicates the protection function settings. The unit shall be continuously self-checking and provide LED indication that the internal circuitry is being monitored and is fully operational.

J. The trip unit shall contain an integral test panel with a test selector switch and a test pushbutton. The test selector switch shall enable the user to select the values of test current within a range of available settings. The basic protection functions shall not be affected during test operations. The breaker shall be capable of being tested in either the TRIP or NO TRIP test mode. Provide a keyed receptacle for use with an optional auxiliary power module. The auxiliary power module shall allow the breaker trip unit to be tested with a 120-volt external power source.

K. A four-digit, 3/4-inch high, LED alphanumeric display shall be provided to indicate the following data:

1. Cause of trip
2. Instantaneous value of maximum phase and ground current
3. Level of fault current that initiated an automatic trip operation
4. Display shall be high output LED for low-level light readability. LCD displays are unacceptable.

L. The trip unit shall include a power/relay module which shall supply control power to the readout display. Following an automatic trip operation of the circuit breaker, it shall maintain the cause of trip history and the mode of trip LED indication as long as its internal power supply is available. Internal relays shall provide contacts for remote indication of mode of trip and high load.

M. A red LED shall be provided on the face of the trip unit pre-set to turn on when 85% of the trip setting is exceeded (a 40-second delay shall be provided to avoid nuisance alarms).

N. Metering display accuracy of the complete system including current sensors, auxiliary CTs, and the trip unit shall be +/- 2% of full scale for current values.

O. The trip unit shall include a potential transformer module, suitable for operation up to 600V, 50/60 Hz. The primary of the PTM shall be connected internally to the load side of the circuit breaker through a dielectric disconnect plug. The unit shall calculate energy monitoring parameters as follows:

1. Peak demand (Megawatts)
2. Present demand (Megawatts)
3. Energy consumption (Megawatt-hours).

P. The energy-monitoring parameter values (peak demand, present demand and energy consumption) shall be indicated in the trip unit alphanumeric display panel.

Q. Metering display accuracy of the complete system of full scale shall be +/- 3% for power values, +/- 4% of full scale for energy values.

R. The trip unit shall be equipped to permit communication via a network twisted pair for remote monitoring and control. The trip unit shall be provided with an address register for identification on the network. All monitored values shall be transmittable over the network.

S. For enhanced system analysis the following additional parameter values shall be calculated and indicated in the trip unit alphanumeric display panel:

1. Line-to-line voltage
2. Power factor
3. Percentage harmonic content
4. Total harmonic distortion (THD).

Programmable Trip Units (Digitrip OPTIM)

A. Each draw-out low-voltage power circuit breaker microprocessor-based tripping system shall consist of three (3) current sensors, a trip unit and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached.

B. Interchangeable rating plugs shall establish the maximum continuous trip ratings of each circuit breaker. Rating plugs shall be fixed-type as indicated. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.

C. Complete system selective coordination shall be provided by the addition of the following individually adjustable time/current curve shaping solid-state elements:

1. All breakers shall have adjustments for long delay pick-up and time.
2. [Main] [Tie] [and Feeders] shall have individual adjustments for short delay pick-up and time, and include selective flat or I^2t curve shaping.
3. [Main] [Tie] [and Feeders] shall have adjustable instantaneous pick-up.
4. Breakers where indicated on the drawings, shall have individually adjustable ground fault current pick-up and time, and include selective flat or I^2t curve shaping.

D. The microprocessor-based trip unit shall have a powered/unpowered selectable thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in a quick succession.

E. Trip units to include zone interlocking capability for the short-time delay and ground fault delay trip functions for

improved system coordination. The zone interlocking system shall restrain the tripping of an upstream circuit breaker and allow the circuit breaker, closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after the pre-set time delay. [Factory shall wire zone interlocking system for breakers within the switchgear.]

F. When the instantaneous setting has been deselected, a selectable discriminator circuit shall be provided to prevent the breaker being closed and latched on to a faulted circuit.

G. Internal ground fault protection or alarm settings shall not exceed 1200 amperes. Provide neutral ground fault sensor for four-wire loads.

H. The trip unit shall have an information system that utilizes battery backed-up LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A trip reset button shall be provided to turn off the LED indication after an automatic trip. A test push-button shall energize an LED to indicate battery status.

I. Circuit breakers where required shall be provided with a 30-volt DC power supply mounted within the assembly. In addition, provide a minimum of one auxiliary switch and one bell alarm, each with form C contacts in each breaker. Provide additional auxiliary switches, bell alarms, shunt trips, and undervoltage releases where indicated on the drawings.

J. Circuit breakers shall be provided with a power/relay module to supply control power. Internal relays shall provide contacts for remote indication of the mode of trip (long delay, short-circuit, ground fault) and high load.

K. A red LED shall be provided on the face of the trip unit and pre-set to flash on and off when an adjustable high load level is exceeded. A time delay shall be provided to avoid nuisance alarms. The microprocessor-based trip units shall be capable of monitoring the following data:

1. Instantaneous value of phase, neutral and ground current
2. Minimum and maximum current values
3. Average demand current
4. System diagnostic information such as alarms and cause of trip
5. Approximate level of fault current that initiated an automatic trip operation.

L. The monitored data shall be displayed by a hand-held programmer, a breaker interface module or a remote computer.

M. The trip unit shall be capable of two-way communication via a network twisted pair for remote monitoring and control. The trip unit shall be provided with an address register for identification on the network. All monitored values shall be transmittable over the network.

N. The trip unit shall contain test capability. Testing shall be carried out by using a hand-held programmer, a breaker interface module or a remote computer to select the values of test current within a range of available settings. The basic protection functions shall not be affected during test operations. The breaker may be tested in either the TRIP or NO TRIP test mode. Provide an optional auxiliary power module to allow the breaker trip unit to be tested with a 120-volt external power source.

O. A hand-held programming unit shall be provided to set/change the network communication breaker address for each device, set the system baud rate, distribution frequency, display breaker information, and display monitored values. In addition, provide password protection for programming time current set points and to perform functional testing of phase and ground trip characteristics. The programmer shall be self-powered by an internal battery. Provide as a minimum one (1) hand-held programming unit per assembly.

P. Circuit breakers shall be provided with a potential transformer module suitable for operation up to 600 volts. The primary of the potential transformer module shall be connected internally to the load side of the circuit breaker through a dielectric disconnect plug.

Q. For enhanced system analysis the following additional parameter values shall be monitored:

1. Peak demand (kW)
2. Present demand (kW)
3. Reverse energy (kWh)
4. Forward energy (kWh)
5. Total energy (kWh)
6. Power factor
7. Percentage harmonic content
8. Total harmonic distortion (THD)

Central Display Unit

A. Where indicated on the drawings, provide a central display unit capable of displaying information and data from trip units specified above.

For centralized local monitoring of the Digitrip 810/910 and OPTIM trip units, select BIM from section B4.

Miscellaneous Devices

A. Key interlocks shall be provided as indicated on the drawings. These interlocks shall keep the circuit breakers trip-free when actuated.

B. Each section of the switchgear shall be provided with a space heater [thermostatically controlled]. Power for the space heaters shall be obtained [from a control power transformer within the switchgear] [from a source as indicated on the drawings]. Supply voltage shall be 120 volts AC.

C. Fused control power transformers shall be provided as indicated on the drawings or as required for proper operation of the equipment. A manual disconnect shall be provided ahead of the primary fuses. [Control power transformers shall have adequate capacity to supply power to the transformer cooling fans.]

Utility Metering

A. Where indicated on the drawings, furnish a separate barriered-off utility metering compartment, complete with hinged sealable door. Bus work shall include provisions for mounting utility company current transformers and potential transformers, or potential taps as required by the utility company. Provide service entrance label and necessary applicable service entrance features per NEC and local code requirements.

Customer Metering

A. Where indicated on the drawings, provide a separate customer metering compartment with front hinged door.

B. Provide current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.

C. Provide [potential transformers including primary and secondary fuses with disconnecting means] [fused potential taps as the potential source] for metering as shown on the drawings.

Select devices as required for paragraph D.

IQ Analyzer section B1
IQ DP-4000 section B1
IQ Generator section B1
IQ Data section B1

A. Microprocessor-Based Metering System

Enclosures

A. NEMA 1 Enclosure

B. Outdoor Walk-in Enclosure

1. Switchgear shall be enclosed in an outdoor walk-in NEMA 3R enclosure conforming to all applicable requirements of UL and designed to withstand wind velocities of [110] [125] mph. The enclosure shall have a roof sloping toward the rear. Outer sections shall be the same widths as indoor structures except the end sections of a walk-in enclosure shall be wider than the inner sections to permit opening the inner door. Each end of the outdoor structure shall have an end trim. Front aisle depth for walk-in structures shall be 42 inches, minimum.

2. The enclosure shall be provided with rear hinged padlockable doors with wind stops for each section. Aisle doors shall be supplied with provisions for padlocking. A steel floor shall be provided in walk-in aisle space and under each vertical section. An anti-skid floor strip shall be provided in the aisle. Ventilating openings shall be provided complete with replaceable fiberglass air filters which are removable from the exterior of the enclosure. Provide necessary space heaters thermostatically controlled for breaker, bus and cable compartments of adequate wattage to prevent the accumulation of moisture within the compartments.

3. Provide panic door hardware on aisle doors at each end of the line-up. External padlocking of the aisle doors shall not prevent operation of the panic hardware from the interior of the enclosure. The construction of the enclosure shall be modular so future sections can be added without affecting NEMA 3R integrity. Provide interior aisle fluorescent lights, 3-way switches and GFI protected receptacles.

4. The enclosure shall be provided with undercoating applied to all members in contact with the foundation surface to retard corrosion.

5. Power for the space heaters, lights and receptacles shall be obtained from a [control power transformer within the switchgear] [source as indicated on the drawings]. Supply voltage shall be 120 volts AC.

6. An overhead circuit breaker lifter shall be provided in the aisle of the enclosure.

7. Each shipping section shall be shipped completely assembled.

Nameplates

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background, and secured with screws. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating.

B. Furnish master nameplate giving switchgear designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.

C. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's drawings.

Finish

A. All exterior and interior steel surfaces of the switchgear shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchgear shall be the manufacturer's standard.

Accessories

A. Provide a [traveling-type circuit breaker lifter, rail-mounted on top of switchgear] [portable circuit breaker transfer truck with manual lifting mechanism].

Transient Voltage Surge Suppression

A. Provide transient voltage surge suppression as specified in section L.

For a complete product specification in CSI format, see **Cutler-Hammer Product Specification Guide**, section 16426.

E

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