



BUILDING-INTEGRATED SOLAR TECHNOLOGY

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## SOLAR EQUIPMENT & SPACE REQUIREMENT

MITREX SOLAR FACADE -  
50kW RESIDENTIAL

## 1. INTRODUCTION

Photovoltaic systems offer a promising solution to combat global warming while providing sustainable energy for the future. In utility scales, solar farms are prevalent and interconnected with the grid. For enhanced efficiency and reduced loss, it is beneficial to have load and generation sources situated close to each other. Solar projects implemented in or on buildings are particularly advantageous as they harness most of the solar energy for immediate use within the building. This approach not only minimizes losses but also alleviates congestion in transmission and distribution lines.

## 2. FOR BUILDING OWNERS

A crucial concern for building owners is the electrical equipment required for solar projects. Beyond cost considerations, they worry about the space these equipment installations demand. This document addresses the necessary equipment for various PV project sizes and scenarios.

## 3. LOGISTICS CONSIDERATIONS

BIPV (Building Integrated Photovoltaics) and regular rooftop solar installations as BAPV (Building applied photovoltaics) differ in terms of installation locations, solar panel types, and mounting equipment. However, both BIPV and BAPV systems share similar components apart from the solar panels. In rooftop projects, a designated area on the flat or tilted roof is necessary. In contrast, BIPV panels replace specific building elements such as facades, windows, railings, and so on, eliminating the need for additional space.

Additional equipment, such as AC equipment, requires some space on the roof, wall, or inside the building (like electrical or mechanical room). The specific requirements for AC equipment depend on factors such as the system size, number of electricity phases (single phase or three phases), maximum DC voltages allowed in the building, and local distribution company (LDC) regulations. When inverters are placed inside the building, DC cables need to be carefully routed through conduits, necessitating penetration points in the structure. The number and size of conduits vary according to each scenario, as detailed in the accompanying table.

## 4. REQUIRED AC EQUIPMENT FOR DIFFERENT SCENARIOS

Mitrex Panels, both BIPV and BAPV, are suitable for a 1000V system voltage. However, certain buildings may be restricted to a maximum of 600V DC based on local codes. Electricity services typically operate at 240V single phase or 208V, 480V, and 600V three phases. The table below outlines the required AC equipment for all the aforementioned scenarios, considering different system sizes.

		600V DC MAX SYSTEM			
# OF PHASES	SINGLE PHASE	THREE PHASE			
VOLTAGE	240V	208V	480V	600V	
5kW	Inverter	Solaredge SE5000H-US	---	---	---
	Disconnect	240V 30A Disconnect	---	---	---
	Panelboard	---	---	---	---
	Transformer	---	---	---	---
	Conduit	1" Conduit	---	---	---
	SCADA	---	---	---	---
10kW	Inverter	Solaredge SE10000H-US	Solaredge SE10KUS	Fronius Symo 15.0-3	Solaredge SE10KUS
	Disconnect	240V 60A Disconnect	240V 60A Disconnect	600V 30A Disconnect x 2	600V 30A Disconnect x 3
	Panelboard	---	---	---	---
	Transformer	---	---	---	600V/208V 15kVA TX
	Conduit	1 1/4" Conduit	1 1/4" Conduit	1 1/2" Conduit	1 1/4" Conduit
	SCADA	---	---	---	---
20kW	Inverter	Solaredge SE10000H-US x 2	Solaredge SE10KUS x 2	Fronius Symo 20.0-3	Solaredge SE10KUS x 2
	Disconnect	240V 200A Disconnect	240V 100A Disconnect	600V 30A Disconnect x 2	600V 30A Disconnect x 2
	Panelboard	240V 200A Panel	240V 100A Panel	---	600V 100A Panel
	Transformer	---	---	---	600V/208V 30kVA TX
	Conduit	1 1/2" Conduit	2" Conduit	1 1/2" Conduit	2" Conduit
	SCADA	---	---	---	---
50kW	Inverter	---	Solaredge SE17.3KUS x 3	SMA Core1 33.3kW x 2	SMA Core1 33.3kW x 2
	Disconnect	---	240V 200A Disconnect	600V 60A Disconnect x 2	600V 60A Disconnect x 2
	Panelboard	---	240V 200A Panel	600V 100A Panel	600V 100A Panel
	Transformer	---	---	---	600V/480V 75kVA TX
	Conduit	---	2" Conduit	3" or 2 x 2" Conduit	3" or 2 x 2" Conduit
	SCADA	---	Depends on the Hydro	Depends on the Hydro	Depends on the Hydro
100kW	Inverter	---	Solaredge SE17.3KUS x 6	SMA Core1 33.3kW x 3	SMA Core1 33.3kW x 3
	Disconnect	---	240V 400A Disconnect	600V 200A Disconnect x 2	600V 200A Disconnect x 2
	Panelboard	---	240V 400A Panel	600V 200A Panel	600V 200A Panel
	Transformer	---	---	---	600V/480V 150kVA TX
	Conduit	---	3" or 2 x 2" Conduit	4" or 2 x 3" or 3 x 2" Conduit	4" or 2 x 3" or 3 x 2" Conduit
	SCADA	---	Depends on the Hydro	Depends on the Hydro	Depends on the Hydro
500kW	Inverter	---	---	SMA Core1 33.3kW x 15	SMA Core1 33.3kW x 15
	Disconnect	---	---	600V 600A Disconnect x 2	600V 600A Disconnect x 2
	Panelboard	---	---	600V 800A Panel	600V 800A Panel
	Transformer	---	---	---	600V/480V 500kVA TX
	Conduit	---	---	5 x 4" Conduit	5 x 4" Conduit
	SCADA	---	---	Depends on the Hydro	Depends on the Hydro

		1000V DC MAX SYSTEM			
# OF PHASES	SINGLE PHASE	THREE PHASE			
VOLTAGE	240V	208V	480V	600V	
5kW	Inverter	Fronius Primo 5.0-1	---	---	---
	Disconnect	240V 30A Disconnect	---	---	---
	Panelboard	---	---	---	---
	Transformer	---	---	---	---
	Conduit	1 1/4" Conduit	---	---	---
	SCADA	---	---	---	---
10kW	Inverter	Fronius Primo 10.0-1	Fronius Symo 10.0-3 (208V)	Fronius Symo 10.0-3	Fronius Symo 10.0-3
	Disconnect	240V 60A Disconnect	240V 60A Disconnect	600V 30A Disconnect x 2	600V 30A Disconnect x 3
	Panelboard	---	---	---	---
	Transformer	---	---	---	600V/480V 15kVA TX
	Conduit	1 1/2" Conduit	1 1/2" Conduit	1 1/2" Conduit	1 1/2" Conduit
	SCADA	---	---	---	---
20kW	Inverter	Fronius Primo 10.0-1 x 2	Fronius Symo 10.0-3 (208V) x 2	Fronius Symo 20.0-3	Fronius Symo 20.0-3
	Disconnect	240V 200A Disconnect	240V 100A Disconnect	600V 30A Disconnect x 2	600V 30A Disconnect x 3
	Panelboard	240V 200A Panel	240V 100A Panel	---	---
	Transformer	---	---	---	600V/480V 30kVA TX
	Conduit	2" Conduit	2" Conduit	1 1/2" Conduit	1 1/2" Conduit
	SCADA	---	---	---	---
50kW	Inverter	---	Fronius Symo 15.0-3 (208V) x 3	SMA Corel 50kW	SMA Corel 50kW
	Disconnect	---	240V 200A Disconnect	600V 60A Disconnect x 2	600V 60A Disconnect x 3
	Panelboard	---	240V 200A Panel	---	---
	Transformer	---	---	---	600V/480V 75kVA TX
	Conduit	---	3" or 2 x 2" Conduit	1 1/2" Conduit	1 1/2" Conduit
	SCADA	---	Depends on the Hydro	Depends on the Hydro	Depends on the Hydro
100kW	Inverter	---	Fronius Symo 15.0-3 (208V) x 7	Solaredge SE100KUS	Solaredge SE100KUS
	Disconnect	---	240V 400A Disconnect	600V 200A Disconnect x 2	600V 200A Disconnect x 3
	Panelboard	---	240V 400A Panel	---	---
	Transformer	---	---	---	600V/480V 150kVA TX
	Conduit	---	4" or 2 x 3" or 4 x 2" Conduit	2 1/2" or 2 x 1 1/2" PVC Conduit	2 1/2" or 2 x 1 1/2" PVC Conduit
	SCADA	---	Depends on the Hydro	Depends on the Hydro	Depends on the Hydro
500kW	Inverter	---	---	Solaredge SE100KUS x 5	Solaredge SE100KUS x 5
	Disconnect	---	---	600V 600A Disconnect x 2	600V 600A Disconnect x 2
	Panelboard	---	---	600V 800A Panel	600V 800A Panel
	Transformer	---	---	600V/480V 500kVA TX	600V/480V 500kVA TX
	Conduit	---	---	2 x 4" or 5 x 2 1/2" Conduit	2 x 4" or 5 x 2 1/2" Conduit
	SCADA	---	---	Depends on the Hydro	Depends on the Hydro

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CASE STUDY

# 50KW SYSTEM ON RESIDENTIAL BUILDING

**BUILDING TYPE:**

Residential building with 180 panels of 350W (total 63 kW DC)

**SYSTEM SIZE:**

3 x 15kW Fronius 15.0-3 208V

**SYSTEM LAYOUT:**

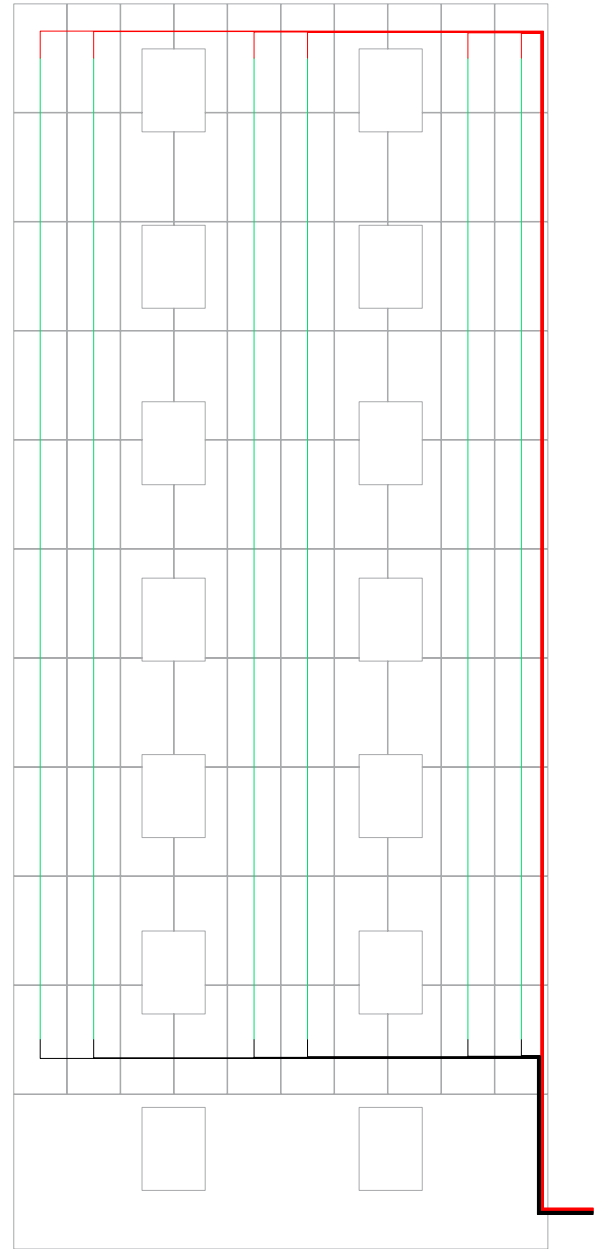
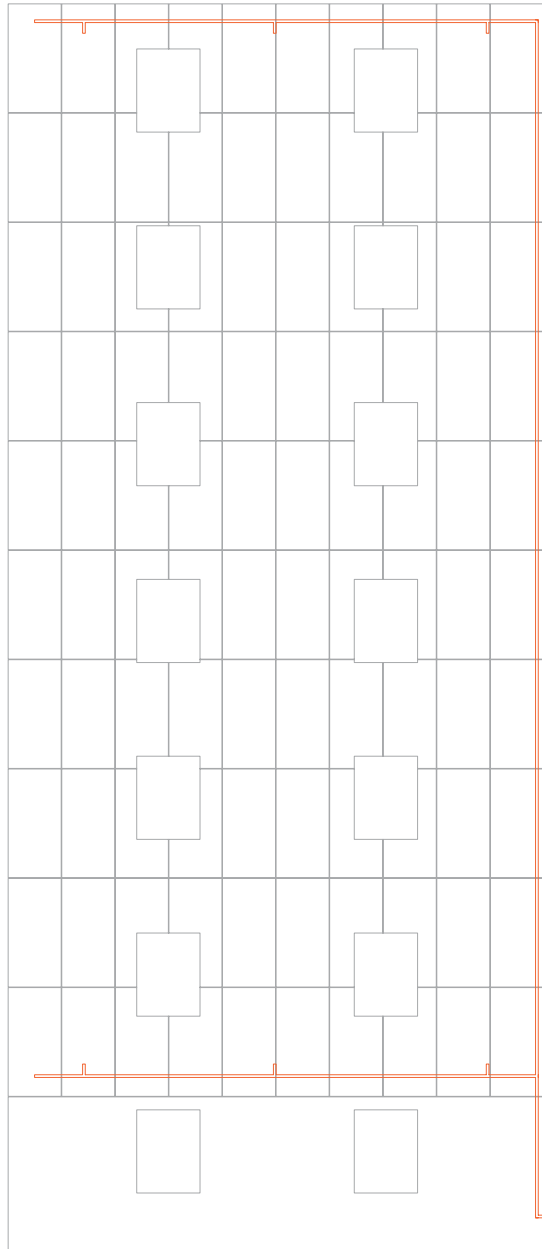
18 strings of 10 panels with one building penetration holes (Conduit size 3")

**PROJECT SOLAR EQUIPMENT:**

One AC Panelboard 200A 240V, two 200A 240V disconnect switches (One could be replaced with breaker inside the main building switchboard if available)

# 50kW SYSTEM WIRING LAYOUT: HOME RUN TO THE BUILDING BASEMENT

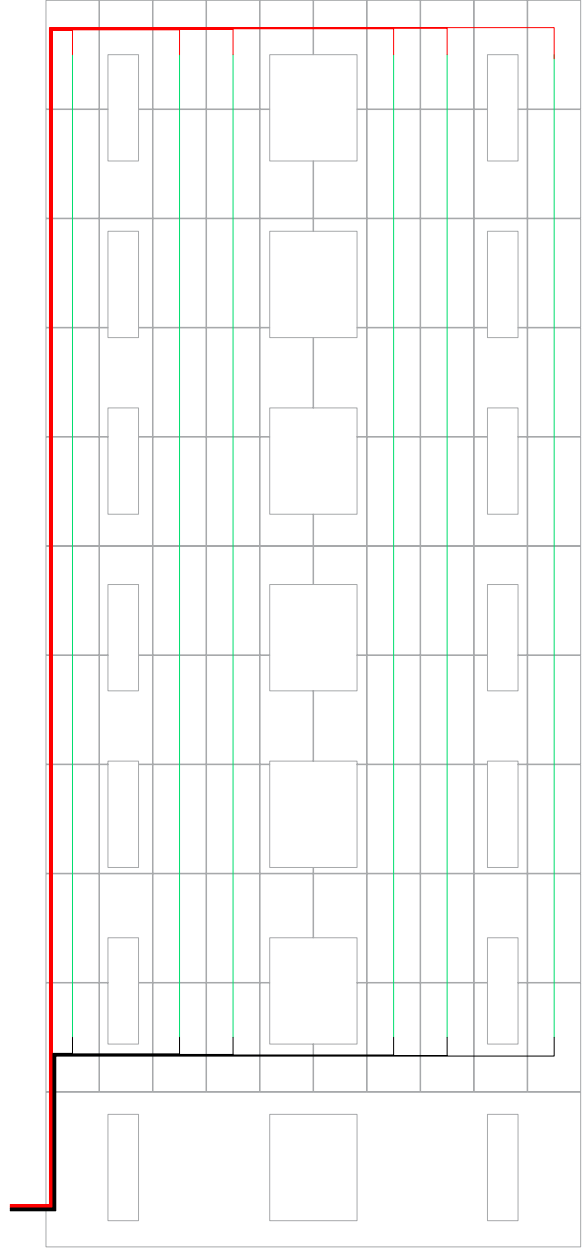
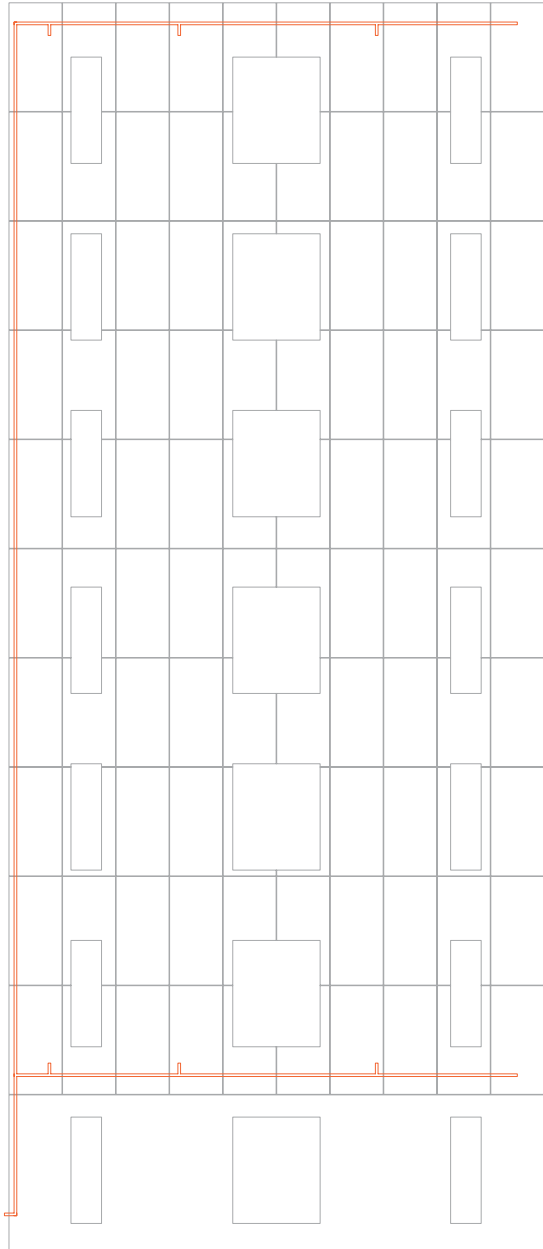
## EAST ELEVATION



- LINE COLOUR REFERENCE
- Building & solar panels layout
  - Conduit layout
  - Electrical strings
  - Home run wiring

# 50kW SYSTEM WIRING LAYOUT: HOME RUN TO THE BUILDING BASEMENT

## WEST ELEVATION



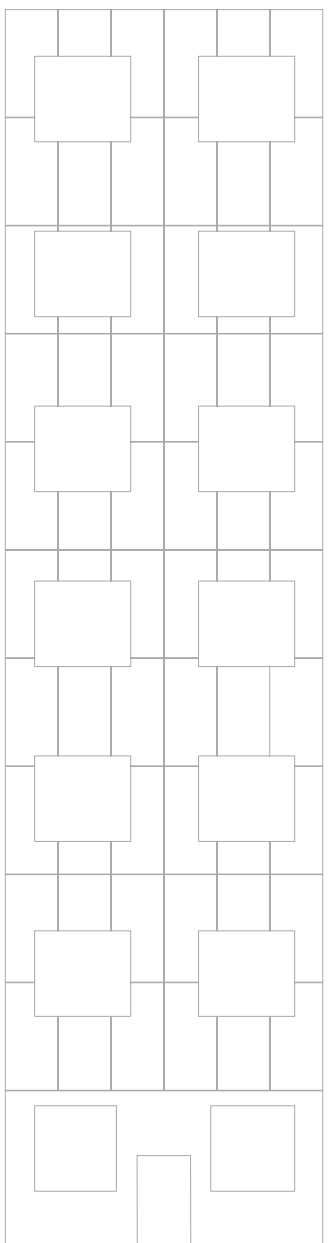
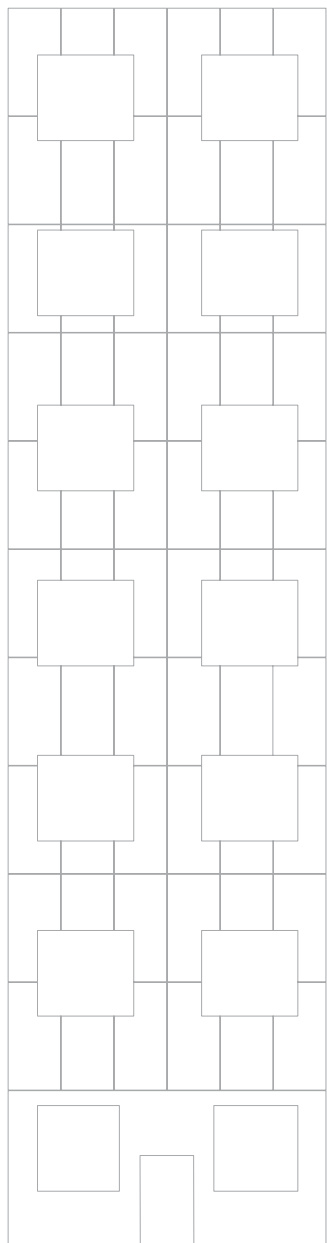
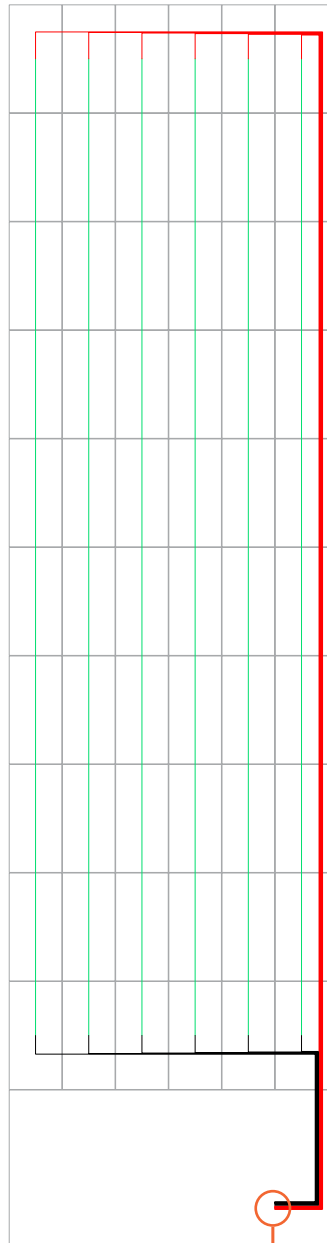
### LINE COLOUR REFERENCE

- Building & solar panels layout
- Conduit layout
- Electrical strings
- Home run wiring

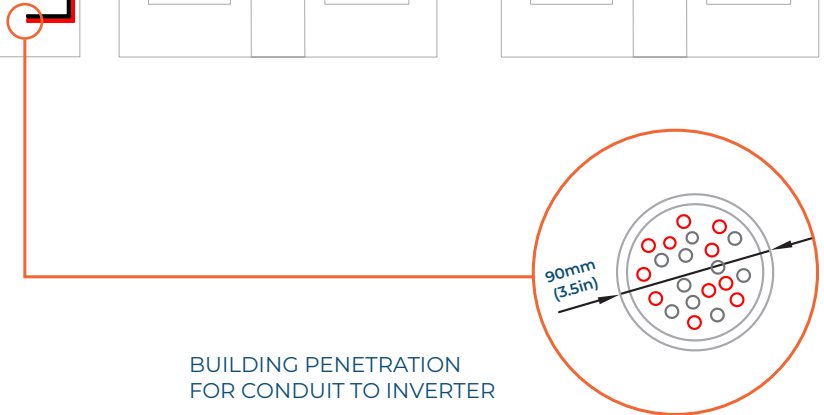
# 50kW SYSTEM WIRING LAYOUT: HOME RUN TO THE BUILDING BASEMENT

## NORTH ELEVATION

## SOUTH ELEVATION

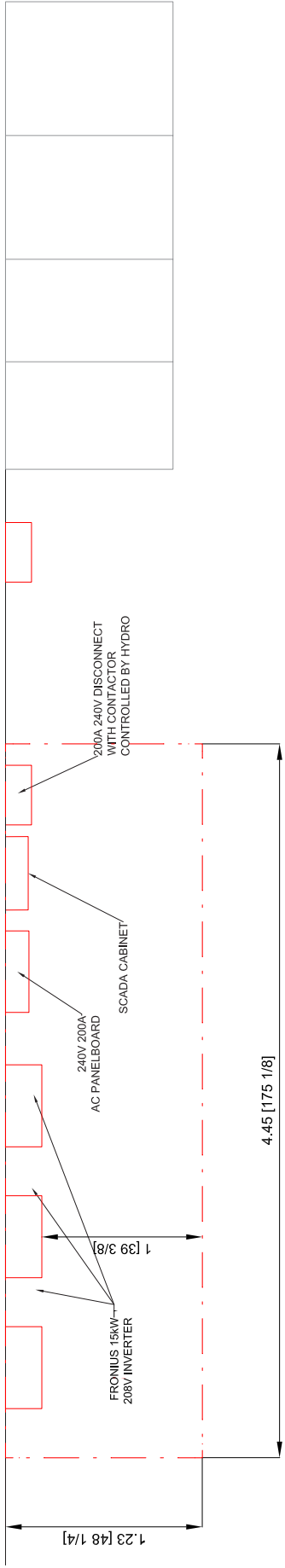


- LINE COLOUR REFERENCE
- Building & solar panels layout
  - Conduit layout
  - Electrical strings
  - Home run wiring



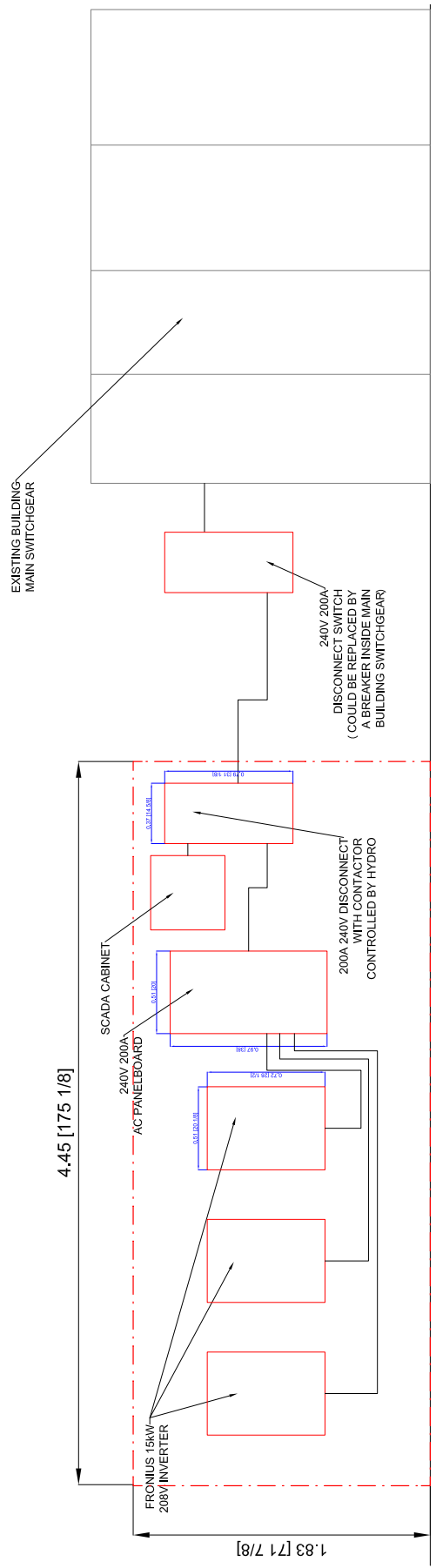
50kW SYSTEM WIRING LAYOUT: HOME RUN TO THE BUILDING BASEMENT

TOP VIEW



Note: Working area is 1m (39.37in) in front of solar equipments as per electrical code.

FRONT VIEW







SHIFTING THE LIMITS

# FRONIUS SYMO



/ Field serviceable



/ SnapINverter mounting system



/ Wireless monitoring



/ Design flexibility



/ Arc Fault Circuit Interruption



Boasting power categories from 10 to 24 kW, the transformerless Fronius Symo is the ideal compact three-phase inverter for commercial applications. Its dual maximum power point tracking, high maximum system voltage, wide input voltage range and unrestricted use indoors and out, ensures maximum flexibility in PV system design. As a member of the new SnapINverter family, the Fronius Symo features the SnapINverter mounting system, allowing for secure and convenient installation and field servicing.

Industry-leading features now come standard with the Fronius Symo, including: arc fault protection, integrated wireless monitoring, and SunSpec Modbus interfaces for seamless monitoring and datalogging via Fronius' online and mobile platform, Fronius Solar.web. This makes the Fronius Symo one of the most communicative, efficient and streamlined inverters on the market.

## TECHNICAL DATA FRONIUS SYMO, ALL SIZES

GENERAL DATA	STANDARD WITH ALL FRONIUS SYMO MODELS
Dimensions (width x height x depth)	20.1 x 28.5 x 8.9 in. / 51.1 x 72.4 x 22.6 cm
Degree of protection	NEMA 4X
Night time consumption	< 1 W
Inverter topology	Transformerless
Cooling	Variable speed fan
Installation	Indoor and outdoor installation
Ambient operating temperature range	-40 F to 140 F (-40 to 60 C)
Permitted humidity	0 - 100 % (non-condensing)
DC connection terminals	6 x DC+ and 6 x DC- screw terminals for copper (solid / stranded / fine stranded) or aluminum (solid / stranded)
AC connection terminals	Screw terminals 14-6 AWG
Certificates and compliance with standards (Except Symo 15.0 208 V)	UL 1741-2010, UL1998 (for functions: AFCI and isolation monitoring), IEEE 1547-2003, IEEE 1547.1-2008, ANSI/IEEE C62.41, FCC Part 15 A & B, NEC Article 690, C22. 2 No. 107.1-01 (September 2001), UL1699B Issue 2 -2013, CSA TIL M-07 Issue 1 -2013
Certificates and compliance with standards (Symo 15.0 208 V)	UL 1741-2015, UL1998 (for functions: AFCI, RCMU and isolation monitoring), IEEE 1547-2003, IEEE 1547.1-2003, ANSI/IEEE C62.41, FCC Part 15 A & B, NEC 2014 Article 690, C22. 2 No. 107.1-01 (September 2001), UL1699B Issue 2 -2013, CSA TIL M-07 Issue 1 -2013

PROTECTIVE DEVICES	STANDARD WITH ALL FRONIUS SYMO MODELS
AFCI & 2014 NEC Compliant	Yes
DC disconnect	Yes
DC reverse polarity protection	Yes
Ground Fault Protection with Isolation Monitor Interrupter	Yes

INTERFACES	AVAILABILITY	AVAILABLE WITH ALL FRONIUS SYMO MODELS
USB (A socket)	Standard	Datalogging and inverter update via USB
2 x RS422 (RJ45 socket)	Standard	Fronius Solar Net, interface protocol
Wi-Fi/Ethernet/Serial/ Datalogger and webserver	Optional	Wireless standard 802.11 b/g/n / Fronius Solar.web, SunSpec Modbus TCP, JSON / SunSpec Modbus RTU
6 inputs and 4 digital I/Os	Optional	Load management; signaling, multipurpose I/O

## TECHNICAL DATA FRONIUS SYMO (10.0-3 208/240, 12.0-3 208/240, 10.0-3 480, 12.5-3 480, 15.0-3 208)

GENERAL DATA		10.0-3 208/240	12.0-3 208/240	10.0-3 480	12.5-3 480	15.0-3 208
Weight		91.9 lbs. / 41.7 kg		76.7 lbs. / 34.8 kg		78.3 lbs. / 35.5 kg

INPUT DATA		10.0-3 208/240	12.0-3 208/240	10.0-3 480	12.5-3 480	15.0-3 208
Max. permitted PV power		15.00 kW	18.00 kW	15.00 kW	18.75 kW	19.5 kW
Max. usable input current (MPPT 1/MPPT 2)		25.0 A / 16.5 A			50.0 A	
Max. usable input current total (MPPT 1 + MPPT 2)		41.5 A				50.0 A
Max. admissible input current (MPPT 1/MPPT 2)		37.5 A / 24.8 A			75.0 A	
Max. admissible input current total (MPPT 1 + MPPT 2)		62.2 A	62.2 A	62.2 A	62.2 A	75.0 A (1 MPPT)
Integrated DC string fuse holders <i>Must be specified when ordering</i>		None	None	None	None	Integrated: 6- and 6+
MPP voltage range		300 - 500 V		300 - 800 V	350 - 800 V	325 - 850 V
Operating voltage range		200 - 600 V		200 - 1,000 V		325 - 1,000 V
Max. input voltage		600 V			1,000 V	
Nominal input voltage		208 V	350 V	N/A	N/A	325 V
		240 V	370 V	N/A	N/A	N/A
		480 V	N/A	675 V	685 V	N/A
Admissible conductor size DC		AWG 14 - AWG 6 copper direct, AWG 6 aluminium direct, AWG 4 copper or aluminium with input combiner				
Number of MPPT		2				1

OUTPUT DATA		10.0-3 208/240	12.0-3 208/240	10.0-3 480	12.5-3 480	15.0-3 208
Max. output power		208 V	9,995 VA	11,995 VA	N/A	N/A
		240 V	9,995 VA	11,995 VA	N/A	N/A
		480 V	N/A	N/A	9,995 VA	12,495 VA
Max. output fault current / Duration		43.1 A RMS / 158.4 ms	43.1 A RMS / 158.4 ms	43.1 A RMS / 158.4 ms	43.1 A RMS / 158.4 ms	67.7 A RMS / 153.0 ms
Max. continuous output current		208 V	27.7 A	33.3 A	N/A	N/A
		240 V	24.0 A	28.9 A	N/A	N/A
		480 V	N/A	N/A	12.0 A	15.0 A
Recommended OCPD/AC breaker size		208 V	35 A	45 A	N/A	N/A
		240 V	30 A	40 A	N/A	N/A
		480 V	N/A	N/A	15 A	20 A
Max. efficiency		97.0 %		97.0 %	98.1 %	98.1 %
CEC efficiency		208 V	96.5 %	96.5 %	N/A	N/A
		240 V	96.5 %	96.5 %	N/A	N/A
		480 V	N/A	N/A	96.5 %	97.0 %
Admissible conductor size AC		AWG 14 - AWG 6				
Grid connection		208 / 240 V	208 / 240 V	480 V Delta +N**		208 V
Frequency		60 Hz				
Total harmonic distortion		< 1.75 %				< 3.5%
Power factor		0 - 1 ind./cap.				

\*\*+N for sensing purposes - no current carrying conductor.

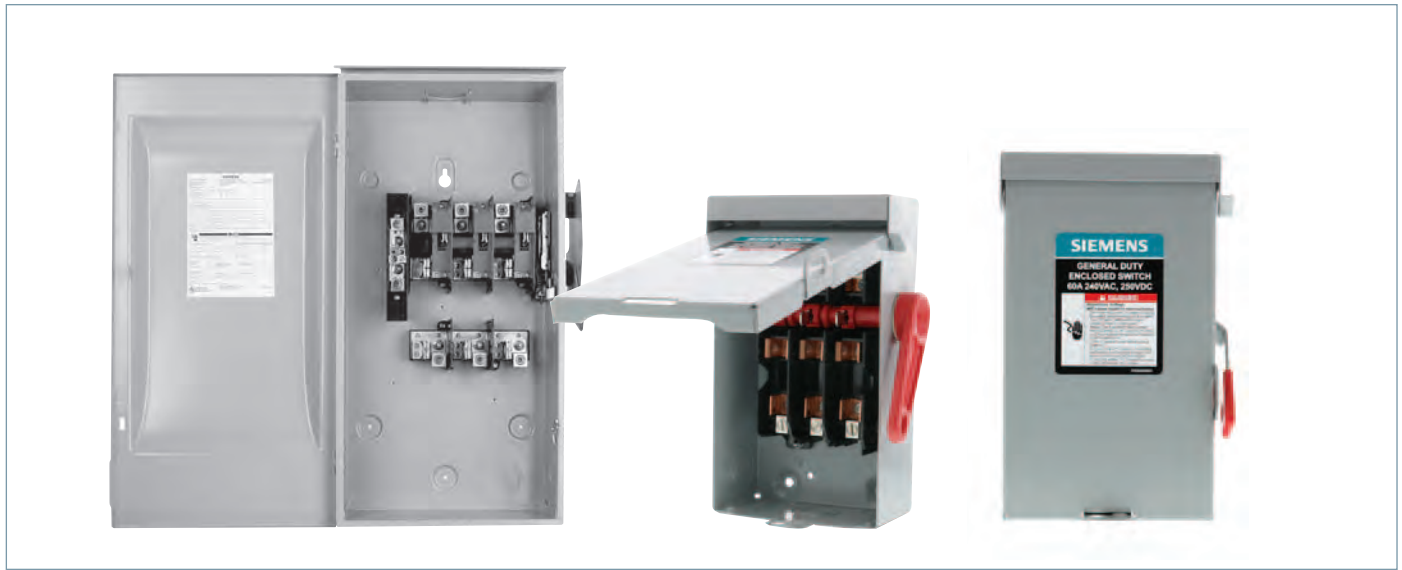
## TECHNICAL DATA FRONIUS SYMO (15.0-3 480, 17.5-3 480, 20.0-3 480, 22.7-3 480, 24.0-3 480)

GENERAL DATA		15.0-3 480	17.5-3 480	20.0-3 480	22.7-3 480	24.0-3 480
Weight		95.7 lbs. / 43.4 kg				
INPUT DATA		15.0-3 480	17.5-3 480	20.0-3 480	22.7-3 480	24.0-3 480
Max. permitted PV power		22.50 kW	26.25 kW	30.00 kW	34.09 kW	36.00 kW
Max. usable input current (MPPT 1/MPPT 2)		33.0 A / 25.0 A				
Max. usable input current total (MPPT 1 + MPPT 2)		51 A				
Max. admissible input current (MPPT 1/MPPT 2)		49.5 A / 37.5 A				
Max. admissible input current total (MPPT 1 + MPPT 2)		76.5 A	76.5 A	76.5 A	76.5 A	76.5 A
Integrated DC string fuse holders <i>Must be specified when ordering</i>		Optional: 6- and 6+	Optional: 6- and 6+	Optional: 6- and 6+	Optional: 6- and 6+	Optional: 6- and 6+
MPP voltage range		350 - 800 V	400 - 800 V	450 - 800 V	500 - 800 V	500 - 800 V
Operating voltage range		200 - 1,000 V				
Max. input voltage		1,000 V				
Nominal input voltage		208 V	N/A	N/A	N/A	N/A
		240 V	N/A	N/A	N/A	N/A
		480 V	685 V	695 V	710 V	720 V
Admissible conductor size DC		AWG 14 - AWG 6 copper direct, AWG 6 aluminium direct, AWG 4 copper or aluminium with input combiner				
Number of MPPT		2				
OUTPUT DATA		15.0-3 480	17.5-3 480	20.0-3 480	22.7-3 480	24.0-3 480
Max. output power		208 V	N/A	N/A	N/A	N/A
		240 V	N/A	N/A	N/A	N/A
		480 V	14,995 VA	17,495 VA	19,995 VA	23,995 VA
Max. output fault current / Duration		30.9 A RMS / 150.4 ms	30.9 A RMS / 150.4 ms	30.9 A RMS / 150.4 ms	30.9 A RMS / 150.4 ms	30.9 A RMS / 150.4 ms
Max. continuous output current		208 V	N/A	N/A	N/A	N/A
		240 V	N/A	N/A	N/A	N/A
		480 V	18.0 A	21.0 A	24.0 A	28.9 A
Recommended OCPD/AC breaker size		208 V	N/A	N/A	N/A	N/A
		240 V	N/A	N/A	N/A	N/A
		480 V	25 A	30 A	30 A	40 A
Max. efficiency		98.0 %				
CEC efficiency		208 V	N/A	N/A	N/A	N/A
		240 V	N/A	N/A	N/A	N/A
		480 V	97.0 %	97.5 %	97.5 %	97.5 %
Admissible conductor size AC		AWG 14 - AWG 6				
Grid connection		480 V Delta +N**				
Frequency		60 Hz				
Total harmonic distortion		< 1.75 %				
Power factor		0 - 1 ind./cap.				

\*\*+N for sensing purposes - no current carrying conductor.

# General Duty Safety Switches

Selection



4 SAFETY SWITCHES

System	Ampere Rating	Indoor — Type 1		Outdoor — Type 3R		Horsepower Rating <sup>①</sup>						
		Catalog Number	Ship Wt. (lbs.) Std. Pkg	Catalog Number	Ship Wt. (lbs.) Std. Pkg	240V AC		250 Volt DC				
						1-Phase, 2-Wire	2-Phase, 4-Wire	3-Phase, 3-Wire	Std.	Max.	Std.	Max.

## 240 Volt Fusible<sup>①</sup>

### 2-Pole, 2-Fuse, and Solid Neutral<sup>②③④</sup>

### 240 Volt AC/250 Volt DC

	30	GF221NA	30 <sup>⑦</sup>	GF221NRA <sup>⑤</sup>	30 <sup>⑦</sup>	1½	3	—	—	3	7½	5
	60	GF222NA	20 <sup>⑥</sup>	GF222NRA <sup>⑤</sup>	20 <sup>⑥</sup>	3	10	—	—	7½	15	10
	100	GF223N	23	GF223NR	23	7½	15	—	—	15	30	20
	200	GF224N	47	GF224NR	48	15	—	—	—	25	60	40

### 3-Pole, 3-Fuse, and Solid Neutral<sup>④</sup>

### 240 Volt AC/250 Volt DC

	30	GF321NA	30 <sup>⑦</sup>	GF321NRA <sup>⑤</sup>	30 <sup>⑦</sup>	1½	3	—	—	3	7½	5
	60	GF322NA	20 <sup>⑥</sup>	GF322NRA <sup>⑤</sup>	20 <sup>⑥</sup>	3	10	—	—	7½	15	10
	100	GF323N	25	GF323NR	25	7½	15	—	—	15	30	20
	200	GF324N	49	GF324NR	50	15	—	—	—	25	60	40
	400	GF325NA	94.6	GF325NRA	94.6	15	—	—	—	50	125	50
	600	GF326NA	95.6	GF326NRA	95.6	15	—	—	—	75	200	—

## 240 Volt Non-Fusible<sup>③④⑪</sup>

### 2-Pole or 3-Pole

### 240 Volt AC/250 Volt DC

	30	GNF221A	20 <sup>⑦</sup>	GNF221RA <sup>⑤</sup>	20 <sup>⑦</sup>	—	3	—	—	—	—	5
	30	GNF321A <sup>⑨</sup>	20 <sup>⑦</sup>	GNF321RA <sup>⑤⑩</sup>	20 <sup>⑦</sup>	—	3	—	—	7½	—	5
	30	GNF321LA <sup>⑩</sup>	30 <sup>⑦</sup>	GNF321RLA <sup>⑤⑩</sup>	30 <sup>⑦</sup>	—	3	—	—	7½	—	5
	60	GNF222A	30 <sup>⑦</sup>	GNF222RA <sup>⑤</sup>	30 <sup>⑦</sup>	—	10	—	—	15	—	10
	60	GNF322A	30 <sup>⑦</sup>	GNF322RA <sup>⑤</sup>	30 <sup>⑦</sup>	—	10	—	—	15	—	10
	100	GNF323	23	GNF323R	24	—	15	—	—	30	—	20
	200	GNF324	46	GNF324R	47	—	15	—	—	60	—	40
	400	GNF325A	114	Use 600V Switch — HNF365RA	—	—	15	—	—	125	—	50
	600	GNF326A	116	Use 600V Switch — HNF366RA	—	—	15	—	—	200	—	—

① Dual horsepower ratings: Std.- applies when non-time delay fuses are installed. Max.- applies when time-delay fuses are installed.  
 ② These switches are UL-listed for application on grounded B-phase systems.  
 ③ Suitable for use on 3-phase motor loads.

④ Service entrance labeled.  
 ⑤ Has provision for ECHA type hub.  
 ⑥ 5 switches per standard package.  
 ⑦ 10 switches per standard package.  
 ⑧ Height reduced switch (45.25 rather than 56 inches in height) for use with 500MCM or smaller conductors.

⑨ Not suitable for service entrance.  
 ⑩ Indicates oversized enclosure.  
 ⑪ Internal shields for 30A to 200A switches to meet 2020 NEC 230.62 touch safe requirements for service entrance equipment can be purchased separately. See accessory section for catalog numbers.

# General and Heavy Duty Safety Switches

Dimensions

## Safety Switch Dimensions (Inches)\* & Shipping Weights

Catalog Number	Height			Width		Depth		Knockout Diagram <sup>①</sup>	Shipping Weight (lbs.)
	Box A	With Door B	With Rain Shed C	Box D	With Handle E	Box F	With Handle G		
GF221NA	8.4	8.56	—	5.08	5.44	2.93	3.96	S4	30(10)
GF221NRA	8.4	8.56	8.56	5.08	5.44	2.93	3.96	S5	30(10)
GF222NA	9.91	10.07	—	6.06	6.42	3.21	4.24	S21	20(5)
GF222NRA	9.91	10.07	10.07	6.06	6.42	3.21	4.24	S22	20(5)
GF223N	21.95	23.15	—	9.64	11.7	5.05	8.63	S10	23
GF223NR	21.95	—	23.46	9.64	11.67	5.05	8.7	S11	24
GF224N	29.9	31.07	—	14.62	16.68	6.36	10.92	S12	47
GF224NR	29.9	—	31.42	14.61	16.68	6.36	10.92	S13	48
GF225NA	45.32	45.81	—	22.4	23.404	6.94	9.93	S18	91.1
GF225NRA	45.32	45.81	—	22.4	23.404	6.94	9.93	S19	91.1
GF226NA	45.32	45.81	—	22.4	23.404	6.94	9.93	S18	95.6
GF226NRA	45.32	45.81	—	22.4	23.404	6.94	9.93	S19	95.6
GF321NA	8.4	8.56	—	5.08	5.44	2.93	3.96	S4	30(10)
GF321NRA	8.4	8.56	8.56	5.08	5.44	2.93	3.96	S5	30(10)
GF322NA	9.91	10.07	—	6.06	6.42	3.21	4.24	S21	20(5)
GF322NRA	9.91	10.07	10.07	6.06	6.42	3.21	4.24	S22	20(5)
GF323N	21.95	23.15	—	9.64	11.7	5.05	8.63	S10	25
GF323NR	21.95	—	23.46	9.64	11.67	5.05	8.7	S11	25
GF324N	29.9	31.07	—	14.62	16.68	6.36	10.92	S12	49
GF324NR	29.9	—	31.42	14.61	16.68	6.36	10.92	S13	50
GF325NA	45.32	45.81	—	22.4	23.404	6.94	9.93	S18	94.6
GF325NRA	45.32	45.81	—	22.4	23.404	6.94	9.93	S19	94.6
GF326NRA	45.32	45.81	—	22.4	23.404	6.94	9.93	S19	99.6
GF326NA	45.32	45.81	—	22.4	23.404	6.94	9.93	S18	99.6
GF326NRA	45.32	45.81	—	22.4	23.404	6.94	9.93	S19	99.6
GNF221A	6.18	6.35	—	4.2	4.56	2.88	3.93	S4	20(10)
GNF221RA	6.18	6.35	6.35	4.2	4.56	2.88	3.93	S5	20(10)
GNF321LA	8.4	8.56	—	5.08	5.43	2.93	3.95	S4	30(10)
GNF321RLA	8.4	8.56	8.56	5.08	5.43	2.93	3.95	S5	30(10)
GNF222A	8.4	8.56	—	5.08	5.43	2.93	3.95	S4	30(10)
LNF222RA	8.4	8.56	8.56	5.08	5.43	2.93	3.95	S20	30(10)
GNF222RA	8.4	8.56	8.56	5.08	5.43	2.93	3.95	S5	30(10)
GNF321A	6.18	6.35	—	4.2	4.56	2.88	3.93	S4	20(10)
GNF321RA	6.18	6.35	6.35	4.2	4.56	2.88	3.93	S5	20(10)
GNF322A	8.4	8.56	—	5.08	5.43	2.93	3.95	S4	30(10)
GNF322RA	8.4	8.56	8.56	5.08	5.43	2.93	3.95	S5	30(10)
GNF323	21.95	23.15	—	9.64	11.7	5.05	8.63	S10	23
GNF323R	21.95	—	23.46	9.64	11.67	5.05	8.7	S11	24
GNF324	29.9	31.07	—	14.62	16.68	6.36	10.92	S12	46
GNF324R	29.9	—	31.42	14.61	16.68	6.36	10.92	S13	47
GNF325A	33.47	33.96	—	22.4	23.404	6.94	9.93	S18	75
GNF326A	33.47	33.96	—	22.4	23.404	6.94	9.93	S18	77
HF221J also HF261J	14.27	17.33	—	6.65	9.02	5.32	10.46	—	13
HF221N also HF261	14.26	15.45	—	6.64	9.01	5.05	10.17	S6	12
HF221NR also HF261R	14.39	—	15.77	6.64	9.01	5.05	10.17	S8	13
HF221S also HF261S	14.27	17.33	—	6.65	9.02	5.32	10.46	—	13
HF222J also HF262J	16.22	19.31	—	9.17	11.47	5.33	10.46	—	19
HF222N also HF262	16.26	17.46	—	9.15	11.53	5.05	10.17	S16	18
HF222NR also HF262R	16.26	—	17.77	9.16	11.53	5.05	10.17	S17	19
HF222S also HF262S	16.22	19.31	—	9.17	11.47	5.33	10.46	—	19
HF223J also HF263J	21.96	23.16	—	9.65	12.02	5.34	10.46	—	24
HF223N also HF263	21.95	23.15	—	9.64	12.01	5.05	10.17	S10	23
HF223NR also HF263R	21.95	—	23.46	9.64	11.97	5.05	10.17	S11	24

\*For inches / millimeters conversion, multiply inches by 25.4.

① Knocks not provided on Type 4 / 4X and 12 or in 800 & 1200A switches.

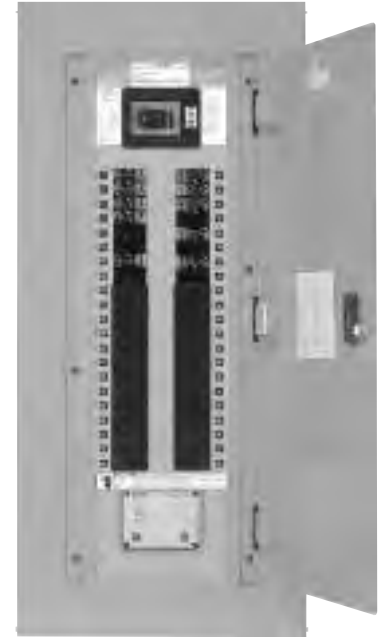
# Application

## Type P1 Panelboards

**Table P1-3 – Main Breaker Panel Size Selector**

Maximum Ampere Rating	Main Breaker Types	Max. No. of Poles	Dimensions in Inches (mm)		
			Unit Space A	Box Height B	Weight In lbs. (kg)
100	BL, BLH	18 30 42	9 (229)	32 (813)	105 (48)
	HBL		15 (381)	38 (965)	120 (55)
	BQD		21 (533)	44 (1118)	135 (61)
125	NGB		9 (229)	32 (813)	110 (50)
			15 (381)	38 (965)	125 (57)
			21 (533)	44 (1118)	140 (64)
225	ED2, ED4, ED6, HED4, HED6		9 (229)	32 (813)	110 (50)
			15 (381)	38 (965)	125 (57)
			21 (533)	44 (1118)	140 (64)
250	QJ2		9 (229)	32 (813)	110 (50)
	QJH2		15 (381)	38 (965)	125 (57)
	QJ2-H		21 (533)	44 (1118)	140 (64)
250	FXD6	9 (229)	32 (813)	115 (52)	
	FD6	15 (381)	38 (965)	130 (59)	
	HFD6, HFXD6	21 (533)	44 (1118)	145 (66)	
≤ 250	MLO	9 (229)	32 (813)	115 (52)	
		15 (381)	38 (365)	125 (57)	
		21 (533)	44 (1118)	135 (61)	
400	JD6, JXD6	18 30 42	9 (229)	56 (1422)	172 (78)
	HJD6		15 (381)	62 (1575)	190 (86)
	HJXD6		21 (533)	68 (1727)	208 (95)
			9 (229)	56 (1422)	115 (52)
	MLO		15 (381)	62 (1575)	130 (59)
			21 (533)	68 (1722)	145 (66)

**Note:** Main breakers use breaker connectors. For sizes, see breaker connector chart. 400 amp main breaker panel has wire bending space for 600 kcmil cables as standard. Use 750 Kcmil lug if 600 Kcmil cable is to be used.


**Table P1-4 – Main Breaker Selection**

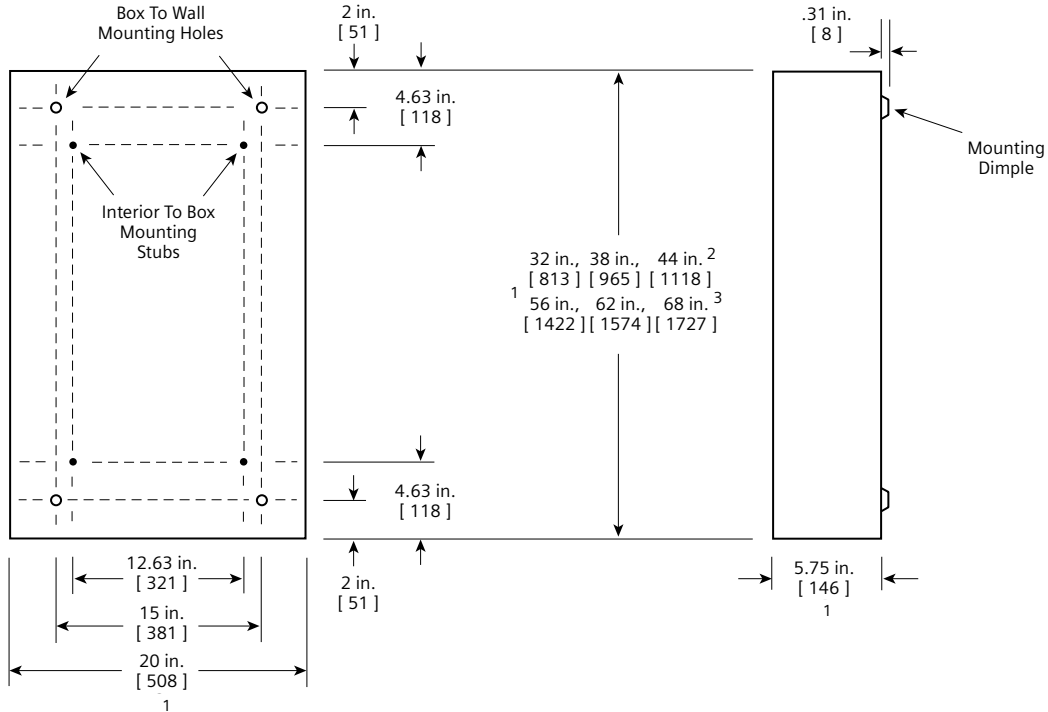
Ampere Rating	Breaker Type	Max. IR (kA) at		Additional Trip Values
		240V AC	480/277V AC	
100	BL (STD)	10	—	15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100
	BLH	22	—	15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100
	HBL	65	—	15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100
	BQD	65	14	15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100
125	NGB (STD)	100	25	50, 60, 70, 80, 90, 100, 110, 125
	ED4 (STD)	65	25	50, 60, 70, 80, 90, 100, 110, 125
	HED4	100	42	50, 60, 70, 80, 90, 100, 110, 125
225	QJ2 (STD)	10	—	60, 70, 80, 90, 100, 110, 125, 150, 175, 200, 225
	QJH2	22	—	60, 70, 80, 90, 100, 110, 125, 150, 175, 200, 225
	QJ2-H	42	—	60, 70, 80, 90, 100, 110, 125, 150, 175, 200, 225
	HQJ2H	100	—	60, 70, 80, 90, 100, 110, 125, 150, 175, 200, 225
250	FXD6 (STD)	65	35	70, 80, 90, 100, 110, 125, 150, 175, 200, 225, 250
	FD6	65	35	70, 80, 90, 100, 110, 125, 150, 175, 200, 225, 250
	HFD6	100	65	70, 80, 90, 100, 150, 175, 200, 225, 250
	HFXD6	100	65	70, 80, 90, 100, 110, 125, 150, 175, 200, 225, 250
400	JXD6 (STD)	65	35	200, 225, 250, 300, 350, 400
	JD6	65	35	200, 225, 250, 300, 350, 400
	HJD6	100	65	200, 225, 250, 300, 350, 400
	HJXD6	100	65	200, 225, 250, 300, 350, 400

# Dimensions

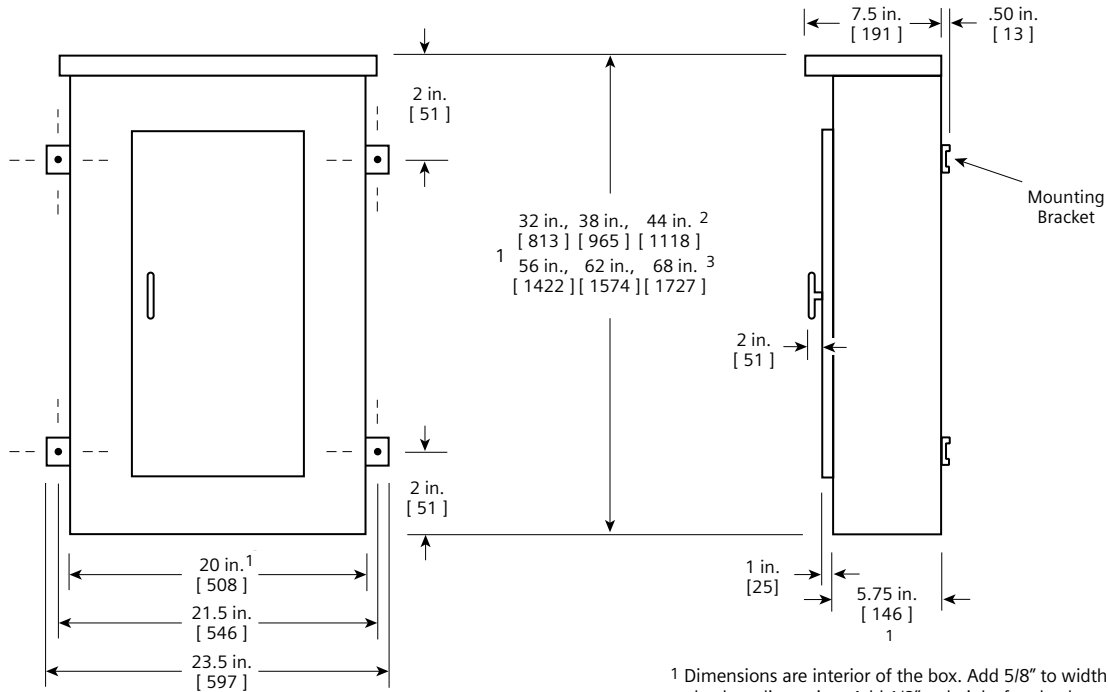
## Type P1 Panelboards

### Type 1 Box

Box is symmetrical



### Type 3R and 3R/12 Box



<sup>1</sup> Dimensions are interior of the box. Add 5/8" to width for absolute dimension. Add 1/8" to height for absolute dimension.

<sup>2</sup> 250 Amp panel.

<sup>3</sup> 400 Amp panel.

Dimensions shown in inches and millimeters [ ].