



APS 400
Low Voltage (<600V) 100 to 400 Amperes

APS 600
Low Voltage (<600V) 400 to 600 Amperes

Single Generator Soft Load Automatic Paralleling Switch

Highlights

UL-508A Listed Device

Multiple Control Modes

Direct Engine Control & Monitoring

Integrated Multifunction Generator Power Control

Load/No Load Test

Complete Set of Protective Relays

System Start Options:

- Auto-schedule (time-based)
- Remote
- Local operator interface

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General Description

The APS 400/600 is designed to be used as a peak shaving control system that allows the generator to operate only when the utility is available. In this mode, a generator operates in parallel with the utility, with both sources of power connected to the load continuously.

The APS 400/600 is a fully integrated control, display and circuit breaker panel. The generator synchronizes to the power source in a continuous parallel mode, supplementing utility power to perform a peak shaving operation.

Applications

Peak Shaving

Utilities typically determine customers' annual demand rates based on the peak load they required during the previous month. In most cases, the peak load for a facility lasts for only short periods of time and represents a fraction of the facility's power requirements. As the required load for a facility climbs, the cost of the delivered power climbs, often at 10 to 20

Paralleling & Transfer Switch System Capabilities

Switch Model	ATS			
	APS			
Application	Peak Shaving	Export-to-Utility	Interruptible Rate	Emergency Standby
Control Mode	Base Load	Import-Export	Closed Transition (to isochronous)	Open Transition (to isochronous)
	System may load shed automatically, if necessary			
Generator Status	Generator is Parallel w/Utility (Closed Transition)		Generator is Isolated from Utility (Open Transition) or Generator is Parallel w/Utility (Closed Transition)	

Figure 2 - Single Unit Systems - Classification Chart

times the non-peak rate. By operating a generator in parallel with the utility during periods of high demand and allowing the generator to supply a fixed portion of the facility load, operators can realize significant savings on utility bills.

Control Modes

The APS 400/600 has the capability to operate in any of the following modes:

Base Load

In Base Load, the generator is operating in parallel with the utility. Generator output remains constant and utility power fluctuates to supply the difference. If generator output exceeds the system load requirements, the excess power may be exported to the utility.

Sequence of Operations

A Generator section contains a paralleling circuit breaker, Emergency Stop Push button, Digital Display, Alarm Light (Horn is Optional), Best Battery Diodes, and a GPC. The paralleling breaker provides 51 protection. The GPC provides generator 32, 81 O/U, 27/59, 47N,

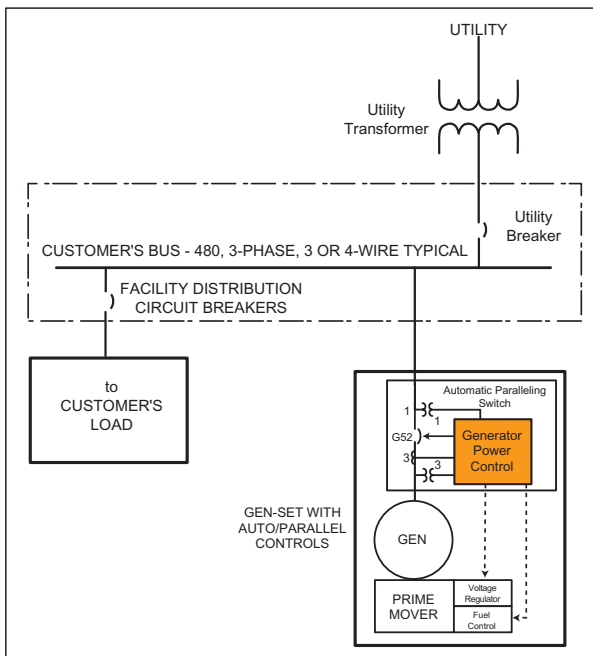


Figure 1 - Oneline - Automatic Paralleling Switch

46N, 25, and 40 protections. All other protection is optional.

Auto Mode

Auto mode and whether to Baseload or Load Share, may be selected via the Display through the Main Menu Control Functions selection.

In Auto Mode a start can be initiated by a Remote Start contact. When a start command has been issued the Engine Start Warning signal will turn on for the Engine Start Warning time (adjustable on the Display). After the Engine Start Warning time has elapsed a Start Gens signal will be sent to the engine controller and once the generator reaches 95% of rated frequency and voltage the synchronizer will be turned on.

A Fail to Start alarm will occur if the generator fails to reach rated frequency and voltage within an adjustable (Fail To Start entry on Display) amount of time. The synchronizer will match the generator frequency, phase and voltage before closing to a live bus. Once the generator is on-line it will smoothly ramp to the Load Sharing or Base Load set point, determined by the Load mode configuration entered on the display.

Test Mode

Test mode may be selected via the Display through the Main Menu Control Functions, or if the front panel selector switch option is chosen, by switching to Test on the front panel switch.

Selecting Test will initiate a start. The Engine Start Warning signal will turn on for the Engine Start Warning time (adjustable on the Display). Once the Engine Start Warning time has elapsed, a Start Gens signal will be sent to the engine controller. Once the generator reaches 95% of rated frequency and voltage the synchronizer will be enabled.

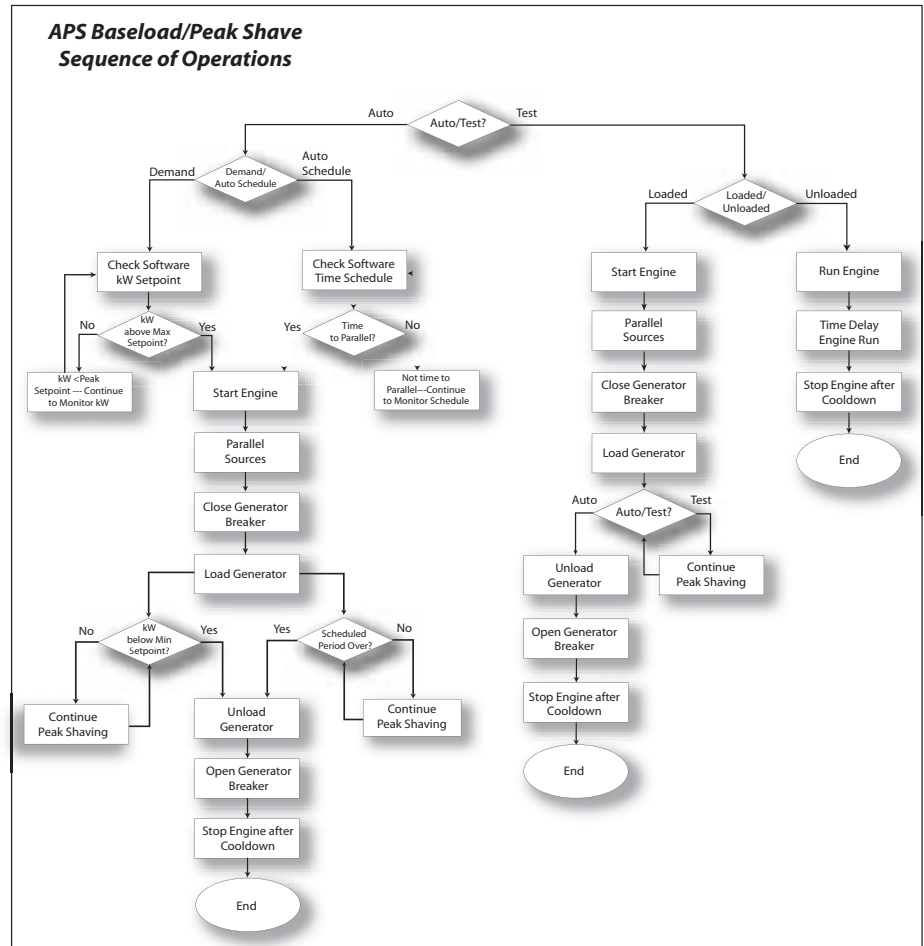


Figure 3 - Sequence of Operations - Baseload/Peak Shave

A Fail to Start alarm will occur if the generator fails to reach rated frequency and voltage within an adjustable (Fail To Start entry on Display) amount of time.

Test - No Load

Once the synchronizer is enabled it will match the generator frequency, phase and voltage. The synchronizer will not close the generator breaker, but will hold the generator frequency, phase and voltage in sync with the load side of the breaker. Once TEST is de-selected the Start Gens signal will be removed.

Test - Loaded

Once the synchronizer is enabled it will match the generator frequency, phase and voltage to the load side of the breaker before closing the generator breaker to a live bus.



Once the generator is on-line it will smoothly ramp to the Load Sharing or Base Load set point, determined by the Load mode configuration entered on the display. De-selecting the Test mode while in the Test loaded state will smoothly unload the generator to the unload trip level set point, then open the generator breaker, Once generator breaker is opened, the Start Gens signal will be removed.

Shutdowns

Any Shutdown or an E-Stop will immediately trip the generator breaker and remove the Start Gens signal. Typically, the engine controller will have its own cool down and protection functions. If an engine control package option has been installed, please refer to the engine control package sequence of operations.

Control power

The 24 VDC is fed to a Vicor DC to DC converter to provide 24VDC to the best-battery voting circuit. The voting circuit also looks at the Engine Battery 24 VDC to determine which is suitable for the control power. KWS backup battery & charger are optional.

Front Panel Control Switches

E-Stop

Pressing the E-Stop will trip the breaker open and issue a shutdown to the engine.

Generator Display

The APS uses the PanelMate D500 to display all metered values and allow operators to modify relay set points and configure system parameters. It also serves as the primary interface for generator, power and control alarms. The PanelMate D500 features a 4-line, 20 character vacuum fluorescent display and status LEDs. Operator input is through a membrane keypad with both function and numeric keys (see the PanelMate Menu Tree).

The Oblong buttons below the display are Soft key Functions. Soft key functions will be programmed and active only when that screen is currently being displayed.

Left/Right, Next/Prev and Keypad

Used to navigate through the display menus. Pressing **Home** will return the display to the main menu.

ALARMS LED



Figure 4 - PanelMate 500 4-Line Display

Indicate a common alarm (such as Engine Shutdown, E-Stop, Reverse Power etc.). Pressing the ALARMS button will display a list of the active alarms.

RESET button

Used to reset the alarms. The alarms will not be reset if the alarm is still active. Selecting Auto mode also resets the alarms.

SAVE CONFIGS button

This button must be pressed when changes are made through the PanelMate to save changed set points or manual entries to Flash memory. If it isn't pressed, cycling power will return the values to their default settings.

ACK-SILENCE button

Used to acknowledge the alarm and silence the horn (optional) without resetting the alarm.

LOGOUT button

Used to exit and deny access to the configuration screen (password protected) once all entries are made.

ENGINE RUNNING LED

Indicates that the engine is actually running. The button is not active.

START LED

Indicates that a start signal is being issued to the generator. The button is not active.

MODE button

Returns the display to the proper screen for selecting mode of operation. The LED on the MODE button will be red when Off, yellow in Auto and green in Test.

Generator System Alarms

Alarms are shown on the display panel on the door of the switchgear. All alarm conditions will trip the switchgear breaker if it is closed and then run the engine for the cool down period. If the engine controller has an engine fault, it will shutdown the engine. The Generator will not be able to parallel again until all alarms are reset.

Standard Engine Interface

The standard ATS is designed to control engine driven generators through the GPC frequency and voltage bias analog outputs. The ranges are +/- 3.0 Vdc (4-20 mA) Frequency bias, +/- 3.0 Vdc (4-20 mA) Voltage bias, and Start control.

Components

Circuit Breakers

The molded case breaker is an enclosed contactor design tested for 100-600A applications. It is provided with a single motor operator. The motor operator is a single-direction, shaded-pole DC motor that enables circuit breaker ON, OFF, and RESET switching. Overload and

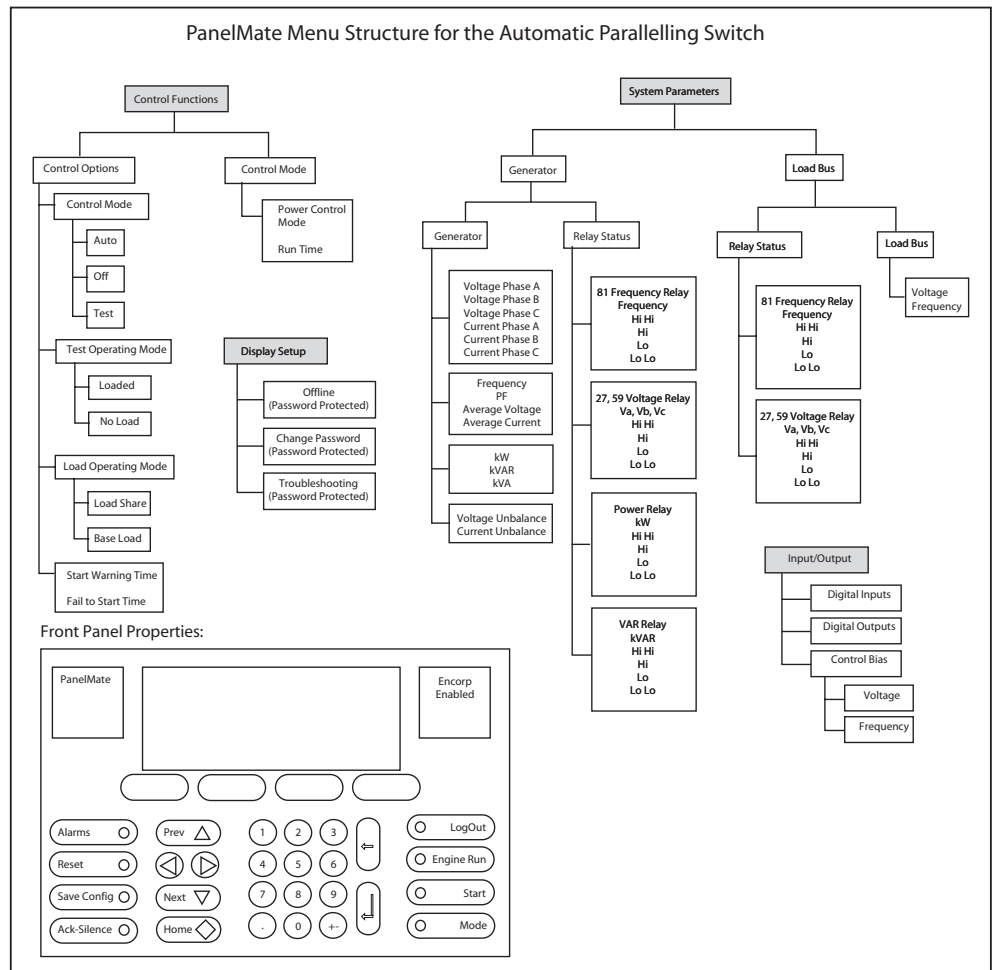


Figure 5 - PanelMate Menu Tree

short circuit protection is provided through the integrated thermal magnetic trip device.

- 100% rating
- Rated for all class loads
- Heavy duty switching and withstand ratings
- High Interrupting capability
- 3 and 4 pole configurations
- Indicators on front indicate open, closed or tripped positions

Protective Relays

Contained within the GPC are the following key generator and utility relaying and control functions:



Over/Undervoltage (27/59)

The Over/Undervoltage (27/59) relay applies to the generator set and utility opening the generator circuit breaker if voltage deviates from assigned set points.

Over/Underfrequency (81)

The Over/Underfrequency (81) relay applies to the generator set and utility opening the generator circuit breaker if voltage deviates from assigned set points.

Reverse Power (32R -Gen)

The Reverse Power (32R-Gen) relay provides reverse-power protection for the generator set by opening the genset breaker if reverse power (kW or VAR) exceeds an assigned set point.

Negative Phase Sequence, Current (46N)

The Negative Phase Sequence, Current (46N) relay provides protection for the load by opening the breaker when the polyphase currents are of reverse-phase sequence, or when the polyphase currents are unbalanced or contain negative phase sequence components above an assigned set point.

Negative Phase Sequence, Voltage (47N)

The Negative Phase Sequence, Voltage (47N) relay provides protection for the load by opening the breaker on an assigned set point of polyphase voltage in the desired phase sequence.

Enclosure

Cable Connectors

Generator, utility and load cables are connected to the bus using copper and aluminum set-screw type cable lugs.

Structures

The enclosure is constructed of formed 11-gauge steel with a single point latch hinged door. Cable entry is accomplished from either top or bottom.

Finish

Sheet-metal parts are cleaned and phosphatized prior to painting. Parts are painted ANSI No. 49 gray.

Environmental Requirements

Table 1 - Environmental Requirements

NEMA Type1	NEMA Type3R:
Ambient temperature rating of 0° to 40° C (32° to 104° F)	Ambient temperature rating of 0° to 40° C (32° to 104° F)

Available Optional Accessories

Alarm Horn

The Alarm Horn will sound when an alarm condition becomes active. Pressing the ACK-SILENCE button on the display will silence the horn until another alarm condition becomes active.

Engine Monitoring Discrete Option #1

Consists of seven (7) discrete inputs for alarm monitoring. The alarm inputs are:

1. Low Oil Pressure
2. High Water Temp
3. Engine Overspeed
4. Overcrank
5. Low Fuel
6. Battery Voltage
7. and 1 user defined input.

The low oil pressure alarm is only active once the rated voltage and frequency are present. All inputs are normally open. Closing an input will indicate the alarm condition. Alarms are latched in the GPC and may be reset via the display once the alarm condition has been corrected. Alarms will be indicated on the digital display, illuminate the alarm light and sound the horn (optional).

Engine Monitoring Analog Option

Consists of four (4) analog inputs for signal monitoring and alarming. Three have been pre-assigned and are:

1. Oil Pressure
2. Water Temperature
3. Battery Voltage (Range will be 0-30 VDC.)

All inputs are ± 10Vdc and the units are scalable via the display. Each input has an alarm, hysteresis and direction set points (adjustable via the Display). Alarms are latched in the GPC and may be reset via the display once the alarm condition has been corrected. Alarms will be indicated on the digital display, illuminate the alarm light, and sound the horn (optional).

NOTE: Low oil pressure and high water temperature alarms are considered shutdown events, and will open the generator breaker and remove the Start Gens signal output. The low oil pressure alarm is only active once the rated voltage and frequency are present.

Engine Start and Stop Control Option

The GPC interfaces with engine controls through two discrete outputs for:

1. Starter and Fuel Inlet control
2. Starter Control Signal

and five (5) discrete inputs for alarm monitoring. The alarm inputs are:

1. Low Oil Pressure
2. High Water Temp
3. Low Battery Voltage
4. Low Fuel Pressure
5. and 1 undefined input.

All inputs are normally open. Closing an input will indicate the alarm condition.

Alarms are latched in the GPC and may be reset via the display once the alarm condition has been corrected. Alarms will be indicated on the digital display, illuminate the alarm light and sound the horn (optional). One magnetic pickup input is used for overspeed and crank disconnect speed sensing.

Uninterruptible Power Supply & Communications Processor Module (Mounted Separately)

An Uninterruptible Power Supply allows the Communications Processor Module (CPM) to remain online continuously during periods when the utility is unavailable and

the generator is in **gen start delay** and **stable delay** prior to an **open transfer** operation.

The CPM is an industrial grade computer that interfaces with the GPC and provides remote communications capability through dialup or LAN connections. The CPM runs various servers which allow remote users to control and configure the GPC. Additionally, the CPM is used for data logging, trending analysis, alarm notification, and other important communication tasks.

The UPS and CPM are mounted outside the ATS in an adjacent cabinet or other appropriate mounting structure.

Load Shed – Load Add Option

Load Shedding - Consists of a discrete output Acromag to shed non-priority load, with the remaining connected load sized for a single generator. The control system will sense a bus under-frequency condition and shed load (up to four breakers) until the frequency returns and stabilizes. On loss of utility the Load Shed output will be active until the generator is online, or the utility returns and the utility stable time has elapsed. Loads should be prioritized with lower priority loads being shed first.

Load Adding - Consists of a discrete output Acromag to add load as generating capacity is added to the bus. The control system will continually monitor the frequency to ensure that additional load does not affect frequency. The generator and discrete load has a user defined max load kW value assigned to it so the system can determine

Name	Description
Alarm Horn	Audible horn which activates upon selected alarm conditions.
Engine Monitor 1	Includes one (1) discrete input module. Monitors dry contacts for oil pressure, water temperature, over speed, over crank, low fuel, and Battery charger failure.
Analog Engine Monitor	Includes one (1) analog input module. Monitors resistive senders for oil pressure, water temperature, and engine battery voltage.
Engine Control	Provides outputs for fuel and starter. Includes speed switch for crank cutout and over speed protection.
UPS & CPM	Uninterruptible Power Supply and Communications Processor Module for remote communications capability
Load Shed / Load Add	Includes one (1) discrete input and one (1) discrete output module. Controls up to four (4) electrically actuated breakers.
7 Day Event Timer	Timer used for auto starts of equipment
Engine Monitor 2	Consists of Engine Monitor 1, and an additional eight (8) undefined, discrete inputs for alarm monitoring.
Load Share/Base load Switch	2 position mode selector switch

Table 2 - Available APS 400 & 600 Options



if a particular load can be added to the bus. Shed loads (up to four breakers) will be re-added to the bus in discrete load increments in a prioritized manner. The load with highest priority being added first, until the bus has reached 95% of the load capacity of the generators. All loads will be re-added to the bus after the utility has returned, the utility stable time has elapsed, and the utility breaker has closed.

This feature requires that the circuit breakers controlling the loads to be shed or added are electrically actuated.

Seven day event timer

The event timer has a large display and uses push-button operation. It can program six different events per week. It can also program each day individually or a block of days.

Engine Monitoring Discrete Option #2

Consists of Engine Monitoring Option #1, and an additional eight (8) undefined, discrete inputs for alarm monitoring. All inputs are normally open inputs, closing an input will indicate the alarm condition. Alarms are latched in the GPC and may be reset via the display once the alarm condition has been corrected. Alarms will be indicated on the digital display, illuminate the alarm light, and sound the horn (optional).

Technical Specifications

Table 3 - APS 400 & 600 Specifications

100-600 Amperes
3- & 4-pole
208-600 Vac
100 KAIC @ 240 Vac
65 KAIC @ 480 Vac
25 KAIC @ 600 Vac
Molded Case Construction
Available in Type 1, or 3R, enclosures

Baseload/Load Share Switch

This switch is normally programmed into the Panel Mate Display as Softkeys. The Baseload/Load Share switch controls the functionality of the system. In "Baseload", the system maintains a fixed value of kW, determined by an adjustable set point and allows the Utility to fluctuate. The set point can be changed through the PanelMate. The "Load Share" option will be used when two or more generators are paralleled. They will all share the load equally, depending on their rated capacity.

Dimensions

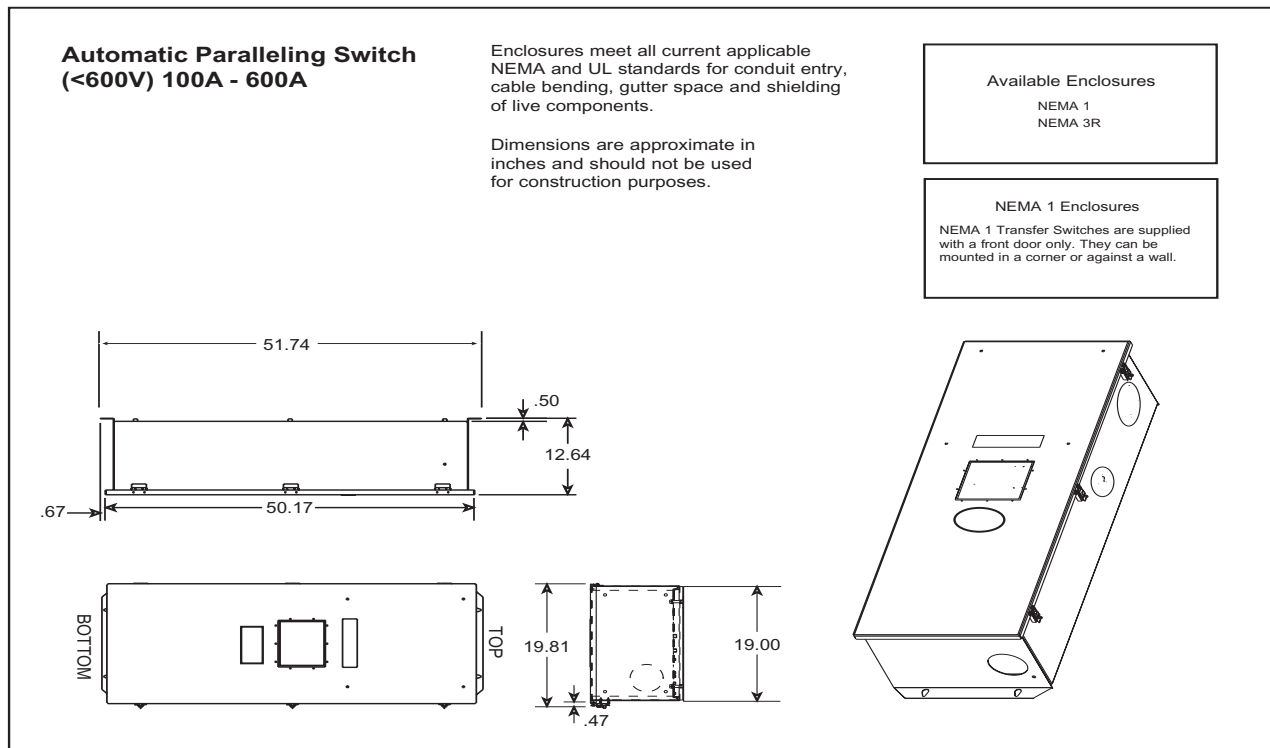


Figure 6 - APS 600 Dimensions



