ADVANCED POWER TECHNOLOGIES

Switchgear Master Control Panel

MCP-Series
Master Control Systems
Solutions Brochure

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SAFE SMART SERVICEABLE SWITCHGEAR & ENGINEERED POWER SYSTEM SOLUTIONS

MADE IN THE USA

ALN: 550 Rev. 04

MCP-Series Applications




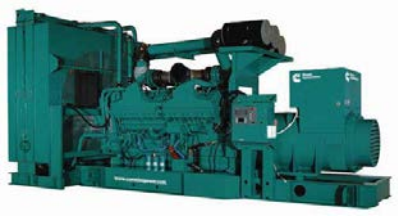

Figure 1: Power Producing Sources that are controlled by MMCP

Microgrid Master Control Panel (MMCP)

- APT understands the need to have reliable monitoring and control of multiple renewable energy sources
- The Microgrid Master Control Panel (MMCP) provides real time integrated control of power production and power consumption for large scale (500kW – 50 MW) microgrids
  - This involves the aggregation of control for various distributed energy resources (DER) in both grid-connected and grid-isolated modes of operation, instantaneous load matching, and active control of microgrid stability
- MMCP provides optimization of use of the diverse DER in various modes of operation, as well as automatic islanding and active synchronized re-connection of the microgrid loads to the utility power grid.
- DER and Energy Storage technologies supported:
  - Natural gas reciprocating engines
  - Natural gas turbines
  - Biogas and Landfill gas reciprocating engines
  - Biogas and Landfill gas turbines
  - Micro-turbines
  - Battery Storage
  - Solar PV array generation
  - Fuel cell generated power
  - Hydro power
  - Wind
  - Battery Storage Driven Generators
  - Other less common DER and Energy Storage such as combined cycle steam generators, flywheel, geothermal, etc.

APT Turnkey Microgrid Solutions

Start Building the Smart Communities of Tomorrow… Today with APT's Microgrid Control & Power Management Technologies

Figure 2: APT Microgrid Equipment & Control Ring Bus System

General MCP-Series Features

Figure 3: ArCryptM-Series Custom Arc Resistant Switchgear with Master Control Panel

Figure 4: Automatic Paralleling Switchgear Control Panel

Figure 5: Master Control Panel displaying APTView Trending Diagram

Isolated or Line-up Integrated Switchgear Master Control Panel

- One of our most popular items on our switchgear master control systems lineup
- Operator Interface:
  - 20” Color touchscreen
  - Microsoft Windows
  - APT industrial computer (AiPC) equipped with the powerful APTView Control & Monitoring Software
  - Provides SCADA graphical user interface (GUI) for control and monitoring of the MCP functions
  - Allows MCP functions to provide the following:
    - System One-Line
    - Storage of all the monitored data every minute with date and time stamp
    - Emails can be sent upon any alarm condition
    - Free license remote monitoring and remote-control software
    - Capability of remote system troubleshooting
    - Adjustable setpoints and modes of operation to allow user to adopt the system operation to changing needs
- Available in NEMA 1 indoor or NEMA 3R outdoor construction
- Operation Overview:
  - MCP-Series Master Control Panel provides native interfaces to APT Automatic Paralleling Switchgear Control Panels, APT Master Control Panels, and most 3rd party controllers via following native interfaces:
    - Modbus TCP/IP Ethernet, Modbus RTU, or Modbus ASCI serial (RS-485/RS-232
    - Analog voltage interfaces:
      - 0-5 VDC
      - +/- 10 VDC
      - 0-3 VDC
      - 0-10 VDC
      - +/- 5 VDC<+/- 3 VDC, etc.
    - Analog current interfaces: 4-20mA, 0-20mA
    - Microprocessor controlled potentiometer
    - Digital Signals: 24VDC, 48VDC, 125VDC, 120VAC, etc.
  - Custom Interfaces to 3rd party devices are available upon request
  - APT MCP-Series provides Modbus TCP/IP Ethernet, over copper of fiber, SCADA interface to a higher level, DCS, or building management system

*Due to continued product improvement, products delivered may differ from what is pictured.
*Optional Equipment Features Are Often Shown in Most Figures.
*Option Availability Subject to Product Series.

APTView Features & Benefits

Figure 6: APTView Home Screen

Figure 7: APTView Touchscreen Human Machine Interface Cell Phone View

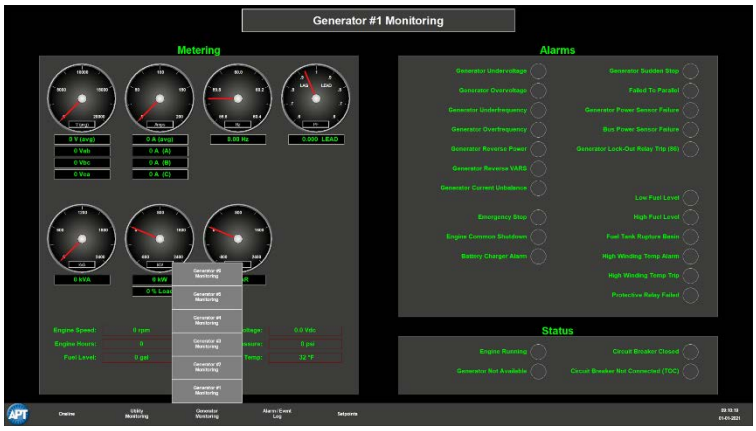

Figure 8: APTView Generator Monitoring & Menu

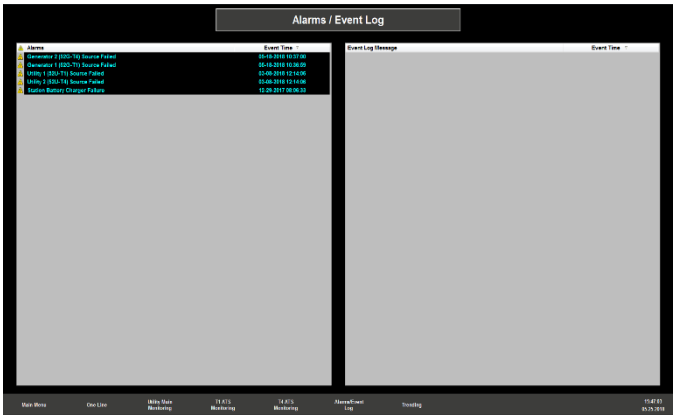

Figure 9: APTView Alarms/Event Log

What is Remote Access Switchgear Control & APTView?

- The concept of remote access switchgear control makes safety the top priority.
- It isolates switchgear operation personnel from the live components of a switchgear and allows for the control of operation from a remote location or an isolated master control station.
- Operators can have the peace of mind that they are utilizing the safest means of operating circuit breakers possible. This is done by eliminating the need for an operator to be anywhere near live or potentially live equipment.
- APTView is APT's own Supervisory Control and Data Acquisition (SCADA) system.
- It utilizes Human Machine Interface (HMI) systems to monitor and control both APT and 3rd party equipment via personal computers or your favorite web or network-connected mobile device.
    - Requires fast internet connection and Static IP.
- Emails can be sent to notify the user of any occurring alarm or event.
- All system alarms and events are logged and date/time stamped.
- Equipment operating parameters are periodically stored for future record/retrieval.
- Customer specified security features to limit access only to the people who need access for maximum security.

Switchgear Control Interface

Figure 10: Stand-alone Fully Isolated Master Control Panel (MCP) with 20" Touchscreen Human Machine Interface Screen

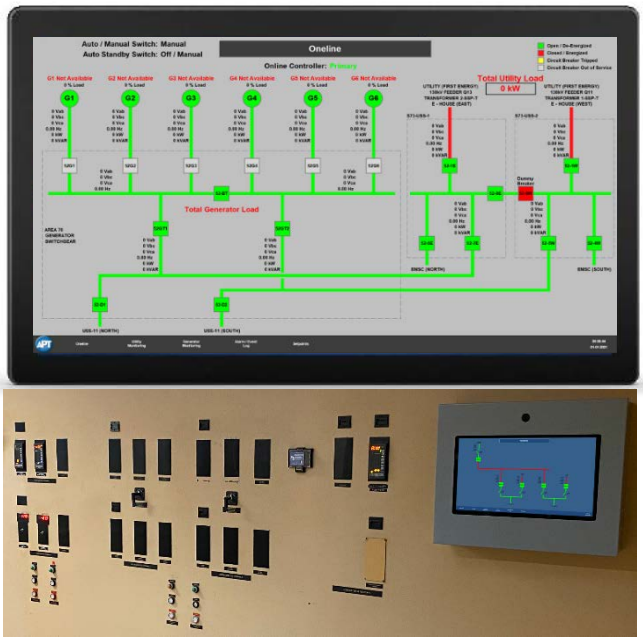

Figure 11: APTView System One-line Diagram with Industrial Personal Computer (AiPC) (top), AiPC Panel with APTView displayed on location (bottom)

Human Machine Graphical User Interface PC

- Industrial Personal Computer (AiPC)
  - Windows10 Operating System
  - Minimum 8GB of RAM
  - Minimum 128GB Solid State Drive (SSD)
  - 20" LCD (Active matrix TFT) Touch Display
    - Shows state-of-the-art graphical display
    - Smartphone-compatible
  - Native resolution of 1920 x 1080
  - Wide angle aspect ratio 16:9
  - Viewing angle of 178°(h) x 178°(w)
  - Horizontal Scan Rate 30 - 82 kHz
  - Vertical Scan Rate 50 - 75 Hz
  - Contrast 3000:1
  - Number of colors 16.7 million
  - 10 touch projected capacitive (PCAP) with Thru-glass capabilities that pass UL-60950 & IK-07 Impact testing
  - Operating Temperature:
    - 0°C to 40°C (32°F to 104°F)
  - Operating Humidity (non-condensing):
    - 20% to 80%

External BAS Interfacing w/ APTView

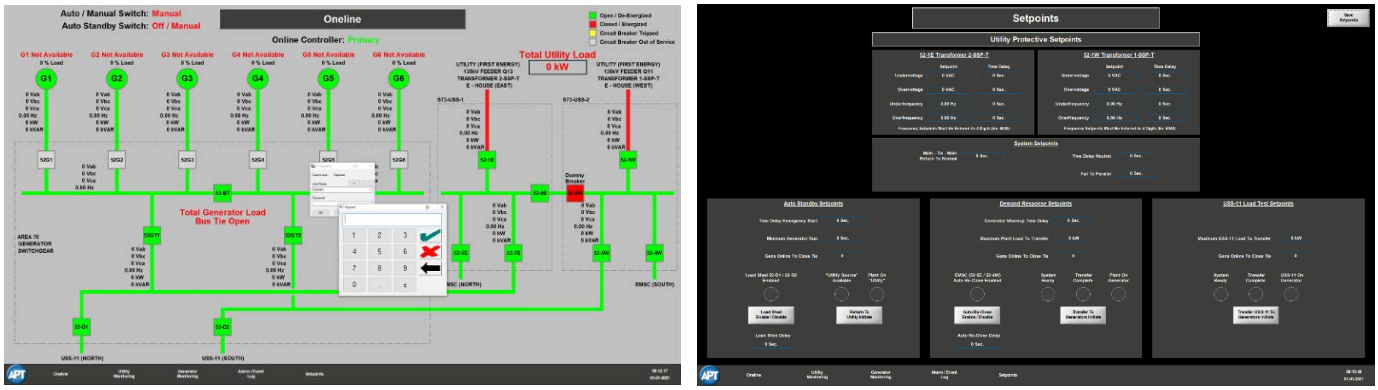

Figure 12: Oneline with Setpoints Login (top left), Setpoint Changes (top right), Trending SCADA Markup (bottom)

Integrated Remote Monitoring & Control

- External Building Automation System Integration with APTView:
  - Information from switchgear is available in MODBUS TCP/IP format and presented through an Ethernet port for easy remote monitoring by the Building Automation System.
  - You can see various electrical parameters, including line to line voltages, generator and utility frequencies, and power.
  - You can also see status of circuit breaker positions and events/alarms.
  - Includes adjustable setpoints.

APT SCADA & Master Control Systems

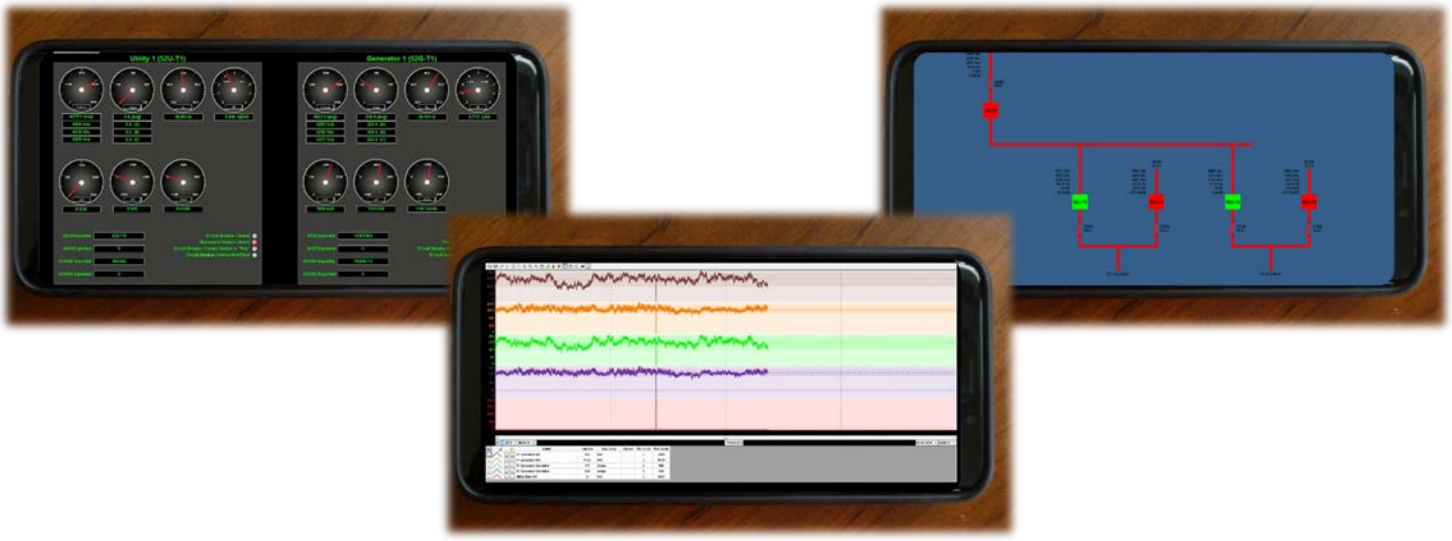

Figure 13: Mobile Version of APTView SCADA HMI with Source Metering Data (top left),
System One-line (top right),
Power Usage Time Adjustable Trend Chart (bottom)*

Generators, Utilities, Renewables Source Control

- (LS) – APT Load Shed Control – maximum one per switchgear:
  - Opens designated feeders during an outage and allows for only critical & life safety loads to be connected to the secondary source.
- (LAC) – APT Load Add Control (Bus Optimization) – maximum one per switchgear:
  - Monitors the total capacity of the bus and the load demand for each load step, and automatically add load to the system if sufficient genset capacity is available to serve the load.
- (BI) – APT Maintenance Bypass/Isolation with Captive Key – maximum one per switchgear:
  - Manually bypass live power flow from source to load in the case that parts of the equipment are disabled/need to be isolated, de-energized for maintenance, testing, or repair.
- (MG) – Microgrid Interconnection – maximum one per switchgear:
  - Provides real time integrated control of power production/supply by renewable energy sources, natural gas / diesel generators, and energy storage for load power consumption for large scale (500kW – 50 MW) microgrid systems.
- (EX) – External (Paralleling and/or Transfer, Load Shed) By Others:
  - Controls facilitated by other manufacturers than APT are to be used in APT switchgear to meet the desired Sequence of Operations. (Customer to Specify Controls Manufacturer & Controls Location)
- (IE) – APT Import/Export Control (add-on to UP/PS) – maximum one per switchgear:
  - Maintains constant utility contribution to a site load by monitoring the utility contribution and trimming generator set load levels up and down as site loads change

APT Paralleling System Modules

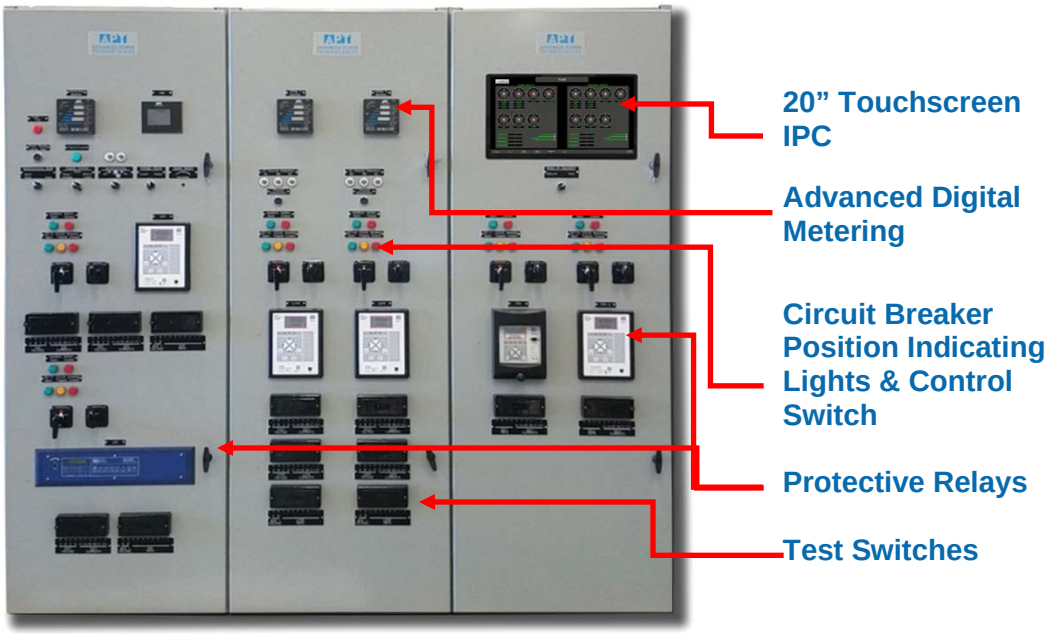

Figure 14: Stand-alone Fully Isolated Master Control Panel (MCP) built with APT Control System Modules: UI (Utility Intertie), CT1 (Automatic Standby Closed Transfer), MG (Microgrid Interconnection)

Figure 15: UP Master Control System with Manual Generator Operation Controls

Multi-source Paralleling & Transfer Controls

- (GP) – APT ACM Generator Paralleling – requires one per generator:
  - Automatic generator paralleling control for each generator, configured to synchronize, bring multiple generators on-line, and service the load.
  - Expandable system architecture allows for any number of generators in the system.
- (PG1) – APT Generator Paralleling Controller – requires one per generator:
  - Automatic synchronizing and load sharing.
  - Hard wired breaker interlocking to prevent generator breakers from closing unless generator main circuit breaker is closed.
- (N1) – APT N+1 Redundant Generator Transfer Control – requires one per switchgear:
  - Control for systems with back-up generator(s) to the back-up generator(s) to provide facilities with levels of redundancy and protect against back-up generator failure.
- (LDC) – APT Load Demand Control – maximum one per switchgear:
  - Manually initiated automatic sequence to avoid extended operation of generators at light load after system has stabilized in emergency operation.
- (IM) – APT Island Mode Control – maximum one per switchgear:
  - Allows safe system operation in isolation from the local electricity distribution network
- (UP) – APT Utility Paralleling (Base Load) – requires one per utility source:
  - Integrated utility grade interconnection protection & control as required to meet ANSI/IEEE 1547 standard with source paralleling controls to parallel a utility source with other utility feeds or generator sources.
  - Includes APT Generator Base Load - Paralleled generator set(s) soft load to a desired constant load level against utility.
- (UI) – APT Utility Intertie – requires one per utility:
  - Stand-alone utility grade interconnection protection & control as required to meet ANSI/IEEE 1547 standard without paralleling or transfer controls.
- (PS) – APT Peak Shaving (Base Load) – maximum one per switchgear:
  - Controls and adjusts the generator load levels to limit the amount of energy purchased from the utility during peak demand hours.

Protective Relaying & Switches

Figure 16: ANSI/IEEE 1547 Utility Intertie Protection Relays, Test Switches, Pistol Grip CB Switch & (86) Knob Grip Lockout Relay*

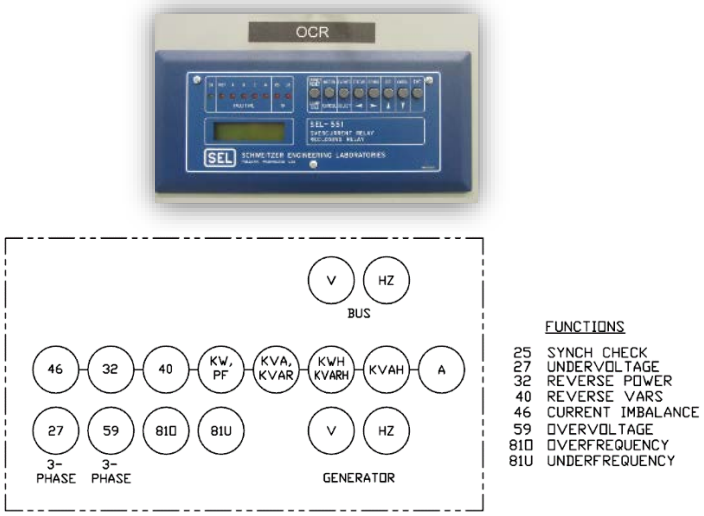

Figure 17: Phase & Ground Fault Time-Overcurrent with Instantaneous Protection Protective Relay & Functions*

Utility Intertie, Generator Syncing, Feeder Protection

- Applications:
  - Utility Intertie & Paralleling Protection
  - Advanced Generator Protection
  - Tie Protection
  - Transformer Protection
  - Feeder Protection
  - Various Differential Protection Schemes
- Typical Relaying functions*:
  - 25 – Synch Check
  - 32 – Reverse Power
  - 50/51 – Inst./Time Overcurrent
  - 50N/51N – Inst./Time Ground Overcurrent
  - 27/59 – Under/Overvoltage
  - 59N – Ground Overvoltage
  - 81U/81O – Under/Overfrequency
  - 40 – Loss of Excitation
  - 60 – Current Balance
  - 67 – Directional Overcurrent
  - 86 – (LO) Lock-Out Relay (Knob Grip)
  - 87 – Differential Protective Relay
  - 87B – Bus Differential
  - 87G – Generator Differential
- (PG)* – Pistol Grip CB Control Switches
  - Red & Green Target to Indicate Circuit Breaker Position Status
- (TS)* – Test Switches
  - Provide a safe, simple, fast and reliable method to isolate, test, and service installed equipment without disturbing the power system
  - Permits convenient isolation of relays, meters, and instrument transformers (PTs & CTs)
  - Allows for quick and easy multi-circuit testing by conventional test methods
- (TP)* – Test Plugs
  - Enables easier measurement, calibration, verification and maintenance of relays, meters, PTs, & CTs
  - Conveniently connects devices measuring the currents and voltages being applied to the relays, meters, PTs, & CTs without interrupting or short-circuiting the circuit

MCP-Series Drawings

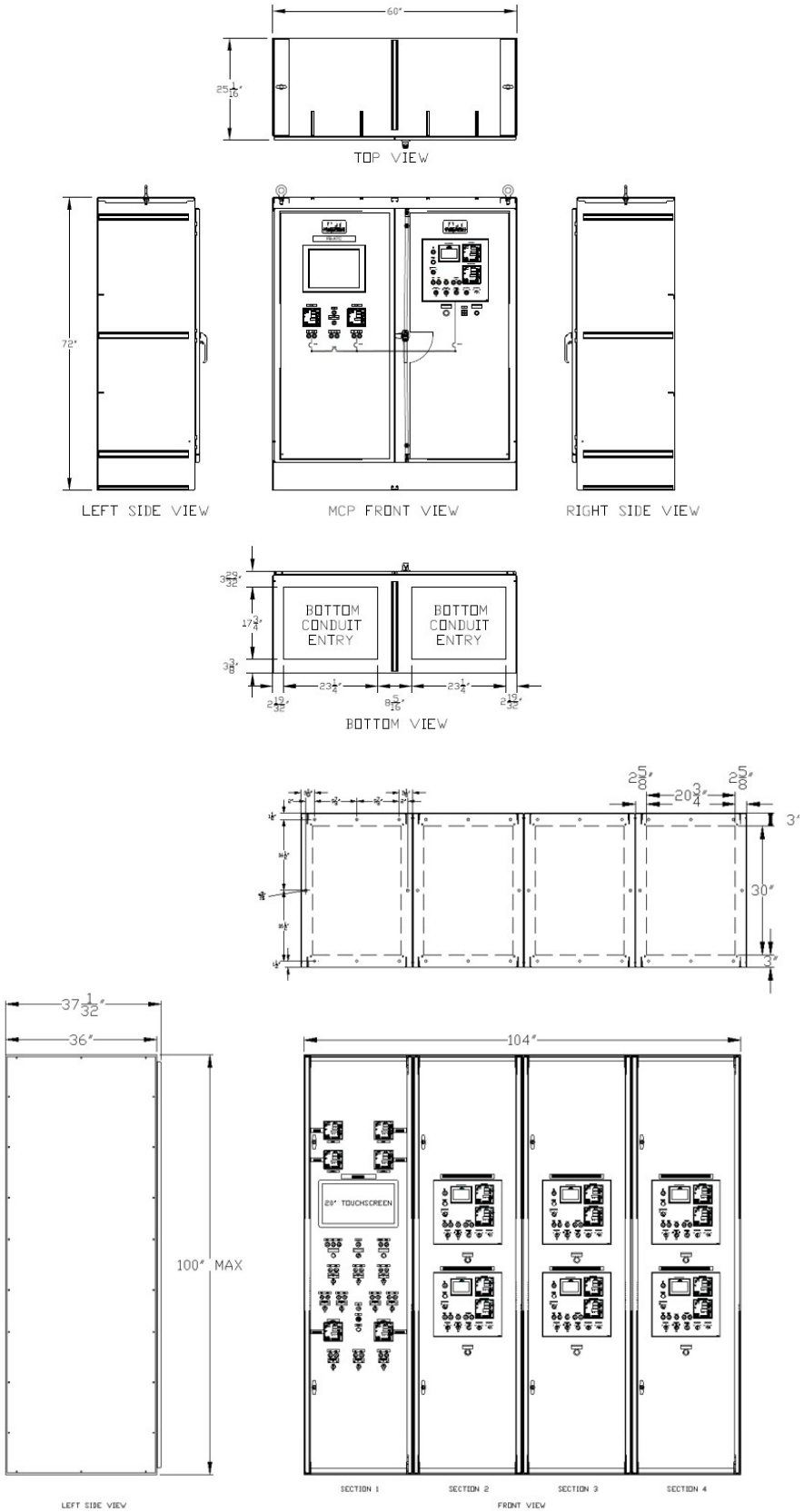

Figure 18: MCP-Series Switchgear Master Control Panel Sample Dimensions

About Advanced Power Technologies



Advanced Power Technologies (APT) is on the cutting edge of the latest engineered power system smart technologies, as it relates to microgrid & storage management, renewable & conventional energy source deployment, demand peak shaving, and facility back-up and co-generation power systems. Located in the central United States and headquartered in Lafayette, Indiana with solutions development engineers around the country, APT provides domestic and international products and services to industry leading companies from around the world. APT engineers have decades of power system experience from working with some of the largest companies in industry. Over the last two decades, we have produced successful solutions for hundreds of large-scale electric power projects involving utility/generator paralleling, transfer, peak shaving, and distribution. We pride ourselves in providing electrical power systems that are engineered and custom built, utilizing state-of-the-art technologies to fit our customer's exact needs. The core of our business is low & medium voltage engineered power systems for a wide range of indoor & outdoor applications, such as:

- Utility(ies) and Generator(s) Paralleling/Transfer/Peak Shaving/Distribution Switchgear
- Microgrids, Microgrid Master Control Panels, SCADA systems
- Containerized Battery Energy Storage Systems (BESS)
- Photovoltaic (PV) Solar Power Collection/Distribution & Renewable Energy Storage Systems
- Low & High Resistance Grounding Systems, Grounding Systems for Photovoltaic Effective Grounding
- High Efficiency Combined Heat and Power Switchgear & Control Systems (CHP, Co-generation)
- Outdoor Walk-In Electrical Houses (E-Houses) & Skid-Mounted Switchgear
- Motor Control Centers & Motor Control Switchgear
- Automatic & Manual Load Transfer Switchgear
- Bypass/Isolation & Power Distribution Circuit Breaker Switchboards
- Generator/Loadbank Quick Connection Switchgear, Switchboards, & Tap Boxes
- Industrial Control Panels

Please see our product webpages on www.apt-power.com for product brochures and relevant information. Actual products may look different from images shown on the website and in brochures, based on actual specifications.
APT cares and understands that each power system is different. We will evaluate various solutions to develop the best solution for a site. APT focuses on our ability to a combine several traditional pieces of equipment/functionality into as little of a footprint possible. This saves on space, the cost of equipment, cost of installation, and accomplishes the most optimal/state-of-the-art design your facilities. APT's desires to foster and grow a culture of continued open communication with each customer. Let APT be your source to provide fully engineered power system equipment solutions for the full customer facility on time, on or under budget, and in the smallest footprint possible. We are always available to assist customers and engineers representing customers in the development of complex power solutions for all facility types.