



### **Voltages**

- Distribution: 380 V, three-phase, 50 Hz line-to-line.
- Utilization: 220 V, single-phase.

### **Grid Transformer**

- Configuration: Delta to star (Dy11), minimum 5 kVA.
- Primary: Matched to incoming three-phase supply, providing 380 V three-phase line-to-line secondary distribution voltages.
- Secondary: Earth link for star point with selectable tapping earth resistor for restricted earth fault protection tests.
- Compatibility: Fully compatible with the power system simulator.

### **Generator and Prime Mover**

- Power Class: 1.0
- Power: Minimum 0.8 kVA.
- Voltage: 400 V, three-phase (Y).
- Excitation: Max 220 V, 1.6 A.
- Frequency: 50 Hz.
- Power Factor: Greater than 0.9.
- Speed: Minimum 1500 rpm.
- Type: Four-pole salient pole AC generator.
- Features: Brushless, with both automatic and manual excitation.
- Motor: Induction motor with shaft encoder, electronic four-quadrant AC vector drive control, and four-position drive inertia switch.

### **Mechanical Data**

- Construction Type: B3.

*Note: Specifications are subject to change, Photos shown above are Indicative, Actual Product can Vary.*



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- Shaft End: 1.
- Base: Aluminum.
- Terminal Box: Top.
- Temperature Class: B (120°).
- Protection (IP): IP20.
- Temperature Detectors: Bimetal switches 110°C NC (normally closed).

### Generator Transformer

- Type: Unit/Power transformer.
- Configuration: 1:1 ratio, delta-to-star (Dy11), impedance matching with adjustable secondary tapping.

### Transmission Lines

- Type: Three-phase model,  $\geq 230$  kV overhead transmission line.
- Length: 150 km to 360 km, with the possibility of 135 km for specific investigations.
- Specifications:
  - Quad Bundle: 240/40.
  - Surge Impedance: 240 Ohm.
  - Natural Power: Max 600 MW.
  - Ohmic Resistance: Max 13 Ohm, 8 Ohm, 5 Ohm.
  - Inductance: Max 290 mH, 174 mH, 116 mH.
  - Operational Capacity: Max 5  $\mu$ F, 3  $\mu$ F, 2  $\mu$ F.
  - Transmission Lines: Seven lines representing 150 km or better, with one line featuring four test points and dedicated three-zone distance protection.
  - Capacitors: Adjacent to lines with selectable values, configurable for pi or T-line configurations.

### Distribution Transformers

- Primary: Three-phase 380 V, 50 Hz.
- Type: Two identical transformers, star-to-delta Yd1 or better.
- Features: Adjustable primary tapings, matched impedances, variable tapings feeding a utilization bus.
- Protection: Dedicated relays (overcurrent, voltage, restricted earth relays) for protection.
- Connectivity: Suitable connection systems for other devices and testing.

### Switched Bus Bar

- Material: Copper.
- System: 400 V / 380 V connection.
- Configuration: Main and standby (reserve) bus.
- Feeders: Six bi-directional feeders, each with circuit breakers.
- Circuit Breakers: Two for each half of the bus, two for coupling between main and reserve buses, and one 'point-on-wave' breaker for a specific feeder.

### Protection Relays

- **For Grid Transformer:**
  - Differential, overcurrent, undercurrent, overfrequency, underfrequency, undervoltage, overvoltage, directional relay, phase sequence relay, feeder management relay, thermal relay.
- **Bus Protection:**
  - 2 x double bus protection.
- **Transformer Protection:**

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- 4 x distribution transformer protection.
- **Compatibility:**
  - All relays must be industrial standard digital protection relays compatible with the power system simulator.
- **Software:**
  - CD-ROM with compatible software and SCADA application.

### Loads

- **Compatibility:** Rating compatible with generator and transmission lines.
- **Configurations:**
  - Delta-connected variable resistors load.
  - Delta-connected variable inductors load.
  - Delta capacitor banks.
  - Dynamic load (induction motor) at the utilization bus, compatible with generator rating.
  - Two sets of loads at the utilization bus, each with delta-connected variable resistors, inductors, and capacitor banks.

### Electrical Supply

- Type: Three-phase.
- Power Output: Minimum 10 kW.
- Input: Three-wire AC, 380 to 400 V AC, 50 Hz.
- Protection: Standard protection system with a power factor above 90%.
- Measuring System: In-built system for voltage and current measurement.

### Fault Switches

- Quantity: Two.
- Type:
  - One standard three-phase switch.
  - One timed circuit breaker with a user-programmable digital timer.

### Software SCADA

- Training Purpose: Complete features for educational purposes.
- Virtual Plant Simulation: Realistic simulations of industrial processes with virtual sensors, actuators, and control systems.
- Interactive HMI: Graphical Human-Machine Interface mimicking real SCADA systems.
- Scenario-Based Training: Pre-built scenarios and exercises for troubleshooting, process optimization, and decision-making.
- Data Analysis Tools: Tools for historical data analysis, trend analysis, and performance metrics.
- Networking Capabilities: Simulate distributed control system environments with networked virtual systems.
- Security Training: Modules on cybersecurity best practices.
- Customization: Allows educators to create custom exercises and scenarios.

### Computer (Optional)

- Type: All-In-One Personal Computer (desktop).
- Power Input: 230V, 50Hz.
- Display: 24 inches or above.
- Storage: 1 TB HDD + 500 GB SSD.
- Processor: Quad-core, 4 GHz or above.
- Memory: 32 GB RAM.
- Resolution: 1080p Full HD (1920 x 1080) and 4K Ultra HD (3840 x 2160).

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- Components: Built-in speakers, SATA DVD Drive (+/-RW), standard keyboard, optical mouse with mouse pad.
- Expansion Slots: Minimum 2, including 1 PCI x 16.
- Network Interface: Gigabit Ethernet, internal Wi-Fi.
- I/O Ports: Minimum 8 USB (at least 2 USB 3.2), 1 HDMI, 1 VGA.
- Operating System: Windows 11 Pro, Linux, or Ubuntu 18.04+.
- Certifications: Windows certification from the original manufacturer.
- Monitor: Slim design with warranty sticker.
- Usage: Suitable for multitasking, gaming, video editing, and other demanding tasks.

**Manuals**

- Teacher and Student Manual: Detailed guides for usage and learning.
- Troubleshooting Manual: Comprehensive troubleshooting instructions.

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