ENEL 674 Industrial and Commercial Power Systems

Group 7

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Project Milestone 2

UPS system

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Executive Summary

When the primary power supply fails, a UPS (Uninterruptible Power Supply) system can be used to provide backup power. It is frequently used to safeguard crucial devices against power disturbances and outages, including computers, servers, and telecommunication networks.

A battery, charger, and inverter are the usual components of a UPS system, which operate together to provide power in the event of an outage. The UPS charges the battery and provide clean, reliable power to the connected devices when the main power supply is available. The UPS automatically switches to battery power in the event of a power interruption or outage to ensure an uninterrupted power supply.

The selection of UPS system is based on following factors, i.e., Load capacity, Battery Back-up time, Voltage regulation, Surge protection, Noise level, Redundancy, Scalability, Maintenance and Cost.

1. Description of UPS model

3-Phase 208/220/120/127V 30kVA/kW Double-Conversion UPS - Unity PF, External Batteries Required Model – S3M30K

Figure 1 : 3-Phase UPS System

Rated input current (Maximum Load)	112.5A (166VAC) / 106.4A (176VAC)
Nominal Input Voltage(s) Supported	120/208V 3-PH Wye; 127/220V 3-PH Wye
Nominal Input Voltage Description	3-Phase Wye, 4 wire (L1, L2, L3, N, G)
Output Capacity (kVA)	30
Frequency Compatibility	50 / 60 Hz
Nominal Output Voltage(s) Supported	120/208V 3-PH Wye; 127/220V 3-PH Wye
External Battery Pack Compatibility	BP240V40L-NIB ;
DC System Voltage (VDC)	±120 VDC
Transfer Time	Online mode: No transfer time (0 ms.); (AC to battery, and Inverter to Bypass, 0 ms)
Dimensions (HWD)	34.17/9.84/35.43 *inch*
AC Economy Efficiency Rating (100% Load)	98.5%

Table 1 : Specification

2. Schematic Diagram of UPS

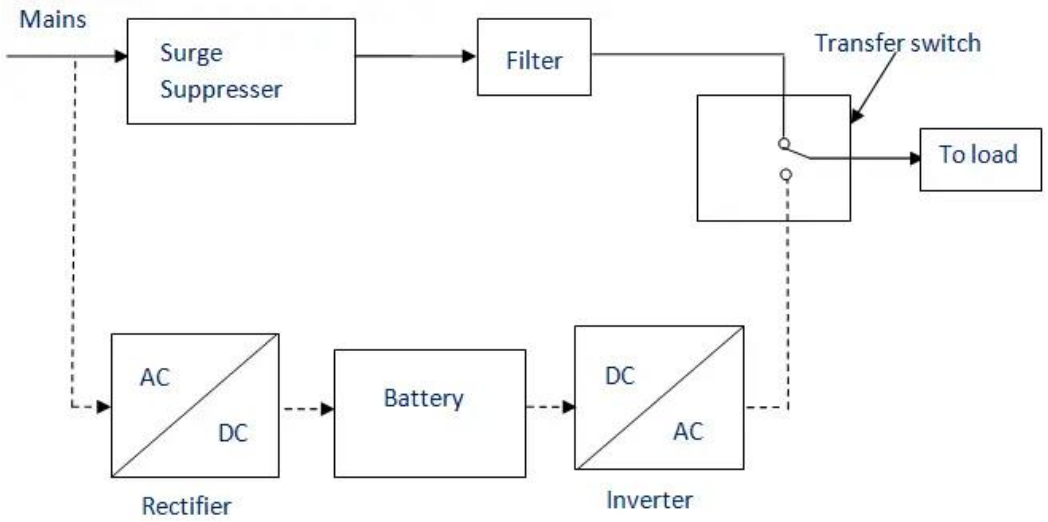


Figure 2 : Schematic Diagram of UPS

The parts of a typical UPS system are graphically represented in a UPS (Uninterruptible Power Supply) block diagram. It demonstrates the data and power flow throughout the UPS system and the interactions between the different parts.

The fundamental elements of a UPS block diagram are:

- Input Power: This is the term for the utility supplied AC power source that powers the UPS system.
- Battery: The UPS system's battery, which supplies backup power during a power loss, is a crucial component. The incoming AC power source normally charges the battery.
- Charger: When the UPS is connected to an AC power supply, the charger oversees charging the battery.
- Inverter: The inverter transforms the battery's DC power into the AC power needed by the connected devices.
- Static switch: Power is transferred from the input power source to the inverter output using a static switch. Also, it is employed to disconnect the input power source for upkeep and repairs.
- Control Logic: The control logic oversees controlling the power transfer between the various components, as well as keeping an eye on the incoming power and the condition of the battery and inverter.
- Output Power: The AC power sent to the connected devices is referred to as the output power.

The UPS block diagram shows how the UPS's many parts work together to keep vital devices powered up in the case of a power outage or other disruption.

3. UPS runtime

For S3M30K UPS model and BP240V40L Battery Pack Model, we are considering $21kW$ of emergency load to run for 4 hours. As per the below figure, the number of battery pack required to run $21kW$ load for 124 minutes is 3. Now to run the same load for 4 hours, we need 6 battery pack qty.

S3M30K Estimated Runtime

UPS Model	Battery Pack Model	Battery Pack Qty	Load in Kilowatts (kW)									
			3kW	6kW	9kW	12kW	15kW	18kW	21kW	24kW	27kW	30kW
S3M30K	BP240V40	1	147	63	38	26	20	15	13	11	9.0	7.7
S3M30K	BP240V40	2	325	147	91	64	48	38	31	27	23	20
S3M30K	BP240V40	3	507	236	148	105	80	64	53	45	38	34
S3M30K	BP240V40L	1	325	147	91	64	48	38	31	27	23	20
S3M30K	BP240V40L	2	688	327	207	148	113	91	76	64	55	49
S3M30K	BP240V40L	3	1,046	510	328	237	183	148	124	106	92	81
S3M30K	BP240V65	1	258	115	70	49	37	29	24	20	17	15
S3M30K	BP240V65	2	553	259	162	115	88	71	58	49	43	37
S3M30K	BP240V65	3	846	407	259	187	144	116	96	82	71	62
S3M30K	BP240V65L	1	553	259	162	115	88	71	58	49	43	37
S3M30K	BP240V65L	2	1,134	555	358	260	201	163	136	116	101	89
S3M30K	BP240V100	1	416	192	119	84	64	51	42	35	30	27
All runtime values are shown in minutes.												

Table 2 Estimated Runtime for S3M30K

Meeting of future load demand by UPS

We have chosen 30 KVA, 3 phase UPS design to meet future load demand increase at emergency bus. We have selected S3M30K UPS model that supports external battery rack. As of now we are using 6 battery pack to run 21KW load; however, we can add furthermore battery rack in future.

4. Battery pack requirement

±120VDC External Battery Cabinet for Select 10-50K S3M-Series 3-Phase UPS - Requires 40x 40Ah Batteries.

Expandable Runtime	Yes
Unit Dimensions (hwd / in.)	$63.000\ x\ 23.600\ x\ 33.500$
Unit Weight (lbs.)	346.4
DC System Voltage (VDC)	$+/-\ 120V\ DC$
Number of Strings in a pack	4
Number of Batteries in a pack	40
Voltage of String	$120V\ DC$
Capacity of String	40Ah/string
Number of Battery pack required	6
Runtime at 21 kW loading	248 minutes

Table 3 Battery pack Specification

5. Features

Battery Backup and VFI Operation Protect Critical Loads

The SmartOnline® S3M30K IGBT UPS supports the continuous availability of your most important operational and IT equipment loads through all power conditions, providing a compact backup power platform that's easy to manage and inexpensive to operate. Sophisticated voltage- and frequency independent (VFI) operation and advanced IGBT rectifier technology with DSP control deliver reliable output power quality. Providing up to 30kVA/kW of clean, continuous power, this 3-phase UPS system is ideally suited for critical applications in banking, education, healthcare, government, and manufacturing sectors.

Best-in-Class Footprint for Easy Integration into Your Network Application

The UPS market's smallest footprint for 3-phase 208V systems lets you install the S3M30K in spaces that would otherwise have required expensive retrofitting. By achieving its compact size without compromising runtime, reliability, or functionality, the S3M30K is recommended for data centers, colocation facilities and edge computing environments that require high efficiency, high performance and clean, reliable power protection, while preserving as much space as possible for revenue-generating server racks.

Efficient Operation and Design Reduces Cost of Ownership

ENERGY STAR 2.0-certified technology provides high operational efficiency to save on utility and cooling costs, as well as protect the environment. This UPS achieves up to 94% efficiency in double-conversion mode and up to 98% in ECO mode, reducing your power and cooling costs. Unity output power factor (1.0) lets you support more equipment. A low THDv (2%) and active power factor correction with DSP control improve output performance. The hardware and firmware platform design reduces the number of unique boards, improving mean time to repair (MTTR) and resulting in reduced downtime. Automatic and maintenance bypass transfer UPS load to utility power during faults, overloads and maintenance, which also avoids costly system downtime.

External Batteries Supply Reliable Backup with Expandable Runtime Options

The S3M30K uses external battery cabinets, including BP240V40/40L, BP240V65/65L and BP240V100 (sold separately), to provide backup support in case of a power failure. These cabinets are available with or without internal batteries. No internal batteries are included with the S3M30K. A one-touch cold-start button powers up the UPS with battery power only.

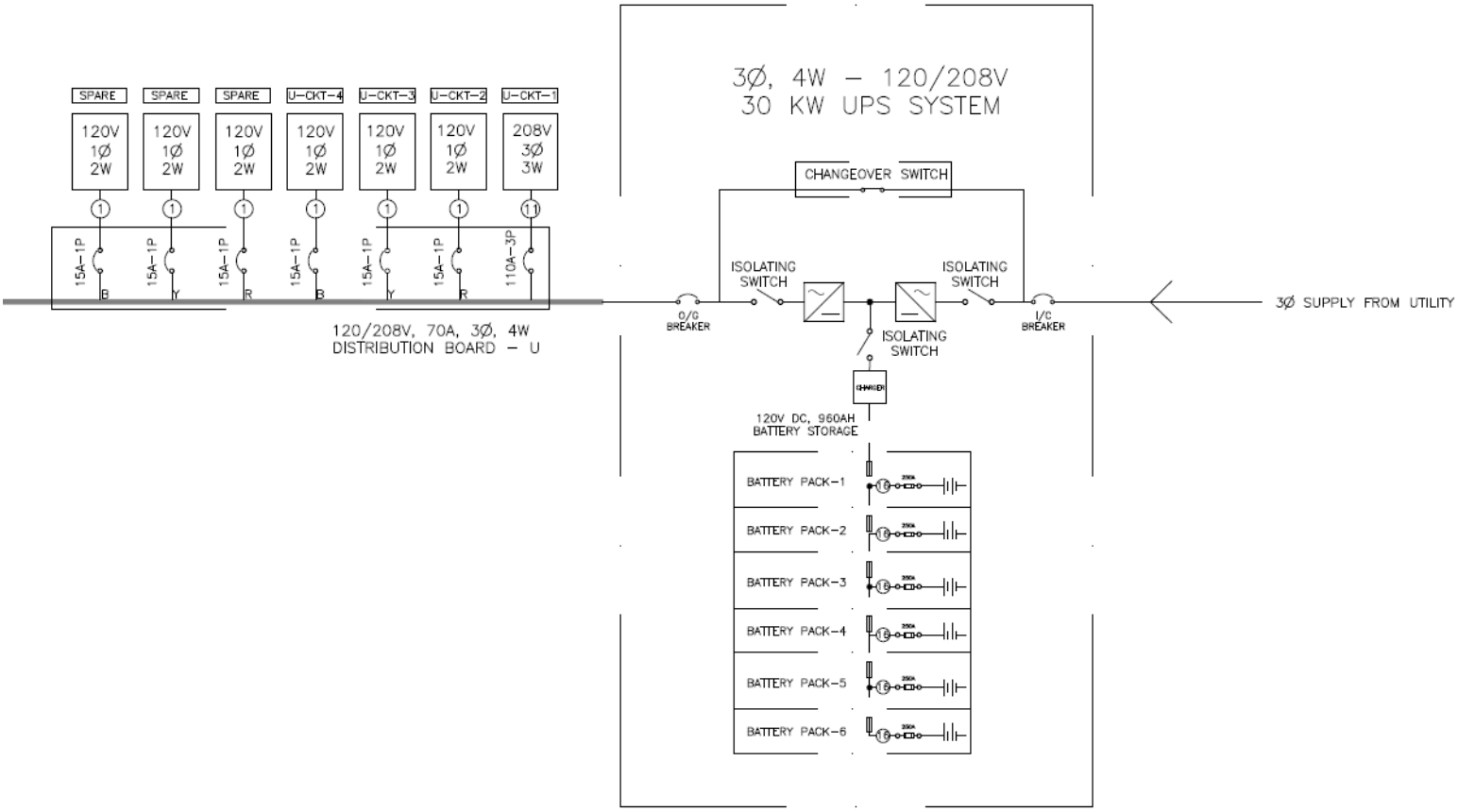
Intuitive LCD Interface Delivers Important Performance Information at a Glance

The large five-inch touchscreen LCD panel displays critical operating conditions and diagnostic data, including battery and load status. Four LEDs provide information about AC, bypass, battery and fault status.

Remote Network Monitoring and Control Available 24 Hours a Day

The optional Java-free WEBCARDLXMINI network management card (sold separately) enables remote management through embedded HTML5 web, SSH/telnet and SNMP interfaces, as well as integration with a wide range of network management systems and DCIM platforms. WEBCARDLXMINI also supports EnviroSense2 (sold separately), which monitors temperature, humidity and other environmental factors. Three MODBUS ports (RS-485, USB, RS-232) may also be used to monitor and manage the UPS. A Remote Emergency Power Off (REPO) port allows shutdown from a safe distance during emergencies.

6. Emergency SLD accommodating UPS system



7. Advantages of UPS system over diesel generator

Instantaneous Backup: UPS systems provide an instantaneous backup power supply to the connected equipment. In contrast, diesel generator backups require time to start and reach their rated output, which can cause power interruptions.

Lower Noise Levels: UPS systems produce lower noise levels compared to diesel generators. This is important in environments such as hospitals, schools, and residential areas where low noise levels are critical.

Lower Emissions: UPS systems do not produce emissions, making them environmentally friendly. Diesel generators, on the other hand, produce harmful emissions that can contribute to air pollution.

Lower Maintenance Costs: UPS systems require minimal maintenance compared to diesel generators. Diesel generators require regular maintenance such as oil changes, filter replacements, and fuel testing.

Smaller Footprint: UPS systems have a smaller physical footprint compared to diesel generators. This is important in areas where space is limited.

Higher Reliability: UPS systems are highly reliable and provide continuous power supply to critical loads without interruption. Diesel generators, on the other hand, are prone to breakdowns and require regular maintenance to ensure their reliability.

Higher Efficiency: UPS systems have a higher efficiency compared to diesel generators. UPS systems convert the AC input power into DC power and then back into AC power with very little loss. Diesel generators, on the other hand, have a lower efficiency due to energy losses associated with the combustion process.

Overall, UPS systems provide a more reliable, environmentally friendly, and cost-effective solution for providing backup power to critical loads compared to diesel generators.

8. Cost comparison of UPS system with diesel generator back-up

A 30kVA diesel generator's price compared to a 30kVA UPS's price can differ according on the manufacturer, features, fuel type, installation cost, and maintenance cost.

On general, the price of a 30kVA UPS ranges from $10,000 to $20,000 (excluding battery rack), depending on the manufacturer, battery type, and amount of backup hours needed. On the other hand, the price of a 30kVA diesel generator can range from $15,000 to $30,000, depending on the manufacturer, the kind of fuel, and the cost of installation. It is crucial to remember that a diesel generator often has lower operating expenses than a UPS since diesel fuel is less expensive than the replacing & commissioning cost of batteries.

9. Conclusion

Uninterruptible Power Supply, or UPS, is a system that gives essential electrical devices backup power in the case of a power outage or other disruption. An input power source, a battery, a charger, an inverter, a static switch, control logic, and an output power source are among the essential parts of a typical UPS system. The battery stores energy for use after an outage, while the input power source initially powers the system. While the inverter transforms DC electricity from the battery into AC power that is used by connected devices, the charger is in charge of charging the battery. The control logic oversees and controls the flow of power between the various components while the static switch moves electricity from the input power source to the inverter output.