

AP990 series three phase UPS offer advanced technologies that increase performance and reliability: two high speed DSPs with complete digital control fully ensure the high quality of power supply , high input power factor make UPS green energy-saving power, besides that, AP990 series offer humanization design: full front access for ease of serviceability, user-friendly interface.

Online UPS

AP990 Series

20KVA - 120KVA

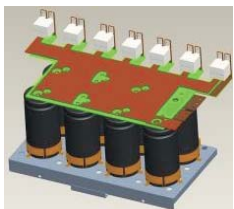
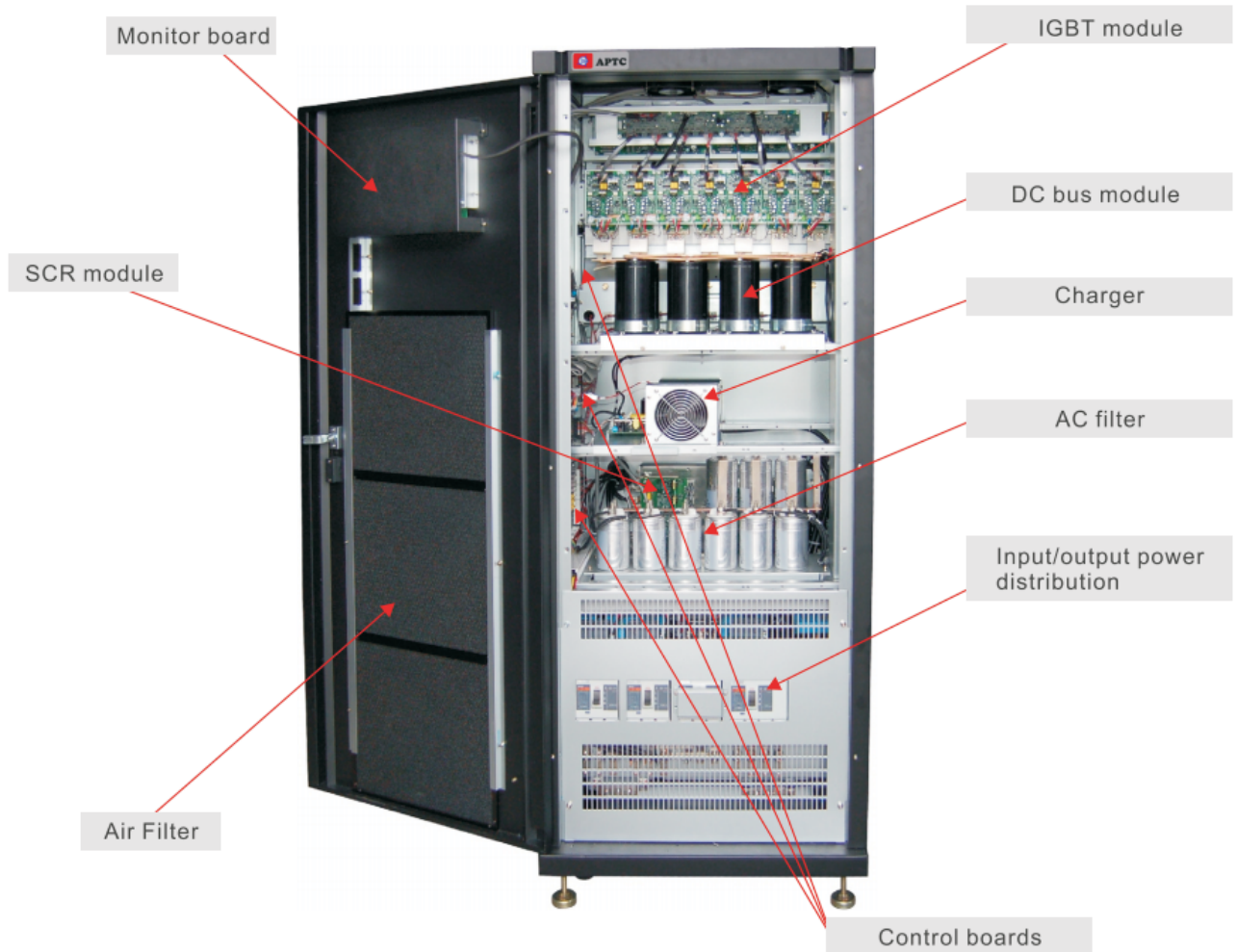
Application area: ISP (Internet Service Provider), IDC
Internet Data Center , computing center,
bank and securities, server center,
industrial automation, precision



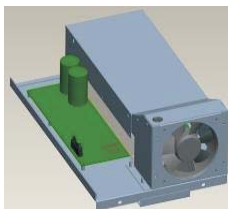
1. AP990 series UPS characteristics

- * Three phase in and out system, compatible with utility of 380/400/415V,50/60Hz
- * Online double conversion, offer the load with best power quality
- * Compatible with all kinds of loads, high overload capability
- * Fully digital control with two DSPs, all the subsystems are digital controlled including the IGBT rectifier, inverter, charger, discharger.
- * Digital circulation current control technology, increases the parallel reliability
- * Wide input voltage window, compatible with different utilities.
- * Green power technology, high input power factor, low current THD (total harmonic distortion), high efficiency
- * Intelligent battery management, extend the battery life.
- * Intelligent self diagnose function, all kinds of fault protection, large capability of history record storage.
- * Fully front maintenance, save the space.
- * Redundancy design of power model fans, increase the system reliability
- * Modularized design of subsystems, convenient field maintenance.
- * Very high MTBF (mean time before failure) (>200,000h) , very low MTTR (Mean Time to Repair) (<0.5 h)
- * Large LCD display, friendly human machine interface.
- * Configured with top and bottom cable connection.
- * All kinds of options include main back feed protection, bypass back feed protection, battery leakage protection, battery start kit and output isolation transformer-lighting protection kit.

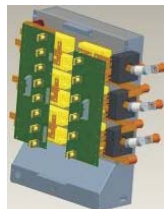
Model	AP9930	AP9940	AP9960	AP9980	AP99100	AP99120
Capacity	20/30 KVA	40 KVA	60 KVA	80 KVA	100 KVA	120 KVA
Main input						
Input voltage	380V / 400V / 415V /480V (line to line)					
Input connection	Three phase four lines					
Power factor	>0.99					
Input current THD (Total Harmonic Distortion)	<3%					
Input voltage window	+20% ~-20%, full load -20% ~-40%, power derating between 100% to 70%					
Frequency window	40~70HZ					
Bypass input						
Input voltage	380V / 400V / 415 / 480V					
Input voltage window	+20% ~-50%					
Input connection	Three phase four lines					
Frequency window	40~70HZ (settable)					
Output						
Voltage precision (balanced load)	380V/400V/415V/480V +/- 0.5% three phase.					
Voltage precision (unbalanced load)	2%					
Output voltage transient	2% (0 ~ 100% load step)					
Voltage THD (linear load)	THD <0.5%					
Voltage THD (nonlinear load)	THD <4%					
Power factor	0.8 (lag)					
Frequency tracking range	50/60Hz ± 3Hz					
Frequency precision (free running)	± 0.01%					
Phase tolerance	120 ± 0.5 (balance and unbalance load)					
Voltage unbalance degree (100% unbalance load)	± 3%					
Frequency tracking speed	0.5Hz/s to 5Hz settable					
Overload capability	105% long time operation					
	110%, transfer to bypass after 1 hour					
	125%, transfer to bypass after 10 minutes					
	150%, transfer to bypass after 1 minute > 150%, transfer to bypass after 200mS					
Bypass overload capability	150%, long time operation					
	150% < load < 180%, last for more than 1 minutes > 1000%, last for more than 100ms					
System						
System efficiency (linear load)	Normal mode: 91% ECO mode: 98%					
Battery mode efficiency (linear load)	91%					
Display	LCD + LED					
EMI	IEC62040-2					
EMS	IEC61000-4-2(ESD)					
	IEC61000-4-3(RS)					
	IEC6100-4-4(EFT)					
	IEC6100-4-5(Surge)					
Noise (1m)	< 62dB					
Insulation resistance	>2M(500VDC)					
Dielectric strength	(input, output to PE) 2820Vdc, leakage current lower than 3.5mA, no flashover in 1 minute					
Surge protection	Meet the requirement of IEC60664-1 class IV, endure surge of 1.2/50us+8/20us higher than 6KV/3KV					
IP Class	IP20					
Battery configuration	12V, 40 units (38~42 units acceptable)					
Installation / Connection	Top or bottom cable connection					
Operation temperature	0~40 °C (0-104°F)					
Relative humidity	0~90 °C (0-194°F) (non-comdensing)					
Noise dB	55		62		65	
Weight (Kg / Pounds)	300 / 661.3 lb	320 / 705.4 lb	360 / 793.6 lb	400 / 881.8 lb	570 / 1256.6 lb	600 / 1322.7 lb
Dimmension (W*D*H)(mm / inches)	700 x 800 x 1820 (27.3 x 31.2 x 70.9 inches)				1000 x 800 x 1880 (39 x 31.2 x 73.3)	
Packing Dimmension (W*D*H)(mm / inches)	785 x 885 x 1980 (30.6 x 34.5 x 77.2 inches)				1095 x 895 x 2100 (42.7 x 34.9 x 81.9)	



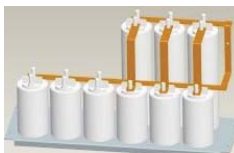
DC bus capacitor module



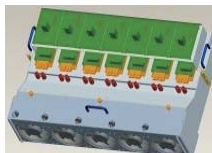
Digital charger module



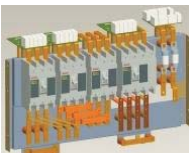
Static switch module



AC filter capacitor module



IGBT module



Input and output power distribution module



3. Characteristics

3.1. Rectifier:

3.1.1. Power factor correction

- ☆ The rectifier of Ap990 series UPS is IGBT based with high power factor, above 0.99 on full load condition. Meanwhile the input current THD is less than 3%.

3.1.2 Soft start of DC bus

- ☆ The DSP controlled rectifier realizes the soft start of DC bus, avoid surge current flows to DC bus capacitors.

3.1.3 Rectifier protection and alarm conditions

A. Main input abnormal

- ☆ If one phase of input is lower than 132V or higher than 264V, the rectifier will be shut off, UPS will transfer to battery mode.

B. Input frequency abnormal

- ☆ If input frequency goes beyond the range of 40~70Hz, the rectifier will be shut off, UPS will transfer to battery mode.

C. Main input phase reverse protection

- ☆ If the input phase reverse is detected before the start of rectifier, the rectifier will not start.

D. DC bus voltage low and high protection

- ☆ Software protection point: if the voltage of positive or negative bus is lower than 344V, UPS will transfer to battery mode, if the voltage of positive or negative bus is lower 300V or higher than 440V, UPS will shut down the rectifier.

- ☆ Hardware protection point: if the voltage of positive or negative bus is higher than 460V, UPS will shut off the rectifier, inverter and the charger. If the bypass is within the acceptable range, UPS will transfer to bypass mode.

E. Pulse by pulse current protection

- ☆ If the current of rectifier is higher than 3 times of rated input current peak, the rectifier will trigger pulse by pulse current protection.

F. Over temperature protection of heatsink

- ☆ All the IGBTs are detected, and if the temperature of the IGBT base is higher than 90°C, the rectifier will be shut down.

G. Input inductor over temperature protection

- ☆ If the temperature of input inductor is higher than $160 \pm 5^\circ\text{C}$, the rectifier will be shut off, UPS will transfer to bypass mode.

H. Soft start fault

- ☆ If the rectifier has already finished the soft start and the DC bus voltage is still lower than 150V.

I. Input over current protection

- ☆ If the input current of the rectifier is higher than 4 to 6 times of the current limitation point, UPS will transfer to battery mode immediately.

3.2. Battery converter

3.2.1 Charger

- ☆ If the utility is available and the rectifier is running, the charger will charge the battery automatically.
- ☆ The transfer between constant current charging, constant voltage charging, float charging is automatically and smoothly.
- ☆ The AP990 Series supports VRLA batteries (valve regulated sealed liquid acid battery), nickel-cadmium battery, wet battery.

3.2.2 Battery discharge

- ☆ If the rectifier is shut off or input over current happens, the battery converter will discharge the batteries and supply power to the inverter.

3.2.3 Battery protection and alarm conditions

A. Battery over voltage protection

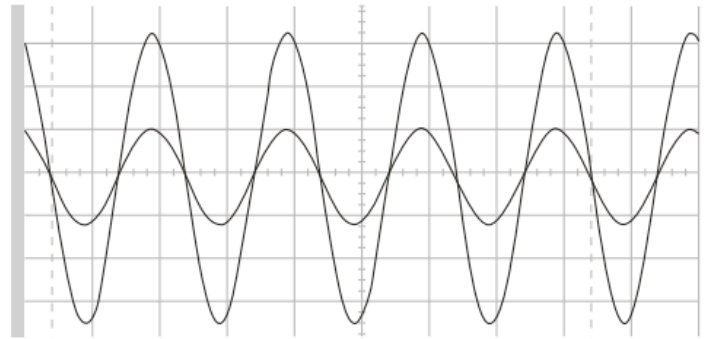
- ☆ Software protection: if the battery voltage is higher than $N_b \times 14.5\text{V}$, battery converter will be shut off. (N_b is the number of cells of the battery bank)
- ☆ Hardware protection: if the battery voltage is higher than $N_b \times 15.0\text{V}$, battery converter will be shut off. (N_b is the number of cells of the battery bank)

B. Battery EOD (end of discharge) protection

- ☆ If the battery voltage is lower than EOD point, battery converter will be shut off. The EOD point is set to 1.65V per cell.

C. Battery discharge pulse by pulse current protection

- ☆ If the current of battery converter is 2 to 2.5 times higher than rated discharge current, the battery converter will trigger pulse by pulse current limitation function.



60KVA input THDi and PF with 380V rating voltage		
	100% linear	100% nonlinear
THDi_A(%)	1.690	2.728
THDi_B(%)	1.472	2.082
THDi_C(%)	1.814	2.244
PF_A	0.9999	0.9999
PF_B	0.9999	0.9999
PF_C	0.9999	0.9999



D. Battery capacity and backup time prediction

☆ When the battery bank is discharged, LCD will display the battery capacity and the backup time, before a period time of EOD

E. Battery converter inductor over temperature protection

☆ If the temperature of battery converter is higher than $160 \pm 5^{\circ}\text{C}$, battery converter will be shut off.

F. Battery reverse alarm

☆ If battery connection is reverse, the battery converter will be shut off, and system will alarm.

G. Battery converter IGBT bridge protection

☆ If battery converter IGBT bridge short circuit fault occurs, battery converter will be shut off.

H. Charger fault alarm

☆ When the battery bank is charging, if the output of battery converter is out of the acceptable error range (10%) for a period of time (5 minutes), the battery converter will be shut off.

3.3. Balance circuit

3.3.1 Function

☆ DC current can be generated by balance circuit to compensate the voltage unbalance between positive and negative DC bus. The total power of the balance circuit is about 20% of the UPS system power.

3.3.2 Protection and alarms

A. Balance circuit over current

☆ If balance circuit bridge short circuit occurs, the balance circuit will be shut off.

B. DC bus voltage unbalance

☆ If the different between positive and negative DC bus exceeds 70V.

C. Balance circuit pulse by pulse current limitation

☆ If the current of balance circuit is 2 to 2.5 time higher than rated balance current, the current pulse by pulse limitation will be triggered.

D. Balance circuit over temperature protection

☆ The temperature of balance circuit is detected, if the temperature is higher than 90 degree, the balance circuit will be shut off.



3.4. Inverter and bypass

(1) Strong overload capability of inverter:

- ☆ 105% long time operation
- ☆ 110%, transfer to bypass after 1 hour
- ☆ 125%, transfer to bypass after 10 minutes
- ☆ 150%, transfer to bypass after 1 minutes.
- ☆ 150%, transfer to bypass after 200mS

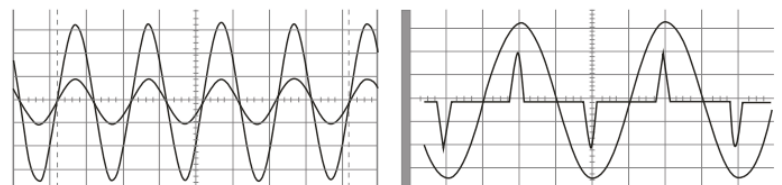
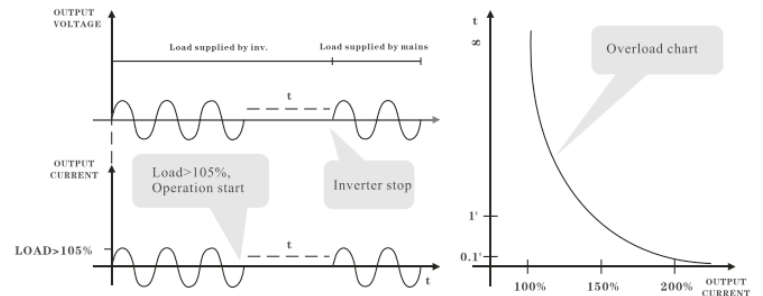
Even strong overload capability of the bypass:

- ☆ 150%, long time operation
- ☆ $150\% < \text{load} < 180\%$, last for more than 1 minutes.
- ☆ $> 1000\%$, last for more than 100ms

(2) Modern advanced digital control technology is applied.

Thus the inverter has the capability of compatible with all kinds of loads.

meanwhile, the output voltage THD is very low.



3.4.1 Bypass configuration

3.4.1.1 Transfer window

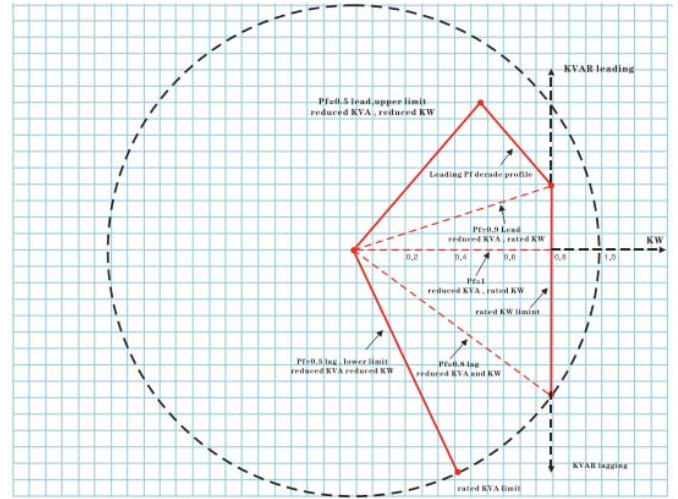
- ☆ The definition of the transfer window is to judge whether the transfer between inverter and bypass is interruptible or uninterruptible. If the bypass voltage or frequency exceeds the acceptable range, UPS will perform interruptible transfer.
- ☆ The voltage transfer window is -20% to +15% of the rated voltage.

3.4.1.2 Synchronize window

- ☆ When the bypass voltage and frequency are within the synchronize window, the inverter can trace the bypass. When voltage or frequency exceeds the synchronize window, inverter will not trace the bypass.
- ☆ The bypass synchronize window can be set by the customer. The frequency synchronize window is $\pm 0.5\text{Hz}$ to $\pm 5\text{Hz}$ of the rated frequency, default is $\pm 3\text{Hz}$.

3.4.1.3 Bypass protection range

- ☆ When the bypass voltage or frequency is beyond protection range, means that the bypass is not available to the load.
- ☆ The bypass protection range includes top limit and bottom limit. Voltage top limit can be +10%, +15% or +20%, default is +15%. Voltage bottom limit can be -10%, -20%, -30% or -40%, default is -20%. Frequency protection range can be $\pm 10\%$ or $\pm 20\%$, default is $\pm 10\%$.



Notes:
 Safe operating area is within the solid red lines for displacement power factor balance 3-phase load
 Safe operating area limits can be exceeded for transient load as described in the PRS

3.4.2 Function

3.4.2.1 Inverter on and off control

- ☆ The inverter can be turned on manually by pushing the "INV ON" button or "FAULT CLEAR" button when fault is fixed. When utility recovers, the inverter will be turned on automatically. The inverter can be turned off manually or automatically when fault is detected. Some serious faults, such as static switch fault, will shut off the inverter forever until system power off.

3.4.2.2 Output transfer logic

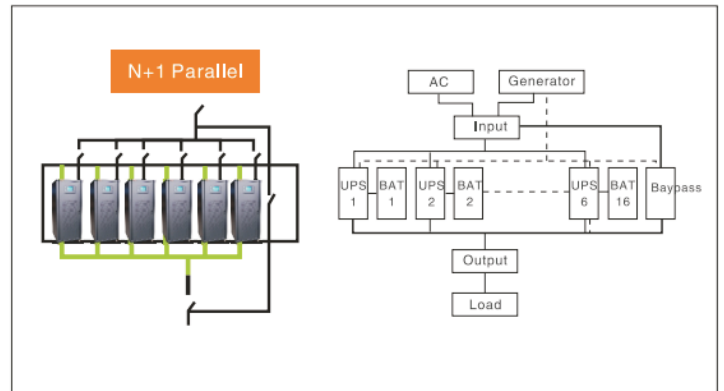
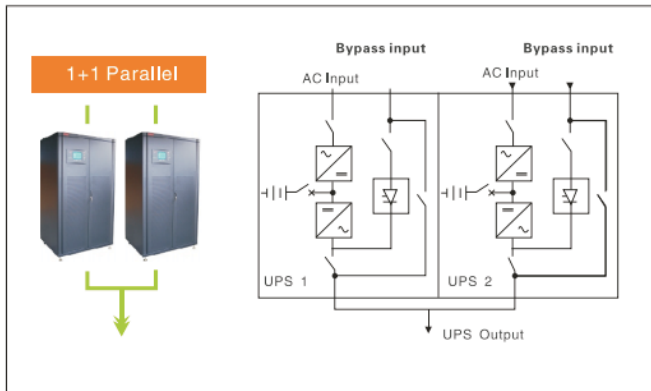
- ☆ The software transfer logic can choose the transfer mode automatically. The transfer mode depends on the bypass mode, inverter status and the fault information. If the bypass is inside the synchronize window, the phase difference between inverter and bypass will be less than 5 degree.

3.4.2.3 ECO (economy operation) mode

- ☆ On ECO mode, the load is feed through the static bypass, and the inverter is on hot standby status. This mode can achieve high efficiency of 98%.

3.4.2.4 Parallel operation

- ☆ Six units of AP990 series UPS can be paralleled together. Flexible operation logic can ensure the high reliability and stability of the parallel system. The digital parallel logic can arrange all the action of all the inverters inside the parallel system.





3.4.3 Protection and alarms

A. Bypass static switch fault protection

- ☆ If one of the bypass static switch short circuit, inverter will be shut off immediately. LCD will display the alarm information, UPS will transfer to bypass mode until system power off.

B. Inverter static switch fault protection

- ☆ If the UPS is on bypass mode and the inverter static switch fault is detected, the transfer from bypass to inverter will be forbidden until system power off.

C. Bypass phase reverse protection

- ☆ If the bypass phase is reverse, UPS will not feed the load on bypass mode.

D. Inverter heatsink over temperature protection

- ☆ The temperature of all the IGBTs are detected. If the temperature of one IGBT base exceeds $90\pm 5^{\circ}\text{C}$, inverter will be shut off and system will transfer to bypass mode. After the temperature drops, system will transfer to normal mode automatically.

E. Output inductor over temperature protection

- ☆ If the temperature of output inductor is higher than $160\pm 5^{\circ}\text{C}$, inverter will be shut off and system will transfer to bypass mode.

F. Inverter fault protection

- ☆ If the inverter output voltage still exceed CBEMA curve after a period time of start, inverter fault will be detected. System will transfer to bypass mode, LCD and buzzer will give out fault information. After pushing the button "FAULT CLEAR", UPS can transfer to normal mode.

G. Inverter bridge short circuit protection

- ☆ If short circuit of inverter is detected, inverter will be shut off immediately.

H. Operation mistake

- ☆ When inverter is online, if the maintenance bypass switch is closed, inverter will be shut off immediately, UPS will transfer to bypass mode.
- ☆ When the maintenance bypass switch is closed, inverter cannot be turned on manually.

I. DC bus voltage abnormal fault

- ☆ If one of the DC bus voltages is higher than 470V or lower than 330V, and lasts for a period of time, inverter will be shut off, UPS will transfer to bypass mode.

J. Inverter overload transfer

- ☆ On overload condition, UPS will transfer to bypass mode after a period of time. After that, the inverter will be on hot standby status.
- If overload condition disappears, system will transfer to normal mode. The transfer is limited to 5 times per hour.

K. Inverter pulse by pulse current limitation

- ☆ If inverter current is higher than 2 to 3 times of rated current, current pulse by pulse limitation will be triggered. On condition of output short circuit, inverter will be protected by this function.

L. Fan fault detection

- ☆ The fault of every fan in UPS can be detected. According to the fan number and the list on the operation manual, the fault fan can be easily found.

M. Inverter asynchronize

- ☆ If the inverter cannot synchronize with the bypass, system will alarm.

N. Parallel system current unbalance

- ☆ If one of the currents unbalances in parallel system exceeds 30%.

3.5 Auxiliary power supply

- ☆ Two auxiliary power supplies are applied for 1+1 redundancy. Each one can supply system control circuit independently. If one fails, the other one can continue to supply the system.

3.6. Internal monitoring

3.6.1 Human machine interface

3.6.1.1 LCD display

A. UPS information

- ☆ UPS name
- ☆ UPS model
- ☆ Time and data
- ☆ Unit number of parallel system
- ☆ UPS alarm information

B. Real time data

- ☆ All the parameters listed below are displayed on LCD, the display error is less than 2%.

Main input

- ☆ Three phase main input phase voltage
- ☆ Three phase main input current
- ☆ Three phase main input frequency
- ☆ Three phase input power factor

Bypass input

- ☆ Three phase bypass input phase voltage
- ☆ Three phase bypass input current
- ☆ Bypass input frequency

UPS output

- ☆ Three phase output voltage
- ☆ Three phase output current
- ☆ Three phase power factor
- ☆ Three phase output frequency

Load information

- ☆ Three phase load percentage
- ☆ Three phase output active power, apparent power, reactive power
- ☆ Load power factor

Battery

- ☆ Battery voltage
- ☆ Battery current
- ☆ Battery backup time prediction
- ☆ Battery temperature
- ☆ Battery capacity

Parallel load

- ☆ Three phase apparent power
- ☆ Three phase active power
- ☆ Three phase reactive power

3.6.1.2 LED display

System power flow is display through 5 colorful LED, which indicate the status of the following:

Rectifier/charger

- ☆ Battery
- ☆ Bypass
- ☆ Inverter
- ☆ Load

When LED is green, means the corresponding circuit is working normally. When LED is red, means the corresponding circuit is not working normally.

When LED is extinguish, means the corresponding circuit is standby.

3.6.1.3 Button

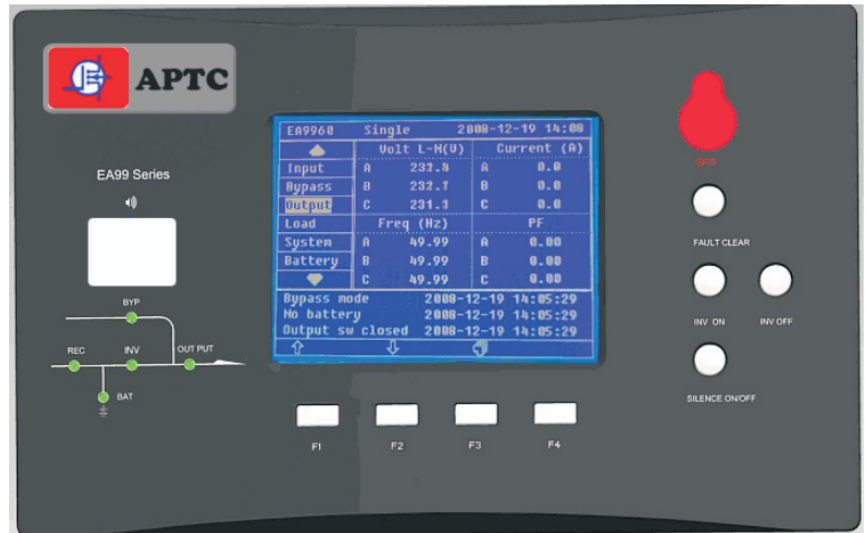
- ☆ There are 9 buttons on the panel, including 5 menu buttons, inverter on button, inverter off button, EPO (emergency power off) button, mute button, and fault clear button.
- ☆ Four menu buttons can be used to choose the LCD menu.
- ☆ Inverter on button is used to turn on the inverter.
- ☆ Inverter off button is used to turn off the inverter.
- ☆ EPO button is used to shut off the system quickly on emergency condition. When EPO button is pushed, the rectifier, inverter, bypass and the battery converter are all turned off.
- ☆ Fault clear button is used to reset the UPS from fault lock status.
- ☆ Mute button is used to turn off the buzzer.

3.6.2 External interface

- ☆ All kinds of input and output dry contacts are supplied, including generator connection signal, UPS fault output signal, external battery switch status signal, external battery switch drive signal, etc.
- The measurement module can measure the environment and battery temperature.

3.6.2.1 Interface with battery cabinet

- ☆ The external battery temperature sensor can be connected to UPS. The battery temperature can be displayed on LCD, and the temperature compensation is realized in battery management module. The battery temperature measurement error is less than 3%.



C. History record

- ☆ When new alarm or fault detected, the history record will be updated immediately.
- ☆ Up to 10000 history records

D. Language

- ☆ Support two languages: Chinese and English.

E. Settings

- ☆ Date and time format
- ☆ Data and time
- ☆ Communication address
- ☆ Communication mode
- ☆ Com1 baud rate
- ☆ Com2 baud rate
- ☆ Com3 baud rate
- ☆ Company telephone number

F. Command

- ☆ Battery maintenance
- ☆ System diagnose
- ☆ Stop testing



3.6.2.3 RS-232 and RS485 communication

- ☆ RS-232 and RS485 can be used for local communication.

3.6.2.4 Intelligent card

- ☆ AP990 series UPS is configured with Modbus and SNMP cards for remote communication.
- ☆ AP990 series UPS has extend communication ports, which can be connected to all kinds of network. UPS status can be monitored by central monitoring system of customer.

Compositive SNMP port

- ☆ The SNMP card is installed inside the UPS, and UPS can be connected to Internet through TCP/IP protocol. Thus the UPS can be managed by any computer in the Internet.

3.7 Battery management

3.7.1 Introduction

- ☆ AP990 series UPS has intelligent battery management, which supports the battery type of VRLA (valve regulated sealed liquid acid battery), nickel-cadmium battery, wet battery.

3.7.2 Basic function

A.Constant current charging

- ☆ The charging current on this mode can be set to the maximum of charging power.

B.Constant voltage charging

- ☆ The charging voltage should be set according to the battery type.
- ☆ The maximum charging voltage should be lower than 2.4V for VRLA battery.

C.Float charging

- ☆ Float charging voltage can be set according to battery type.
- ☆ The float charging voltage should be between 2.2V and 2.3V for VRLA battery.

D.Float charging compensation (optional)

- ☆ The compensation parameter can be set according to battery type.

E.Battery EOD protection

- ☆ If battery voltage is lower than EOD point, battery converter will be shut off.

3.7.3 Advanced function

A.Battery maintenance

- ☆ The battery maintenance can be started through the panel. After starting this function, system will transfer to battery mode to test the batteries. After finishing the test, system will transfer to normal mode automatically.

B.Battery capacity prediction

- ☆ For VRLA battery, if the battery has been fully discharged, the battery capacity curve will be recorded. If the battery has never been fully discharged, customer can start battery capacity prediction manually to discharge the battery to EOD. If the capacity curve does not exist, the default VRLA battery curve will be applied.
- ☆ The remaining capacity of battery will be displayed when battery bank is discharging. For nickel-cadmium and wet battery, the default capacity curve is applied.

C.Backup time prediction

- ☆ The backup time prediction is based on the current load.
- ☆ When environment temperature is 25 degree, the prediction error will be lower than 10%.

D.Short backup time alarm

- ☆ Before a period time of battery EOD, UPS will give out alarm information. This time can be set from 3 minutes to 30 minutes.

3.8. Modularized design, fully front maintenance

- ☆ Modularized design makes EA990 very convenient to maintain. All the maintenance can be realized by opening the front door. All the subsystems of the UPS are designed to independent modules, thus increase the convenience of manufacturing and maintenance.

3.9 Options

- ☆ Main back feed protection and bypass back feed protection kits
- ☆ Battery start kit
- ☆ Battery leakage protection kit
- ☆ Lighting protection kit
- ☆ Inner output transformer

