Development of Small - Capacity UPS "SANUPS ASE"

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1. Introduction

Supplying steady and high-quality power to computers sensitive to voltage fluctuations is essential for today's network systems to function properly for running IT business smoothly as IT technology continues to develop. It is through this purpose that more and more communication equipment such as servers connected to the Internet are equipped with an uninterrupted power supply (hereafter referred to as UPS). With the cost of such a load device coming down, the competition has become more intense, particularly in the 1kVA class market.

There is also a growing demand to control power consumption to meet environmental concerns.

It is against this backdrop that we have developed a new product, "SANUPS ASE," with the greatest emphasis placed on a stable power supply, the same as before with our conventional models while ensuring compact size, easy operation, network compatibility, as well as improvement in maintenance and cost performance.

This article outlines "SANUPS ASE."

2. Background to Development

2.1 High Quality/Low Price

Of all the UPS markets, the fiercest price war is being fought on the 1kVA class UPS market where so many models are offered by so many players who opt for the cheap "Line interactive system/Off-line power supply system" as a trade-off for performance.

In contrast, Sanyo Denki has always adopted the "Continuous inverter power supply system/On-line power supply system" to ensure high quality power will be supplied. Currently available on the market from Sanyo Denki is the "SUNUPS ASC" Series. However, we find the "SANUPS ASC" Series (1-5kVA) not good enough for us to stay competitive on the 1kVA class market. We need a new model with a "Continuous inverter power supply system/On-line power supply system" that can satisfy the need for high-quality power supply and low price.

2.2 Environmental Consideration

In response to growing concern about global warming, there is a growing demand for a UPS with environmental considerations reflected in its design and a highly energy efficient.

"SANUPS ASE" is what we have developed to meet such a demand.

3. Features

"SANUPS ASE" has been developed to give us a competitive edge over the traditionally intensive 1kVA market.

With the development of 1kVA, 100V type/single unit system completed, it already has been launched onto the market.

Fig. 1 shows "SANUPS ASE"

Fig. 1 "SANUPS ASE"

3.1 High Efficiency/High Power Factor

(1) 3-arm continuous inverter power supply system

Today we see the "Line interactive system/Off-line power supply system" used for an increasing number of UPSs as a means to achieve high efficiency. But this system may often fail to respond millisecond failure in commercial power supply, often damaging the load equipment such as computers.

For this new product, the 3-arm-type continuous inverter system has been used in the main circuit to achieve high efficiency of the already proven continuous inverter power supply system. The first arm is for the input converter, the third arm is for the output inverter, and the second arm is shared by the both.

The overall efficiency of the entire system from the AC input to the overall output has been improved by some 10% to as high as 91% (in rated operating condition).

"High power factor converter control" is used for the rectifier in the input, achieving a significant reduction of harmonics. Further more, the input voltage and input current are always controlled in the same phase to eliminate reactive power, thus reducing the input capacity to allow the power receiving facility to be put to effective use.

3.2 High Reliability/Economy

(1) Improving MTBF

We have introduced the 3-arm main circuit and reviewed the circuit to simplify the circuit configuration, thus reducing the number of components.

The control circuits for the UPS are all digital using DSP (Digital Signal Processor) to reduce the number of components.

All these resulted in some 50% reduction of number of components as compared with conventional models, contributing to the improved MTBF (Mean Time Between Failures).

(2) Stable power supply/Sine Wave Output Less Stressful to Load Devices

On the continuous inverter power supply system, there is no output switching time, which proved to be problematic when an input error occurs with the line interactive system/Off-line power supply system. Power continues to be supplied to the load devices uninterrupted even at the time of power supply troubles, such as power outage, momentary outage, voltage fluctuation, high frequency noise, and frequency fluctuation.

Further more, the output voltage waveform is sine wave, which is less stressful to the load devices and matches them perfectly.

(3) Economy

We try to use as many overseas components as possible to keep the cost down.

All such components supplied from overseas are subject to the same vigorous inspection and control as domestically supplied components to maintain good quality.

3.3 Compact/Light weight and Rack-Mountable

As a result of the reduced number of components in the main circuit and the fully digitaled control circuit, the total number of components used is now half that used in conventional models, making the product more compact and lighter. The continuous inverter power supply system UPS of 380mm (W)×405mm (D)×86mm (H) is one of the smallest in the industry.

It can be installed anywhere as it can be mounted vertically, horizontally, or on a 19-inch rack (2U).

Fig. 2 is a sample installation of "SANUPS ASE".

Fig. 2 Sample Installation of "SANUPS ASE".

3.4 Output Outlet Control

It is equipped with the continuous output outlet 1 line (commercial power is supplied when UPS is stopped) and the line control function outlet 2 line to provide both a reliable power supply and ease of control.

Typical connection samples are given below:

(1) System configuration sample 1 (To control the power supply to the peripherals and a stand-alone computer system)

"SANUPS ASE" used in conjunction with "SAN GUARD IV Lite" can control the power supply from a computer to its peripherals. Using its setting function allows power to be sequentially supplied or shut off to the load, and Windows NT to be shut down. Fig. 3 is System Configuration Sample 1.

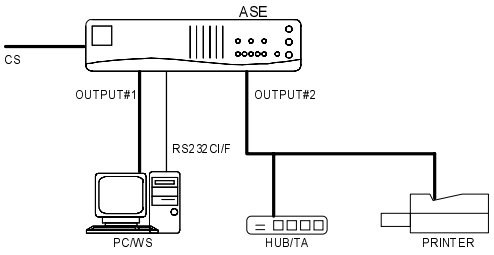

Fig. 3 System Configuration Sample 1.

(2) System configuration sample 2 (To automatically control the power supply, or to control it from the server which is connected to the continuous output while multiple computers are connected to the controllable output)

The continuous output outlet (OUTLET#0) continues to supply power to the load even if the UPS is stopped or faulty. Therefore, compared to the outputs that can be controlled separately (OUTPUT#1, #2), this configuration, despite its highly reliable power supply, has some limitations on the control, such as turning it on and off. Fig. 4 is System Configuration Sample 2.

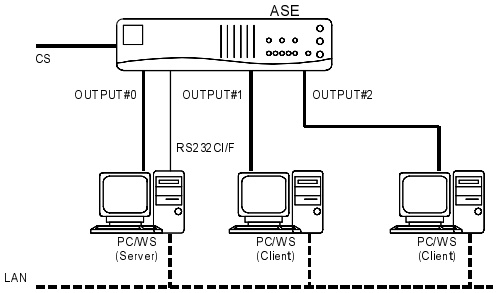

Fig. 4 System Configuration Sample 2

(3) System Configuration (To feed power to multiple computers and manage and control these power supplies remotely)

Using "SANUPS ASE" in conjunction with "SAN GUARD IV Lite" and "SAN GUARD IV Integrated Control" allows managing multiple system groups, in each of which multiple computers are connected to a single "SANUPS ASE". Fig. 5 is System Configuration Sample 3.

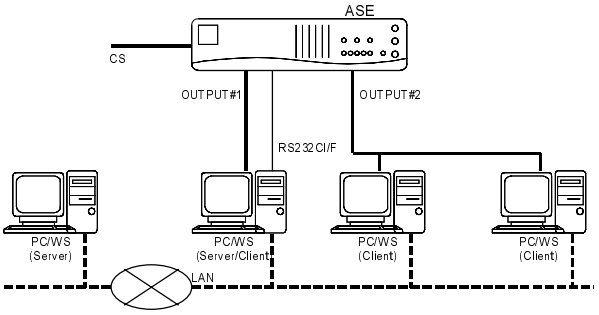

Fig. 5 System Configuration Sample 3

3.5 Supporting Network

To support UPS control in the network environment, various communications with computers are required.

"SANUPS ASE" comes with RS-232C as standard feature, as opposed to it being optional with conventional models, making Windows NT UPS service etc. available via the connector cable provided as a standard accessory.

The "Ring signal send function" added as a new feature now enables a PC to be activated by modem's "ring signal" send function.

Using the optional LAN interface card in conjunction with the UPS management software "SAN GUARD IV" enables "SUNUPS ASE" to provide strong support to the network environment. Its features are as follows:

(1) Capable of safely controlling multiple (up to 10) computers connected to one UPS via network safely.
(2) Capable of controlling the status of UPS using a Web browser.
(3) No need to install UPS management software in WS (Unix, Linux).
(4) Applicable to sophisticated server systems such as clustering configurations.
(5) Relieves the network manager's workload, thanks to the significant improvement on the UPS management capability.
(6) Schedule operation cuts down on power consumption and automated operation provides effective power supply.

Fig. 6 shows the interface card, and Fig. 7 shows a sample network connection.

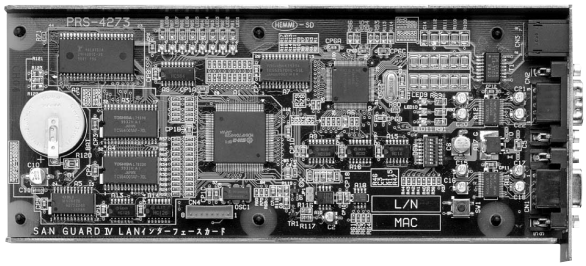

Fig. 6 Interface Card

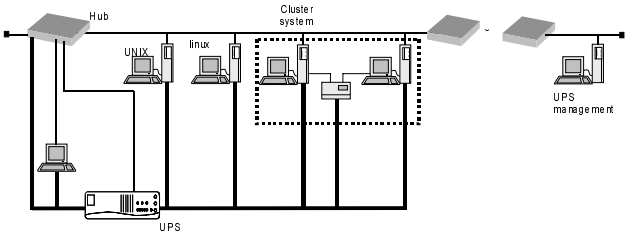

Fig. 7 Sample Network Connection

3.6 Ease of Maintenance/Reducing Maintenance Cost

With more and more computers incorporated into networks running 24 hours continuously, we are having an increasing number of cases where power cannot be cut off even when maintaining the UPS.

"SANUP ASE" has a battery built into a plastic tray which can be easily detached, making hot-swap possible where the battery can be replaced without having to shut down the system.

In addition, the optional maintenance bypass unit allows you to inspect and service the UPS, including replacing its parts without turning off the power supply to load devices such as computers.

The battery, which is a consumable part, lasts as long as 5 years, reducing the cost of maintenance involving battery replacement.

The fan motor, which is another consumable part, has a longer service life because the temperature generated inside the UPS is reduced to increase efficiency, consequently lowering reducing fan motor temperature. The UPS is also constructed such that the fan motor is replaced easily, a measures for the day when the service life is over. Fig. 8 shows the internal construction of the unit.

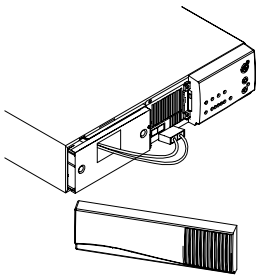

Fig. 8 Internal Construction of the Unit

3.7 Wide I/O Range

Four types, 100V, 110V, 115V, and 120V are available to select according to the input/output voltage to be used.

3.8 Options

Various options are available to meet the specific user needs. Such options are as follows:

(1) Long discharging time battery (15, 30, 45, 60, 180 min)
(2) Rack mount tools
(3) LAN interface card
(4) Dry contact I/O card
(5) Maintenance bypass unit

4. Circuit Organization

Fig. 9 is the block diagram of "SANUPS ASE" unit circuit.

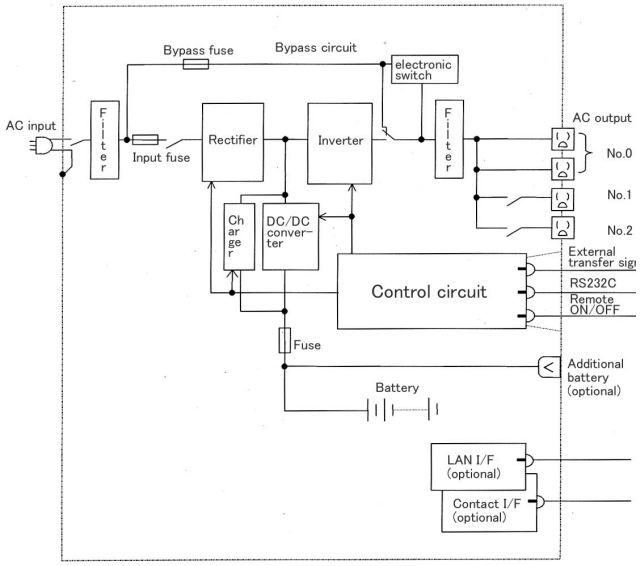

Fig. 9 Circuit Block Diagram

4.1 Main Circuit Configuration

"SANUPS ASE" consists of a high power factor converter, inverter, charger, output selector switch, bypass circuit, and battery.

(1) Newly developed 3-arm continuous inverter system is introduced to achieve high efficiency and reduction in the number of components used.

(2) Battery voltage is boosted via high frequency transformer to reduce the size.

4.2 Control Circuit Organization

In "SANUPS ASE", control of UPS is made by DSP, and sequence control is made by CPU.

(1) Control

The converter, inverter, DC/DC (stepping up battery voltage), and various detection and protection are all controlled by a single DSP. As a result, the number of control circuit components is reduced by 60%.

Fig. 10 is the block diagram of the new controls.

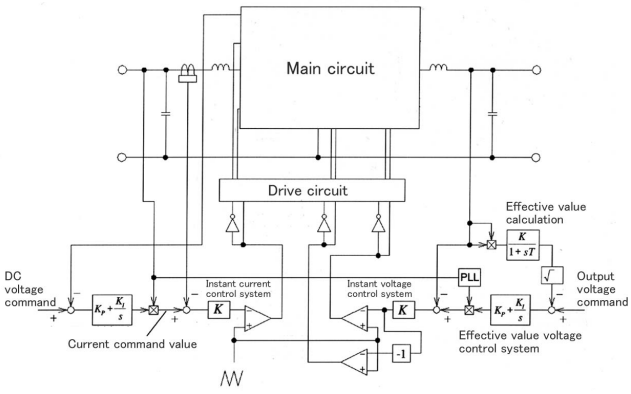

Fig. 10 DSP Control Block Diagram

(2) Sequence

The status transition sequence is introduced to replace the logic sequence used for conventional models.

This reduces the memory capacity to 70%, allowing a cheaper CPU to be selected to achieve the low price.

Fig. 11 is a typical status transition sequence adopted for this model.

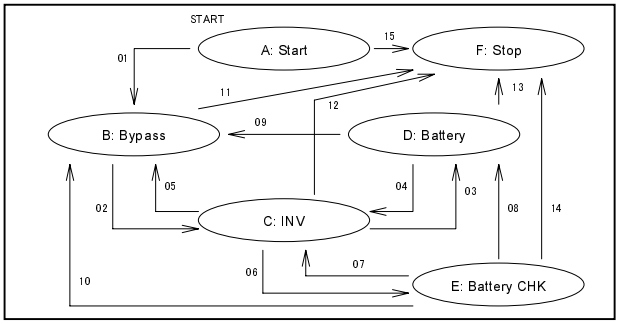

Fig. 11 Status Transition Sequence

4.3 Electrical Characteristics

Table 1 lists the standard specifications of "SANAPS ASE".

5. Conclusion

Increasingly sophisticated IT technology will bring with it highly reliable and more network-oriented computers running on the Internet, demanding that UPSs deliver lower cost, higher reliability, higher performance, and compactness.

We are determined and ready to respond to such demands swiftly by developing products that meet these demands to the greatest satisfaction of our customers.

Finally, we would like to express our heartfelt gratitude to many for their assistance in our developing and producing the product.

Table 1 "SANUPS ASE" Standard Specifications

Item			Standard or Property	Remark
Output capacity			1KVA/0.7kW	-
Cooling system			Forced air cooling	-
AC INPUT	Number of phases		Single phase 2-wire	-
	Voltage		100, 110, 115, 120V within ±15%	Switch selectable (same as with output voltage
	Frequency		50Hz or 60Hz ±1, ±3, ±5%	Fluctuation range depends on output frequency accuracy setting
	Required capacity		0.9kVA	Maximum capacity with battery fully charged
	Input power factor		0.95 or more	For rated output
AC OUTPUT	Number of phases		Single phase 2-wire	-
	Voltage		100, 110, 115, 120V	Switch selectable
	Voltage setting accuracy		Within ±2%	-
	Frequency		50Hz or 60Hz	Same as input frequency(Auto select)
	Frequency accuracy		Rated frequency ±3.0% (when in sync with commercial power supply)	1, 3, 5% switch selectable For free running oscillation: within ±0.5%
	Voltage waveform		Sine wave	-
	Voltage waveform distortion rate		For linear load: Within 3% For 100% rectifier load: Within 7%	For rated output
	Transient voltage fluctuation	Load sharp change	Rated voltage within ±5%	0 <-> 100% change or change output
		Power outage/return		For rated output
		Input voltage sharp change		±10% change
	Response time		Within 3 cycles	-
	Load power factor		0.7 (delay)	Fluctuation range 0.7 (delay) - 1.0
	Over-current protection action		Switches automatically to bypass circuit if 105% - 120% is exceeded	With auto-return function
	Overload capacity	Inverter	105% - 120%	1 min
			120% or more	Instant
		Bypass	200%	30sec
			800%	2 cycles
Battery	Type		Small seal lead storage battery	-
	Rated capacity		7A h	20 hour rate
	Quantity		3 (12V/piece)	-
	Backup time		6min (700W) 10min(500W)	For rated load at 25℃ ambient temp
Ambient condition			Ambient temp 0 – 40℃ RH: 30 - 90%	-
Noise			40dB or less	1m from the front, A characteristic

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