SANYO DENKI TECHNICAL REPORT No.9 May-2000
Features: Technical Developments in 1999

Development of Medium-capacity UPS "AMB T3"

Shinichi Morita Shigeya Koyama Toshinori Misaidu
Mitsuru Takasugi

1. Introduction

Recent advances in technology with telecommunications equipment are eye-catching. Computers and various other electronics devices are being downsized quickly, and uninterruptible power supplies (hereinafter referred to as "UPS") that feed them are also being required more than ever to become smaller in size and lighter in weight. To meet these requirements, we developed "SANUPS 030 AMB," a fully remodeled version of the traditional medium-capacity UPS. This product was developed to achieve a reduction in size and weight and increase ease of assembly and maintenance, by means of a floating converter (hereinafter referred to as "F-CONV") based on a semiconductor insulation system, instead of the traditional input/output insulation based on an inverter transformer.

2. Features

Here is a description of the major features of this UPS.

2.1 Reduction in Size and Weight

The "AMB" incorporates an F-CONV and an advanced system for mounting components for the input/output insulation component, instead of the insulation transformer used in traditional models. As a result, in comparison with the traditional model of "AMA," when 20kVA is applied, the new product achieved a reduction by 55% in volume, 45% in weight, and 40% in footprint. Fig. 1 shows an external view of the "AMB." In components of 20kVA and lower, we considered the possibility of their being installed in offices. We therefore installed a caster on the bottom of the unit and constructed a structure that facilitates installation and relocation.

2.2 Improved Maintainability and Safety

UPSs incorporate a battery, cooling fan and other components that need periodic replacement. This UPS is based on a unit structure that allows servicepersons to take out only the components that need replacement or maintenance. The result is improved convenience in maintenance. We also used an optional maintenance bypass box to separate it from the UPS, thus making the system a completely non-voltage system. The result is even higher electric safety during servicing as compared to traditional models.

Fig. 2 shows an external view of the unit.

2.3 Network Connectivity

UPSs these days need not only traditional interfaces based on contact signals but also various interfaces with computers. This UPS comes with a serial interface fro communications between the UPS and a computer as standard equipment, in order to convey measurement, monitoring, control and more detailed information, in addition to a contact-based external interface. The serial interface can be provided with special-purpose software "SAN GUARD Ⅲ "installed on the computer, so that the user can use

automatic shutdowns at the time of blackouts, along with scheduled runs, operation status displays, display of measurements and other functions.

The user can also mount an optional LAN interface card, so that he or she can manage the network by means of Sanyo Denki's UPS management software "SAN GUARD Ⅳ."

Fig. 3 shows a typical configuration when an interface is used.

2.4 Specifications and Options

This UPS have a input and a output of 3 phases, 3 wires and 200V. Its capacity system ranges from 10kVA to 30kVA. Table 1 shows the major specifications of the 20kVA type.

In addition, there are a wide variety of options, including an extended backup time for blackouts, maintenance bypass box, and input/output abnormal voltage response.

Table 1 Standard specifications of "AMB"

Item		Standard specifications
Rated capacity		20kVA/16kW
System	Rectifier system	High power factor converter
	Inverter system	PWM inverter
	Insulation system	Semiconductor insulation system
AC input	Frequency	50/60Hz ± 5%
	Number of phases	3 phases, 3 wires
	Voltage	200V ± 10%
	Power factor	0.95 and above
	Current distortion factor	5% and below
AC output	Frequency	50/60 Hz
	Number of phases	3 phases, 3 wires
	Voltage	200V
	Voltage precision	± 2% and below
	Transient voltage fluctuations	± 5% and below
	Voltage distortion factor	5% and below (under a 100% rectifier load)
	Load power factor	0.8
Battery	Backup time	Approx. 10 minutes
	Type	Small size sealed lead-acid battery
Other	Operating conditions	Ambient temperature, 0–40°C; humidity, 90% and below
	Noise	57dB and below
	Cooling system	Forced air cooling
	Outside dimensions	500(W)×700(D)×1350(H) mm
	Weight	Approx. 460kg

3. Circuit Configuration

Fig. 4 shows a block diagram of the main circuit of this UPS. The main circuit consists of an input/output filter, high power factor converter, F-CONV, PWM inverter, output switching circuit, and other components.

The control circuit consists of a control unit that runs and controls the UPS, and an intelligent unit that provides guidance, trouble displays, battery checks, displays of measurements and other functions.

3.1 Configuration of the Main Circuit

Unlike traditional models, the main circuit of the new product incorporates a semiconductor-based F-CONV instead of an insulated transformer. The F-CONV

employs a trench gate IGBT module based on a low ON-voltage, thus achieving an overall efficiency of at least 85%. The high power factor converter and the PWM inverter employs an intelligent power module incorporating six elements, thus greatly reducing the number of components, such as snubber circuit and drive circuit.

The F-CONV insulates the DC output of the high power factor converter and the DC input of the inverter, while controlling the inverter input voltage on a constant voltage basis. Fig. 5 shows a circuit configuration of the F-CONV. The F-CONV consists of four switching elements (IGBTs) and a reactor. The two primary switching elements and the two secondary switching elements are switched on a time-sharing manner to insulate the primary from the secondary. Turning on the Tr1 and Tr2 at the same time in a circuit as shown in Fig. 5 generates a current in L1, resulting in energy being accumulated. At that time, the D1 and D2 on the secondary are off. Turning off the Tr1 and Tr2 discharges energy accumulated in the L1 to the secondary C2 via the D1 and D2. Since the primary IGBTs and the secondary diode are not turned on simultaneously, no current flows between the primary and the secondary, resulting in the system being insulated.

This obviates the need for an insulated transformer, making it possible to downsize the unit.

With this UPS, the secondary switching element can be equipped with an IGBT module to convey power bi-directionally. Voltage fluctuations are therefore suppressed in transient conditions such as quick load changes and output switching.

3.2 Configuration of the Control Circuit

This UPS was equipped with an additional communications function, in addition to the basic control, monitoring, measurement, LCD display and other conventional functions of UPSs.

The system consists of a sequence controller that controls the UPS and an intelligent unit that controls monitoring, measurement, display, communications and other functions. These were integrated into one unit to make the system compact.

4. Conclusion

We have so far given an overview of the "AMB." It is expected that computers will be further networked and decentralized, with the scope of UPSs spreading. We are determined to be committed to increasing not only reliability but also adaptability to the networked society and eco-friendliness while improving product quality and functions.

We would like to express our thanks to many people who gave us help and advice in developing and manufacturing this equipment.

Shinichi Morita
Joined company in 1986
Power Systems Division, 1st Design Dept.
Worked on development and design of uninterruptible power supplies

Shigeya Koyama
Joined company in 1989
Power Systems Division, 1st Design Dept.
Worked on development and design of uninterruptible power supplies

Toshinori Misaidu
Joined company in 1992
Power Systems Division, 1st Design Dept.
Worked on development and design of uninterruptible power supplies

Mitsuru Takasugi
Joined company in 1988
Power Systems Division, 1st Design Dept.
Worked on development and design of uninterruptible power supplies

fig. 1 External view of the ″AMB″

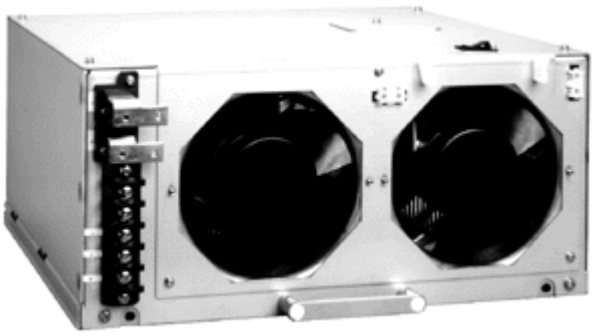
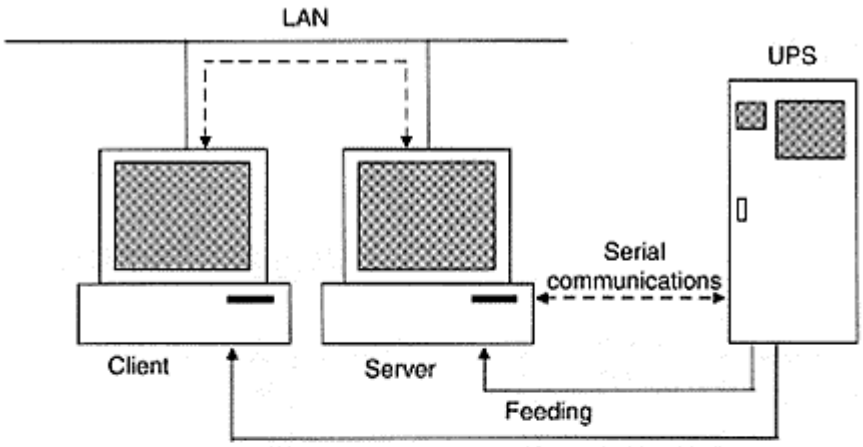
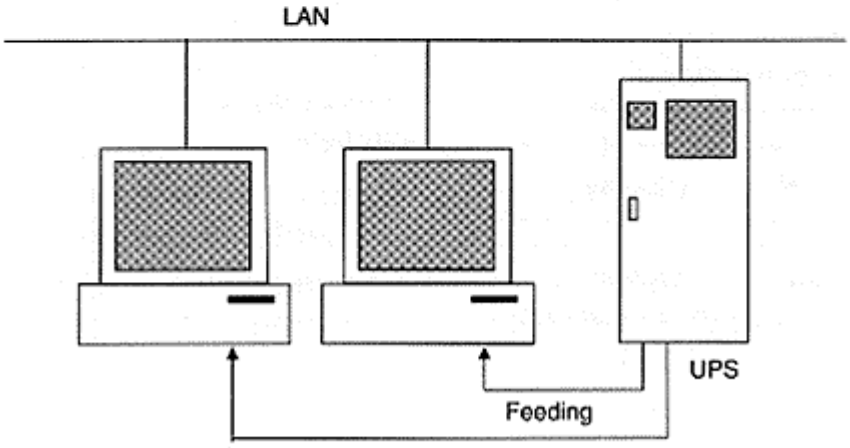


fig. 2 External view of a typical unit



(1) A typical system when equipped with SAN GUARD III



(2) A typical system when equipped with SAN GUARD IV

fig. 3 Typical system configuration

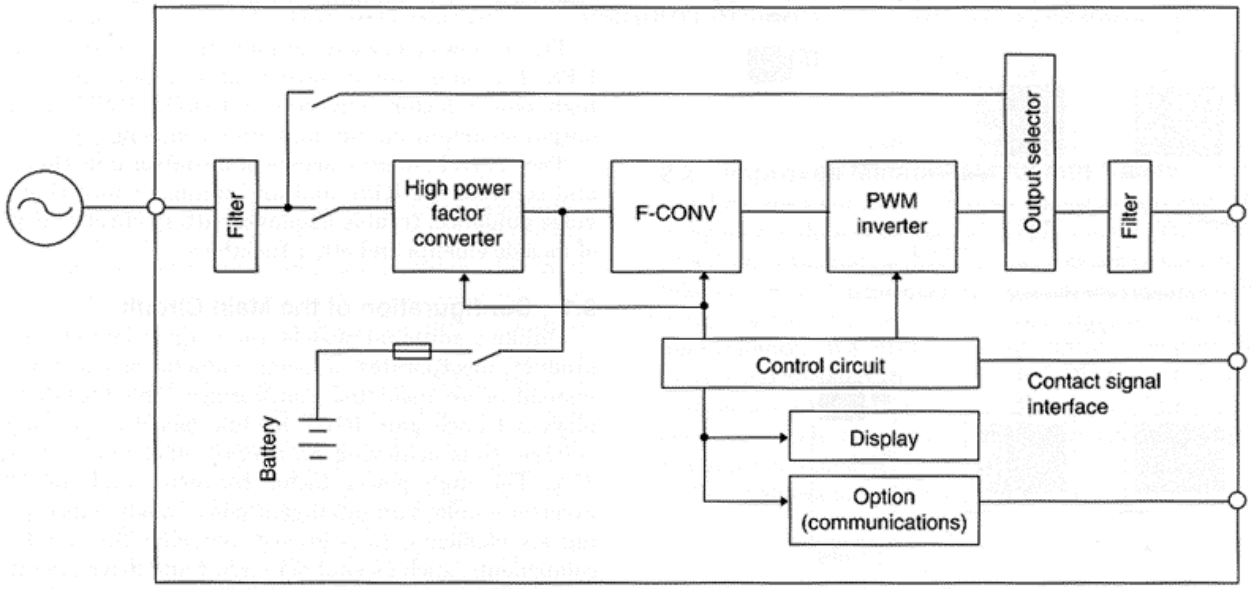


fig. 4 Block diagram of the main circuit

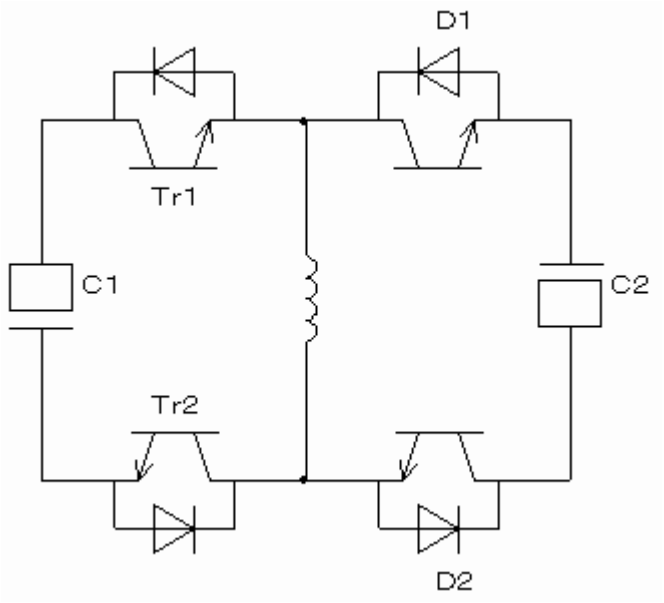


fig. 5 Circuit configuration of the F-CONV