e-Front runners

All IGBT Type

Fuji Large-capacity UPS

UPS6000F Series

Three-phase 100 to 1,000kVA

Fuji Electric Systems Co., Ltd.

REC 82-2d

Fuji's UPS for today's computerized world

On-line support for all applications

UPS6000F Series

Data communication devices and computers constitute the backbone of society today and so require utmost reliability.
First and foremost, a stable power supply without momentary failures is indispensable.
Fuji Electric dominates the market for UPS which protect such devices and systems against power failures and disturbances.
The Fuji UPS6000F series features the latest in power electronics, systems, digitization and high-frequency switching. It also offers outstanding load matching and suppression of harmonic currents commonly found in electronic devices.

UPS: Uninterruptible Power System

- **Internet data center**
- **Financial institutions (banks, insurance companies, securities firms)**
- **Public services (satellites, broadcasting, media, telecommunications)**
- **Totalizer systems (horse races, cycle races)**
- **Traffic control systems (aviation, railroad, automobile)**
- **Plants (utilities, industrial, etc.)**
- **Telecommunications, new media (VAN, INS, etc.)**
- **Other (information processing services, medical systems, etc.)**

Features

All IGBT type UPS

PWM rectifier

- High input power factor: 0.98 or higher (almost 1.0)
- Low input harmonic content: 5% or less (needs no external filter)
- Power walk-in function provided as standard (soft shift of load to emergency generator)

High-frequency PWM inverter

- Performance optimum for computer load.
  Under rectifier load, the waveform distortion is small (below 5%), and the transient voltage regulation is also small.

Efficiency of 91% or more

- Latest IGBTs
- Latest circuit design

High performance

- Uninterruptible feed by on-line UPS
- Overload capacity: 125% for 10min, 150% for 1min

High reliability

- Adoption of the latest device
- Reduction of parts achieved by the latest UPS technology
- Screening test, burn-in test, high quality control
- High quality backed by strong field record

Long-life battery as standard

- The standard rectifier can charge a long-life battery.

Can be used for many types of system

- Synchronized and uninterrupted switching with bypass
- Standby redundancy system
- Parallel redundancy system (N≦8)
- Battery control function (automatic deterioration diagnosis, replacement advance notice indication)
- Guidance function

High reliability and high performance proven by top market share

High performance by high-speed switching

High-performance IGBTs (Insulated Gate Bipolar Transistors) achieve higher-frequency switching and larger current characteristics than conventional bipolar transistors, and are the next-generation IGBTs.
By adopting a new third-generation IGBT with lower loss and improved higher-frequency switching characteristics compared with conventional second-generation IGBTs, the UPS6000F series has achieved even higher reliability and performance.

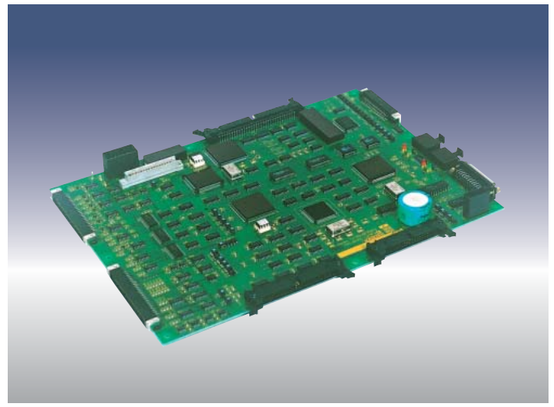
High reliability ensured by IGBT power module

High reliability and maintainability are essential for IGBT power modules in particular. On the module, therefore, IGBTs, fuses, drive circuitry, etc. are integrated, and a large current substrate is adopted for wiring, thereby assuring high reliability. The plug-in type tray module can be maintained on the front panel.

Innovation by all-digital control

All-digital design by latest control processor

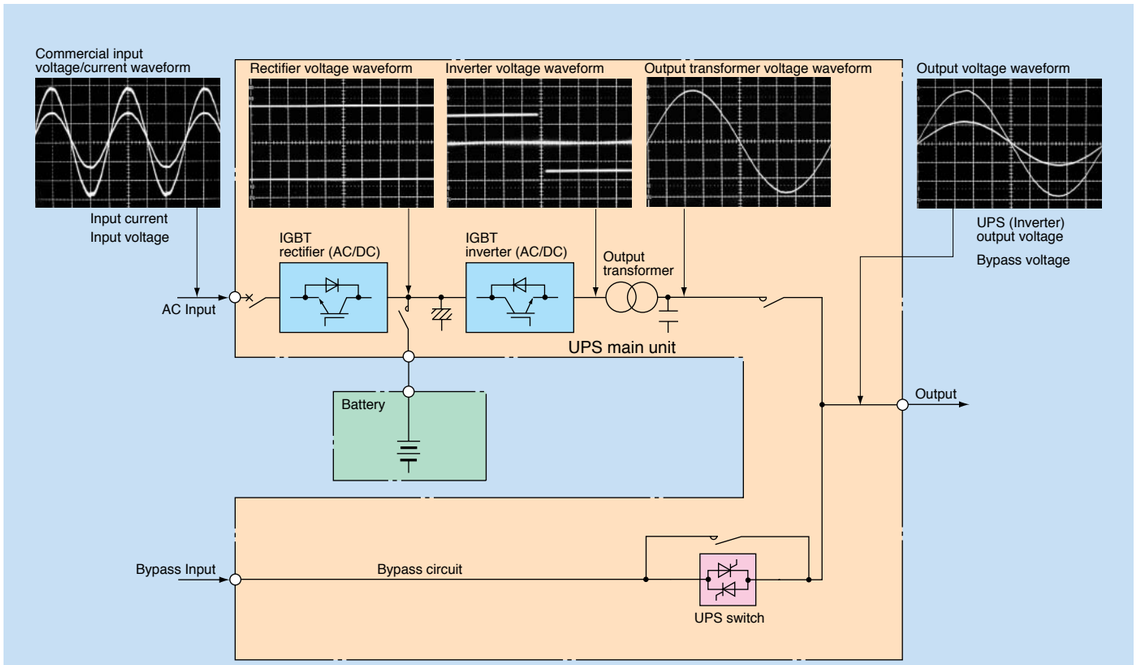
The all-digital design with high-performance processor, DSP (Digital Signal Processor), RISC (Reduced Instruction Set Computer) and ASIC (Application Specified IC) has allowed the number of parts to be considerably reduced, thereby enhancing reliability.



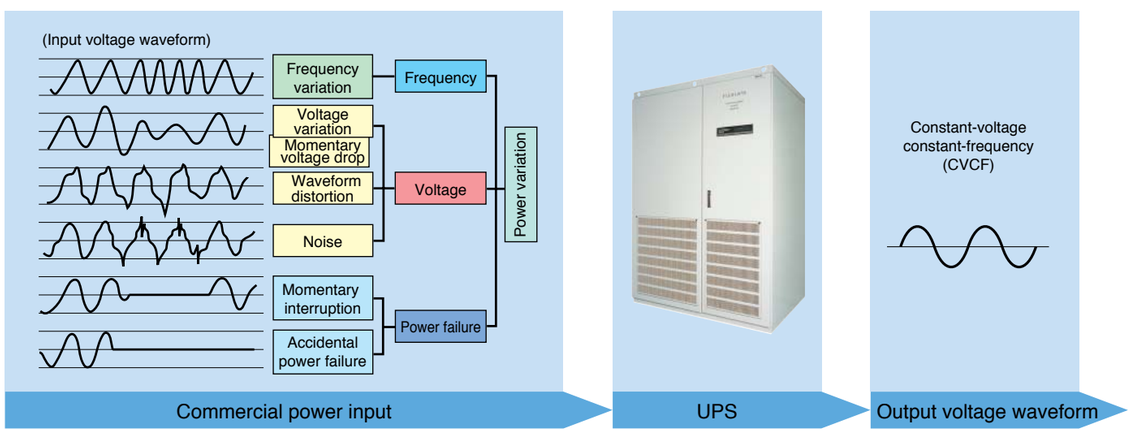
High reliability ensured by separating the control section and monitoring section

The reliability is enhanced by separating the control section and monitoring section, and designing the monitoring section in double systems, software and hardware.

Basic UPS Configuration Diagram

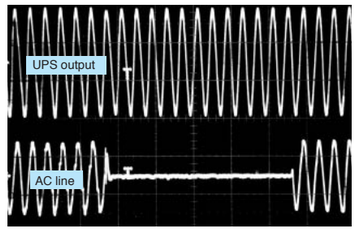


Full protection from power disturbances



Operation of Uninterruptible Power System

■ **Normal mode of operation**
During a normal UPS mode of operation, the unregulated commercial AC power line supplies AC power to the UPS input terminals where it is converted in the rectifier/charge to a regulated DC voltage. This voltage is used to operate the static inverter, and simultaneously maintain a full charge on the storage battery.
The static inverter converts to DC power to regulated, constant voltage and constant frequency, AC power and then supply it to the critical AC load.



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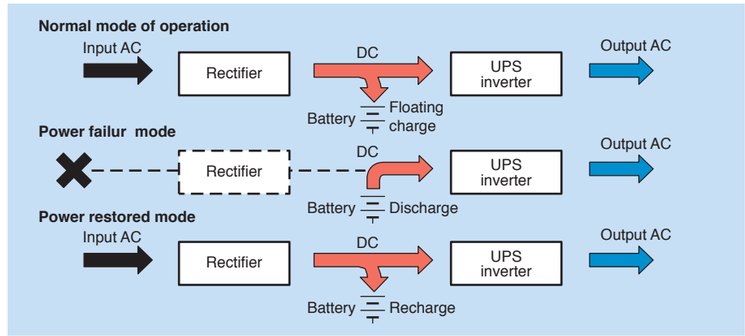
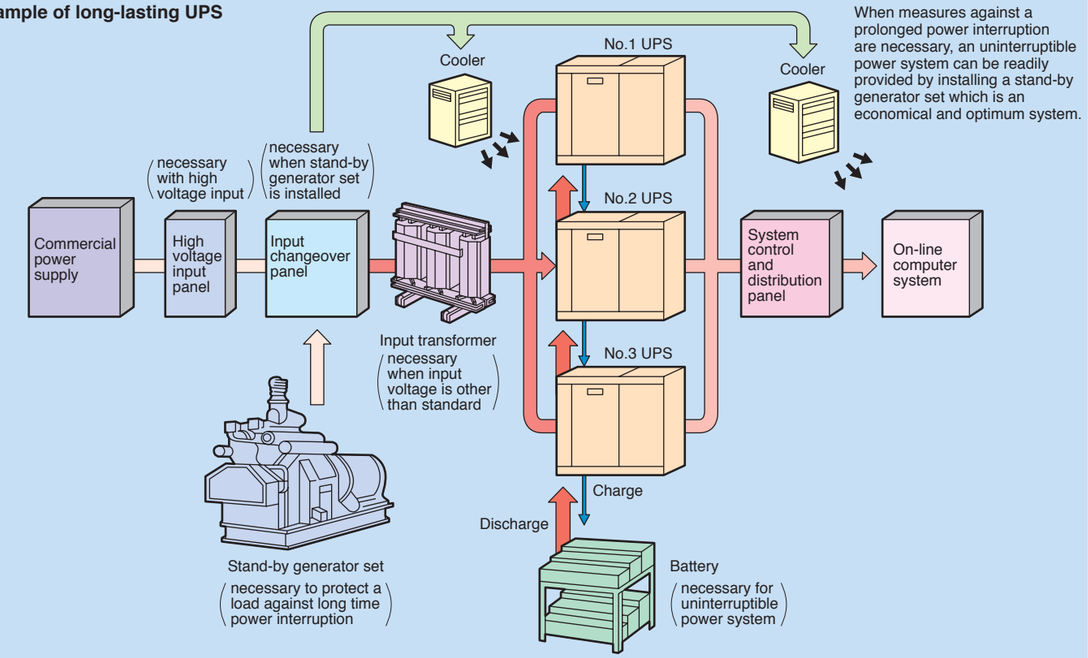
■ **Power failure mode**
When outages or fluctuations of the commercial AC power line occur, the storage battery provides a continuous source of DC operating power to the inverter. During a AC line outage, the battery assumes the total DC load required by the inverter for a specified time period or until the AC input power resumes.

■ **Power restored mode**
When the AC input power returns, the rectifier/charger resumes its DC output to the inverter while recharging the depleted battery.



Example of long-lasting UPS



When measures against a prolonged power interruption are necessary, an uninterruptible power system can be readily provided by installing a stand-by generator set which is an economical and optimum system.

All IGBT Type UPS

PWM Rectifier

A new third-generation IGBT is also adopted for the rectifier to achieve higher performance based on PWM*1 rectifier control through the feed forward*2 and the observer*3 functions.

*1: Pulse Width Modulation *2: Forecast control *3: State monitoring

Suppresses input harmonic current

The momentary waveform control function controls the rectifier input current to be sinusoidal, thereby suppressing harmonic current and eliminating the effect of harmonic current on the local generator or the phase advance capacitor. A harmonic suppression filter need not be installed on the input side.

Higher input power factor

By controlling AC input current to the same phase as the voltage, most of the reactive power has been eliminated, and the input power factor is kept around 1.0, thus minimizing the input capacity.

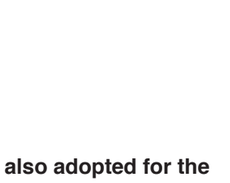
Power walk-in

The soft start (power walk-in control) of input current at the startup of the UPS or power restoration after a power failure does not cause shock to the input power.

Operation principle of PWM converter

The operation principle of the PWM rectifier is described using a single-phase circuit as an example.
The PWM rectifier generates voltage (Vrec) so that the input current (Ii) is kept at the same phase as the input voltage (Vi) and sinusoidal, which suppresses harmonics and achieves a higher power factor.

PWM rectifier method



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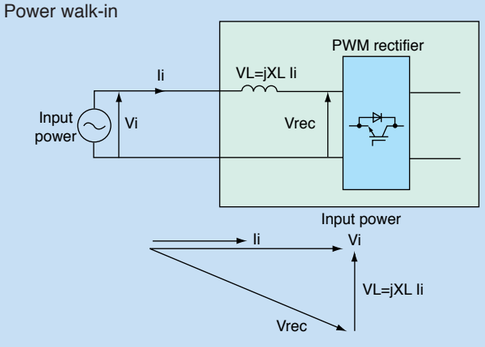
Power walk-in



PWM Inverter

Zero deviation prediction type instantaneous PWM inverter control has decreased the distortion factor of the output voltage and improved the stability of parallel operation.

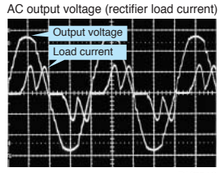
No shock to loads

The soft start function of gradually increasing the output voltage at startup suppresses the rush current from load systems (such as a transformer and capacitive loads), thus achieving a startup system which is gentle on loads.

Stable sinusoidal voltage

The instantaneous waveform control keeps the waveform of the output voltage from the load that feeds distorted current such as PCs (rectifier load), thus achieving output voltage that contains almost no harmonics.

AC output voltage (rectifier load current)



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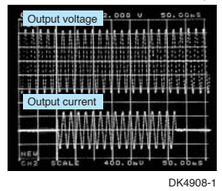
Output voltage free from excessive transient variations

Even if an abrupt 100% load change occurs, the output voltage is kept stable with almost no variations.

Output voltage waveform
(at the occurrence of abrupt 100% load change)



DK4908-1

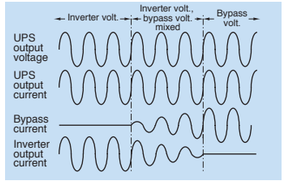
Voltage is balanced between phases

Almost no unbalance of output voltage is generated even with unbalanced load over three phases, thanks to individual three-phase control.

Suppresses the voltage variation at bypass switching

Soft shift of load allows switching with bypass, free from excessive voltage variations.

Output voltage waveform
(under 100% load, switched to bypass circuit)



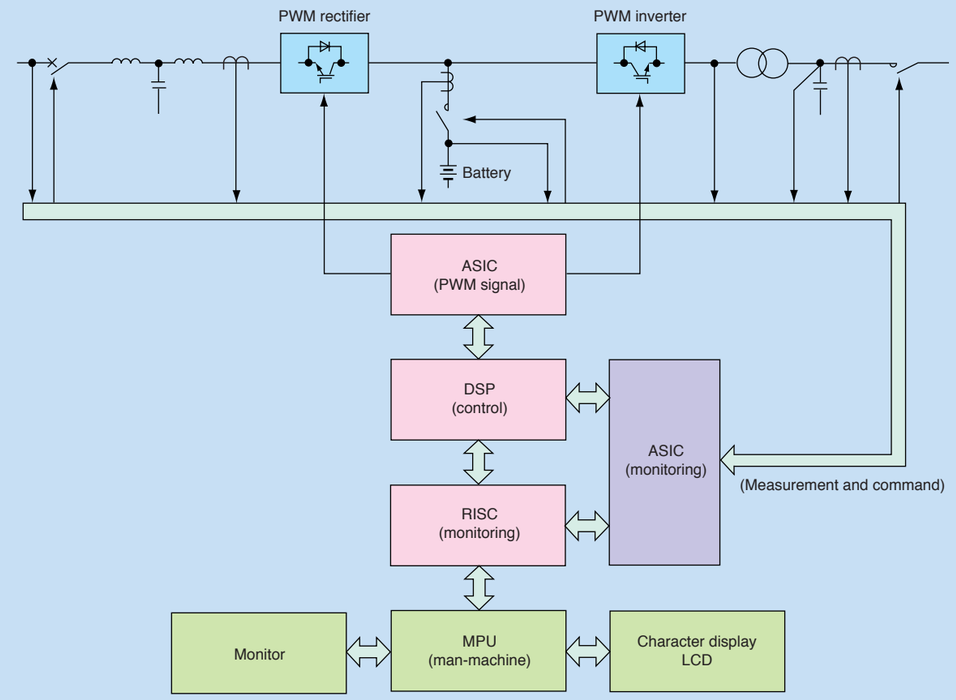
High Reliability and Performance Achieved by DDC*4 with Integrated Advanced Technologies

The fully digital system with high-performance processor, DSP, RISC, and ASIC delivers high performance and high reliability.

- Fewer parts raises reliability.
- The substantial self-diagnostic function performs accurate system failure diagnoses, backing up the system. (The intelligent sequence allows optimum judgment.)
- The configuration consisting of RISC*5, which is for sequences including communication, display, guidance, operation, failure history processing, measurement, failure monitoring, startup, and switching, DSP*6, which is for PWM rectifier control and PWM inverter control, ASIC*7, which is a PWM pulse and overcurrent quick judgment circuit, high-speed judgment sequence, and ASIC, which is an auto switching circuit for when a failure occurs, allows the control function and failure monitoring function to act independently from each other. Furthermore, by duplexing part of the monitoring function both in software and hardware, even higher reliability has been achieved.
- Since all the adjustments are set digitally, a control circuit having minimum fluctuation due to secular changes or least affected by temperature fluctuation has been adopted.

*4: Direct Digital Control *5: Reduced Instruction Set Computer
*6: Digital Signal Processor *7: Application Specific Integrated Circuit

Control block diagram



Network-capable Remote Maintenance System

Fuji Electric Call Center

Features

Low cost

- The Web/SNMP card equipped as standard eliminates the need for additional devices.
- No communication cost is incurred thanks to the user's e-mail function.

* When the network and the mail server of the user are used
* A remote maintenance agreement must be signed separately.

Improved maintenance function

- Increased remote maintenance cycle (our company ratio)

Four times a year (phone line system) → **Weekly (LAN system)**

- Issues alerts for when inspection or parts replacement is required.

Improved monitoring function

- Monitoring performed 24 hours a day, 365 days a year allows our trained engineers to take appropriate measures immediately in case of failure.

Enhanced security

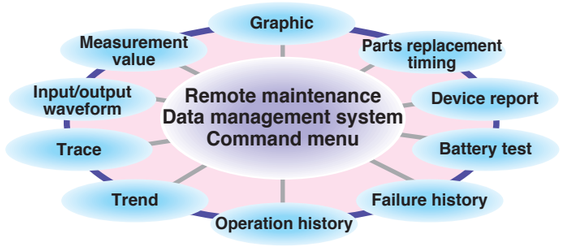
- User authentication with user ID and password (enhanced security based on SSL authentication by VeriSign Japan K.K.)
- Thorough virus checks with Fuji mail server

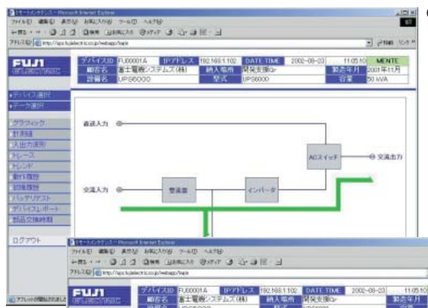
Convenient functions

- Users can freely change the Fuji Electric Call Center contacts to be used when a failure occurs.
- Requests for quotation for maintenance or on-site maintenance can be made via the remote maintenance Web page.

Web server monitoring function

- Information about the UPS can be checked using a browser such as Internet Explorer if you have an Internet connection.





Graphic window

Measure-ment window

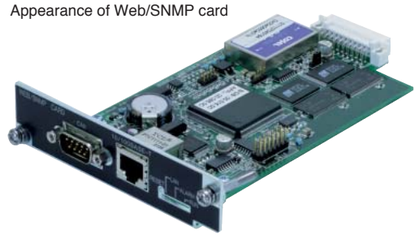
Parts replacement interval window

* To browse the data via the Internet, JavaRuntime (international version) may need to be downloaded from the website of SunMicrosystems (free of charge).

The Web/SNMP card equipped as standard allows the latest network applications to be used.

A JEMA-MIB-compliant Web/SNMP card for UPS has been developed.

Appearance of Web/SNMP card



Web function

The UPS status can be monitored and settings changed by using a browser such as Internet Explorer.

Mailing function

The destination of mails to be transmitted at the time of UPS events, failures, and periodic communications can be freely set by the UPS user.

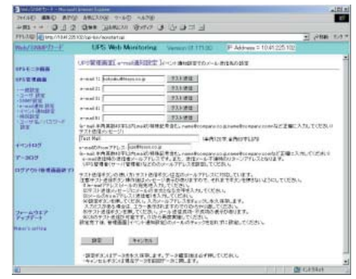
Remote maintenance function

By using your own mailing function, you can request Fuji Electric Call Center to monitor your system for failures 24 hours a day, 365 days a year.

* A remote maintenance agreement must be signed separately.

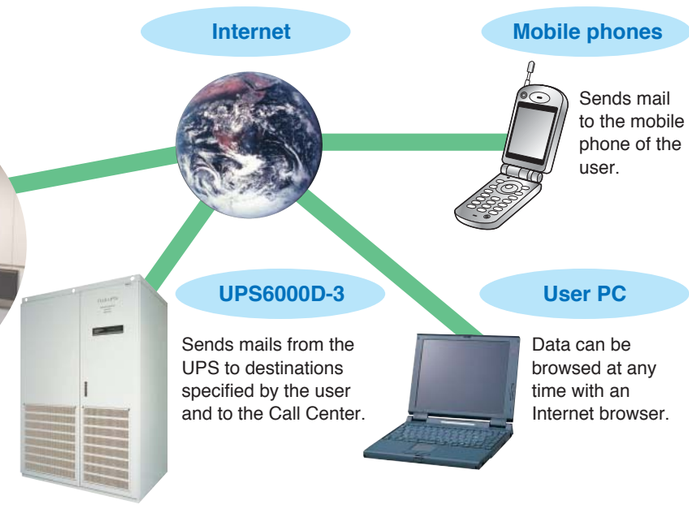
UPS monitoring main window

E-mail notification setting window

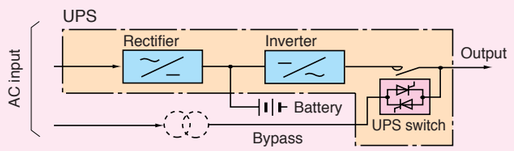
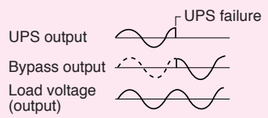


Typical system configuration

- Failure monitoring performed 24 hours a day, 365 days a year
- Measures taken by trained engineers



System Configuration

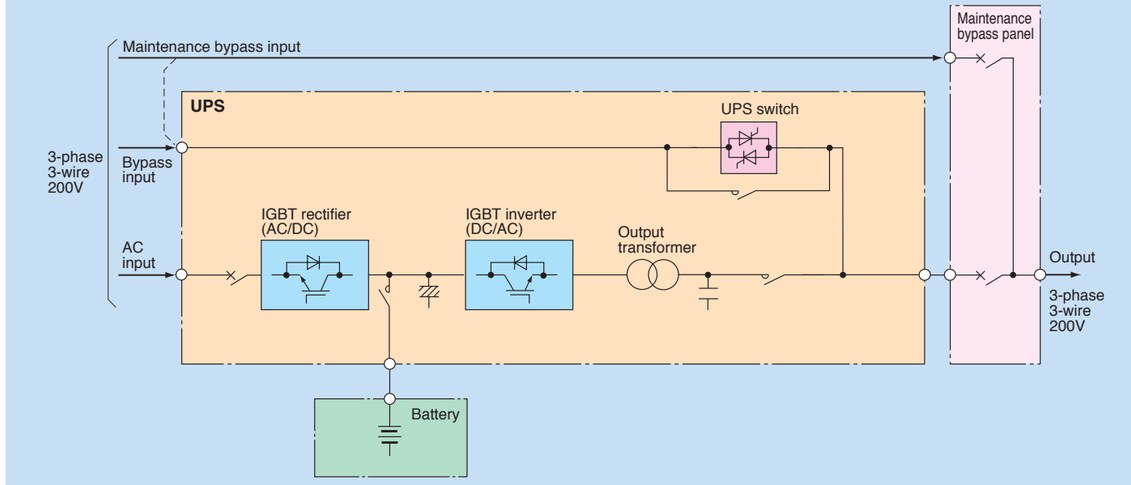
Operation method	Circuit configuration	Waveform switching at occurrence of UPS failure	Outline
Single unit operation FSP−V			Since a thyristor switch is used, uninterruptible switching to the bypass circuit can be made even if the UPS fails.
Standby operation FSP−IX			An operating UPS and a standby UPS are provided. If the operating UPS fails, it is switched synchronously and without interruption to the standby UPS. Since the standby circuit is also protected by UPS, the reliability is significantly higher than the above uninterruptible backup method.
Parallel operation FSP−VIII−2			The redundant system with two fully independent UPS systems provided with a bypass circuit connected in parallel is easy to upgrade from only one UPS system, to create an exceptionally reliable system.

Note: **FSP−V:** Bypass backup method
FSP−IX: Standby redundant method
FSP−VIII−2: Parallel redundant method

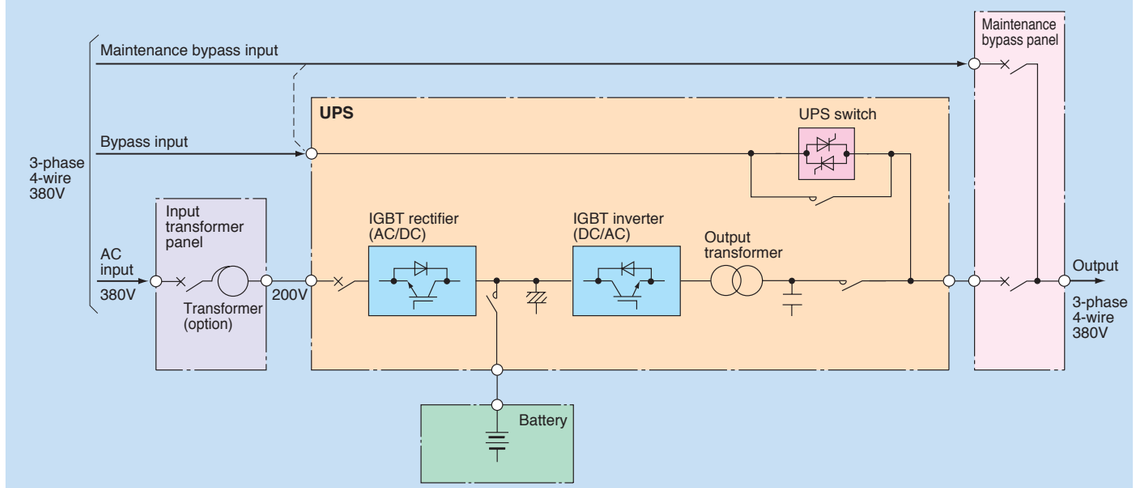
Circuit Configuration (I)

The following configuration represents a single system consisting of only one UPS unit.
It is a typical uninterruptible backup system provided with a bypass circuit.
The configuration is often used for small to medium-scale systems.

3-phase 3-wire 200V input/output



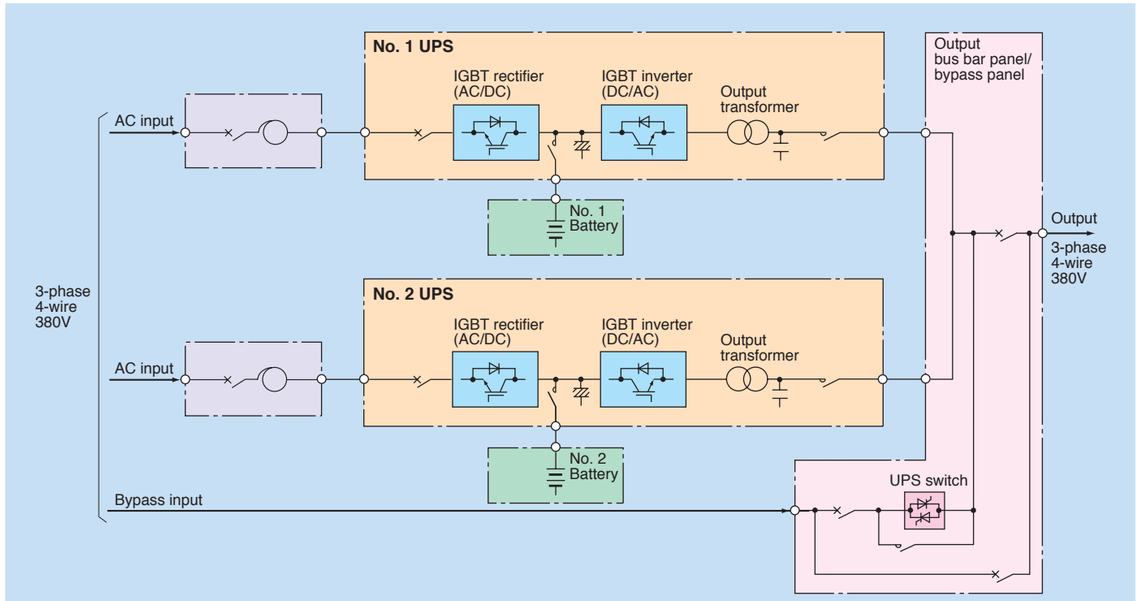
3-phase 4-wire 380V input/output



Circuit Configuration (II), (III)

Circuit configuration (II)

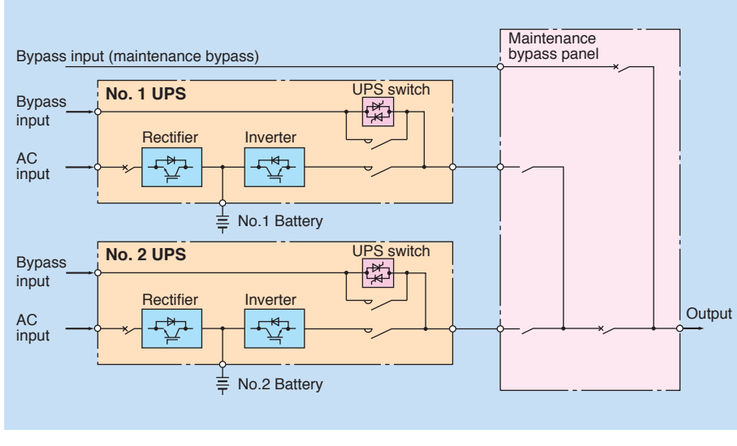
The following configuration represents a high-reliability system consisting of two UPS units (parallel operation).



Circuit configuration (III)

The parallel redundant system is a new system with even greater reliability thanks to our excellent individual control function.

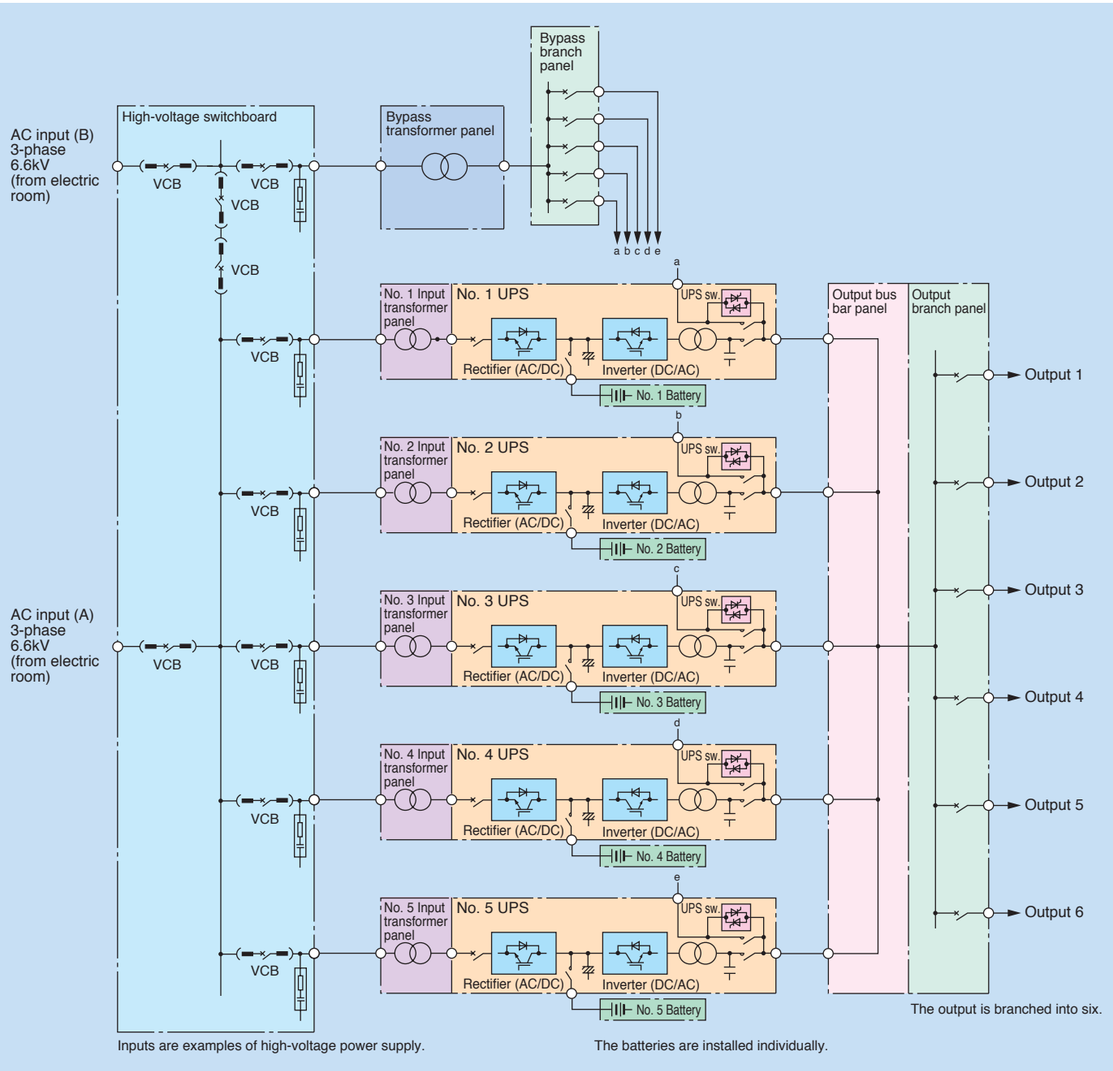
Fully independent parallel redundant system
Redundancy has been accomplished even with the bypass circuit with shared parts eliminated completely, so all the redundant units can be maintained independently.



Circuit Configuration (IV)

Circuit configuration (IV)

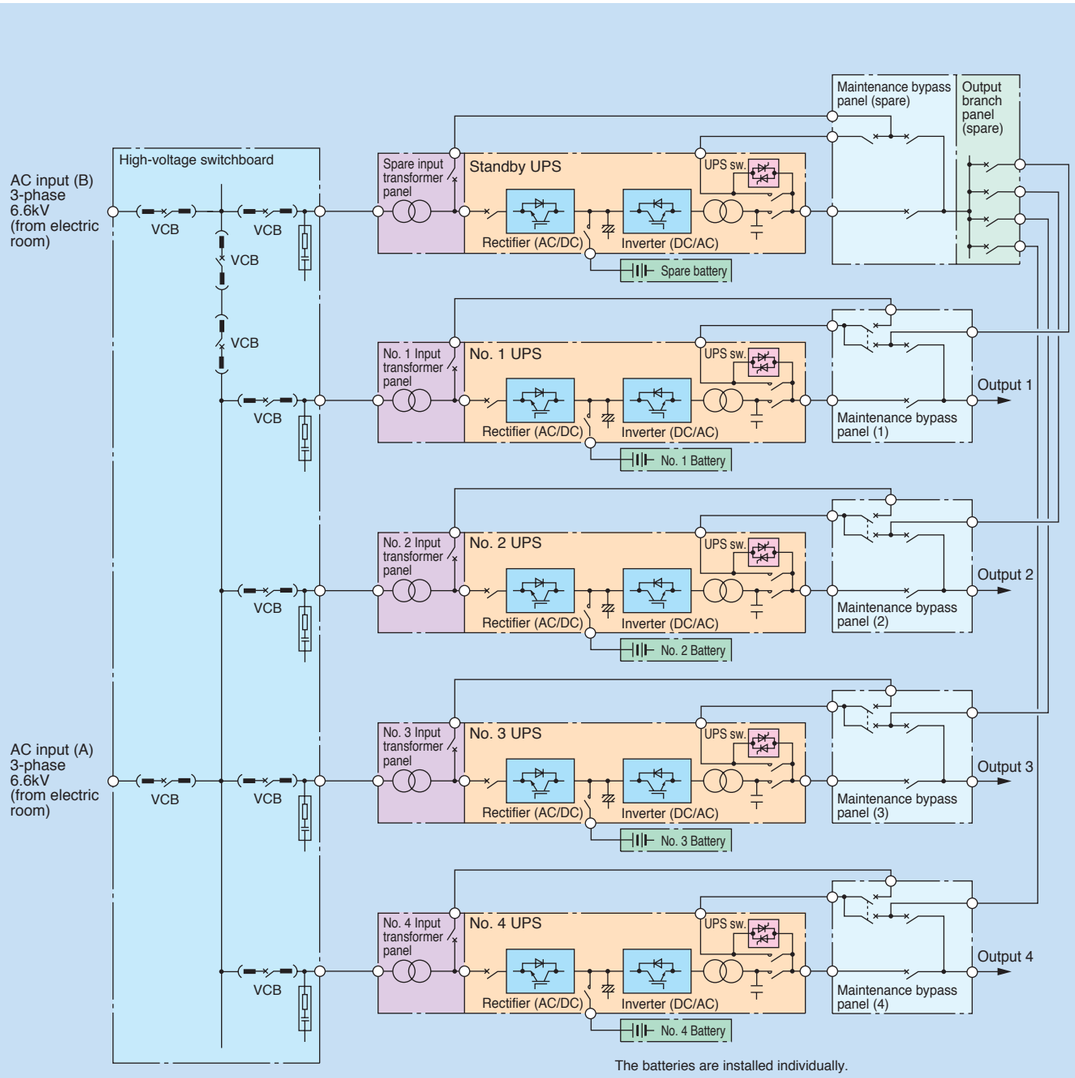
The following configuration represents a large-scale (1,000kVA or higher) high-reliability system consisting of five UPS units. High-voltage inputs are shown as examples.



Circuit Configuration (V)

Circuit configuration (V)

The following configuration represents a typical standby redundant system consisting of five UPS units.



The batteries are installed individually.

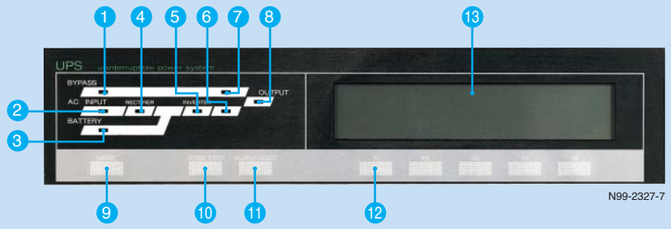
Rated Specifications

Series		UPS6000F Series									
Model		3/100	3/150	3/200	3/250	3/300	3/400	3/500	3/600	3/750	3/1000
Input	Voltage*1 [V]	200±10%									
	Frequency [Hz]	50 or 60±5%									
	No. of phases and wires	3-phase, 3-wire									
	Harmonic current	5% max. (at normal mode of UPS operation)									
	Power factor	0.98 min. (at normal mode of UPS operation)									
DC circuit	Rated voltage [V]	360 (lead acid battery: 180 cells)									
	Voltage variation range [V]	288 to 414									
Output*2	Rated apparent power [kVA]	100	150	200	250	300	400	500	600	750	1000
	Voltage [V]	200, 208, 210, 220 (50Hz only), 230 (60Hz only), 380, 400, 415, 440									
	Frequency [Hz]	50 or 60									
	No. of phases and wires	3-phase, 3-wire or 3-phase, 4-wire									
	Load power factor	0.7 (lag) to 1.0, Rated value: 0.8 (lag)									
	Voltage tolerance (steady state)	±1.0%									
	Dynamic voltage characteristics	Complying with IEC 62040-3 (see Fig. 1.)									
	Transient voltage regulation	(1) ±5%: at abrupt step load from 0 to 100% or vice-varsa (2) ±2%: at abrupt ±10% change of input voltage (3) ±2%: at failure/recovery of commercial power (4) ±5%: at disconnection of one module (for parallel operation system only) (5) ±5%: UPS ← Bypass (for FSP-V and FSP-VIII systems only) Conditions at switching between UPS and bypass circuits vary depending on the characteristics of the bypass power. Conditions (1) to (5) should not be overlapped.									
	Recovery time	50ms max.									
	Voltage waveform distortion (total harmonic distortion)	2.5% max. (root mean square value of total harmonics under 100% linear load) 5% max. (root mean square value of total harmonics under 100% rectifier load)									
	Voltage unbalance	±2% (under 100% unbalanced load)									
	Frequency tolerance	±0.01% (for internal oscillation)									
	External synchronization range	±1% (for FSP-V or FSP-VIII system only)									
	Overload capability	125% for 10min, 150% for 1min									
	Overcurrent limiting value	150% (current drooping characteristics function when overcurrent exceeds 150%, keeping the overcurrent to less than 150%.)									
	Output phase angle	120°±1° (under balanced load) 120°±3° (under 100% unbalanced load)									
	Voltage adjustment range	±5% (under rated load)									
Others	Ambient temperature	0 to +40℃ (for operation), +18 to +27℃ (recommended)									
	Relative humidity	20 to 80%									
	Altitude	1000m max.									
	Noise	70dB (A) max.	75dB (A) max.								
	Dielectric strength	2000V for 1min (main circuit)									
	Insulation resistance	3MΩ or more (with 500V megger)									

*1: A transformer (option) is required for voltages other than 200V.
*2: At normal mode of UPS operation

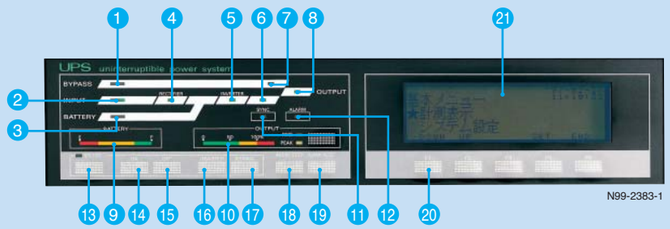
Operation indicator panel

300kVA or lower



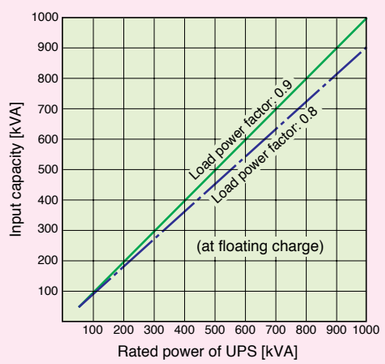
1 Bypass input power receiving indicator lamp (Green)
2 AC input power receiving indicator lamp (Green)
3 DC input power receiving indicator lamp (Green)
4 Rectifier operation indicator lamp (Green)
5 Inverter operation indicator lamp (Green)
6 Inverter power supply indicator lamp (Green)
7 Bypass power supply indicator lamp (Orange)
8 Output indicator lamp (Green)
9 Operation selector switch
10 Buzzer stop
11 Alarm reset
12 Function keys (5)
13 LC display unit

400kVA or higher

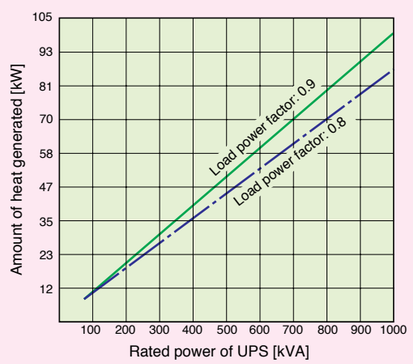


1 Bypass input power receiving indicator lamp (Green)
2 AC input power receiving indicator lamp (Green)
3 DC input power receiving indicator lamp (Green)
4 Rectifier operation indicator lamp (Green)
5 Inverter operation indicator lamp (Green)
6 Inverter power supply indicator lamp (Green)
7 Bypass power supply indicator lamp (Orange)
8 Output indicator lamp (Green)
9 Battery status indicator lamp (Red/Orange/Green)
10 Output current indicator lamp (Green/Orange/Red)
11 Synchronous operation indicator lamp (Green)
12 Failure indicator lamp (Red)
13 Operation selector switch
14 Inverter operation switch
15 Inverter stop switch
16 Inverter power supply changeover switch
17 Bypass power supply changeover switch
18 Buzzer stop switch
19 Failure reset switch
20 Function keys (5)
21 LC display unit

Input capacity



Amount of heat generated



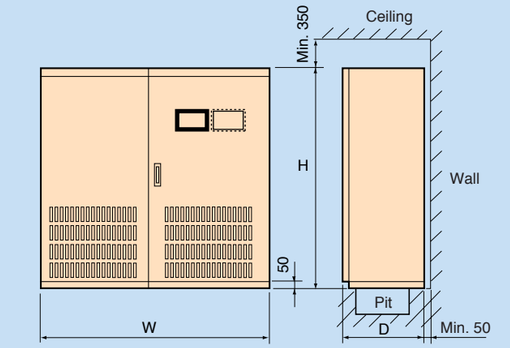
External Dimensions and Mass

UPS main unit

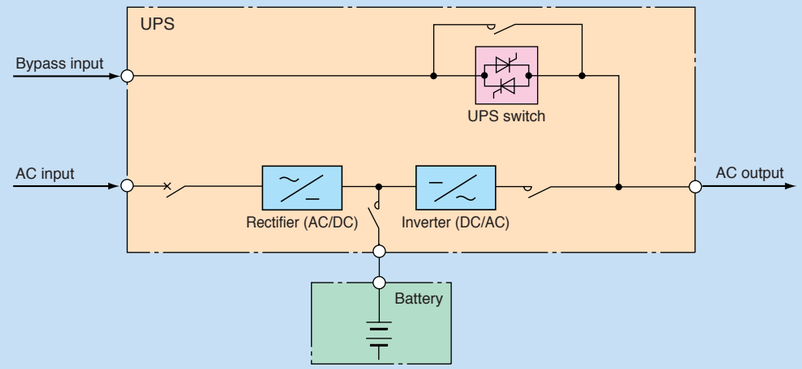
UPS power [kVA]	Dimensions [mm] W	D	H	Mass [kg]
100	800	1000	1950	1100
150	1000	1000	1950	1300
200	1200	1000	1950	1800
250	1400	1000	1950	1900
300	1400	1000	1950	2400
400	2800	1000	1950	3600
500	2800	1000	1950	3900
600	5600	1200	2350	7000
750	5600	1200	2350	7600
1000	5600	1200	2350	8600

Note 1: The dimensions and mass listed above are for one UPS main unit.
Note 2: Both input and output: 3-phase, 3-wire, 200V.
Note 3: Output bus bar panel, maintenance bypass panel, and input transformer panel are not included.

UPS [Unit: mm]



UPS system configuration



Battery

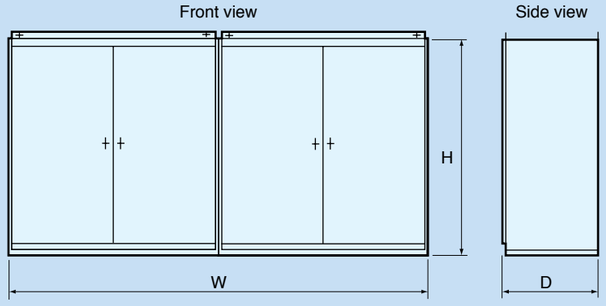
The UPS uses battery power if commercial power is interrupted. Using a battery to compensate for a power failure lasting for a long time is not economical; in general, the battery capacity is to compensate for a power failure of approximately 5 to 10 minutes. A local power generator should be provided to compensate for a power failure that lasts longer.
Various battery types are available.
For economic reasons, rapid-discharge lead acid batteries are generally used for the UPS.
A total of 180 lead battery cells with cell voltage of 2V are connected in series to obtain a nominal DC voltage of 360V for application to the 6000F series.
The capacity of the battery to be used is determined by the discharge characteristics of the battery, duration of compensation for a power failure, etc. Refer to the following table for the capacity of type FVH lead acid batteries.

Valve regulated type lead-acid battery for high-rate discharge

UPS power [kVA/kW]	Nominal DC voltage [V]	Battery capacity [Ah/10hR] (type FVH) (discharge time: 10min)	Battery panel (cubicle storage type)			
			Dimensions [mm]			Mass [kg]
			W	D	H	
100/80	360	100	1800	750	1950	2100
150/120	360	150	2800	750	1950	3180
200/160	360	200	2000	1000	1950	4120
250/200	360	300	2800	1000	1950	5740
300/240	360	300	2800	1000	1950	5740
400/320	360	400	3800	1000	1950	8240
500/400	360	500	4500	1000	1950	9940
600/480	360	600	5100	1000	1950	11370
750/600	360	700	6200	1000	1950	14030
1000/800	360	900	7500	1000	1950	16840

Note: The above values are for the ambient temperature of 25℃.

Dimensions of battery panel (cubicle storage type)



Installation Plan

UPS chamber

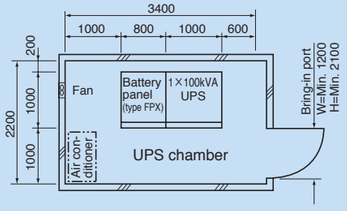
- Since the UPS can be maintained on the front panel, rear maintenance space is not required.
- The UPS is forcibly cooled with a fan. Be sure to take dust-proof measures such as plastic tiling or dust-proof coating. A ceiling height of 2400mm or higher is recommended.
- The UPS is designed for use within the room temperature range of −10 to +40℃. However, an air conditioner should be installed to assure stable operation of the UPS and keep the UPS operating until it comes to the end of its service life. The recommended service temperature range is from +18 to 27℃.
- The bottom-pit system is adopted as standard for wiring the inputs/outputs of the UPS. Be sure to install wiring pits.
(pit dimensions: 200 to 250mm (depth), 400 to 500mm (width))
If wiring pits cannot be installed, a ceiling rack or a ceiling duct can be used.
- Be sure to ground the UPS as follows.
Class C (10Ω or less), Exclusive grounding is recommended.
- Provide a receptacle on a wall surface for maintaining the UPS.
- Each system can be brought in separately.

Battery chamber

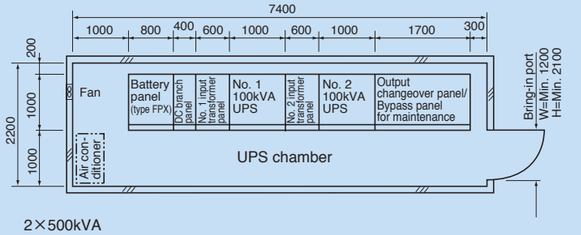
- The battery chamber should be an exclusive incombustible area. Apply acid-proof finish on the floor and the wall (up to the height of around 1,000mm).
- Since a small amount of oxygen gas is generated while the battery is charged, provide a ventilation fan.
- Allow space of 600mm or more in front of the maintenance surface.
- Installation of a sink for maintenance is recommended.
- Since batteries are subject to the Fire Prevention Ordinance, notification of installation of battery facilities is required.
(note: applicable only within Japan.)

[Unit: mm]

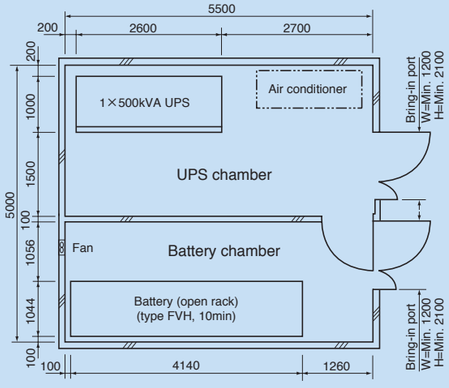
1×100kVA
Uninterruptible backup system



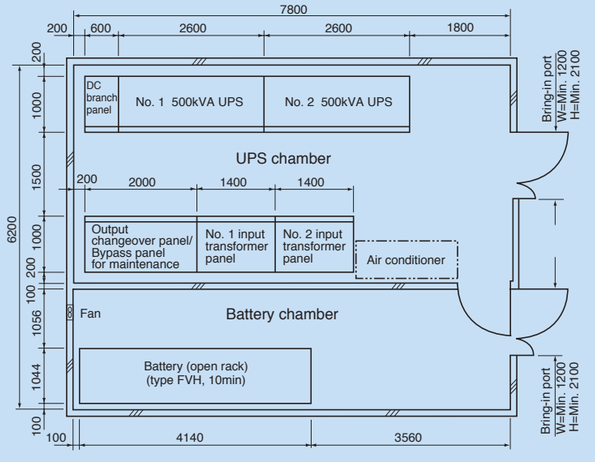
2×100kVA
Parallel, redundant, uninterruptible backup system



1×500kVA
Uninterruptible backup system



2×500kVA
Parallel, redundant, uninterruptible backup system



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