

**We support stable electric power.**



**Supporting Smart Grids**



## **Bidirectional DC-DC Converters**

**Achieves a high-efficiency conversion of 94% despite being isolated type through digital control**

Verification tests are in progress in various locations for smart grids, which promote optimization of power supply-demand balances using information technologies. For this reason, the TDK has developed new bidirectional DC-DC converters, which will serve as an important platform for power conversion in geographically-dispersed power grids that are interconnected to storage battery systems or direct current power supply systems. Through the adoption of advanced technologies including digital control, highly efficient, seamless conversion has been realized. We offer a line of high-performance bidirectional DC-DC converters the “EZA series (TDK-Lambda brand product)”, which are designed for various applications including energy storage systems in office buildings or commercial facilities.

## Bidirectional DC-DC converter that converts power between DC power supplies and energy storage system

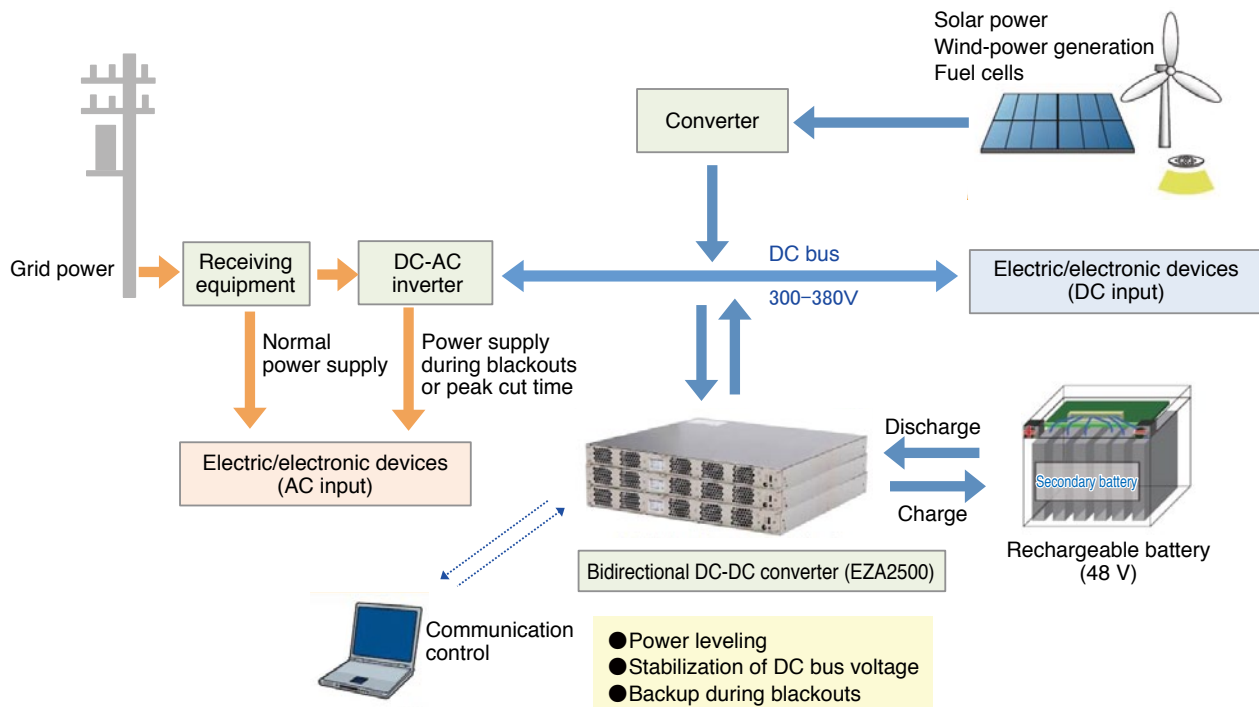
Since electronic devices are driven by DC, commercial AC is converted to DC before use. However, as power conversion generates loss, reducing the number of conversions leads to energy conservation. Therefore, the introduction of DC power supply systems that supply DC power instead of conventional commercial AC is being considered for smart grids.

In a DC power supply system, DC power between 300 and 400V is supplied to a building, factory or house through a DC bus, and power generated by solar power generation or wind power generation is supplied to the DC bus through a power conditioner. Surplus power is sent to the energy storage system

using lithium ion batteries or other types of batteries. The EZA series bidirectional DC-DC converter is a power supply unit that exchanges power between the DC bus and energy storage system.

Conventionally, when such a power supply is needed, there is no choice but to either develop a special power supply or to switch between 2 DC-DC converters, one for step up conversion and the other for step down conversion. However, the new EZA series converters are state-of-the-art power supplies that realize both step up and step down power conversion in just one DC-DC converter.

### Application example of a bidirectional DC-DC power converter: a small to medium-sized energy storage system (for industrial/commercial use)



## Achieves a high efficiency of 94% in both charging and discharging through digital control

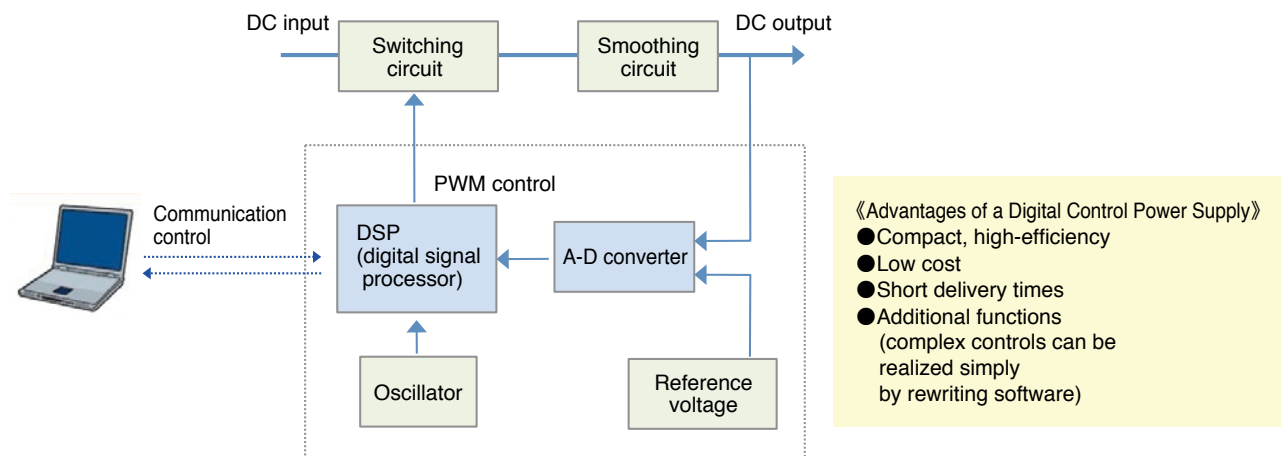
The EZA series bidirectional DC-DC converters take advantage of our accumulated digital control power supply technologies. Switching power supplies, which are mainstream for today's power supplies, achieve stable output voltage by feeding back the monitored output voltage information and controlling (PWM: pulse width modulation) the ON/OFF durations of switching elements. In a conventional analog controlling power supply, the signals for controlling these ON/OFF durations are processed by an analog circuit. On the other hand, a digital control power supply performs this signal processing on a digital signal processing circuit realized by the A-D converter, DSP (digital signal processor) and software.

The primary feature of the EZA series converters is that they

achieve high-efficiency conversion, while being isolated type converters using a transformer. The EZA series' voltage ratio of the DC bus to the battery side is approximately 6 to 1. Generally, the higher the voltage ratio is, the lower the conversion efficiency. However, the EZA series converters have realized bidirectional conversion with an efficiency of 94% or higher in both charging and discharging, by adopting advanced digital control technology.

In addition to their compactness and high efficiency, a great advantage of digital control power supplies is that various additional functions or complex controls required of power supplies, such as a failure diagnosis function, can be realized simply by rewriting software, without developing new ICs.

### □ Circuit block of a digital control DC-DC converter



The monitored output voltage is converted into digital signals by the A-D converter, and PWM control is performed through digital processing by the DSP, in order to stabilize fluctuating voltage. A power supply in which communication control is also digitally controlled is called a full digital power supply.

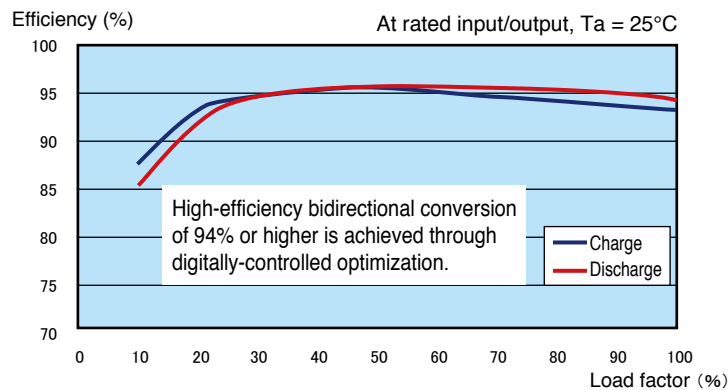
## Seamless bidirectional conversion stabilizes voltage of the DC bus

The EZA series bidirectional DC-DC converters exert excellent performance in stabilizing the voltage of the DC bus. In particular, the voltage of the DC bus of a smart grid interconnected with solar power generation or wind power generation always fluctuates due to the reverse power flow of the power supplied by the generator side. The EZA series converters feature a self-communicating operation mode as well as an external control operation mode in which the converters obey directions from the system controller to switch the conversion direction. In the self communicating mode, the converters detect the voltage of the DC bus independently, as well as independently decide the conversion direction to stabilize input and output voltages,

thus stabilizing the DC bus voltage. In addition, optimal control combining an isolated transformer and synchronized rectification realizes seamless bidirectional switching without stopping the converter, with the switching time between charge and discharge being as short as 15 ms (typically). Furthermore, serial communication (RS485) enables control of current, voltage and conversion direction, and status monitoring.

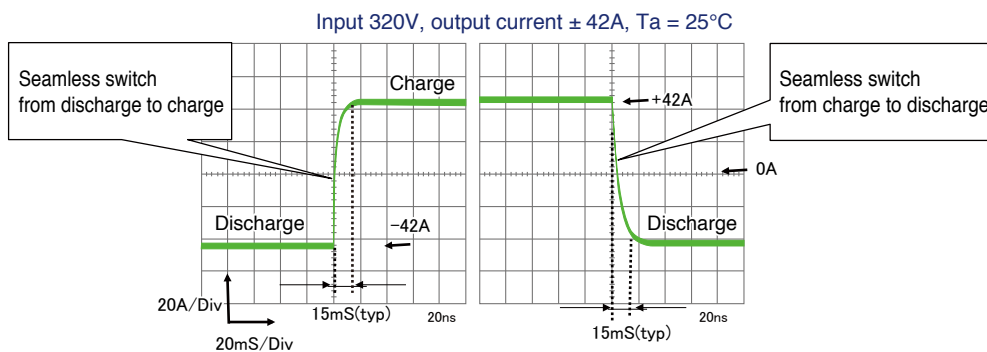
The EZA series converters have achieved these advanced functions in one compact, high-efficiency converter. They are compact, highly efficient, high-performance bidirectional DC-DC converters that enable intelligent power conversion in the era of smart grids.

### □ Load factor – conversion efficiency characteristics of the EZA 2500 series bidirectional DC-DC converter



### □ Charge-discharge switching characteristics of the EZA 2500 series bidirectional DC-DC converter (Discharge → charge → discharge switching characteristics, 48V side current waveform)

- Seamless switching through the combination of an isolated transformer and synchronized rectification
- Charge/discharge switching time is as short as 15 ms (typically)
- Realizes stabilization of the DC bus voltage of smart grids, etc.



## Bidirectional DC-DC converter taking an active role in the use of regenerative energy of industrial equipment

Digital control power supplies are used as power supplies of hybrid electric vehicles (HEVs) or electric vehicles (EVs), due to the fact that the greater the output power of the power supply is, the more effective they are in improving efficiency. In addition, it is predicted that energy storage systems of smart houses and in-vehicle batteries of HEVs or EVs will share power as needed or be interconnected with grid power to contribute to peak cuts or peak shifts of power consumption in the coming era of smart grids. In such a scene, the EZA series bidirectional DC-DC converters will play an important role.

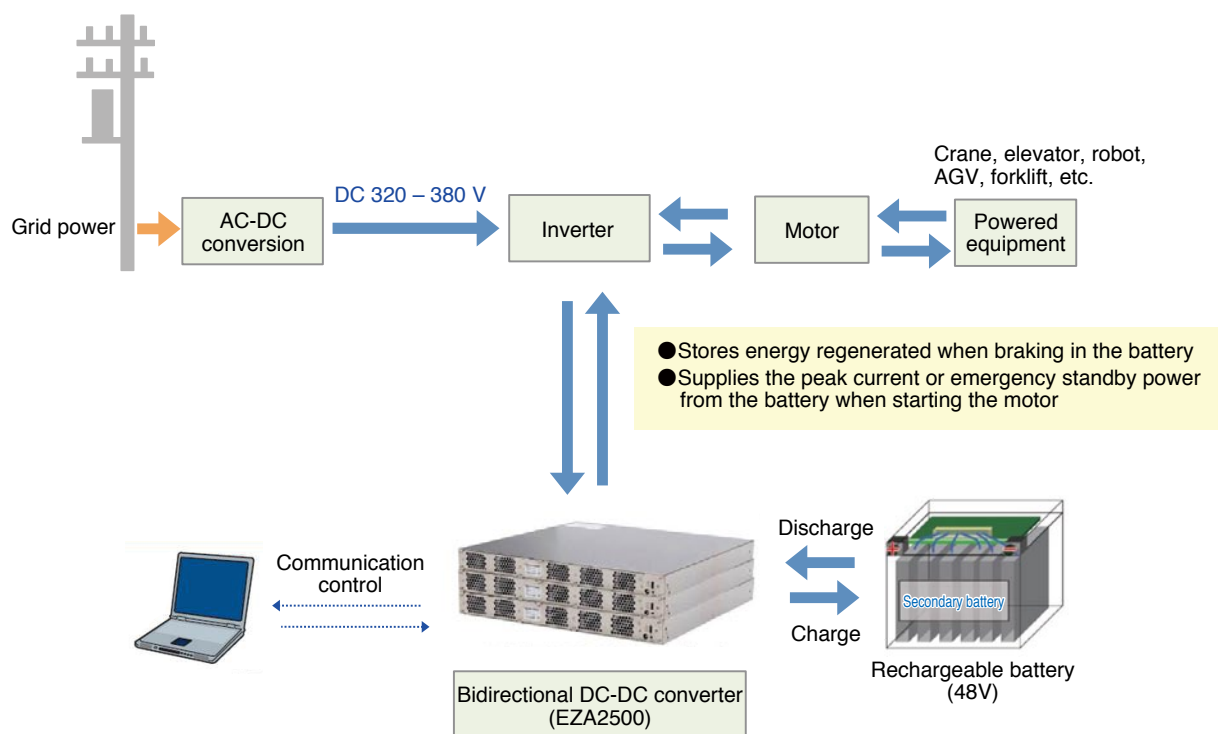
Moreover, they can be used not only for charge/discharge management of rechargeable batteries but for various types of industrial equipment, including elevators, cranes or automated guided vehicles (AGVs).

Such industrial equipment is started and stopped very frequently;

therefore, energy can be reused without being wasted by storing the regenerative energy generated during deceleration of the motors in rechargeable batteries and supplying the stored power at the startup of the motor when a large amount of power is required, thereby promoting power conservation.

Power supply technologies have made great advancements in the past 10 years. It is estimated that power supplies of the latest type can reduce an approximate total of 30,000 t of CO<sub>2</sub> emissions in one year, compared to older type power supplies that were on the market in 2000. These advanced power supply products have been developed by combining accumulated core technologies, including material technologies such as ferrite materials, transformer technologies and circuit technologies. With these new products, we will make further contributions to power conservation and CO<sub>2</sub> reduction in the era of smart grids.

### □ Application example of the EZA Series bidirectional DC-DC converters: devices requiring energy regeneration



## □ Main Features

- 1** Input/output isolated type, which is safe and provides a good noise countermeasure
- 2** Achieves bidirectional conversion efficiency of 94% through digitally controlled optimization
- 3** Capable of autonomous operation and can automatically change conversion direction to stabilize input or output voltage
- 4** Capable of changing the conversion direction at high speed (15 ms or less), without stopping the converter
- 5** Serial communication (RS485) enables control of current, voltage and conversion direction, and status monitoring
- 6** Compact, space saving type (1U full rack)




## □ Main applications

**Energy storage systems (charge and discharge control of lithium ion batteries, lead acid batteries, etc., that are connected to the DC bus),  
Devices requiring energy regeneration (cranes, elevators, robots, AGVs, forklift, etc.)**

## □ Main specifications

Product name	EZA2500-32048	
Item	Charge	Discharge
Output voltage	48V(36-60V)	320V(300-380V)
Input voltage	320V(300-380V)	48V(36-60V)
Max. efficiency	94%	94%
Max. output	2.5kW	
Size	W : 422.8mm H : 43.6mm(1U) D : 400mm	
External control	RS485	
Operation mode	Self communicating/external control mode (mode can be externally set via RS485)	
Other	Input output isolation, expandable by parallel operation	

\*Please contact the following number for details on the products.  
TDK-Lambda Corporation, Product Information,  
 Toll Free: 0120-507039 (Weekdays 9:00 – 17:00)