

6. Major Applications

6-1 Power Supply Circuits

Stable DC power supplies are divided into intermittent control types (switching regulator) and Continuous control types (Dropper).

Recent trends have shown an overwhelming growth in switching regulators, and so we talk mainly about switching regulators below.

The capacitors used in switching regulators are selected depending on the circuit. A forward Switching regulator is shown as an example in Fig.25. Another type is a flyback regulator.

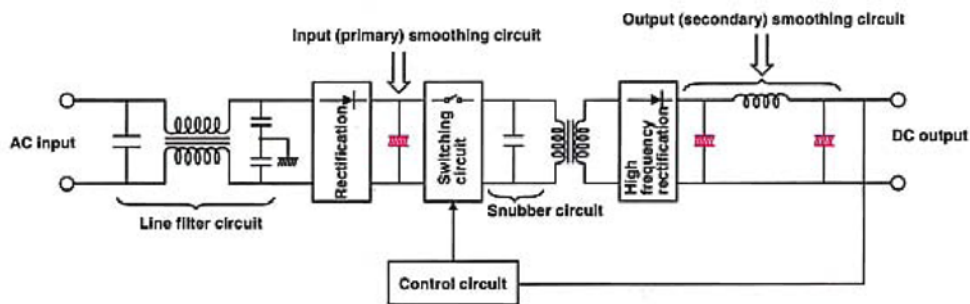


Fig.25 Example of capacitor use

Examples of capacitor use

- ① Line filter circuits: ceramic capacitors, film capacitors
- ② Input smoothing circuits: aluminum electrolytic capacitors, (laminated ceramic capacitors)
- ③ Snubber circuits: ceramic capacitors
- ④ Output smoothing circuits: aluminum electrolytic capacitors, laminated ceramic capacitors, film capacitors, aluminum solid electrolytic capacitors, tantalum electrolytic capacitors
- ⑤ Control circuits: ceramic capacitors, film capacitors, tantalum electrolytic capacitors, aluminum electrolytic capacitors

(1) Aluminum Electrolytic capacitors for Input (Primary) Smoothing Circuits

The Aluminum electrolytic capacitors for input smoothing circuits used on commercial voltages (100 VAC, 200 VAC) and commercial frequencies (60 Hz, 50 Hz) must have a high withstand voltage and a ripple current resistance complying with twice the commercial frequency (normally full-wave current).

These capacitors have large volumes (ground contact areas) compared to other components they are assembled with, and so the demand for more compact capacitors, as well as power supplies, is strong. Another problem is the need for longer aluminum electrolytic capacitor lives, but products guaranteed for 5000 hours at 105°C have recently been developed, thus realizing freedom from maintenance for 10 years.

(2) Aluminum Electrolytic capacitors for Output Smoothing Circuits

The rated voltage of aluminum electrolytic capacitors used for smoothing at switching frequencies (20k~500kHz) is determined by the output voltage, and they must have low impedance (low ESR) at switching frequencies.

Therefore aluminum electrolytic capacitors for output smoothing are designed to have low impedance at 20k~500kHz, and the recent development of a low resistance electrolyte using new materials has resulted in products with 1/3 to 1/4 the impedance of conventional products with the same volume.

These low impedance products also have an extremely stable life, and they are expected to become

6-2 Inverters

With the advancement of power devices for high electric power, semiconductor devices for controlling power supplies with capacitors from 1W to 10kW have come into practical application.

With the application of these devices, the use of electronic devices incorporating inverter circuits has rapidly increased for everything from communications, data processing and industrial use to home appliances, the most common of which is the inverter air conditioner.

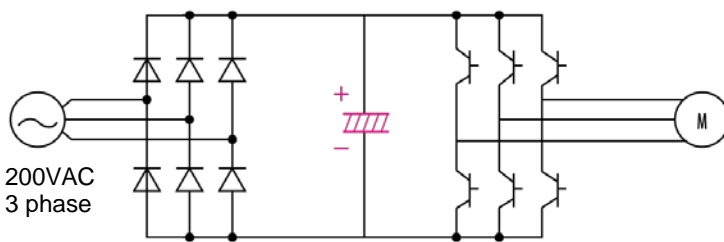
The smoothing circuits of the input sections of these inverter circuits also use aluminum electrolytic capacitors.

The capacitors used in conventional series power supplies have to have a high ripple current resistance and a long life. Here we describe an example of an inverter application and the necessity of using an aluminum electrolytic capacitor in the inverter circuit and in smoothing.

o General Use Inverter

Electric motors are widely used in all types of matching equipment, building ventilator fans, and factory manufacturing equipment, and the use of general use inverters for the rotational control of these motors is increasing rapidly because they permit variable speed control and improve total efficiency.

The input section of these general-use inverters smoothes a 200-VAC, three-phase current employs a power



transistor to make an alternating current for driving the motor.

The principal type of circuit used is shown in Fig.26. The electrolytic capacitor used in the smoothing section must normally be rated for 350-450V and have excellent ripple current resistance.

The type of capacitor used depends on the output capacity. In the case of a large output capacity, a single screw terminal type aluminum capacitor or two or more in parallel are used, and in the case of a small output, printed circuit board types are used in parallel. One point to be careful of when selecting a capacitor is the rated voltage since the voltages at both

○ **Inverter Air Conditioners**

(Since inverter air conditioners for home use came on the market in 1983 because of their efficiency and low power consumption, their production volume has skyrocketed.)

Aluminum electrolytic capacitors are also used for input smoothing in these products, and depending on the AC power input, they can generally be classified by the following circuit types.

Input	Typical circuit	Electrolytic capacitor					
		C ₁ , C ₂			C ₃		
		Rated voltage	Rated capacitance	Ripple current	Rated voltage	Rated capacitance	Ripple current
1 phase 100V		250V	330 680 μ F	3A 8A at 60Hz	330V	1300 2200 μ F	3A 6A at 120Hz
1 phase 200V		350V	70 220 μ F	3A 6A at 60Hz	350V	1300 2200 μ F	3A 6A at 120Hz
3 phase 200V					350V	470 1000 μ F	2.1A 4.5A at 120Hz

The capacitors C₁ and C₂ in particular, in the initial stage of single phase 100 VAC and 200 VAC circuits must have a low capacitance and an extremely high ripple current resistance in order to raise the power factor, and compared to capacitors for general power supply circuits, they must have high heat resistance and low loss.

To meet these needs, we are developing and manufacturing low loss anode foils and high conductivity.

○ **Others**

The use of devices employing inverter circuits is also increasing in uninterrupted power supplies, inverter power supplies for train air conditioners and other purely industrial applications.

To obtain large capacitance, multiple aluminum electrolytic capacitors are often connected in series and parallel, thus increasing the importance of capacitance balance and leakage current balance.

7. ECU for Automotive

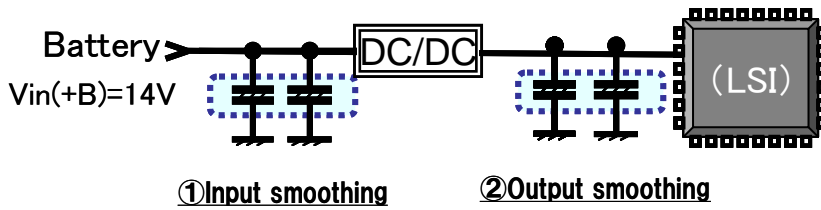
The electronization of in-vehicle control is accelerating these days.

ECU (electrical control unit) which carries out in-vehicle control is asked for high reliance, a miniaturization, and high quality, and many aluminum electrolytic capacitors are used for it.

A typical application example is shown below.

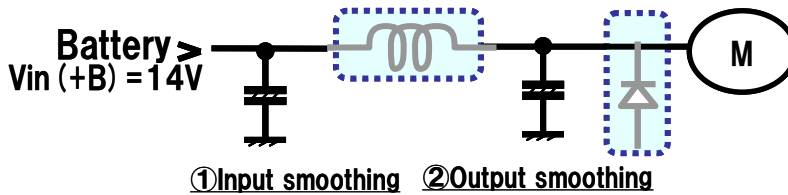
(1) Power train ECU

(Engine, HV-Inverter etc.)

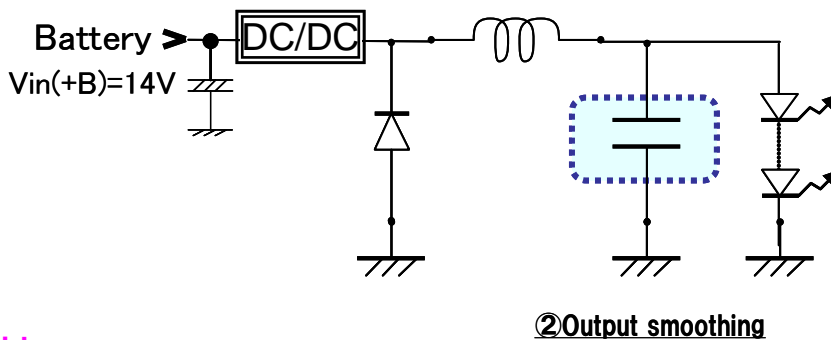


(2) Motor control ECU

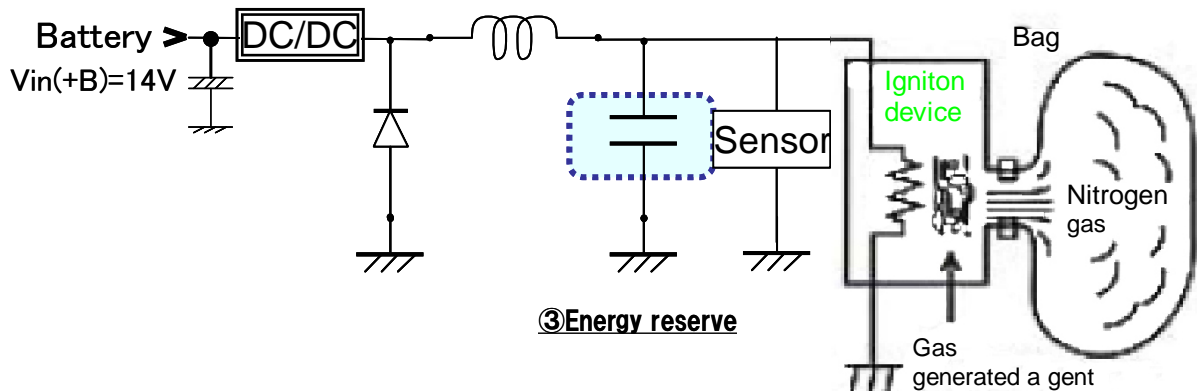
(Power steering, a blower / radiator fan motor, an electric pump etc.)



(3) LED Lump



(4) Airbag



In automotive application, there are mainly an object for smoothing of input and output of the power supply of ECU and an object for energy reserve.

The rated voltage of 25V~50V is mainly used.

Not only current aluminum capacitor, aluminum capacitor with conductive polymer and electrolyte is increasing due to improve quality, performance, with standing-voltage. and it contributes to the small size of ECU, and a weight saving these days.