

### 1. Introduction

Soft-switching is conceived as a technology for preventing transistor-based switching from making switching loss or receiving electromagnetic interference. It is already being used in electromagnetic cooking utensils, switching power supplies, etc. With the development of high-speed transistors, this technology is being considered for use in converters and inverters for large power applications.

### 2. Inverters

Inverters refer to devices for converting direct current to alternating current. The scope of this application is not particularly limited. Since they can control electric power, they are used for controlling load. Particularly in the case of motors, they can control speed, torque and regeneration.

**Fig. 1** shows an early circuit of a soft-switching inverter for motor use. A resonance circuit is added to an ordinary inverter circuit. It has a number of problems because of increased cost due to the presence of an additional circuit and high voltage that is applied from the resonance. The principle of operation, shown in Fig. 1, enables intermittent positive voltage to be applied to the inverter via a diode clamp by generating higher resonance (about 50 kHz) than the inverter current with the capacitor and the coil of the additional circuit. No switching loss is generated and higher harmonics are suppressed by selecting the switching element when the applied voltage is zero.

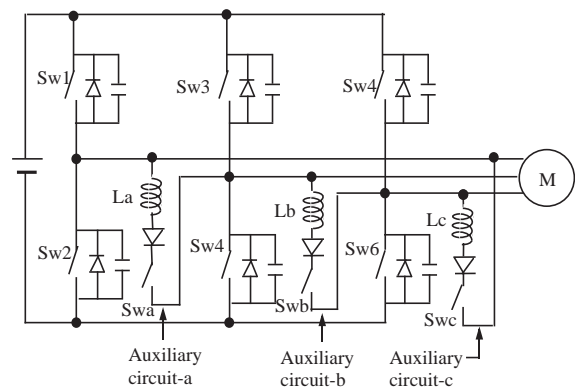
**Fig. 2** shows the circuit of the type of soft-switching inverter reviewed by this laboratory. In this circuit configuration, no voltage exceeding the supply voltage is applied to the element. It has a problem of

inferior motor drive characteristics, however. In this connection, we reviewed the control method and verified that, in principle, it is possible to obtain the drive characteristics equivalent to one under conventional control (**Fig. 3**). Further improvement is required, however, since the problem of cost remains to be solved.

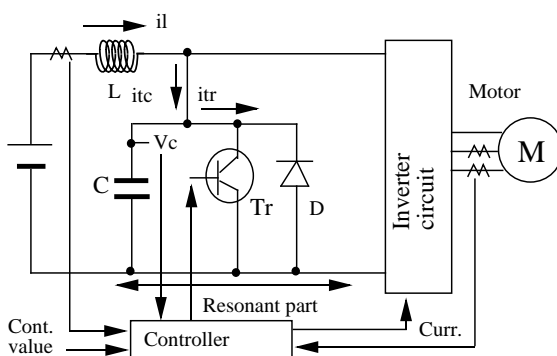
### 3. Future Prospects

Soft-switching is basically an excellent technology and the most promising candidate for the next inverter technology development program. To realize practical application of this technology, it is important to develop circuit engineering that would reduce the cost, and develop common function sharing technology with peripheral electronic devices.

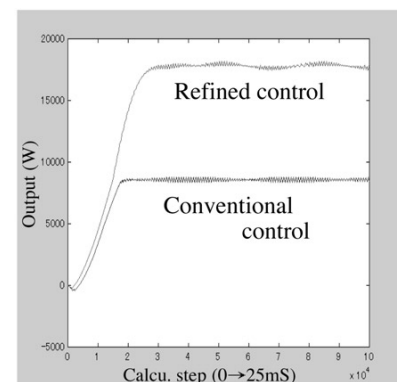
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**Fig. 2**  $\Delta$ -config. soft-switching inverter.



**Fig. 1** First-stage circuit of soft-Sw inverter.



**Fig. 3** Example of simulation output.