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Hitachi Power Devices Technical Information PD Room

In this month's issue, we will present the snubber circuit constants, which we could not describe due to space limitations in our description of the IGBT snubber circuit presented in the sixth issue of PD Room, and will also present how surge voltage occurs in a diode.

Snubber circuit constants

1) Collector current class and snubber capacitor capacity

The capacitor capacity of a snubber circuit can be calculated with $C = Lst\left(\frac{I}{\Delta V}\right)^2$ (1). The table below gives approximate guides.

Rated collector current	Snubber condenser Capacitance (μF)
50A class	0.10 to 0.22
75A class	0.15 to 0.33
100A class	0.22 to 0.68
150A class	0.33 to 1.00
200A class	0.47 to 1.50
300A class	0.68 to 2.20
400A class	1.00 to 3.00
600A class	2.00 to 4.70

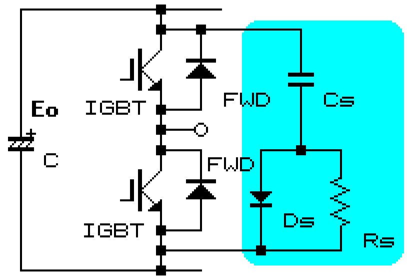


Fig.1 Snubber circuit

You may need larger capacities than the capacity values indicated in the left-hand table, depending on the inductance of the main circuit wiring.

For a snubber capacitor, use a polyester film capacitor or an oil capacitor with good frequency characteristics.

2) Snubber resistance

Resistor capacity varies according to capacitor capacity and ICBT's driving frequency. When voltage ΔV overcharged to the snubber is used, εSN generated when the current I is turned off becomes $\varepsilon SN = 0.5 \times Cs \times \Delta V^2$ ---(2).

Most of this energy can be considered to be consumed by snubber resistance.

Supposing that the output current of a voltage inverter or something similar is a sinusoidal current with the current I in Equation (1) as a peak value, the energy of the snubber circuit can be considered to occur like a sine wave with εSN in Equation (2) as a peak value.

Therefore, the average generated loss PSN in the P-N snubber circuit, taking into account the switching of the top and bottom arms, becomes $PSN = \frac{2}{\pi} \times \varepsilon SN \times fc$ ---(3) (where fc is a switching frequency).

For a resistance value, determine such a value that does not allow oscillation of the collector current at IGBT turn-on.

$Rs \geq 2\sqrt{\frac{Lsn}{Cs}}$ ---(4) Lsn: Inductance of the snubber wiring

Note also that Rs represents resistance in discharging ΔV overcharged to Cs, so that the top limit must be noted.

3) Snubber diode

For a snubber diode, use one of the same class as IGBT's rated collector emitter voltage value. Use a device with a current rating of 1/10 to 1/5 of that of the UGBT used.

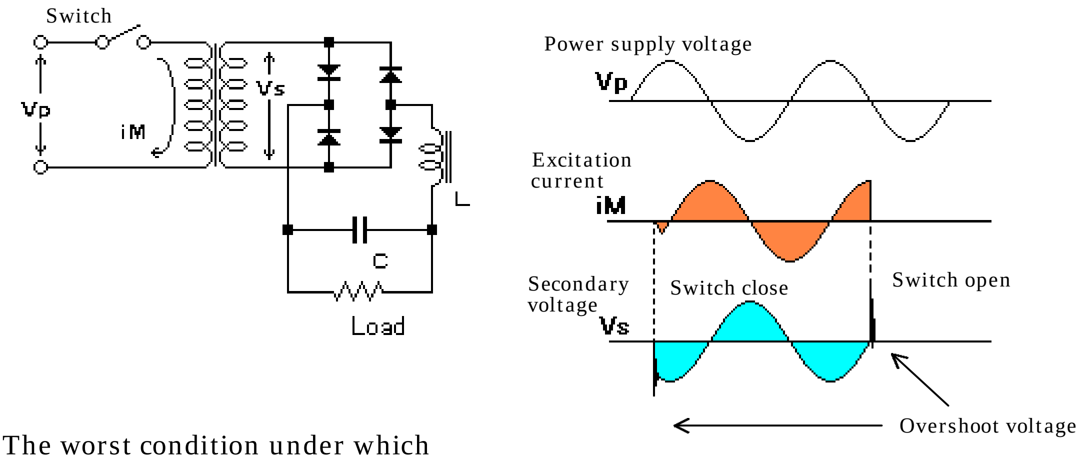
That is all for IGBT's snubber circuit.

How surge voltage occurs and how to prevent it (diode)

This month and next month, we will explain how surge voltage occurs in a rectifying circuit and how to prevent it.

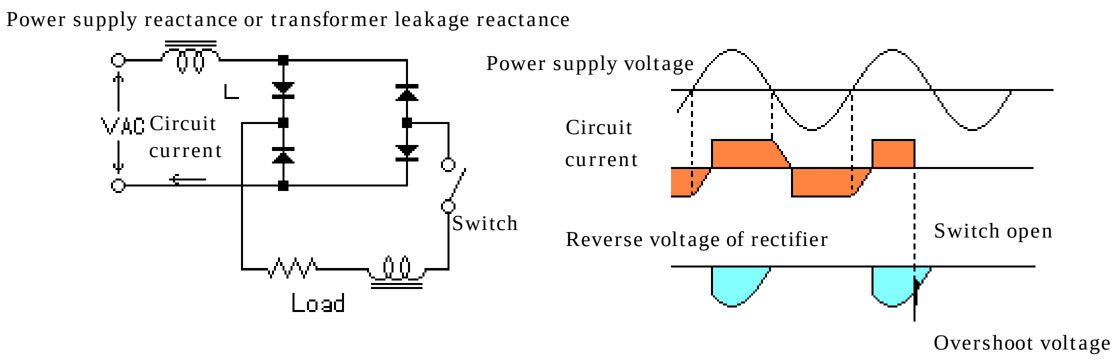
1) How surge voltage occurs when a switch is opened and closed

1-1) How surge voltage occurs when the AC primary is opened (off) and closed (off)



The worst condition under which overvoltage occurs when the primary switch is shut down in a circuit incorporating a transformer is when excitation current is turned off when the load side is open. This voltage is excited in the secondary and applied to the device as overvoltage, and may cause destruction. When the switch is turned on, and when the entered phase peaks, a double voltage occurs under the worst condition, because the load side contains a capacitor. If there is a load, the voltage declines greatly.

1-2) How surge voltage occurs when the DC side is open (off)



When the DC switch is open, the discharge of energy accumulated in the AC reactance is inhibited by the diode, so that overvoltage occurs and it is applied to the device.

1-3) Measures to protect the device

①Install a snubber capacitor (C between A and K).

②Use an avalanche diode.

③Insert a surge suppression device (such as a ZNR) in the transformer primary or secondary.

In the next issue, we will explain how overvoltage occurs due to the hole accumulation effect of a device.

Next issue : How overvoltage occurs