Control Performance of Single-Phase STATCOM and BTB by Three-Level Inverters

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The so-called three level inverters have been widely used for industry applications because of high-voltage output ability and low harmonic contents. These applications are mainly suitable for driving ac motors. Nowadays, attention has been paid to larger-capacity inverters applicable to power system control. This paper describes their applications to power systems.

First, harmonic analysis of the three-level inverter is achieved at the condition that two dc capacitor voltages

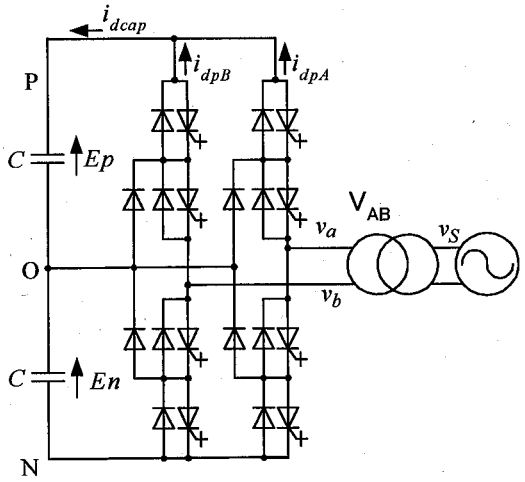

Fig. 1. Three-level inverter.

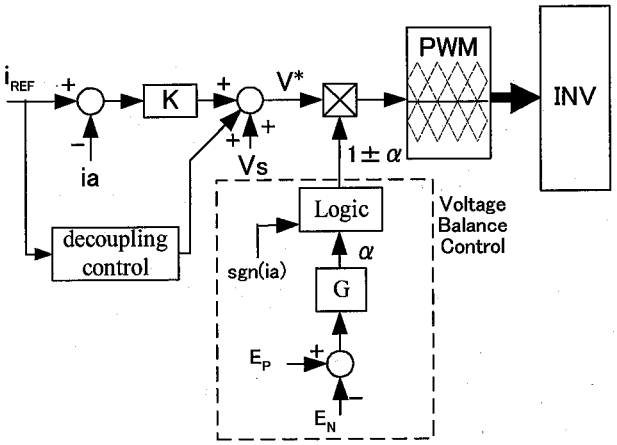

fig. 2. Control bock of voltage balance.

are unbalanced. The line-to-line voltage V_{AB} of the Fig. 1 is expressed as follows.

(1) dc component (m=0, n=0)

$$V_{AB(00)} = 0 \quad \cdots\cdots (1)$$

(2) fundamental component (m=1, n=0)

$$V_{AB(10)} = a(E_P + E_N)\sin\omega_0 t \quad \cdots\cdots (2)$$

(3) harmonics of fundamental component (m, n=0)

$$V_{AB(m0)} = 0 \quad \cdots\cdots (3)$$

(4) harmonics of carrier frequency±even harmonics of fundamental component

$$V_{AB(mn,m=\pm 2,4,..)} = (\cos n\pi - 1)\frac{2}{n\pi^2}H(a,n) \times (E_P - E_N)\cos(m\omega_0 t + n\omega_c t) \quad \cdots\cdots (4)$$

(5) harmonics of carrier frequency±odd harmonics of fundamental component

$$V_{AB(mn,m=\pm 1,3,..)} = (\cos n\pi + 1)\frac{2}{n\pi}J_m(an\pi) \times (E_P + E_N)\sin(m\omega_0 t + n\omega_c t) \quad \cdots\cdots (5)$$

Second, a control method for balancing the two dc capacitor voltages is proposed. Fig. 2. shows the control block of voltage balance. Finally, applications of single-phase three-level inverters to STATCOMs and BTBs are introduced. Their control performance is confirmed by computer simulation. The reactive power control performance and active power control performance were simulated. The system can control active power, reactive power and dc voltage balance even when the power system voltage is changed on the system fault.

The single phase power systems are used for electric train applications. The single phase STATCOMs and BTBs using the three-level inverters are suitable for the stabilization of the system voltage and the interconnection of the power system.