Introduction for MLVERT series Medium Voltage AC Drive

MLVERT series Medium voltage AC drive is made for Hi-power 3kV, 3.3kV, 4.16kV, 6kV, 6.6kV and 10kV motor. They operate with adjustable output frequency and voltage to control the motor rotating speed for energy saving.

Generally, An AC adjustable speed drive as shows in figure 1, it has an AC Medium Voltage Drive(MVD) and peripheral Switch K1~K3, which K1 is for bypass, K2 and K3 are for isolation. When the motor operates at Adjustable Speed Mode, K1 switched off, K2 and K3 switched on; when the AC drive need for maintenance, K2 and K3 switched off for isolation, K1 switched on for bypass, so the motor can work at constantly speed as it was.

A MVD AC Drive, sometimes as has two main parts: One is the input transformer; another is the so-called converter, as shown in Fig 1.

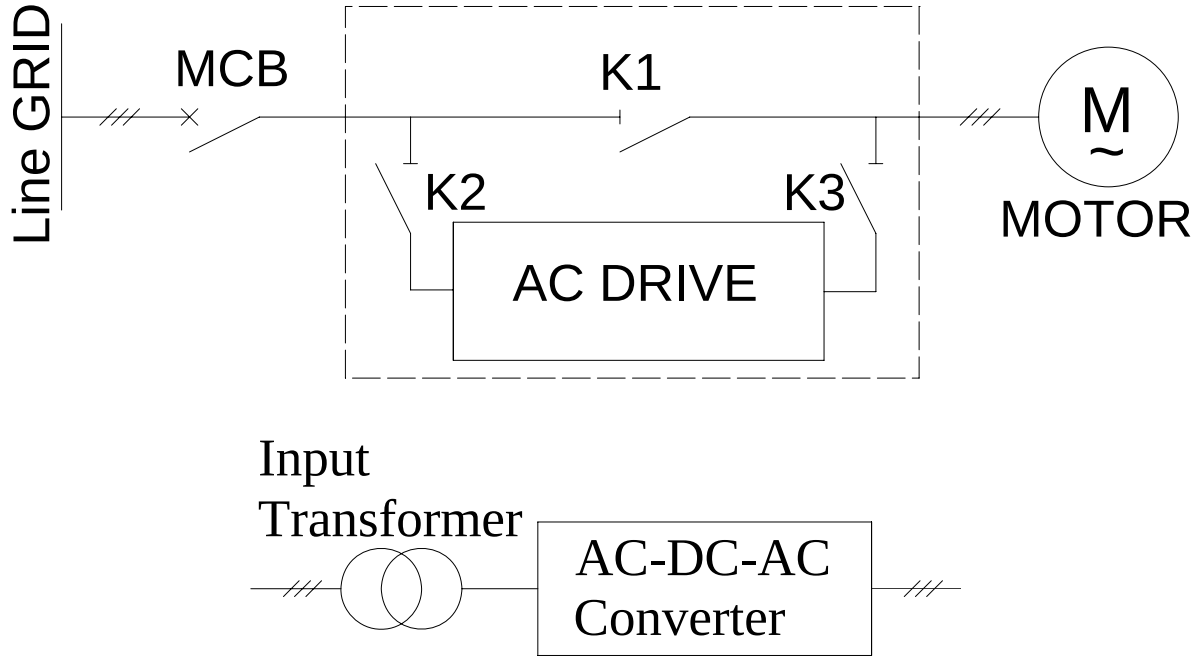

Fig. 1 Schematic Circuit of an AC Adjustable Speed Drive

The input transformer transforms the AC line grid voltage to the converter-needed voltage, which can be a group of secondary windings with law voltage. Some converters can work without transformer.

The AC-DC-AC converter change the 50Hz/60Hz AC Voltage to DC voltage with a rectifier, DC link with a large capacitor, which so-called as DC Filter; then an inverter change the DC voltage to AC variable voltage and variable frequency (for short as VVVF). When a motor work with a VVVF power supply, it can operate at any rotation speed by change the power supply's frequency. Any motion control of motor can use this method or the similar method.

The inverter is consists of some power electronics component, like IGBT (Isolated Gate Bipolar Transistor), IGCT (Integrated Gate Commutated Thyristor), Diode and etc. A MVD can

have different structure of inverter or converter.

MLVERT series' MVD has two sub-series: D series and S series, their differences mainly at the inverter. MLVERT D-series converter has a structure as shown in figure 2.

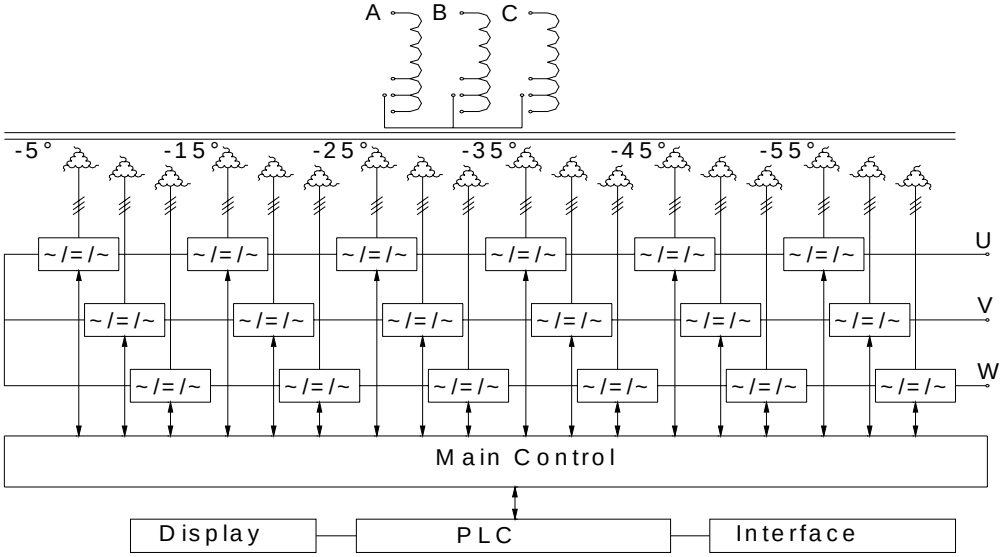

Fig 2 Schematic of Cascaded Cells Multi-level Inverter

This structure has an Input transformer, transformer's primary winding with star connection, secondary windings with a lead or lag elongate delta connection; each secondary winding isolated as floating power supply to the inverter cell. 4 or 6 cell or even more cells series-connected as one phase. Three phase Star-connected to output 3kV to 10kV line voltage. This connection method sometimes called Cascade. Every inverter cell has a structure like figure 3:

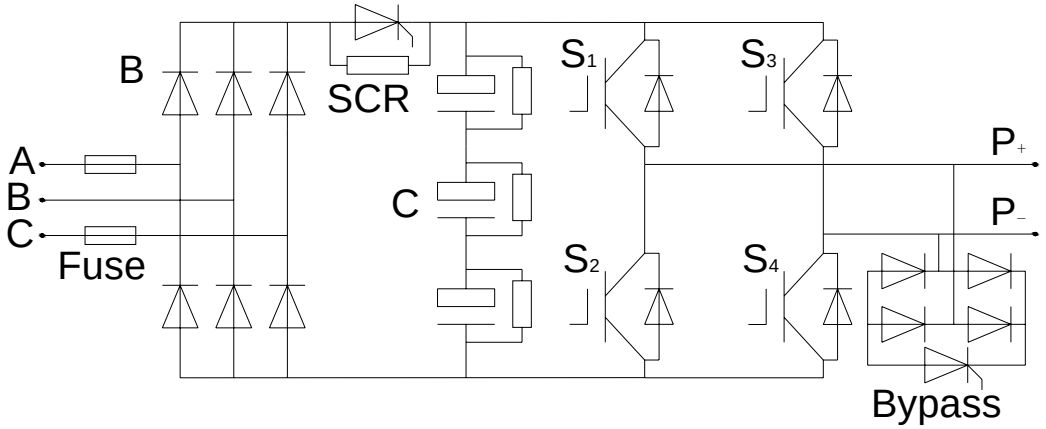

Fig 3 Schematic of an Inverter Cell

The cell input is from the transformer's secondary windings as a floating AC 610V/50Hz power supply, by the rectifier bridge B, AC changes to DC. SCR and its parallel-connected resistor as a soft-start circuit to protect the surge current of DC link capacitor when power on. DC link capacitor C uses series-connected Aluminum Electrolytic Capacitor, its voltage specification is 400V, about 6800uF~10000uF. The main inverter bridge uses S1~S4, 4 reverse conducting IGBT, construct an "H" type bridge. To control the "H" bridge, we use the Pulse Width Modulation (PWM)

method. At the cell's output end, it has a bypass circuit with a 4 diodes full wave rectifier bridge parallel-connected a SCR. When the cell is failure, the control system will trigger the bypass SCR, the cell's output will be shorted. If we bypass the other two-phase's two cell, then the output voltage is still symmetrical in phase, the motor can non-stop.

MLVERT S-series' MVD has another structure, as shown in figure 4.

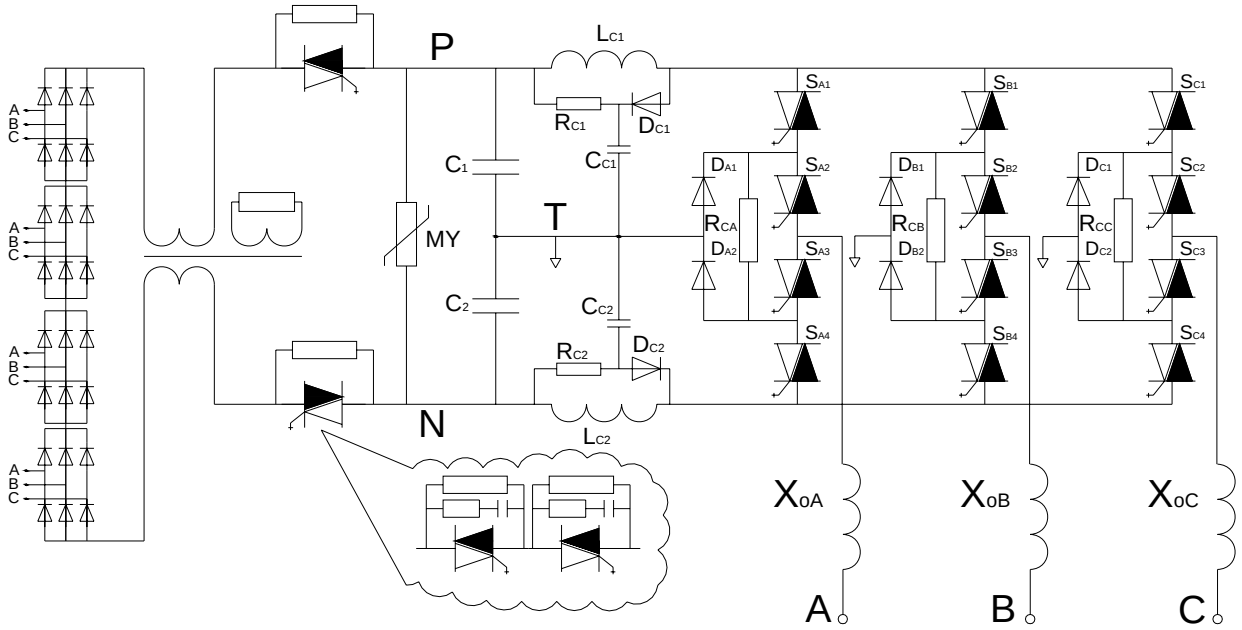

Fig 4 Schematic of Neutral Point Clamping Tri-level Inverter

This series MVD consists of IGCT (Integrated Gate Commutated Thyristor). For 6kV and more, need IGCT series-connection, 2 or even more. Like D series, it has an input transformer too. Two or four secondary windings through capsule diode bridge to be changed to the DC voltage, Then it can be changed to another frequency or voltage to motor. The inverter use the large-scale component, IGCT, it has a high DC voltage, with the tri-level inverter, it can output even less harmonic.

S-series' phase output is just like the D-series' cell output, shown in figure 5. Modulation: Compare a sinusoidal signal wave to a two-phase triangle carrier wave, if signals large than two carriers, then output positive pole, else if signals less than two carriers, then output negative pole, else output neutral pole. This means TRI-LEVEL PWM.

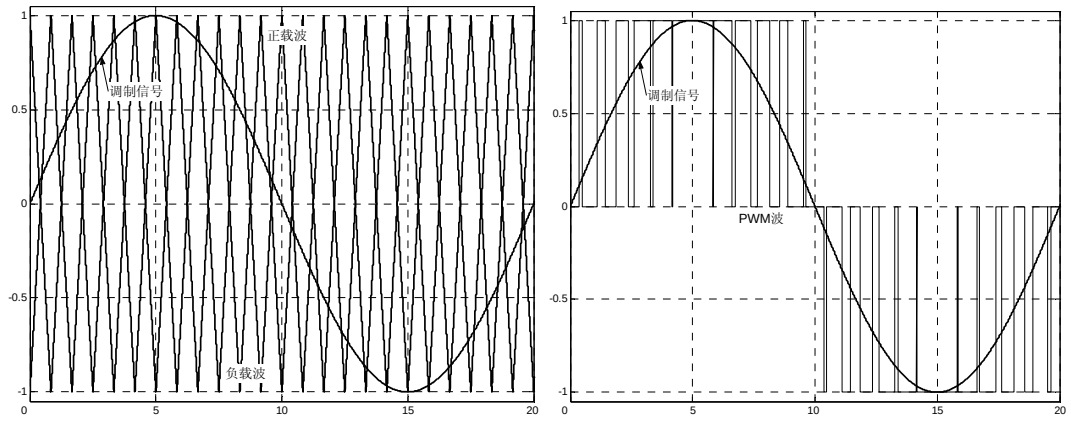

Fig 5 Modulation and PWM output

If this PWM wave power supply direct to the motor, the harmonic components of the PWM wave voltage will produce harmonic current in the motor. The harmonic current will produce the additional heat in the stator and rotor parts, and torque pulsation on the output axis. So, in the S-series MVD, the output end series connected an LC filter to treat the harmonic component of the INVERTER output line voltage. S-series MVD output a quasi-sinusoidal line voltage with very low *dv/dt*.

D series MVD with low voltage output cell by phase-shift series-connection, output a multi-step PWM wave to fit the reference sinusoidal wave. This multi-step wave has very low harmonic component and can work with filter-less.

D series MVD can get any output voltage by series-connected different cells to fit the different local grid voltage class, like 3kV, 3.3kV, 4.16kV, 6kV, 6.6kV, 10kV and even large.

S series has a common DC bus, so, it can work with multi-MVD to share one DC bus. It can be more efficiency when some MVD need feedback energy to the power supply for braking.

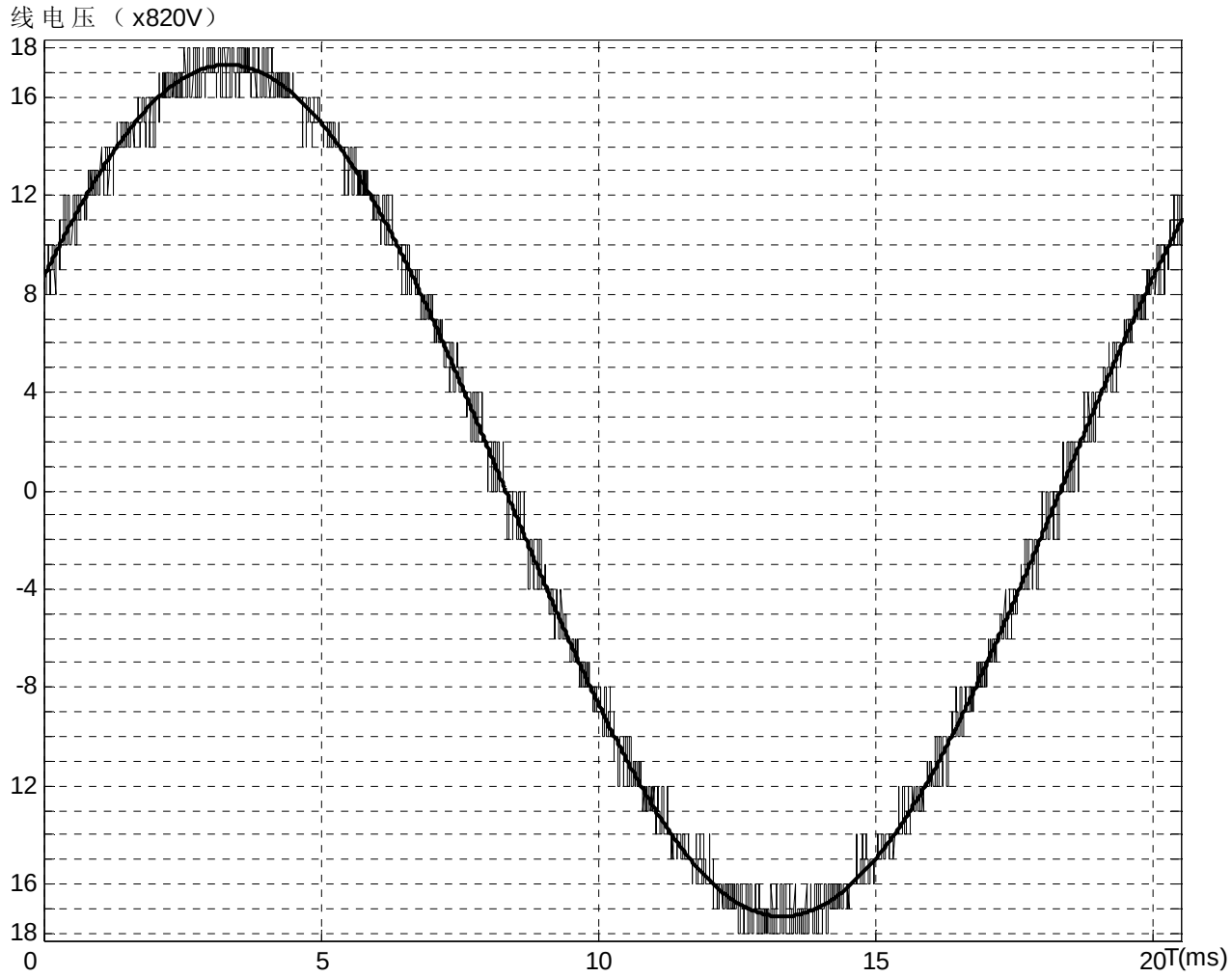

Fig 6 Cascaded Cells Multi-level 10kV output line voltage

MLVERT series MVD mainly used to the motion control of High power high voltage motor.

These motors can be worked with pumps, fans and etc. Large pumps and fans that need adjustable speed operating can be found in the power plants, water station, miner or metal industry.

We give the product to the motor variable speed control. The Voltage range can be 3kV~10kV, Power range can be 220kW~5000kW.