

2.7 Firing Schemes for Converters

The firing circuit consists of step down transformer, uncontrolled rectifier, comparator, differentiator, mono stable multi vibrator, oscillator, AND gate, pulse amplifier and pulse transformer.

The complete circuit diagram of triggering circuit is shown in Fig. 2.24. A single-phase transformer with center tapped secondary windings has been used. The main purpose of this transformer is to step down 50Hz, 220 V to 6-0-6 V. The secondary voltage of the transformer is compared with a dc reference signal using a 741C op-amp comparator to produce an alternating rectangular waveform of a variable pulse width.

The output of the comparator ideally swings between +5 and -5 V at every crossing transformer output dc reference voltage. Using a variable resistor, the dc reference voltage can be altered and hence the rectangular waveform of variable pulse width is obtained at output terminal.

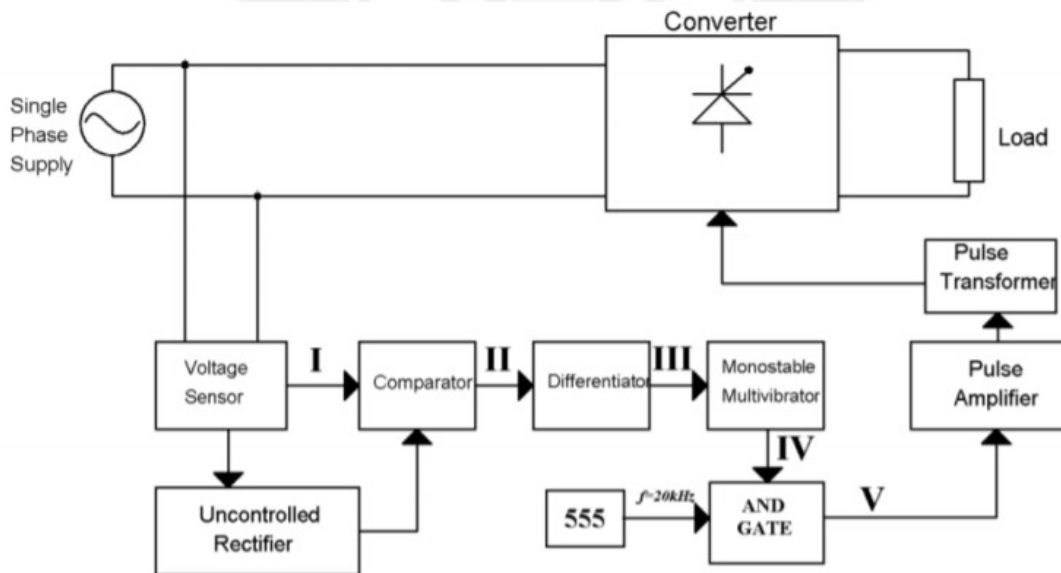


Figure 2.7.1 Firing circuit for full converter

[Source: "Power Electronics" by P.S.Bimbra, Khanna Publishers Page: 224]

A simple R-C differentiator is used to differentiate the rectangular voltage waveform. The elements R and C are selected as $10\text{K}\Omega$ and $0.01\mu\text{F}$, respectively. Monostable multivibrator often called a on shot multivibrator, is a pulse generating circuit in which the duration of this pulse is determined by the RC network connected externally to the 555 timer. A 555 timer produces an output pulse using a positive going edge trigger to produce a delay angle between 0° and 90° for the conversion mode of operation.

The differentiator is blocked by a connected diode. The number of comparators and monostable blocks are 2 blocks to produce firing pulses for conversion and inversion mode together. The values of R9 and C7 for the monostable are chosen so that the pulse width is approximately 0.5ms. Once triggered, the circuit's output will remain in the high state until the set time elapses. The output will not change its state even if an input trigger is applied again during this time interval. The output will remain in the low state until a trigger is again applied. IC 555 timer is used as oscillator.

The square wave output waveform of of 20kHz by connecting suitable resistor and capacitor. Pulse gating of thyristor is not suitable for RL loads, this difficulty can be overcome by using continuous gating. However, continuous gating may lead to increased thyristor losses and distortion of output pulse. So, a pulse train generated by modulating the gate pulse at high frequency is used to trigger the thyristor. This high frequency wave is known as carrier wave and is generated by using 555 timer. The outputs of monostable multivibrator and oscillator are applied to the AND gate. IC 7408 two input AND gate is used for this purpose. A long duration pulse may saturate the pulse transformer and the firing pulse may be distorted so high frequency modulation is necessary.

The duty cycle is kept less than 50 percent, so that the magnetic flux in the transformer can be reset. The modulation pulse also reduces the gate dissipation.