Triangular Comparator Firing Scheme

As we know that SCR is a controlled device which requires firing pulses to turn ON. To make use of this device in the rectifier applications we need to generate the firing pulses by which we can make device in the conduction state. So there are various methods to generate the firing pulse to trigger the thyristors. One of these methods is Triangular comparator firing scheme. The following description shows the basic working of this scheme.

The triangular firing scheme consists of following main blocks:

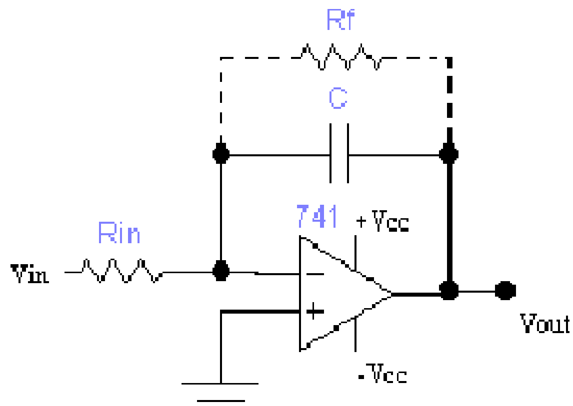
1. Step down transformer
2. Zero crossing detectors
3. Integrators
4. Comparators
5. Reference voltage generation
6. Pulse amplifier & isolation sections

1. **Step down transformer**: In this particular block the AC voltage is step down to lower voltages. These voltages are used for synchronization i.e. with respect to this signal the gate pulse will be generated. Output of the step down transformer is taken as center tapped. For example if the ac mains input is 230V/50Hz or 110V/60Hz & suppose output is V1, 0, V2. with the frequency of 50Hz/60Hz. Now this ac voltage is fed to the zero crossing detector1 & zero crossing detector2.

2. **Zero crossing detectors**: Zero crossing detector is also called as sine wave to square wave converter. It works on the basic principle of comparator. In comparator the input signal is compare with the some reference voltage Vref. As the input signal crosses the +Vref the op-amp goes into the positive saturation. Similarly, as the signal crosses the – Vref the op-amp goes into the negative saturation & in this way a sinusoidal signal gets converted into the square wave. Now instead of using some reference voltage, if this reference voltage pin is grounded then this configuration gets converted into the zero crossing detector. Now the input signal is compared with the 0V. As the signal rises above the 0V the output of the op-amp gets into the positive saturation for this instance the output of the op-amp is high till the zero crossing comes. As signal crosses below 0V the output of the op-amp gets into the negative saturation for this instance the output of the op-amp is high till next zero crossing comes & in this way a zero crossing detector works.

3. **Integrator:** The following figure shows circuit schematic for an integrator. If we replaced the feedback resistor with a capacitor. Therefore, any feedback current must be based on a change in output voltage. As feedback current flows, the

capacitor will gain an electric charge, which will change according to the cumulative effects of the output signal.
If the input voltage is zero, no input current will flow. Therefore no feedback current can flow and the output voltage will remain constant. If the input voltage is non-zero, the basic equation for the output voltage becomes Vout = -Vin/RC + K, where R is the input resistance in ohms, C is the feedback capacitance in farads, and K is a fixed constant representing the accumulated voltage from the past. If the input voltage is constantly changing, the output voltage at any instant will be the integral of all past input voltage values. For example, a square wave input will actually produce another triangular wave as its output.



The relationship between Vin and Vout can be given as follows

$$\mathbf{V_{out}(t);\ -\frac{1}{R_{in}C}\int V_{in}\,(t)dt + V_{out(t=0)}}$$

A couple of factors are of interest with these circuits:

1. If the input is a constant positive dc voltage, the output will be a negative linear ramp. There is no exponential factor in an op amp integrator. The equation for the ramp will be Vout = -Vint/RC, where t is time in seconds.

2. In an analog computer, an "initial condition" can be applied as a starting voltage on the capacitor, at the beginning of the integration process.

3. The integrator has an automatic and natural tendency to damp out any high-frequency noise that may appear in the input signal.

4. It is essential to avoid any long-term dc offset in the input voltage; if such an offset is present, it will cause the output voltage to gradually shift toward one extreme or the other, and stay there. In an analog computer, such an offset problem is avoided by limiting the time during which the integration process is allowed to continue. At the end of that time, the circuit is reset back to its initial conditions before being allowed to repeat the operation.

4. Comparators: In comparator the input signal is compare with the some reference voltage Vref. As the input signal crosses the Vref the op-amp goes into the positive saturation. The output of the comparator is high till the signal comes below to the Vref.

5. Reference voltage generation: This block consists of a potentiometer connected between +VCC & -VCC. As the knob of potentiometer varies from minimum to maximum the resistance of the potentiometer changes, with respect to this change the voltage at the Vref pin changes which is compared with integrator outputs.

6. Pulse Amplifier & Isolation Section: As the current in the pulse is not sufficient to trigger the thyristor. To amplify the current, pulse amplification is needed. As we know that the voltage level of these pulses is too small & thyristors works on the high voltage applications. To isolate this low voltage circuitry & high voltage circuitries there should be some protection to lower voltage circuit failure, we need to place opto-isolators or pulse transformer by which no hazardous effect comes in between.