MONOLITHIC SWITCHING REGULATOR [µA78S40]

The µA78S40 consists of a temperature compensated voltage reference, duty cycle controllable oscillator with an active current limit circuit, a high gain comparator, a high- current, high voltage output switch, a power switching diode & an uncommitted op-amp.

Important features of the µA78S40 switching regulators are:

- Step up, down & Inverting operation
- Operation from 2.5 to 40V input
- 80dB line & load regulations
- Output adjustable from 1.3 to 40V
- Peak current to 1.5A without external resistors
- Variable frequency, variable duty cycle device

The internal switching frequency is set by the timing capacitor C_T, connected between pin12 & ground pin 11. the initial duty cycle is 6:1. The switching frequency & duty cycle can be modified by the current limit circuitry, I_{PK}sense, pin14, 7 the comparator, pin9 & 10.

Comparator:

The comparator modifies the OFF time of the output switch transistor Q1 & Q2. In the step – up & step down modes, the non-inverting input(pin9) of the comparator is connected to the voltage reference of 1.3V (pin8) & the inverting input (pin10) is connected to the output terminal via the voltage divider network.

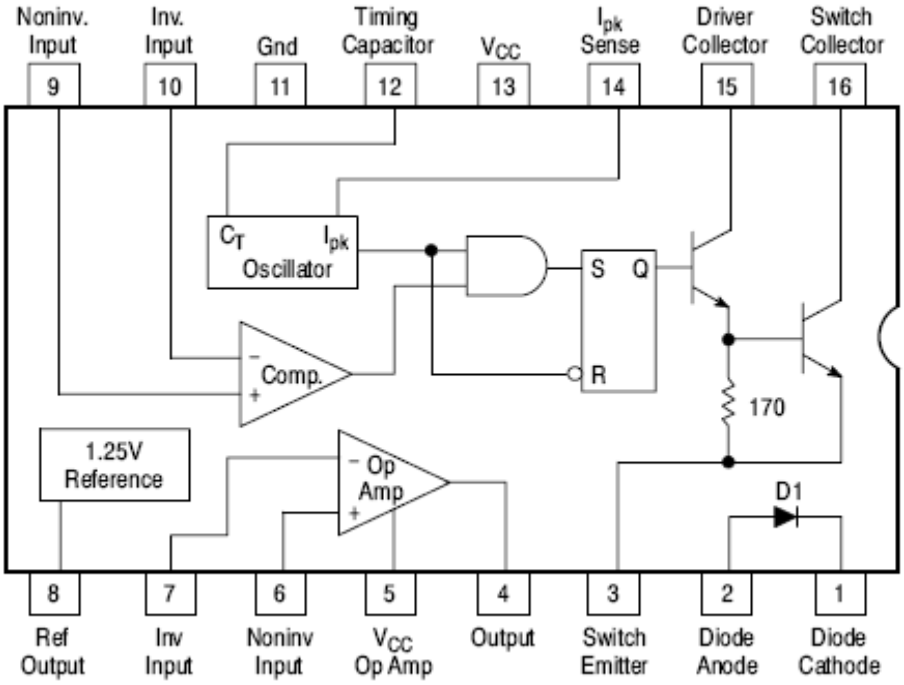
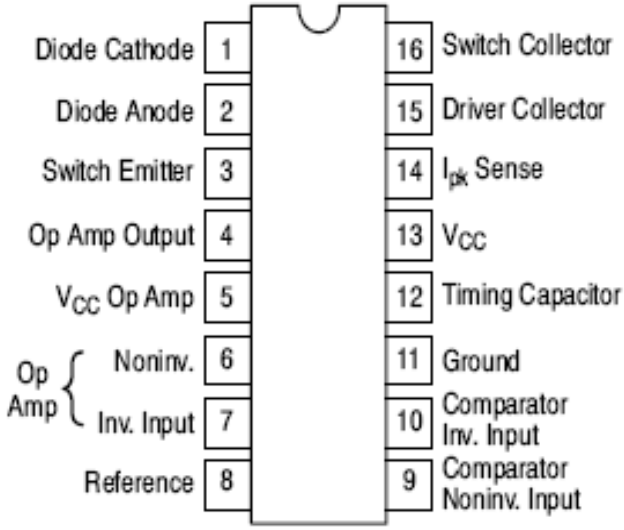


Fig: Functional block diagram of µA78S40



- In the Inverting mode ✦ the non – inverting input is connected to both the voltage reference & the output terminal through 2 resistors & the inverting terminal is connected to ground.
- When the output voltage is correct, the comparator output is in high state & has no effect on the circuit operation.
- However, if the output is too high & the voltage at the inverting terminal is higher than that at the non-inverting terminal , then the comparator output goes low.
- In the LOW state the comparator inhibits the turn on of the output switching transistors. This means that, as long as the comparator output is low, the system is in off time.
- As the output current rises or the output voltage falls, the off time of the system decreases.
- Consequently, as the output current nears its maximum Io_{MAX}, the off time approaches its minimum value.

In all 3 modes (Step down, step up, Inverting), the current limit circuit is completed by connecting a sense resistor Rsc, between I_{PK} sense & Vcc.

- The current limit circuit is activated when a 330mV potential appears across Rsc.
- Rsc is selected such that 330mV appears across it when the desired peak current I_{PK}, flows through it.
- When the peak current is reached, the current limit circuit is turned on.
- The forward voltage drop, V_D, across the internal power diode is used to determine the value of inductor L off time & efficiency of the switching regulator.
- Another important quantity used in the design of a switching regulator is the saturation voltage Vs

  - In the step down mode an “output saturation volt” is 1.1V typical, $1.3V_{MAX}$.
  - In the step up mode an “Output saturation volt” is 0.45V typical, 0.7 maximum.

$$Rsc = \frac{330mV}{DesiredPeakCurrent}$$

- The desired peak current value is reached, the current limiting circuit turns ON & immediately terminates the ON time & starts OFF time.

- As we increase I_L (load current), Vout will decreased, to compensate for this, the ON time of the output is increased automatically.
- If the I_L decreased then Vout increased, to compensate for this, the OFF time of the output is increased automatically.

Source : https://aihteienotes.files.wordpress.com/2014/07/lic-notes.doc