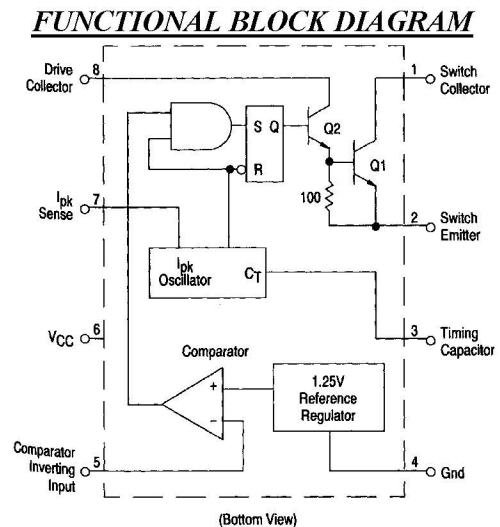


DC-TO-DC CONVERTER CONTROL CIRCUITS

The IL34063A is a monolithic control circuit containing the primary functions required for DC-to-DC converters. These devices consist of an internal temperature compensated reference, comparator, controlled duty cycle oscillator with an active current limit circuit, driver and high current output switch. This series was specifically designed to be incorporated in Step-Down and Step-Up and Voltage-Inverting applications with a minimum number of external components.

FEATURES

- Operation from 3.0 V to 40 V Input
- Low Standby Current
- Current Limiting
- Output Switch Current to 1.5 A
- Output Voltage Adjustable
- Frequency Operation to 100 kHz
- Precision 2% Reference



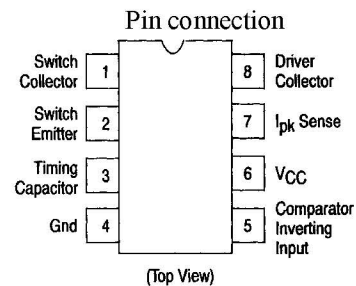
MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|------------------|-------------|--------------|
| Power Supply Voltage | V_{CC} | 40 | Vdc |
| Comparator Input Voltage Range | V_{IR} | -0.3 to +40 | Vdc |
| Switch Collector Voltage | $V_{C(switch)}$ | 40 | Vdc |
| Switch Emitter Voltage ($V_{pin 1} = 40 V$) | $V_{E(switch)}$ | 40 | Vdc |
| Switch Collector to Emitter Voltage | $V_{CE(switch)}$ | 40 | Vdc |
| Driver Collector Voltage | $I_{C(driver)}$ | 40 | Vdc |
| Driver Collector Current (Note 1) | $I_{C(driver)}$ | 100 | mA |
| Switch Current | I_{SW} | 1.5 | A |
| Power Dissipation and Thermal Characteristics | | | |
| DIP Package, N Suffix $T_A = +25^\circ C$ | P_D | 1.25 | W |
| Thermal Resistance | $R_{\theta JA}$ | 100 | $^\circ C/W$ |
| SOP Package, D Suffix $T_A = +25^\circ C$ | P_D | 625 | mW |
| Thermal Resistance | $R_{\theta JA}$ | 160 | $^\circ C/W$ |
| Operating Junction Temperature | T_J | +150 | $^\circ C$ |
| Operating Ambient Temperature Range | T_A | -40 to +85 | $^\circ C$ |
| Storage Temperature Range | T_{stg} | -65 to +150 | $^\circ C$ |

* Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

ORDERING INFORMATION

| Device | Package | Packing |
|-----------|---------|---------|
| TK34063AD | SOP-8 | Reel |
| TK34063AN | DIP-8 | Tube |
| | | |


ELECTRICAL CHARACTERISTICS

($V_{CC} = 5.0\text{ V}$, $T_A = -40$ to $+85^\circ\text{C}$ unless otherwise specified.)

| Characteristics | Symbol | Min | Typ | Max | Unit |
|--|---------------|---------------|-----------|---------------|---------------|
| OSCILLATOR | | | | | |
| Frequency ($V_{Pin5} = 0\text{ V}$, $C_T = 1.0\text{ nF}$, $T_A = 25^\circ\text{C}$) | fosc | 24 | 33 | 42 | kHz |
| Charge Current ($V_{CC} = 5.0\text{ V to } 40\text{ V}$, $T_A = 25^\circ\text{C}$) | Ichg | 24 | 33 | 42 | μA |
| Discharge Current ($V_{CC} = 5.0\text{ V to } 40\text{ V}$, $T_A = 25^\circ\text{C}$) | Idischg | 140 | 200 | 260 | μA |
| Discharge to Charge Current Ratio (Pin7 to Vcc, $T_A = 25^\circ\text{C}$) | Idischg/Ichg | 5.2 | 6.2 | 7.5 | — |
| Current Limit Sense Voltage (Ichg = Idischg, $T_A = 25^\circ\text{C}$) | Vipk(sense) | 250 | 300 | 350 | mV |
| OUTPUT SWITCH (Note 3) | | | | | |
| Saturation Voltage, Darlington Connection ($I_{SW} = 1.0\text{ A}$, Pins 1, 8 connected) | $V_{CE(sat)}$ | — | 1.0 | 1.3 | V |
| Saturation Voltage ($I_{SW} = 1.0\text{ A}$, $R_{Pin8} = 82\ \Omega$ to V_{CC} . Forced $\beta = 20$) | $V_{CE(sat)}$ | — | 0.45 | 0.7 | V |
| DC Current Gain ($I_{SW} = 1.0\text{ A}$, $V_{CE} = 5.0\text{ V}$, $T_A = 25^\circ\text{C}$) | h_{FE} | 50 | 120 | — | — |
| Collector Off-State Current ($V_{CE} = 40\text{ V}$) | $I_{C(off)}$ | — | 0.01 | 100 | μA |
| COMPARATOR | | | | | |
| Threshold Voltage ($T_A = 25^\circ\text{C}$) ($T_A = T_{LOW}$ to T_{HIGH}) | Vth | 1.225 1.21 | 1.25 — | 1.275 1.29 | V |
| Threshold Voltage ($T_A = 25^\circ\text{C}$) ** | Vth | 1.2375 | 1.25 | 1.2625 | V |
| Threshold Voltage Line Regulation ($V_{CC} = 3.0\text{ V to } 40\text{ V}$) | Regline | — | 1.4 | 5.0 | mV |
| Input Bias Current ($V_{in} = 0\text{ V}$) | I_{IB} | — | -40 | -400 | nA |
| TOTAL DEVICE | | | | | |
| Supply Current ($V_{CC} = 5.0\text{ V to } 40\text{ V}$, $C_T = 1.0\text{ nF}$, $V_{pin7} = V_{CC}$. $V_{Pin5} > V_{th}$, Pin 2 = Gnd, Remaining pins open) | I_{CC} | — | 2.5 | 4.0 | mA |

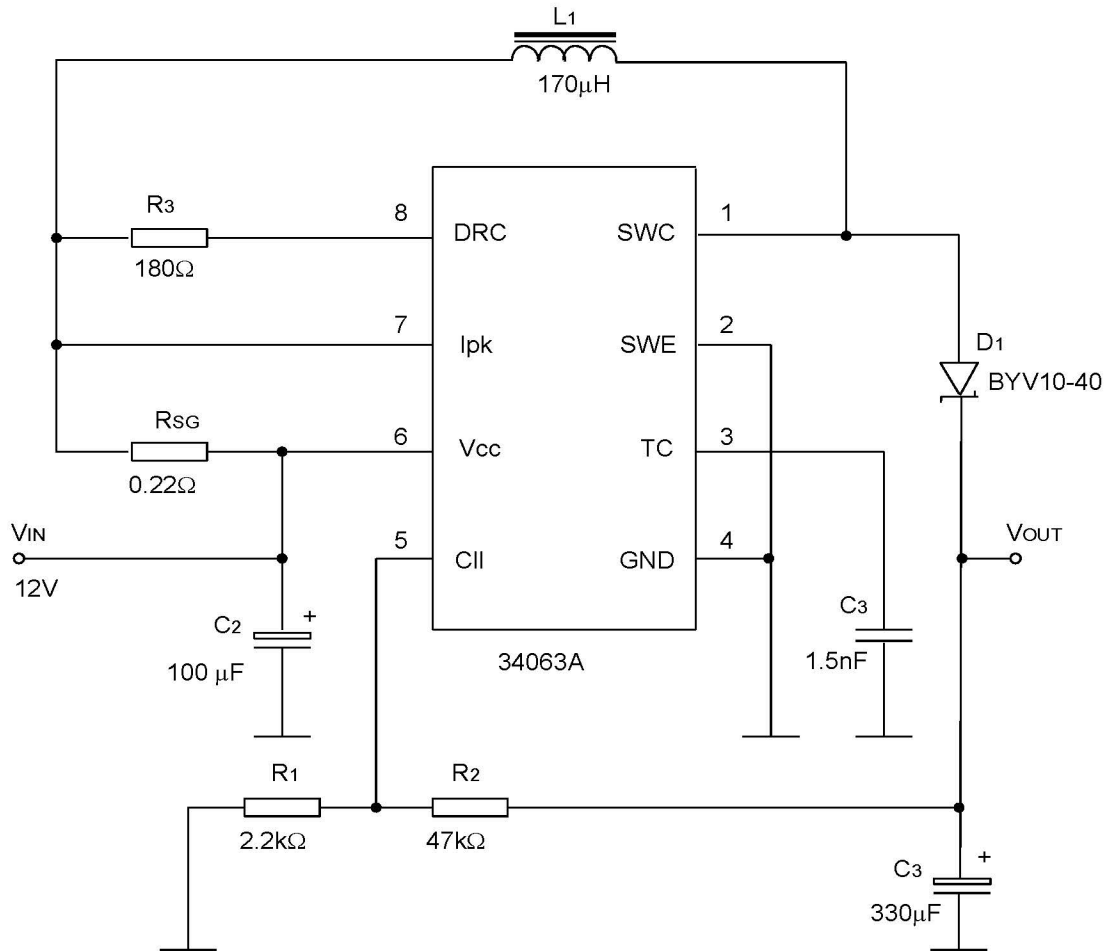
NOTES:

- Maximum package power dissipation limits must be observed.
- Low duty cycle pulse techniques are used during test to maintain Junction temperature as close to ambient temperature as possible
- If the output switch is driven into hard saturation (non Darlington configuration) at low switch currents ($< 300\text{ mA}$) and high driver currents ($> 30\text{ mA}$), it may take up to $2.0\ \mu\text{s}$ to come out of saturation This condition will shorten the off time at frequencies $> 30\text{ kHz}$, and is magnified at high temperatures This condition does not occur with a Darlington configuration, since the output switch cannot saturate If a non Darlington configuration is used, the following output drive condition is recommended

Forced β of output switch = I_C , output / (I_C , driver -7.0 mA^*) > 10

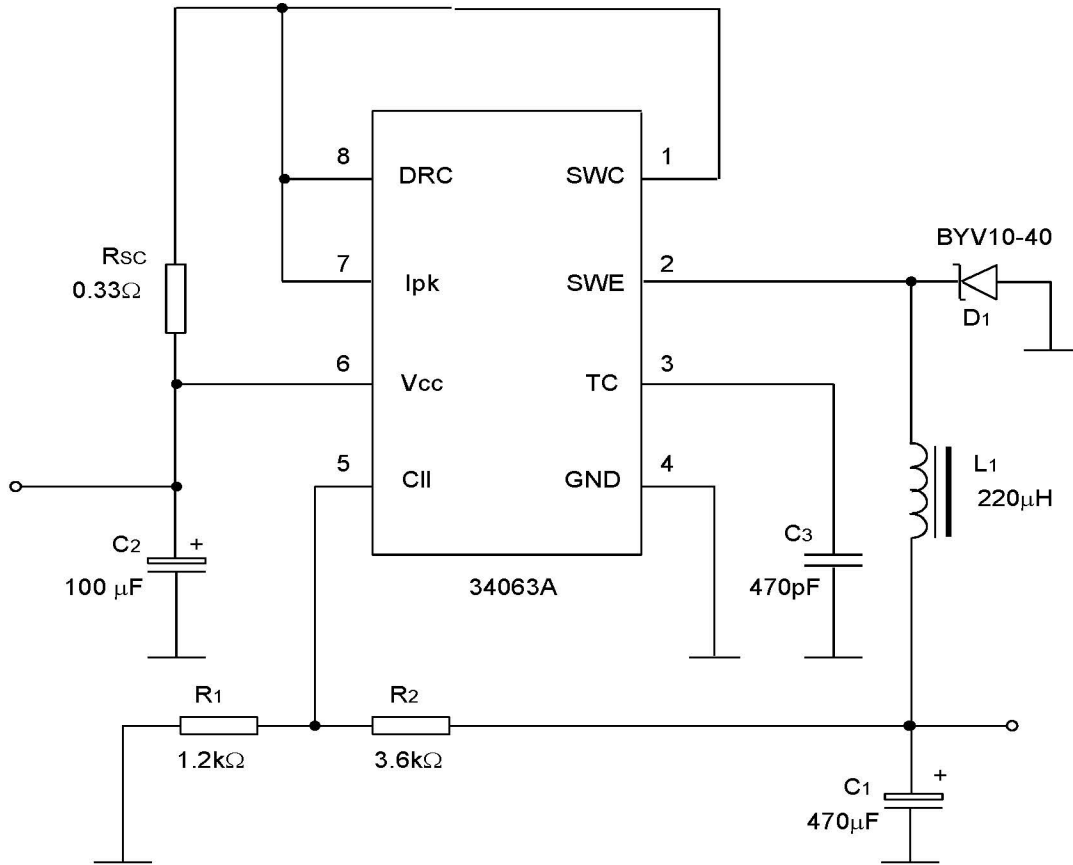
*The $100\ \Omega$. resistor in the emitter of the driver device requires about 7.0 mA before the output switch conducts

**Possible version for shipment

TYPICAL APPLICATION CIRCUITS
Step-Up Converter

Test Condition ($V_{OUT} = 28\text{ V}$)

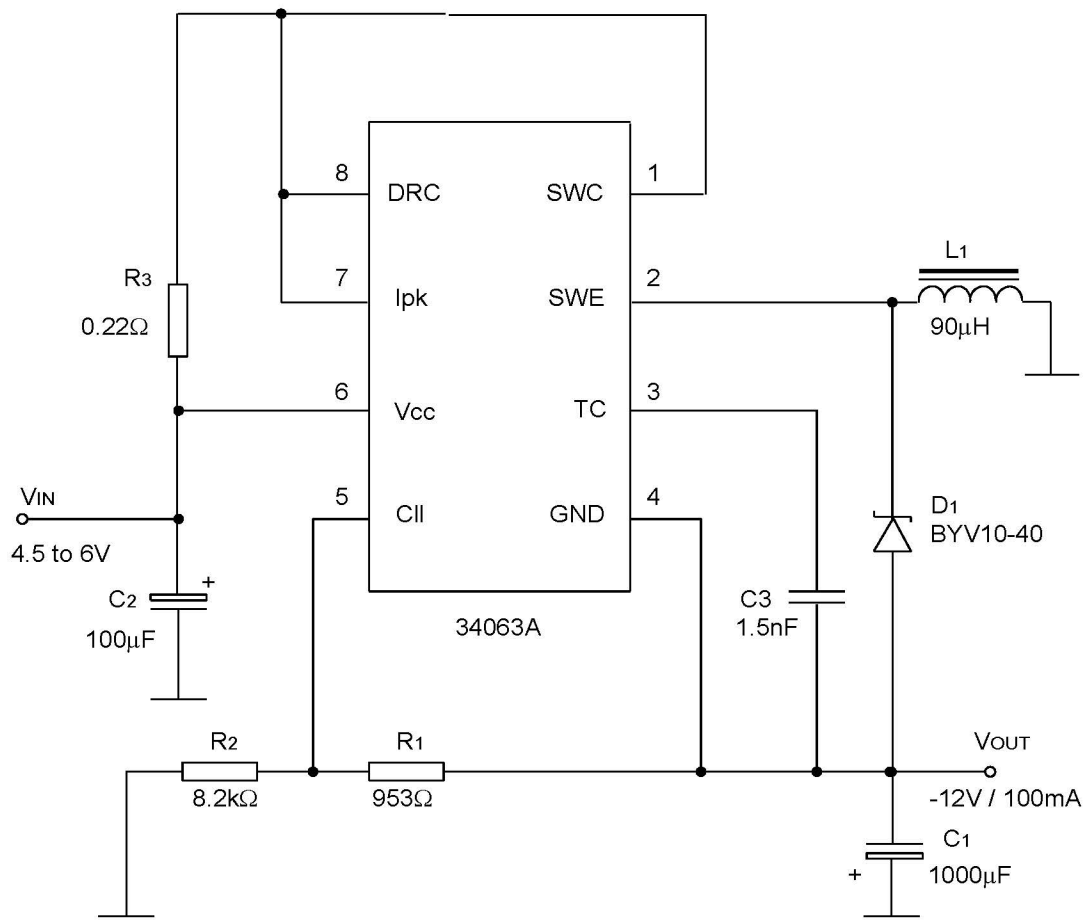
| Test | Conditions | Value (Typ) | Unit |
|-----------------|--|-------------|------|
| Line Regulation | $V_{IN} = 8\text{ to }16\text{ V}, I_O = 175\text{ mA}$ | 30 | mV |
| Load Regulation | $V_{IN} = 12\text{ V}, I_O = 75\text{ to }175\text{ mA}$ | 10 | mV |
| Output Ripple | $V_{IN} = 12\text{ V}, I_O = 175\text{ mA}$ | 300 | mV |
| Efficiency | $V_{IN} = 12\text{ V}, I_O = 175\text{ mA}$ | 89 | % |

Step-Down Converter


 Test Condition ($V_{OUT} = 5\text{ V}$)

| Test | Conditions | Value (Typ) | Unit |
|-----------------|--|-------------|------|
| Line Regulation | $V_{IN} = 15\text{ to }25\text{ V}, I_O = 500\text{ mA}$ | 5 | mV |
| Load Regulation | $V_{IN} = 25\text{ V}, I_O = 50\text{ to }500\text{ mA}$ | 30 | mV |
| Output Ripple | $V_{IN} = 25\text{ V}, I_O = 500\text{ mA}$ | 100 | mV |
| Efficiency | $V_{IN} = 25\text{ V}, I_O = 500\text{ mA}$ | 80 | % |
| ISC | $V_{IN} = 25\text{ V}, R_{LOAD} = 0.1\ \Omega$ | 1.2 | A |

Voltage Inverting Converter


 Test Condition ($V_{OUT} = -12\text{ V}$)

| Test | Conditions | Value (Typ) | Unit |
|-----------------|--|-------------|------|
| Line Regulation | $V_{IN} = 4.5\text{ to }6\text{ V}, I_O = 100\text{ mA}$ | 15 | mV |
| Load Regulation | $V_{IN} = 5\text{ V}, I_O = 10\text{ to }100\text{ mA}$ | 20 | mV |
| Output Ripple | $V_{IN} = 5\text{ V}, I_O = 100\text{ mA}$ | 230 | mV |
| Efficiency | $V_{IN} = 5\text{ V}, I_O = 100\text{ mA}$ | 58 | % |
| ISC | $V_{IN} = 5\text{ V}, R_{LOAD} = 0.1\ \Omega$ | 0.9 | A |

Calculation

| Parameter | Step-Up (Discontinuous mode) | Step-Down (Continuous mode) | Voltage Inverting (Discontinuous mode) |
|----------------------------|--|--|--|
| t_{on}/t_{off} | $\frac{V_{out} + V_F - V_{in(min)}}{V_{in(min)} - V_{sat}}$ | $\frac{V_{out} + V_F}{V_{in(min)} - V_{sat} - V_{out}}$ | $\frac{ V_{out} + V_F}{V_{in} - V_{sat}}$ |
| $(t_{on} + t_{off})_{max}$ | $1/f_{min}$ | $1/f_{min}$ | $1/f_{min}$ |
| C_T | $4.5 \times 10^{-5} t_{on}$ | $4.5 \times 10^{-5} t_{on}$ | $4.5 \times 10^{-5} t_{on}$ |
| $I_{PK(switch)}$ | $2I_{out(max)}[(t_{on}/t_{off}) + 1]$ | $2I_{out(max)}$ | $2I_{out(max)}[(t_{on}/t_{off}) + 1]$ |
| R_{SC} | $0.3/I_{PK(switch)}$ | $0.3/I_{PK(switch)}$ | $0.3/I_{PK(switch)}$ |
| C_O | $\equiv \frac{I_{out} t_{on}}{V_{ripple(p-p)}}$ | $\frac{I_{PK(switch)} (t_{on} + t_{off})}{8V_{ripple(p-p)}}$ | $\equiv \frac{I_{out} t_{on}}{V_{ripple(p-p)}}$ |
| $L(min)$ | $\frac{V_{in(min)} - V_{sat}}{I_{PK(switch)}} t_{on(max)}$ | $\frac{V_{in(min)} - V_{sat} - V_{out}}{I_{PK(switch)}} t_{on(max)}$ | $\frac{V_{in(min)} - V_{sat}}{I_{PK(switch)}} t_{on(max)}$ |

NOTES:

V_{sat} = Saturation voltage of the output switch

V_F = Forward voltage drop of the output rectifier

THE FOLLOWING POWER SUPPLY CHARACTERISTICS MUST BE CHOSEN:

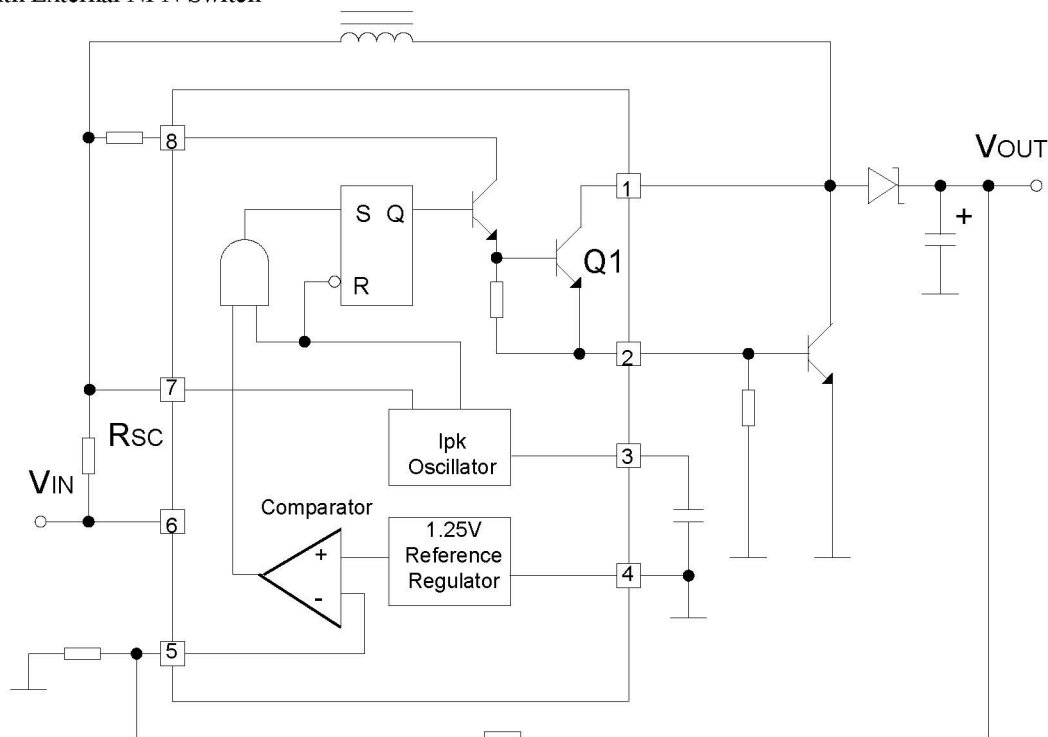
V_{in} = Nominal input voltage

V_{out} = Desired output voltage, $|V_{out}| = 1.25(1 + R_2/R_1)$

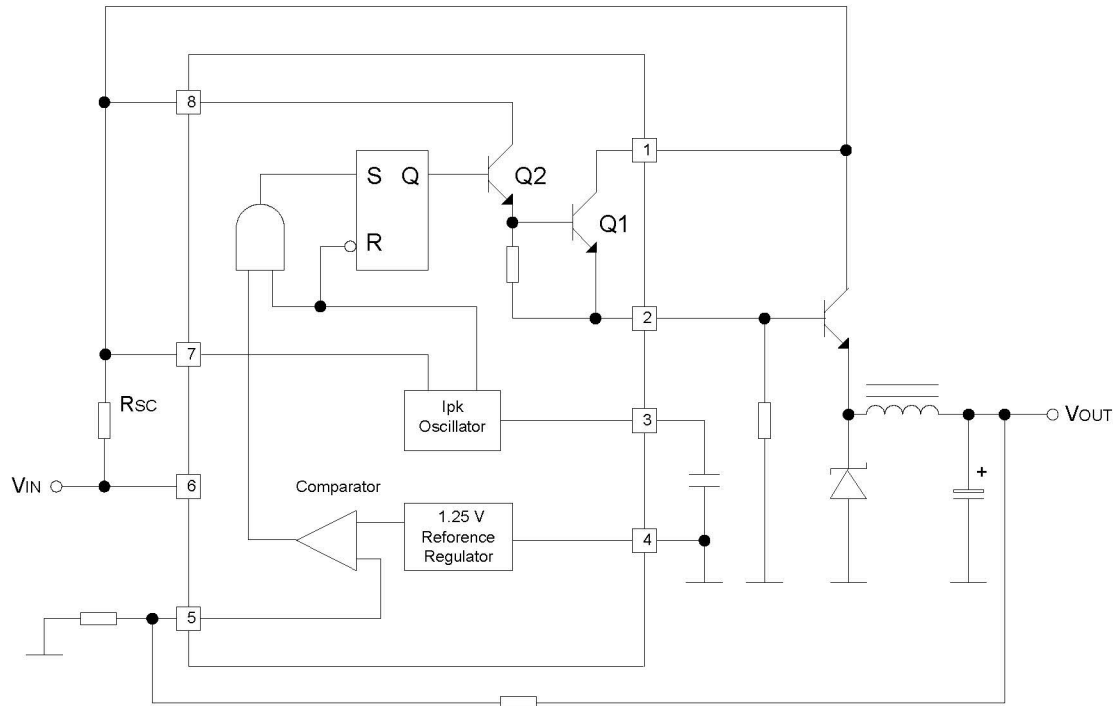
I_{out} = Desired output current

f_{min} = Minimum desired output switching frequency at the selected values of V_{in} and l_o

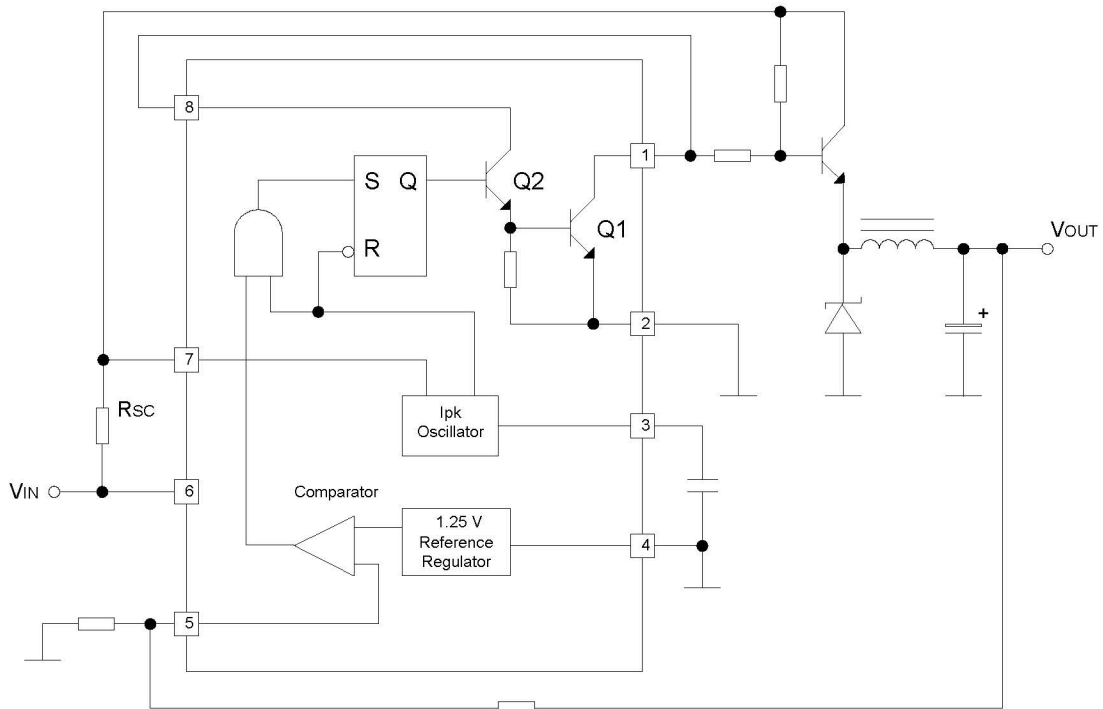
V_{ripple} = Desired peak to peak output ripple voltage. In practice, the calculated capacitor value will and to be increased due to its equivalent series resistance and board layout. The ripple voltage should be kept to a low value since it will directly affect the line and load regulation.

Step-up With External NPN Switch


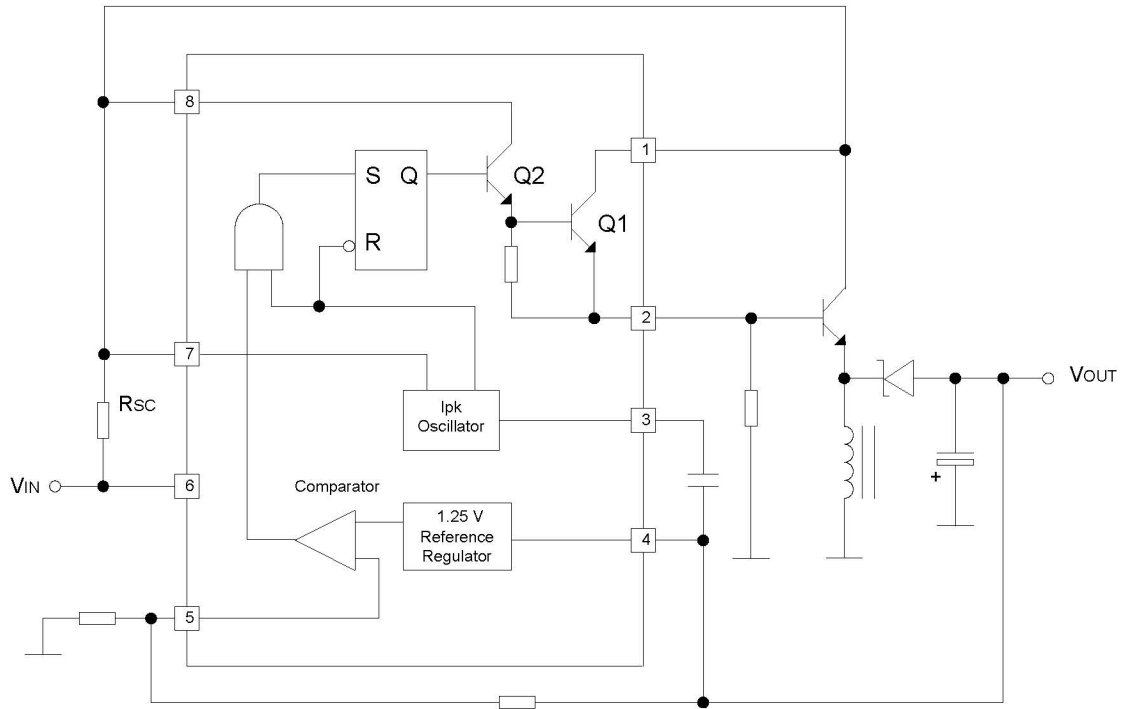
Step-down With External NPN Switch



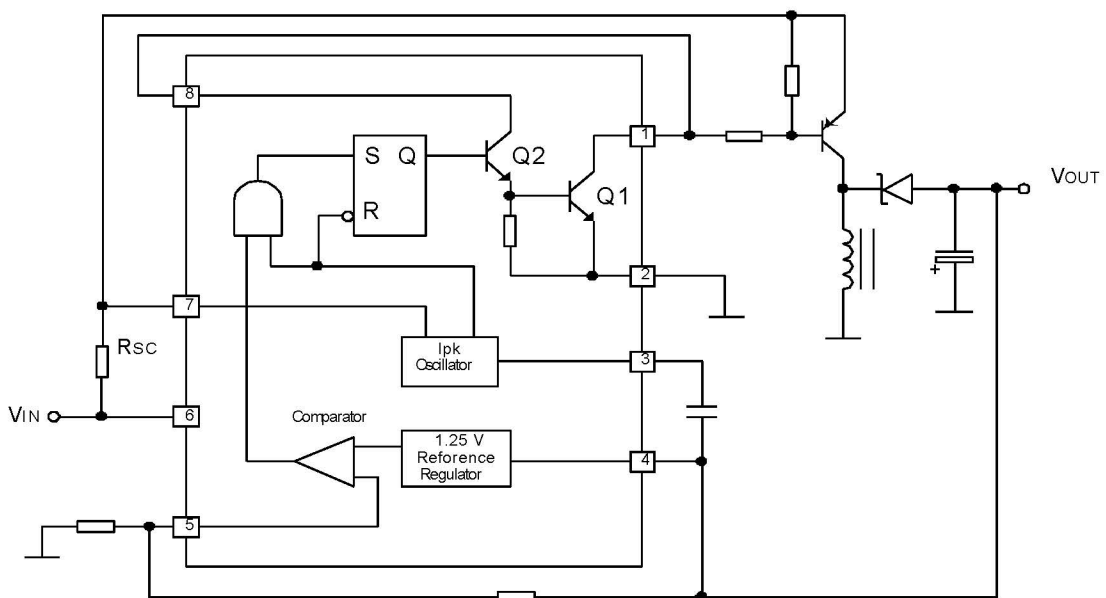
Step-down With External PNP Switch



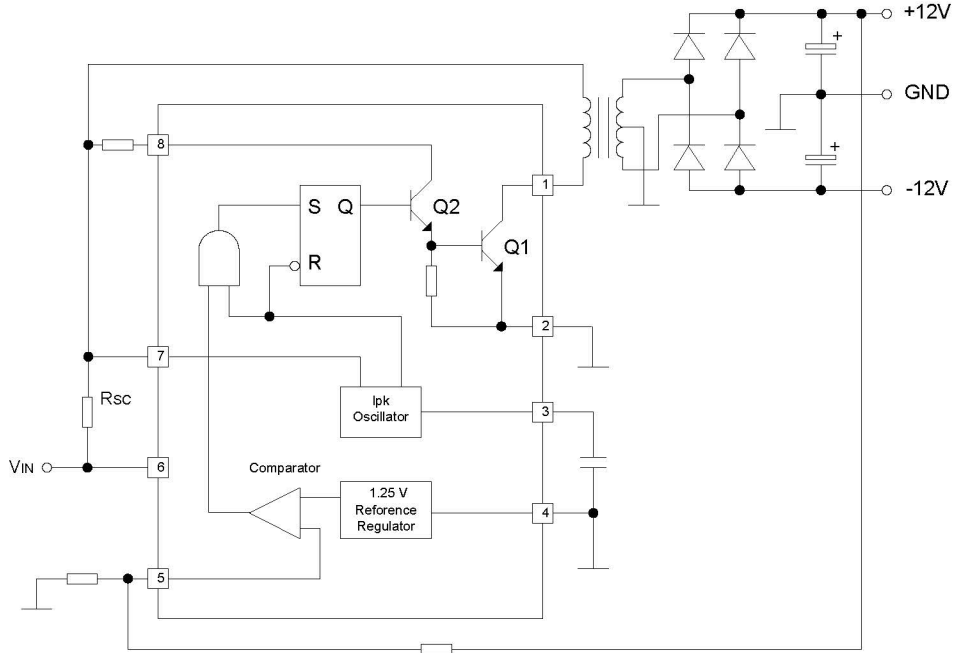
Voltage Inverting With External NPN Switch



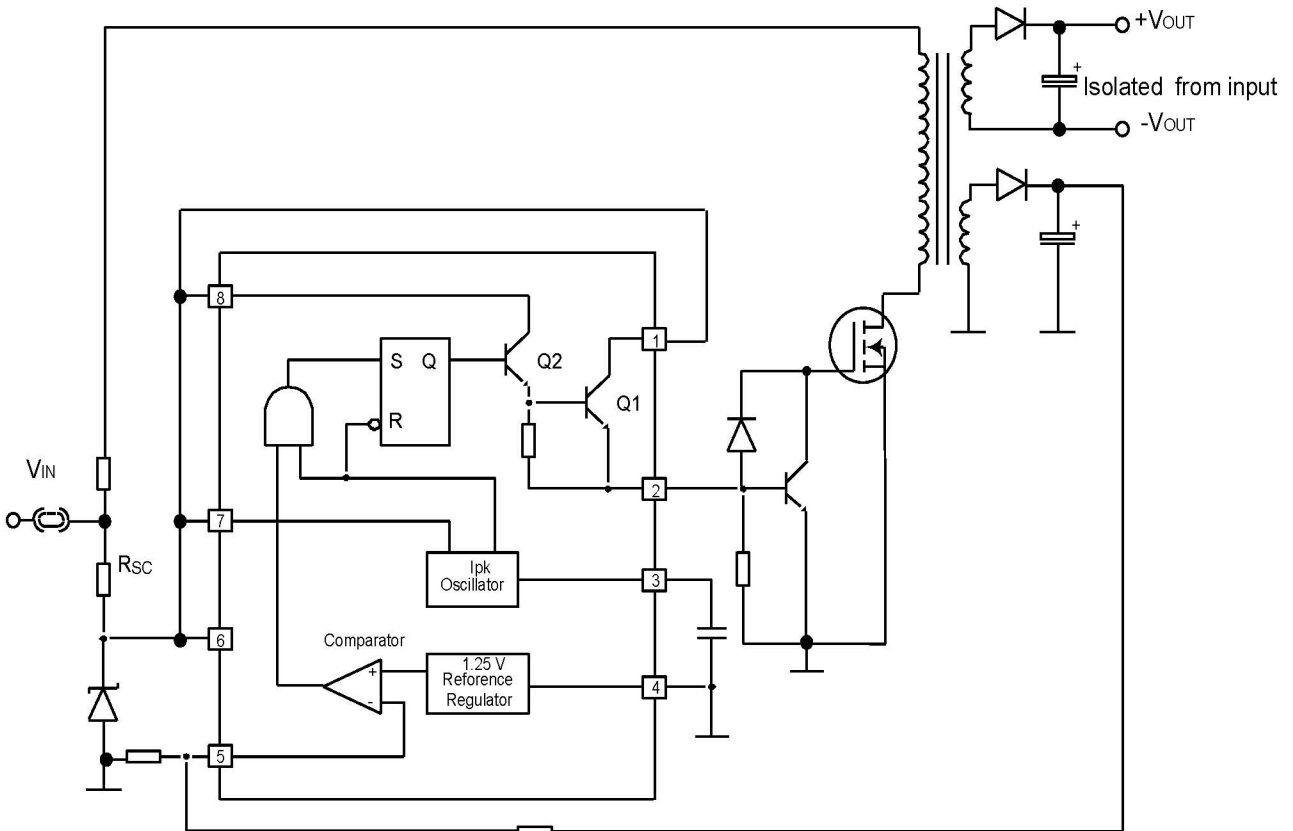
Voltage Inverting With External PNP Saturated Switch



Dual Output Voltage

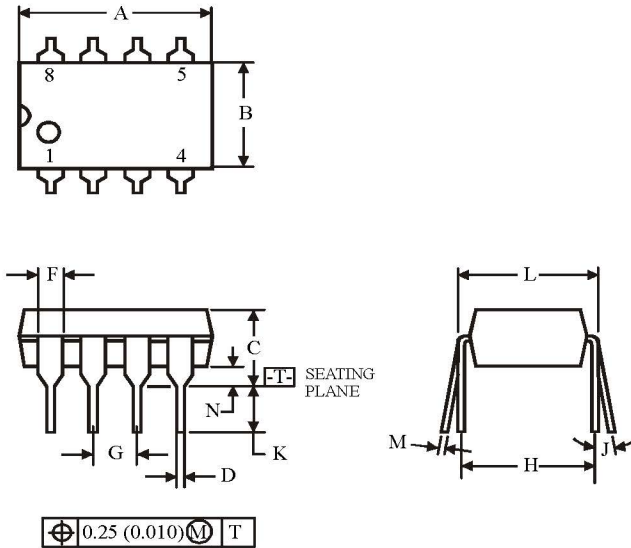
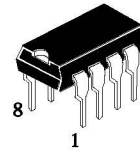


Higher Output Power, Higher Input Voltage



PACKAGE DIMENSIONS

N SUFFIX PLASTIC DIP

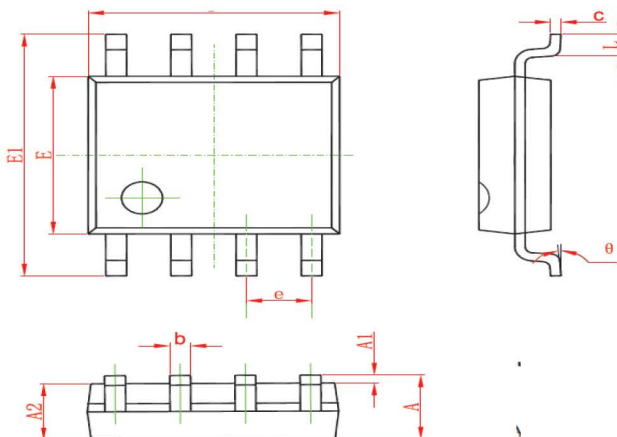
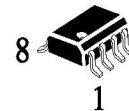


| Symbol | Dimension, mm | |
|--------|---------------|-------|
| | MIN | MAX |
| A | 8.51 | 10.16 |
| B | 6.1 | 7.11 |
| C | | 5.33 |
| D | 0.36 | 0.56 |
| F | 1.14 | 1.78 |
| G | 2.54 | |
| H | 7.62 | |
| J | 0° | 10° |
| K | 2.92 | 3.81 |
| L | 7.62 | 8.26 |
| M | 0.2 | 0.36 |
| N | 0.38 | |

NOTES:

- Dimensions "A", "B" do not include mold flash or protrusions.
Maximum mold flash or protrusions 0.25 mm (0.010) per side.

D SUFFIX SOIC



| Symbol | Dimension, mm | |
|--------|---------------|------|
| | MIN | MAX |
| D | 4.8 | 5 |
| E | 3.84 | 4.04 |
| A | 1.5 | 1.7 |
| b | 0.3 | 0.5 |
| L | 0.52 | 0.72 |
| e | 1.27 | |
| θ | 0° | 8° |
| A1 | 0.04 | 0.12 |
| C | 0.04 | 0.12 |
| E1 | 5.9 | 6.1 |

NOTES:

- Dimensions A and B do not include mold flash or protrusion.
- Maximum mold flash or protrusion 0.15 mm (0.006) per side for A; for B - 0.25 mm (0.010) per side.