

## DC-DC CONVERTER CONTROL CIRCUITS

- OUTPUT SWITCH CURRENT IN EXCESS OF 1.5A
- 2% REFERENCE ACCURACY
- LOW QUIESCENT CURRENT: 2.5mA (TYP.)
- OPERATING FROM 3V TO 40V
- FREQUENCY OPERATION TO 100KHz
- ACTIVE CURRENT LIMITING

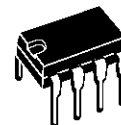
### DESCRIPTION

The MC34063A series is a monolithic control circuit delivering the main functions for DC-DC voltage converting.

The device contains an internal temperature compensated reference, comparator, duty cycle controlled oscillator with an active current limit circuit, driver and high current output switch.

Output voltage is adjustable through two external resistors with a 2% reference accuracy.

Employing a minimum number of external components the MC34063A devices series is designed for Step-Down, Step-Up and Voltage-Inverting applications.

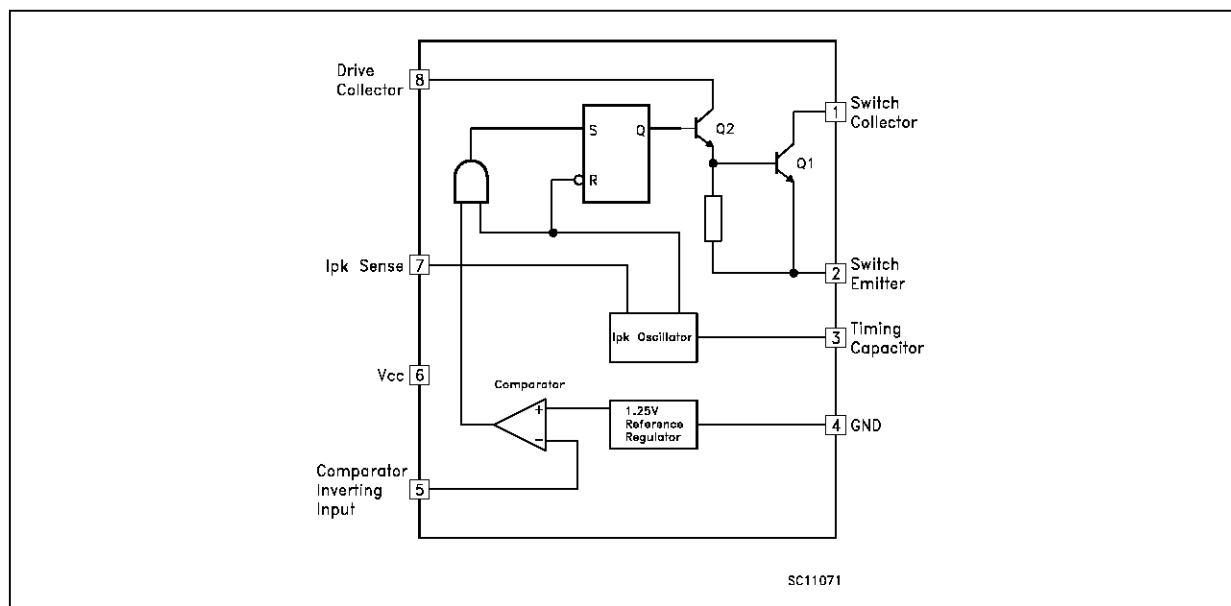


DIP-8



SO-8

### BLOCK DIAGRAM



# MC34063A

## ABSOLUTE MAXIMUM RATINGS

| Symbol           | Parameter   | Value                 | Unit     |
|------------------|---|-----------------------|----------|
| V <sub>CC</sub>  | Power Supply Voltage  | 50                    | V        |
| V <sub>ir</sub>  | Comparator Input Voltage Range  | -0.3 to 40            | V        |
| V <sub>SWC</sub> | Switch Collector Voltage  | 40                    | V        |
| V <sub>SWE</sub> | Switch Emitter Voltage (V <sub>SWC</sub> = 40V)   | 40                    | V        |
| V <sub>CE</sub>  | Switch Emitter to Collector Voltage   | 40                    | V        |
| V <sub>dc</sub>  | Driver Collector Voltage  | 40                    | V        |
| I <sub>dc</sub>  | Driver Collector Current  | 100                   | mA       |
| I <sub>SW</sub>  | Switch Current  | 1.5                   | A        |
| P <sub>tot</sub> | Power Dissipation at T <sub>amb</sub> = 25 °C (for <b>Plastic Package</b> )<br>(for <b>SOIC Package</b> ) | 1.25<br>0.625         | W        |
| T <sub>op</sub>  | Operating Ambient Temperature Range (for <b>AC SERIES</b> )<br>(for <b>AB SERIES</b> )                    | 0 to 70<br>- 40 to 85 | °C<br>°C |
| T <sub>stg</sub> | Storage Temperature Range   | - 40 to 150           | °C       |

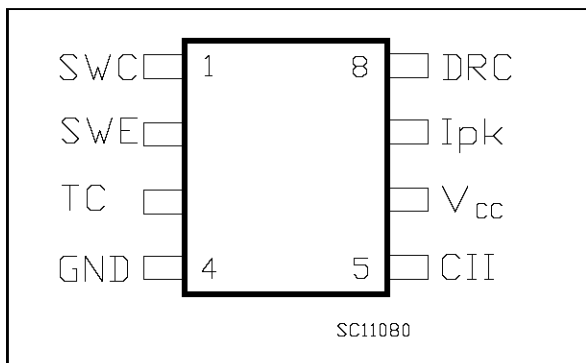
Absolute Maximum Rating are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

## THERMAL DATA

| Symbol               | Parameter                               | DIP-8   | SO-8 | Unit |
|----------------------|---|---------|------|------|
| R <sub>thj-amb</sub> | Thermal Resistance Junction-ambient (*) | Max 100 | 160  | °C/W |

(\*) This value depends from thermal design of PCB on which the device is mounted.

## CONNECTION DIAGRAM (top view)



## PIN CONNECTIONS

| Pin No | Symbol          | Name and Function          |
|--------|-----------------|----------------------------|
| 1      | SWC             | Switch Collector           |
| 2      | SWE             | Switch Emitter             |
| 3      | TC              | Timing Capacitor           |
| 4      | GND             | Ground                     |
| 5      | CII             | Comparator Inverting Input |
| 6      | V <sub>CC</sub> | Voltage Supply             |
| 7      | I <sub>pk</sub> | I <sub>pk</sub> Sense      |
| 8      | DRC             | Voltage Driver Collector   |

## ORDERING NUMBERS

| Type      | DIP-8      | SO-8       | SO-8 (tape & reel) |
|-----------|------------|------------|--------------------|
| MC34063AB | MC34063ABN | MC34063ABD | MC34063ABD-TR      |
| MC34063AC | MC34063ACN | MC34063ACD | MC34063ACD-TR      |

**ELECTRICAL CHARACTERISTICS** (Refer to the test circuits,  $V_{CC} = 5V$ ,  $T_a = T_{LOW}$  to  $T_{HIGH}$ , unless otherwise specified, see note 2)

#### OSCILLATOR

| Symbol               | Parameter                         | Test Conditions                                | Min. | Typ. | Max. | Unit    |
|----------------------|-----------------------------------|--|------|------|------|---------|
| $f_{OSC}$            | Frequency                         | $V_{pin5} = 0V$ $C_T = 1nF$ $T_a = 25^\circ C$ | 24   | 33   | 42   | KHz     |
| $I_{chg}$            | Charge Current                    | $V_{CC} = 5$ to $40V$ $T_a = 25^\circ C$       | 24   | 33   | 42   | $\mu A$ |
| $I_{dischg}$         | Discharge Current                 | $V_{CC} = 5$ to $40V$ $T_a = 25^\circ C$       | 140  | 200  | 260  | $\mu A$ |
| $I_{dischg}/I_{chg}$ | Discharge to Charge Current Ratio | $Pin\ 7 = V_{CC}$ $T_a = 25^\circ C$           | 5.2  | 6.2  | 7.5  |         |
| $V_{ipk(sense)}$     | Current Limit Sense Voltage       | $I_{chg} = I_{dischg}$ $T_a = 25^\circ C$      | 250  | 300  | 350  | mV      |

#### OUTPUT SWITCH

| Symbol        | Parameter                                 | Test Conditions  | Min. | Typ. | Max. | Unit    |
|---------------|---|--|------|------|------|---------|
| $V_{CE(sat)}$ | Saturation Voltage, Darlington Connection | $I_{SW} = 1A$ Pins 1, 8 connected  |      | 1    | 1.3  | V       |
| $V_{CE(sat)}$ | Saturation Voltage                        | $I_{SW} = 1A$ $R_{pin8} = 82\ \Omega$ to $V_{CC}$ , Forced $\beta \sim 20$ |      | 0.45 | 0.7  | V       |
| $h_{FE}$      | DC Current Gain                           | $I_{SW} = 1A$ $V_{CE} = 5V$ $T_a = 25^\circ C$                             | 50   | 120  |      |         |
| $I_{C(off)}$  | Collector Off-State Current               | $V_{CE} = 40V$   |      | 0.01 | 100  | $\mu A$ |

#### COMPARATOR

| Symbol       | Parameter                         | Test Conditions                                     | Min.          | Typ. | Max.          | Unit   |
|--------------|-----------------------------------|---|---------------|------|---------------|--------|
| $V_{th}$     | Threshold Voltage                 | $T_a = 25^\circ C$<br>$T_a = T_{LOW}$ to $T_{HIGH}$ | 1.225<br>1.21 | 1.25 | 1.275<br>1.29 | V<br>V |
| $Reg_{line}$ | Threshold Voltage Line Regulation | $V_{CC} = 3$ to $40V$                               |               | 1    | 5             | mV     |
| $I_B$        | Input Bias Current                | $V_{IN} = 0V$                                       |               | -5   | -400          | nA     |

#### TOTAL DEVICE

| Symbol   | Parameter      | Test Conditions  | Min. | Typ. | Max. | Unit |
|----------|----------------|--|------|------|------|------|
| $I_{CC}$ | Supply Current | $V_{CC} = 5$ to $40V$ $C_T = 1nF$<br>$Pin\ 7 = V_{CC}$ $V_{pin5} > V_{th}$ $Pin\ 2 = GND$<br>Remaining pins open |      | 2.5  | 4    | mA   |

#### NOTES:

1) Maximum package power dissipation limit must be observed.

2)  $T_{LOW} = 0^\circ C$ ,  $T_{HIGH} = 70^\circ C$  (AC series);  $T_{LOW} = -40^\circ C$ ,  $T_{HIGH} = 85^\circ C$  (AB series).

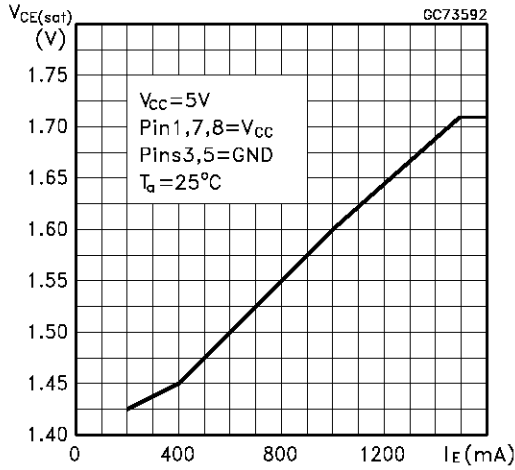
3) If Darlington configuration is not used, care must be taken to avoid deep saturation of output switch. The resulting switch-off time may be adversely affected. In a Darlington configuration the following output driver condition is suggested:

Forced  $\beta$  of output current switch =  $I_{C(OUTPUT)}/(I_{C(DRIVER)} - 1mA^*) \geq 10$

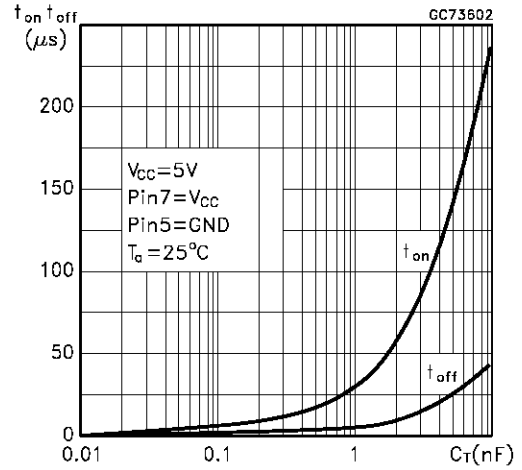
\* Current less due to a built in 1K $\Omega$  antileakage resistor.

**TYPICAL ELECTRICAL CHARACTERISTICS**

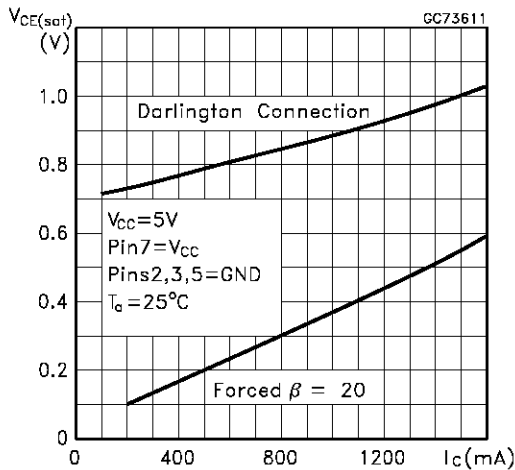
Emitter Follower Configuration Output Saturation Voltage vs Emitter Current



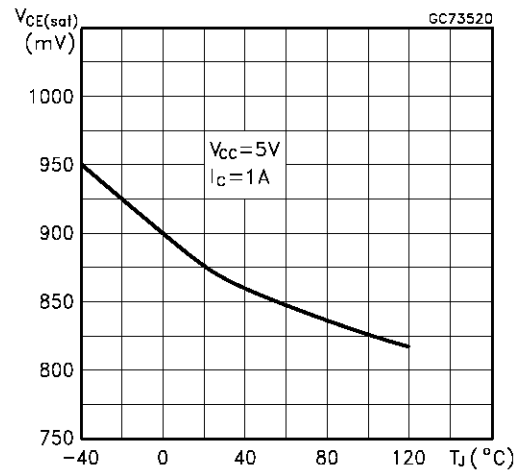
Output Switch ON-OFF Time vs Oscillator Timing Capacitor



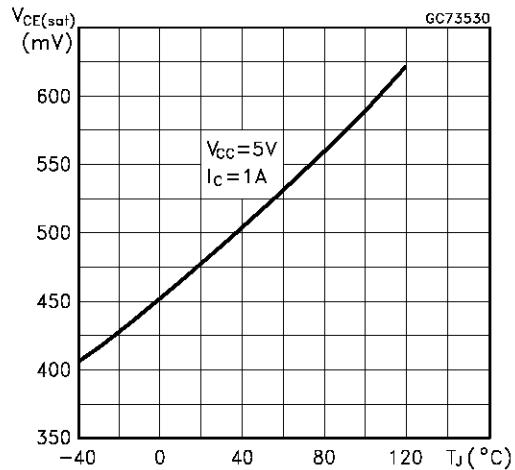
Common Emitter Configuration Output Switch Saturation Voltage vs Collector Current



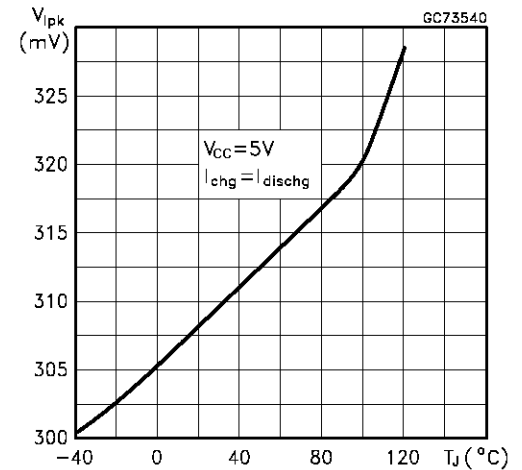
Darlington Configuration Collector Emitter Saturation Voltage ( $V_{CE(sat)}$ ) vs Temperature



Power Collector Emitter Saturation Voltage ( $V_{CE(sat)}$ ) vs Temperature

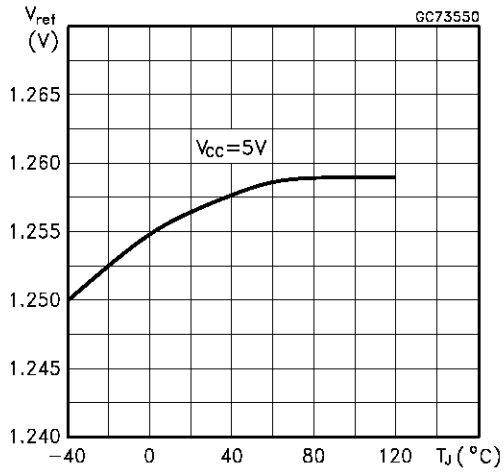


Current Limit Sense Voltage ( $V_{ipk}$ ) vs Temperature

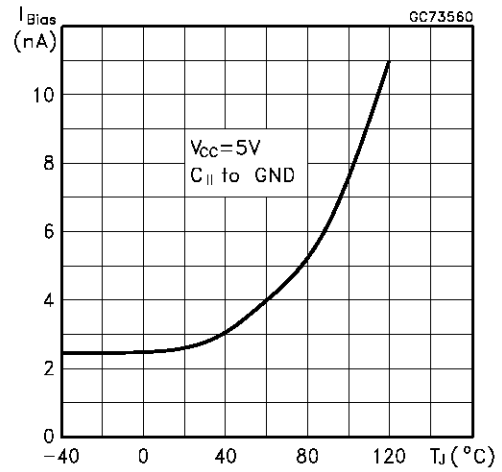


**TYPICAL ELECTRICAL CHARACTERISTICS (Continued)**

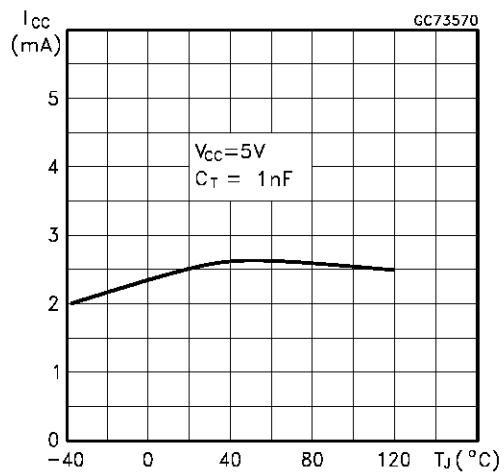
Reference Voltage vs Temperature



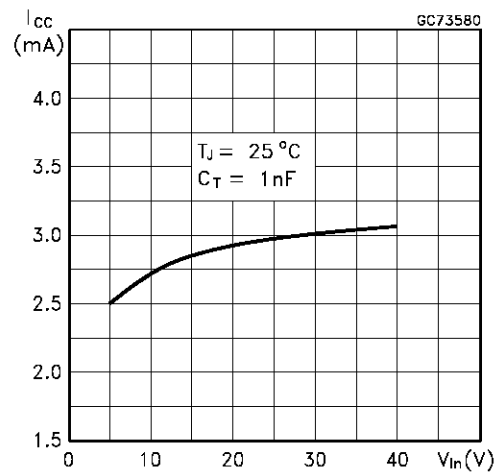
Bias Current vs Temperature



Supply Current vs Temperature



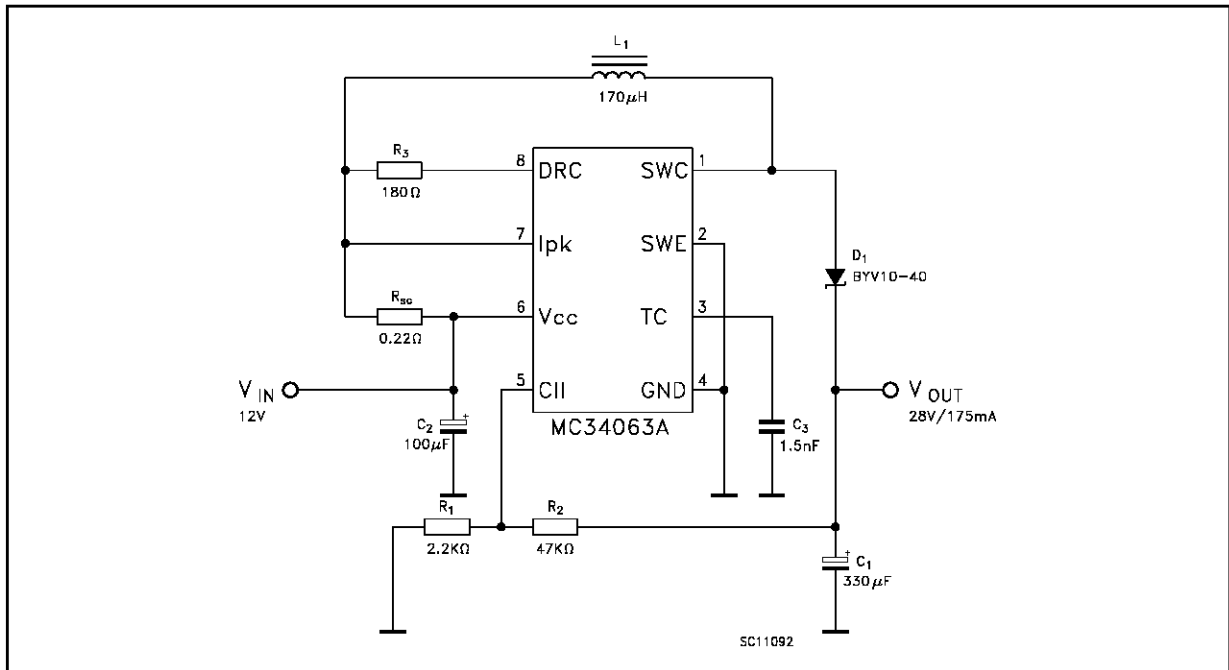
Supply Current vs Input Voltage



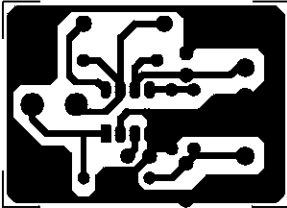
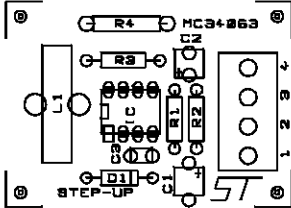
# MC34063A

## TYPICAL APPLICATION CIRCUIT

### Step-Up Converter



### Printed Demoboard

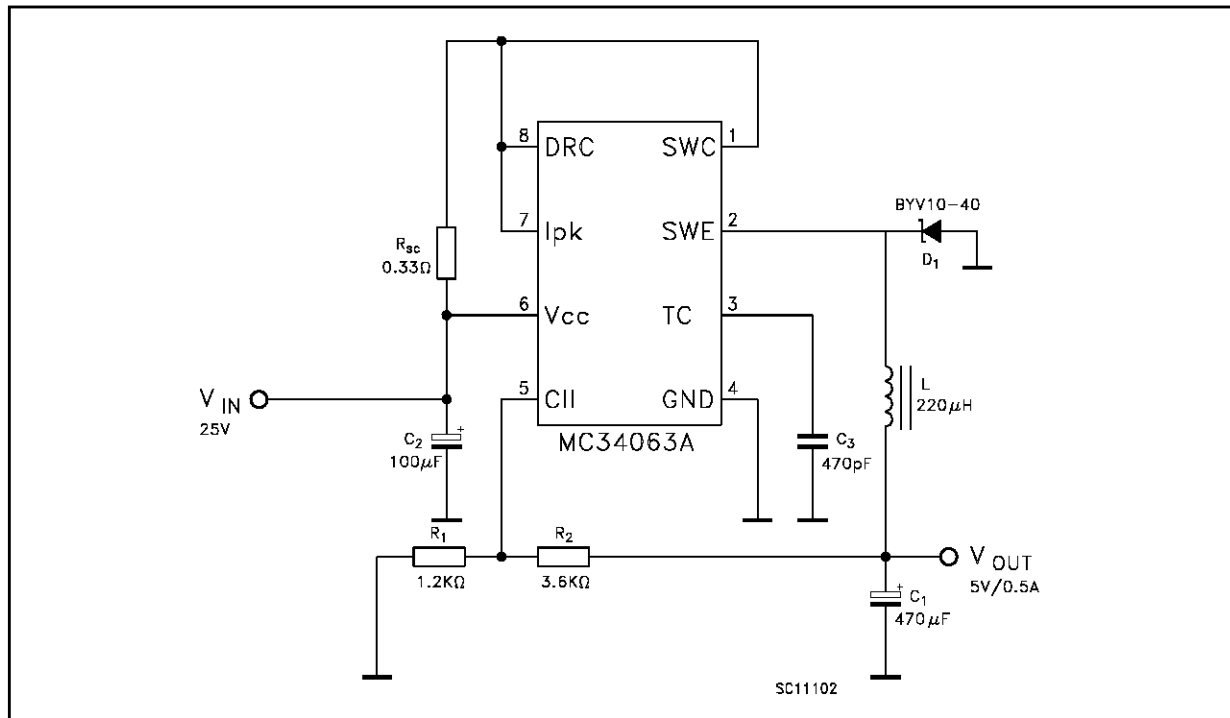



| Symbol | Pin |
|--------|-----|
| Vout   | 1   |
| GND    | 2   |
| GND    | 3   |
| Vin    | 4   |

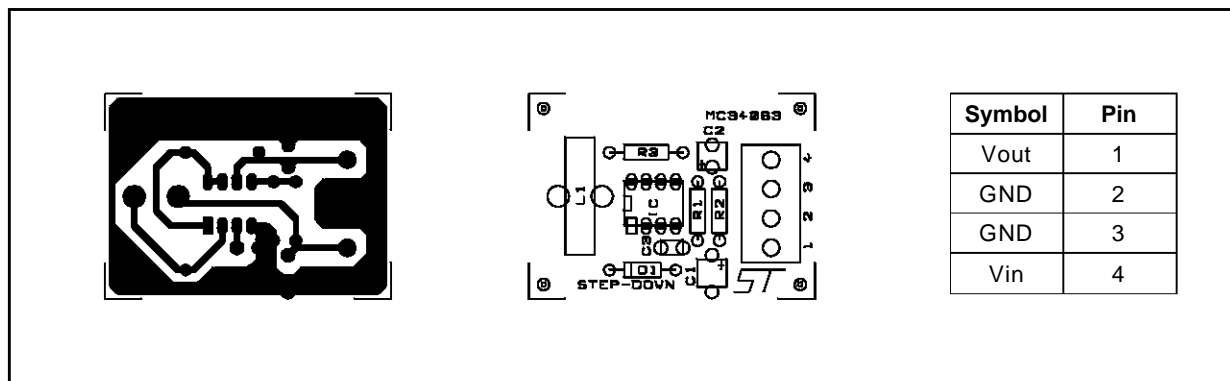
### Test Condition ( $V_{OUT} = 28V$ )

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

Step-Down Converter



Printed Demoboard

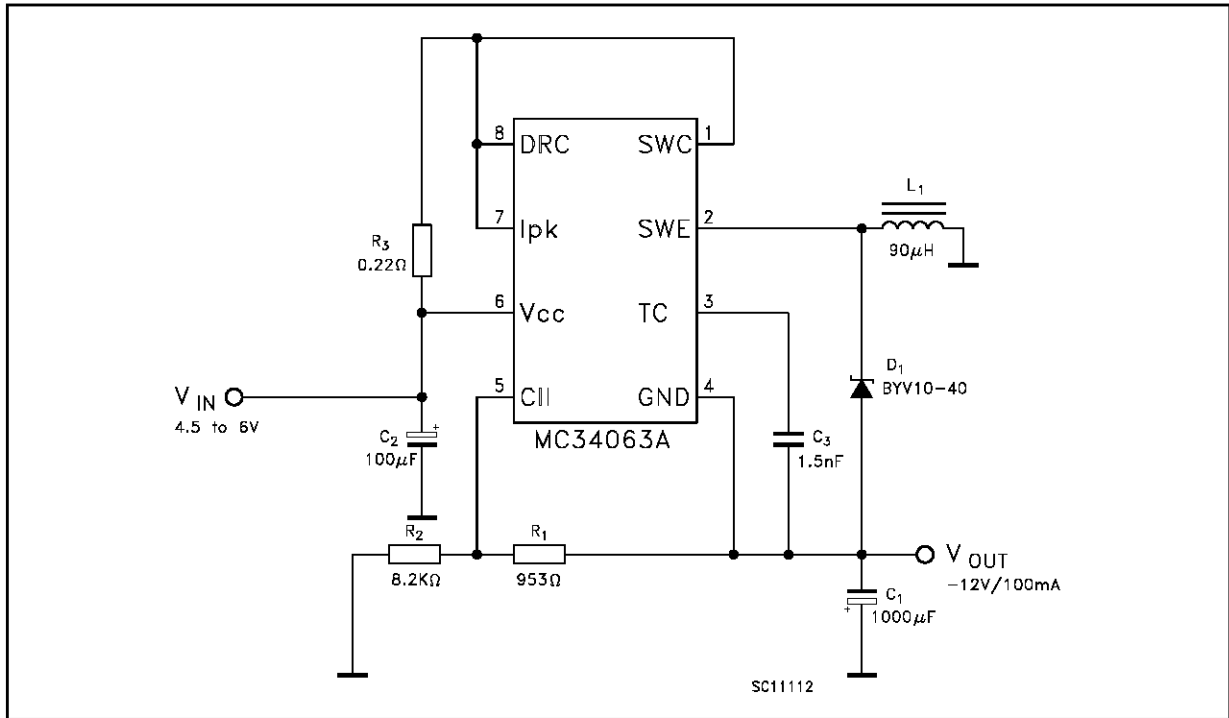


Test Condition ( $V_{OUT} = 5V$ )

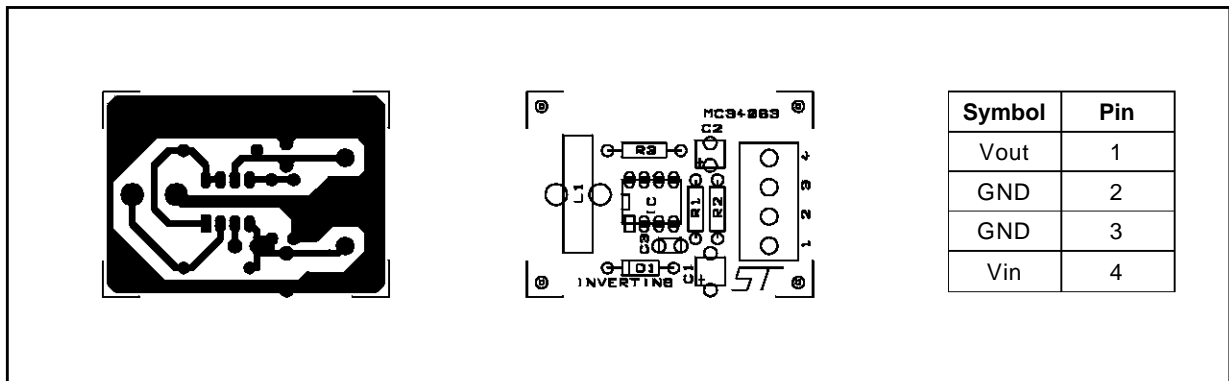
| Test            | Conditions  | Value (Typ.) | Unit |
|-----------------|---|--------------|------|
| Line Regulation | $V_{IN} = 15 \text{ to } 25V, I_O = 500 \text{ mA}$ | 5            | mV   |
| Load Regulation | $V_{IN} = 25V, I_O = 50 \text{ to } 500 \text{ mA}$ | 30           | mV   |
| Output Ripple   | $V_{IN} = 25V, I_O = 500 \text{ mA}$                | 100          | mV   |
| Efficiency      | $V_{IN} = 25V, I_O = 500 \text{ mA}$                | 80           | %    |
| Isc             | $V_{IN} = 25V, R_3 = 0.1\Omega$                     | 1.2          | A    |

# MC34063A

## Voltage Inverting Converter



## Printed Demoboard



## Test Condition (V<sub>OUT</sub> = -12V)

| Test            | Conditions   | Value (Typ.) | Unit |
|-----------------|--|--------------|------|
| Line Regulation | V <sub>IN</sub> = 4.5 to 6V, I <sub>O</sub> = 100 mA | 15           | mV   |
| Load Regulation | V <sub>IN</sub> = 5V, I <sub>O</sub> = 10 to 100 mA  | 20           | mV   |
| Output Ripple   | V <sub>IN</sub> = 5V, I <sub>O</sub> = 100 mA        | 230          | mV   |
| Efficiency      | V <sub>IN</sub> = 5V, I <sub>O</sub> = 100 mA        | 58           | %    |
| I <sub>sc</sub> | V <sub>IN</sub> = 5V, R <sub>3</sub> = 0.1Ω          | 0.9          | A    |



Calculation

| Parameter                  | Step-Up<br>(Discontinuous mode)                             | Step-Down<br>(Continuous mode)                                   | Voltage Inverting<br>(Discontinuous mode)              |
|----------------------------|---|--|--|
| Inductor                   | 170 $\mu$ H   | 220 $\mu$ H  | 90 $\mu$ H   |
| $t_{on}/t_{off}$           | $\frac{V_{out} + V_F - V_{in(min)}}{V_{in(min)} - V_{sat}}$ | $\frac{V_{out} + V_F}{V_{in(min)} - V_{sat} - V_{out}}$          | $\frac{ V_{out}  + V_F}{V_{in} - V_{sat}}$             |
| $(t_{on} + t_{off})_{max}$ | $1/f_{min}$   | $1/f_{min}$  | $1/f_{min}$  |
| $C_T$                      | $4.5 \times 10^{-5} t_{on}$                                 | $4.5 \times 10^{-5} t_{on}$                                      | $4.5 \times 10^{-5} t_{on}$                            |
| $I_{PK(switch)}$           | $2I_{out(max)}[(t_{on}/t_{off}) + 1]$                       | $2I_{out(max)}$  | $2I_{out(max)}[(t_{on}/t_{off}) + 1]$                  |
| $R_{SC}$                   | $0.3/I_{PK(switch)}$  | $0.3/I_{PK(switch)}$   | $0.3/I_{PK(switch)}$                                   |
| $C_O$                      | $\cong \frac{I_{out} t_{on}}{V_{ripple(p-p)}}$              | $\frac{I_{PK(switch)}(t_{on} + t_{off})}{8V_{ripple(p-p)}}$      | $\cong \frac{I_{out} t_{on}}{V_{ripple(p-p)}}$         |
| $L(min)$                   | $\frac{V_{min} - V_{sat}}{I_{PK(switch)}} t_{on(max)}$      | $\frac{V_{min} - V_{sat} - V_{out}}{I_{PK(switch)}} t_{on(max)}$ | $\frac{V_{min} - V_{sat}}{I_{PK(switch)}} t_{on(max)}$ |

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

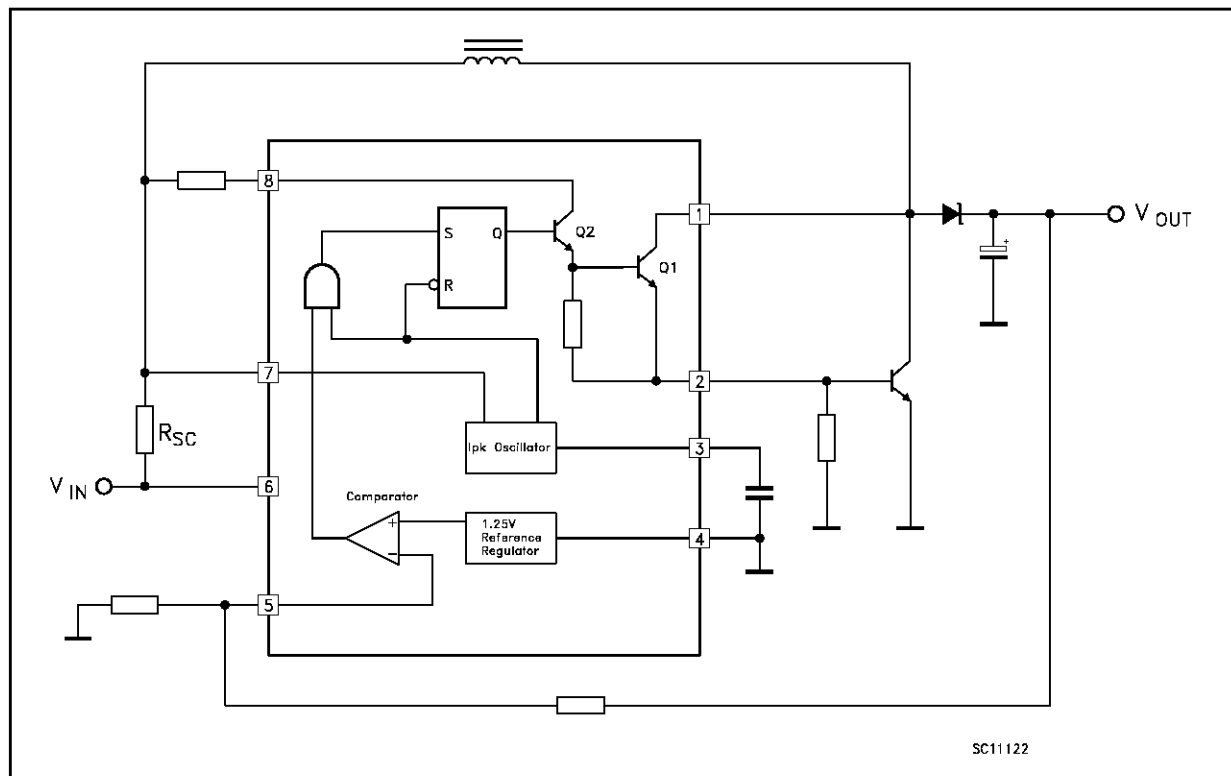
$V_{out}$  = Desired output voltage,  $|V_{out}| = 1.25(1 + R_2/R_1)$

$I_{out}$  = Desired output current

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

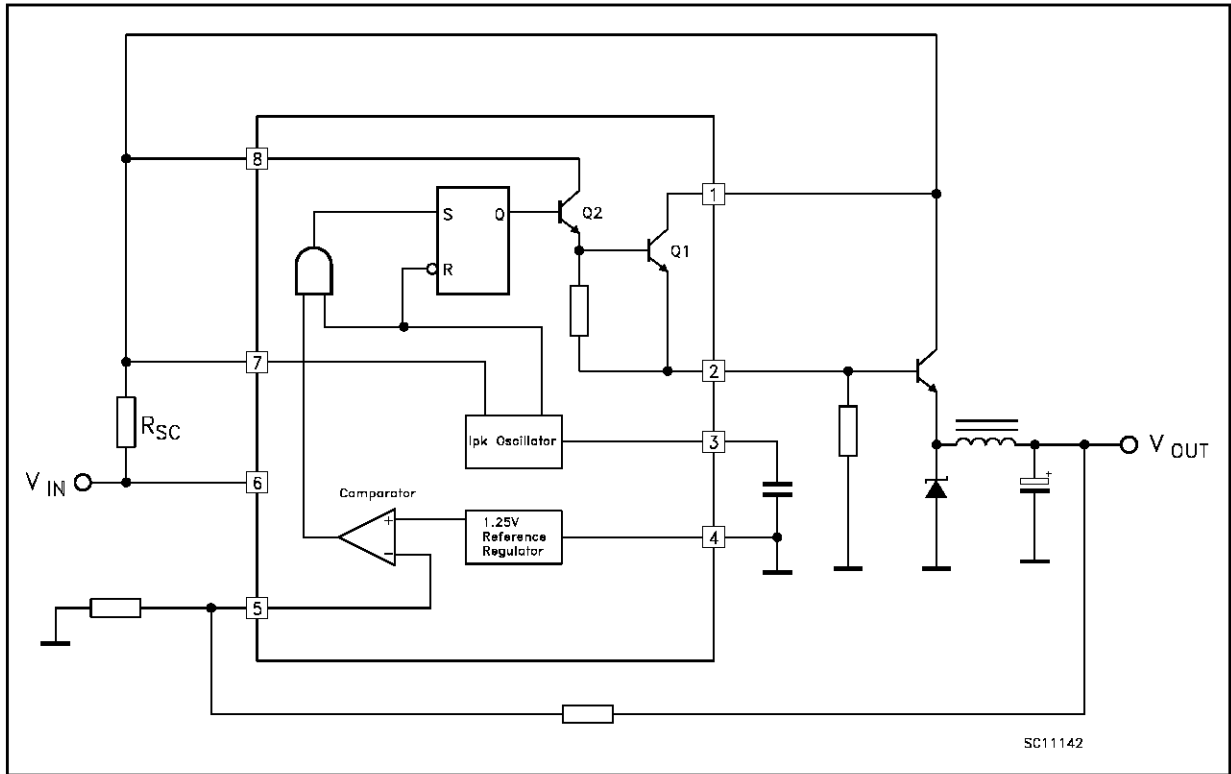
$V_{ripple}$  = Desired peak to peak output ripple voltage. In practice, the calculated capacitor value will need to be increased due to its equivalent series resistance and board layout. The ripple voltage should be kept to a low value since it will directly affect the line and load regulation.

Step-up With External NPN Switch

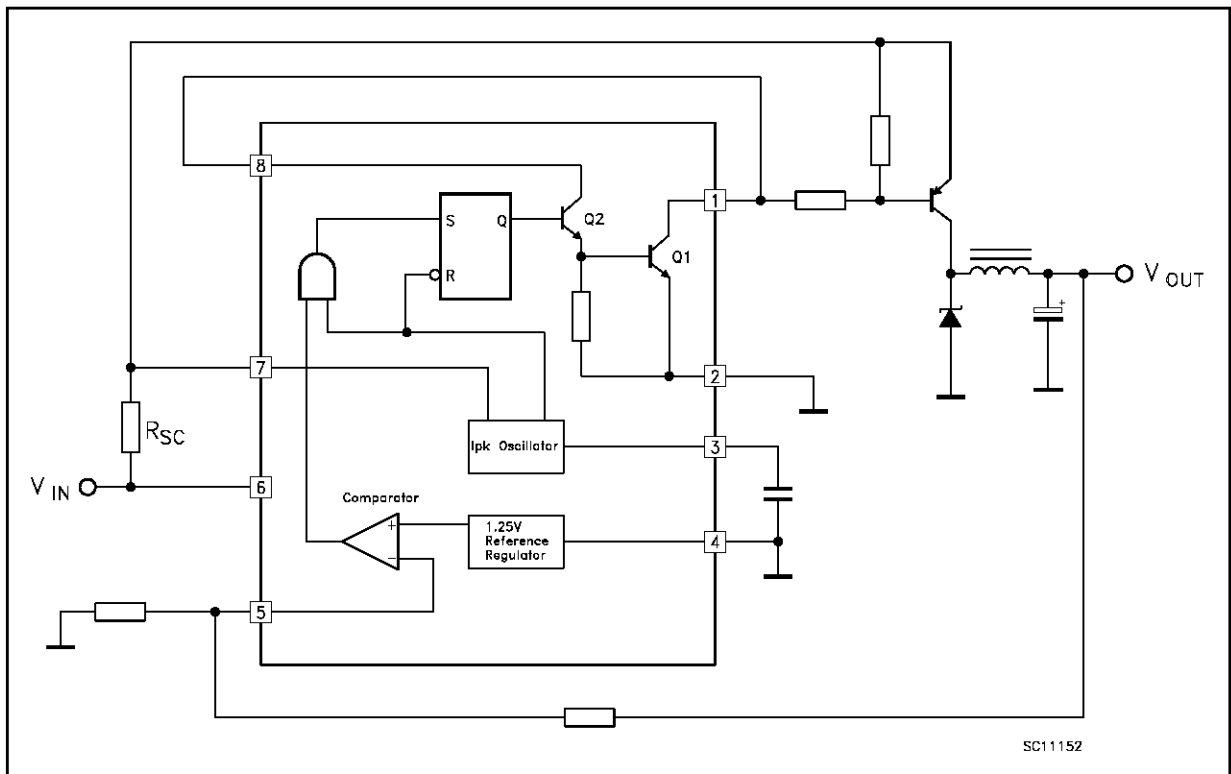


# MC34063A

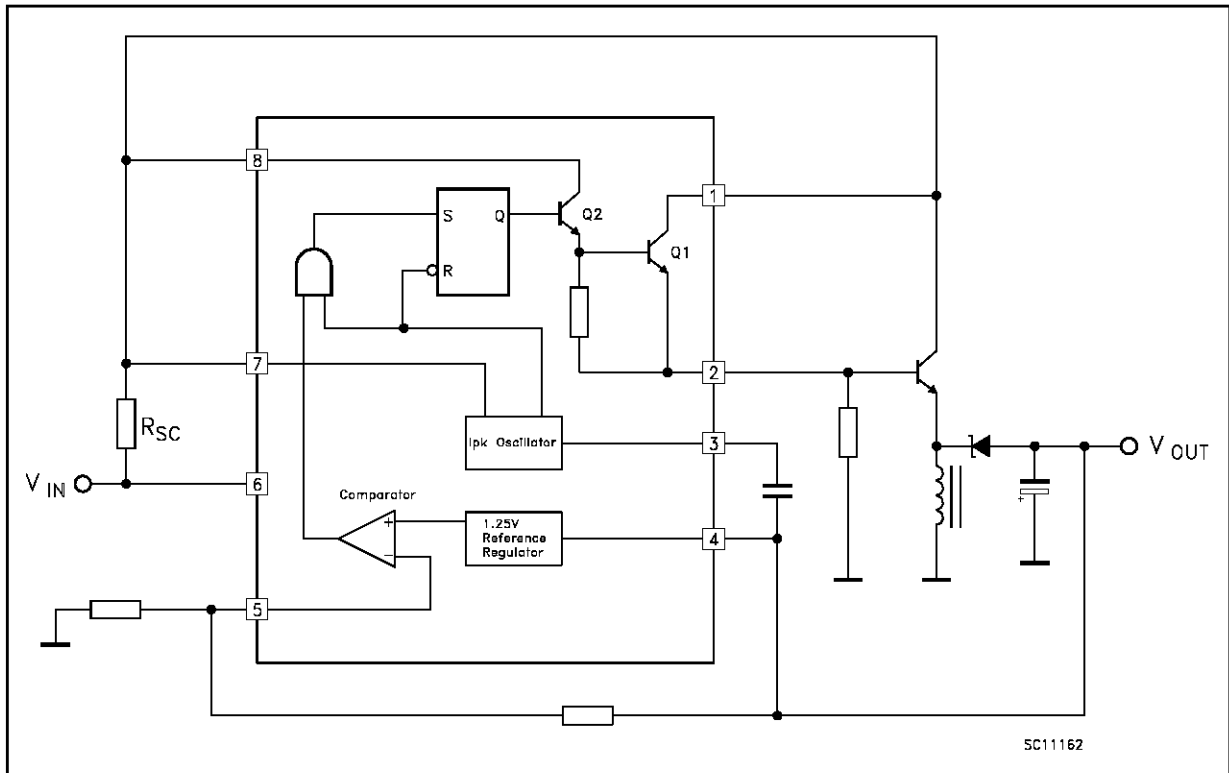
## Step-down With External NPN Switch



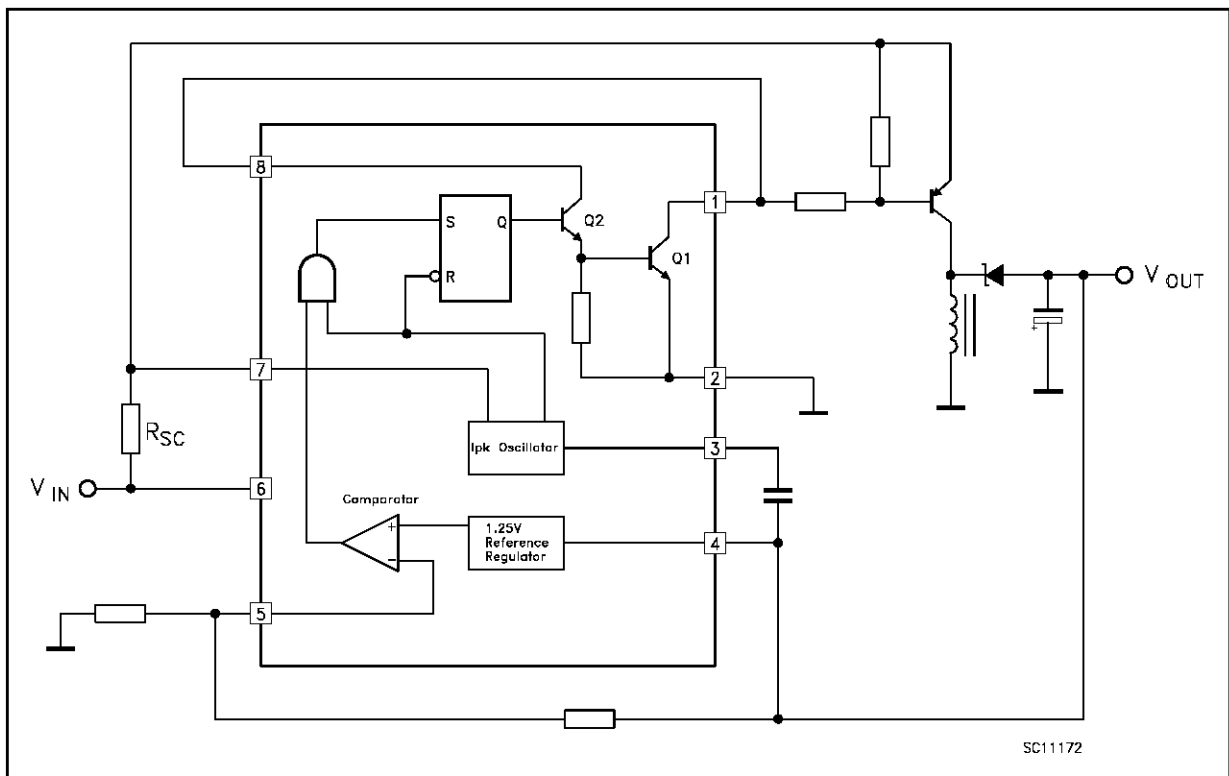
## Step-down With External PNP Switch



Voltage Inverting With External NPN Switch

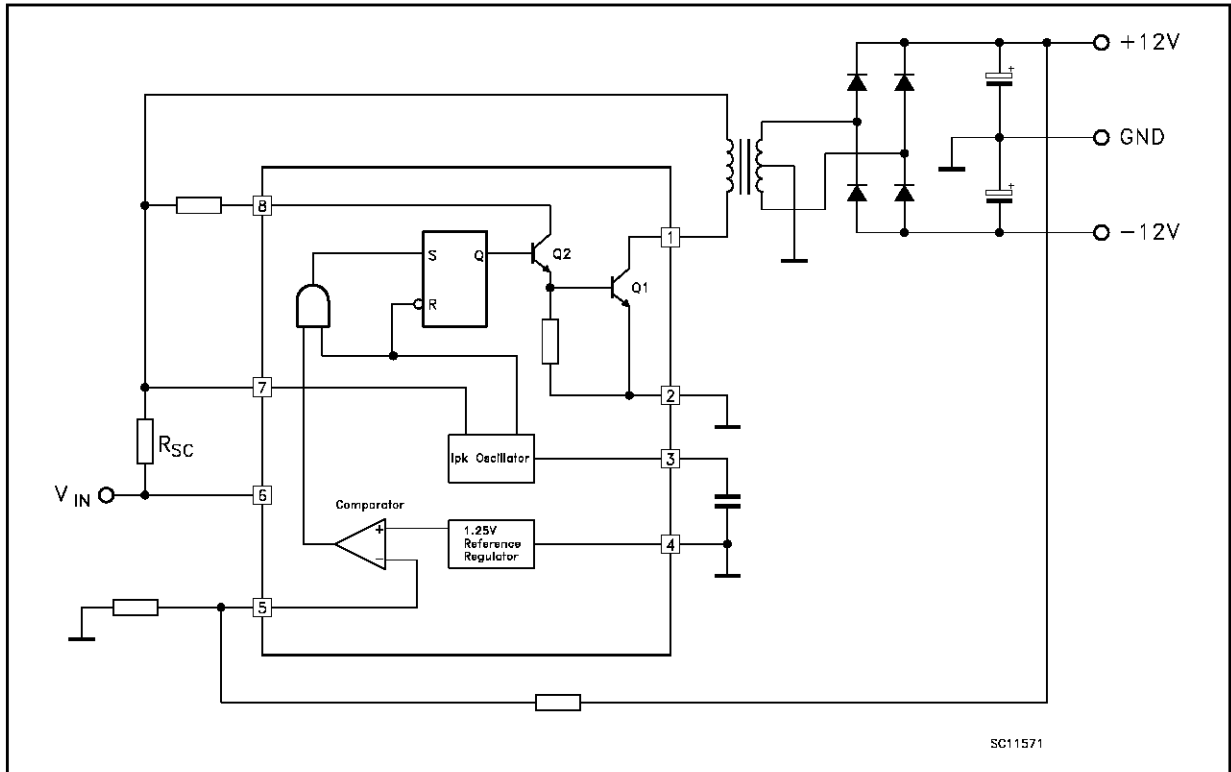


Voltage Inverting With External PNP Saturated Switch

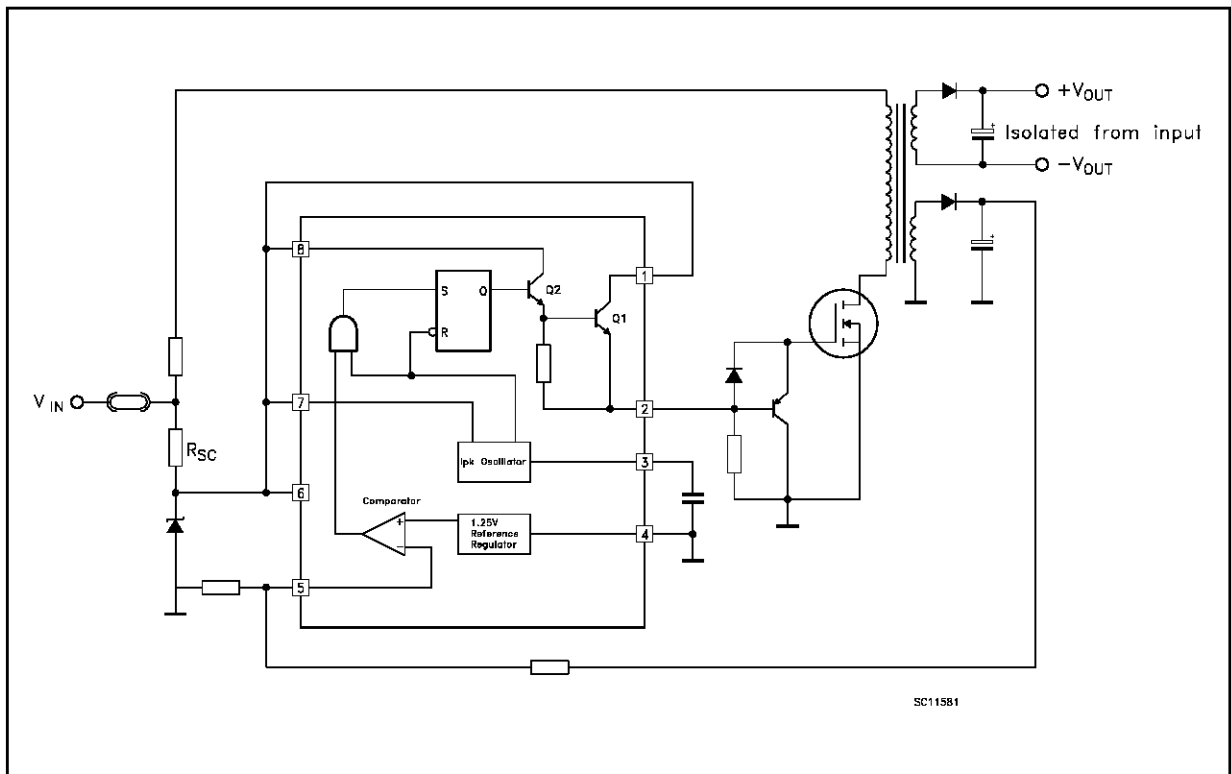


# MC34063A

## Dual Output Voltage

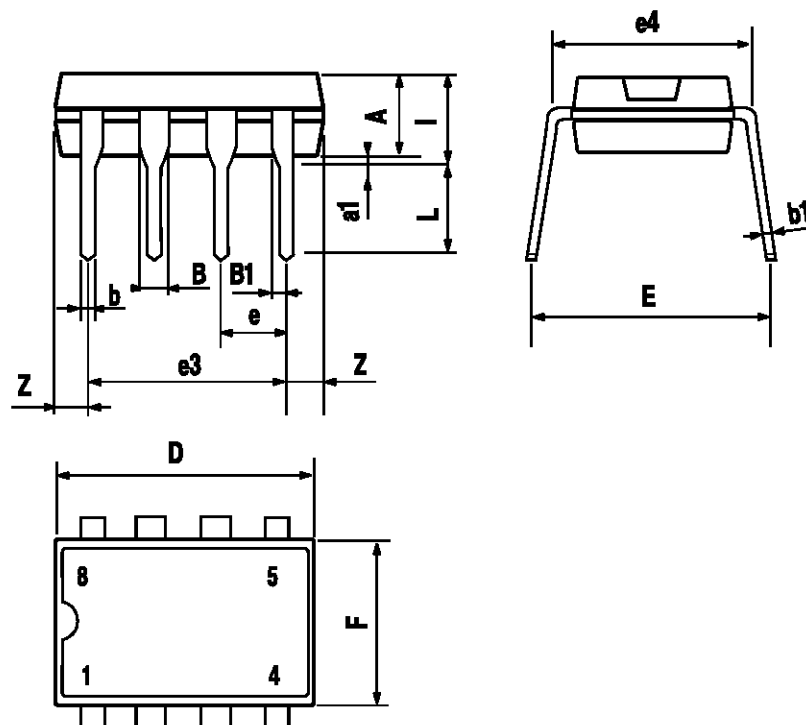


## Higher Output Power, Higher Input Voltage



## Plastic DIP-8 MECHANICAL DATA

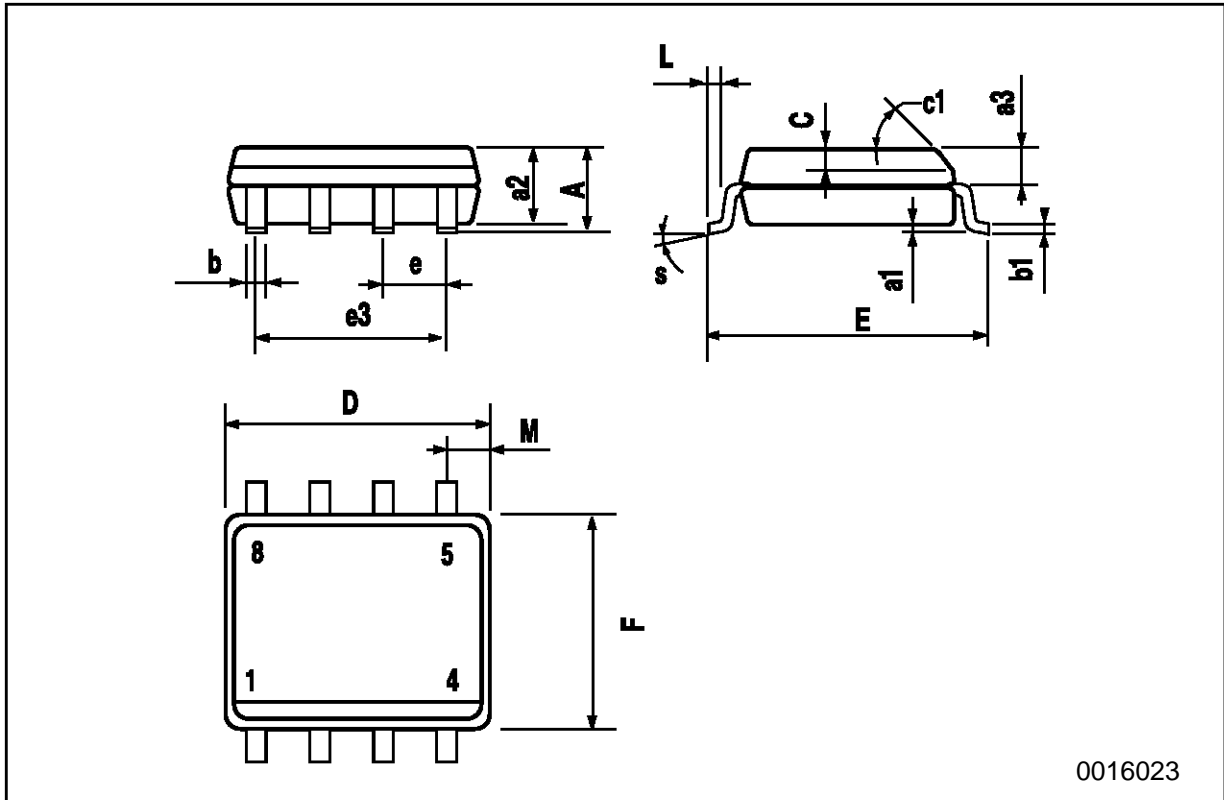
| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |      | 3.3  |      |       | 0.130 |       |
| a1   | 0.7  |      |      | 0.028 |       |       |
| B    | 1.39 |      | 1.65 | 0.055 |       | 0.065 |
| B1   | 0.91 |      | 1.04 | 0.036 |       | 0.041 |
| b    |      | 0.5  |      |       | 0.020 |       |
| b1   | 0.38 |      | 0.5  | 0.015 |       | 0.020 |
| D    |      |      | 9.8  |       |       | 0.386 |
| E    |      | 8.8  |      |       | 0.346 |       |
| e    |      | 2.54 |      |       | 0.100 |       |
| e3   |      | 7.62 |      |       | 0.300 |       |
| e4   |      | 7.62 |      |       | 0.300 |       |
| F    |      |      | 7.1  |       |       | 0.280 |
| I    |      |      | 4.8  |       |       | 0.189 |
| L    |      | 3.3  |      |       | 0.130 |       |
| Z    | 0.44 |      | 1.6  | 0.017 |       | 0.063 |



P001F

**SO-8 MECHANICAL DATA**

| DIM. | mm        |      |      | inch  |       |       |
|------|-----------|------|------|-------|-------|-------|
|      | MIN.      | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |           |      | 1.75 |       |       | 0.068 |
| a1   | 0.1       |      | 0.25 | 0.003 |       | 0.009 |
| a2   |           |      | 1.65 |       |       | 0.064 |
| a3   | 0.65      |      | 0.85 | 0.025 |       | 0.033 |
| b    | 0.35      |      | 0.48 | 0.013 |       | 0.018 |
| b1   | 0.19      |      | 0.25 | 0.007 |       | 0.010 |
| C    | 0.25      |      | 0.5  | 0.010 |       | 0.019 |
| c1   | 45 (typ.) |      |      |       |       |       |
| D    | 4.8       |      | 5.0  | 0.188 |       | 0.196 |
| E    | 5.8       |      | 6.2  | 0.228 |       | 0.244 |
| e    |           | 1.27 |      |       | 0.050 |       |
| e3   |           | 3.81 |      |       | 0.150 |       |
| F    | 3.8       |      | 4.0  | 0.14  |       | 0.157 |
| L    | 0.4       |      | 1.27 | 0.015 |       | 0.050 |
| M    |           |      | 0.6  |       |       | 0.023 |
| S    | 8 (max.)  |      |      |       |       |       |



0016023

Information furnished is believed to be accurate and reliable. However, SGS-THOMSON Microelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of SGS-THOMSON Microelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. SGS-THOMSON Microelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of SGS-THOMSON Microelectronics.

© 1997 SGS-THOMSON Microelectronics - Printed in Italy - All Rights Reserved

SGS-THOMSON Microelectronics GROUP OF COMPANIES

Australia - Brazil - Canada - China - France - Germany - Hong Kong - Italy - Japan - Korea - Malaysia - Malta - Morocco - The Netherlands - Singapore - Spain - Sweden - Switzerland - Taiwan - Thailand - United Kingdom - U.S.A