

DC/DC CONVERTER CONTROL CIRCUITS

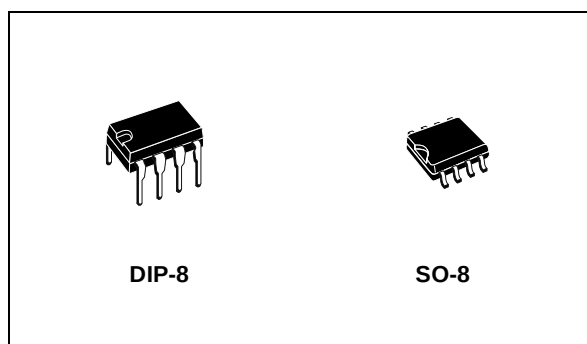
- OUTPUT SWITCH CURRENT IN EXCESS OF 1.5A
- 2% REFERENCE ACCURACY
- LOW QUIESCENT CURRENT: 2.5mA (TYP.)
- OPERATING FROM 3V TO 40V
- FREQUENCY OPERATION TO 100KHz
- ACTIVE CURRENT LIMITING

DESCRIPTION

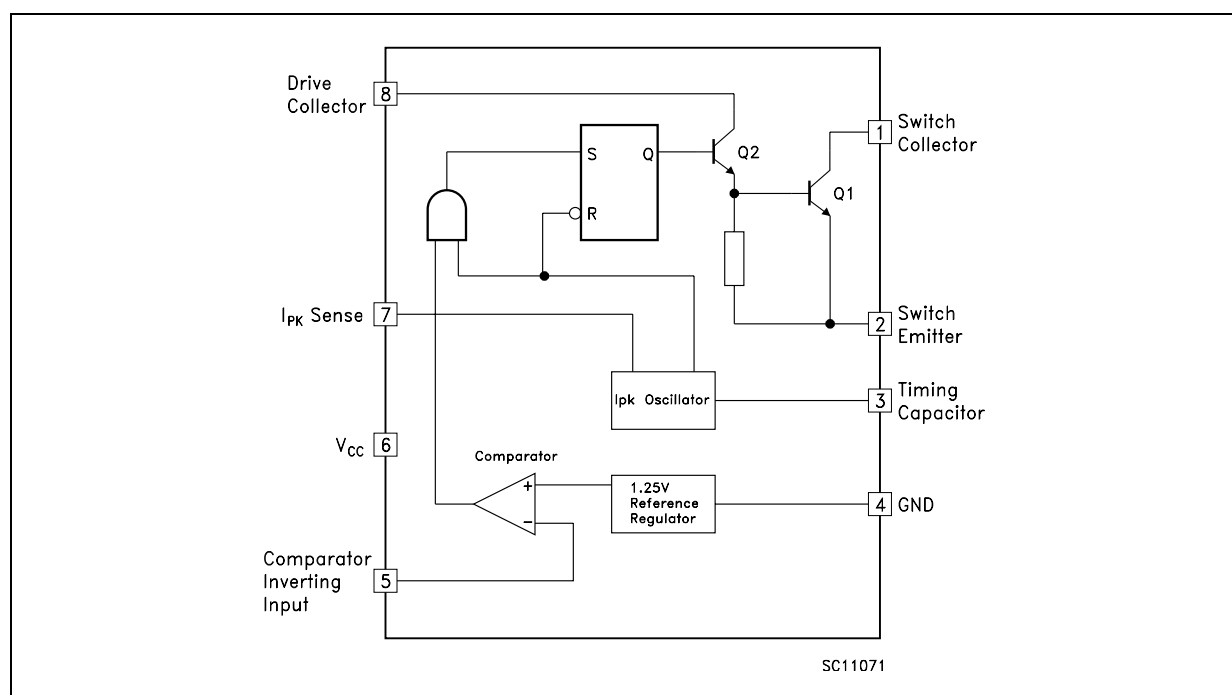
The MC34063A/E series is a monolithic control circuit delivering the main functions for DC/DC voltage converting.

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/E devices series is designed for Step-Down, Step-Up and Voltage-Inverting applications.



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V_{CC}	Power Supply Voltage		50	V
V_{IR}	Comparator Input Voltage Range		-0.3 to 40	V
V_{SWC}	Switch Collector Voltage		40	V
V_{SWE}	Switch Emitter Voltage ($V_{SWC} = 40V$)		40	V
V_{CE}	Switch Collector to Emitter Voltage		40	V
V_{DC}	Driver Collector Voltage		40	V
I_{DC}	Driver Collector Current		100	mA
I_{SW}	Switch Current		1.5	A
P_{TOT}	Power Dissipation at $T_A = 25^\circ C$	for DIP-8	1.25	W
		for SO-8	0.625	
T_J	Operating Junction Temperature		150	$^\circ C$
T_{STG}	Storage Temperature Range		-40 to 150	$^\circ C$
T_{OP}	Operating Ambient Temperature Range	for AC and EC SERIES	0 to 70	$^\circ C$
		for AB SERIES	-40 to 85	
		for EB SERIES	-40 to 125	

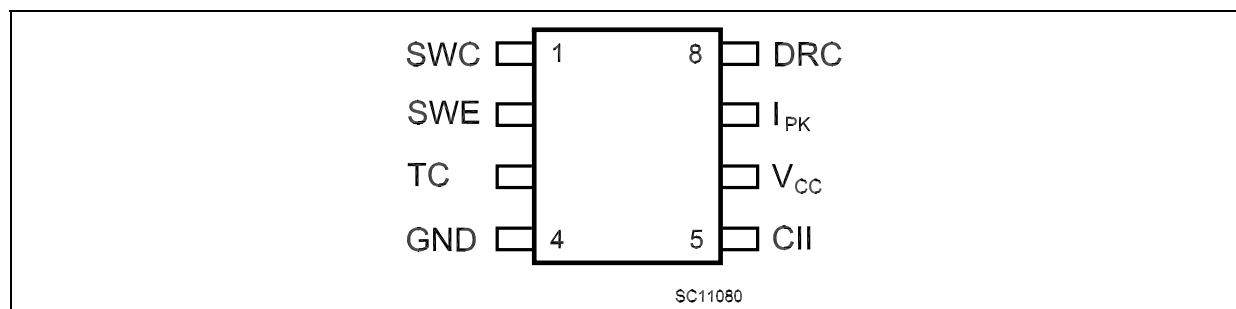
Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

THERMAL DATA

Symbol	Parameter	DIP-8	SO-8	Unit
$R_{thj-amb}$	Thermal Resistance Junction-ambient (*)	100	160	$^\circ C/W$
$R_{thj-case}$	Thermal Resistance Junction-case	42	20	$^\circ C/W$

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

CONNECTION DIAGRAM (top view)



PIN DESCRIPTION

Pin N°	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_{CC}	Voltage Supply
7	I_{PK}	I_{PK} Sense
8	DRC	Voltage Driver Collector

ORDERING CODES

TYPE	DIP-8	SO-8	SO-8 (TAPE & REEL)
MC34063AB	MC34063ABN	MC34063ABD	MC34063ABD-TR
MC34063AC	MC34063ACN	MC34063ACD	MC34063ACD-TR
MC34063EB	MC34063EBN	MC34063EBD	MC34063EBD-TR
MC34063EC	MC34063ECN	MC34063ECD	MC34063ECD-TR

(*) The "A" version is not recommended for new designs.

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	$V_{PIN5} = 0V$ $C_T = 1\text{ nF}$ $T_A = 25^\circ\text{C}$	24	33	42	KHz
I_{CHG}	Charge Current	$V_{CC} = 5\text{ to }40V$ $T_A = 25^\circ\text{C}$	24	33	42	μA
I_{DISCHG}	Discharge Current	$V_{CC} = 5\text{ to }40V$ $T_A = 25^\circ\text{C}$	140	200	260	μA
I_{DISCHG}/I_{CHG}	Discharge to Charge Current Ratio	$PIN\ 7 = V_{CC}$ $T_A = 25^\circ\text{C}$	5.2	6.2	7.5	μA
$V_{IPK(sense)}$	Current Limit Sense Voltage	$I_{CHG} = I_{DISCHG}$ $T_A = 25^\circ\text{C}$	250	300	350	mV

OUTPUT SWITCH

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Saturation Voltage, Darlington Connection	$I_{SW} = 1\text{ A}$ $PIN\ 7, 8\text{ connected}$		1	1.3	V
$V_{CE(sat)}$	Saturation Voltage	$I_{SW} = 1\text{ A}$ $R_{PIN8} = 82\ \Omega\text{ to }V_{CC}$ Forced $\beta \sim 20$		0.45	0.7	V
h_{FE}	DC Current Gain	$I_{SW} = 1\text{ A}$ $V_{CE} = 5\text{ V}$ $T_A = 25^\circ\text{C}$	50	120		
$I_{C(off)}$	Collector Off-State Current	$V_{CE} = 40\text{ V}$		0.01	100	μA

COMPARATOR

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

TOTAL DEVICE

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CC}	Supply Current	$V_{CC} = 5 \text{ to } 40 \text{ V}$ $C_T = 1 \text{ nF}$ $PIN 7 = V_{CC}$ $V_{PIN5} > V_{TH}$ $PIN 2 = GND$ Remaining pins open	for MC34063A		2.5	4	mA
			for MC34063E		1.5	4	
$V_{START-UP}$	Start-Up Voltage (Note 4)	$T_A = 25^\circ\text{C}$ $C_T = 1 \mu\text{F}$, $PIN 5 = 0$	for MC34063A		2.1		V
			for MC34063E		1.5		

NOTES:

1) Maximum package power dissipation limit must be observed.

2) $T_{LOW} = 0^\circ\text{C}$, $T_{HIGH} = 70^\circ\text{C}$ (AC and EC series); $T_{LOW} = -40^\circ\text{C}$, $T_{HIGH} = 85^\circ\text{C}$ (AB series); $T_{LOW} = -40^\circ\text{C}$, $T_{HIGH} = 125^\circ\text{C}$ (EB 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 β of output current switch = $I_{COOUTPUT} / (I_{CDRIVER} - 1\text{mA}^*) \geq 10$

* Current less due to a built in $1\text{K}\Omega$ anti leakage resistor.

4) Start-up Voltage is the minimum Power Supply Voltage at which the internal oscillator begins to work.

TYPICAL PERFORMANCE CHARACTERISTICS

Figure 1 : Emitter Follower Configuration Output Saturation Voltage vs Emitter Current

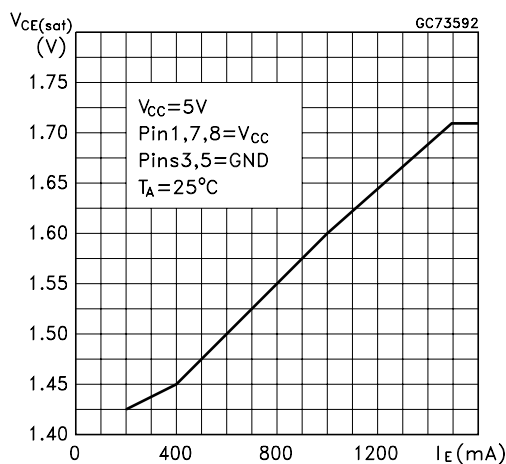


Figure 2 : Output Switch ON-OFF Time vs Oscillator Timing Capacitor

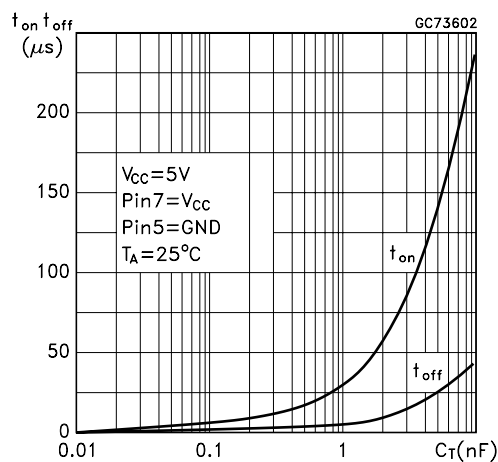


Figure 3 : Common Emitter Configuration Output Switch Saturation Voltage vs Collector Current

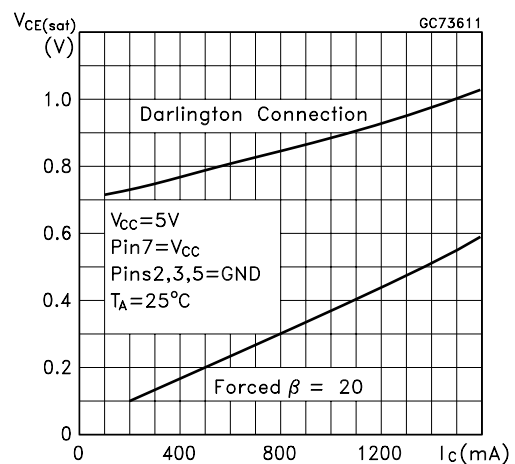


Figure 4 : Darlington Configuration Collector Emitter Saturation Voltage ($V_{CE(sat)}$) vs Temperature

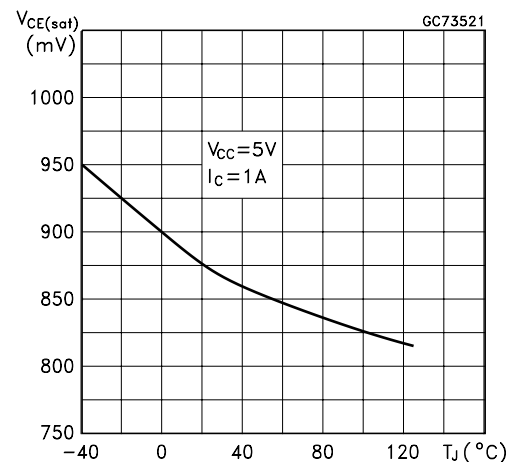
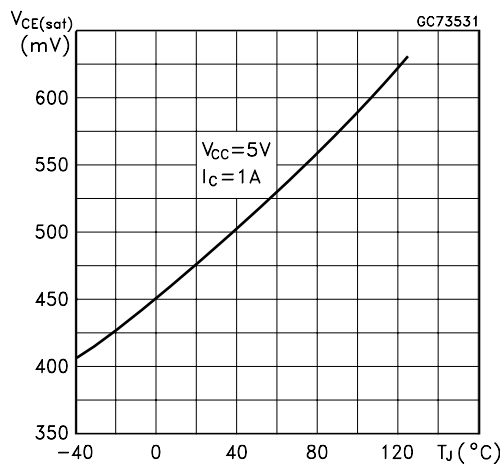
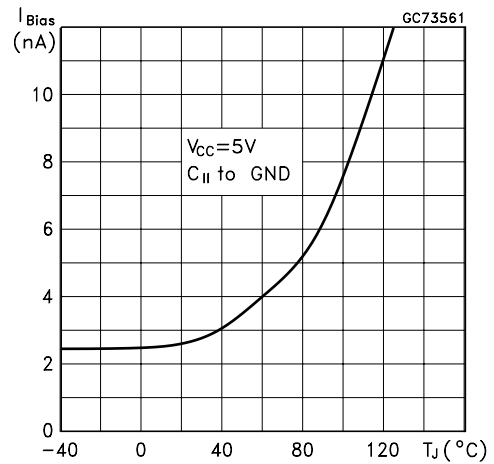
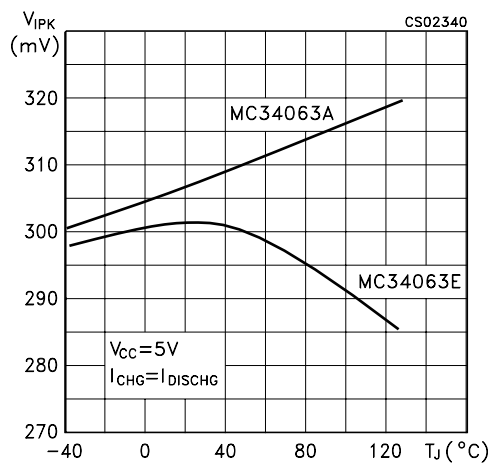
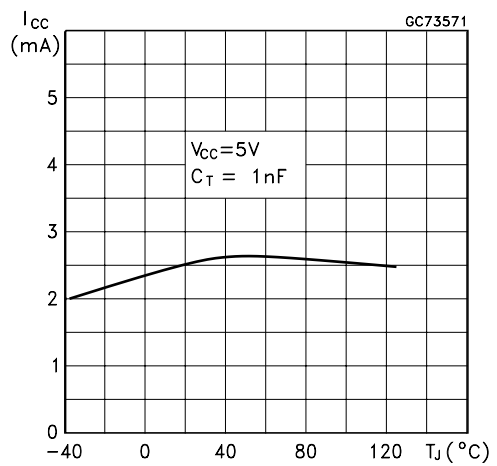
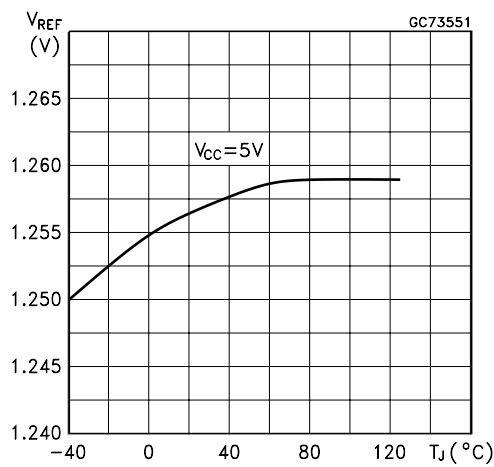
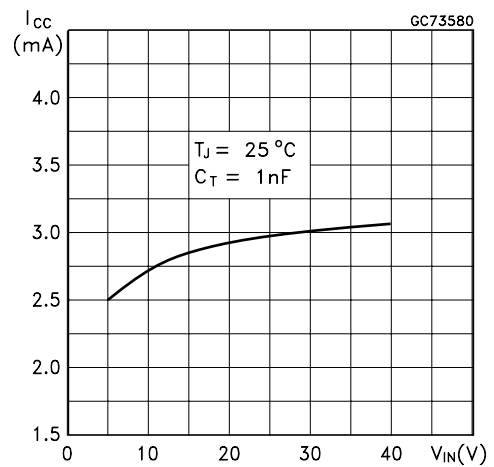
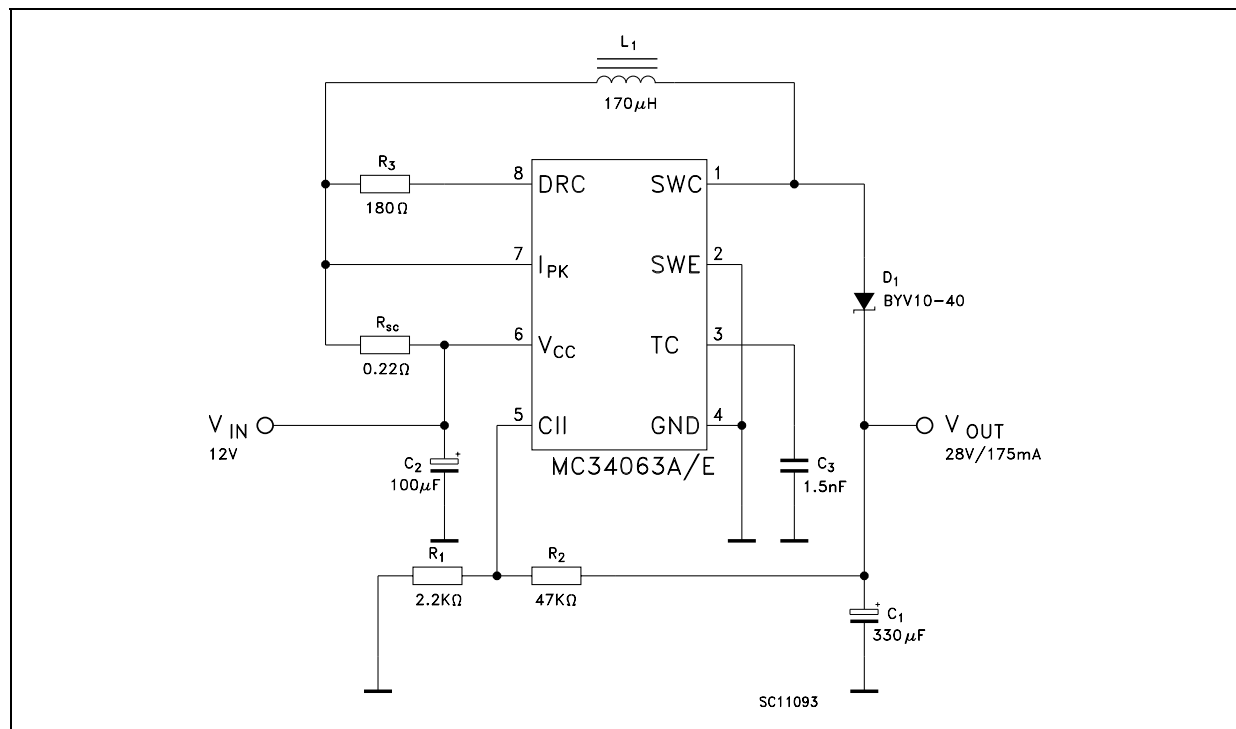


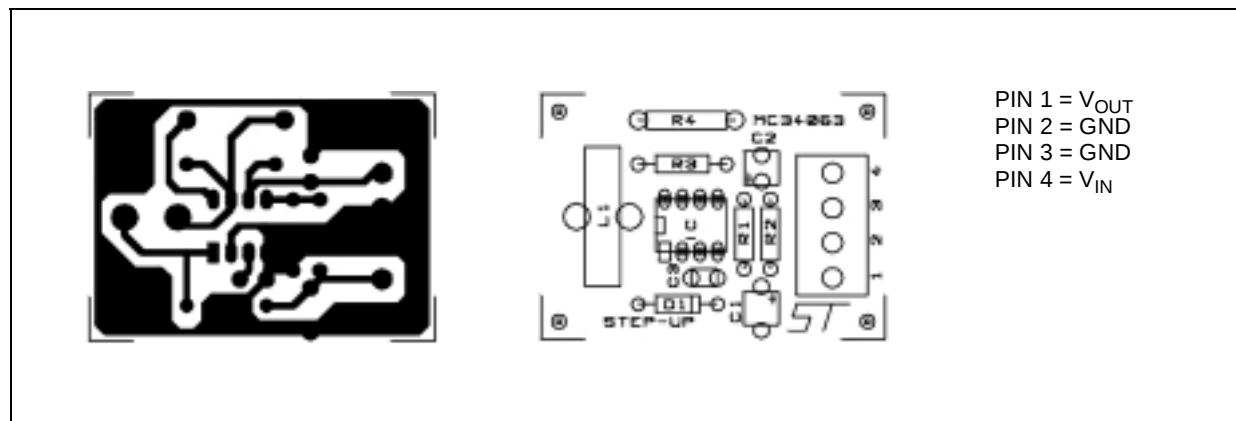
Figure 5 : Power Collector Emitter Saturation Voltage (V_{CEsat}) vs Temperature**Figure 8 : Bias Current vs Temperature****Figure 6 : Current Limit Sense Voltage (V_{IPK}) vs Temperature****Figure 9 : Supply Current vs Temperature****Figure 7 : Reference Voltage vs Temperature****Figure 10 : Supply Current vs Input Voltage**

TYPICAL APPLICATION CIRCUIT

Step-UP Converter

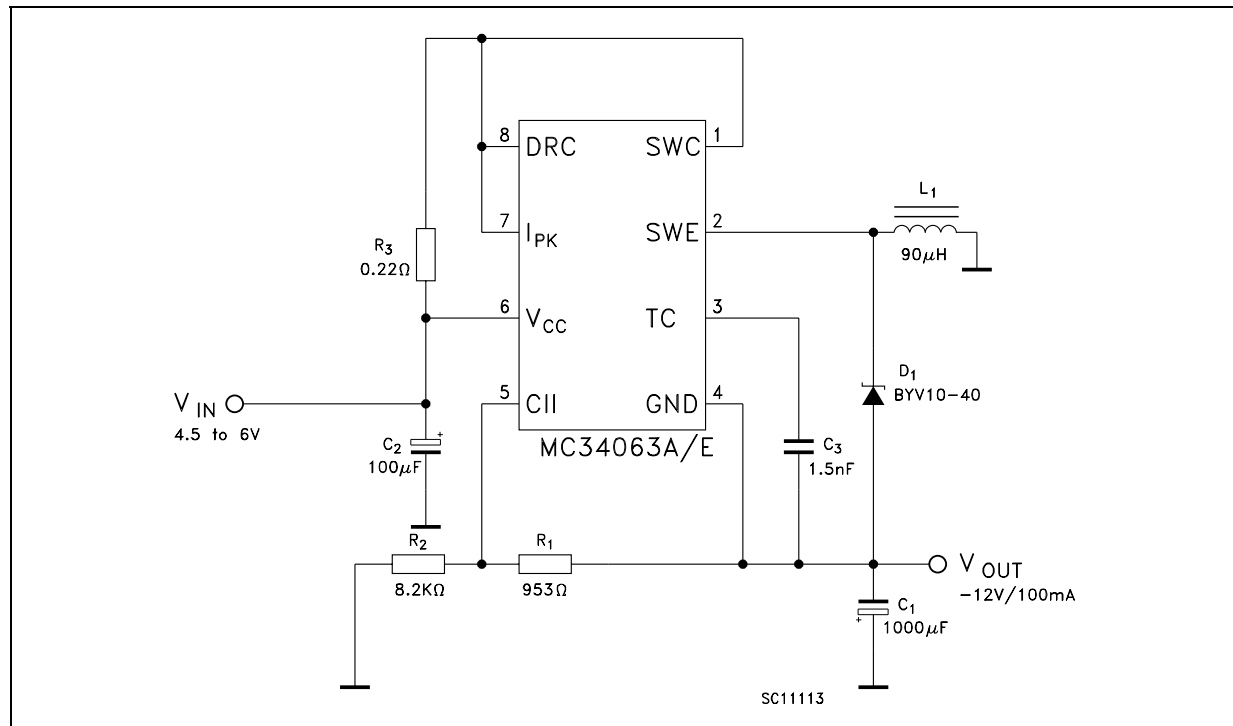


Printed Demoboard

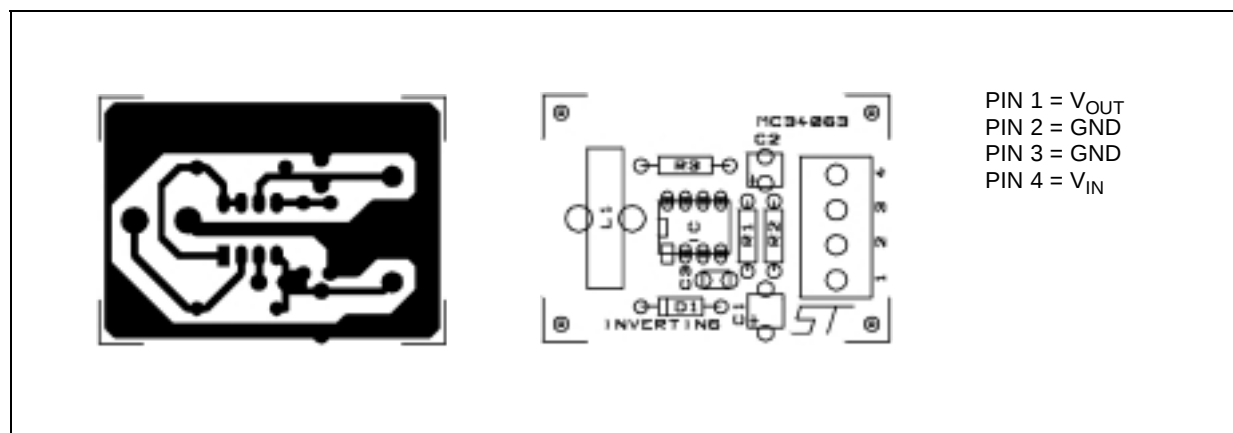
Test Condition ($V_{OUT} = 28V$)

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	%

Voltage Inverting Converter



Printed Demoboard



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

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	%
I_{SC}	$V_{IN} = 5 \text{ V}$, $R_{LOAD} = 0.1 \Omega$	0.9	A

Calculation

Parameter	Step-Up (Discontinuous mode)	Step-Down (Continuous mode)	Voltage Inverting (Discontinuous mode)
t_{on}/t_{off}	$\frac{V_{OUT} + V_F - V_{IN(min)}}{V_{IN(min)} - V_{sat}}$	$\frac{V_{OUT} + V_F}{V_{IN(min)} - V_{sat} - V_{OUT}}$	$\frac{ V_{OUT} + V_F}{V_{IN} - V_{sat}}$
$(t_{on} + t_{off}) \text{ max}$	$1/f_{min}$	$1/f_{min}$	$1/f_{min}$
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	$\frac{I_{out} t_{on}}{V_{ripple(p-p)}}$	$\frac{I_{PK(switch)}(t_{on} + t_{off})}{8V_{ripple(p-p)}}$	$\frac{I_{out} t_{on}}{V_{ripple(p-p)}}$
$L_{(min)}$	$\frac{V_{IN(min)} - V_{sat}}{I_{PK(switch)}} \times t_{on(min)}$	$\frac{V_{IN(min)} - V_{sat} - V_{out}}{I_{PK(switch)}} \times t_{on(min)}$	$\frac{V_{IN(min)} - V_{sat}}{I_{PK(switch)}} \times t_{on(min)}$

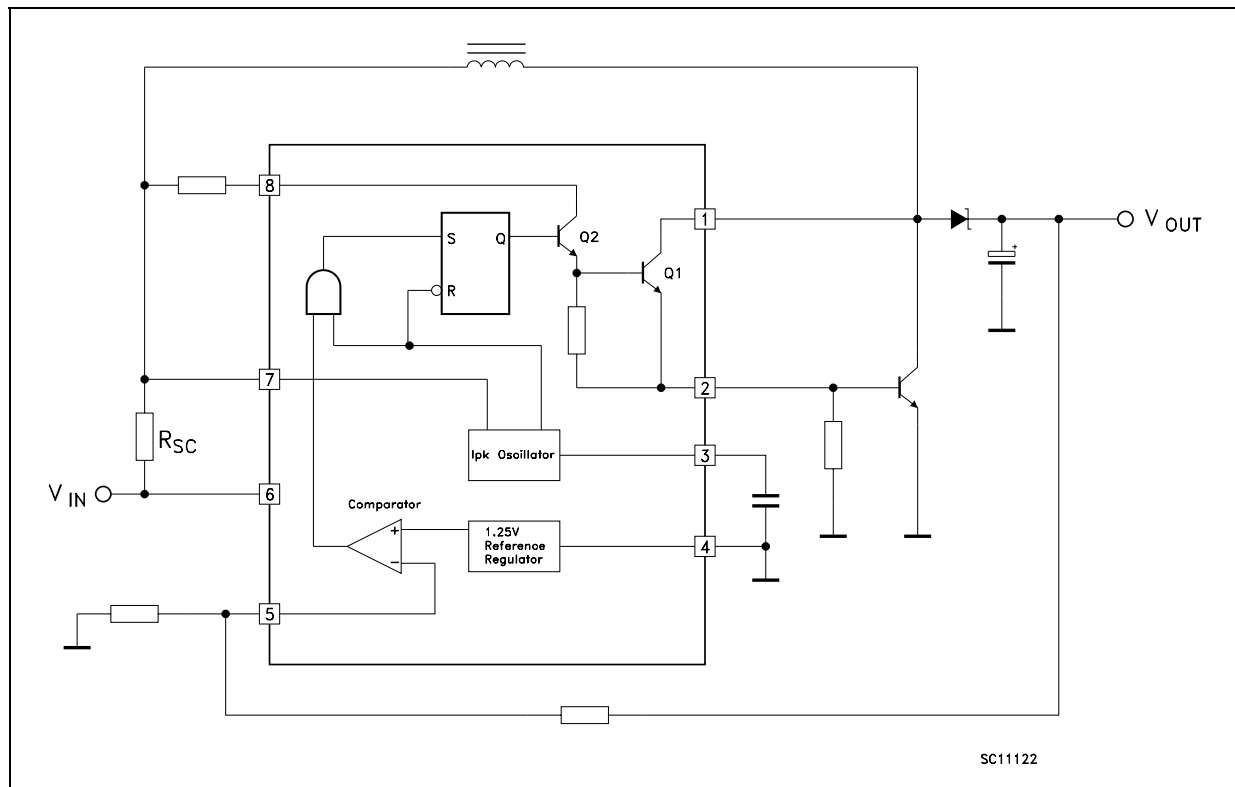
NOTES:

 V_{SAT} = Saturation voltage of the output switch V_F = Forward voltage drop of the output rectifier

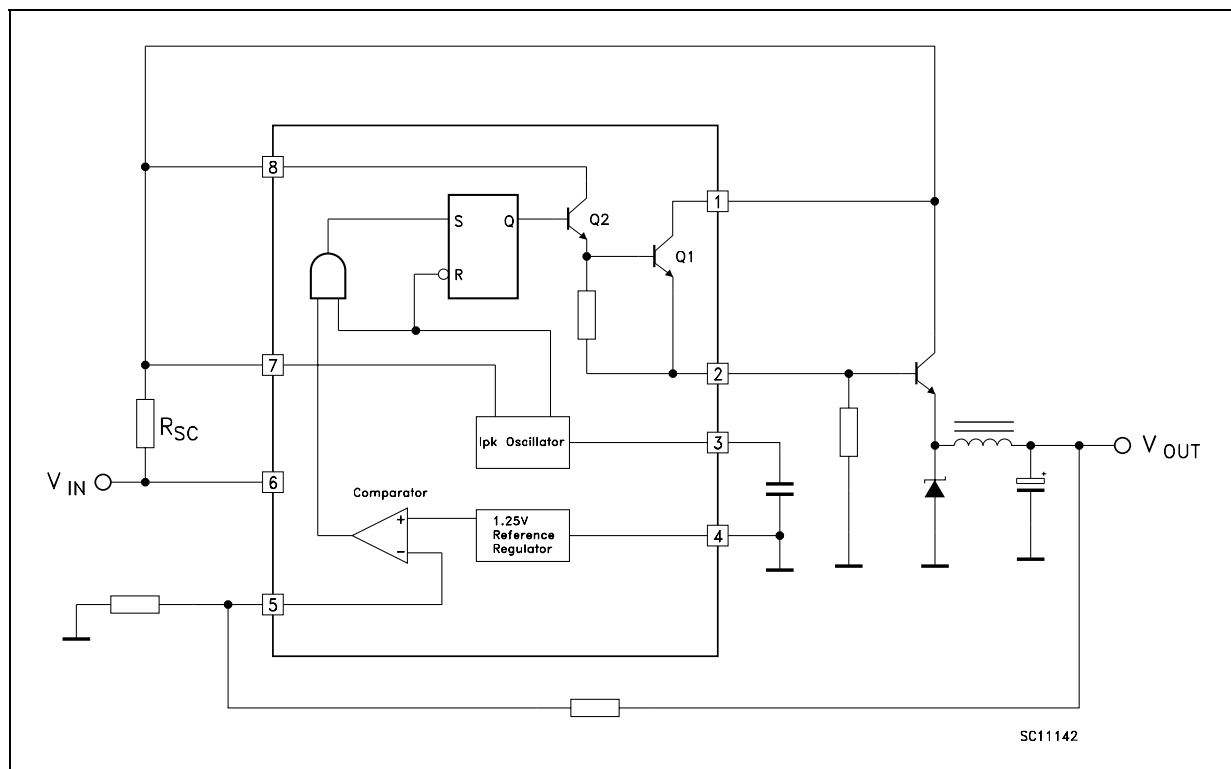
THE FOLLOWING POWER SUPPLY CHARACTERISTICS MUST BE CHOSEN:

 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 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.

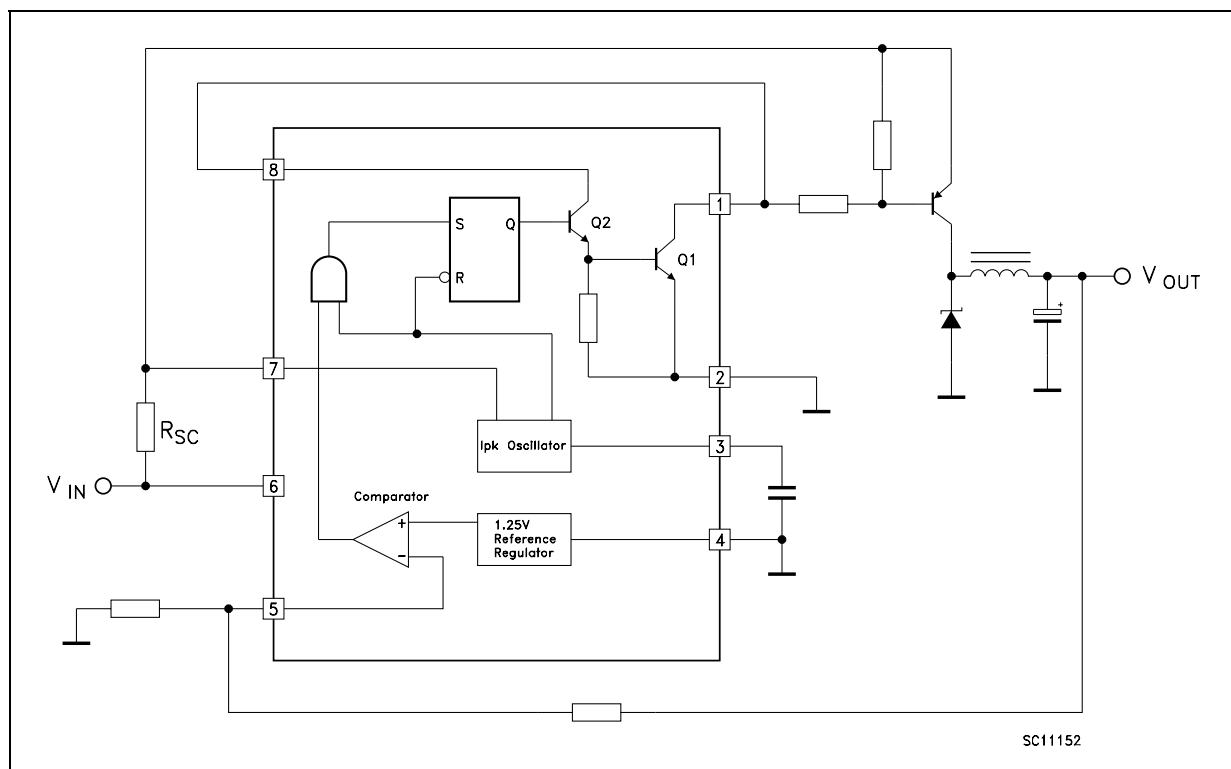
Step-Up With External NPN Switch



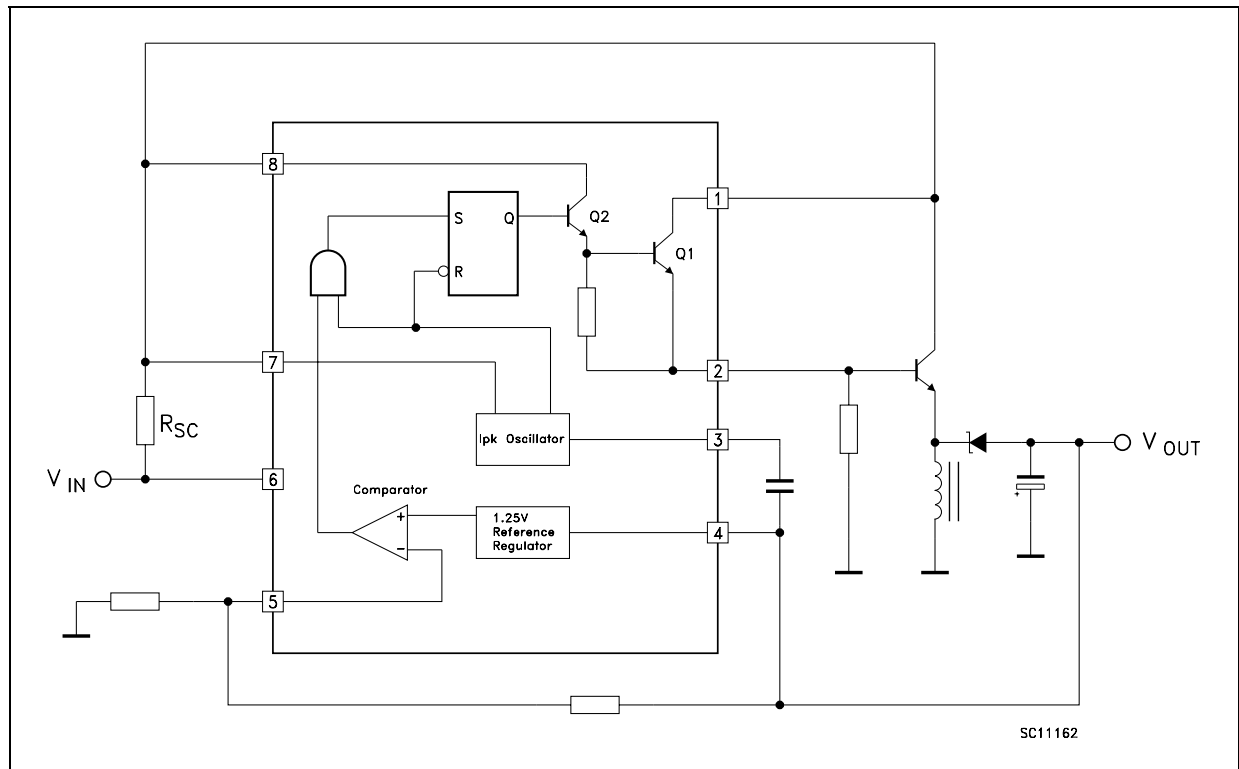
Step-Down With External NPN Switch



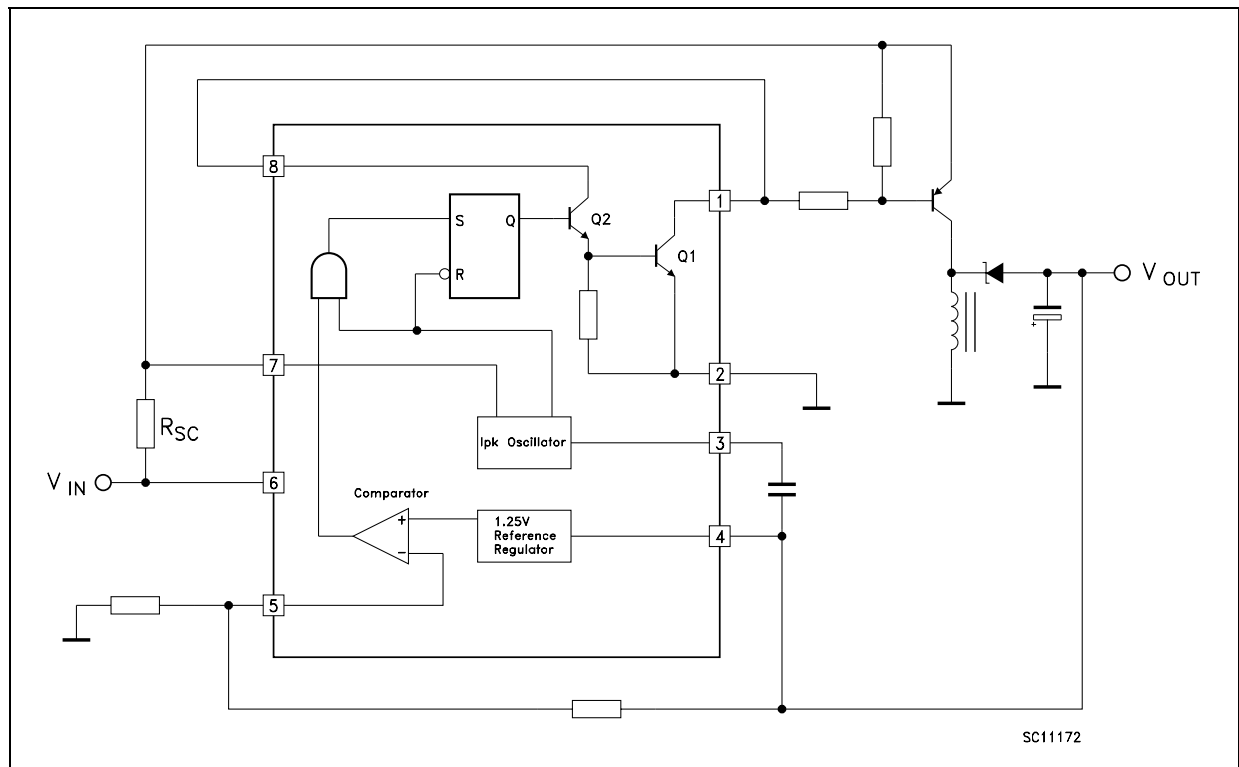
Step-Down With External PNP Switch



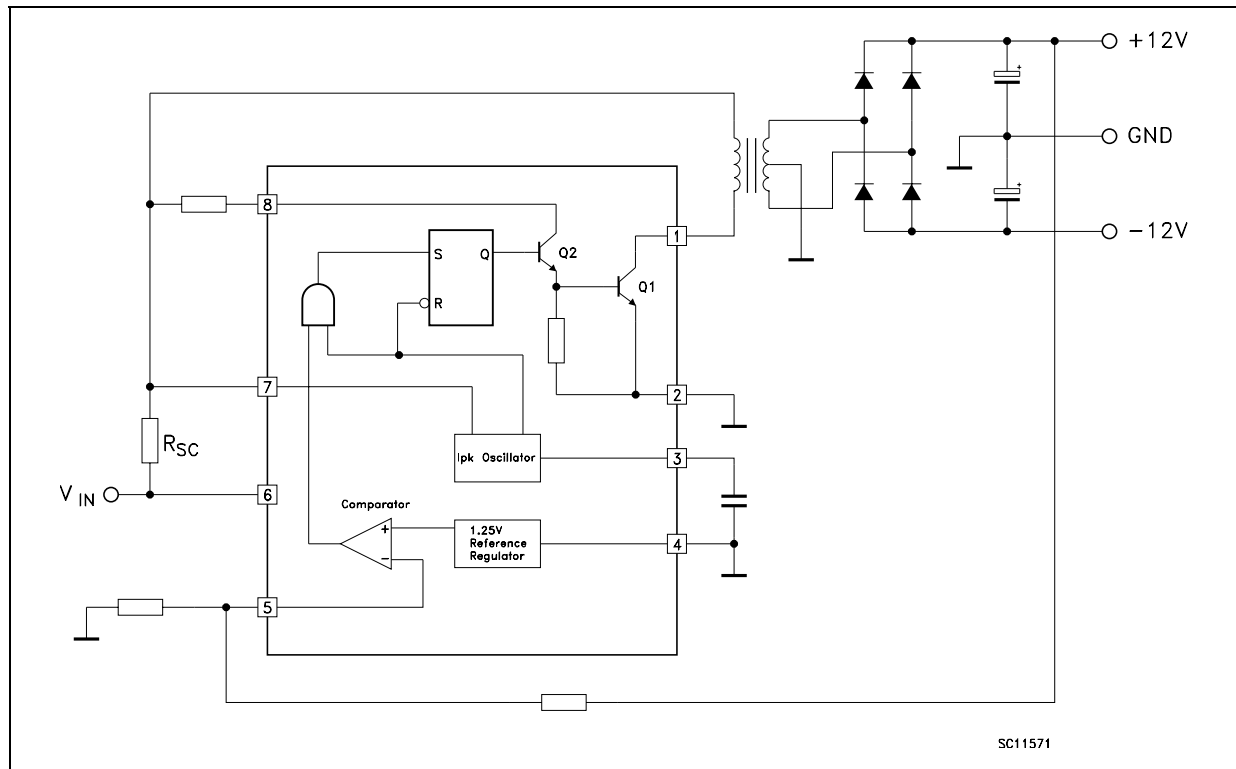
Voltage Inverting With External NPN Switch



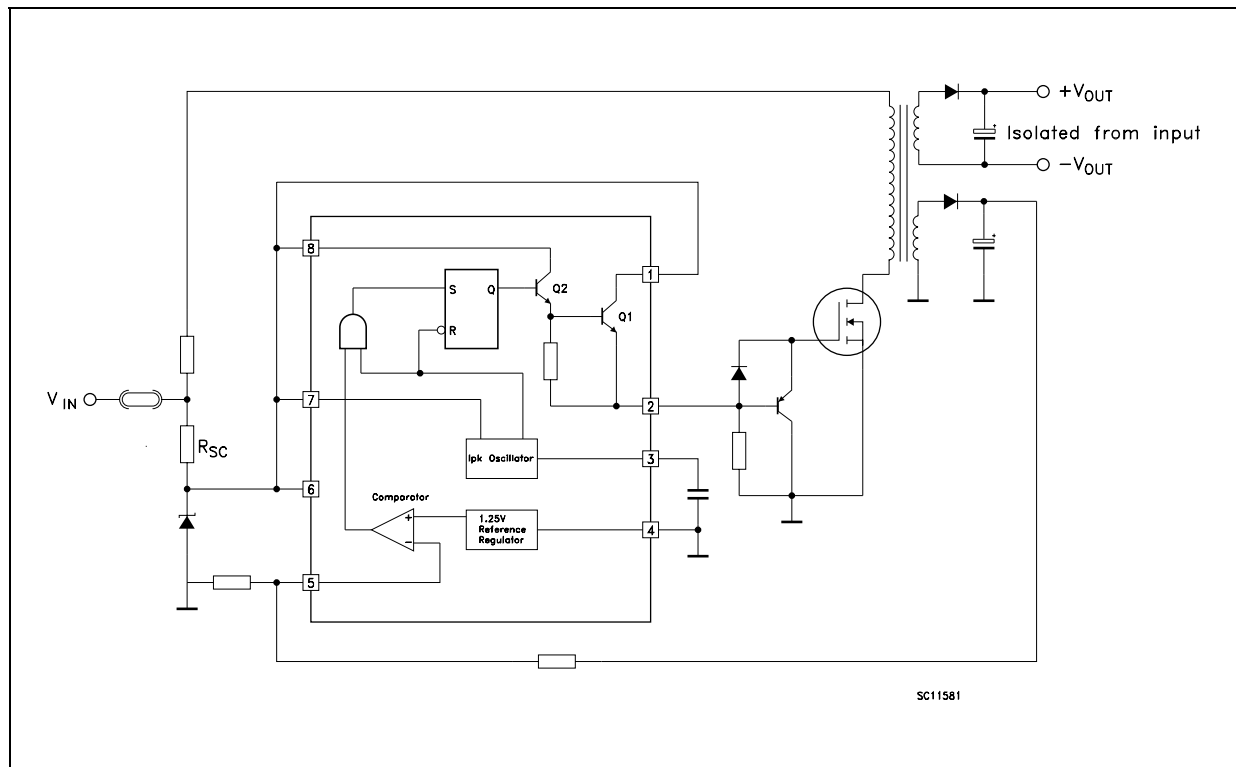
Voltage Inverting With External PNP Saturated Switch



Dual Output Voltage

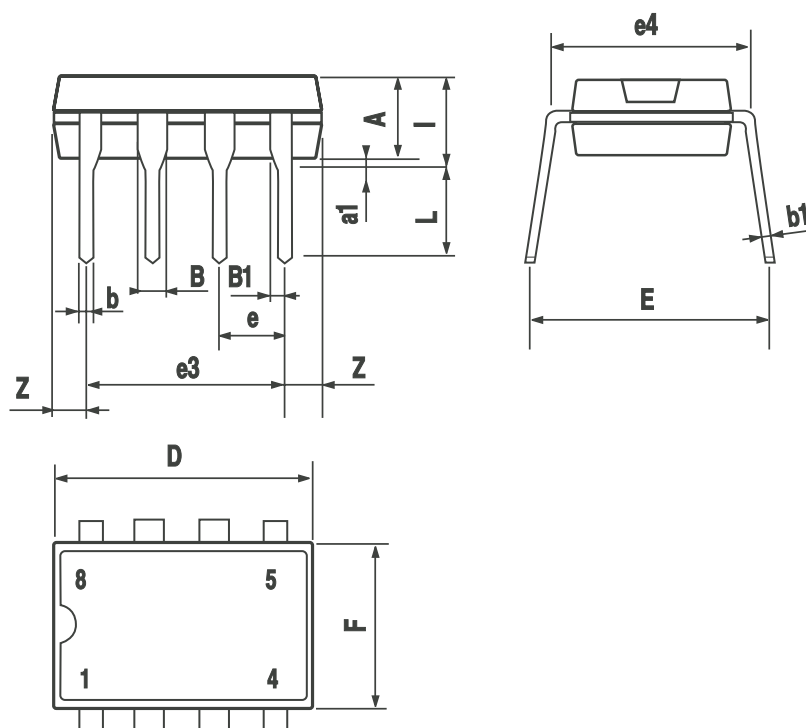


Higher Output Power, Higher Input Voltage



Plastic DIP-8 MECHANICAL DATA

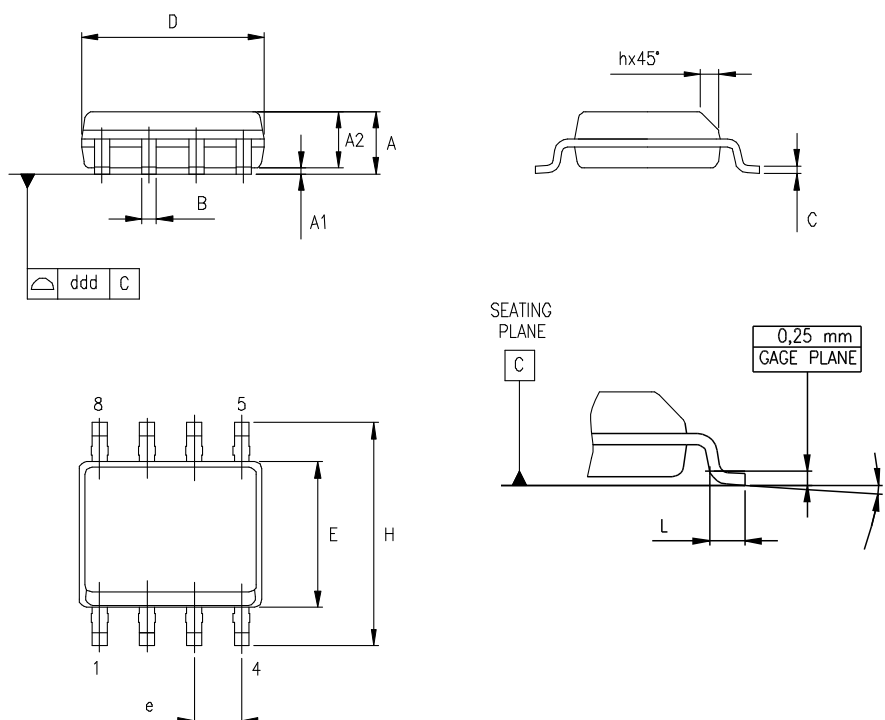
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A		3.3			0.130	
a1	0.7			0.028		
B	1.39		1.65	0.055		0.065
B1	0.91		1.04	0.036		0.041
b		0.5			0.020	
b1	0.38		0.5	0.015		0.020
D			9.8			0.386
E		8.8			0.346	
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			7.1			0.280
I			4.8			0.189
L		3.3	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



P001F

SO-8 MECHANICAL DATA

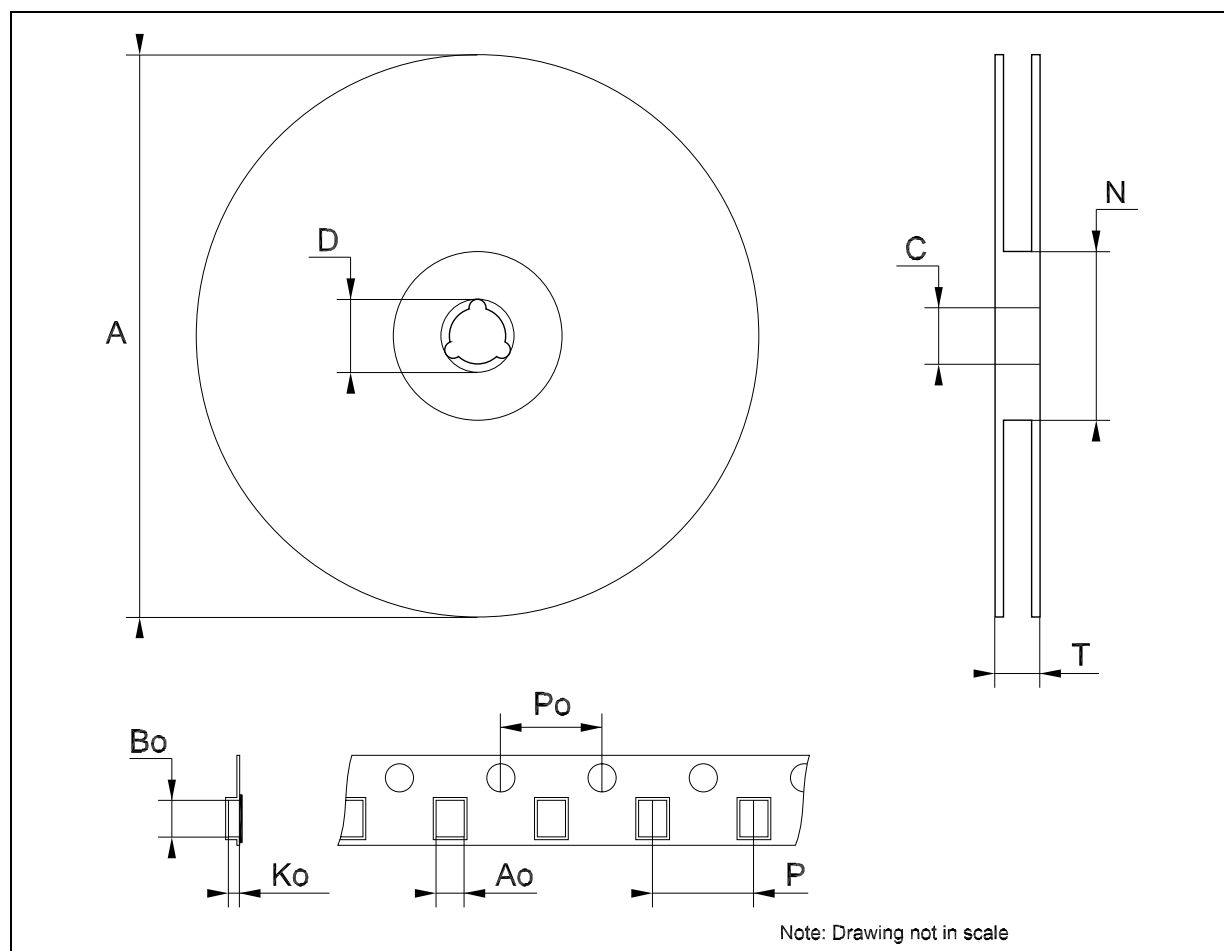
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.04		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D	4.80		5.00	0.189		0.197
E	3.80		4.00	0.150		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	8° (max.)					
ddd			0.1			0.04



0016023/C

Tape & Reel SO-8 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	8.1		8.5	0.319		0.335
Bo	5.5		5.9	0.216		0.232
Ko	2.1		2.3	0.082		0.090
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319



Information furnished is believed to be accurate and reliable. However, STMicroelectronics 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 STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

The ST logo is a registered trademark of STMicroelectronics
All other names are the property of their respective owners

© 2004 STMicroelectronics - All Rights Reserved
STMicroelectronics GROUP OF COMPANIES

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan -
Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States.
<http://www.st.com>