



MIK34063A

DC-TO-DC CONVERTER CONTROLLER

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GENERAL DESCRIPTION

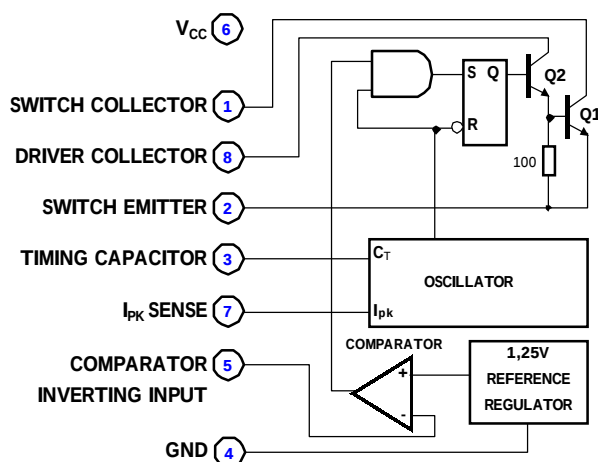
The MIK34063A is a monolithic control circuit containing the primary functions required for DC-to-DC converters. This device consist of an internal temperature compensated reference comparator, controlled duty cycle oscillator with an active current limit circuit, driver and high current output switch. It can be used for Step-Down and Step-Up and Voltage-Inverting applications with a minimum number of external components.

FEATURES

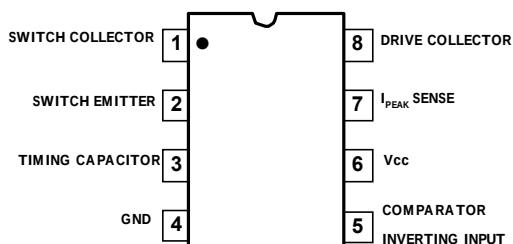
- Operation from 3.0V to 40V.
- Current limiting.
- Low standby current.
- Output switch current to 1.5A without external transistors.
- Frequency of operation from 100Hz to 100kHz.
- Step-up, step-down or inverting switch regulators.
- Precision 2% Reference.
- Output voltage adjustable.



SCHEMATIC DIAGRAM

SOP-8  MIK34063ADDIP-8  MIK34063AP

PIN CONNECTIONS (top view)



ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	VALUE (MAX)	UNIT
V_{CC}	Power Supply Voltage	40	V
V_{IR}	Comparator Input Voltage Range	-0.3 to 40	V
$V_{C(switch)}$	Switch Collector Voltage	40	V
$V_{E(switch)}$	Switch Emitter Voltage ($V_{PIN} = 40$ V)	40	V
$V_{CE(switch)}$	Switch Collector to Emitter Voltage	40	V
$V_{C(driver)}$	Driver Collector Voltage	40	V
$I_{C(driver)}$	Driver Collector Current (Note 1)	100	mA
I_{SW}	Switch Current	1.5	A
T_J	Operating Junction Temperature	150	°C
T_A	Operating Ambient Temperature Range	0 to 70	°C
T_{STG}	Storage Temperature Range	-65 to 150	°C
POWER DISSIPATION AND THERMAL CHARACTERISTICS			
DIP-8 plastic package (MIK34063AP)			
P_D	$T_A = 25^\circ\text{C}$	1.25	W
$P_{\theta JA}$	Thermal Resistance Junction-ambient (Note 2)	100	°C/W
SOP-8 plastic package (MIK34063A)			
P_D	$T_A = 25^\circ\text{C}$	0.625	W
$P_{\theta JA}$	Thermal Resistance Junction-ambient (Note 2)	160	°C/W

NOTES:

- 1: Maximum package power dissipation limit must be observed.
- 2: This value depends from thermal design of PCB on which the device is mounted.



ELECTRICAL CHARACTERISTICS

(Refer to test circuits; $V_{CC} = 5V$; $T_A = T_{LOW}$ to T_{HIGH} (see Note 3), unless otherwise specified)

SYMBOL	CHARACTERISTICS	MIN	TYP	MAX	UNIT
OSCILLATOR					
F_{OSC}	Frequency ($V_{pin5} = 0V$; $C_T = 1.0\text{ nF}$; $T_A = 25^\circ\text{C}$)	24	33	42	kHz
I_{CHG}	Charge Current ($V_{CC} = 5.0V$ to $40V$; $T_A = 25^\circ\text{C}$)	24	35	42	μA
I_{DISCHG}	Discharge Current ($V_{CC} = 5.0V$ to $40V$; $T_A = 25^\circ\text{C}$)	140	220	260	μA
I_{DISCHG}/I_{CHG}	Discharge to Charge Current Ratio (Pin 7 to V_{CC} ; $T_A = 25^\circ\text{C}$)	5.2	6.5	7.5	—
$V_{IPK(SENSE)}$	Current Limit Sense Voltage ($I_{CHG} = I_{DISCHG}$; $T_A = 25^\circ\text{C}$)	250	300	350	mV
OUTPUT SWITCH (Note 4)					
$V_{CE(SAT)}$	Saturation Voltage. Darlington Connection ($I_{SW} = 1.0\text{ A}$; Pins 1, 8 connected)	—	1	1.3	V
$V_{CE(SAT)}$	Saturation Voltage (see Note 5) ($I_{SW} = 1.0\text{ A}$; $R_{pin 8} = 82\Omega$ to V_{CC} ; Forced $\beta \approx 20$)	—	0.45	0.7	V
h_{FE}	DC Current Gain ($I_{SW} = 1.0\text{ A}$; $V_{CE} = 5.0\text{ V}$; $T_A = 25^\circ\text{C}$)	50	75	—	—
$I_{C(OFF)}$	Collector Off-State Current ($V_{CE} = 40\text{ V}$)	—	40	100	μA
COMPARATOR					
V_{TH}	Threshold Voltage				
	($T_A = 25^\circ\text{C}$)	1.225	1.25	1.275	V
	($T_A = T_{LOW}$ to T_{HIGH})	1.21	—	1.29	
Reg_{line}	Threshold Voltage Line Regulation ($V_{CC} = 3.0V$ to $40V$)	—	1.4	5	mV
I_{IB}	Input Bias Current ($V_{IN} = 0\text{ V}$)	—	-20	-400	nA
TOTAL DEVICE					
I_{CC}	Supply Current ($V_{CC} = 5.0\text{ V}$ to 40 V ; $C_T = 1.0\text{ nF}$; Pin 7 = V_{CC} ; $V_{pin 5} > V_{TH}$; Pin 2 = GND ; remaining pins open)	—	—	4.0	mA

NOTES:

- $T_{LOW} = 0^\circ\text{C}$; $T_{HIGH} = +70^\circ\text{C}$.
- 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 ($\leq 300\text{ mA}$) and high driver currents ($\geq 30\text{ mA}$), it may take up to $2.0\text{ }\mu\text{s}$ for it to come out of saturation. This condition will shorten the off time at frequencies $\geq 30\text{ kHz}$, 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:

$$\text{Forced } \beta \text{ of output current switch} \approx I_{C \text{ OUTPUT}} / (I_{C \text{ DRIVER}} - 7.0\text{ mA}^*) \geq 10$$

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



DESIGN FORMULA TABLE

CALCULATION	STEP-UP	STEP-DOWN	VOLTAGE-INVERTING
t_{ON}/t_{OFF}	$\frac{V_{OUT} + V_F - V_{IN(MIN)}}{V_{IN(MIN)} - V_{SAT}}$	$\frac{V_{OUT} + V_F}{V_{IN(MIN)} - V_{SAT} - V_{OUT}}$	$\frac{ V_{OUT} + V_F}{V_{IN} - V_{SAT}}$
$(t_{ON} + t_{OFF})_{MAX}$	$\frac{1}{f_{MIN}}$	$\frac{1}{f_{MIN}}$	$\frac{1}{f_{MIN}}$
C_T	$4.0 \times 10^{-5} t_{ON}$	$4.0 \times 10^{-5} t_{ON}$	$4.0 \times 10^{-5} t_{ON}$
$I_{PK(SWITCH)}$	$2 I_{OUT(MAX)} \left(\frac{t_{ON}}{t_{OFF}} + 1 \right)$	$2 I_{OUT(MAX)}$	$2 I_{OUT(MAX)} \left(\frac{t_{ON}}{t_{OFF}} + 1 \right)$
R_{SC}	$0.3/I_{PK(SWITCH)}$	$0.3/I_{PK(SWITCH)}$	$0.3/I_{PK(SWITCH)}$
$L_{(MIN)}$	$\left(\frac{(V_{IN(MIN)} - V_{SAT})}{I_{PK(SWITCH)}} \right) t_{ON(MAX)}$	$\left(\frac{(V_{IN(MIN)} - V_{SAT} - V_{OUT})}{I_{PK(SWITCH)}} \right) t_{ON(MAX)}$	$\left(\frac{(V_{IN(MIN)} - V_{SAT})}{I_{PK(SWITCH)}} \right) t_{ON(MAX)}$
C_O	$9 \frac{I_{OUT} t_{ON}}{V_{RIPPLE(PP)}}$	$\frac{I_{PK(SWITCH)} (t_{ON} + t_{OFF})}{8 V_{RIPPLE(PP)}}$	$9 \frac{I_{OUT} t_{ON}}{V_{RIPPLE(PP)}}$

TERMS and DEFINITIONS

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, $|V_{OUT}| = 1.25 \left(1 + \frac{R2}{R1} \right)$

I_{OUT} – desired output current

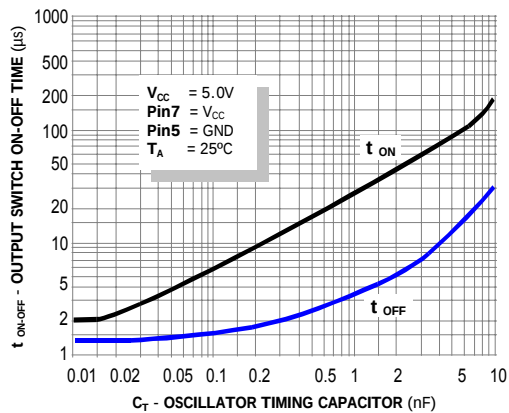
f_{MIN} – minimum desired output switching frequency at the selected values of V_{IN} and I_O

$V_{RIPPLE(PP)}$ – 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.

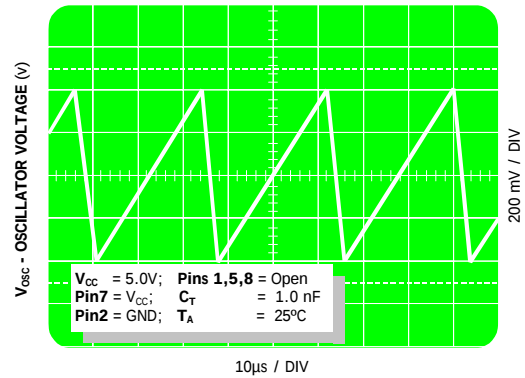


TYPICAL PERFORMANCE CHARACTERISTICS

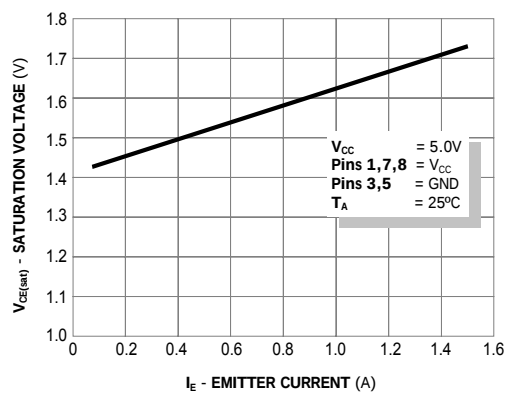
**OUTPUT SWITCH ON-OFF TIME
VERSUS OSCILLATOR TIMING CAPACITOR**



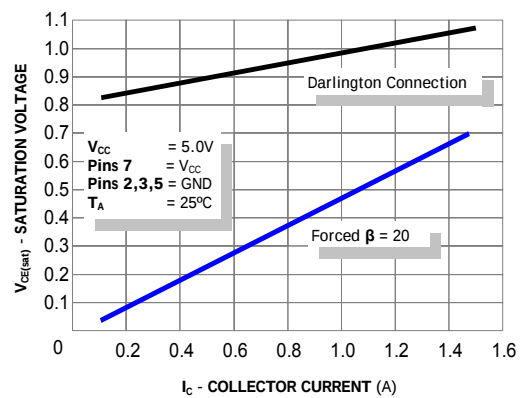
TIMING CAPACITOR WAVEFORM



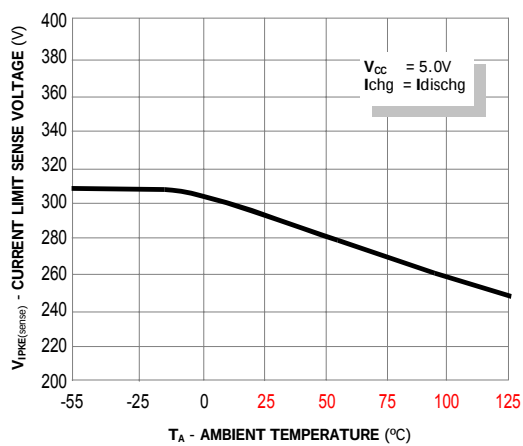
**EMITTER FOLLOWER CONFIGURATION OUTPUT
SATURATION VOLTAGE
VERSUS EMITTER CURRENT**



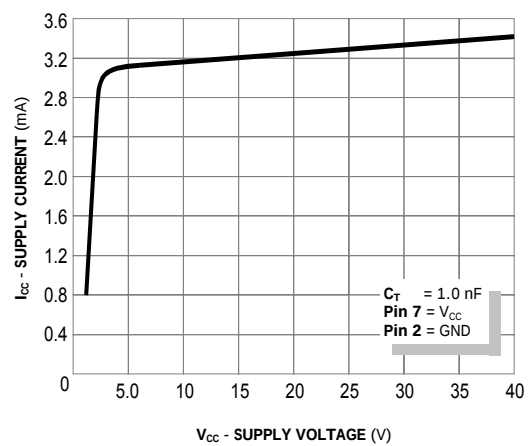
**COMMON EMITTER CONFIGURATION OUTPUT
SWITCH SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT**



**CURRENT LIMIT SENSE VOLTAGE
VERSUS TEMPERATURE**



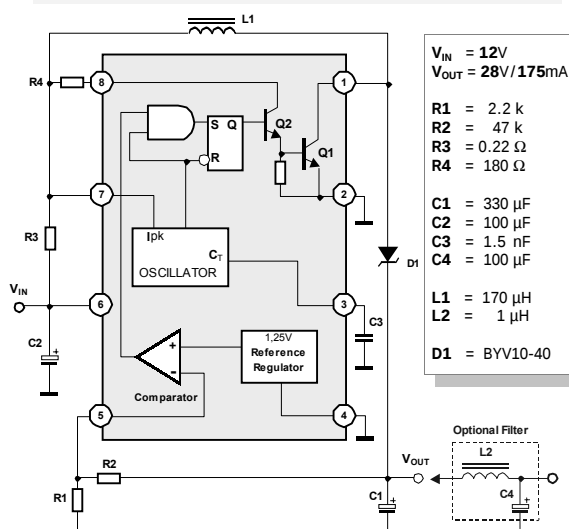
**STANDBY SUPPLY CURRENT
VERSUS SUPPLY VOLTAGE**



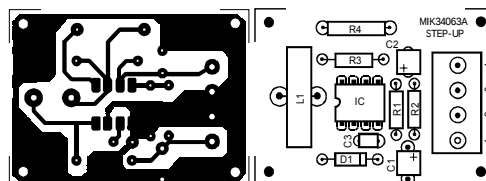


TYPICAL APPLICATION CIRCUIT

STEP-UP CONVERTER

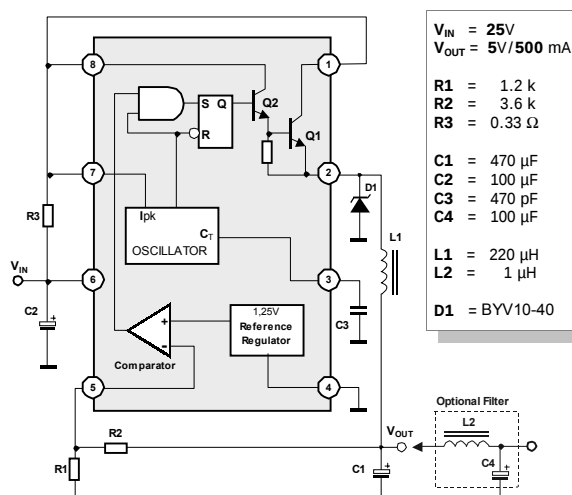


STEP-UP CONVERTER — PRINTED DEMOBOARD

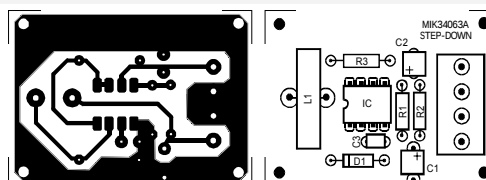
 V_{IN} = contact 1 GND = contact 2,3 V_{OUT} = contact 4

TEST	CONDITIONS	RESULTS
Line Regulation	$V_{in} = 8.0 \pm 16 V$; $I_o = 175 mA$	30 mV = $\pm 0.05\%$
Load Regulation	$V_{in} = 12 V$; $I_o = 75 \pm 175 mA$	10 mV = $\pm 0.017\%$
Output Ripple	$V_{in} = 12 V$; $I_o = 175 mA$	400 mVpp
Efficiency	$V_{in} = 12 V$; $I_o = 175 mA$	87.7%
Output Ripple With Optional Filter	$V_{in} = 12 V$; $I_o = 175 mA$	40 mVpp

STEP-DOWN CONVERTER

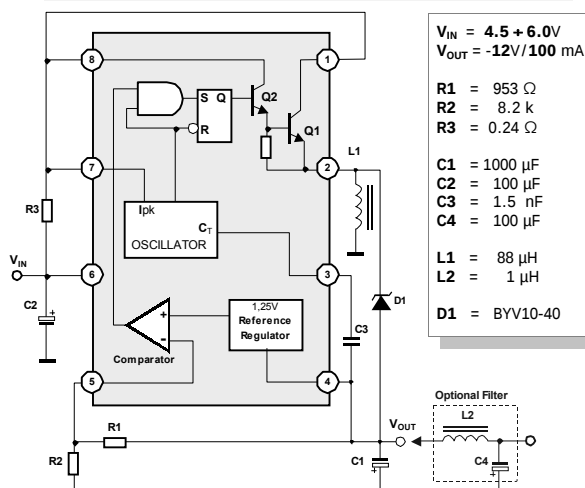


STEP-DOWN CONVERTER — Printed Demoboard

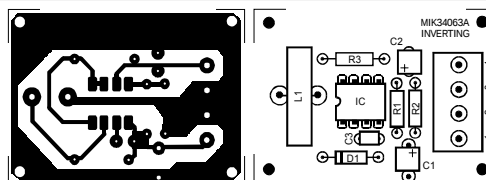
 V_{IN} = contact 1 GND = contact 2,3 V_{OUT} = contact 4

TEST	CONDITIONS	RESULTS
Line Regulation	$V_{in} = 15 \pm 25V$; $I_o = 500 mA$	12 mV = $\pm 0.12\%$
Load Regulation	$V_{in} = 25V$; $I_o = 50 \pm 500 mA$	3.0 mV = $\pm 0.03\%$
Output Ripple	$V_{in} = 25V$; $I_o = 500 mA$	120 mVpp
Short Circuit Current	$V_{in} = 25V$; $R_L = 0.1 \Omega$	1.1 A
Efficiency	$V_{in} = 25V$; $I_o = 500 mA$	83.7%
Output Ripple With Optional Filter	$V_{in} = 25V$; $I_o = 500 mA$	40 mVpp

VOLTAGE INVERTING CONVERTER



VOLTAGE INVERTING CONVERTER — Printed Demoboard

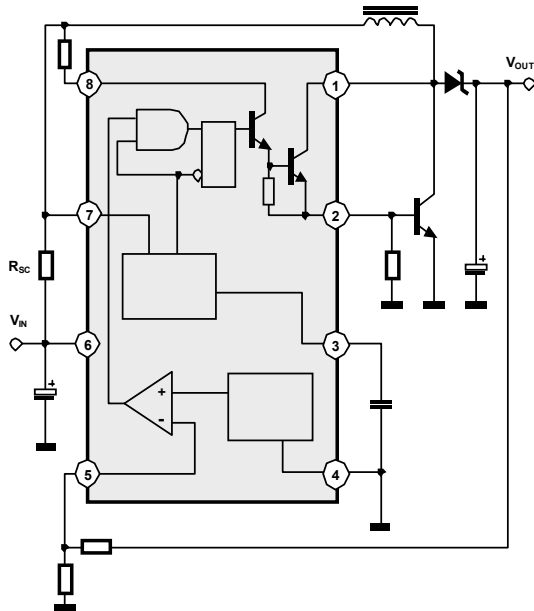
 V_{IN} = contact 1 GND = contact 2,3 V_{OUT} = contact 4

TEST	CONDITIONS	RESULTS
Line Regulation	$V_{in} = 4.5 \pm 6V$; $I_o = 100 mA$	3 mV = $\pm 0.012\%$
Load Regulation	$V_{in} = 5.0V$; $I_o = 10 \pm 100 mA$	0.022 V = $\pm 0.09\%$
Output Ripple	$V_{in} = 5.0V$; $I_o = 100 mA$	500 mVpp
Short Circuit Current	$V_{in} = 5.0V$; $R_L = 0.1 \Omega$	910 mA
Efficiency	$V_{in} = 5.0V$; $I_o = 100 mA$	62.2%
Output Ripple With Optional Filter	$V_{in} = 5.0V$; $I_o = 100 mA$	70 mVpp

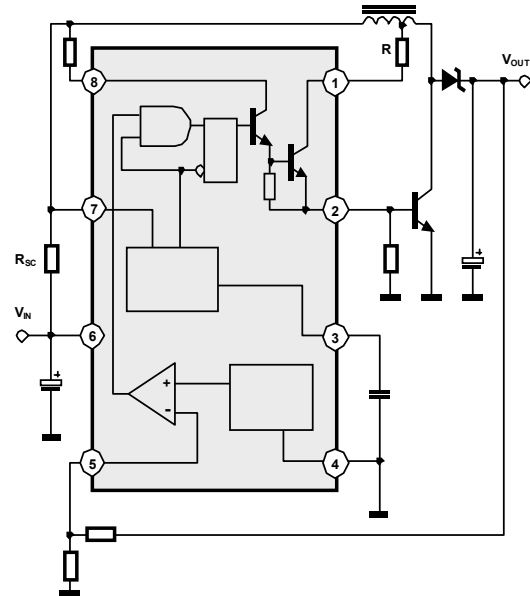


TYPICAL APPLICATION CIRCUIT (CONTINUED)

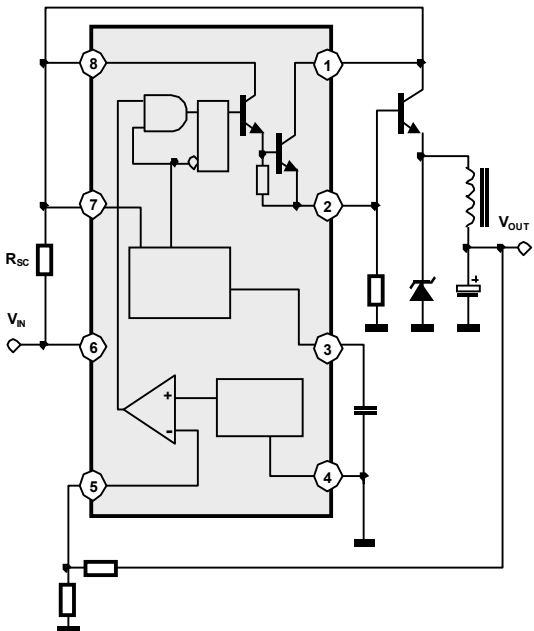
**STEP-UP with
EXTERNAL NPN SWITCH**



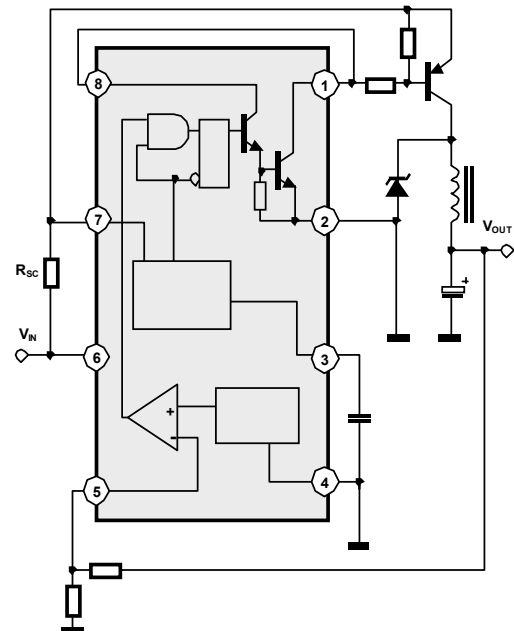
**STEP-UP with
EXTERNAL NPN SATURATED SWITCH (see Note 5)**



**STEP-DOWN with
EXTERNAL NPN SWITCH**

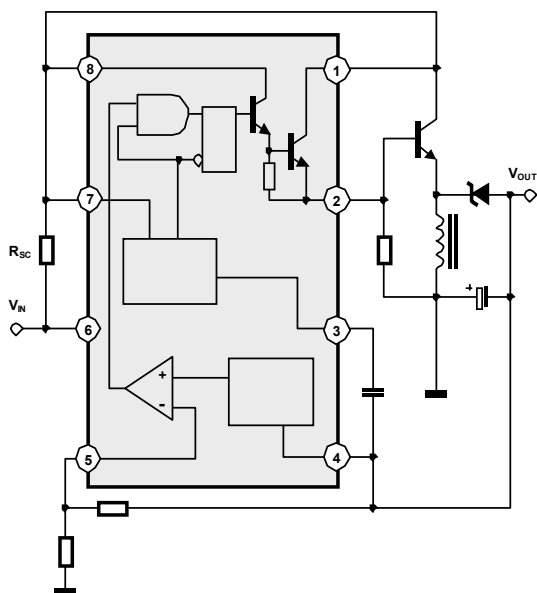
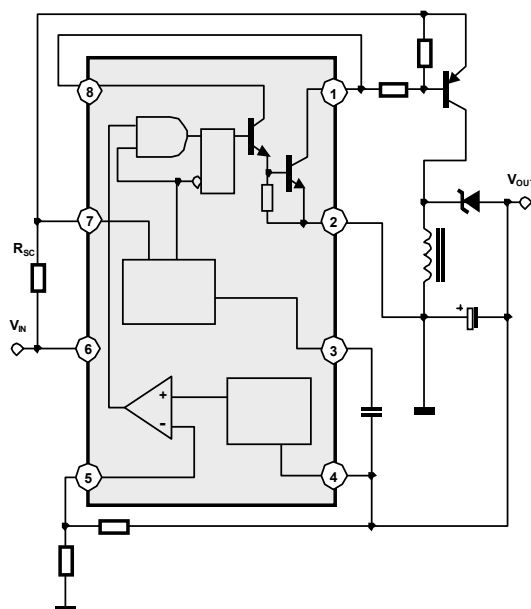


**STEP-DOWN with
EXTERNAL PNP SATURATED SWITCH**

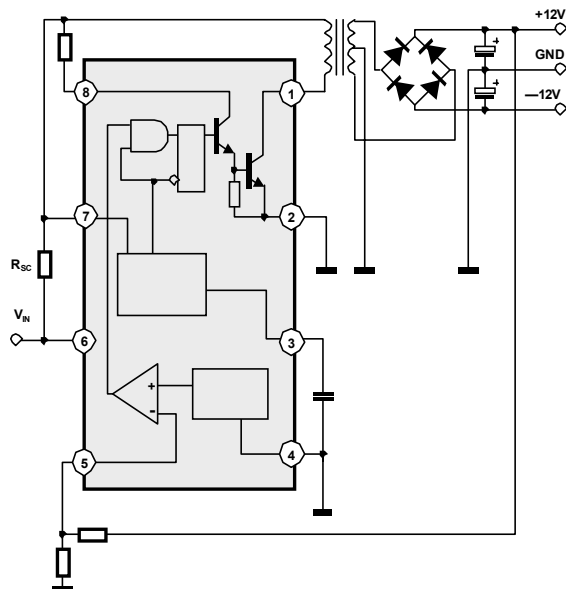
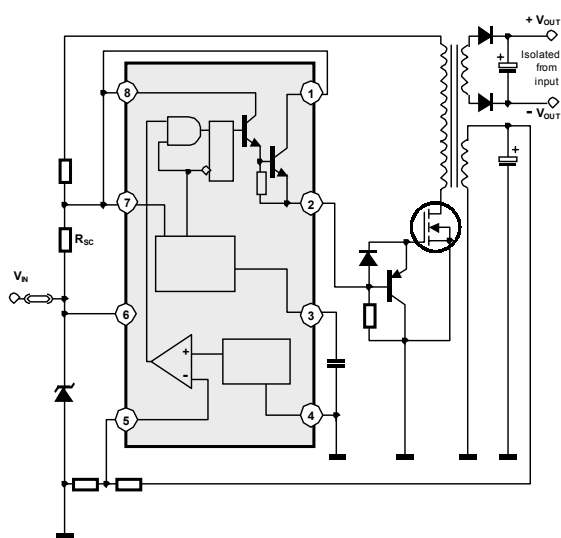




TYPICAL APPLICATION CIRCUIT (CONTINUED)

VOLTAGE INVERTING with
EXTERNAL NPN SWITCHVOLTAGE INVERTING with
EXTERNAL PNP SATURATED SWITCH

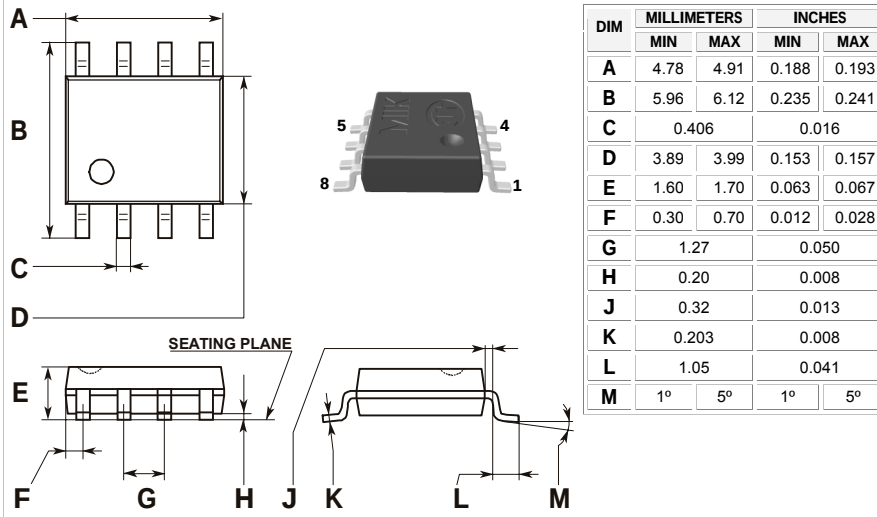
DUAL OUTPUT VOLTAGE

HIGHER OUTPUT POWER,
HIGHER INPUT VOLTAGE

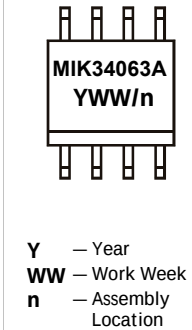


PHYSICAL DIMENSIONS AND MARKING DIAGRAMS

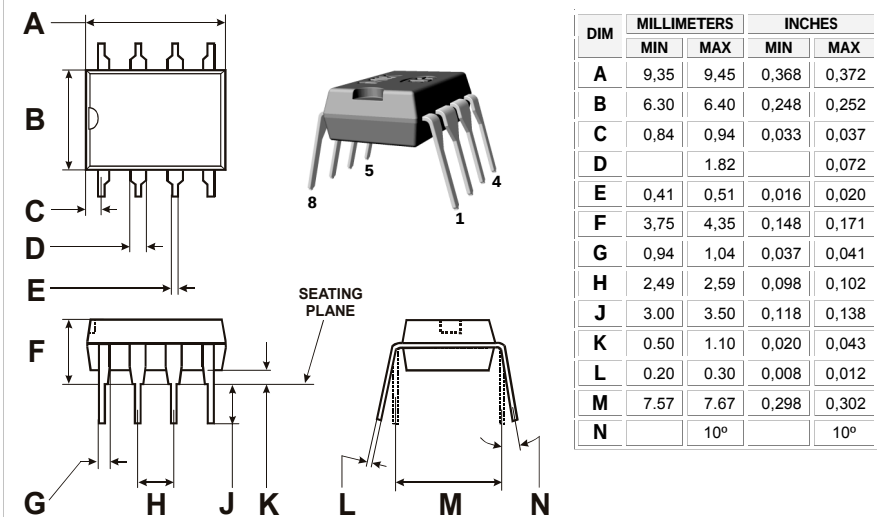
SOP-8 PACKAGE



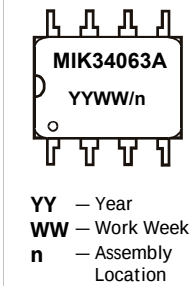
SOP-8 MARKING DIAGRAM



DIP-8 PACKAGE



DIP-8 MARKING DIAGRAM





ORDERING INFORMATION

ORDERING NUMBER	PACKAGE	OPERATING TEMPERATURE RANGE	SHIPPING
MIK34063AD	SOP-8 plastic	0°C ÷ 70°C	100 Units/Tube
MIK34063AP	DIP-8 plastic		50 Units/Tube

NOTE: The form of packing is stipulated in the contract.

The information presented in this Data sheet is believed to be accurate and reliable. Application circuits shown are typical examples illustrating the operation of the device. MIKRON can assume no responsibility for use of any application circuits.

In the interest of product improvement, MIKRON reserves the right to change specifications and data without notice.

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