DATA SHEET
MARCH 2003

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REV. 1-03

REPLACEMENT
of MC34063A

MIK34063A

DC–TO–DC CONVERTER CONTROLLER

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GENERAL DESCRIPTION

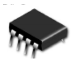
The MIK34063A is a monolithic control circuit containing the primary functions required for DC–to–DC converters. This device consist of an internal temperature compensated reference comparator, controlled duty cycle oscillator with an active current limit circuit, driver and high current output switch.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

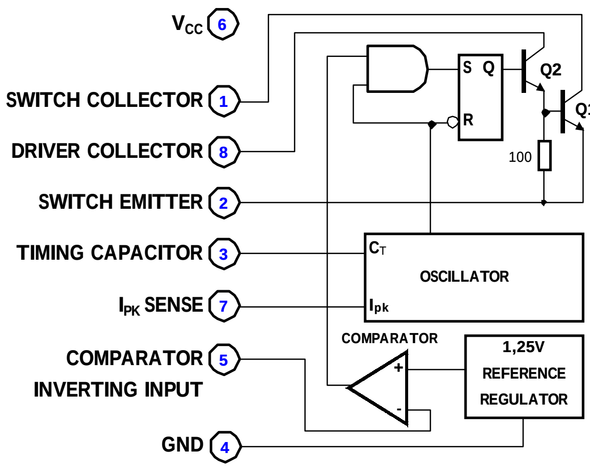
FEATURES

- 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.

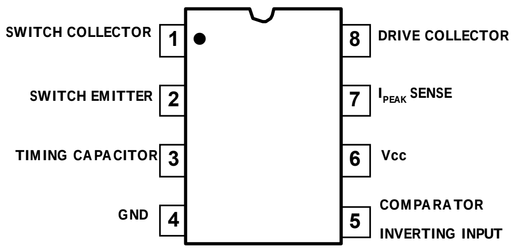
SCHEMATIC DIAGRAM

SOP-8  MIK34063AD

DIP-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} 1= 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	ºC
T_A	Operating Ambient Temperature Range	0 to 70	ºC
T_{STG}	Storage Temperature Range	-65 to 150	ºC
POWER DISSIPATION AND THERMAL CHARACTERISTICS			
DIP-8 plastic package (MIK34063AP)			
P_D	T_A = 25°C	1.25	W
$P_{\Theta JA}$	Thermal Resistance Junction-ambient (Note 2)	100	ºC/W
SOP-8 plastic package (MIK34063A)			
P_D	T_A = 25°C	0.625	W
$P_{\Theta JA}$	Thermal Resistance Junction-ambient (Note 2)	160	ºC/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 (Vpin5 = 0V; C_T = 1.0 nF; T_A = 25°C)	24	33	42	kHz
I_{CHG}	Charge Current (V_{CC} = 5.0V to 40V; T_A = 25°C)	24	35	42	µA
I_{DISCHG}	Discharge Current (V_{CC} = 5.0V to 40V; T_A = 25°C)	140	220	260	µA
I_{DISCHG}/I_{CHG}	Discharge to Charge Current Ratio (Pin 7 to V_{CC}; T_A = 25°C)	5.2	6.5	7.5	—
$V_{IPK(SENCE)}$	Current Limit Sense Voltage ($I_{CHG} = I_{DISCHG}$; T_A = 25°C)	250	300	350	mV
OUTPUT SWITCH (Note 4)					
$V_{CE(SAT)}$	Saturation Voltage. Darlington Connection (I_{SW} = 1.0 A; Pins 1. 8 connected)	—	1	1.3	V
$V_{CE(SAT)}$	Saturation Voltage (see Note 5) (I_{SW} = 1.0 A; Rpin 8 = 82Ω to V_{CC}; Forced $\beta \approx 20$)	—	0.45	0.7	V
h_{FE}	DC Current Gain (I_{SW} = 1.0 A; V_{CE} = 5.0 V; T_A = 25°C)	50	75	—	—
$I_{C(OFF)}$	Collector Off-State Current (V_{CE} = 40 V)	—	40	100	µA
COMPARATOR					
V_{TH}	Threshold Voltage				
	(T_A=25°C)	1.225	1.25	1.275	V
	($T_A = T_{LOW}$ to T_{HIGH})	1.21	—	1.29	V
Reg_{line}	Threshold Voltage Line Regulation (Vcc=3.0V to 40V)	—	1.4	5	mV
I_{IB}	Input Bias Current (V_{IN} =0 V)	—	-20	-400	nA
TOTAL DEVICE					
I_{CC}	Supply Current (V_{CC} = 5.0 V to 40 V; C_T = 1.0 nF; Pin 7 = V_{CC}; Vpin 5 > V_{TH}; Pin 2 = **GND**; remaining pins open)	—	—	4.0	mA

NOTES:

3. T_{LOW} = 0 ºC; T_{HIGH} = +70ºC.
4. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient temperature as possible.
5. If the output switch is driven into hard saturation (non–Darlington configuration) at low switch currents (≤ 300 mA) and high driver currents (≥ 30 mA), it may take up to 2.0 µs for it to come out of saturation. This condition will shorten the off time at frequencies ≥ 30 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 current switch ≈ $I_{C\ OUTPUT}$ / ($I_{C\ DRIVER}$ - 7.0 mA*) ≥ **10**

* The 100 Ω 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}	$\frac{V_{OUT} + V_F - V_{IN(MIN)}}{V_{IN(MIN)} - V_{SAT}}$	$\frac{V_{OUT} + V_F}{V_{IN(MIN)} - V_{SAT} - V_{OUT}}$	$\frac{\lvert V_{OUT} \rvert + V_F}{V_{IN} - V_{SAT}}$
$(t_{ON} + t_{OFF})_{MAX}$	$\frac{1}{f_{MIN}}$	$\frac{1}{f_{MIN}}$	$\frac{1}{f_{MIN}}$
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

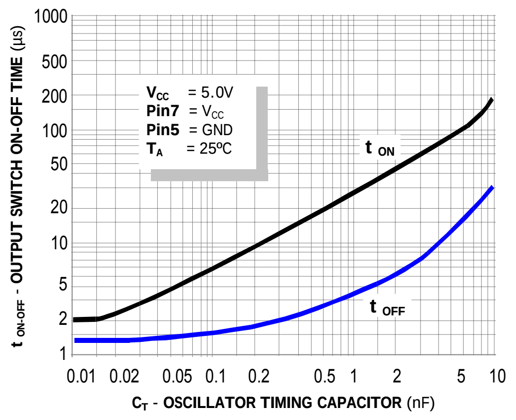
V_{SAT} = saturation voltage of the output switch.
V_F = forward voltage drop of the output rectifier.

The following power supply characteristics must be chosen:

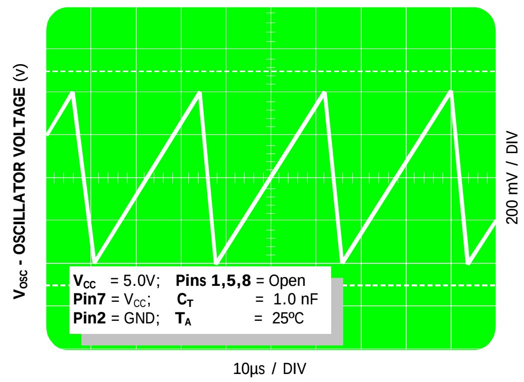
V_{IN} – nominal input voltage
V_{OUT} – desired output voltage, $\lvert V_{OUT} \rvert = 1.25 \left(1 + \frac{R2}{R1} \right)$
I_{OUT} – desired output current
f_{MIN} – minimum desired output switching frequency at the selected values of V_{IN} and I_O
$V_{RIPPLE(PP)}$ – desired peak–to–peak output 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

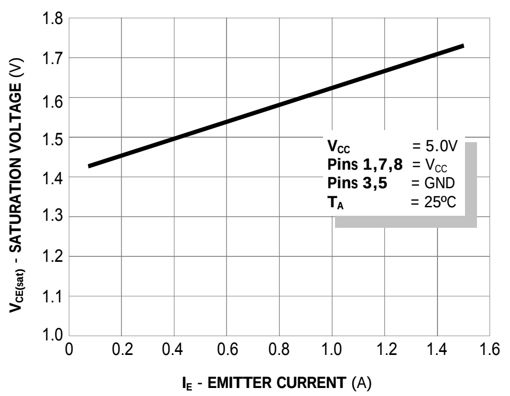
OUTPUT SWITCH ON–OFF TIME VERSUS OSCILLATOR TIMING CAPACITOR



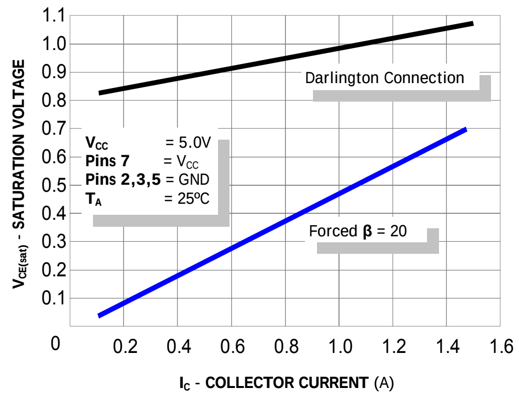
TIMING CAPACITOR WAVEFORM



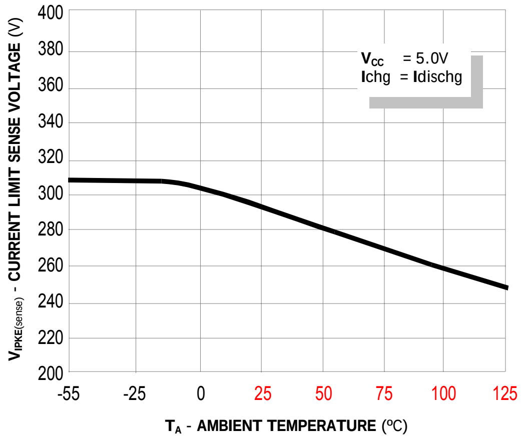
EMITTER FOLLOWER CONFIGURATION OUTPUT SATURATION VOLTAGE VERSUS EMITTER CURRENT



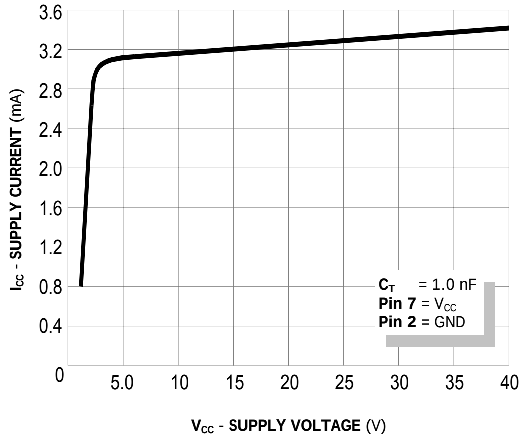
COMMON EMITTER CONFIGURATION OUTPUT SWITCH SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



CURRENT LIMIT SENSE VOLTAGE VERSUS TEMPERATURE

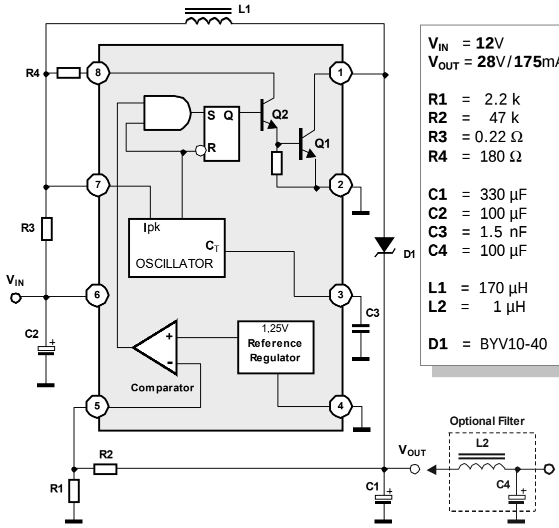


STANDBY SUPPLY CURRENT VERSUS SUPPLY VOLTAGE



TYPICAL APPLICATION CIRCUIT

STEP-UP CONVERTER



V_{IN} = **12**V
V_{OUT} = **28**V/**175**mA

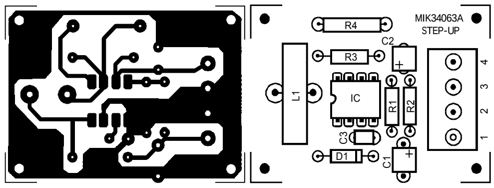
R1 = 2.2 k
R2 = 47 k
R3 = 0.22 Ω
R4 = 180 Ω

C1 = 330 µF
C2 = 100 µF
C3 = 1.5 nF
C4 = 100 µF

L1 = 170 µH
L2 = 1 µH

D1 = BYV10-40

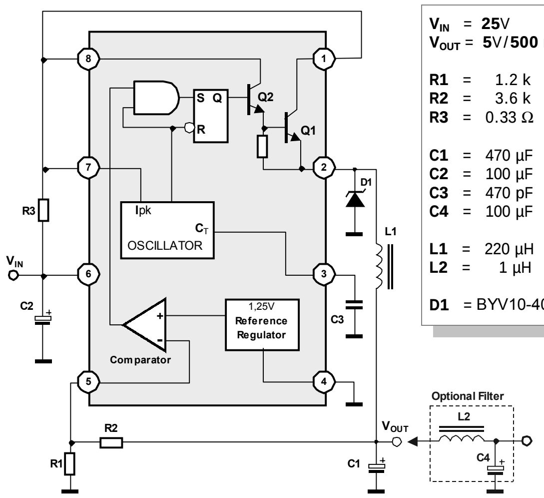
STEP-UP CONVERTER — PRINTED DEMOBOARD



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

TEST	CONDITIONS	RESULTS
Line Regulation	**Vin** = 8.0 ÷ 16 V; I_O = 175 mA	30 mV = ±0.05%
Load Regulation	**Vin** = 12 V; I_O = 75 ÷ 175 mA	10 mV = ±0.017%
Output Ripple	**Vin** = 12 V; I_O = 175 mA	400 mVpp
Efficiency	**Vin** = 12 V; I_O = 175 mA	87.7%
Output Ripple With Optional Filter	**Vin** = 12 V; I_O = 175 mA	40 mVpp

STEP-DOWN CONVERTER



V_{IN} = **25**V
V_{OUT} = **5**V/**500** mA

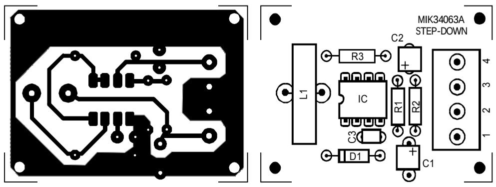
R1 = 1.2 k
R2 = 3.6 k
R3 = 0.33 Ω

C1 = 470 µF
C2 = 100 µF
C3 = 470 pF
C4 = 100 µF

L1 = 220 µH
L2 = 1 µH

D1 = BYV10-40

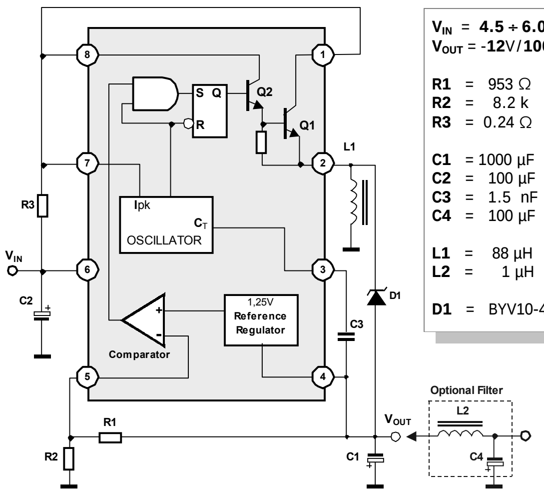
STEP-DOWN CONVERTER — Printed Demoboard



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

TEST	CONDITIONS	RESULTS
Line Regulation	**Vin** = 15 ÷ 25V; I_O = 500 mA	12 mV = ±0.12%
Load Regulation	**Vin** = 25V; I_O = 50 ÷ 500 mA	3.0 mV = ±0.03%
Output Ripple	**Vin** = 25V; I_O = 500 mA	120 mVpp
Short Circuit Current	**Vin** = 25V; R_L = 0.1 Ω	1.1 A
Efficiency	**Vin** = 25V; I_O = 500 mA	83.7%
Output Ripple With Optional Filter	**Vin** = 25V; I_O = 500 mA	40 mVpp

VOLTAGE INVERTING CONVERTER



V_{IN} = **4.5 ÷ 6.0**V
V_{OUT} = **-12**V/**100** mA

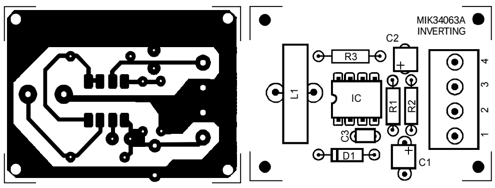
R1 = 953 Ω
R2 = 8.2 k
R3 = 0.24 Ω

C1 = 1000 µF
C2 = 100 µF
C3 = 1.5 nF
C4 = 100 µF

L1 = 88 µH
L2 = 1 µH

D1 = BYV10-40

VOLTAGE INVERTING CONVERTER — Printed Demoboard

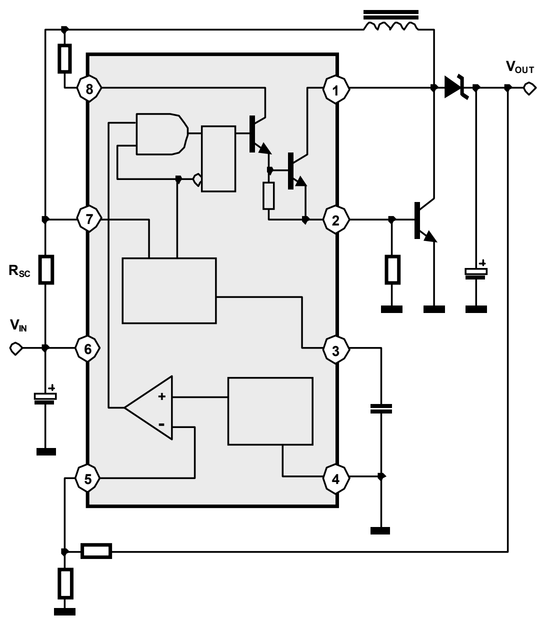


V_{IN} = contact **1** **GND** = contact 2,3 V_{OUT} = contact **4**

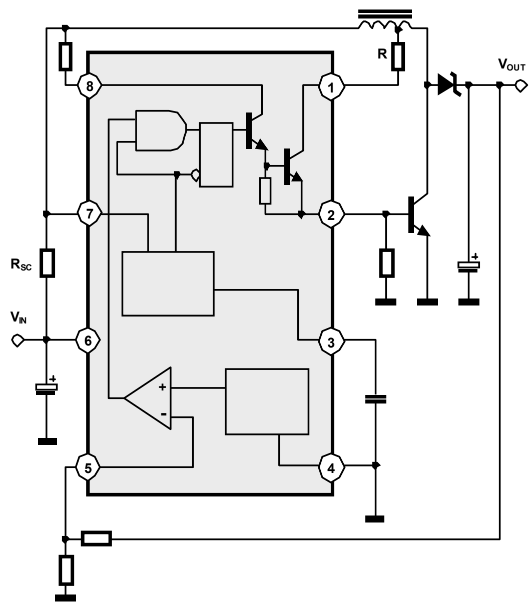
TEST	CONDITIONS	RESULTS
Line Regulation	**Vin** = 4.5 ÷ 6V; I_O = 100 mA	3 mV = ±0.012%
Load Regulation	**Vin** = 5.0V; I_O = 10 ÷ 100 mA	0.022 V = ±0.09%
Output Ripple	**Vin** = 5.0V; I_O = 100 mA	500 mVpp
Short Circuit Current	**Vin** = 5.0V; R_L = 0.1 Ω	910 mA
Efficiency	**Vin** = 5.0V; I_O = 100 mA	62.2%
Output Ripple With Optional Filter	**Vin** = 5.0V; I_O = 100 mA	70 mVpp

TYPICAL APPLICATION CIRCUIT (CONTINUED)

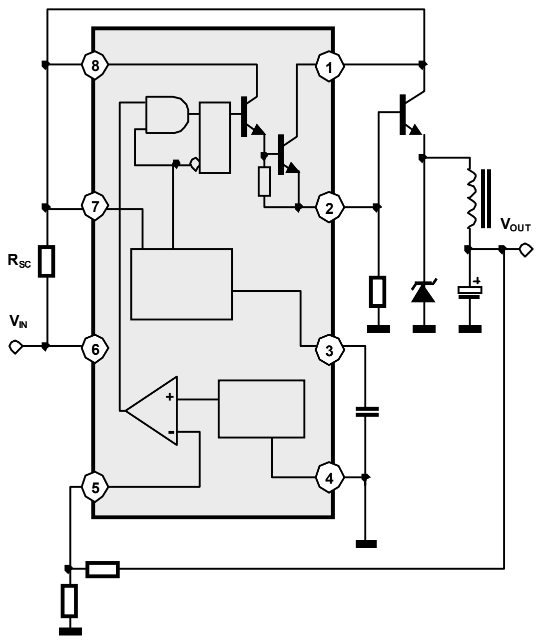
STEP-UP with EXTERNAL NPN SWITCH



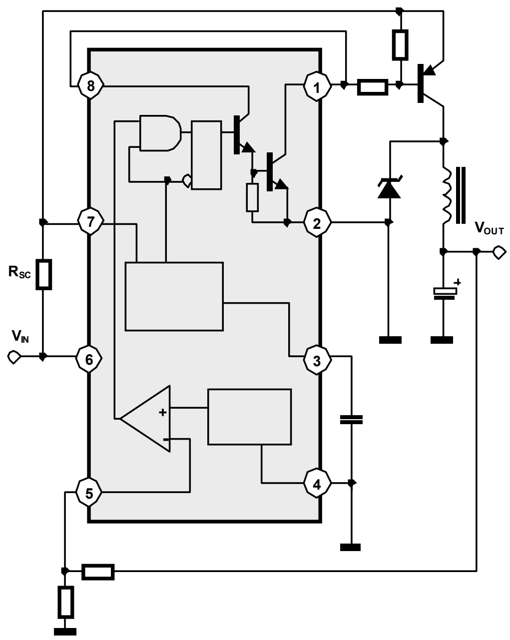
STEP-UP with EXTERNAL NPN SATURATED SWITCH (see Note 5)



STEP-DOWN with EXTERNAL NPN SWITCH

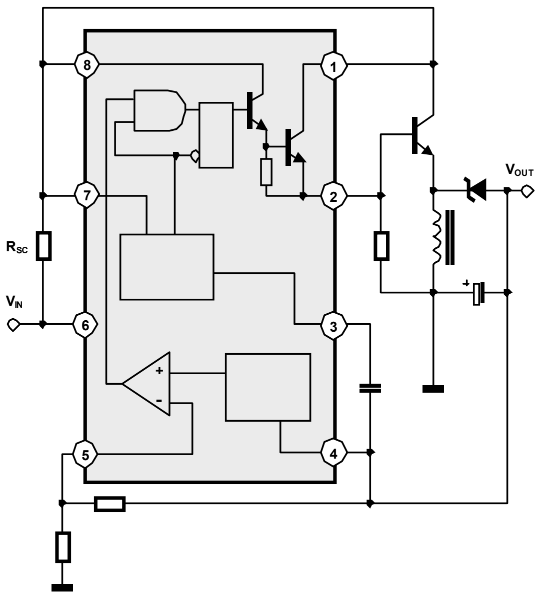


STEP-DOWN with EXTERNAL PNP SATURATED SWITCH

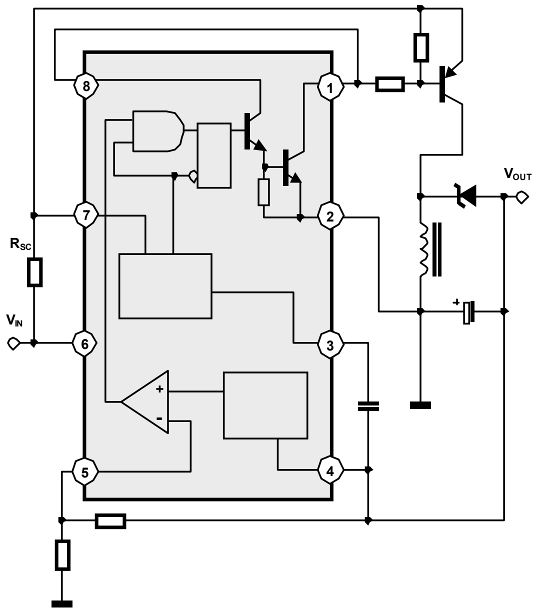


TYPICAL APPLICATION CIRCUIT (CONTINUED)

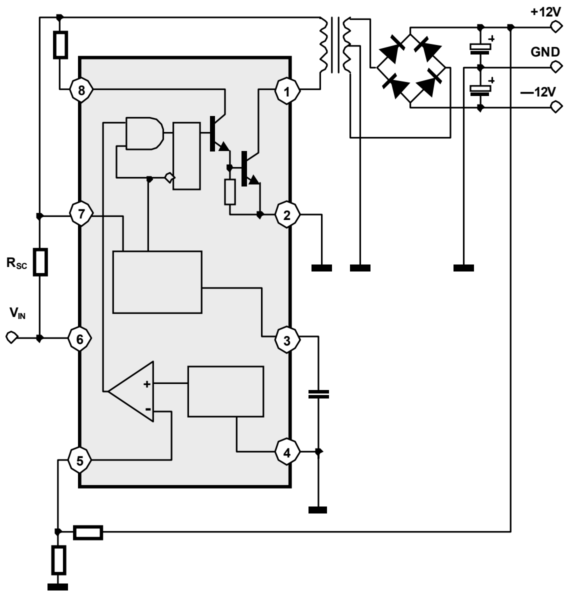
VOLTAGE INVERTING with EXTERNAL NPN SWITCH



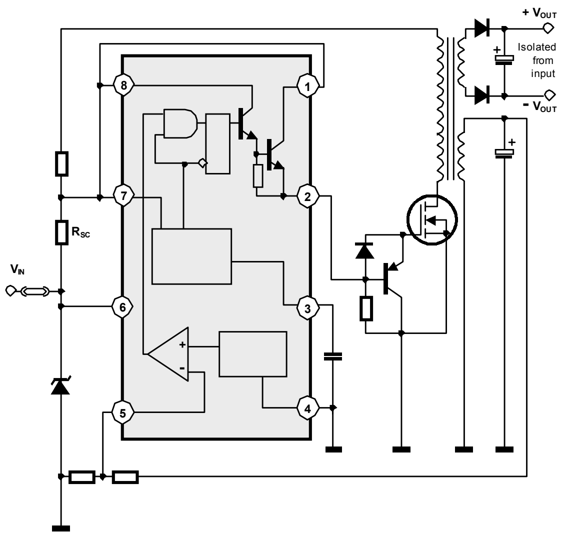
VOLTAGE INVERTING with EXTERNAL PNP SATURATED SWITCH



DUAL OUTPUT VOLTAGE

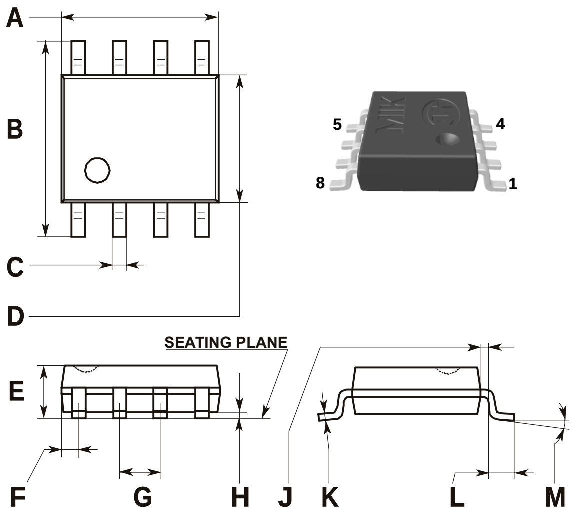


HIGHER OUTPUT POWER, HIGHER INPUT VOLTAGE



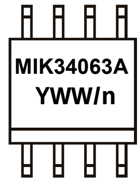
PHYSICAL DIMENSIONS AND MARKING DIAGRAMS

SOP-8
PACKAGE



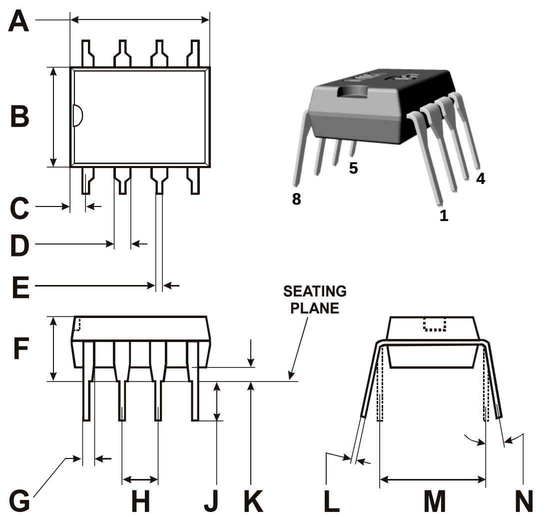
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.78	4.91	0.188	0.193
B	5.96	6.12	0.235	0.241
C	0.406		0.016	
D	3.89	3.99	0.153	0.157
E	1.60	1.70	0.063	0.067
F	0.30	0.70	0.012	0.028
G	1.27		0.050	
H	0.20		0.008	
J	0.32		0.013	
K	0.203		0.008	
L	1.05		0.041	
M	1°	5°	1°	5°

SOP-8
MARKING DIAGRAM



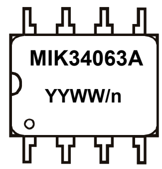
Y — Year
WW — Work Week
n — Assembly Location

DIP-8
PACKAGE



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9,35	9,45	0,368	0,372
B	6.30	6.40	0,248	0,252
C	0,84	0,94	0,033	0,037
D		1.82		0,072
E	0,41	0,51	0,016	0,020
F	3,75	4,35	0,148	0,171
G	0,94	1,04	0,037	0,041
H	2,49	2,59	0,098	0,102
J	3.00	3.50	0,118	0,138
K	0.50	1.10	0,020	0,043
L	0.20	0.30	0,008	0,012
M	7.57	7.67	0,298	0,302
N		10°		10°

DIP-8
MARKING DIAGRAM



YY — Year
WW — Work Week
n — Assembly Location

ORDERING INFORMATION

ORDERING NUMBER	PACKAGE	OPERATING TEMPERATURE RANGE	SHIPPING
MIK34063A**D**	SOP-8 plastic	0°C ÷ 70°C	100 Units/Tube
MIK34063A**P**	DIP-8 plastic		50 Units/Tube

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

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