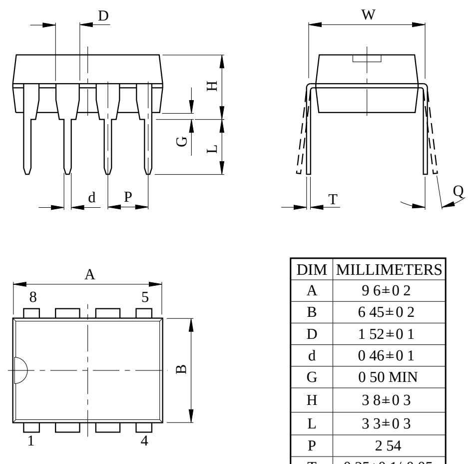
DC/DC Converter Controller

The FAC34063AP/AF series 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 or Step-Up or Voltage-Inverting applications with a minimum number of external components.

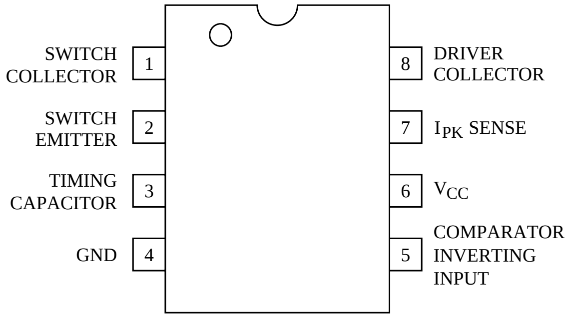


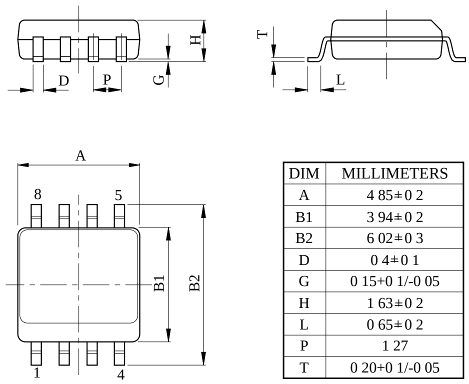
DIM	MILLIMETERS
A	9 6±0 2
B	6 45±0 2
D	1 52±0 1
d	0 46±0 1
G	0 50 MIN
H	3 8±0 3
L	3 3±0 3
P	2 54
T	0 25+0 1/-0 05
W	7 62
Q	0 - 15°

DIP-8

FEATURES

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



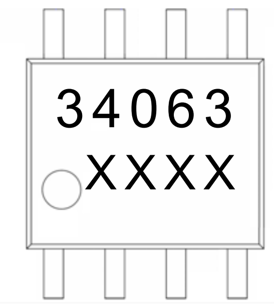


DIM	MILLIMETERS
A	4 85±0 2
B1	3 94±0 2
B2	6 02±0 3
D	0 4±0 1
G	0 15+0 1/-0 05
H	1 63±0 2
L	0 65±0 2
P	1 27
T	0 20+0 1/-0 05

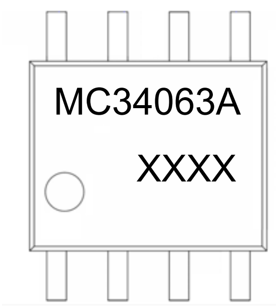
SOP-8

Mark specifications by factory

The First Factory



The second factory

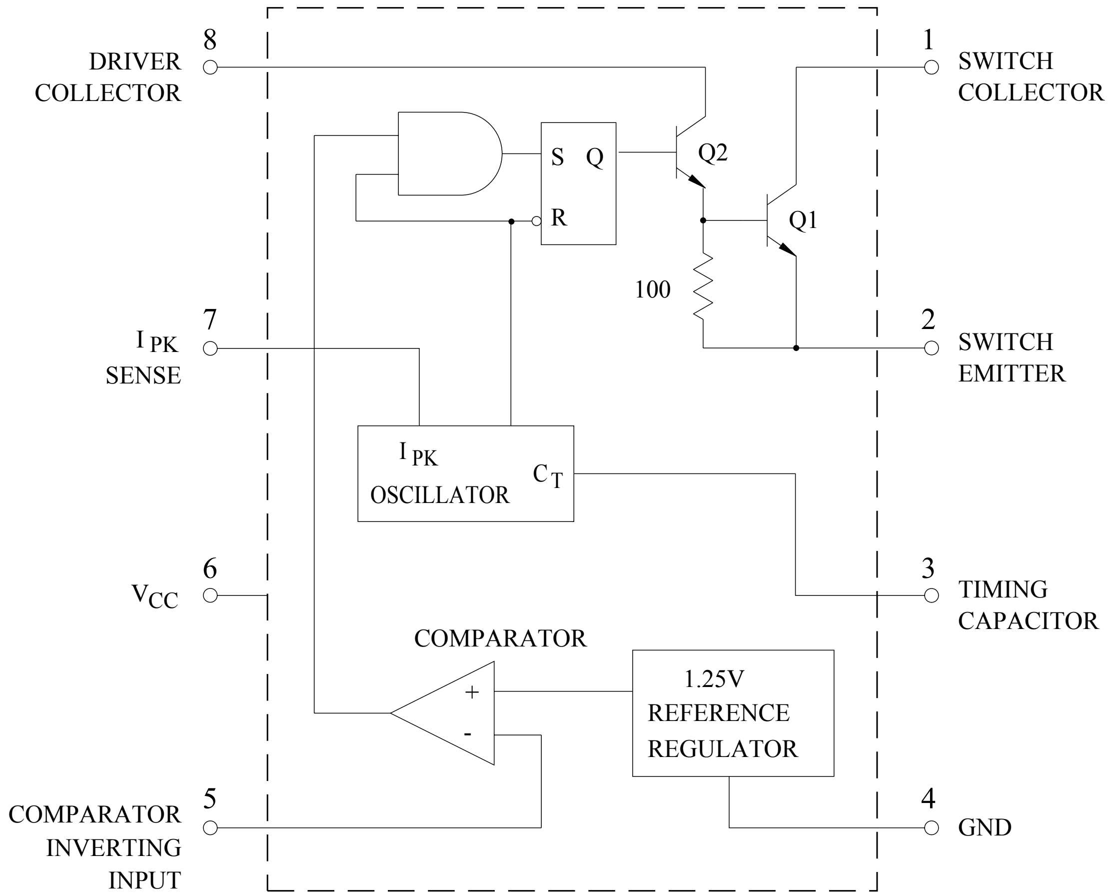


MAXIMUM RATINGS (Ta=25℃)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Power Supply Voltage		V_{CC}	40	V
Comparator Input Voltage Range		V_{IR}	-0.3 ~ 40	V
Switch Collector Voltage		$V_{C(SWITCH)}$	40	V
Switch Emitter Voltage (V_{PIN1}=40V)		$V_{E(SWITCH)}$	40	V
Switch Collector to Emitter Voltage		$V_{CE(SWITCH)}$	40	V
Driver Collector Voltage		$V_{C(DRIVER)}$	40	V
Driver Collector Current (Note 1)		$I_{C(DRIVER)}$	100	mA
Switch Current		I_{SW}	1.5	A
Power Dissipation	FAC34063AP	P_D	500	mW
	FAC34063AF		320	
Operating Temperature		T_{opr}	-40 ~ 85	℃
Storage Temperature		T_{stg}	-65 ~ 150	℃

Note 1) Maximum package power dissipation limits must be observed.

BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS (V_{CC}=5.0V, Ta=25℃, unless otherwise specified)

OSCILLATOR SECTION

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Frequency	f_{OSC}	V_{PIN5}=0V, C_T=1.0nF	24	33	42	kHz
Charge Current	I_{CHG}	V_{CC}=5.0～40V	24	33	42	μA
Discharge Current	I_{DISCHG}	V_{CC}=5.0～40V	140	200	260	μA
Discharge to Charge Current Ratio	I_{DISCHG}/I_{CHG}	Pin 7～V_{CC}	5.2	6.5	7.5	-
Current Limit Sense Voltage	$V_{IPK(SENSE)}$	I_{DISCHG}=I_{CHG}	250	300	350	mV

OUTPUT SWITCH SECTION (Note 2)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Saturation Voltage, Darlington Connection	$V_{CE(SAT1)}$	I_{SW}=1.0A, Pins 1, 8 Connection	-	1.0	1.3	V
Saturation Voltage (Note 3)	$V_{CE(SAT2)}$	I_{SW}=1.0A, Forced $\beta = \simeq 20$ R_{PIN8}=82 Ω to V_{CC}	-	0.45	0.7	V
DC Current Gain	h_{FE}	I_{SW}=1.0A, V_{CE}=5.0A,	50	120	-	-
Collector Off-State Current	$I_{C(OFF)}$	V_{CE}=40V	-	0.01	100	μA

COMPARATOR SECTION

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Threshold Voltage	V_{TH1}	Ta=25℃	1.225	1.25	1.275	V
Threshold Voltage	V_{TH2}	Ta=T_{LOW} ~T_{HIGH}	1.21	-	1.29	V
Threshold Voltage Line Regulation	Reg line	V_{CC}=3.0～40V	-	1.4	5.0	mV
Input Bias Current	I_{IB}	V_{IN}=0	-	-40	-400	nA

TOTAL DEVICE

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{CC}	V_{CC}=5.0～40V, C_T=1.0nF, Pin 7=V_{CC}, Pin 2=GND, V_{PIN5}>V_{TH}, remaining pins open	-	2.5	4.0	mA

Note) 2. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient temperature as possible.

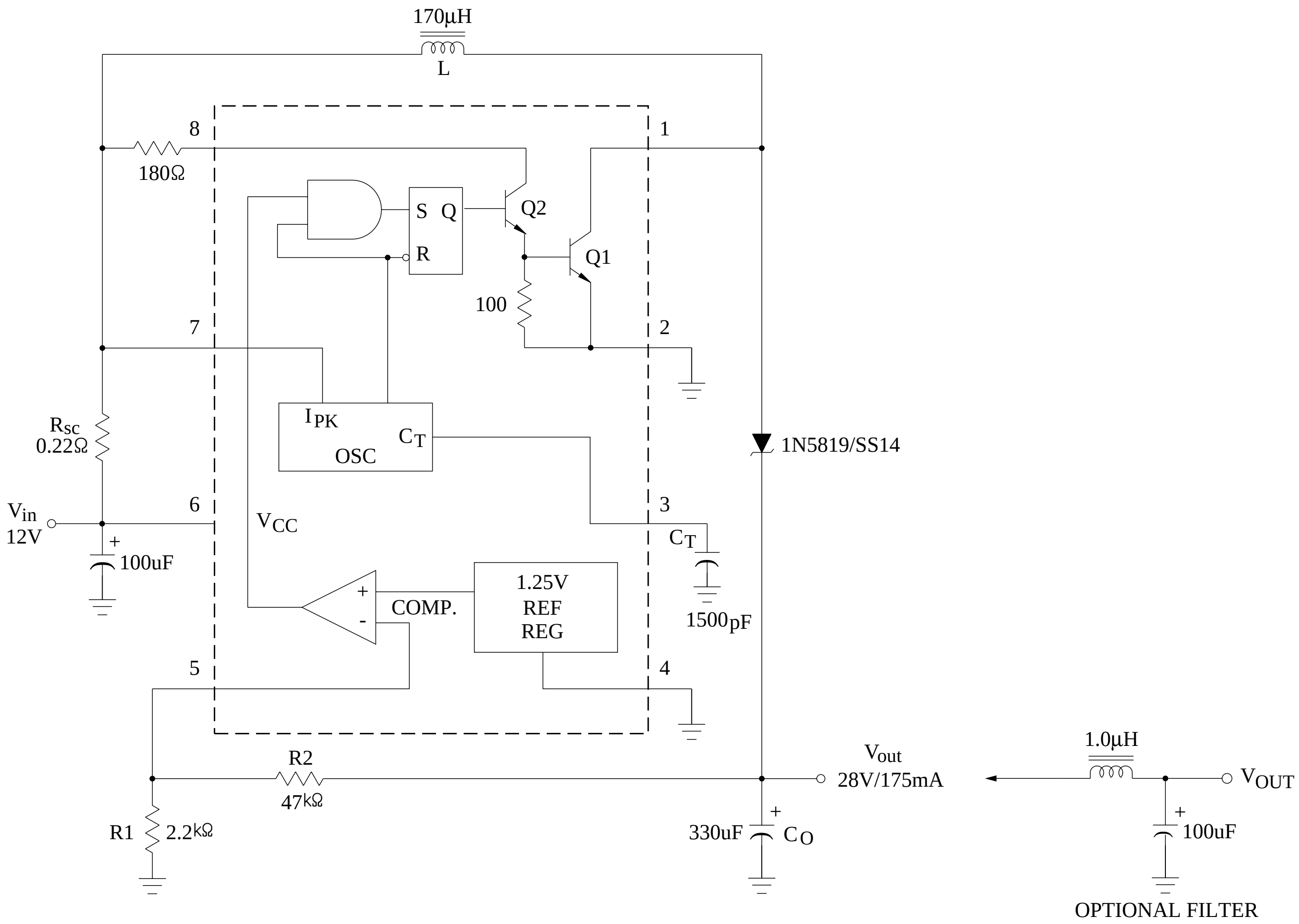
3. If the output switch is driven into hard saturation (non-Darlington configuration) at low switch currents (≤ 300mA) and high driver currents (≥ 30mA), it may take up to 2.0μS for it to come out of saturation. This condition will shorten the off time at frequencies ≥30kHz, and is magnified at high 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 ;

$$\text{Forced} \quad \text{of output switch :} \ \frac{I_C \text{ output}}{I_C \text{ driver-7.0mA *}} \geq 10$$

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

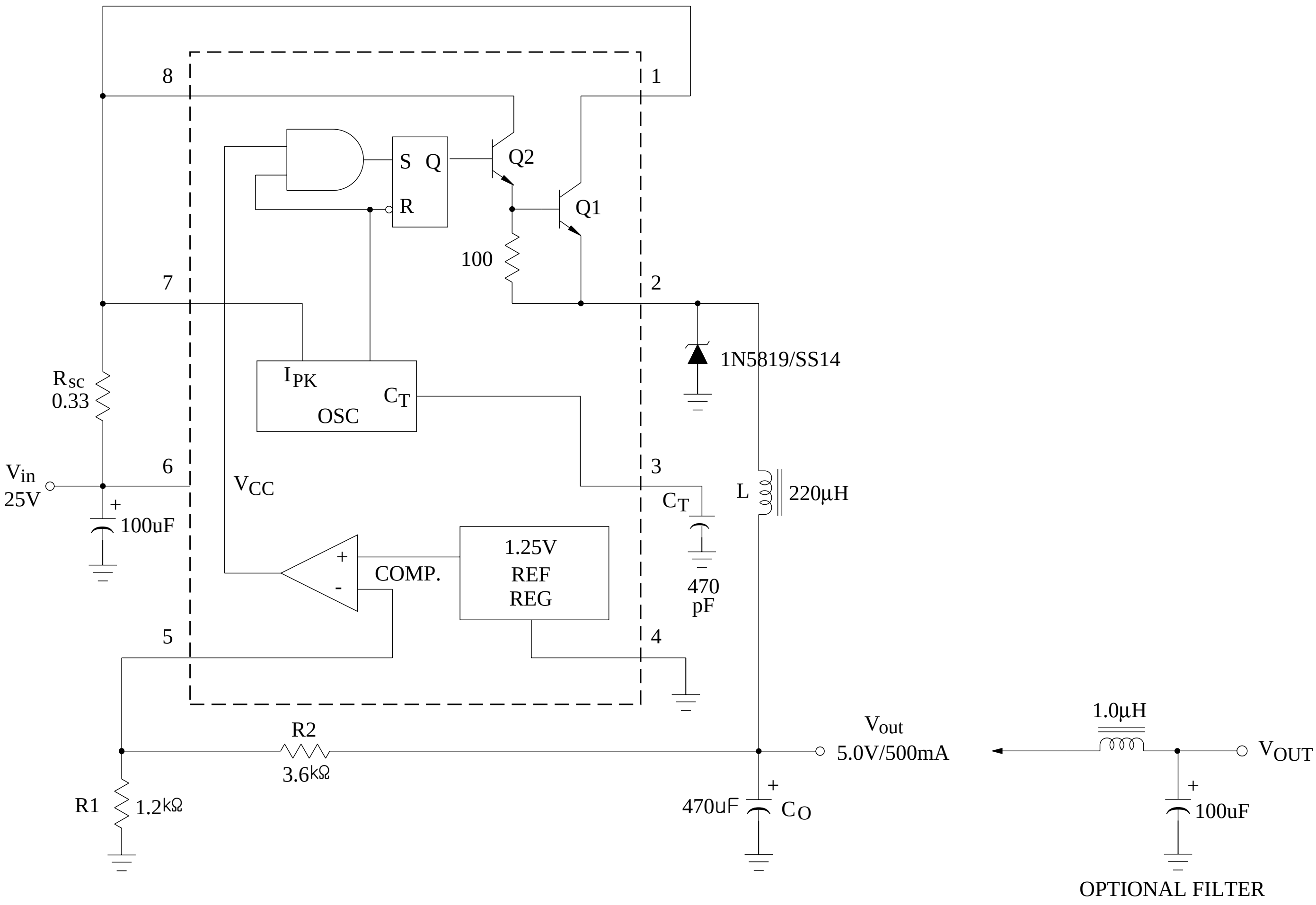
APPLICATION CIRCUIT

(1) Step-up Converter



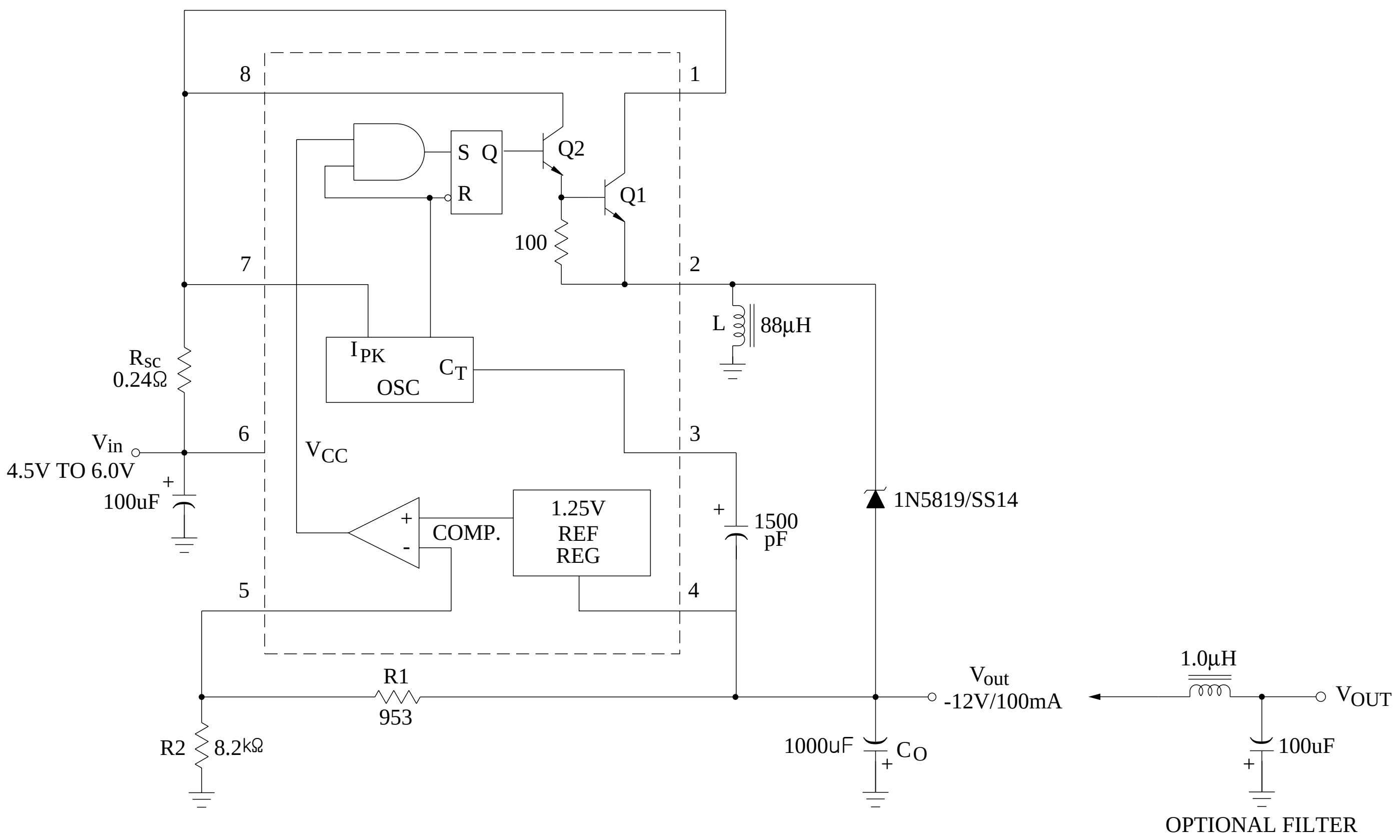
TEST	CONDITIONS	RESULTS
Line Regulation	V_{IN}=8.0V to 16V, I_O=175mA	30mV= ±0.05%
Load Regulation	V_{IN}=12V, I_O=75mA to 175mA	10mV= ±0.017%
Output Ripple	V_{IN}=12V, I_O=175mA	300 mVpp
Efficiency	V_{IN}=12V, I_O=175mA	89%

(2) Step-Down Converter



TEST	CONDITIONS	RESULTS
Line Regulation	V_{IN}=15V to 25V, I_O=500mA	5mV
Load Regulation	V_{IN}=25V, I_O=50mA to 500mA	3.0mV
Output Ripple	V_{IN}=25V, I_O=500mA	100 mVpp
Short Circuit Current	V_{IN}=25V, R_L=0.1Ω	1.2A
Efficiency	V_{IN}=25V, I_O=500mA	80%

(2) Voltage Inverting Converter



TEST	CONDITIONS	RESULTS
Line Regulation	V_{IN}=4.5V to 6.0V, I_O=100mA	3.0mV= ±0.012%
Load Regulation	V_{IN}=5.0V, I_O=10mA to 100mA	0.022V= ±0.09%
Output Ripple	V_{IN}=5.0V, I_O=100mA	500 mVpp
Short Circuit Current	V_{IN}=5.0V, R_L=0.1Ω	0.9A
Efficiency	V_{IN}=5.0V, I_O=100mA	58%

Calculation

Parameter	Step-Up (Discontinuous mode)	Step-Down (Continuous mode)	Voltage Inverting (Discontinuous mode)
t_{on}/t_{off}	$\frac{V_{out}+V_F-V_{in(min)}}{V_{in(min)}-V_{sat}}$	$\frac{V_{out}+V_F}{V_{in(min)}-V_{sat}-V_{out}}$	$\frac{\lvert V_{out}\rvert+V_F}{V_{in}-V_{sat}}$
$(t_{on}+t_{off})max$	$1/f_{min}$	$1/f_{min}$	$1/f_{min}$
C_T	$4.5x10^{-5}t_{on}$	$4.5x10^{-5}t_{on}$	$4.5x10^{-5}t_{on}$
$I_{PK(switch)}$	$2I_{out(max)}[(t_{on}/t_{off})+1]$	$2I_{out(max)}$	$2I_{out(max)}[(t_{on}/t_{off})+1]$
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, $\lvert V_{out}\rvert = 1.25(1+R_2/R_1)$

I_{out} = Desired output current

fmin = Minimum desired output switching frequency at the selected values of Vin and lo

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.