AT7174

1.25MHz, 4A, High Efficiency PWM Step-Down DC/DC Converter

Immense Advance Tech.

FEATURES

- 2.7V to 5.5V Input Voltage Range
- All Ceramic Capacitor Design
- High Efficiency：Up to 95%
- 1.25MHz Constant Switching Frequency
- 4A Available Load Current
- 100% Duty Cycle Low Dropout Operation
- Current Mode Control
- Short Circuit Protection
- Thermal Fault Protection
- Compact package: TDFN3X3 -10L

APPLICATION

- Set Top Box
- Microprocessor care supply
- LCD TV
- Access-Point Router
- Network Cards
- Mini-notebook PC
- Tablet PC

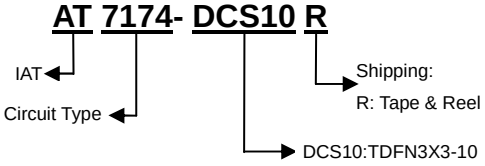
DESCRIPTION

The AT7174 is a 4A synchronous step-down regulator designed to operate with an input voltage range of 2.7V to 5.5V. The device requires only three external filter components for a complete a step down regulator solution. The internal switch and synchronous rectifier are integrated for high efficiency.

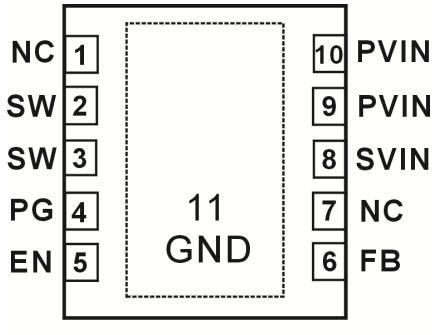
The switching frequency is set at 1.25MHz, allowing the use of the small surface mount inductors and capacitors. It can run 100% duty cycle for low dropout application.

The AT7174 is available in a thermally-enhanced, 3mm x 3mm x 0.6mm TDFN-3x3-10L Package and has a rated temperature range of -40 to 85℃.

ORDER INFORMATION



PIN CONFIGURATIONS (TOP VIEW)



TDFN3x3-10

PIN DESCRIPTIONS

Pin Symbol	Pin Description
SW	Switch Output. Connect this pin to the switching end of the inductor.
PG	Power Good Indicator. Pull-High Resistor is Needed.
EN	On/Off Control Input. Pull EN above 1.5V to turn the device on.
FB	Feedback Input. Connect FB to the center point of the external resistor divider. The feedback threshold voltage is 0.6V.
SVIN	Signal Input. Drive 2.7V to 5.5V voltage to this pin to power on this chip. Connecting a 1uF(min) ceramic bypass capacitor between SVIN and GND to eliminate noise.
PVIN	Power Supply Input. Drive 2.7V to 5.5V voltage to this pin to power on this chip. Connecting a 10uF(min) ceramic bypass capacitor between PVIN and GND to eliminate noise.
GND	Ground. This pin is the voltage reference for the regulated output voltage. For this reason care must be taken in its layout.
NC	No connection

TYPICAL APPLICATION CIRCUITS

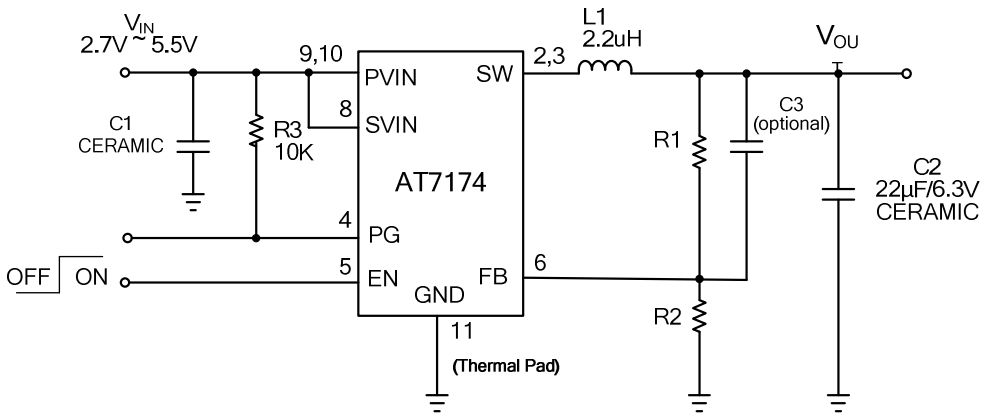
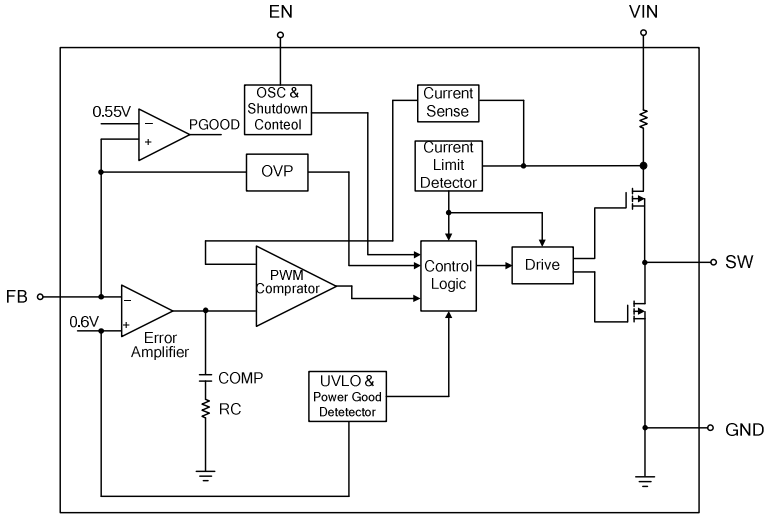


Figure 1 Typical Application Circuit

V_{OUT}	C1	R1	R2	C3	L1
3.3V	22uF*2	30K	6.8K	Optional	2.2uH
2.5V	22uF	15K	4.7K	Optional	2.2uH
1.8V	22uF	20K	10K	Optional	2.2uH
1.2V	10uF	10K	10K	Optional	2.2uH
1.0V	10uF	10K	15K	Optional	2.2uH

Table 1 Recommended Component Selection

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (Note 1)

Parameter	Symbol	Max Value	Unit
Supply Voltage	V_{IN}	6	V
Switching Voltage	V_{SW}	-0.3 to V_{IN} + 0.3	V
All Other Pins		-0.3V to 6	V
Junction Temperature	T_J	150	℃
Storage Temperature Range	T_{STG}	-65 to +150	℃
Thermal Resistance	Θ_{JA}	70	℃/ W
Thermal Resistance	Θ_{JC}	8	℃/ W
ESD Rating (Human Body Model) (Note 2)	V_{ESD}	2	kV

RECOMMENDED OPERATING CONDITIONS (Note 3)

Parameter	Symbol	Operation Conditions	Unit
Lead Temperature(Soldering) 5 Sec.	T_{LEAD}	260	℃
Supply Voltage, V_{IN}	V_{IN}	2.7 to 5.5	V
Output Voltage, V_{OUT}	V_{OUT}	0.6 to 5	V
Operating Junction Temperature Range	T_J	-40 to +125	℃
Operating Ambient Temperature Range	T_A	-40 to +85	℃
Power Dissipation, P_D @ T_A=25℃	P_D	1.43	W

Note 1: Stresses listed as the above “Absolute Maximum Ratings” may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

Note 2: Devices are ESD sensitive. Handling precaution recommended.

Note 3: The device is not guaranteed to function outside its operating conditions.

ELECTRICAL CHARACTERISTICS

V_{IN}=5V, T_a=25℃, unless otherwise specified

Function Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Regulated FB Voltage	V_{FB}		0.588	0.6	0.612	V
FB Input Current	I_{FB}	V_{FB} = 0.65V	-50	—	50	nA
Input Voltage Range	V_{IN}		2.7	—	5.5	V
Quiescent Current	I_Q	V_{EN} = V_{IN} ,V_{FB} = 0.65V	—	550	—	μA
Shutdown Current	I_S	V_{EN} = 0V , V_{IN} = 5.5V	—	0.1	1	μA
IN Under Voltage Lockout Threshold	UVLO	Rising Edge	—	2.2	—	V
IN Under Voltage Lockout Hysteresis			—	0.2	—	V
PFET On Resistance	R_{PFET}	I_{SW} = 200mA	—	0.085	—	Ω
NFET On Resistance	R_{NFET}	I_{SW} = 200mA		0.065		Ω
SW Leakage Current	I_{LEAK}		-1	—	1	μA
PFET Current Limit	I_{LIMIT}	Duty Cycle = 100%, Current Pulse Width < 1ms	4.5	5	—	A
Oscillator Frequency	Fsw	V_{IN} = 3.6V, I_{OUT} = 30mA	1	1.25	1.5	MHz
Maximum Duty Cycle	DC_{MAX}		—	100	—	%
Minimum On-Time		T_{ON}	—	80	—	nS
Thermal Shutdown Trip Threshold	T_{SD}		—	150	—	℃
EN High-Level Input Voltage	V_{EN-HI}	-40°C≦T_A≦85°C	1.5	—	—	V
EN Low-Level Input Voltage	V_{EN-LO}		—	—	0.4	V
EN Input Current	I_{EN}	V_{EN} = 0V to 5.5V	-1	—	1	μA

APPLICATION INFORMATION

Setting Output Voltage

The external resistor divider sets the output voltage. The feedback resistor R1 also sets the feedback loop bandwidth with the internal compensation capacitor. The recommended R2 value is below 10Kohm. Table 1 shows a list of resistor selection for common output voltages

$$Vout = 0.6 \times \left[1 + \frac{R1}{R2}\right] V$$

Selecting the Inductor

A 1μH to 10μH inductor with DC current rating at least 25% higher than the maximum load current is recommended for most applications. For best efficiency, the inductor DC resistance shall be <200mΩ.

For most designs, the required inductance value can be derived from the following equation.

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times F_{SW}}$$

Where ΔIL is the inductor ripple current. Choose inductor ripple current approximately 30% of the maximum load current, 1.0A.

The maximum inductor peak current is:

$$I_{L(MAX)} = I_{LOAD} + \frac{\Delta I_L}{2}$$

Under light load conditions below 100mA, larger inductance is recommended for improved efficiency.

Selecting the Input Capacitor

With the maximum ripple current through input capacitor is about 1.5 Arms, a typical X7R or better grade ceramic capacitor with 6V rating and greater than 22uF capacitance can handle this ripple current well. To minimize the potential noise problem, place this ceramic capacitor really close to the IN and GND pins. Care should be taken to minimize the loop area formed by CIN, and IN/GND pins.

Selecting the Output Capacitor

The output capacitor is selected to handle the output ripple noise requirements. Both steady state ripple and transient requirements must be taken into consideration when selecting this capacitor. For the best performance, it is recommended to use X7R or better grade ceramic capacitor with 6V rating and greater than 40uF capacitance.

The output ripple ΔVOUT is approximately:

$$\Delta V_{OUT} \le \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times F_{SW} \times L} \times \left[ESR + \frac{1}{8 \times F_{SW} \times C_2}\right]$$

PCB Layout Recommendation

1. The high current paths (GND, VIN and SW) should be placed very close to the device with short, direct and wide traces.
2. Place the input capacitors, output capacitors as close to the device as possible. Trace to these capacitors should be as short and wide as possible to minimize parasitic inductance and resistance.
3. Place VIN bypass capacitors close to the VIN and GND pin.
4. The external feedback resistors shall be placed

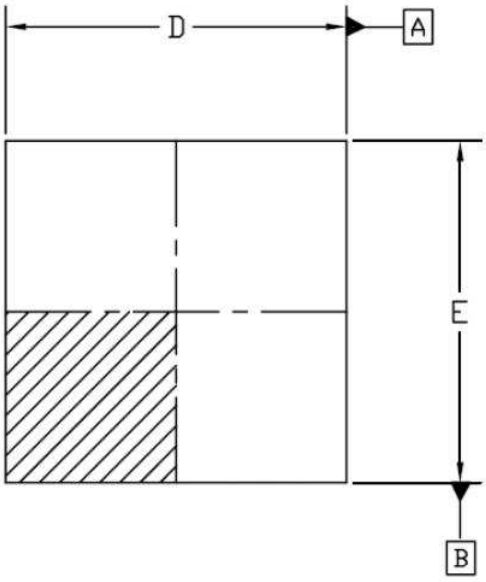
next to the FB pin.

5. Keep the switching node SW short and away from the feedback network.

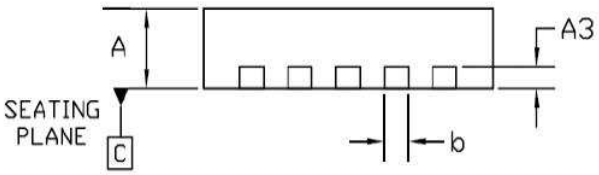
6. If the system chip interfacing with the EN pin has a high impedance state at shutdown mode and the IN pin is connected directly to a power source such as a Li Ion battery, it is desirable to add a pull down 1Mohm resistor between the EN and GND pins to prevent the noise from falsely turning on the regulator at shutdown mode.

PACKAGE OUTLINE DIMENSIONS
TDFN3X3-10 PACKAGE OUTLINE DIEMNSIONS

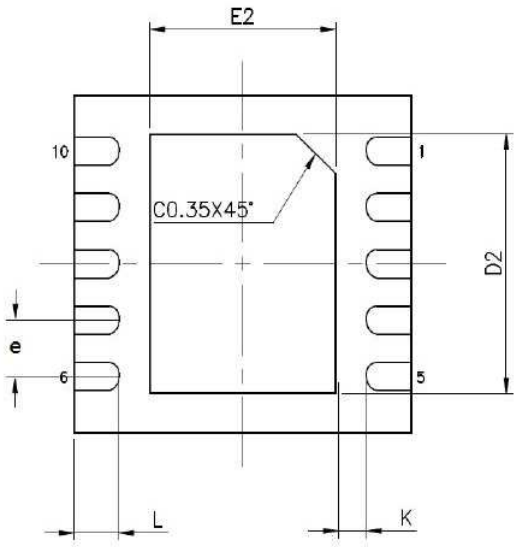
Top View



Side View



Bottom View



UNIT:mm

SYMBOLS	Min	Typ	Max
A	0.70	0.75	0.80
A3	-----	0.203	-----
b	0.20	0.25	0.30
D	2.85	3.00	3.15
D2	2.25	2.35	2.45
E	2.85	3.00	3.15
E2	1.5	1.60	1.70
e	-----	0.50	-----
L	0.35	0.40	0.45
K	0.2	-----	-----