DATA SHEET IC W373

1MHz, High Efficiency, Step-Up Converter with Internal FET Switch

Features

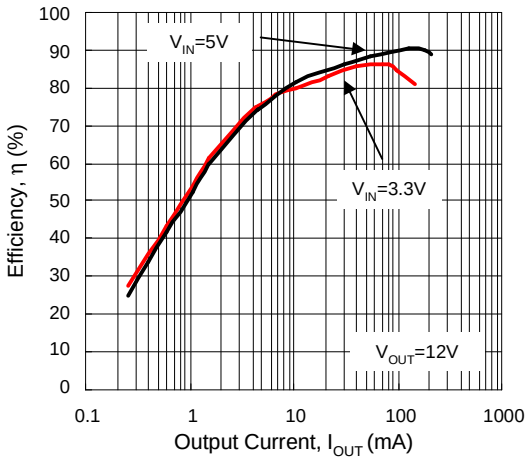
- Wide 2.5V to 6V Input Voltage Range
- Built-in 0.6Ω N-Channel MOSFET
- Built-in Soft-Start
- High Efficiency up to 90%
- <1μA Quiescent Current During Shutdown
- Current-Mode Operation
  - Stable with Ceramic Output Capacitors
  - Fast Transient Response
- Current-Limit Protection
- Over-Temperature Protection with Hysteresis
- Available in a Tiny 5-Pin SOT-23 and TSOT-23 Packages
- Lead Free and Green Devices Available (RoHS Compliant)

Applications

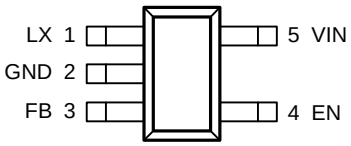
- Cell Phone and Smart Phone
- PDA, PMP, MP3
- Digital Camera
- Boost Regulators

General Description

The APW7137 is a fixed switching frequency (1MHz typical), current-mode, step-up regulator with an integrated N-channel MOSFET. The device allows the usage of small inductors and output capacitors for portable devices. The current-mode control scheme provides fast transient response and good output voltage accuracy. The APW7137 includes under-voltage lockout, current-limit, and over-temperature shutdown preventing damage in the event of an output overload.

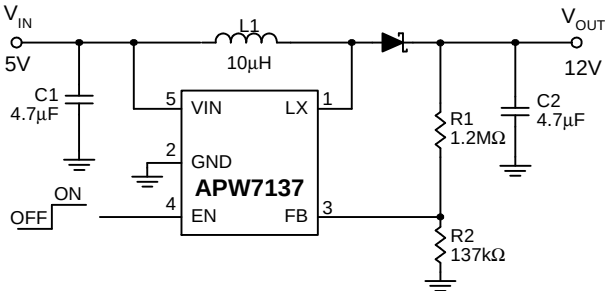


Pin Configuration



SOT-23-5 / TSOT-23-5
(Top View)

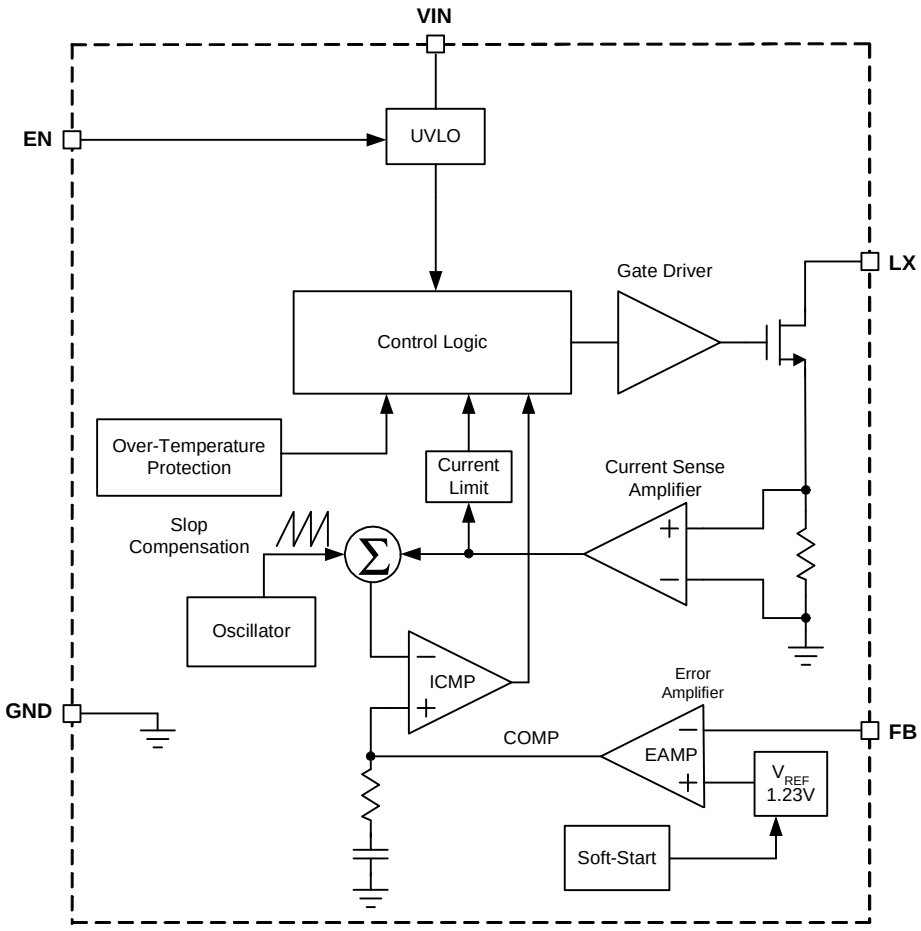
Simplified Application Circuit



Pin Description

PIN.		FUNCTION
NO	NAME	
1	LX	Switch pin. Connect this pin to inductor/diode here.
2	GND	Power and signal ground pin.
3	FB	Feedback Input. The device senses feedback voltage via FB and regulate the voltage at 1.23V. Connecting FB with a resistor-divider from the output that sets the output voltage in the range from V_{IN} to 30V.
4	EN	Enable Control Input. Forcing this pin above 1.0V enables the device. Forcing this pin below 0.4V to shut it down. In shutdown, all functions are disabled to decrease the supply current below 1μA. Do not left this pin floating.
5	VIN	Main Supply Pin. Must be closely decoupled to GND with a 2.2μF or greater ceramic capacitor.

Block Diagram



Typical Application Circuits

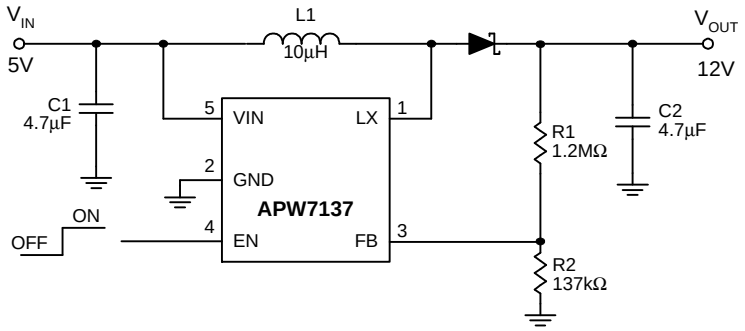


Figure 1. Typical 5V to 12V Supply

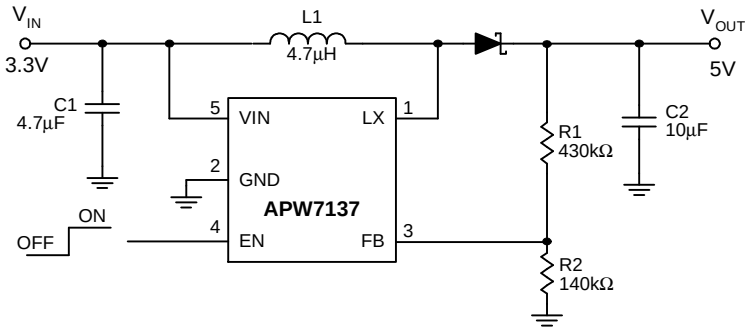


Figure 2. Standard 3.3V to 5V Supply

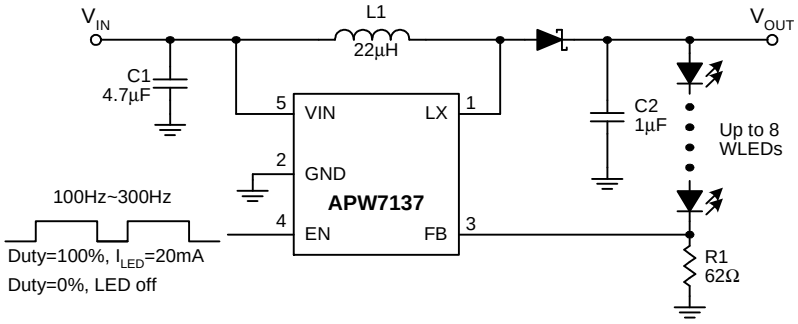


Figure 3. Brightness control using a PWM signal apply to EN

Typical Application Circuits (Cont.)

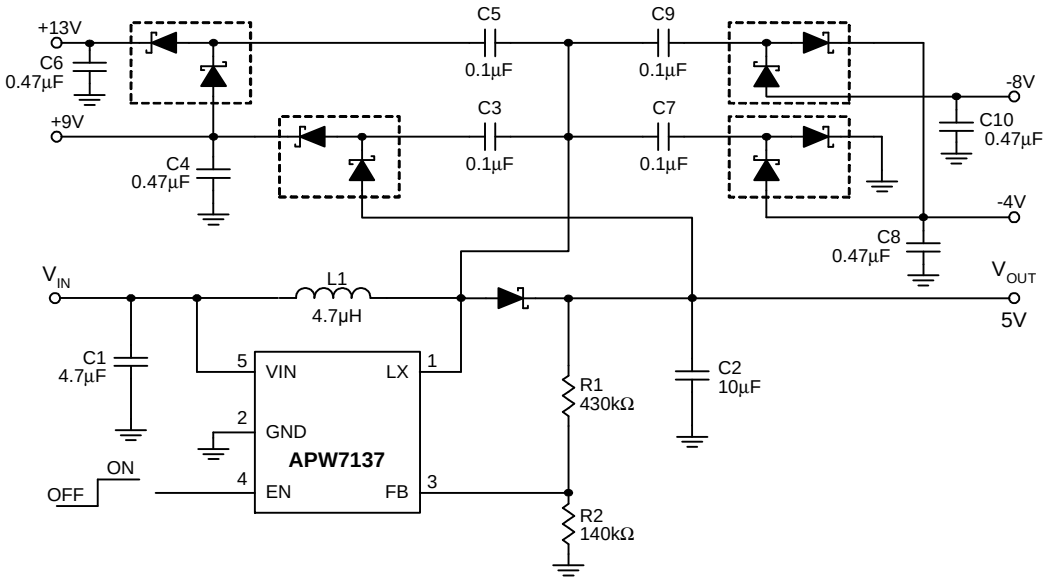


Figure 4. Multiple Output for TFT-LCD Power Supply

Function Description

Main Control Loop

The APW7137 is a constant frequency and current-mode switching regulator. In normal operation, the internal N-channel power MOSFET is turned on each cycle when the oscillator sets an internal RS latch, and then turned off when an internal comparator (ICMP) resets the latch. The peak inductor current at which ICMP resets the RS latch is controlled by the voltage on the COMP node which is the output of the error amplifier (EAMP). An external resistive divider connected between V_{OUT} and ground allows the EAMP to receive an output feedback voltage V_{FB} at FB pin. When the load current increases, it causes a slightly to decrease in V_{FB} associated with the 1.23V reference, which in turn, it causes the COMP voltage to increase until the average inductor current matches the new load current.

VIN Under-Voltage Lockout (UVLO)

The Under-Voltage Lockout (UVLO) circuit compares the input voltage at VIN with the UVLO threshold to ensure the input voltage is high enough for reliable operation. The 100mV (typ) hysteresis prevents supply transients from causing a restart. Once the input voltage exceeds the UVLO rising threshold, startup begins. When the input voltage falls below the UVLO falling threshold, the controller turns off the converter.

Soft-Start

The APW7137 has a built-in soft-start to control the output voltage rise during start-up. During soft-start, an internal ramp voltage, connected to the one of the positive inputs of the error amplifier, raises up to replace the reference voltage (1.23V typical) until the ramp voltage reaches the reference voltage.

Current-Limit Protection

The APW7137 monitors the inductor current, flows through the N-channel MOSFET, and limits the current peak at current-limit level to prevent loads and the APW7137 from damaging during overload or short-circuit conditions.

Over-Temperature Protection (OTP)

The over-temperature circuit limits the junction temperature of the APW7137. When the junction temperature exceeds 150°C, a thermal sensor turns off the power MOSFET allowing the devices to cool. The thermal sensor allows the converters to start a soft-start process and regulates the output voltage again after the junction temperature cools by 40°C. The OTP is designed with a 40°C hysteresis to lower the average Junction Temperature (T_J) during continuous thermal overload conditions increasing the lifetime of the device.

Enable/Shutdown

Driving EN to the ground places the APW7137 in shutdown mode. When in shutdown, the internal power MOSFET turns off, all internal circuitry shuts down, and the quiescent supply current reduces to 1μA maximum.

Application Information (Cont.)

Output Capacitor Selection (Cont.)

For ceramic capacitor application, the output voltage ripple is dominated by the ΔV_{COUT}. When choosing the input and output ceramic capacitors, the X5R or X7R with their good temperature and voltage characteristics are recommended.

Output Voltage Setting

The output voltage is set by a resistive divider. The external resistive divider is connected to the output which allows remote voltage sensing as shown in "Typical Application Circuits". A suggestion of the maximum value of R1 is 2MΩ and R2 is 200kΩ for keeping the minimum current that provides enough noise rejection ability through the resistor divider. The output voltage can be calculated as below:

$$V_{OUT} = V_{REF} \cdot \left(1 + \frac{R1}{R2}\right) = 1.23\left(1 + \frac{R1}{R2}\right)$$

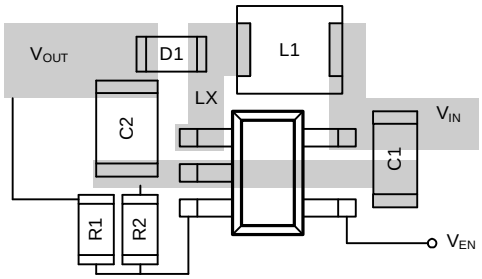
Diode Selection

To achieve the high efficiency, a Schottky diode must be used. The current rating of the diode must meet the peak current rating of the converter.

Layout Consideration

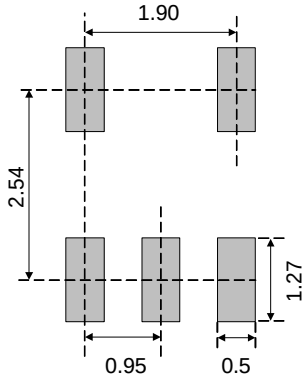
For all switching power supplies, the layout is an important step in the design especially at high peak currents and switching frequencies. If the layout is not carefully done, the regulator might show noise problems and duty cycle jitter.

1. The input capacitor should be placed close to the VIN and the GND without any via holes for good input voltage filtering.
2. To minimize copper trace connections that can inject noise into the system, the inductor should be placed as close as possible to the LX pin to minimize the noise coupling into other circuits.
3. Since the feedback pin and network is a high impedance circuit the feedback network should be routed away from the inductor. The feedback pin and feedback network should be shielded with a ground plane or trace to minimize noise coupling into this circuit.
4. A star ground connection or ground plane minimizes ground shifts and noise is recommended.



Optimized APW7137 Layout

Recommended Minimum Footprint

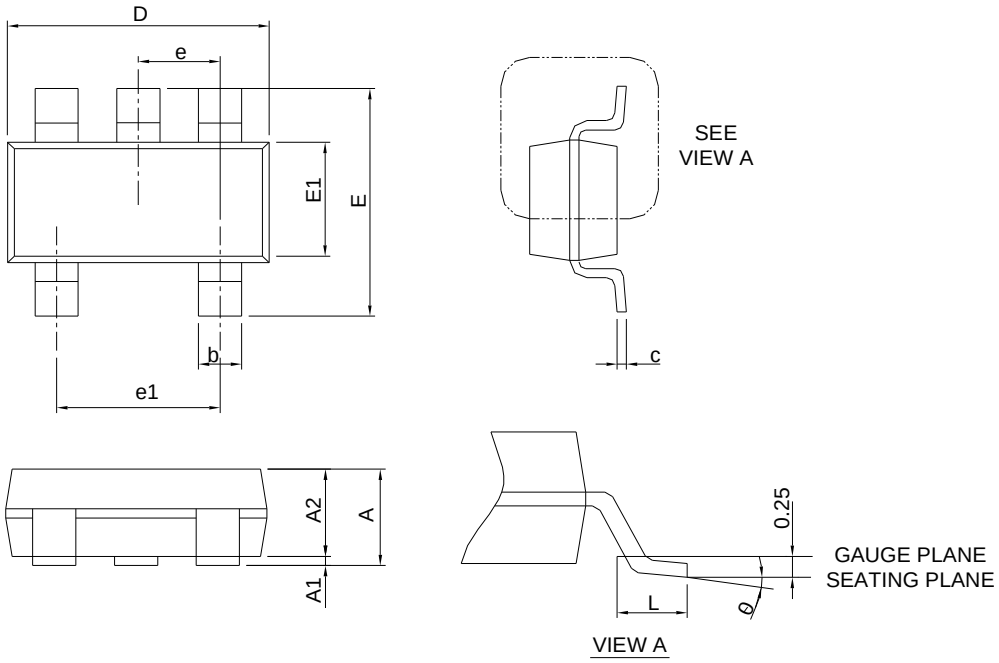


Unit: mm

SOT-23-5/TSOT-23-5

Package Information

SOT-23-5



SYMBOL	SOT-23-5			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.45		0.057
A1	0.00	0.15	0.000	0.006
A2	0.90	1.30	0.035	0.051
b	0.30	0.50	0.012	0.020
c	0.08	0.22	0.003	0.009
D	2.70	3.10	0.106	0.122
E	2.60	3.00	0.102	0.118
E1	1.40	1.80	0.055	0.071
e	0.95 BSC		0.037 BSC	
e1	1.90 BSC		0.075 BSC	
L	0.30	0.60	0.012	0.024
θ	0°	8°	0°	8°

Note : 1. Follow JEDEC TO-178 AA.
2. Dimension D and E1 do not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 10 mil per side.

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