LM2735 BOOST and SEPIC DC-DC Regulator

National Semiconductor
Application Note 1658
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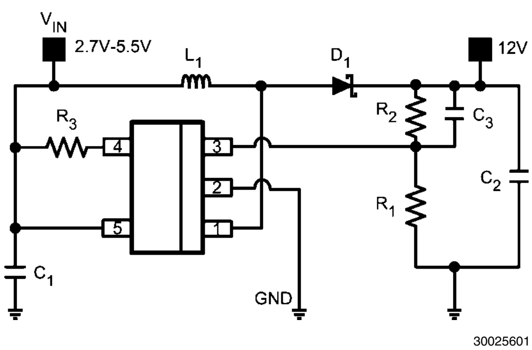
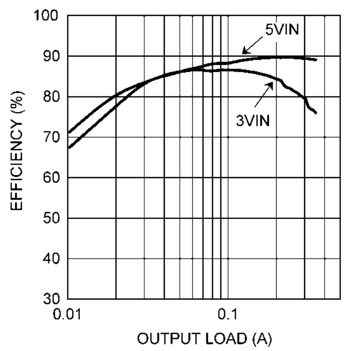
Introduction

The LM2735 is an easy-to-use, space-efficient 2.1A low-side switch regulator ideal for Boost and SEPIC DC-DC regulation. It provides all the active functions to provide local DC/DC conversion with fast-transient response and accurate regulation in the smallest PCB area. Switching frequency is internally set to either 520kHz or 1.6MHz, allowing the use of extremely small surface mount inductor and chip capacitors while providing efficiencies up to 90%. Current-mode control and internal compensation provide ease-of-use, minimal component count, and high-performance regulation over a wide range of operating conditions. External shutdown features an ultra-low standby current of 80 nA ideal for portable applications. Tiny SOT23-5, LLP-6, and eMSOP-8 packages provide space-savings. Additional features include internal soft-start, circuitry to reduce inrush current, pulse-by-pulse current limit, and thermal shutdown.

Typical Boost Application Circuit

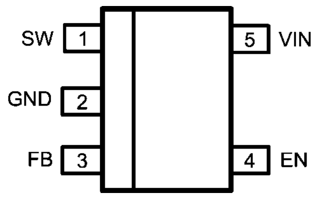




Efficiency vs Load Current V_O = 12V

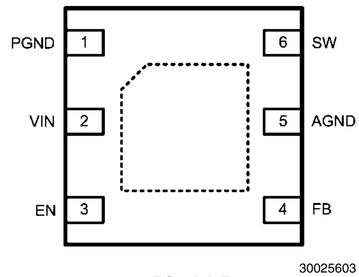
Connection Diagrams

Top View



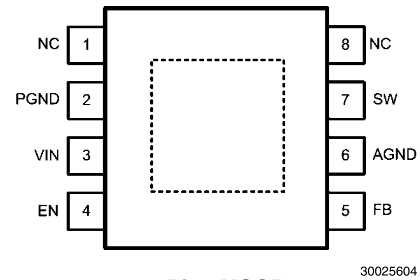
5-Pin SOT23

Top View



6-Pin LLP

Top View



8-Pin eMSOP

Design Guide

ENABLE PIN / SHUTDOWN MODE

The LM2735 has a shutdown mode that is controlled by the Enable pin (EN). When a logic low voltage is applied to EN, the part is in shutdown mode and its quiescent current drops to typically 80 nA. Switch leakage adds up to another 1 µA from the input supply. The voltage at this pin should never exceed V_{IN} + 0.3V.

THERMAL SHUTDOWN

Thermal shutdown limits total power dissipation by turning off the output switch when the IC junction temperature exceeds 160°C. After thermal shutdown occurs, the output switch doesn't turn on until the junction temperature drops to approximately 150°C.

SOFT-START

This function forces V_{OUT} to increase at a controlled rate during start up. During soft-start, the error amplifier's reference voltage ramps to its nominal value of 1.255V in approximately 4.0ms. This forces the regulator output to ramp up in a more linear and controlled fashion, which helps reduce inrush current.

INDUCTOR SELECTION

The Duty Cycle (D) can be approximated quickly using the ratio of output voltage (V_O) to input voltage (V_{IN}):

$$\frac{V_{OUT}}{V_{IN}} = \left(\frac{1}{1-D}\right) = \frac{1}{D'}$$

Therefore:

$$D = \frac{V_{OUT} - V_{IN}}{V_{OUT}}$$

Power losses due to the diode (D1) forward voltage drop, the voltage drop across the internal NMOS switch, the voltage drop across the inductor resistance (R_{DCR}) and switching losses must be included to calculate a more accurate duty cycle (See Calculating Efficiency and Junction Temperature for a detailed explanation). A more accurate formula for calculating the conversion ratio is:

$$\frac{V_{OUT}}{V_{IN}} = \frac{\eta}{D'}$$

Where η equals the efficiency of the LM2735 application.

The inductor value determines the input ripple current. Lower inductor values decrease the size of the inductor, but increase the input ripple current. An increase in the inductor value will decrease the input ripple current.

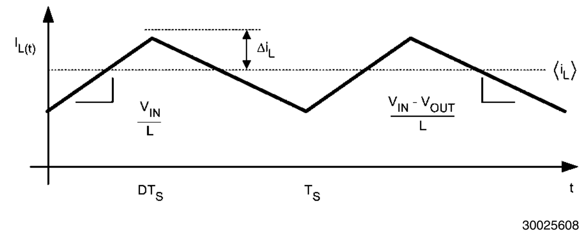


FIGURE 1. Inductor Current

$$\frac{2\Delta i_L}{DT_S} = \left(\frac{V_{IN}}{L}\right)$$

$$\Delta i_L = \left(\frac{V_{IN}}{2L}\right) \times DT_S$$

A good design practice is to design the inductor to produce 10% to 30% ripple of maximum load. From the previous equations, the inductor value is then obtained.

$$L = \left(\frac{V_{IN}}{2 \times \Delta i_L}\right) \times DT_S$$

Where: $1/T_S = F_{SW}$ = switching frequency

One must also ensure that the minimum current limit (2.1A) is not exceeded, so the peak current in the inductor must be calculated. The peak current (I_{LPK}) in the inductor is calculated by:

$$IL_{pk} = I_{IN} + \Delta I_L$$

or

$$IL_{pk} = I_{OUT} / D' + \Delta I_L$$

When selecting an inductor, make sure that it is capable of supporting the peak input current without saturating. Inductor saturation will result in a sudden reduction in inductance and prevent the regulator from operating correctly. Because of the speed of the internal current limit, the peak current of the inductor need only be specified for the required maximum input current. For example, if the designed maximum input current is 1.5A and the peak current is 1.75A, then the inductor should be specified with a saturation current limit of >1.75A. There is no need to specify the saturation or peak current of the inductor at the 3A typical switch current limit.

Because of the operating frequency of the LM2735, ferrite based inductors are preferred to minimize core losses. This presents little restriction since the variety of ferrite-based inductors is huge. Lastly, inductors with lower series resistance (DCR) will provide better operating efficiency. For recommended inductors see Example Circuits.

INPUT CAPACITOR

An input capacitor is necessary to ensure that V_{IN} does not drop excessively during switching transients. The primary specifications of the input capacitor are capacitance, voltage, RMS current rating, and ESL (Equivalent Series Inductance). The recommended input capacitance is 10 µF to 44 µF depending on the application. The capacitor manufacturer specifically states the input voltage rating. Make sure to check any recommended deratings and also verify if there is any significant change in capacitance at the operating input voltage and the operating temperature. The ESL of an input capacitor is usually determined by the effective cross sectional area of the current path. At the operating frequencies of the LM2735, certain capacitors may have an ESL so large that the resulting impedance (2πfL) will be higher than that required to provide stable operation. As a result, surface mount capacitors are strongly recommended. Multilayer ceramic capacitors (MLCC) are good choices for both input and output capacitors and have very low ESL. For MLCCs it is recommended to use X7R or X5R dielectrics. Consult capacitor manufacturer datasheet to see how rated capacitance varies over operating conditions.

OUTPUT CAPACITOR

The LM2735 operates at frequencies allowing the use of ceramic output capacitors without compromising transient response. Ceramic capacitors allow higher inductor ripple without significantly increasing output ripple. The output capacitor is selected based upon the desired output ripple and transient response. The initial current of a load transient is provided mainly by the output capacitor. The output impedance will therefore determine the maximum voltage perturbation. The output ripple of the converter is a function of the capacitor's reactance and its equivalent series resistance (ESR):

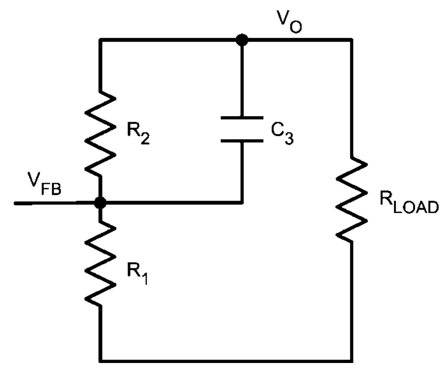
$$\Delta V_{OUT} = \Delta i_L \times R_{ESR} + \left(\frac{V_{OUT} \times D}{2 \times F_{SW} \times R_{Load} \times C_{OUT}} \right)$$

When using MLCCs, the ESR is typically so low that the capacitive ripple may dominate. When this occurs, the output ripple will be approximately sinusoidal and 90° phase shifted from the switching action .

Given the availability and quality of MLCCs and the expected output voltage of designs using the LM2735, there is really no need to review any other capacitor technologies. Another benefit of ceramic capacitors is their ability to bypass high frequency noise. A certain amount of switching edge noise will couple through parasitic capacitances in the inductor to the output. A ceramic capacitor will bypass this noise while a tantalum will not. Since the output capacitor is one of the two external components that control the stability of the regulator control loop, most applications will require a minimum at 4.7 µF of output capacitance. Like the input capacitor, recommended multilayer ceramic capacitors are X7R or X5R. Again, verify actual capacitance at the desired operating voltage and temperature.

SETTING THE OUTPUT VOLTAGE

The output voltage is set using the following equation where R1 is connected between the FB pin and GND, and R2 is connected between V_{OUT} and the FB pin.



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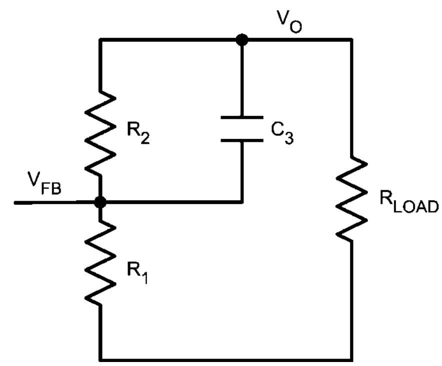
A good value for R1 is 10kΩ.

$$R_2 = \left(\frac{V_{OUT}}{V_{REF}} - 1 \right) \times R_1$$

COMPENSATION

The LM2735 uses constant frequency peak current mode control. This mode of control allows for a simple external compensation scheme that can be optimized for each application. Lower output voltages should have a zero set close to 10 kHz, and higher output voltages will usually have the zero set closer to 5 kHz.



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$$F_{ZERO\text{-}CF} = \frac{1}{2\pi (R_2 \times C_3)}$$

PCB Layout Considerations

When planning layout there are a few things to consider when trying to achieve a clean, regulated output. The most important consideration when completing a Boost Converter layout is the close coupling of the GND connections of the C_{OUT} capacitor and the LM2735 PGND pin. The GND ends should be close to one another and be connected to the GND plane with at least two through-holes. There should be a continuous ground plane on the bottom layer of a two-layer board except under the switching node island. The FB pin is a high impedance node and care should be taken to make the FB trace short to avoid noise pickup and inaccurate regulation. The feedback resistors should be placed as close as possible to the IC, with the AGND of R1 placed as close as possible to the GND (pin 5 for the LLP) of the IC. The V_{OUT} trace to R2 should be routed away from the inductor and any other traces that are switching. High AC currents flow through the V_{IN}, SW and V_{OUT} traces, so they should be as short and wide as possible. However, making the traces wide increases radiated noise, so the designer must make this trade-off. Radiated noise can be decreased by choosing a shielded inductor. The remaining components should also be placed as close as possible to the IC. Please see Application Note AN-1229 for further considerations and the LM2735 demo board as an example of a four-layer layout.

Below is an example of a good thermal & electrical PCB design. This is very similar to our LM2735 demonstration boards that are obtainable via the National Semiconductor website. The demonstration board consists of a two layer PCB with a common input and output voltage application. Most of the routing is on the top layer, with the bottom layer consisting of a large ground plane. The placement of the external components satisfies the electrical considerations, and the thermal performance has been improved by adding thermal vias and a top layer "Dog-Bone".

Example of Proper PCB Layout

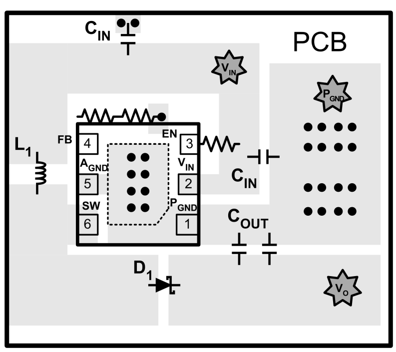

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FIGURE 2. Boost PCB Layout Guidelines

Thermal Design

PCB design with thermal performance in mind:

The PCB design is a very important step in the thermal design procedure. The LM2735 is available in three package options (5 pin SOT23, 8 pin eMSOP & 6 pin LLP). The options are electrically the same, but difference between the packages is size and thermal performance. The LLP and eMSOP have thermal Die Attach Pads (DAP) attached to the bottom of the packages, and are therefore capable of dissipating more heat than the SOT23 package. It is important that the customer choose the correct package for the application. A detailed thermal design procedure has been included in this data sheet. This procedure will help determine which package is correct, and common applications will be analyzed.

SEPIC Converter

The LM2735 can easily be converted into a SEPIC converter. A SEPIC converter has the ability to regulate an output voltage that is either larger or smaller in magnitude than the input voltage. Other converters have this ability as well (CUK and Buck-Boost), but usually create an output voltage that is opposite in polarity to the input voltage. This topology is a perfect fit for Lithium Ion battery applications where the input voltage for a single cell Li-Ion battery will vary between 3V & 4.5V and the output voltage is somewhere in between. Most of the analysis of the LM2735 Boost Converter is applicable to the LM2735 SEPIC Converter.

SEPIC Design Guide:

SEPIC Conversion ratio without loss elements:

$$\frac{V_O}{V_{IN}} = \frac{D}{D'}$$

Therefore:

$$D = \frac{V_O}{V_O + V_{IN}}$$

$$\frac{V_O}{V_{IN}} = \left(\frac{D}{1 - D}\right) x\ \eta$$

$$D = \left(\frac{V_O}{(V_{IN}\ x\ \eta) + V_O}\right)$$

It is important to remember that the internal switch current is equal to I_{L1} and I_{L2}. During the D interval design the converter so that the minimum guaranteed peak switch current limit (2.25A) is not exceeded.

$$I_{L2} = \left(\frac{D}{D'}\right) x\ I_{L1}$$

and

$$I_{L1} = \left(\frac{D}{D'}\right) x \left(\frac{V_O}{R}\right)$$

Substituting I_{L1} into I_{L2}

$$I_{L2} = \frac{V_O}{R}$$

SEPIC Converter PCB Layout

The layout guidelines described for the LM2735 Boost-Converter are applicable to the SEPIC Converter. Below is a proper PCB layout for a SEPIC Converter.

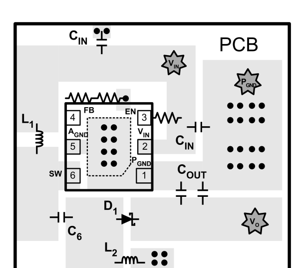

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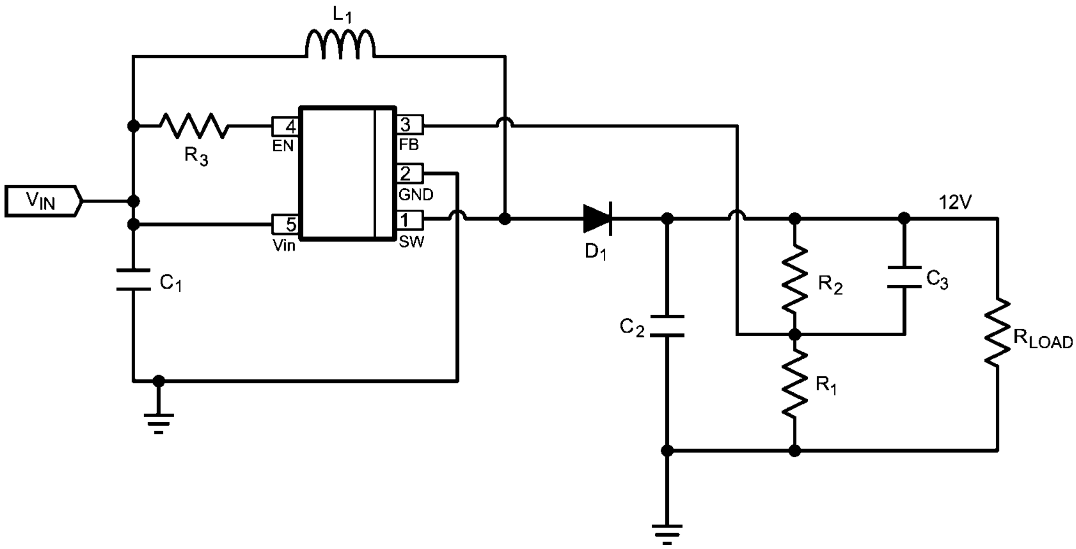
FIGURE 3. SEPIC PCB Layout

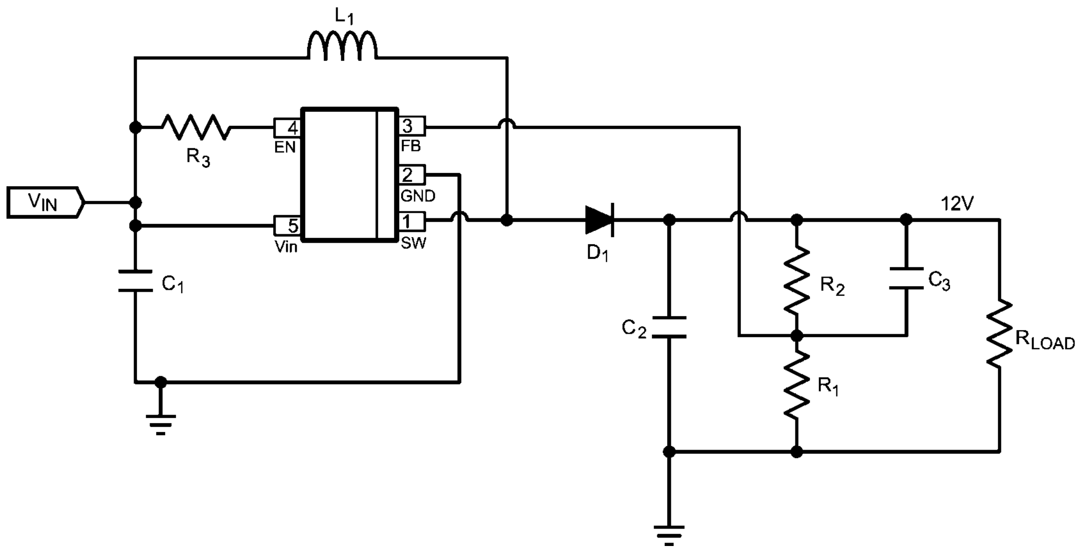
LM2735X SOT23-5 Design Example 1:



LM2735X (1.6MHz): Vin = 5V, Vout = 12V @ 350mA

Part ID	Part Value	Manufacturer	Part Number
U1	2.1A Boost Regulator	NSC	LM2735XMF
C1, Input Cap	22µF, 6.3V, X5R	TDK	C2012X5R0J226M
C2 Output Cap	10µF, 25V, X5R	TDK	C3216X5R1E106M
C3 Comp Cap	330pF	TDK	C1608X5R1H331K
D1, Catch Diode	0.4V_f Schottky 1A, 20V_R	ST	STPS120M
L1	15µH 1.5A	Coilcraft	MSS5131-153ML
R1	10.2kΩ, 1%	Vishay	CRCW06031022F
R2	86.6kΩ, 1%	Vishay	CRCW06038662F
R3	100kΩ, 1%	Vishay	CRCW06031003F

LM2735Y SOT23-5 Design Example 2:



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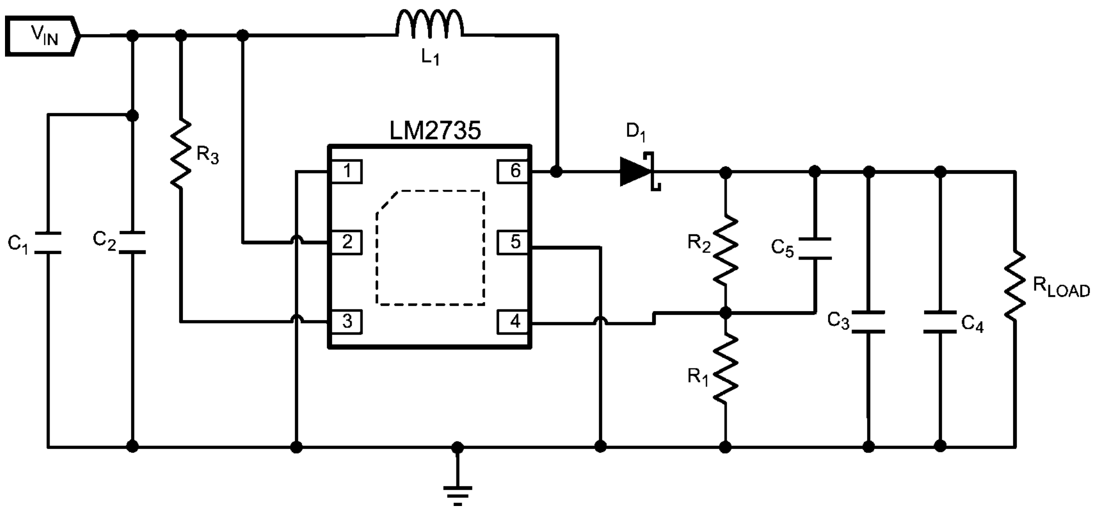
LM2735Y (520kHz): Vin = 5V, Vout = 12V @ 350mA

Part ID	Part Value	Manufacturer	Part Number
U1	2.1A Boost Regulator	NSC	LM2735YMF
C1, Input Cap	22µF, 6.3V, X5R	TDK	C2012X5R0J226M
C2 Output Cap	10µF, 25V, X5R	TDK	C3216X5R1E106M
C3 Comp Cap	330pF	TDK	C1608X5R1H331K
D1, Catch Diode	0.4V_f Schottky 1A, 20V_R	ST	STPS120M
L1	33µH 1.5A	Coilcraft	DS3316P-333ML
R1	10.2kΩ, 1%	Vishay	CRCW06031022F
R2	86.6kΩ, 1%	Vishay	CRCW06038662F
R3	100kΩ, 1%	Vishay	CRCW06031003F

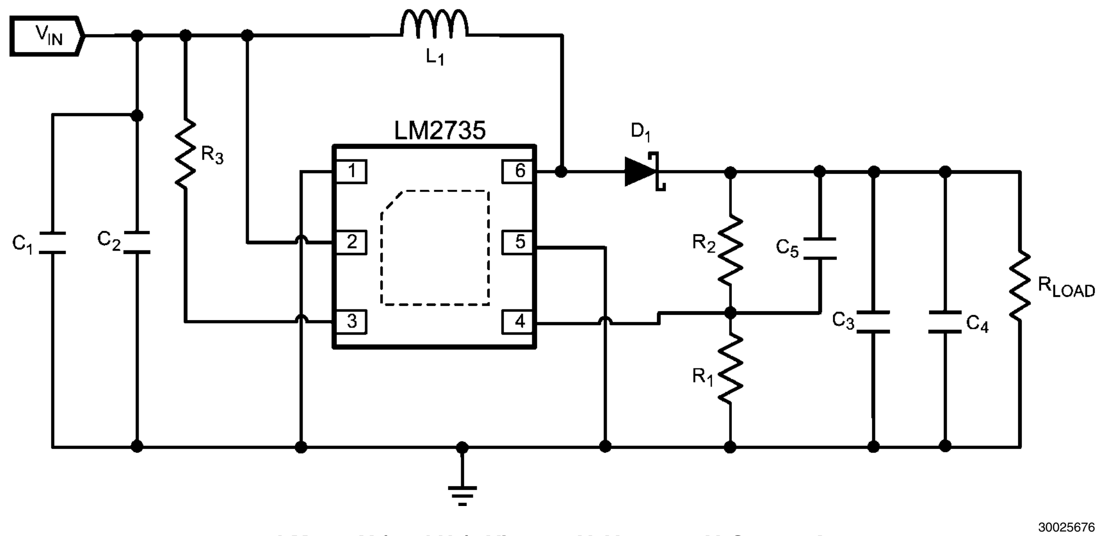
LM2735X LLP-6 Design Example 3:



LM2735X (1.6MHz): Vin = 3.3V, Vout = 12V @ 350mA

Part ID	Part Value	Manufacturer	Part Number
U1	2.1A Boost Regulator	NSC	LM2735XSD
C1 Input Cap	22µF, 6.3V, X5R	TDK	C2012X5R0J226M
C2 Input Cap	No Load		
C3 Output Cap	10µF, 25V, X5R	TDK	C3216X5R1E106M
C4 Output Cap	No Load		
C5 Comp Cap	330pF	TDK	C1608X5R1H331K
D1, Catch Diode	0.4V_f Schottky 1A, 20V_R	ST	STPS120M
L1	6.8µH 2A	Coilcraft	DO1813H-682ML
R1	10.2kΩ, 1%	Vishay	CRCW06031022F
R2	86.6kΩ, 1%	Vishay	CRCW06038662F
R3	100kΩ, 1%	Vishay	CRCW06031003F

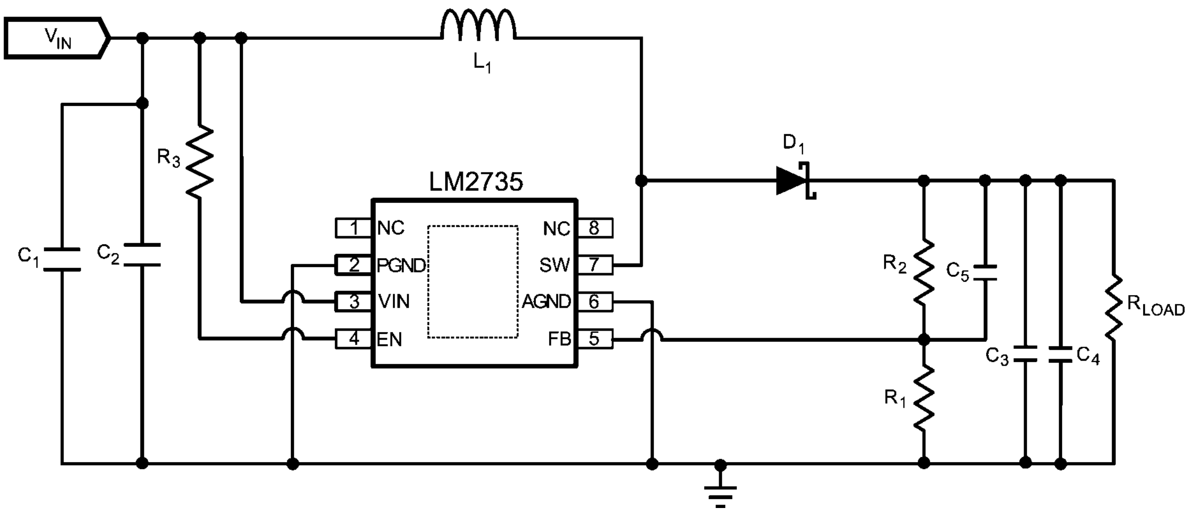
LM2735Y LLP-6 Design Example 4:



LM2735Y (520kHz): Vin = 3.3V, Vout = 12V @ 350mA

Part ID	Part Value	Manufacturer	Part Number
U1	2.1A Boost Regulator	NSC	LM2735YSD
C1 Input Cap	22µF, 6.3V, X5R	TDK	C2012X5R0J226M
C2 Input Cap	No Load		
C3 Output Cap	10µF, 25V, X5R	TDK	C3216X5R1E106M
C4 Output Cap	No Load		
C5 Comp Cap	330pF	TDK	C1608X5R1H331K
D1, Catch Diode	0.4V_f Schottky 1A, 20V_R	ST	STPS120M
L1	15µH 2A	Coilcraft	MSS5131-153ML
R1	10.2kΩ, 1%	Vishay	CRCW06031022F
R2	86.6kΩ, 1%	Vishay	CRCW06038662F
R3	100kΩ, 1%	Vishay	CRCW06031003F

LM2735Y eMSOP-8 Design Example 5:



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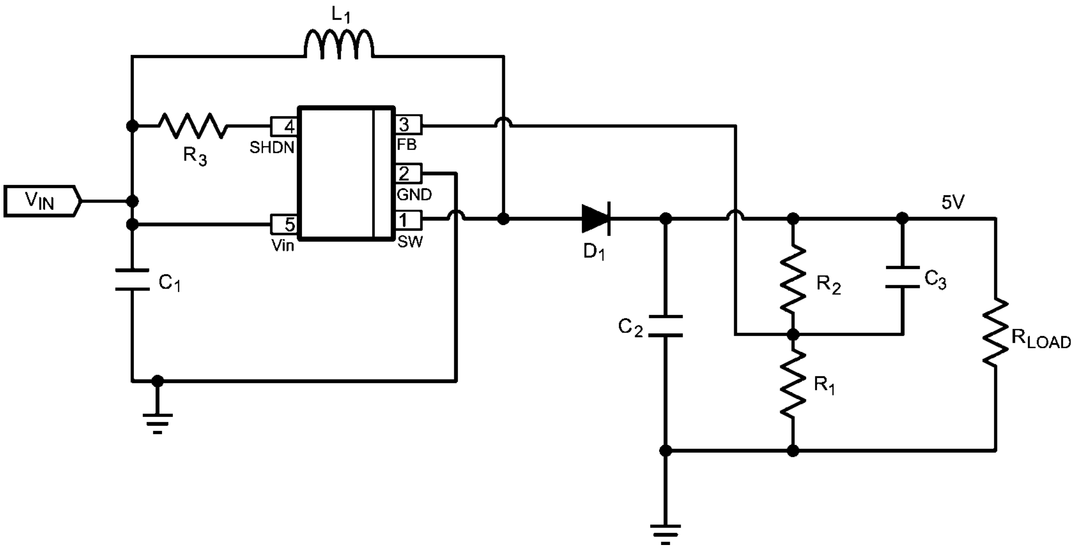
LM2735Y (520kHz): Vin = 3.3V, Vout = 12V @ 350mA

Part ID	Part Value	Manufacturer	Part Number
U1	2.1A Boost Regulator	NSC	LM2735YMY
C1 Input Cap	22µF, 6.3V, X5R	TDK	C2012X5R0J226M
C2 Input Cap	No Load		
C3 Output Cap	10µF, 25V, X5R	TDK	C3216X5R1E106M
C4 Output Cap	No Load		
C5 Comp Cap	330pF	TDK	C1608X5R1H331K
D1, Catch Diode	0.4V_f Schottky 1A, 20V_R	ST	STPS120M
L1	15µH 1.5A	Coilcraft	MSS5131-153ML
R1	10.2kΩ, 1%	Vishay	CRCW06031022F
R2	86.6kΩ, 1%	Vishay	CRCW06038662F
R3	100kΩ, 1%	Vishay	CRCW06031003F

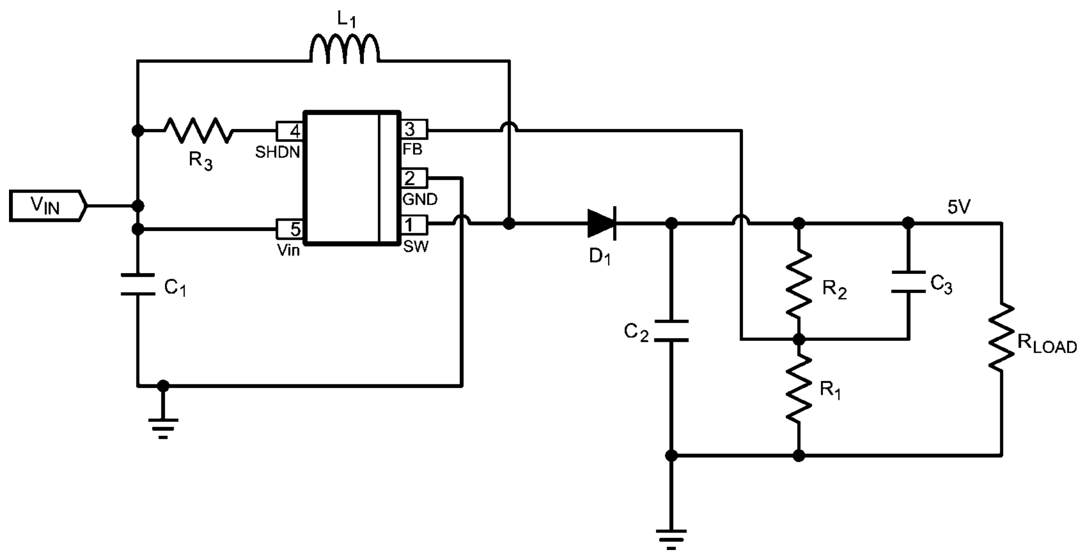
LM2735X SOT23-5 Design Example 6:



LM2735X (1.6MHz): Vin = 3V, Vout = 5V @ 500mA

Part ID	Part Value	Manufacturer	Part Number
U1	2.1A Boost Regulator	NSC	LM2735XMF
C1, Input Cap	10µF, 6.3V, X5R	TDK	C2012X5R0J106K
C2, Output Cap	10µF, 6.3V, X5R	TDK	C2012X5R0J106K
C3 Comp Cap	1000pF	TDK	C1608X5R1H102K
D1, Catch Diode	0.4V_f Schottky 1A, 20V_R	ST	STPS120M
L1	10µH 1.2A	Coilcraft	DO1608C-103ML
R1	10.0kΩ, 1%	Vishay	CRCW08051002F
R2	30.1kΩ, 1%	Vishay	CRCW08053012F
R3	100kΩ, 1%	Vishay	CRCW06031003F

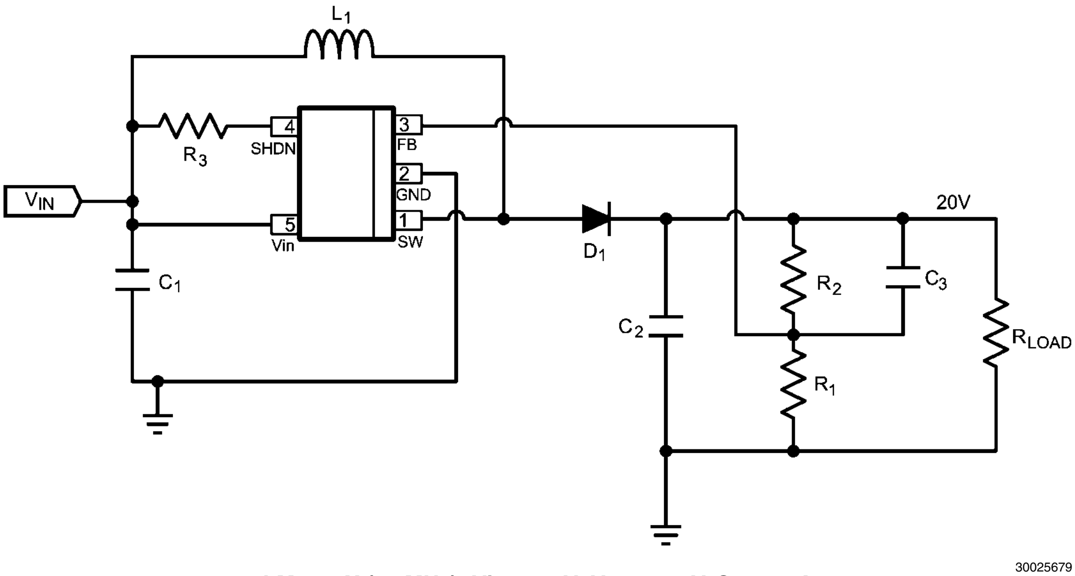
LM2735Y SOT23-5 Design Example 7:



LM2735Y (520kHz): Vin = 3V, Vout = 5V @ 750mA

Part ID	Part Value	Manufacturer	Part Number
U1	2.1A Boost Regulator	NSC	LM2735YMF
C1 Input Cap	22µF, 6.3V, X5R	TDK	C2012X5R0J226M
C2 Output Cap	22µF, 6.3V, X5R	TDK	C2012X5R0J226M
C3 Comp Cap	1000pF	TDK	C1608X5R1H102K
D1, Catch Diode	0.4V_f Schottky 1A, 20V_R	ST	STPS120M
L1	22µH 1.2A	Coilcraft	MSS5131-223ML
R1	10.0kΩ, 1%	Vishay	CRCW08051002F
R2	30.1kΩ, 1%	Vishay	CRCW08053012F
R3	100kΩ, 1%	Vishay	CRCW06031003F

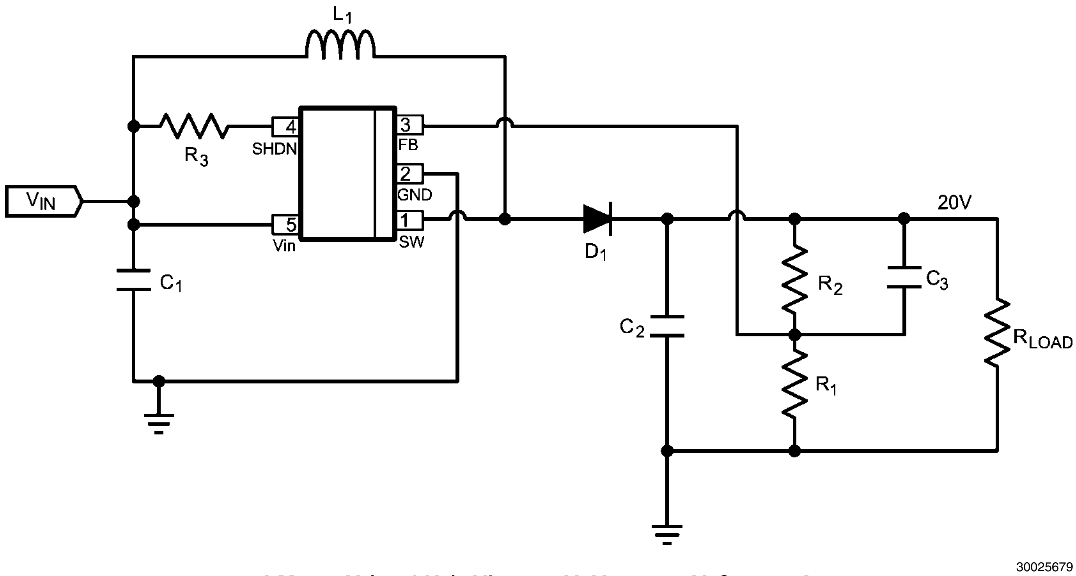
LM2735X SOT23-5 Design Example 8:



LM2735X (1.6MHz): Vin = 3.3V, Vout = 20V @ 100mA

Part ID	Part Value	Manufacturer	Part Number
U1	2.1A Boost Regulator	NSC	LM2735XMF
C1, Input Cap	22µF, 6.3V, X5R	TDK	C2012X5R0J226M
C2, Output Cap	4.7µF, 25V, X5R	TDK	C3216X5R1E475K
C3 Comp Cap	470pF	TDK	C1608X5R1H471K
D1, Catch Diode	0.4V_f Schottky 500mA, 30V_R	Vishay	MBR0530
L1	10µH 1.2A	Coilcraft	DO1608C-103ML
R1	10.0kΩ, 1%	Vishay	CRCW06031002F
R2	150kΩ, 1%	Vishay	CRCW06031503F
R3	100kΩ, 1%	Vishay	CRCW06031003F

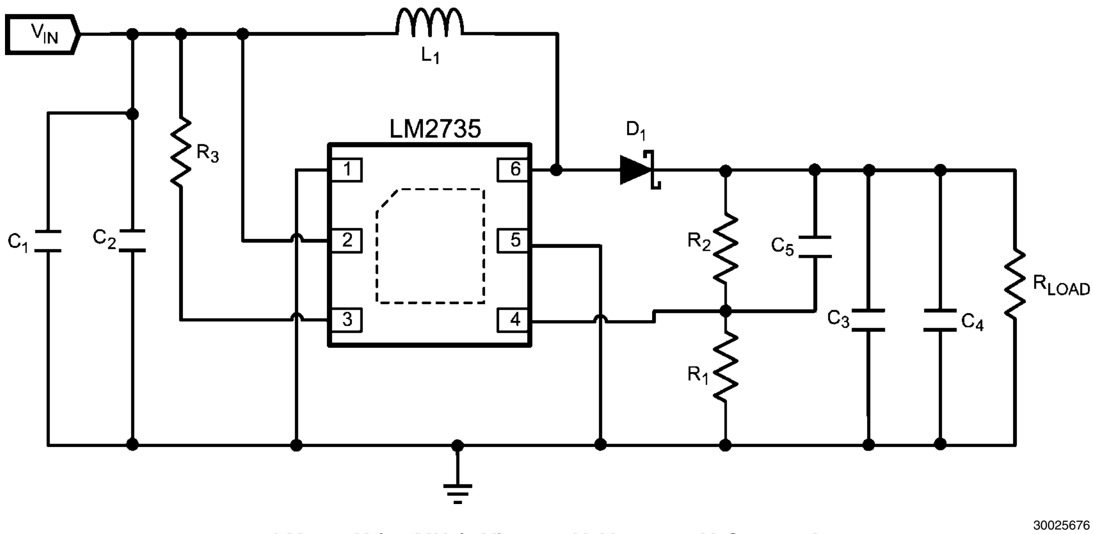
LM2735Y SOT23-5 Design Example 9:



LM2735Y (520kHz): Vin = 3.3V, Vout = 20V @ 100mA

Part ID	Part Value	Manufacturer	Part Number
U1	2.1A Boost Regulator	NSC	LM2735YMF
C1 Input Cap	22µF, 6.3V, X5R	TDK	C2012X5R0J226M
C2 Output Cap	10µF, 25V, X5R	TDK	C3216X5R1E106M
C3 Comp Cap	470pF	TDK	C1608X5R1H471K
D1, Catch Diode	0.4V_f Schottky 500mA, 30V_R	Vishay	MBR0530
L1	33µH 1.5A	Coilcraft	DS3316P-333ML
R1	10.0kΩ, 1%	Vishay	CRCW06031002F
R2	150.0kΩ, 1%	Vishay	CRCW06031503F
R3	100kΩ, 1%	Vishay	CRCW06031003F

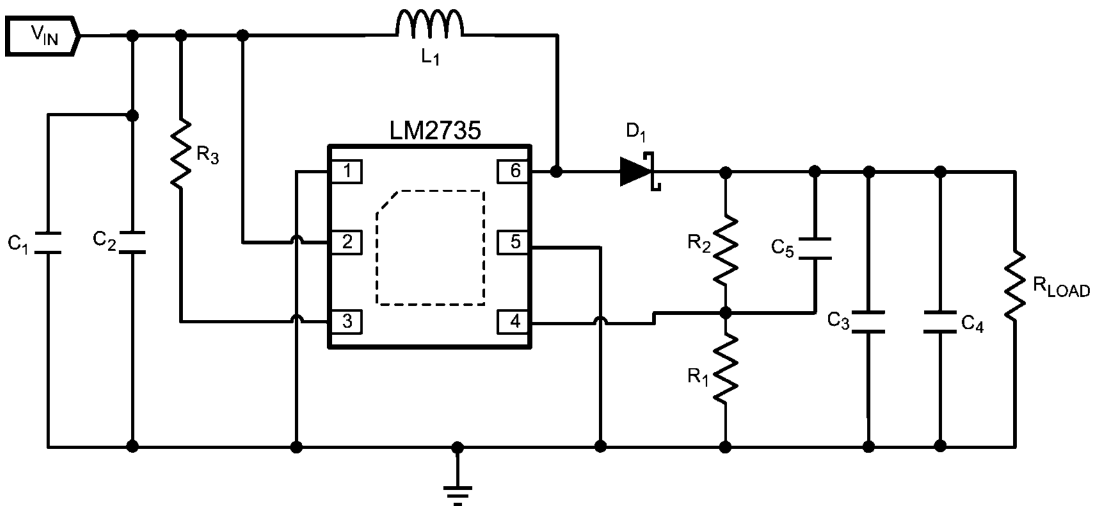
LM2735X LLP-6 Design Example 10:



LM2735X (1.6MHz): Vin = 3.3V, Vout = 20V @ 150mA

Part ID	Part Value	Manufacturer	Part Number
U1	2.1A Boost Regulator	NSC	LM2735XSD
C1 Input Cap	22µF, 6.3V, X5R	TDK	C2012X5R0J226M
C2 Input Cap	22µF, 6.3V, X5R	TDK	C2012X5R0J226M
C3 Output Cap	10µF, 25V, X5R	TDK	C3216X5R1E106M
C4 Output Cap	No Load		
C5 Comp Cap	470pF	TDK	C1608X5R1H471K
D1, Catch Diode	0.4V_f Schottky 500mA, 30V_R	Vishay	MBR0530
L1	8.2µH 2A	Coilcraft	DO1813H-822ML
R1	10.0kΩ, 1%	Vishay	CRCW06031002F
R2	150kΩ, 1%	Vishay	CRCW06031503F
R3	100kΩ, 1%	Vishay	CRCW06031003F

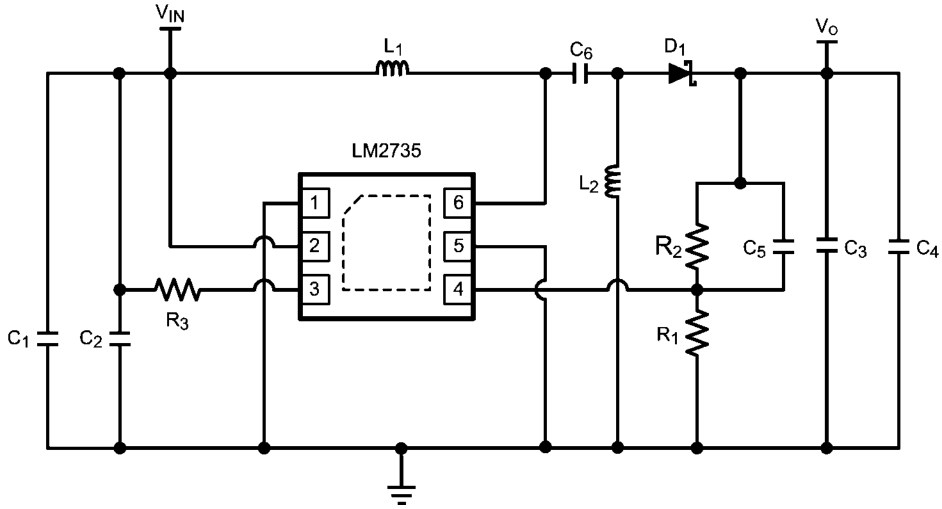
LM2735Y LLP-6 Design Example 11:



LM2735Y (520kHz): Vin = 3.3V, Vout = 20V @ 150mA

Part ID	Part Value	Manufacturer	Part Number
U1	2.1A Boost Regulator	NSC	LM2735YSD
C1 Input Cap	10µF, 6.3V, X5R	TDK	C2012X5R0J106K
C2 Input Cap	10µF, 6.3V, X5R	TDK	C2012X5R0J106K
C3 Output Cap	10µF, 25V, X5R	TDK	C3216X5R1E106M
C4 Output Cap	No Load		
C5 Comp Cap	470pF	TDK	C1608X5R1H471K
D1, Catch Diode	0.4V_f Schottky 500mA, 30V_R	Vishay	MBR0530
L1	22µH 1.5A	Coilcraft	DS3316P-223ML
R1	10.0kΩ, 1%	Vishay	CRCW06031002F
R2	150kΩ, 1%	Vishay	CRCW06031503F
R3	100kΩ, 1%	Vishay	CRCW06031003F

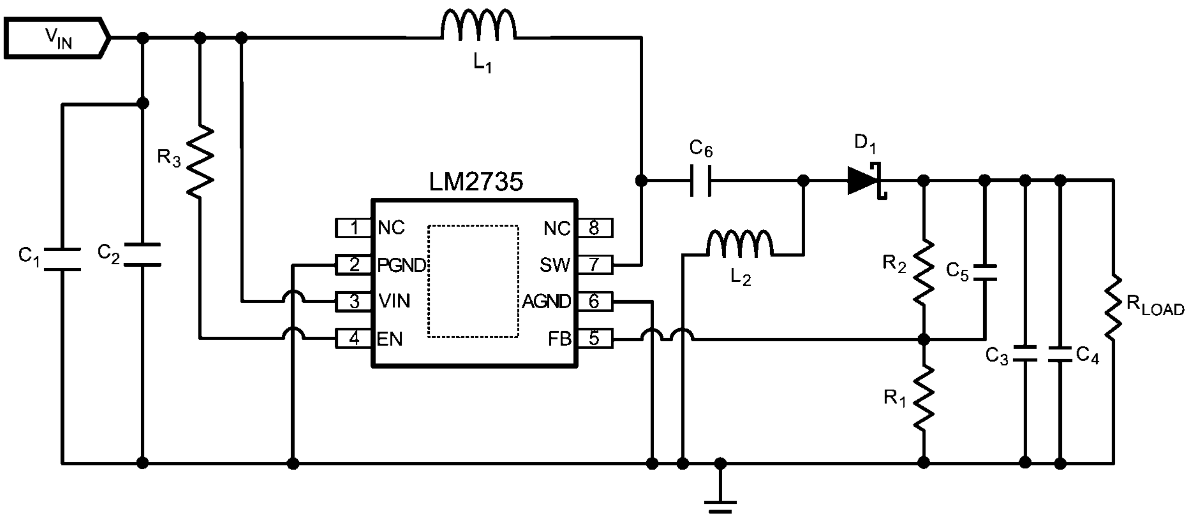
LM2735X LLP-6 SEPIC Design Example 12:



LM2735X (1.6MHz): Vin = 2.7V - 5V, Vout = 3.3V @ 500mA

Part ID	Part Value	Manufacturer	Part Number
U1	2.1A Boost Regulator	NSC	LM2735XSD
C1 Input Cap	22µF, 6.3V, X5R	TDK	C2012X5R0J226M
C2 Input Cap	No Load		
C3 Output Cap	10µF, 25V, X5R	TDK	C3216X5R1E106M
C4 Output Cap	No Load		
C5 Comp Cap	2200pF	TDK	C1608X5R1H222K
C6	2.2µF 16V	TDK	C2012X5R1C225K
D1, Catch Diode	0.4V_f Schottky 1A, 20V_R	ST	STPS120M
L1	6.8µH	Coilcraft	DO1608C-682ML
L2	6.8µH	Coilcraft	DO1608C-682ML
R1	10.2kΩ, 1%	Vishay	CRCW06031002F
R2	16.5kΩ, 1%	Vishay	CRCW06031652F
R3	100kΩ, 1%	Vishay	CRCW06031003F

LM2735Y eMSOP-8 SEPIC Design Example 13:



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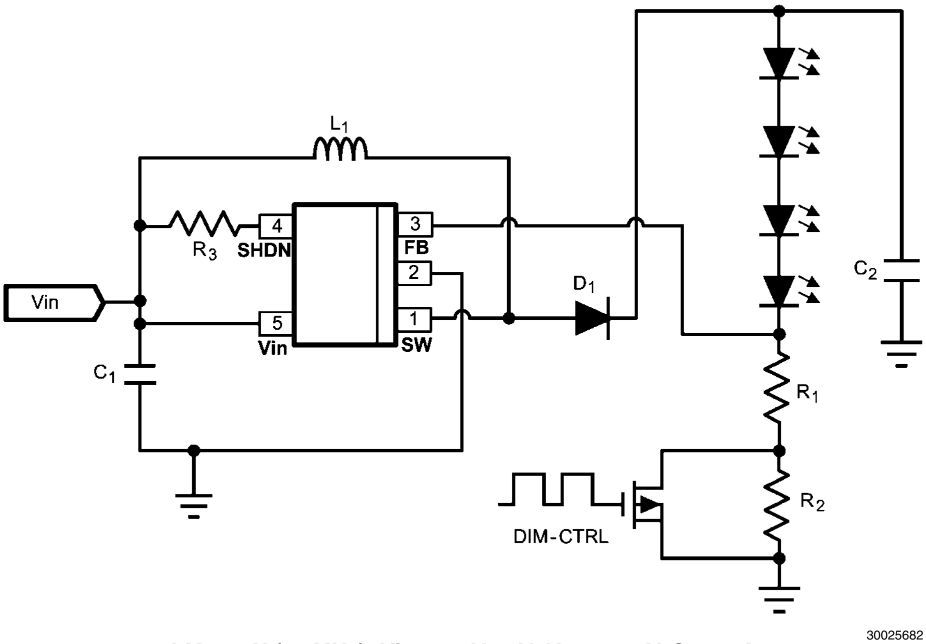
LM2735Y (520kHz): Vin = 2.7V - 5V, Vout = 3.3V @ 500mA

Part ID	Part Value	Manufacturer	Part Number
U1	2.1A Boost Regulator	NSC	LM2735YMY
C1 Input Cap	22µF, 6.3V, X5R	TDK	C2012X5R0J226M
C2 Input Cap	No Load		
C3 Output Cap	10µF, 25V, X5R	TDK	C3216X5R1E106M
C4 Output Cap	No Load		
C5 Comp Cap	2200pF	TDK	C1608X5R1H222K
C6	2.2µF 16V	TDK	C2012X5R1C225K
D1, Catch Diode	0.4V_f Schottky 1A, 20V_R	ST	STPS120M
L1	15µH 1.5A	Coilcraft	MSS5131-153ML
L2	15µH 1.5A	Coilcraft	MSS5131-153ML
R1	10.2kΩ, 1%	Vishay	CRCW06031002F
R2	16.5kΩ, 1%	Vishay	CRCW06031652F
R3	100kΩ, 1%	Vishay	CRCW06031003F

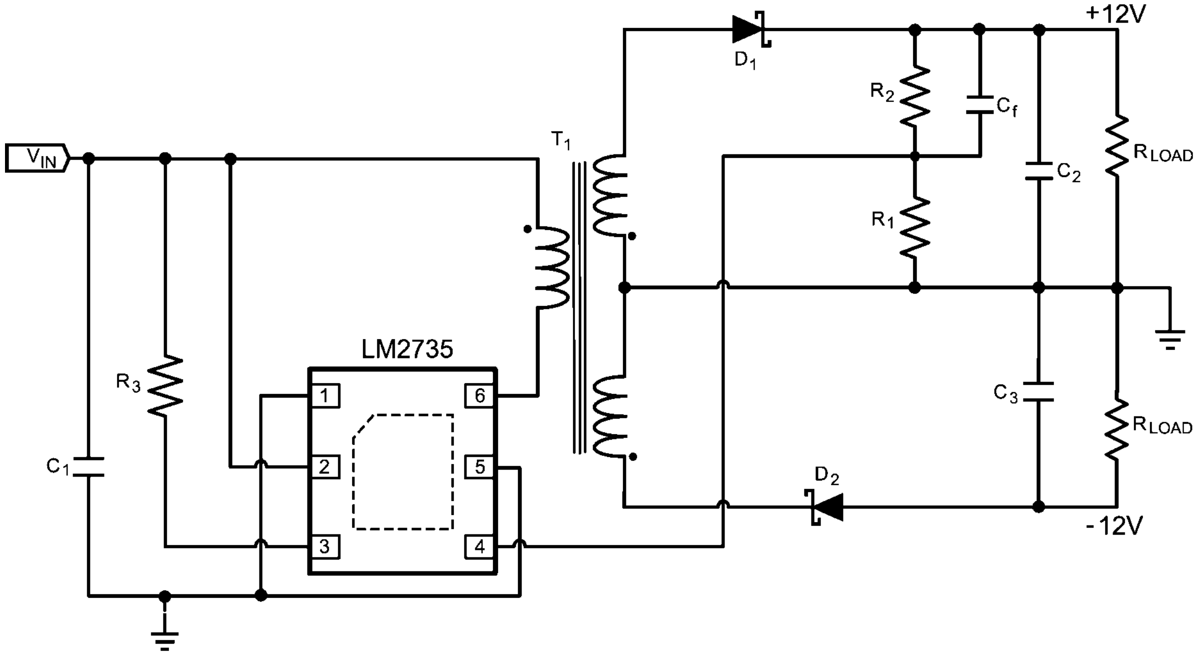
LM2735X SOT23-5 LED Design Example 14:



LM2735X (1.6MHz): Vin = 2.7V - 5V, Vout = 20V @ 80mA

Part ID	Part Value	Manufacturer	Part Number
U1	2.1A Boost Regulator	NSC	LM2735XMF
C1 Input Cap	22µF, 6.3V, X5R	TDK	C2012X5R0J226M
C2 Output Cap	4.7µF, 25V, X5R	TDK	C3216JB1E475K
D1, Catch Diode	0.4V_f Schottky 500mA, 30V_R	Vishay	MBR0530
L1	15µH 1.5A	Coilcraft	MSS5131-153ML
R1	80.6Ω, 1%	Vishay	CRCW080580R6F
R2	402Ω, 1%	Vishay	CRCW08054020F
R3	100kΩ, 1%	Vishay	CRCW06031003F

LM2735Y LLP-6 FlyBack Design Example 15:



LM2735Y (520kHz): Vin = 5V, Vout = ±12V 150mA

Part ID	Part Value	Manufacturer	Part Number
U1	2.1A Boost Regulator	NSC	LM2735YSD
C1 Input Cap	22µF, 6.3V, X5R	TDK	C2012X5R0J226M
C2 Output Cap	10µF, 25V, X5R	TDK	C3216X5R1E106M
C3 Output Cap	10µF, 25V, X5R	TDK	C3216X5R1E106M
Cf Comp Cap	330pF	TDK	C1608X5R1H331K
D1, D2 Catch Diode	0.4V_f Schottky 500mA, 30V_R	Vishay	MBR0530
T1			
R1	10.0kΩ, 1%	Vishay	CRCW06031002F
R2	86.6kΩ, 1%	Vishay	CRCW06038662F
R3	100kΩ, 1%	Vishay	CRCW06031003F

Notes

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