LINEAR TECHNOLOGY

DESIGN NOTES

Single LTC1149 Provides 3.3V and 5V in Surface Mount

Design Note 77

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This Design Note describes a circuit which uses one LTC1149 to regulate both a 3.3V and a 5V output with a 17W capability. The circuit presented is an improved version of the one detailed in Design Note 72 (DN72). Enhancements include an emphasis upon the use of surface mount components and an extended input voltage range (6V to 24V vs 8V to 24V).

The schematic diagram is given in Figure 3. For the principles of operation, please refer to DN72 (copies are available from any LTC representative). One significant difference between this circuit and that of DN72 is that QN2's gate drive is AC-coupled, ensuring full enhancement of QN2 even at low input voltages. The circuit as shown operates down to V_{IN} = 7V. Adding two 220µF capacitors in parallel with C3/C4 extends minimum V_{IN} to 6V or less.

The assembled circuit (Demo Circuit 027A) measures only 2.15" × 1.63" (Figure 1). This compact and inexpensive design provides excellent efficiency, generally approaching and often exceeding 90% (Figure 2).[1] Cross-regulation between the two outputs is also quite good (Table 1).[1] Additionally, network D1/D2/C7 ensures that the 3.3V and 5V outputs both reach their rated voltages at the same time following power-up.

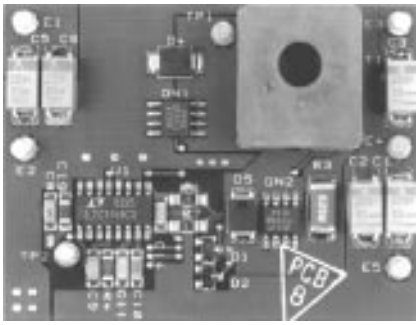

Figure 1. Demonstration Circuit Board

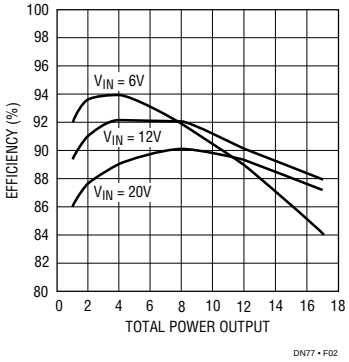

Figure 2. Efficiency vs P_{OUT} and V_{IN}

Table 1. Cross-Regulation vs V_{IN} and I_{OUT}

V_{IN}	$I_{3.3V}$	$V_{3.3V}$	I_{5V}	V_{5V}
6.00V	0mA	3.36V	0mA	5.03V
	5A	3.23V	0mA	5.06V
	2.12A	3.41V	2A	4.80V
	0mA	3.55V	3A	4.68V
8.00V	0mA	3.36V	0mA	5.04V
	5A	3.24V	0mA	5.07V
	2.12A	3.39V	2A	4.90V
	0mA	3.47V	3A	4.81V
24.00V	0mA	3.38V	0mA	5.14V
	5A	3.24V	0mA	5.12V
	2.12A	3.31V	2A	4.98V
	0mA	3.36V	3A	4.93V

Customizing the Circuit

The circuit of Figure 3 is the result of a significant R&D effort by LTC, providing a 3.3V/5V power solution combining performance and price benefits with manufacturability and reliability. At the same time the circuit flexible enough to accommodate a number of variations. Some of these are:

1. Peak Power > 17W: Useful for starting disk drives and other "surge" loads, increased peak power is obtained by lowering the value of R3, and if necessary adding capacitance to the 3.3V output to meet equivalent series resistance requirements. Under most conditions, the total ripple current rating of the 3.3V output capacitance is

[1]Data at V_{IN} = 6V taken with C_{5V} = (4 × 220µF).

determined by maximum **continuous** power, (capacitor current ratings are determined by I^2R heating and have an associated thermal time constant). For additional details and assistance, contact the factory.

2. **Lower Power Output:** When the full 17W capability featured here is not needed, some input and output filter capacitors can be removed from the circuit. Frequently QP2 can be deleted as well, and a smaller transformer used. Please consult LTC for further information.

3. **Lowest Cost:** Circuit cost can be reduced by using aluminum electrolytic capacitors for C1 to C6 and C15 to C18. The Nichicon "PL" or United Chemi-Con "LXF" series are good choices. On the outputs, Sanyo 10SA220M OSCON capacitors (220µF, 10V) provide excellent performance in a small case size. Deleting D5 will save area and cost with only a slight efficiency reduction. In low voltage applications, the LTC1148 can be substituted for the LTC1149, with quiescent current and price advantages. For applications where $V_{IN} \geq 12V$, QP2 can often be removed with little or no effect on efficiency.

Construction Notes:

1. Figure 3 shows several ground lines. These should be run separately (single point ground). Heavy line widths in the schematic indicate wide power and ground traces on the PC board.

2. Pin 10 of the LTC1149 is sensitive to switching noise. The PCB layout should take this into account.

3. The Demonstration Board uses tantalum input filter capacitors (C5/C6 and C17/C18) for space reasons. For best life, specific voltage and current derating criteria apply to tantalum devices. **If these capacitors are to be subjected to voltages in excess of 18V DC, contact the capacitor vendor. For applications where the input will be subjected to high dv/dt or high di/dt surges (e.g., switch closure to a battery pack), aluminum electrolytic input capacitors are definitely preferred due to their higher reliability under such conditions.**

Other:

Linear Technology has a Gerber file of this Demonstration Board (DC027A) available along with a complete parts list. For this Demonstration Board, a Hurricane Electronics Lab throughhole transformer (HL-8700) was used to reduce overall height. Beckman Industrial Corporation has developed a very low profile, surface mount transformer suitable for applications where $V_{IN} \geq 9V$ (HM00-93839). Capacitors C1 to C6 and C15 to C18 are AVX "TPS" series capacitors and **should not** be casually substituted. For more information, Hurricane can be reached at (801) 635-2003, Beckman at (714) 447-2656, and AVX Application Assistance at (800) 282-4975.

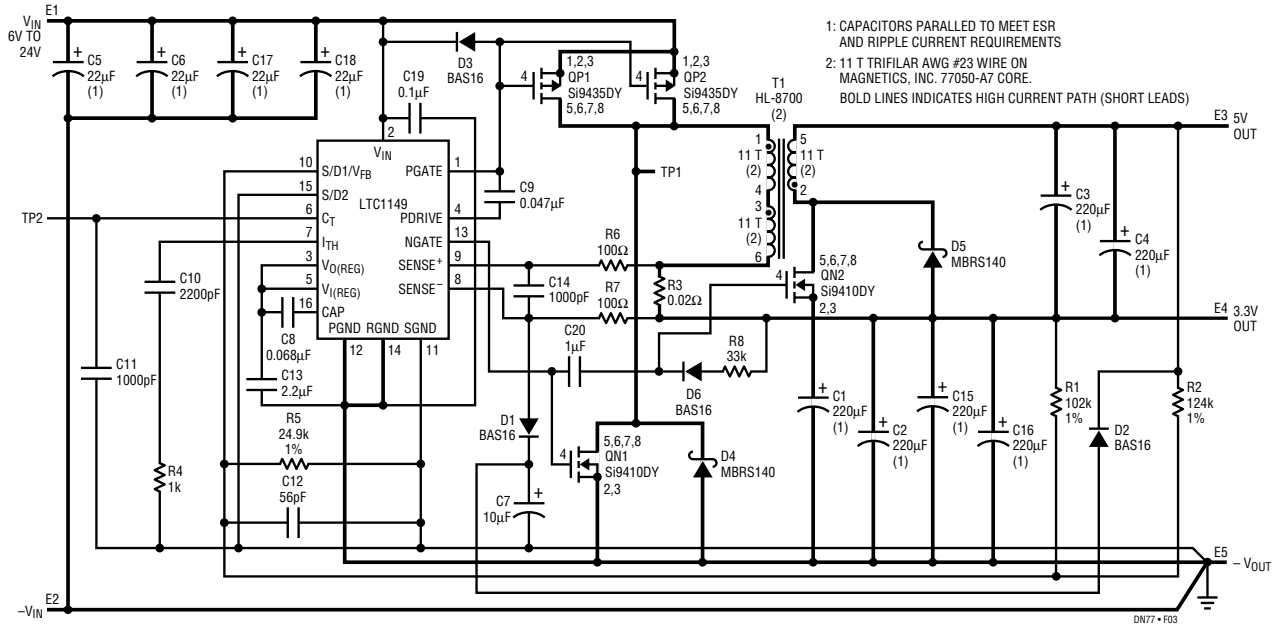

Figure 3. Single LTC1149 Provides 3.3V and 5V in SMT

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