

# LTC3805-5

## Low Noise SEPIC DC/DC Converter

### DESCRIPTION

Demonstration circuit 1576 is high efficiency non-isolated SEPIC (Single Ended Primary Inductor Converter) converter featuring the LTC3805-5 switching controller. The DC1576 converts 5V to 30V input to 12V output and provides over 3A of output current. The converter operates at 300kHz with efficiency over 90%. With proper amount of airflow, the DC1576 converter can generate over 3A of output current. The DC1576 can be easily modified to generate output voltages in the range from 0.8V to 48V.

Also, the DC1576 can be modified for other input voltages like 5V-36V, 9V-36V, 36V-72V, and so on. The wider input voltage range will decrease the converter

efficiency. Therefore, narrow input voltage range will be more desirable.

The LTC3805-5 can be synchronized to an external clock of up to 400kHz. Please refer to LTC3805-5 data sheet for design details and applications information.

**Design files for this circuit board are available. Call the LTC factory.**

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**Table 1. Performance Summary**

| PARAMETER                       | CONDITION                                  | VALUE                |
|---------------------------------|--|----------------------|
| Minimum Input Voltage           | $I_{OUT} = 0A$ to 3A                       | 5V                   |
| Maximum Input Voltage           | $I_{OUT} = 0A$ to 3A                       | 30V                  |
| $V_{OUT}$                       | $V_{IN} = 5V$ to 20V, $I_{OUT} = 0A$ to 3A | 12V $\pm 3\%$        |
| Typical Output Ripple $V_{OUT}$ | $V_{IN} = 5V$ to 20V, $I_{OUT} = 0A$ to 3A | 100mV <sub>p-p</sub> |
| Nominal Switching Frequency     |  | 300kHz               |

### QUICK START PROCEDURE

Demonstration circuit 1576 is easy to set up to evaluate the performance of LTC3805-5 circuit. Refer to **Figure 1** for proper measurement equipment setup and follow the procedure below:

**NOTE:** When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the  $V_{in}$  or  $V_{out}$  and GND terminals. See Figure 2. for proper scope probe technique.

1. With power off, connect the input power supply to  $V_{in}$  and GND. Make sure that the input power sup-

ply has sufficient current rating at minimum input voltage for the required output load.

2. Turn on the power at the input.

**NOTE:** Make sure that the input voltage does not exceed 30V.

3. Check for the proper output voltage.  
 $V_{out} = 12V, \pm 3\%$ .

If there is no output, temporarily disconnect the load to make sure that the load is not set too high.

4. Once the proper output voltage is established, adjust the load within the operating range and ob-

serve the output voltage regulation, ripple voltage, efficiency and other parameters.

- The DC1576 is equipped with an output capacitor  $C_{OUT4}$  (150uF) that approximates typical system rail capacitance. If system board already has capacitance of similar value  $C_{OUT4}$  can be removed. The

input capacitor  $C_{in1}$  is optional and is used to help with filtering when board is connected to lab supply with long leads. The capacitor  $C_{in1}$  can be removed if the input power source is close and has low source impedance.

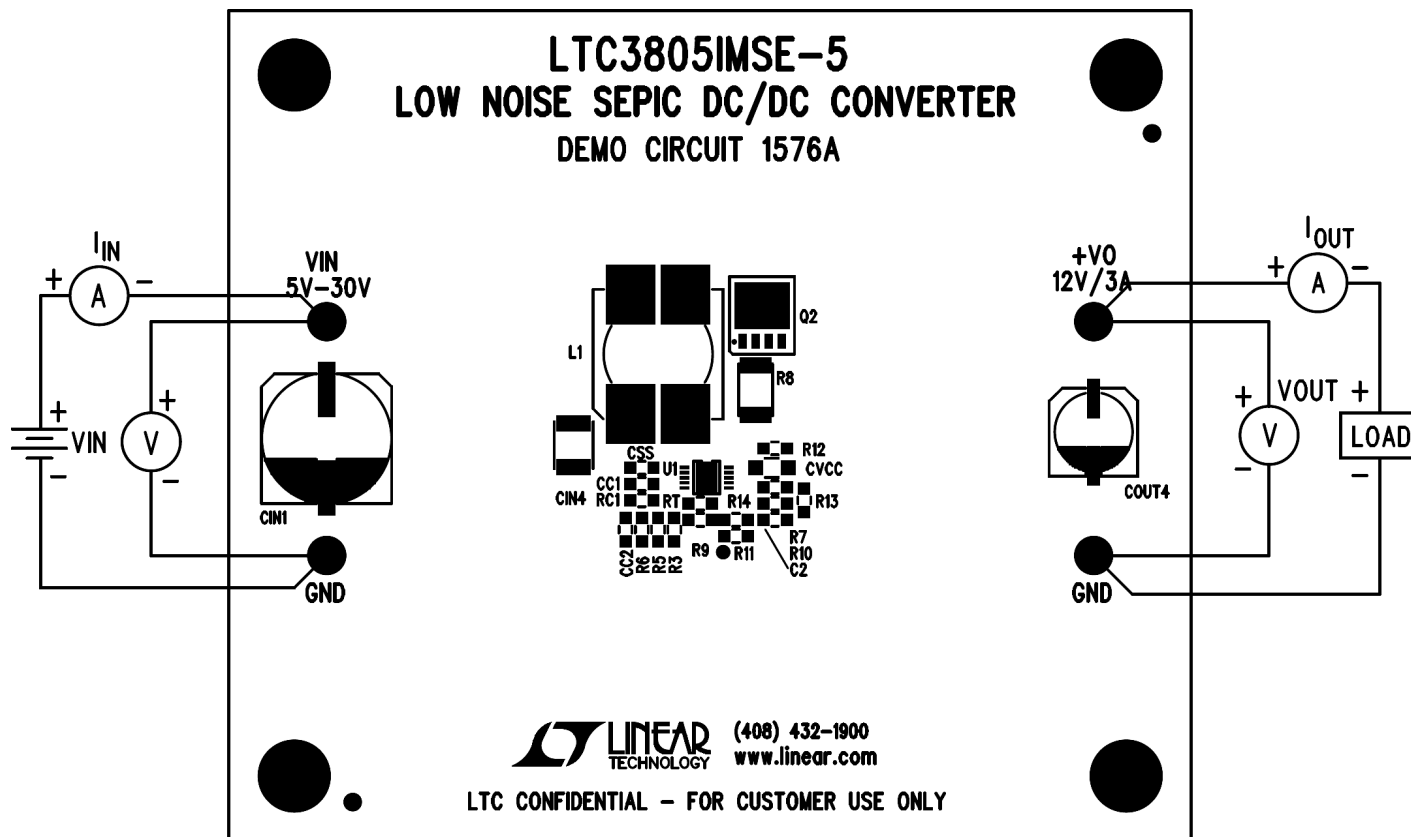


Figure 1. Proper Measurement Equipment Setup

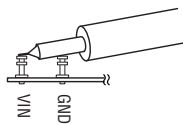


Figure 2. Measuring Input or Output Ripple

## CHANGING THE OUTPUT VOLTAGE

To set the output voltage lower than 12V, change the bottom voltage divider resistor connected to FB pin

of U1 (see the schematic on page 5). For example, to get 9V output, change R3 resistor value to 11k.

However, keep in mind that changing the transformer as well may increase the efficiency.

The optional Q1 circuit is used to get the circuit running. Once the circuit is running, the 12V output is used to bias U1 via D2. The startup circuit Q1 is turned off by pulling the emitter of Q1 above 7V. Please contact LTC factory for details.

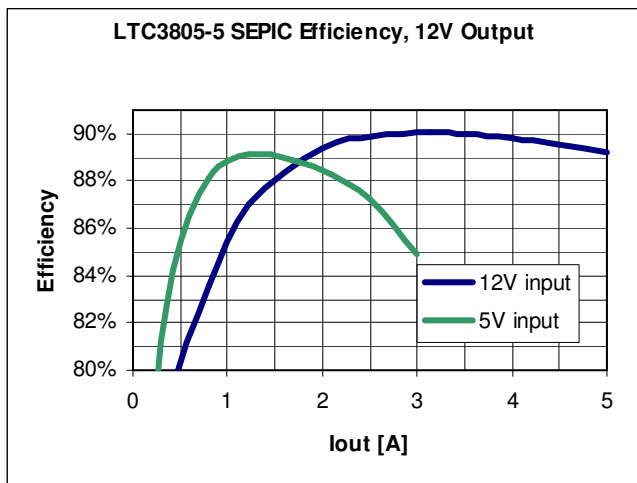


Figure 3. High efficiency of DC1576 allows the board to be used in thermally critical applications with outputs over 3A.

### OUTPUT LOAD STEP RESPONSE

The load step response of DC1576 is very fast even though relatively small amount of output capacitance is present (100uF ceramic and 150uF electrolytic). The load step transients are shown in Figure 4. To improve load step response further or to reduce the output ripple, more output capacitance can be added. Low ESR output caps will have greatest effect on reducing the ripple and load step transients.

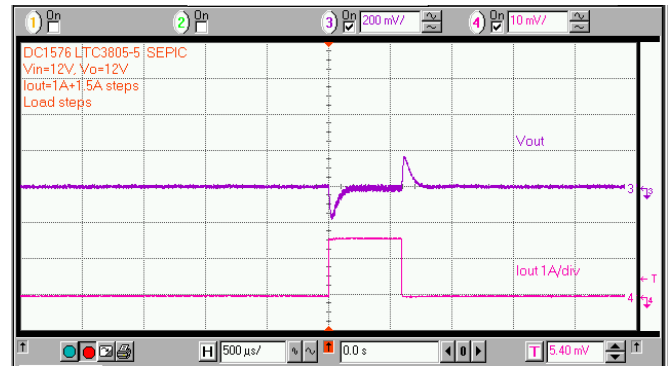


Figure 4. Fast transient response of DC1576 is achieved with a small amount of output capacitance.

### SOFT START FUNCTION

The DC1576 features soft-start circuit that controls the inrush current and output voltage ramp at startup. The capacitor  $C_{SS}$  controls the startup period. The startup waveforms are shown in figure 5.

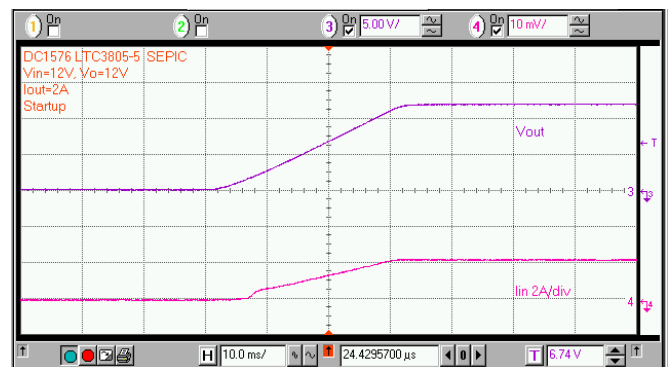
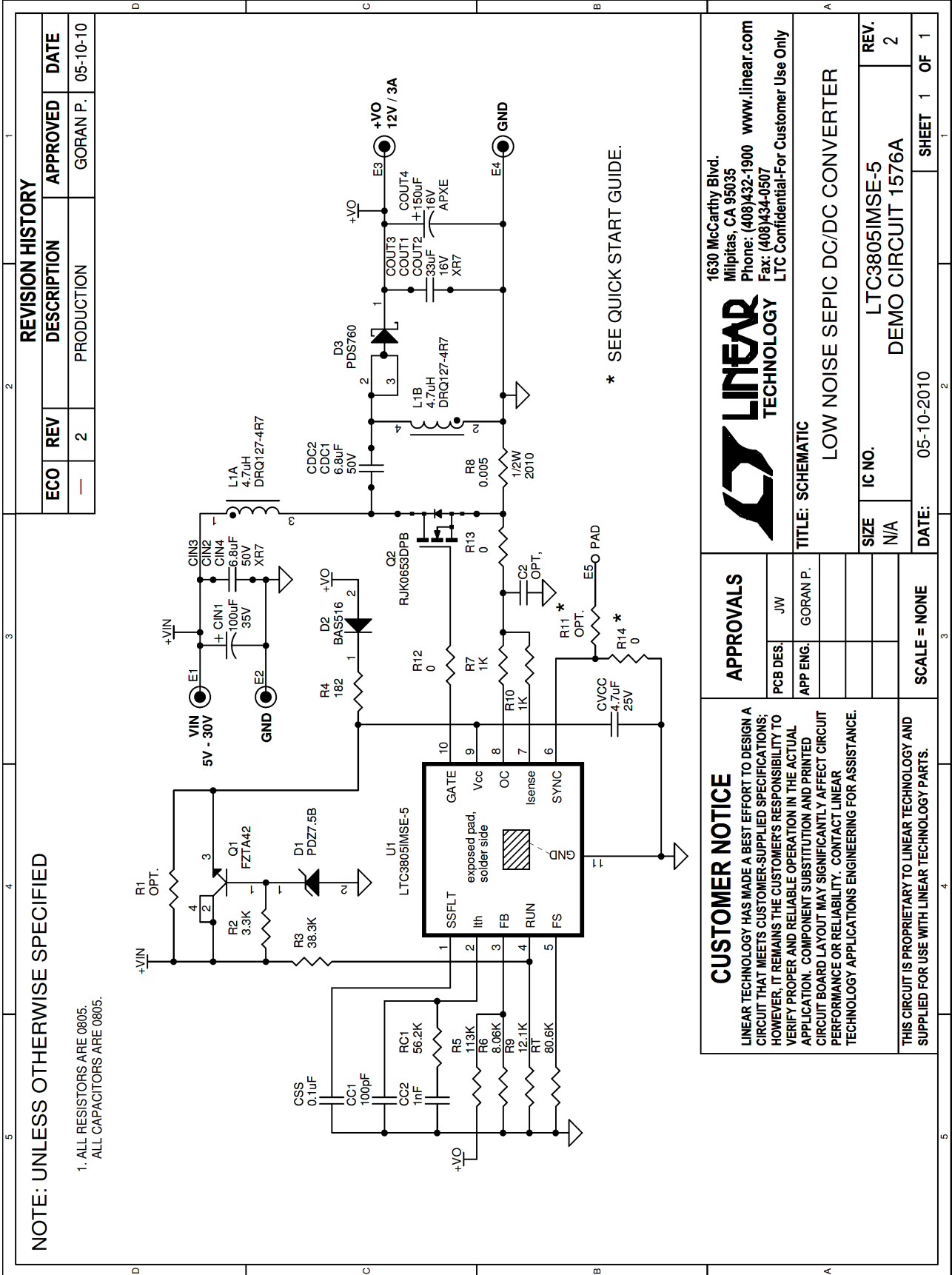


Figure 5. The DC1576 ramps the output slowly at startup without generating an input current surge.



NOTE: UNLESS OTHERWISE SPECIFIED

- 1. ALL RESISTORS ARE 0805.
- ALL CAPACITORS ARE 0805.

\* SEE QUICK START GUIDE.

| REVISION HISTORY |     |             |          |          |
|------------------|-----|-------------|----------|----------|
| ECO              | REV | DESCRIPTION | APPROVED | DATE     |
| —                | 2   | PRODUCTION  | GORAN P. | 05-10-10 |

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**APPROVALS**

|          |          |
|----------|----------|
| PCB DES. | JW       |
| APP ENG. | GORAN P. |

**TITLE: SCHEMATIC**  
**LOW NOISE SEPIC DC/DC CONVERTER**

|                    |               |      |
|--------------------|---------------|------|
| SIZE               | IC NO.        | REV. |
| N/A                | LTC3805IMSE-5 | 2    |
| DEMO CIRCUIT 1576A |               |      |

**SCALE = NONE**

DATE: 05-10-2010 SHEET 1 OF 1

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| <b>REQUIRED CIRCUIT COMPONENTS:</b>              |            |                          |   |                                      |
|--|------------|--------------------------|---|--------------------------------------|
| <b>Item</b>                                      | <b>Qty</b> | <b>Reference</b>         | <b>Part Description</b>                 | <b>Manufacturer / Part #</b>         |
| 1  | 1          | CC1                      | CAP., X7R, 100pF, 50V, 10%, 0805        | AVX, 08055C101KAT1A                  |
| 2  | 1          | CC2                      | CAP., COG, 1000pF, 50V, 5%, 0805        | TDK, C2012C0G1H102J                  |
| 3  | 1          | CIN1                     | CAP., HVH Series, 100uF 35V 20%         | SUN ELECT., 35HVH100M                |
| 4  | 5          | CIN2,CIN3,CIN4,CDC1,CDC2 | CAP., X7R, 6.8uF, 50V, 20%, 1812        | TDK, C4532X7R1H685M                  |
| 5  | 3          | COU1,COU2,COU3           | CAP., X5R, 33uF, 16V, 20%, 1812         | TDK, C4532X5R1C336M                  |
| 6  | 1          | COU4                     | CAP., ALUM., 150uF, 16V                 | NIPPON CHEMI-CON, APXE160ARA151MH80G |
| 7  | 1          | CSS                      | CAP., X7R, 0.1uF, 50V, 20%, 0805        | AVX, 08055C104MAT2A                  |
| 8  | 1          | CVCC                     | CAP., X5R, 4.7uF, 25V, 20%, 0805        | AVX, 08053D475MAT2A                  |
| 9  | 1          | D1                       | DIODE, VOLTAGE REGULATOR, 7.5V, SOD323  | NXP, PDZ7.5B                         |
| 10   | 1          | D2                       | DIODE, HIGH-SPEED DIODE, SOD-523        | NXP, BAS516                          |
| 11   | 1          | D3                       | DIODE, SCHOTTKY RECTIFIER 7A, POWERDI5  | DIODES/ZETEX, PDS760-13              |
| 12   | 1          | L1                       | IND., 4.7uH Coupled Inductor            | COILTRONICS, DRQ127-4R7-R            |
| 13   | 1          | Q1                       | XSTR, NPN, HIGH VOLTAGE, FZTA42, SOT223 | DIODES/ZETEX, FZTA42TA               |
| 14   | 1          | Q2                       | MOSFET, N-CH, POWER,                    | RENESAS RJK0653DPB                   |
| 15   | 1          | R1                       | RES., CHIP 100K 1/8W 5%, 0805           | VISHAY, CRCW0805100KJNEA             |
| 16   | 1          | R2                       | RES., CHIP 3.3K 1/8W 5%, 0805           | VISHAY, CRCW08053K30JNEA             |
| 17   | 1          | R3                       | RES., CHIP 38.3K 1/8W 1%, 0805          | VISHAY, CRCW080538K3FKEA             |
| 18   | 1          | R4                       | RES., CHIP 182 1/8W 1% 0805             | VISHAY, CRCW0805182RFKEA             |
| 19   | 1          | R5                       | RES., CHIP 113K 1/8W 1%, 0805           | VISHAY, CRCW0805113KFKEA             |
| 20   | 1          | R6                       | RES., CHIP 8.06K 1/8W 1%, 0805          | VISHAY, CRCW08058K06FKEA             |
| 21   | 2          | R7,R10                   | RES., CHIP 1K 1/8W 5%, 0805             | VISHAY, CRCW08051K00JNEA             |
| 22   | 1          | R8                       | RES., CHIP 0.005 OHMS 1/2W, 1%, 2010    | VISHAY, WSL20105L000FEA              |
| 23   | 1          | R9                       | RES., CHIP 12.1K 1/8W 1%, 0805          | VISHAY, CRCW080512K1FKEA             |
| 24   | 3          | R12,R13,R14              | RES., CHIP 0 1/8W 0805                  | VISHAY, CRCW08050000Z0EA             |
| 25   | 1          | RC1                      | RES., CHIP 56.2K 1/8W 1%, 0805          | VISHAY, CRCW080556K2FKEA             |
| 26   | 1          | RT                       | RES., CHIP 80.6K 1/8W 1%, 0805          | VISHAY, CRCW080580K6FKEA             |
| 27   | 1          | U1                       | IC, LTC3805IMSE-5                       | LINEAR TECH., LTC3805IMSE-5          |
| <b>ADDITIONAL DEMO BOARD CIRCUIT COMPONENTS:</b> |            |                          |   |                                      |
| 1  | 0          | C2 (OPT)                 | CAP., 0805                              |                                      |
| 2  | 0          | R11 (OPT)                | OPT.                                    |                                      |
| <b>HARDWARE-FOR DEMO BOARD ONLY:</b>             |            |                          |   |                                      |
| 1  | 4          | MTG 4 CORNERS            | STAND-OFF, NYLON, 0.25" TALL (SNAP ON)  | KEYSTONE, 8831 (SNAP ON)             |

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