

DESCRIPTION

Demonstration circuit 638 is a 36-72V_{IN} to 3.3V@3.5A isolated synchronous Flyback converter featuring the LT1725. This circuit was designed primarily to meet Voice over IP requirements, providing 3.3V@3.5A from a 37-54V/350mA source. However, converter operation is seamless over the full 36-72V input range. Isolation voltage is 1500VDC. The circuit features feedback without

an opto-isolator, programmable load regulation compensation, input under voltage lockout and short circuit cycling protection to minimize thermal stress.

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

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Table 1. Performance Summary (T_A = 25°C)

| PARAMETER | CONDITION | VALUE |
|------------------------------------|---|----------------------|
| Minimum Input Voltage | | 36V |
| Maximum Input Voltage | | 72V |
| Output Voltage (V _{OUT}) | V _{IN} = 36V to 72V, I _{OUT} = 0A to 3.5A | 3.3V ± 3% |
| Maximum Input Current | V _{IN} = 37V, I _{OUT} = 3.5A | 350mA |
| Inrush Transient | V _{IN} = 72V | 0.1 A ² s |
| Nominal Switching Frequency | | 200kHz |
| Output Short Circuit Period | Cycling, Auto-restart at 36 V _{IN} | 700ms |
| Dynamic Response | Peak Deviation | 200mV |
| | Load Step 50% to 100% | |
| | Settling Time (to within 10mV of set point) | 100µs 200µs |
| Efficiency | V _{IN} = 48V, I _{OUT} = 3.5A | 89.5% Typical |
| Output Ripple | V _{IN} = 48V, I _{OUT} = 3.5A (20MHz BW) | 200mV _{p-p} |
| Isolation Voltage | | 1500VDC |
| Isolation Resistance | | 10MΩ |
| Isolation Capacitance | | 2200pF |

OPERATING PRINCIPLES

CIRCUIT OVERVIEW

This synchronous Flyback converter operates at a nominal switching frequency of 200kHz. Output voltage control is done by U1, the LT1725 controller. Galvanic isolation is met with transformer T1 and T2. C7 is used as a local bypass to reduce common-mode currents.

The primary side power path is comprised of T1, C25 and Q1 (the primary switch). Power is transferred during the off time of Q1. MOSFET Q3 is the secondary synchronous rectifier. C1, C2 and C29 form the secondary output filter. L1 and C30 form the primary input filter. An auxiliary winding on T1 performs two functions; it provides output feedback information and supplies bias voltage to the

QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 638

36V-72VIN, TO 3.3V@3.5A, 350MA INPUT CURRENT SYNCHRONOUS FLYBACK CONVERTER

LT1725. A driver, comprised of Q12 and Q13, synchronizes with the LT1725 via T2, a small pulse transformer, to provide gate drive to the secondary switching MOSFET.

During an output short circuit, the primary bias supply collapses. This results in the converter harmlessly cycling on and off, reducing power dissipation. The cycling rate is nominally 1.4Hz with 36V input. When the short is removed, the converter returns to normal operation.

When input voltage is applied, R8 provides trickle charge current to C10 resulting in a turn on delay of approximately 1.5s at 36V_{IN}.

SAFETY AND ISOLATION

The demo board is designed to meet the requirements of UL 60950, 3rd Edition for basic insulation in secondary circuits. The input is considered a TNV-2 circuit, and the output is SELV. The bridging capacitor C7 has an agency file number. A 5A fast blow type fuse must be placed in series with the ungrounded (hot) input line. The transformer is designed to meet the basic insulation

QUICK START PROCEDURE

Demonstration circuit 638 is easy to set up to evaluate the performance of the LT1725. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

When measuring the output voltage ripple, refer to note included in Figure 1. Care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the output voltage ripple by touching the probe tip directly across the output capacitor C29 as shown in Figure 1.

Connect a 36V supply to V_{IN} as shown on Figure 1.
1. For normal operation, a minimum of 36V must be applied at the input. Input voltages

lower than 36V will keep the converter from turning on due to the undervoltage lockout feature in the LT1725.

CONDUCTED EMI

Tests for conducted emissions were performed for the demo board. An external filter using a 5μH inductor and 10μF film capacitor is required for the CISPR 22 class B limit. No tests for radiated RFI were performed. Proper grounding and layout technique must be observed to minimize radiation. See Figure 2 for EMI test setup. For EMI graphs see Figures 3 and 4.

RELIABILITY

Reliability prediction for the circuit has been calculated using the Telcordia (formerly Bellcore) SR-332. The black box technique was used. The calculation was made assuming a grounded, fixed, controlled environment and quality level II. A 50% electrical stress at 40°C yields an MTBF (mean time between failures) of 5.3 million hours.

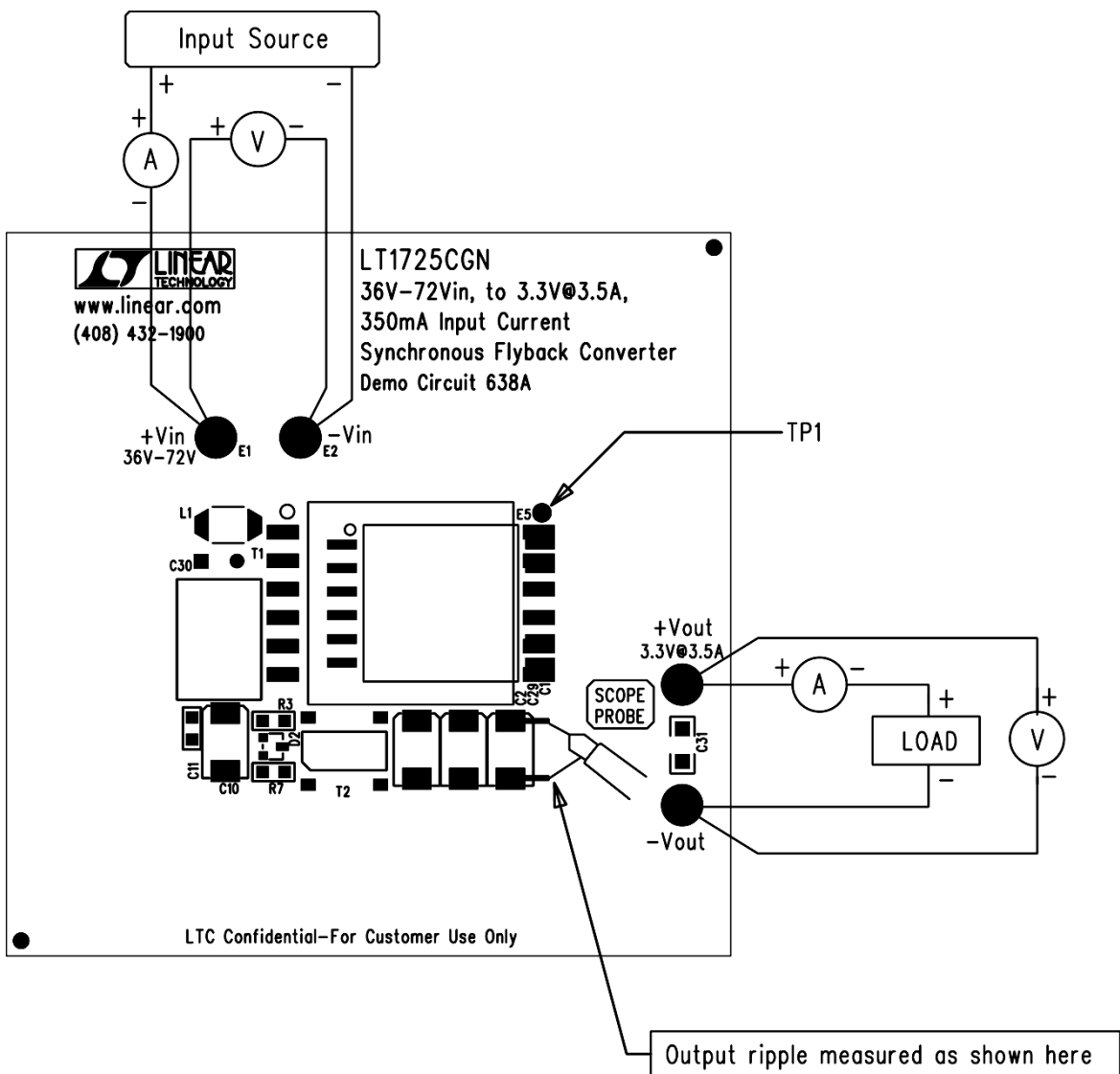
Connect a 0-5A load and meters to the V_{OUT} pins as shown on Figure 1.

After all connections are made, turn on the input power and verify the output voltage, regulation, ripple voltage, efficiency and other parameters.

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

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Output ripple measured as shown here

Figure 1. Proper Measurement Equipment Setup

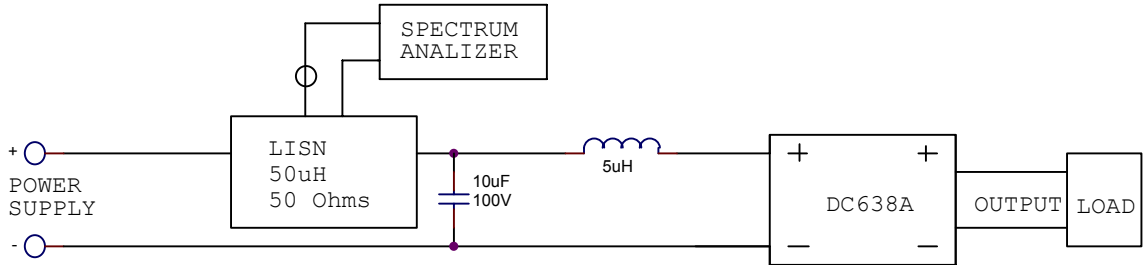


Figure 2. EMI Setup

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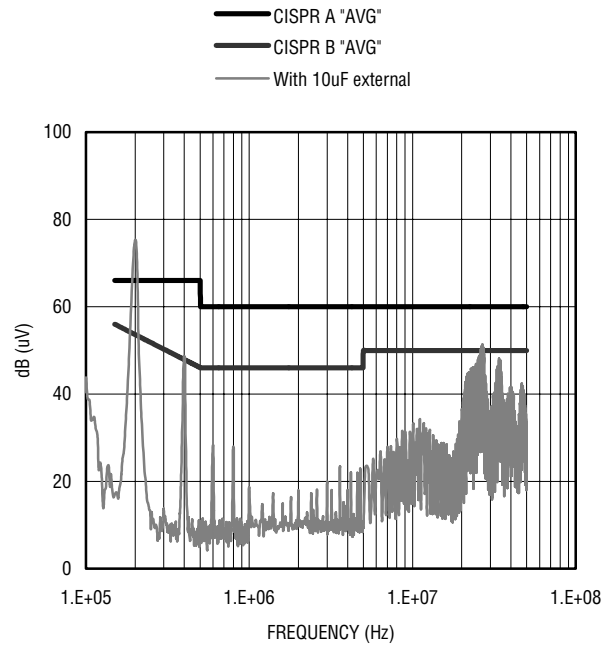


Figure 3. EMI Without Filter

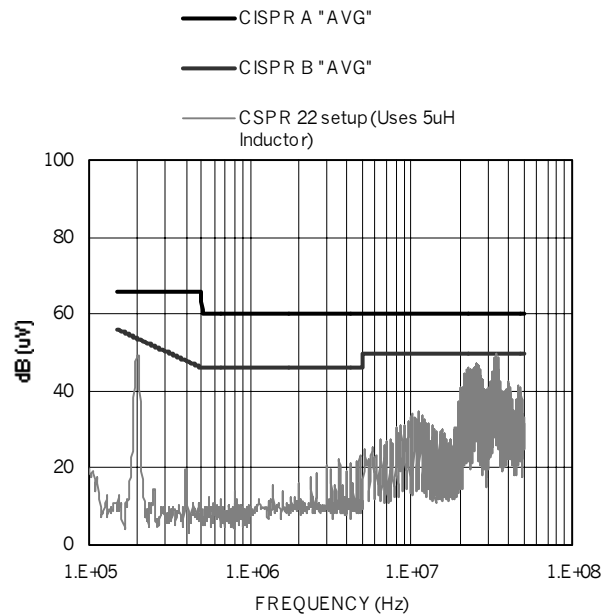
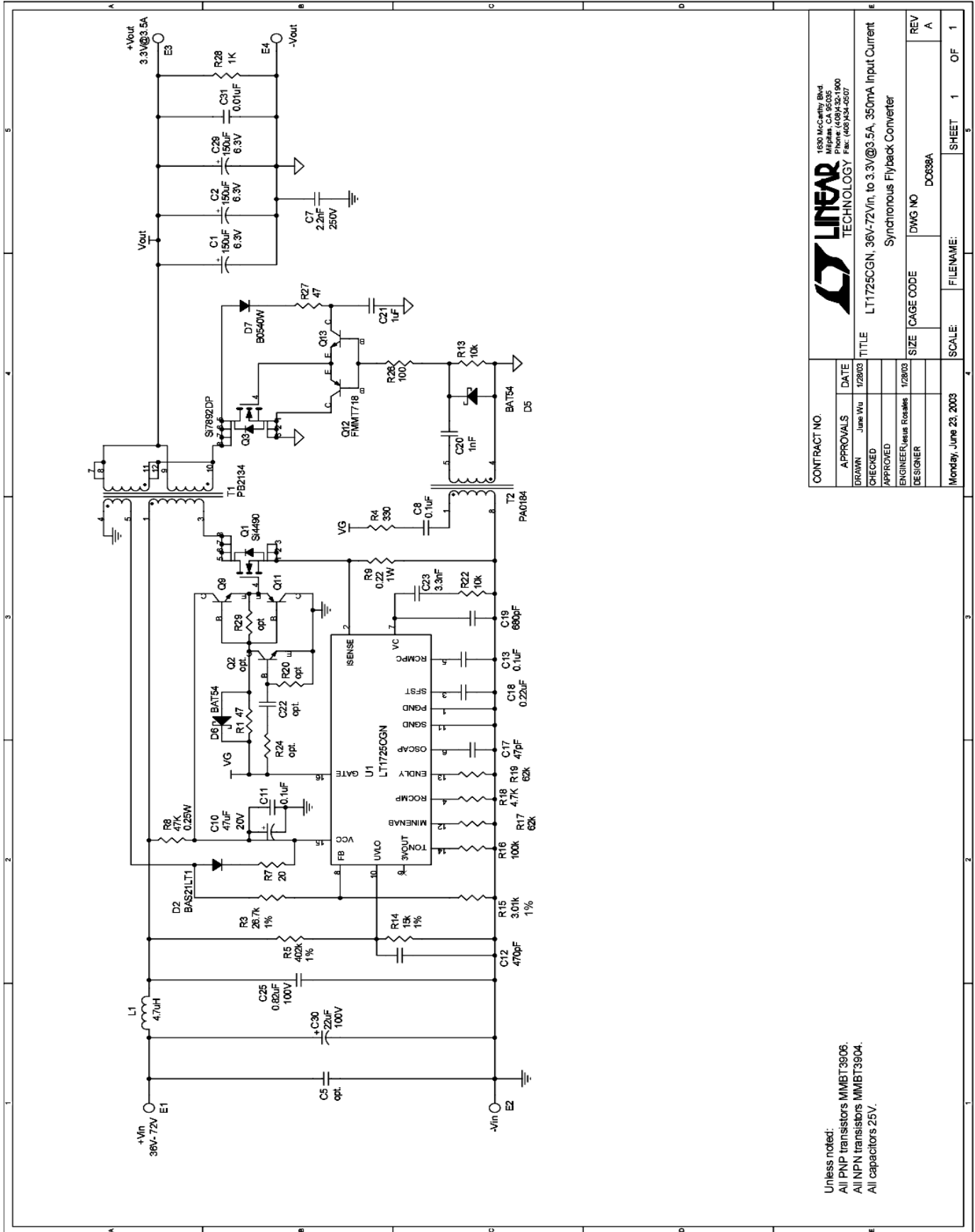


Figure 4. EMI With Filter

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36V-72VIN, TO 3.3V@3.5A, 350mA INPUT CURRENT SYNCHRONOUS FLYBACK CONVERTER



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|--|-------------------------|-----------|--------------|
| CONTRACT NO. | | DATE | |
| APPROVALS | June Wu | 1/28/03 | |
| CHECKED | | | |
| APPROVED | | | |
| DESIGNER | ENGINEER, JESUS ROSALES | 1/28/03 | |
| TITLE | | SIZE | CAGE CODE |
| L1175CGN, 36V-72Vin, to 3.3V@3.5A, 350mA Input Current | | DWG NO | REV |
| Synchronous Flyback Converter | | DO638A | A |
| Monday, June 23, 2003 | SCALE: | FILENAME: | SHEET 1 OF 1 |

Unless noted:
 All PNP transistors MMBT3906.
 All NPN transistors MMBT3904.
 All capacitors 25V.