

ISL97656 SEPIC for 3V_{IN} to 12V_{IN} to 3.3V_{OUT} at 1A Application

Introduction

There are several applications where one needs to generate a constant output voltage which is right in the middle of the input voltage range. This circuit can easily be implemented by using any boost regulator, as long as it can handle the input voltage range, and the output load current configured in a SEPIC (Single Ended Primary Inductively Coupled) configuration. The SEPIC circuit in Figure 1 is designed for a raid disk application to generate a constant 3.3V_{out} to provide power to an FPGA, white LED driver, and EEPROM from an input voltage source that ranges from 3V to 12V by using ISL97656. The ISL97656 is a selectable 640kHz, or 1.2MHz constant switching frequency, high efficiency boost regulator for 2.3V_{IN} to 5.5V_{IN} applications. It has an internal 120mΩ, 4A power switch which allows over 90% efficiency and has an external compensation pin which allows ceramic capacitors on the output.

Since the input voltage range on the ISL97656 is from 2.3V to 5.5V and the system applications requires input to vary from 3V to 12V, a discrete bias supply is created by using D₂ (3.1V zener) and R₁ (100Ω). This bias supply is only used for start-up, and gets disconnected when the ISL97656 starts regulating 3.3V on the output. When there is no output voltage, Q₁ is off, Q₂ and Q₃ are on, hence, D₂ zener diode

generates approximately 3.1V, which supplies input power to the chip. Once the external soft-start capacitor times out, the ISL97656 starts switching at 1.2MHz since the “Freq” pin is grounded and starts regulating 3.3V on the output. At this time, output turns on Q₁ which turns-off Q₂ and Q₃, turning D₂ zener diode off. At this point, the ISL97656 is powered from the output through D₃, Schottky diode. The purpose of disconnecting the zener diode from the circuit by using Q₁, Q₂ and Q₃, is to prevent excessive power loss when the input voltage is 12V. This power loss across the zener diode will translate into poor SEPIC efficiency at load currents of less than 200mA. If output efficiency is not a major concern, then remove R₅, R₆, R₇, Q₁, Q₂, and Q₃ and connect the top side of R₁ directly to the input supply. The bill of material for this evaluation board is listed in Table 1, and the front and back side of this evaluation board is shown in Figures 2 and 3.

Figure 4 shows the ISL97656 efficiency from 12V_{IN}, and Figure 5 from 3V_{IN}. It can be seen that the ISL97656 SEPIC circuit is 80+% efficient from 12V_{IN} vs. about 75% from 3V_{IN}. Figure 6 shows the output voltage ripple of 71mV at 0.7A of load current. The output voltage ripple is about 2% and can be further reduced by adding another output capacitor in parallel.

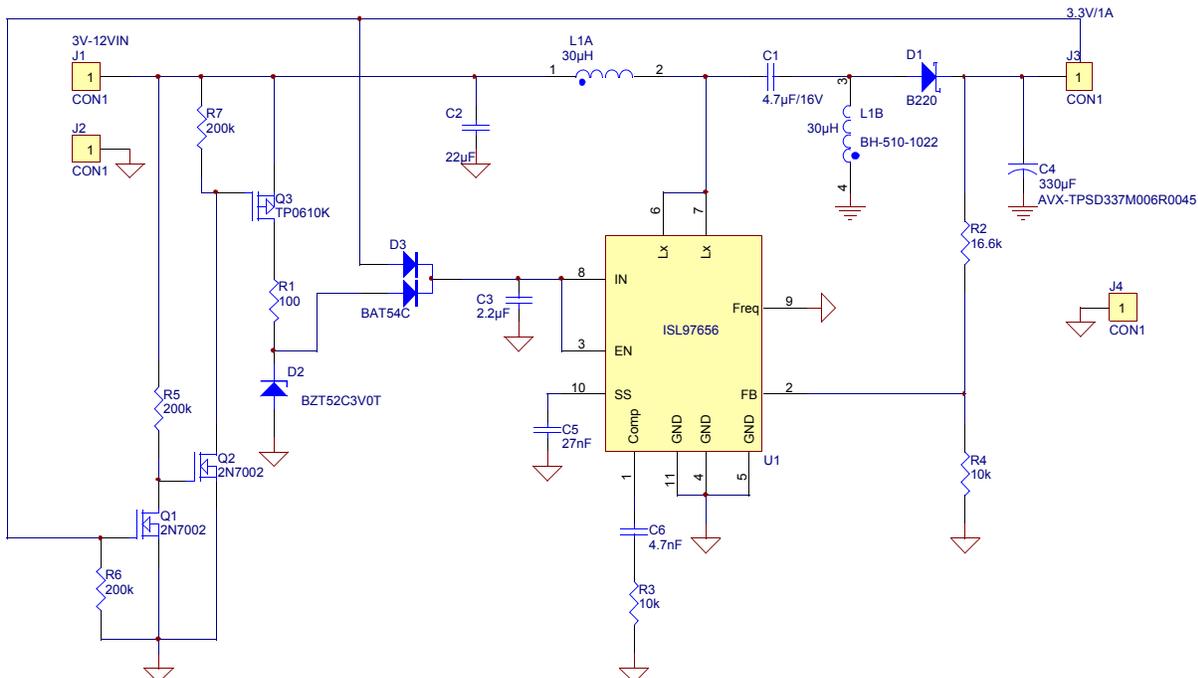


FIGURE 1. ISL97656 SEPIC SCHEMATIC FOR 3V to 12V_{IN} TO 3.3V_{OUT} AT 1A

TABLE 1. ISL97656 SEPIC BILL OF MATERIAL

PART TYPE	DESIGNATOR
2.2 μ F	C3
4.7 μ F/16V	C1
2N7002	Q1
TPK0610K	Q3
2N7002	Q2
10k	R3
4.7nF	C6
10K	R4
16.6k	R2
22 μ F	C2
27nF	C5
100	R1
200k	R6
200k	R7
200k	R5
330 μ F	C4
B220	D1
BAT54C	D3
BZT52C3V0T	D2
BH Elect, 510-1022	L1A/B
U1	ISL97656

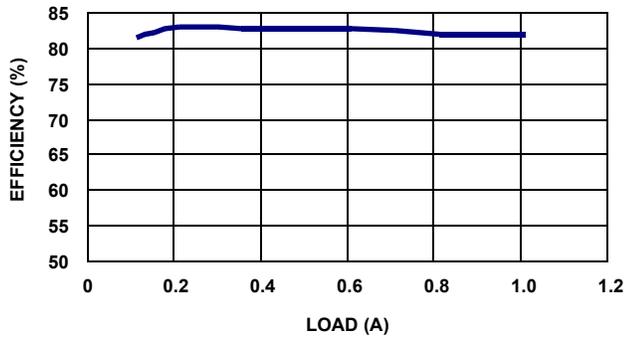


FIGURE 4. ISL97656 SEPIC BOARD EFFICIENCY FROM 12V_{IN}

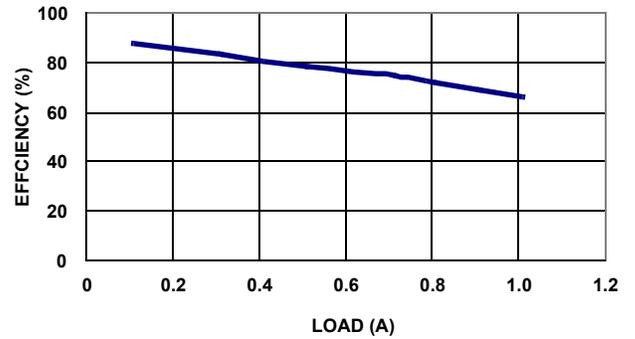


FIGURE 5. ISL97656 SEPIC BOARD EFFICIENCY FROM 3V_{IN}

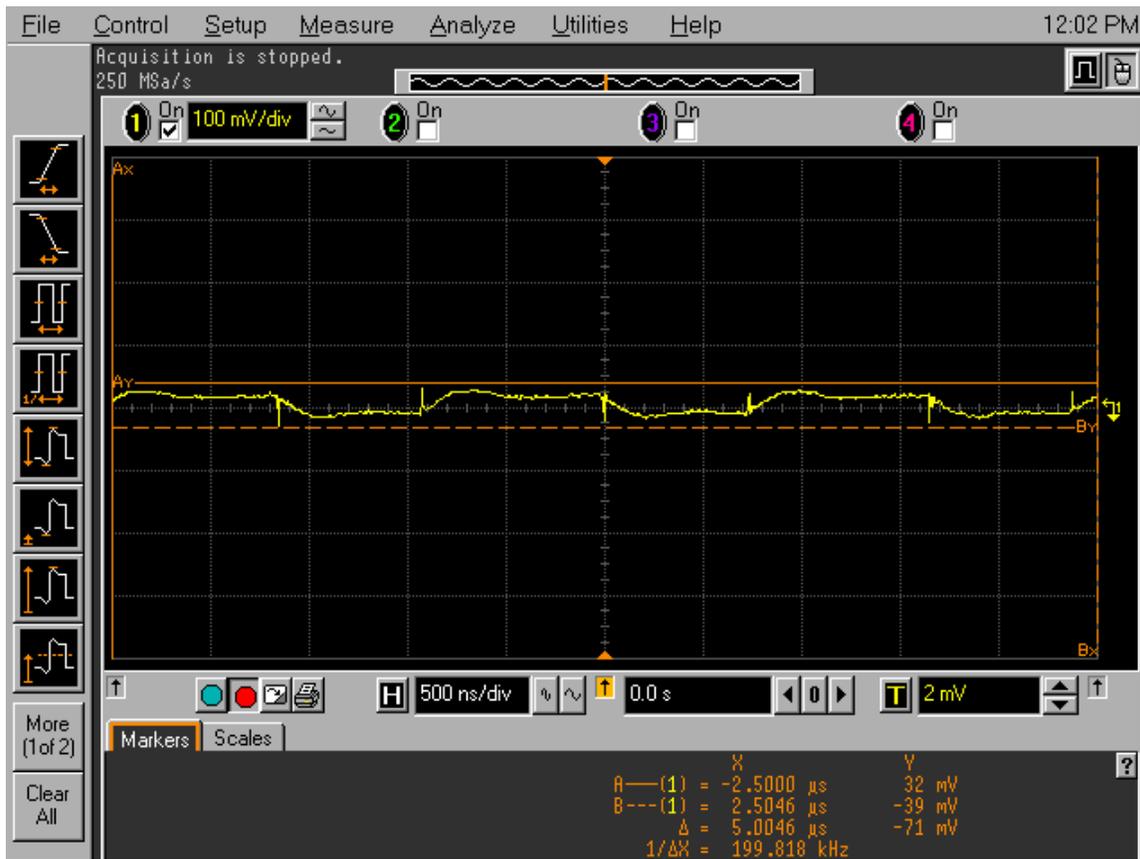


FIGURE 6. ISL97656 SEPIC BOARD OUTPUT VOLTAGE RIPPLE FOR 12V_{IN} TO 3.3V_{OUT} AT 0.7A

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Renesas Electronics America Inc.
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.
Tel: +1-408-432-8888, Fax: +1-408-434-5351

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-651-700, Fax: +44-1628-651-804

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852-2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886-2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5338